# HYDROLOGY / HYDRAULICS STUDY

**Project No. CUP2019-5**

**FOR THE:**
***ALL RIGHT SELF-STORAGE***
*8708 Cottonwood Ave*
*Santee CA 92071*
*APN: 384-370-25*

**PREPARED FOR:**
***Michael Deutsch***
*111 C ST. SUITE 200*
*ENCINITAS, CA92024*
*Contact: Olivier Andreu*
*Tel: (858) 625-0657*

**PREPARED BY:**
***EXCEL ENGINEERING***
*440 State Place*
*Escondido, CA 92029*
*Tel: (760) 745-8118*
*Project No: 18-005*

**DATE PREPARED:**
September 6, 2018

**REVISION DATE(S):**
May 06, 2019
March 3, 2020

EXCEL
ENGINEERING

# TABLE OF CONTENTS

# 1.0 PROJECT DESCRIPTION

## 1.1 Purpose of Study

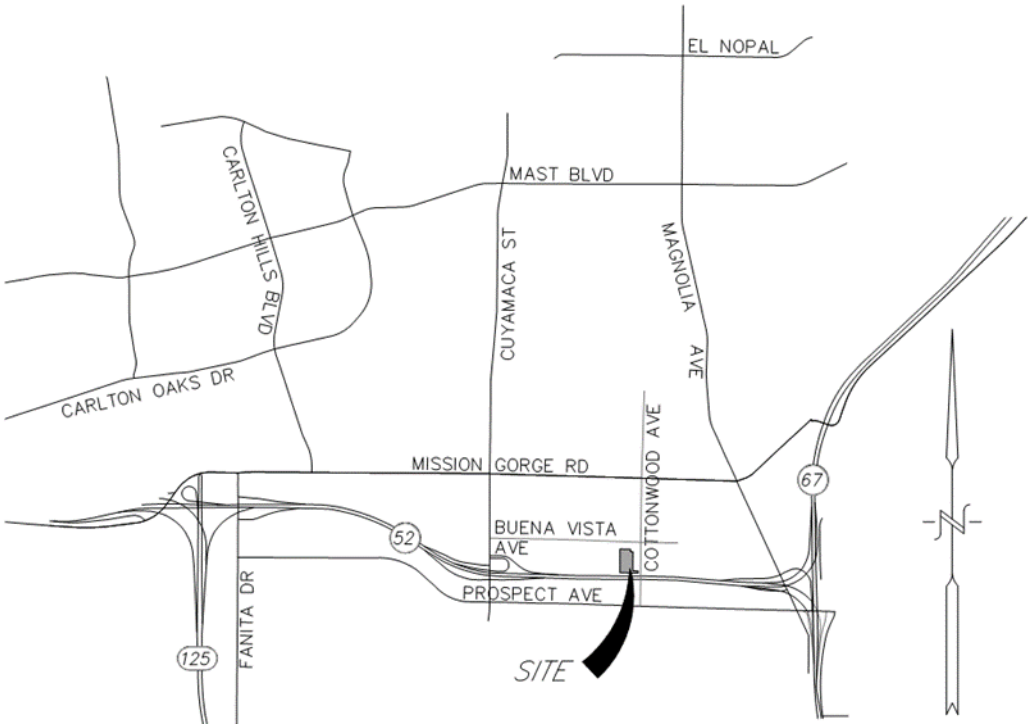
The purpose of this study is to support the design and construction of five buildings to be used for self-storage, with site improvements. The study will provide sizing of proposed drainage structures, confirm post developed runoff does not exceed pre-developed peak flows, and insure there will be no negative impacts to surrounding and downstream properties.

## 1.2 Project Description

The project proposes to build five buildings, in two construction phases, to be used for self-storage. Phase 1 consists of a 3-story Building A (25,923 SF), a 1-story Building B (4,413 SF) and a 1-story Building C which includes a unit for the caretaker (5,920 SF). In addition to the three buildings, 50 open spaces are proposed for recreational vehicles, vehicle and boat storage. Associated improvements will include walkways, a single trash enclosure, 26 parking spaces, landscaping, and all necessary utilities (storm, sewer, water, dry, etc.). Phase 2 will replace the 50 open spaces from Phase 1 with a 1-story Building D (8,316 SF) and 3-story Building E (16,602 SF). In addition to 26 parking spaces added in Phase 1, 3 additional parking spaces will be added in Phase 2 totaling 29 parking spaces.

Additional improvements include onsite private sewer, domestic water, and fire service.

## 2.0 VICINITY MAP




## 3.0 DESCRIPTION OF WATERSHED

### 3.1 Pre-Development Topography

The project site resides in the location of a previous mobile home park. The mobile homes have been removed while the roads and drainage infrastructure remain. The existing infrastructure includes a single ribbon gutter at the center of the road and two inlets reside on the easterly and westerly portions of the property. As illustrated in the pre-developed drainage map the existing topography is relatively flat and over time the inlets have become clogged and runoff is conveyed overland to the westerly boundary of the property along an existing wall. The runoff then ponds and seeps through the wall joint and out to a curb and gutter within the neighboring property. The runoff then reaches Buena Vista Ave where it is conveyed to the public storm drain system.

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

### 3.2 Post-Development Topography

The project does not propose any major grade changes to the existing topography. The site will be graded to facilitate footings for the storage units, new driveway

section and curb and gutter along the property line. Surface storm water will be directed to inlets that convey storm water, via an underground storm drain network, to a storm-capture storage facility. The existing 4" storm drain pipe at the westerly boundary will be unclogged and used for conveyance of runoff produced by the site. The runoff within the storage facility will be gravity flow to a 12" storm drain pipe and outfall to the curb face near Buena Vista Ave and to the public storm drain system. The overflow is then conveyed to the neighboring curb & gutter and ultimately to the same public storm drain system along Buena Vista Ave as pre-developed conditions do today.

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

### 3.3 Hydrologic Unit Contribution

The project is located in the Santee HSA within the Lower San Diego, in the San Diego Hydrologic Unit. (907.12).

## 4.0 METHODOLOGY

### 4.1 Drainage system overview

The proposed drainage system for this project is designed to comply with the 2003 San Diego Hydrology Manual and the 2014 San Diego Hydraulic Design Manual.

The drainage system designed for this project consist of various sizes of HDPE pipe to convey storm runoff and detains the runoff within a 3' Detention Pipe System. The runoff will be cleaned via a Modular Wetlands System. 100-year overflow will be conveyed through a 12" pipe to the westerly neighbor's curb & gutter. Catch and release, then gravity flow to the POC point.

The following sections detail the calculations performed and resulting compliance with the aforementioned design manuals.

### 4.2 Hydrology Software

The "Rational Hydrology Method, San Diego County (2003 Manual)" module of the CIVILCADD/CIVIL DESIGN Engineering software version 7.4 is used in this study. Referred to as CivilD within this report.

### 4.3 Detention Software

Resulting hydrographs from the hydrology software are used to determine detention capacity. This study uses the 2015 Hydraflow Hydrograph extension to determine the maximum ponding elevation and capacity for the underground Detention System.

### 4.4 Hydraulics Software

Hydraflow Storm Sewers 2015 is used in this step. Runoffs calculated from the rational method are entered into this software to design and size the storm drain systems.

## 5.0 CALCULATIONS

### 5.1 Determination of Watersheds within Project Limits

To determine if the proposed design will have a negative impact to the downstream facilities, the design ensured that the Pre & Post Development condition areas were approximately identical. Thus, making it easier to see increases or decrease of storm water within the watershed.

See Attachment 2 for the topographic maps.

### 5.2 Calculate Runoff Coefficient

The proposed project site was found to lay within Hydraulic Soil Group “D”.

To determine the runoff coefficient “C” for the pre-development conditions, Table 3-1 of the San Diego Hydrology Manual was utilized. The existing site use contained densely packed mobile homes with garages and car ports and thus High Density Residential (HDR) is selected. To ensure this analysis is conservative, HDR for 24 DU/A was used instead of the 43 DU/A. The selected “C” value for the existing conditions is 0.71.

The “C” value selection for the post developed condition is determined by its use as well. The proposed use is for a self-storage facility with no manufacturing or office spaces. The selected Land Use Element within Table 3-1 for this project was General Commercial (G. Com). The resulting “C” value used for the proposed condition is 0.82.

### 5.3 Calculate Manning Roughness Coefficient

Per section 4.2.1.1 Basin Factor (n), the average Manning Roughness Coefficient for gentle slopes along paved streets is 0.013. This value will be used for this study.

## 5.4 Calculate Storm Flows using the Modified Rational Method

Post-development peak flows are calculated in accordance with the 2003 Hydrology Design Manual and utilizing the CivilD software.

The project directs all runoff to inlets that convey water through an underground storm drain network. The runoff is then directed to an underground storm storage tank where a Modular Wetland System treats the water quality volume.

Flow entering the detention tank will be analyzed in Section 5.5 to determine the peak flow runoff.

The project proposes storm runoff from the Modular Wetland System to a 12" storm drain line and gravity flows out to Buena Vista Ave.

To compare the outflows to POC-1, Node 3 within the existing conditions and Node 109 of the post-development flows (after detention) are compared. See table below:

**SUMMARY: PEAK 100-YEAR RUNOFF**

| | Node # | Tc (min) | Runoff (cfs) |
|---|---|---|---|
| Pre-dev | 3 | 13.53 | 7.40 |
| Post-dev | 109 | 6.27 | 14.05 |
| Post-Mitigated | 109 | 18.00 | 1.498 |
| | | Reduction | 5.902 |

**SUMMARY: PEAK 50-YEAR RUNOFF**

| | Node # | Tc (min) | Runoff (cfs) |
|---|---|---|---|
| Pre-dev | 3 | 13.70 | 6.750 |
| Post-dev | 109 | 6.36 | 12.80 |
| Post-Mitigated | 109 | 42.00 | 0.722 |

**SUMMARY: PEAK 10-YEAR RUNOFF**

| | Node # | Tc (min) | Runoff (cfs) |
|---|---|---|---|
| Pre-dev | 3 | 14.32 | 4.848 |
| Post-dev | 109 | 6.68 | 9.173 |
| Post-Mitigated | 109 | 132.00 | 0.091 |

See Attachment 3 for calculations.

## 5.5 Design / Analyze Proposed Storm Drain Facilities

Hydraflow Storm Sewer Extension for Autodesk Autocad Civil 3D 2015, version 10.4, (Storm Sewer), is used to design the storm drain network to convey the 100-year storm event flows.

All underground storm drain pipes are analyzed with 100-year flow calculations and found to not be under pressure. Calculations confirm that all proposed drainage improvements will adequately convey 100-year peak runoff. Results can be found in Attachment 4 of this report.

Detention calculations within the detention system are analyzed using Hydrograph Hydraflow. The runoff volume is stored within a storm-capture system. The 3' Detention Pipe System is over a footprint of 6,902 sqft.

The low flow exiting the detention system is treated via Modular Wetland System and is then allowed to runoff to gravity flow out a 4" pipe along the westerly property line. Ultimately the runoff is conveyed to the public storm drain system within Buena Vista Ave.

The storm water gravity flows out the detention system and through the neighboring retaining wall. The runoff then gravity flows along a curb and gutter within the neighboring property and ultimately to the same inlet location as the low flow.

See Attachment 3 for post-development runoff calculations.
See Attachment 4 for detention calculations.

## 6.0 CONCLUSION

This study and resulting data indicate that the project will not increase 100-year peak runoff downstream of the project. It can therefore be concluded that this project will result in no negative impact on the existing downstream storm drain facilities or adjacent and downstream properties.

Because the project is not located within or discharges to navigable waters, water of the United States, or federal jurisdictional wetlands, as defined by the Clean Water Act, no 401/404 permit is required.

In conclusion, the project has met the City of Santee minimum requirements for the peak flow control.

## 7.0 REFERENCES

County of San Diego, Department of Public Works, Flood Control Section, June2003 San Diego County Hydrology Manual

County of San Diego, Department of Public Works, Flood Control Section, September 2014 San Diego County Hydraulic Design Manual

## 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 Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

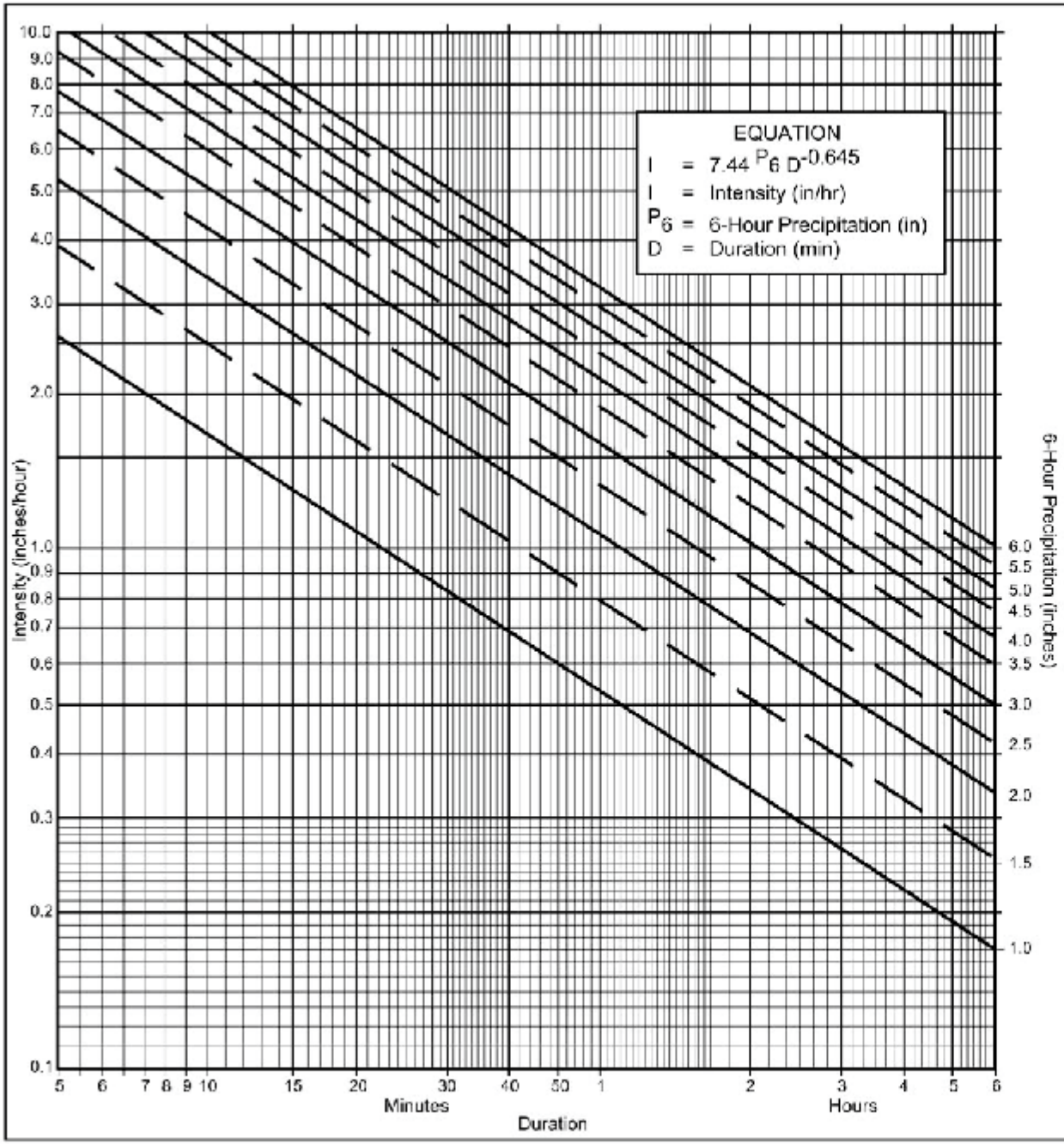
**ENGINEER OF WORK**
Excel Engineering
440 State Place
Escondido, CA 92029
Tel – (760)745-8118
Fax – (760)745-1890

Project Number: 18-005

_____ 03/03/20

Robert D. Dentino, RCE 45629 Date
Registration Expire: December 31, 2020

# 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 applicaple 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 100 year

(b) $P_6$ = 3.1 in., $P_{24}$ = 5.5, $\frac{P_6}{P_{24}}$ = 56.4 %(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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Duration | I | I | I | I | I | I | I | I | I | I | I |
| 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 |

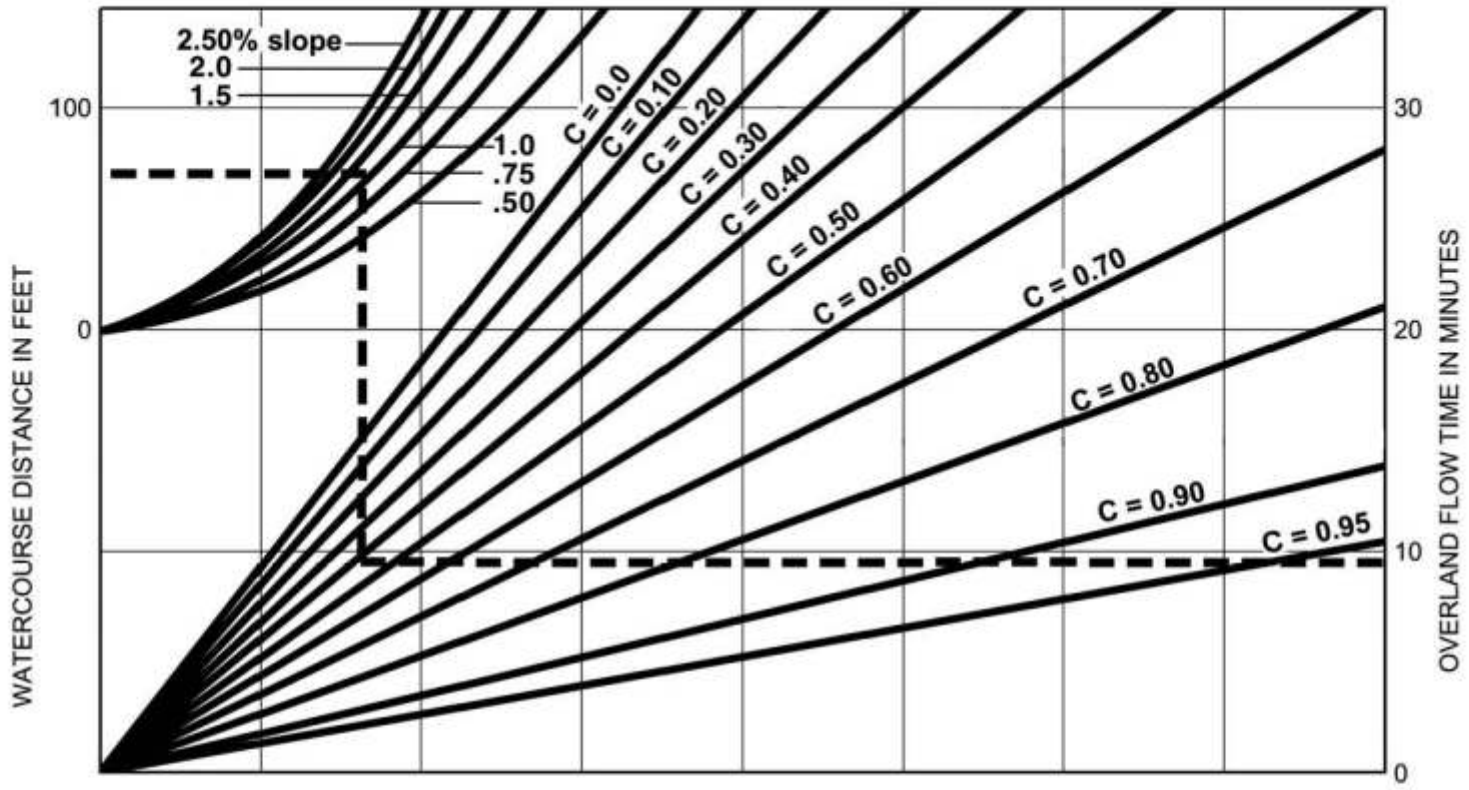
**Intensity-Duration Design Chart - Template**

**FIGURE 3-1**

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

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

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




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**

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

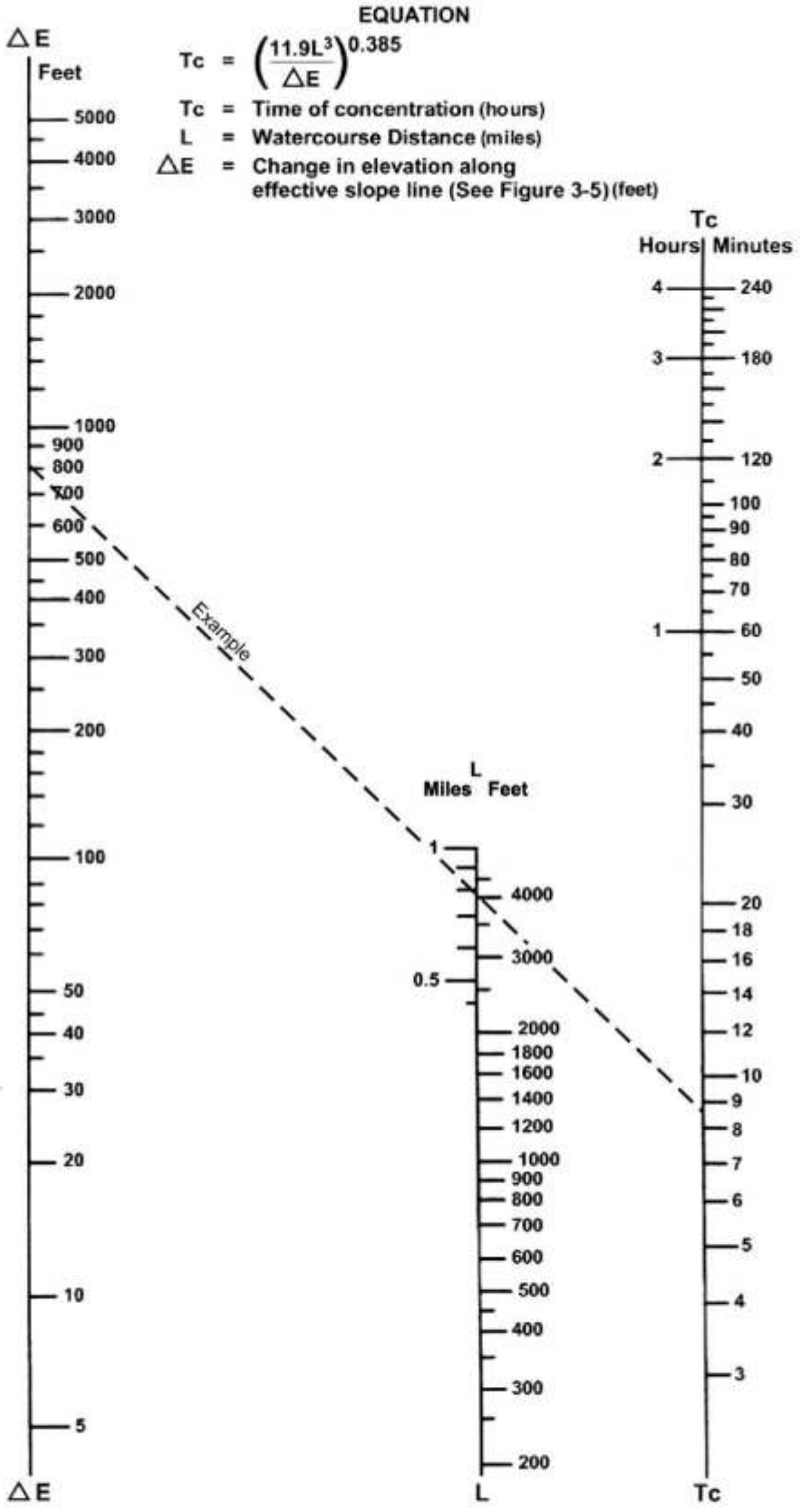
Table 3-2 provides limits of the length (Maximum Length ($L_M$)) of sheet flow to be used in hydrology studies. Initial $T_i$ values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

**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 |

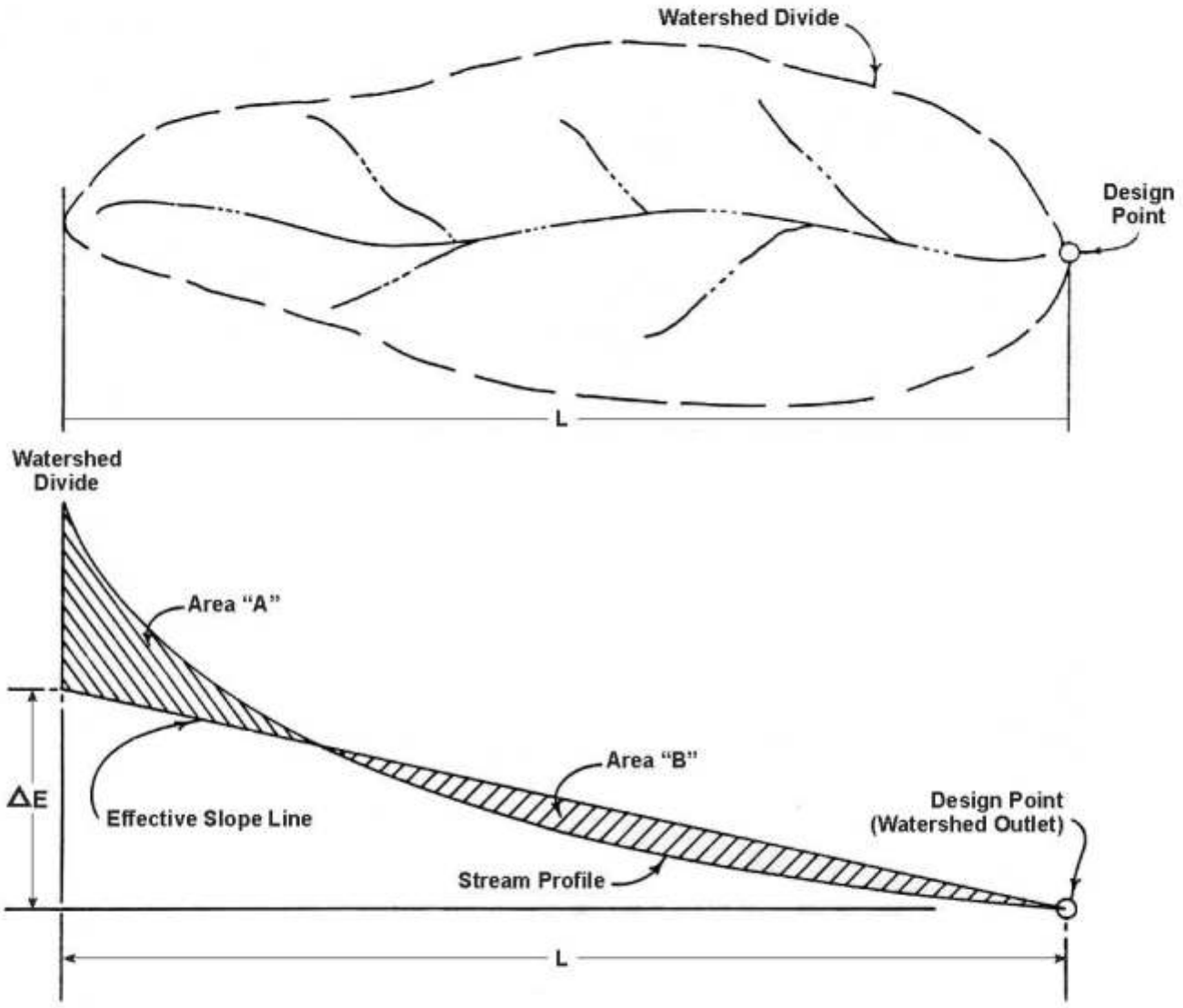
*See Table 3-1 for more detailed description




SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

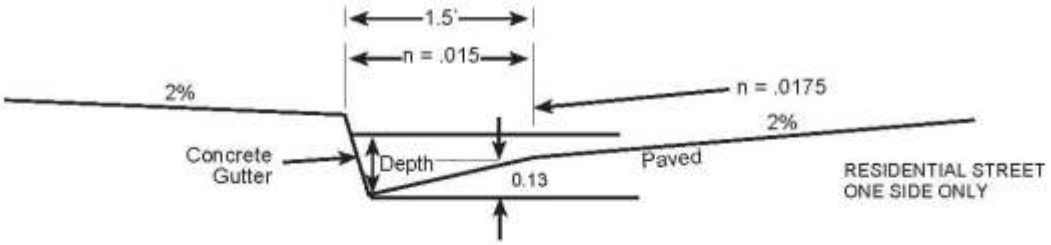


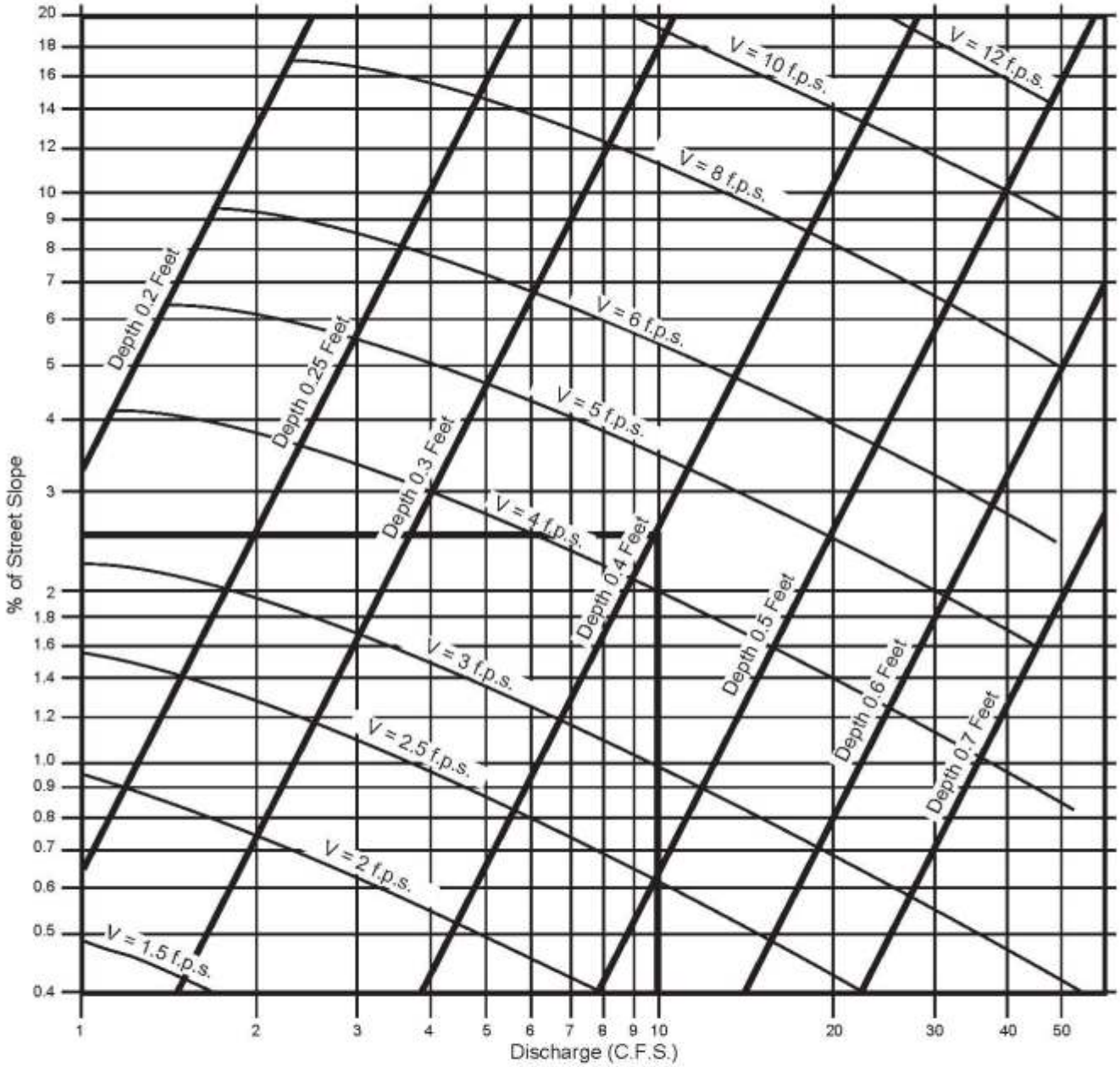

SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

Computation of Effective Slope for Natural Watersheds

3-5



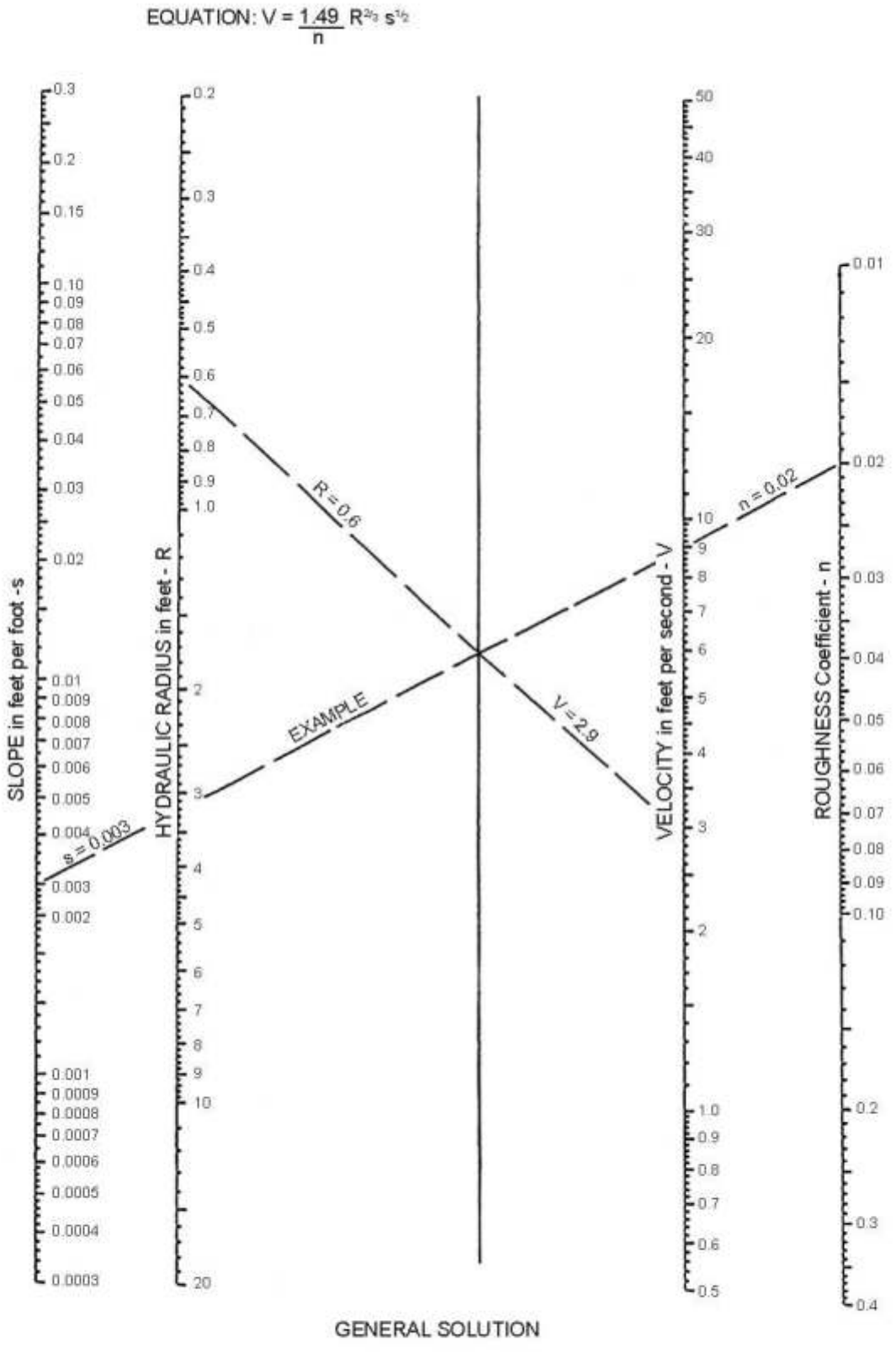

**EXAMPLE:**
**Given: Q = 10 S = 2.5%**
**Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.**

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

**Gutter and Roadway Discharge - Velocity Chart**

**3-6**




SOURCE: USDOT, FHWA, HDS-3 (1961)

FIGURE

**Manning's Equation Nomograph**

**3-7**

# ATTACHMENT 2

# County of San Diego Hydrology Manual

*Soil Hydrologic Groups*

## Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

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

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

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S



3 0 3 Miles

# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**10 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

Cottonwood
6HR: 1.7"

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

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

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

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles

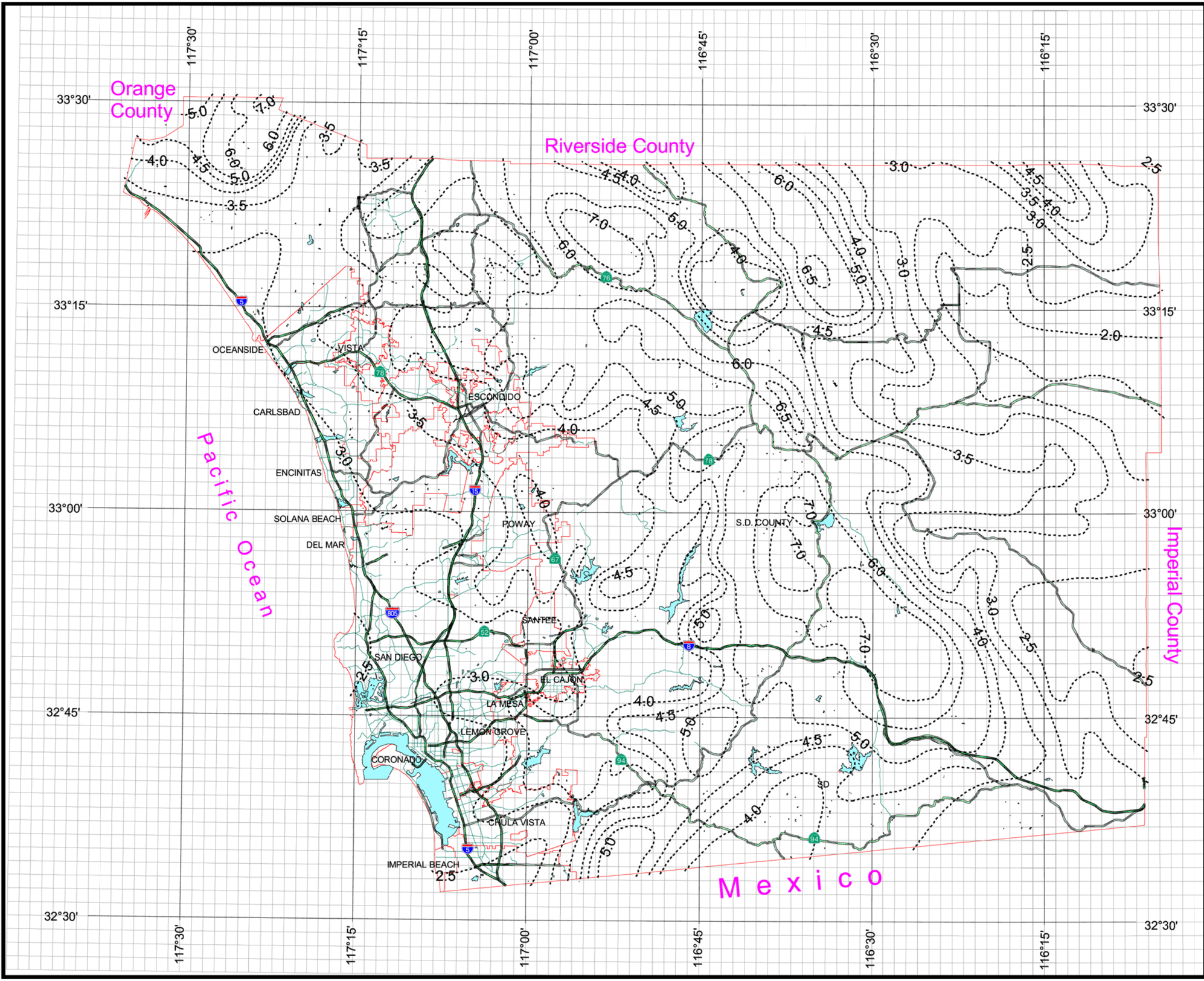
# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**10 Year Rainfall Event - 24 Hours**

Isopluvial (inches)

Cottonwood
24HR: 2.9"




DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles

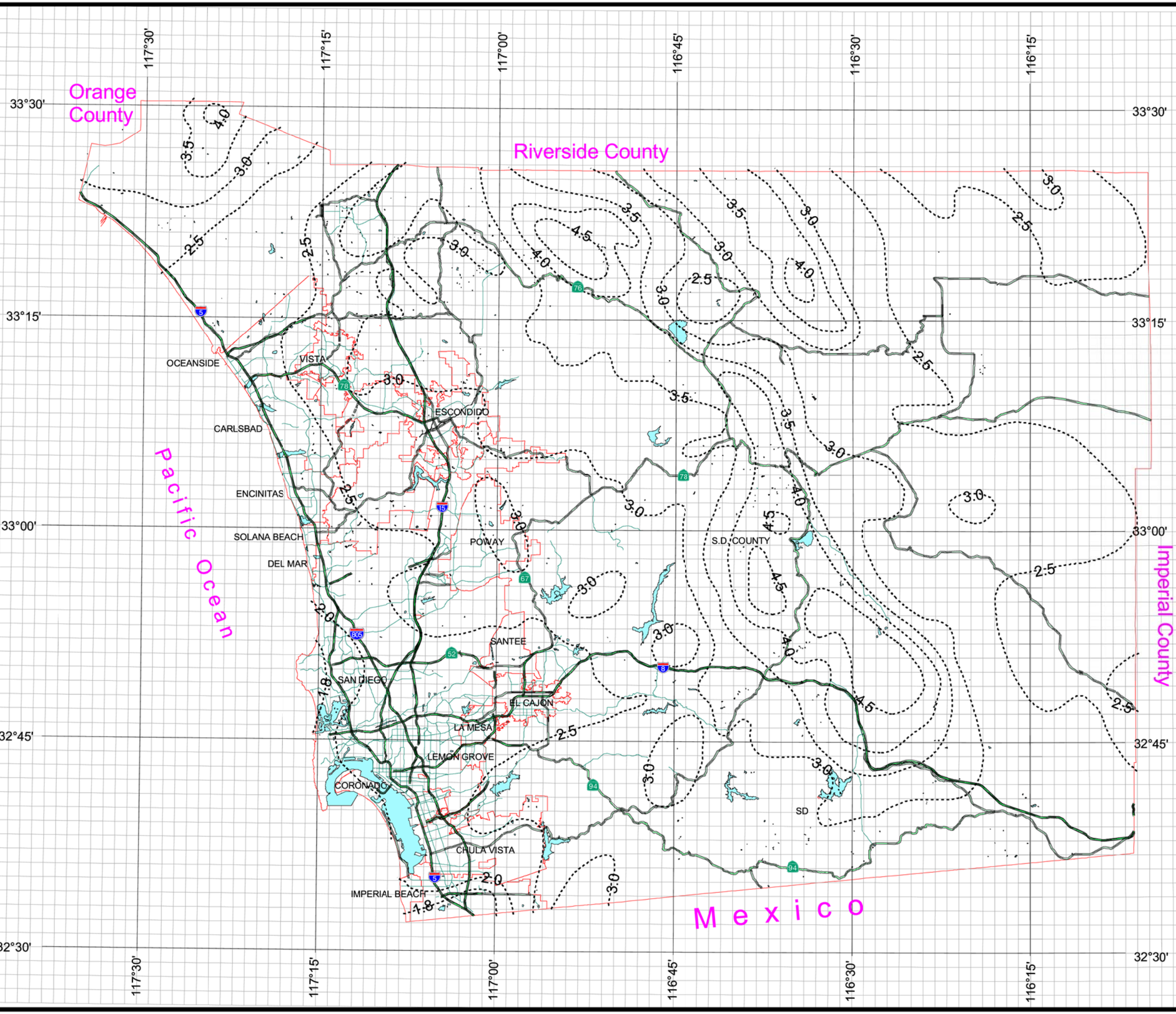
# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**50 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

Cottonwood
6HR: 2.3"




DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S



3 0 3 Miles

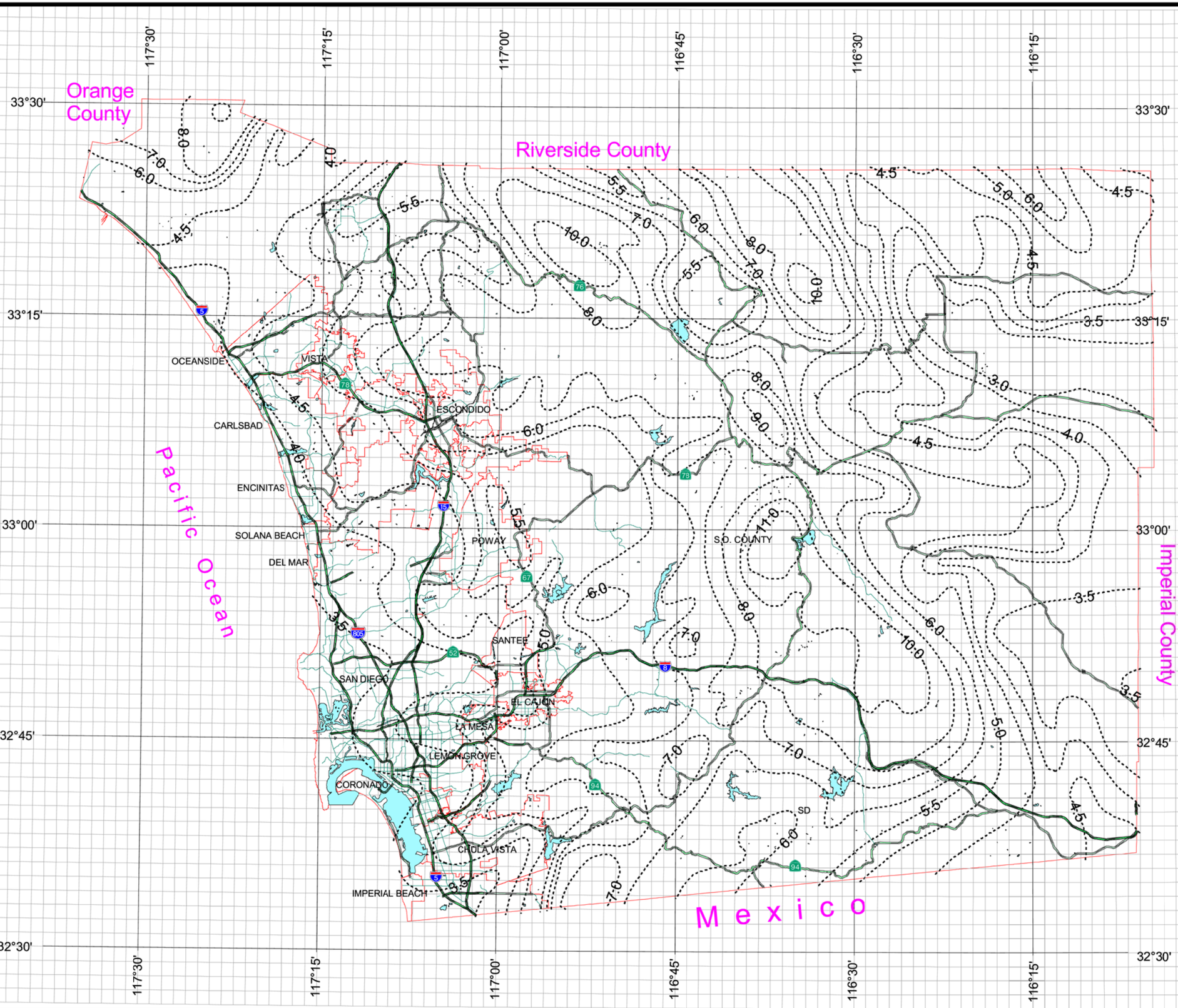
# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**50 Year Rainfall Event - 24 Hours**

Isopluvial (inches)

Cottonwood
24HR: 4.5"




DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles

# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 6 Hours**

Isopluvial (inches)

Cottonwood
6HR: 2.5"

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

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

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

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles

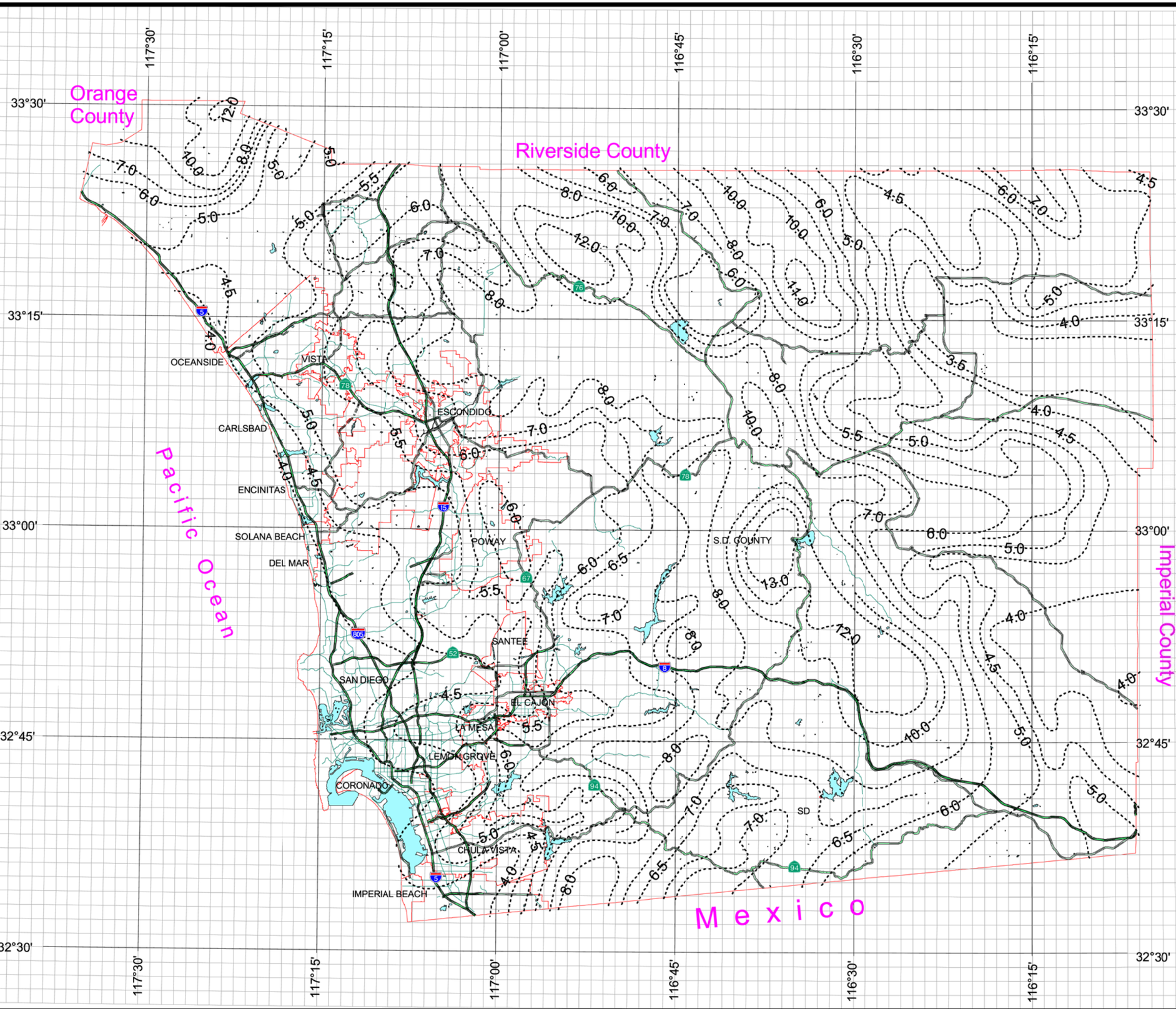
# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 24 Hours**

Isopluvial (inches)

Cottonwood
24HR: 5.0"



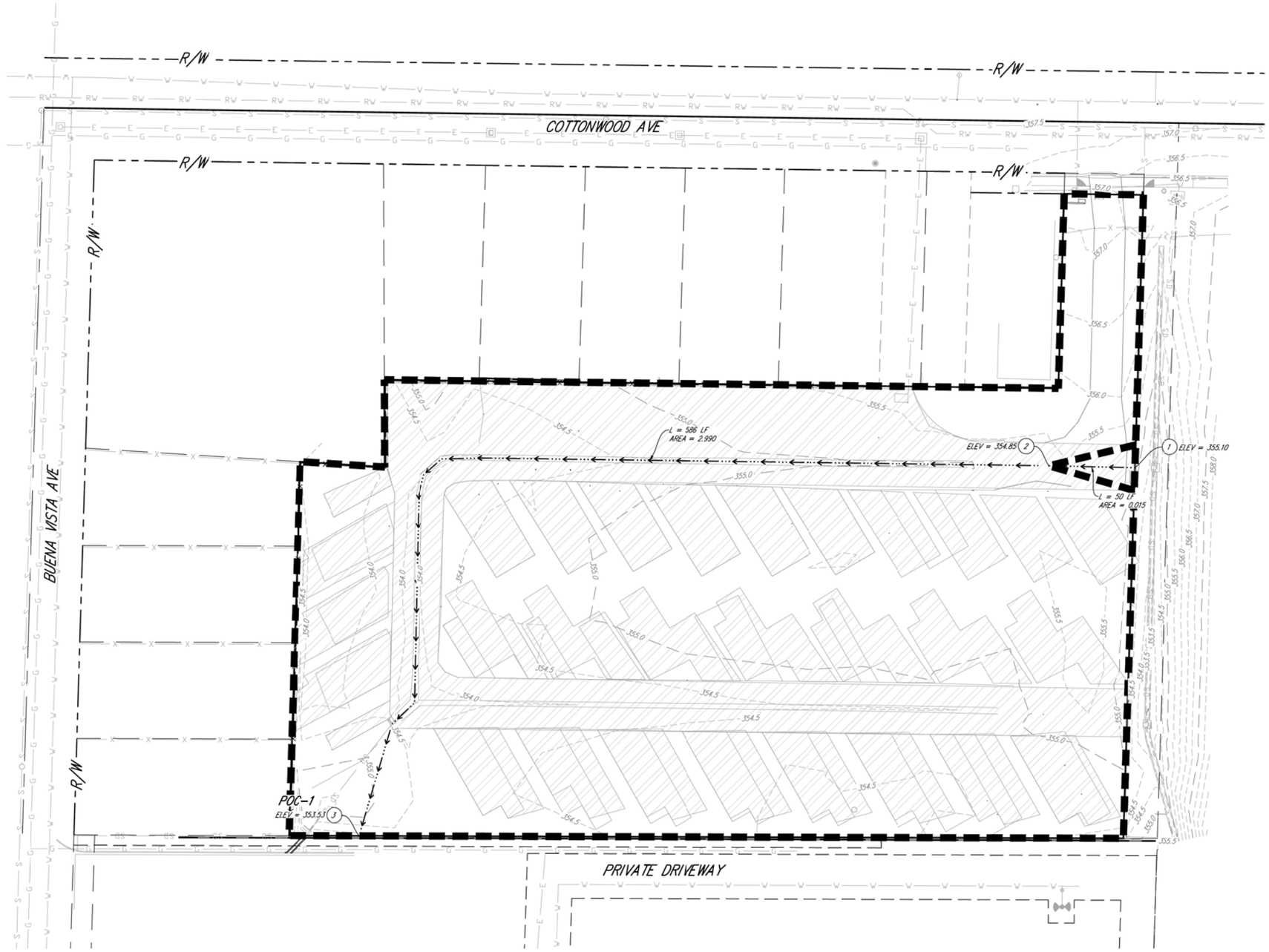

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!



N W E S

3 0 3 Miles




**LEGEND - ABBREVIATIONS:**

| | |
|---|---|
| | INDICATES TRIBUTARY AREA BOUNDARY |
| → | FLOWLINE SURFACE |
| L=80FT | FLOW DISTANCE |
| 101 | NODE NUMBER |
| 0.743 ACRES | TOTAL SUB TRIBUTARY AREA |

SCALE: 1"=30'

0 30 60 90 120

ENGINEER OF WORK

EXCEL ENGINEERING

LAND PLANNING • ENGINEERING • SURVEYING
440 STATE PLACE, ESCONDIDO, CA 92029
PH (760)745-8118 FAX (760)745-1890

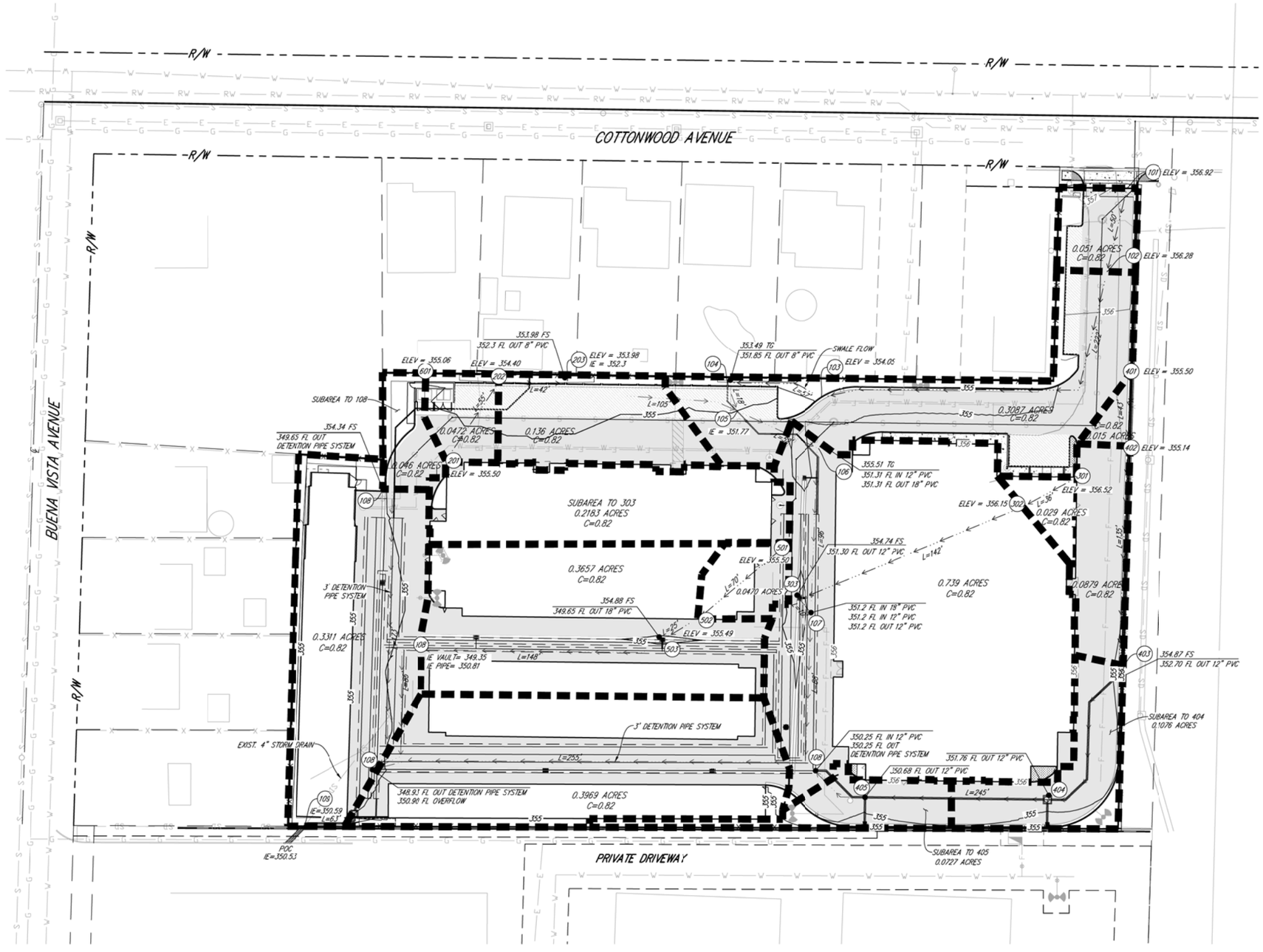
ROBERT D. DENTINO
RCE: 45629 EXP:12/31/20

February 21, 2020
DATE

REGISTERED PROFESSIONAL ENGINEER
ROBERT D. DENTINO
No. 45629
Exp. 12-31-20
CIVIL
STATE OF CALIFORNIA

**ALL RIGHT SELF-STORAGE**
**PRE DEVELOPMENT TOPO MAP**

V:\18\18025\Engineering\SDP\Storm-SDP\Civil\18025_PreDev.dwg 2/21/2020 2:45 PM DRONAN PLOT SIZE: ----




**LEGEND - ABBREVIATIONS:**

| | |
|---|---|
| ▬ ▬ ▬ | INDICATES TRIBUTARY AREA BOUNDARY |
| — — — | INDICATES SUB TRIBUTARY AREA BOUNDARY |
| ···→··· | FLOWLINE SURFACE |
| ···→··· | FLOWLINE UNDERGROUND |
| L=80FT | FLOW DISTANCE |
| 101 | NODE NUMBER |
| 0.743 ACRES | TOTAL SUB TRIBUTARY AREA |

ENGINEER OF WORK


EXCEL ENGINEERING
LAND PLANNING • ENGINEERING • SURVEYING
440 STATE PLACE, ESCONDIDO, CA 92029
PH (760)745-8118 FAX (760)745-1890


ROBERT D. DENTINO
RCE: 45629 EXP:12/31/20

March 4, 2020
DATE

REGISTERED PROFESSIONAL ENGINEER
ROBERT D. DENTINO
No. 45629
Exp.12-31-20
CIVIL
STATE OF CALIFORNIA

**ALL RIGHT SELF-STORAGE**
**POST DEVELOPMENT MAP**

v 18\18020\Engineering\SDP\Storm-SDP\HYD\Civil\18020_PostDevMap 3/4/2020 12:24 PM ORIGINAL PLOT SIZE: ----

# ATTACHMENT 3

```
                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: 02/21/20
------------------------------------------------------------------------
18005 Cottonwood Ave
PRE-DEVELOPED CONDITION
10-year Storm Event
FILE: 18005pre10yr.RSD3
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6332

------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  1.700
24 hour precipitation(inches) =  2.900
P6/P24 =    58.6%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  355.100(Ft.)
Lowest elevation =  354.850(Ft.)
Elevation difference =    0.250(Ft.) Slope =  0.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
```

```
for the top area slope value of   0.50 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.25 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7100)*(  50.000^.5)/(   0.500^(1/3)]=   6.25
Rainfall intensity (I) =      3.877(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.710
Subarea runoff =      0.041(CFS)
Total initial stream area =        0.015(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.483(CFS)
Depth of flow =   0.261(Ft.), Average velocity =   1.211(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2             15.00              0.00
        3             30.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      2.483(CFS)
  '     '        flow top width =     15.689(Ft.)
  '     '    velocity=    1.211(Ft/s)
  '     '        area =      2.051(Sq.Ft)
  '     '        Froude number =     0.590

Upstream point elevation =   354.850(Ft.)
Downstream point elevation =   353.530(Ft.)
Flow length =   586.000(Ft.)
Travel time  =    8.07 min.
Time of concentration =   14.32 min.
Depth of flow =   0.261(Ft.)
Average velocity =   1.211(Ft/s)
Total irregular channel flow =     2.483(CFS)
Irregular channel normal depth above invert elev. =   0.261(Ft.)
Average velocity of channel(s) =   1.211(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      2.272(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
```

```
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      2.272(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      2.134
Subarea runoff =      4.806(CFS) for      2.990(Ac.)
Total runoff =      4.848(CFS)  Total area =       3.005(Ac.)
Depth of flow =   0.336(Ft.), Average velocity =   1.431(Ft/s)
End of computations, total study area =           3.005 (Ac.)
```

18005 Cottonwood Avenue
Pre-Development Condition
10-year Storm Event

```
                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: 02/20/20
--------------------------------------------------------------------------
18005 Cottonwood Avenue
Post Development
10-year Storm Event
File:18005postdev10yr.rd3
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6332

--------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  1.700
24 hour precipitation(inches) =  2.900
P6/P24 =    58.6%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  356.920(Ft.)
Lowest elevation =  356.280(Ft.)
Elevation difference =    0.640(Ft.) Slope =  1.280 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
```

```
for the top area slope value of   1.28 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.60 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.280^(1/3)]=   3.60
Calculated TC of    3.596 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.187(CFS)
Total initial stream area =        0.051(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.755(CFS)
Depth of flow =   0.206(Ft.), Average velocity =   3.045(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.755(CFS)
  '     '        flow top width =      1.411(Ft.)
  '     '    velocity=    3.045(Ft/s)
  '     '        area =      0.248(Sq.Ft)
  '     '        Froude number =     1.280

Upstream point elevation =   356.280(Ft.)
Downstream point elevation =   354.050(Ft.)
Flow length =   222.000(Ft.)
Travel time  =    1.22 min.
Time of concentration =    4.81 min.
Depth of flow =   0.206(Ft.)
Average velocity =   3.045(Ft/s)
Total irregular channel flow =     0.755(CFS)
Irregular channel normal depth above invert elev. =   0.206(Ft.)
Average velocity of channel(s) =   3.045(Ft/s)
 Adding area flow to channel
Calculated TC of    4.811 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.295
Subarea runoff =      1.135(CFS) for      0.309(Ac.)
Total runoff =      1.322(CFS)  Total area =       0.360(Ac.)
Depth of flow =   0.283(Ft.), Average velocity =   3.643(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.611(Ft.), Average velocity =   1.772(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              2.00              0.00
        3              4.00              1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =      1.322(CFS)
  '     '        flow top width =      2.443(Ft.)
  '     '    velocity=    1.772(Ft/s)
  '     '        area =      0.746(Sq.Ft)
  '     '        Froude number =     0.565

Upstream point elevation =   354.050(Ft.)
Downstream point elevation =   353.490(Ft.)
Flow length =    57.000(Ft.)
Travel time  =    0.54 min.
Time of concentration =    5.35 min.
Depth of flow =   0.611(Ft.)
Average velocity =   1.772(Ft/s)
Total irregular channel flow =     1.322(CFS)
Irregular channel normal depth above invert elev. =   0.611(Ft.)
Average velocity of channel(s) =   1.772(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
```

```
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________
Upstream point/station elevation =   351.890(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =    18.00(Ft.) Slope =   0.0067  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.322(CFS)
Given pipe size =      8.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.430(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.215(Ft.)
 Minor friction loss =      0.334(Ft.)  K-factor =   1.50
Pipe flow velocity =      3.79(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     5.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
_____________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.360(Ac.)
Runoff from this stream =      1.322(CFS)
Time of concentration =    5.43 min.
Rainfall intensity =     4.249(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
_____________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   55.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  354.400(Ft.)
Elevation difference =    1.100(Ft.) Slope =  2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.46 minutes
```

```
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   2.000^(1/3)]=   3.46
Calculated TC of    3.464 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.173(CFS)
Total initial stream area =        0.047(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.422(CFS)
Depth of flow =   0.147(Ft.), Average velocity =   2.503(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.422(CFS)
  '     '        flow top width =      1.294(Ft.)
  '     '    velocity=    2.503(Ft/s)
  '     '        area =      0.169(Sq.Ft)
  '     '        Froude number =     1.221

Upstream point elevation =   354.400(Ft.)
Downstream point elevation =   353.980(Ft.)
Flow length =    42.000(Ft.)
Travel time  =    0.28 min.
Time of concentration =    3.74 min.
Depth of flow =   0.147(Ft.)
Average velocity =   2.503(Ft/s)
Total irregular channel flow =     0.422(CFS)
Irregular channel normal depth above invert elev. =   0.147(Ft.)
Average velocity of channel(s) =   2.503(Ft/s)
 Adding area flow to channel
Calculated TC of    3.744 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.150
Subarea runoff =      0.500(CFS) for      0.136(Ac.)
Total runoff =      0.672(CFS)  Total area =       0.183(Ac.)
Depth of flow =   0.193(Ft.), Average velocity =   2.926(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________________
Upstream point/station elevation =   352.300(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =   105.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.672(CFS)
Given pipe size =      8.00(In.)
Calculated individual pipe flow  =     0.672(CFS)
Normal flow depth in pipe =    5.33(In.)
Flow top width inside pipe =    7.54(In.)
Critical Depth =    4.64(In.)
Pipe flow velocity =      2.72(Ft/s)
Travel time through pipe =    0.64 min.
Time of concentration (TC) =     4.39 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.183(Ac.)
Runoff from this stream =      0.672(CFS)
Time of concentration =    4.39 min.
Rainfall intensity =     4.479(In/Hr)
Summary of stream data:

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


1        1.322      5.43                4.249
2        0.672      4.39                4.479
Qmax(1) =
           1.000 *    1.000 *     1.322) +
           0.949 *    1.000 *     0.672) + =       1.960
```

```
Qmax(2) =
          1.000 *    0.808 *     1.322) +
          1.000 *    1.000 *     0.672) + =       1.741

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.322       0.672
Maximum flow rates at confluence using above data:
        1.960        1.741
Area of streams before confluence:
        0.360        0.183
Results of confluence:
Total flow rate =      1.960(CFS)
Time of concentration =     5.426 min.
Effective stream area after confluence =      0.543(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.770(Ft.)
Downstream point/station elevation =   351.310(Ft.)
Pipe length  =    52.00(Ft.) Slope =   0.0088  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.960(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.960(CFS)
Normal flow depth in pipe =    6.60(In.)
Flow top width inside pipe =   11.94(In.)
Critical Depth =    7.16(In.)
Pipe flow velocity =      4.43(Ft/s)
Travel time through pipe =    0.20 min.
Time of concentration (TC) =     5.62 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.310(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    96.00(Ft.) Slope =   0.0011  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.960(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     1.960(CFS)
Normal flow depth in pipe =    9.54(In.)
Flow top width inside pipe =   17.97(In.)
Critical Depth =    6.33(In.)
Pipe flow velocity =      2.06(Ft/s)
Travel time through pipe =    0.78 min.
```

```
Time of concentration (TC) =     6.40 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.543(Ac.)
Runoff from this stream =      1.960(CFS)
Time of concentration =    6.40 min.
Rainfall intensity =     3.821(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   36.000(Ft.)
Highest elevation =  356.520(Ft.)
Lowest elevation =  356.150(Ft.)
Elevation difference =    0.370(Ft.) Slope =  1.028 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.03 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.87 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.028^(1/3)]=   3.87
Calculated TC of    3.868 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.107(CFS)
Total initial stream area =        0.029(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 =      1.471(CFS)
Depth of flow =   0.331(Ft.), Average velocity =   3.363(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              2.00              0.00
        3              4.00              0.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =      1.471(CFS)
  '     '        flow top width =      2.646(Ft.)
  '     '    velocity=    3.363(Ft/s)
  '     '        area =      0.437(Sq.Ft)
  '     '        Froude number =     1.457

Upstream point elevation =   356.150(Ft.)
Downstream point elevation =   354.740(Ft.)
Flow length =   142.000(Ft.)
Travel time  =    0.70 min.
Time of concentration =    4.57 min.
Depth of flow =   0.331(Ft.)
Average velocity =   3.363(Ft/s)
Total irregular channel flow =     1.471(CFS)
Irregular channel normal depth above invert elev. =   0.331(Ft.)
Average velocity of channel(s) =   3.363(Ft/s)
 Adding area flow to channel
Calculated TC of    4.572 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.633
Subarea runoff =      2.729(CFS) for      0.743(Ac.)
Total runoff =      2.835(CFS)  Total area =       0.772(Ac.)
Depth of flow =   0.423(Ft.), Average velocity =   3.962(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
```

```
Upstream point/station elevation =   351.300(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    10.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.835(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.835(CFS)
Normal flow depth in pipe =    8.09(In.)
Flow top width inside pipe =   11.25(In.)
Critical Depth =    8.66(In.)
Pipe flow velocity =      5.03(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     4.61 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.772(Ac.)
Runoff from this stream =      2.835(CFS)
Time of concentration =    4.61 min.
Rainfall intensity =     4.479(In/Hr)
Summary of stream data:

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


1        1.960      6.40                3.821
2        2.835      4.61                4.479
Qmax(1) =
           1.000 *    1.000 *     1.960) +
           0.853 *    1.000 *     2.835) + =       4.378
Qmax(2) =
           1.000 *    0.720 *     1.960) +
           1.000 *    1.000 *     2.835) + =       4.246

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.960       2.835
Maximum flow rates at confluence using above data:
        4.378        4.246
Area of streams before confluence:
        0.543        0.772
Results of confluence:
Total flow rate =      4.378(CFS)
Time of concentration =     6.398 min.
Effective stream area after confluence =      1.315(Ac.)
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.200(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =    88.00(Ft.) Slope =   0.0108  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.378(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.102(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.329(Ft.)
 Minor friction loss =      0.724(Ft.)  K-factor =   1.50
Pipe flow velocity =      5.57(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =     6.66 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.315(Ac.)
Runoff from this stream =      4.378(CFS)
Time of concentration =    6.66 min.
Rainfall intensity =     3.723(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   43.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  355.140(Ft.)
Elevation difference =    0.360(Ft.) Slope =  0.837 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
```

```
for the top area slope value of   0.84 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.14 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   0.837^(1/3)]=   4.14
Calculated TC of    4.143 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.055(CFS)
Total initial stream area =        0.015(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.217(CFS)
Depth of flow =   0.159(Ft.), Average velocity =   1.173(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.217(CFS)
  '     '        flow top width =      1.319(Ft.)
  '     '    velocity=    1.173(Ft/s)
  '     '        area =      0.185(Sq.Ft)
  '     '        Froude number =     0.552

Upstream point elevation =   355.140(Ft.)
Downstream point elevation =   354.870(Ft.)
Flow length =   135.000(Ft.)
Travel time  =    1.92 min.
Time of concentration =    6.06 min.
Depth of flow =   0.159(Ft.)
Average velocity =   1.173(Ft/s)
Total irregular channel flow =     0.217(CFS)
Irregular channel normal depth above invert elev. =   0.159(Ft.)
Average velocity of channel(s) =   1.173(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.956(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      3.956(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.084
Subarea runoff =      0.279(CFS) for      0.088(Ac.)
Total runoff =      0.334(CFS)  Total area =       0.103(Ac.)
Depth of flow =   0.205(Ft.), Average velocity =   1.355(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________________
Upstream point/station elevation =   352.700(Ft.)
Downstream point/station elevation =   351.760(Ft.)
Pipe length  =    94.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.334(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.334(CFS)
Normal flow depth in pipe =    2.48(In.)
Flow top width inside pipe =    9.72(In.)
Critical Depth =    2.86(In.)
Pipe flow velocity =      2.85(Ft/s)
Travel time through pipe =    0.55 min.
Time of concentration (TC) =     6.61 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      404.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Rainfall intensity (I) =      3.741(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.61 min.
Rainfall intensity =      3.741(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.173
Subarea runoff =      0.313(CFS) for      0.108(Ac.)
```

```
Total runoff =      0.647(CFS)  Total area =       0.211(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________________
Upstream point/station elevation =   351.760(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =   145.00(Ft.) Slope =   0.0104  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.647(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.647(CFS)
Normal flow depth in pipe =    3.43(In.)
Flow top width inside pipe =   10.84(In.)
Critical Depth =    4.01(In.)
Pipe flow velocity =      3.50(Ft/s)
Travel time through pipe =    0.69 min.
Time of concentration (TC) =     7.30 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      405.000 to Point/Station      405.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Rainfall intensity (I) =      3.508(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     7.30 min.
Rainfall intensity =      3.508(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.233
Subarea runoff =      0.170(CFS) for      0.073(Ac.)
Total runoff =      0.817(CFS)  Total area =       0.284(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.284(Ac.)
Runoff from this stream =      0.817(CFS)
Time of concentration =    7.30 min.
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

```
Rainfall intensity =     3.508(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  356.260(Ft.)
Lowest elevation =  355.760(Ft.)
Elevation difference =    0.500(Ft.) Slope =  1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.90 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.000^(1/3)]=   3.90
Calculated TC of    3.904 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.180(CFS)
Total initial stream area =        0.049(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.465(CFS)
Depth of flow =   0.331(Ft.), Average velocity =   3.352(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              2.00              0.00
        3              4.00              0.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
```

```
Sub-Channel flow  =      1.465(CFS)
  '     '        flow top width =      2.645(Ft.)
  '     '    velocity=    3.352(Ft/s)
  '     '        area =      0.437(Sq.Ft)
  '     '        Froude number =     1.453

Upstream point elevation =   355.760(Ft.)
Downstream point elevation =   355.000(Ft.)
Flow length =    77.000(Ft.)
Travel time  =    0.38 min.
Time of concentration =    4.29 min.
Depth of flow =   0.331(Ft.)
Average velocity =   3.352(Ft/s)
Total irregular channel flow =     1.465(CFS)
Irregular channel normal depth above invert elev. =   0.331(Ft.)
Average velocity of channel(s) =   3.352(Ft/s)
 Adding area flow to channel
Calculated TC of    4.287 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      4.479(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      4.479(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.614
Subarea runoff =      2.571(CFS) for      0.700(Ac.)
Total runoff =      2.751(CFS)  Total area =       0.749(Ac.)
Depth of flow =   0.419(Ft.), Average velocity =   3.924(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      503.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   349.650(Ft.)
Downstream point/station elevation =   349.350(Ft.)
Pipe length  =   148.00(Ft.) Slope =   0.0020  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.751(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.751(CFS)
Normal flow depth in pipe =    9.86(In.)
Flow top width inside pipe =   17.92(In.)
Critical Depth =    7.55(In.)
Pipe flow velocity =      2.78(Ft/s)
```

```
Travel time through pipe =    0.89 min.
Time of concentration (TC) =     5.18 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.749(Ac.)
Runoff from this stream =      2.751(CFS)
Time of concentration =    5.18 min.
Rainfall intensity =     4.381(In/Hr)
Summary of stream data:

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


1        4.378      6.66                3.723
2        0.817      7.30                3.508
3        2.751      5.18                4.381
Qmax(1) =
           1.000 *    1.000 *     4.378) +
           1.000 *    0.912 *     0.817) +
           0.850 *    1.000 *     2.751) + =       7.461
Qmax(2) =
           0.942 *    1.000 *     4.378) +
           1.000 *    1.000 *     0.817) +
           0.801 *    1.000 *     2.751) + =       7.146
Qmax(3) =
           1.000 *    0.777 *     4.378) +
           1.000 *    0.709 *     0.817) +
           1.000 *    1.000 *     2.751) + =       6.732

Total of 3 streams to confluence:
Flow rates before confluence point:
       4.378       0.817       2.751
Maximum flow rates at confluence using above data:
        7.461        7.146        6.732
Area of streams before confluence:
        1.315        0.284        0.749
Results of confluence:
Total flow rate =      7.461(CFS)
Time of concentration =     6.661 min.
Effective stream area after confluence =      2.348(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      601.000 to Point/Station      108.000
```

```
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      3.723(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
The area added to the existing stream causes a
a lower flow rate of Q =      7.308(CFS)
therefore the upstream flow rate of Q =      7.461(CFS) is being used
Time of concentration =     6.66 min.
Rainfall intensity =      3.723(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      1.963
Subarea runoff =      0.000(CFS) for      0.046(Ac.)
Total runoff =      7.461(CFS)  Total area =       2.394(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      3.723(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.66 min.
Rainfall intensity =      3.723(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.244
Subarea runoff =      0.893(CFS) for      0.343(Ac.)
Total runoff =      8.355(CFS)  Total area =       2.737(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      3.723(In/Hr) for a    10.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.66 min.
Rainfall intensity =      3.723(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.464
Subarea runoff =      0.818(CFS) for      0.268(Ac.)
Total runoff =      9.173(CFS)  Total area =       3.005(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   350.590(Ft.)
Downstream point/station elevation =   350.530(Ft.)
Pipe length  =    12.10(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.173(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     3.919(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.802(Ft.)
 Minor friction loss =      3.177(Ft.)  K-factor =   1.50
Pipe flow velocity =     11.68(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     6.68 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** 6 HOUR HYDROGRAPH ****
________________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =   6.68
Basin Area =     3.00 Acres
6 Hour Rainfall =  1.700 Inches
Runoff Coefficient =  0.820
Peak Discharge =     9.17 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
       6               0.250
       12               0.252
```

| | |
|---|---|
| 18 | 0.258 |
| 24 | 0.261 |
| 30 | 0.267 |
| 36 | 0.271 |
| 42 | 0.278 |
| 48 | 0.281 |
| 54 | 0.289 |
| 60 | 0.293 |
| 66 | 0.301 |
| 72 | 0.306 |
| 78 | 0.315 |
| 84 | 0.320 |
| 90 | 0.331 |
| 96 | 0.336 |
| 102 | 0.348 |
| 108 | 0.355 |
| 114 | 0.369 |
| 120 | 0.376 |
| 126 | 0.393 |
| 132 | 0.401 |
| 138 | 0.421 |
| 144 | 0.431 |
| 150 | 0.455 |
| 156 | 0.468 |
| 162 | 0.497 |
| 168 | 0.513 |
| 174 | 0.550 |
| 180 | 0.571 |
| 186 | 0.621 |
| 192 | 0.650 |
| 198 | 0.721 |
| 204 | 0.765 |
| 210 | 0.877 |
| 216 | 0.950 |
| 222 | 1.162 |
| 228 | 1.323 |
| 234 | 1.943 |
| 240 | 2.738 |
| 246 | 9.173 |
| 252 | 1.558 |
| 258 | 1.043 |
| 264 | 0.816 |
| 270 | 0.683 |
| 276 | 0.595 |
| 282 | 0.531 |
| 288 | 0.482 |
| 294 | 0.443 |
| 300 | 0.411 |
| 306 | 0.384 |
| 312 | 0.362 |

| | |
|---|---|
| 318 | 0.342 |
| 324 | 0.325 |
| 330 | 0.310 |
| 336 | 0.297 |
| 342 | 0.285 |
| 348 | 0.274 |
| 354 | 0.264 |
| 360 | 0.255 |
| 366 | 0.247 |

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

6 - H O U R  S T O R M

R u n o f f  H y d r o g r a p h

---

Hydrograph in 1 Minute intervals ((CFS))

---

| Time(h+m) | Volume Ac.Ft | Q(CFS) | 0 | 2.3 | 4.6 | 6.9 | 9.2 |
|---|---|---|---|---|---|---|---|
| 0+ 0 | 0.0000 | 0.00 | Q | \| | \| | \| | \| |
| 0+ 1 | 0.0001 | 0.04 | Q | \| | \| | \| | \| |
| 0+ 2 | 0.0002 | 0.08 | Q | \| | \| | \| | \| |
| 0+ 3 | 0.0003 | 0.12 | Q | \| | \| | \| | \| |
| 0+ 4 | 0.0006 | 0.17 | Q | \| | \| | \| | \| |
| 0+ 5 | 0.0009 | 0.21 | Q | \| | \| | \| | \| |
| 0+ 6 | 0.0012 | 0.25 | VQ | \| | \| | \| | \| |
| 0+ 7 | 0.0015 | 0.25 | VQ | \| | \| | \| | \| |
| 0+ 8 | 0.0019 | 0.25 | VQ | \| | \| | \| | \| |
| 0+ 9 | 0.0022 | 0.25 | VQ | \| | \| | \| | \| |
| 0+10 | 0.0026 | 0.25 | VQ | \| | \| | \| | \| |
| 0+11 | 0.0029 | 0.25 | VQ | \| | \| | \| | \| |
| 0+12 | 0.0033 | 0.25 | VQ | \| | \| | \| | \| |
| 0+13 | 0.0036 | 0.25 | VQ | \| | \| | \| | \| |
| 0+14 | 0.0040 | 0.25 | VQ | \| | \| | \| | \| |
| 0+15 | 0.0043 | 0.26 | VQ | \| | \| | \| | \| |
| 0+16 | 0.0047 | 0.26 | VQ | \| | \| | \| | \| |
| 0+17 | 0.0050 | 0.26 | VQ | \| | \| | \| | \| |
| 0+18 | 0.0054 | 0.26 | VQ | \| | \| | \| | \| |
| 0+19 | 0.0058 | 0.26 | VQ | \| | \| | \| | \| |
| 0+20 | 0.0061 | 0.26 | VQ | \| | \| | \| | \| |
| 0+21 | 0.0065 | 0.26 | VQ | \| | \| | \| | \| |
| 0+22 | 0.0068 | 0.26 | VQ | \| | \| | \| | \| |
| 0+23 | 0.0072 | 0.26 | VQ | \| | \| | \| | \| |
| 0+24 | 0.0075 | 0.26 | VQ | \| | \| | \| | \| |
| 0+25 | 0.0079 | 0.26 | VQ | \| | \| | \| | \| |
| 0+26 | 0.0083 | 0.26 | VQ | \| | \| | \| | \| |
| 0+27 | 0.0086 | 0.26 | \|Q | \| | \| | \| | \| |
| 0+28 | 0.0090 | 0.27 | \|Q | \| | \| | \| | \| |
| 0+29 | 0.0094 | 0.27 | \|Q | \| | \| | \| | \| |
| 0+30 | 0.0097 | 0.27 | \|Q | \| | \| | \| | \| |
| 0+31 | 0.0101 | 0.27 | \|Q | \| | \| | \| | \| |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0+32 | 0.0105 | 0.27 | Q | | | | |
| 0+33 | 0.0108 | 0.27 | Q | | | | |
| 0+34 | 0.0112 | 0.27 | Q | | | | |
| 0+35 | 0.0116 | 0.27 | Q | | | | |
| 0+36 | 0.0120 | 0.27 | Q | | | | |
| 0+37 | 0.0123 | 0.27 | Q | | | | |
| 0+38 | 0.0127 | 0.27 | Q | | | | |
| 0+39 | 0.0131 | 0.27 | Q | | | | |
| 0+40 | 0.0135 | 0.28 | Q | | | | |
| 0+41 | 0.0138 | 0.28 | Q | | | | |
| 0+42 | 0.0142 | 0.28 | Q | | | | |
| 0+43 | 0.0146 | 0.28 | Q | | | | |
| 0+44 | 0.0150 | 0.28 | Q | | | | |
| 0+45 | 0.0154 | 0.28 | Q | | | | |
| 0+46 | 0.0158 | 0.28 | Q | | | | |
| 0+47 | 0.0162 | 0.28 | Q | | | | |
| 0+48 | 0.0165 | 0.28 | Q | | | | |
| 0+49 | 0.0169 | 0.28 | Q | | | | |
| 0+50 | 0.0173 | 0.28 | QV | | | | |
| 0+51 | 0.0177 | 0.28 | QV | | | | |
| 0+52 | 0.0181 | 0.29 | QV | | | | |
| 0+53 | 0.0185 | 0.29 | QV | | | | |
| 0+54 | 0.0189 | 0.29 | QV | | | | |
| 0+55 | 0.0193 | 0.29 | QV | | | | |
| 0+56 | 0.0197 | 0.29 | QV | | | | |
| 0+57 | 0.0201 | 0.29 | QV | | | | |
| 0+58 | 0.0205 | 0.29 | QV | | | | |
| 0+59 | 0.0209 | 0.29 | QV | | | | |
| 1+ 0 | 0.0213 | 0.29 | QV | | | | |
| 1+ 1 | 0.0217 | 0.29 | QV | | | | |
| 1+ 2 | 0.0221 | 0.30 | QV | | | | |
| 1+ 3 | 0.0225 | 0.30 | QV | | | | |
| 1+ 4 | 0.0229 | 0.30 | QV | | | | |
| 1+ 5 | 0.0234 | 0.30 | QV | | | | |
| 1+ 6 | 0.0238 | 0.30 | QV | | | | |
| 1+ 7 | 0.0242 | 0.30 | QV | | | | |
| 1+ 8 | 0.0246 | 0.30 | QV | | | | |
| 1+ 9 | 0.0250 | 0.30 | QV | | | | |
| 1+10 | 0.0254 | 0.30 | QV | | | | |
| 1+11 | 0.0259 | 0.30 | Q V | | | | |
| 1+12 | 0.0263 | 0.31 | Q V | | | | |
| 1+13 | 0.0267 | 0.31 | Q V | | | | |
| 1+14 | 0.0271 | 0.31 | Q V | | | | |
| 1+15 | 0.0276 | 0.31 | Q V | | | | |
| 1+16 | 0.0280 | 0.31 | Q V | | | | |
| 1+17 | 0.0284 | 0.31 | Q V | | | | |
| 1+18 | 0.0288 | 0.32 | Q V | | | | |
| 1+19 | 0.0293 | 0.32 | Q V | | | | |
| 1+20 | 0.0297 | 0.32 | Q V | | | | |
| 1+21 | 0.0302 | 0.32 | Q V | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1+22 | 0.0306 | 0.32 | \|Q V | \| | \| | \| | \| |
| 1+23 | 0.0310 | 0.32 | \|Q V | \| | \| | \| | \| |
| 1+24 | 0.0315 | 0.32 | \|Q V | \| | \| | \| | \| |
| 1+25 | 0.0319 | 0.32 | \|Q V | \| | \| | \| | \| |
| 1+26 | 0.0324 | 0.32 | \|Q V | \| | \| | \| | \| |
| 1+27 | 0.0328 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+28 | 0.0333 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+29 | 0.0337 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+30 | 0.0342 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+31 | 0.0346 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+32 | 0.0351 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+33 | 0.0355 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+34 | 0.0360 | 0.33 | \|Q V | \| | \| | \| | \| |
| 1+35 | 0.0365 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+36 | 0.0369 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+37 | 0.0374 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+38 | 0.0379 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+39 | 0.0383 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+40 | 0.0388 | 0.34 | \|Q V | \| | \| | \| | \| |
| 1+41 | 0.0393 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+42 | 0.0398 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+43 | 0.0403 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+44 | 0.0407 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+45 | 0.0412 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+46 | 0.0417 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+47 | 0.0422 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+48 | 0.0427 | 0.35 | \|Q V | \| | \| | \| | \| |
| 1+49 | 0.0432 | 0.36 | \|Q V | \| | \| | \| | \| |
| 1+50 | 0.0437 | 0.36 | \|Q V | \| | \| | \| | \| |
| 1+51 | 0.0442 | 0.36 | \|Q V | \| | \| | \| | \| |
| 1+52 | 0.0447 | 0.36 | \|Q V | \| | \| | \| | \| |
| 1+53 | 0.0452 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+54 | 0.0457 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+55 | 0.0462 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+56 | 0.0467 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+57 | 0.0472 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+58 | 0.0477 | 0.37 | \|Q V | \| | \| | \| | \| |
| 1+59 | 0.0482 | 0.38 | \|Q V | \| | \| | \| | \| |
| 2+ 0 | 0.0488 | 0.38 | \|Q V | \| | \| | \| | \| |
| 2+ 1 | 0.0493 | 0.38 | \|Q V | \| | \| | \| | \| |
| 2+ 2 | 0.0498 | 0.38 | \|Q V | \| | \| | \| | \| |
| 2+ 3 | 0.0503 | 0.38 | \|Q V | \| | \| | \| | \| |
| 2+ 4 | 0.0509 | 0.39 | \|Q V | \| | \| | \| | \| |
| 2+ 5 | 0.0514 | 0.39 | \|Q V | \| | \| | \| | \| |
| 2+ 6 | 0.0520 | 0.39 | \|Q V | \| | \| | \| | \| |
| 2+ 7 | 0.0525 | 0.39 | \|Q V | \| | \| | \| | \| |
| 2+ 8 | 0.0530 | 0.40 | \|Q V | \| | \| | \| | \| |
| 2+ 9 | 0.0536 | 0.40 | \|Q V | \| | \| | \| | \| |
| 2+10 | 0.0541 | 0.40 | \|Q V | \| | \| | \| | \| |
| 2+11 | 0.0547 | 0.40 | \|Q V | \| | \| | \| | \| |

```
2+12      0.0552      0.40  |Q    V   |          |          |          |
2+13      0.0558      0.40  |Q    V   |          |          |          |
2+14      0.0564      0.41  |Q    V   |          |          |          |
2+15      0.0569      0.41  |Q    V   |          |          |          |
2+16      0.0575      0.41  |Q    V   |          |          |          |
2+17      0.0581      0.42  |Q    V   |          |          |          |
2+18      0.0587      0.42  |Q    V   |          |          |          |
2+19      0.0592      0.42  |Q    V   |          |          |          |
2+20      0.0598      0.42  |Q    V   |          |          |          |
2+21      0.0604      0.43  |Q     V  |          |          |          |
2+22      0.0610      0.43  |Q     V  |          |          |          |
2+23      0.0616      0.43  |Q     V  |          |          |          |
2+24      0.0622      0.43  |Q     V  |          |          |          |
2+25      0.0628      0.44  |Q     V  |          |          |          |
2+26      0.0634      0.44  |Q     V  |          |          |          |
2+27      0.0640      0.44  |Q     V  |          |          |          |
2+28      0.0646      0.45  |Q     V  |          |          |          |
2+29      0.0652      0.45  |Q     V  |          |          |          |
2+30      0.0659      0.45  |Q     V  |          |          |          |
2+31      0.0665      0.46  |Q     V  |          |          |          |
2+32      0.0671      0.46  | Q    V  |          |          |          |
2+33      0.0678      0.46  | Q    V  |          |          |          |
2+34      0.0684      0.46  | Q    V  |          |          |          |
2+35      0.0690      0.47  | Q     V |          |          |          |
2+36      0.0697      0.47  | Q     V |          |          |          |
2+37      0.0703      0.47  | Q     V |          |          |          |
2+38      0.0710      0.48  | Q     V |          |          |          |
2+39      0.0717      0.48  | Q     V |          |          |          |
2+40      0.0723      0.49  | Q     V |          |          |          |
2+41      0.0730      0.49  | Q     V |          |          |          |
2+42      0.0737      0.50  | Q     V |          |          |          |
2+43      0.0744      0.50  | Q     V |          |          |          |
2+44      0.0751      0.50  | Q     V |          |          |          |
2+45      0.0758      0.50  | Q     V |          |          |          |
2+46      0.0765      0.51  | Q     V |          |          |          |
2+47      0.0772      0.51  | Q      V|          |          |          |
2+48      0.0779      0.51  | Q      V|          |          |          |
2+49      0.0786      0.52  | Q      V|          |          |          |
2+50      0.0793      0.53  | Q      V|          |          |          |
2+51      0.0800      0.53  | Q      V|          |          |          |
2+52      0.0808      0.54  | Q      V|          |          |          |
2+53      0.0815      0.54  | Q      V|          |          |          |
2+54      0.0823      0.55  | Q      V|          |          |          |
2+55      0.0830      0.55  | Q      V|          |          |          |
2+56      0.0838      0.56  | Q      V|          |          |          |
2+57      0.0846      0.56  | Q      V|          |          |          |
2+58      0.0854      0.56  | Q      V|          |          |          |
2+59      0.0861      0.57  | Q       V          |          |          |
3+ 0      0.0869      0.57  | Q       V          |          |          |
3+ 1      0.0877      0.58  | Q       V          |          |          |
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

```
3+ 2       0.0885      0.59  | Q       V         |          |          |
3+ 3       0.0894      0.60  | Q       V         |          |          |
3+ 4       0.0902      0.60  | Q       V         |          |          |
3+ 5       0.0910      0.61  | Q       V         |          |          |
3+ 6       0.0919      0.62  | Q       V         |          |          |
3+ 7       0.0928      0.63  | Q       V         |          |          |
3+ 8       0.0936      0.63  | Q       V         |          |          |
3+ 9       0.0945      0.64  | Q       |V        |          |          |
3+10       0.0954      0.64  | Q       |V        |          |          |
3+11       0.0963      0.65  | Q       |V        |          |          |
3+12       0.0972      0.65  | Q       |V        |          |          |
3+13       0.0981      0.66  | Q       |V        |          |          |
3+14       0.0990      0.67  | Q       |V        |          |          |
3+15       0.0999      0.69  | Q       |V        |          |          |
3+16       0.1009      0.70  |  Q      |V        |          |          |
3+17       0.1019      0.71  |  Q      |V        |          |          |
3+18       0.1029      0.72  |  Q      | V       |          |          |
3+19       0.1039      0.73  |  Q      | V       |          |          |
3+20       0.1049      0.74  |  Q      | V       |          |          |
3+21       0.1059      0.74  |  Q      | V       |          |          |
3+22       0.1070      0.75  |  Q      | V       |          |          |
3+23       0.1080      0.76  |  Q      | V       |          |          |
3+24       0.1090      0.76  |  Q      | V       |          |          |
3+25       0.1101      0.78  |  Q      | V       |          |          |
3+26       0.1112      0.80  |  Q      | V       |          |          |
3+27       0.1124      0.82  |  Q      |  V      |          |          |
3+28       0.1135      0.84  |  Q      |  V      |          |          |
3+29       0.1147      0.86  |  Q      |  V      |          |          |
3+30       0.1159      0.88  |  Q      |  V      |          |          |
3+31       0.1171      0.89  |  Q      |  V      |          |          |
3+32       0.1184      0.90  |  Q      |  V      |          |          |
3+33       0.1196      0.91  |  Q      |  V      |          |          |
3+34       0.1209      0.93  |   Q     |   V     |          |          |
3+35       0.1222      0.94  |   Q     |   V     |          |          |
3+36       0.1235      0.95  |   Q     |   V     |          |          |
3+37       0.1249      0.99  |   Q     |   V     |          |          |
3+38       0.1263      1.02  |   Q     |   V     |          |          |
3+39       0.1277      1.06  |   Q     |   V     |          |          |
3+40       0.1292      1.09  |   Q     |    V    |          |          |
3+41       0.1308      1.13  |   Q     |    V    |          |          |
3+42       0.1324      1.16  |    Q    |    V    |          |          |
3+43       0.1340      1.19  |    Q    |    V    |          |          |
3+44       0.1357      1.22  |    Q    |    V    |          |          |
3+45       0.1374      1.24  |    Q    |     V   |          |          |
3+46       0.1392      1.27  |    Q    |     V   |          |          |
3+47       0.1409      1.30  |    Q    |     V   |          |          |
3+48       0.1428      1.32  |    Q    |     V   |          |          |
3+49       0.1447      1.43  |     Q   |     V   |          |          |
3+50       0.1468      1.53  |     Q   |      V  |          |          |
3+51       0.1491      1.63  |      Q  |      V  |          |          |
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3+52 | 0.1515 | 1.74 | \| Q \| | V \| | \| | \| |
| 3+53 | 0.1540 | 1.84 | \| Q \| | V \| | \| | \| |
| 3+54 | 0.1567 | 1.94 | \| Q \| | V \| | \| | \| |
| 3+55 | 0.1595 | 2.08 | \| Q\| | V \| | \| | \| |
| 3+56 | 0.1626 | 2.21 | \| Q\| | V \| | \| | \| |
| 3+57 | 0.1658 | 2.34 | \| Q | V\| | \| | \| |
| 3+58 | 0.1692 | 2.47 | \| Q | V\| | \| | \| |
| 3+59 | 0.1728 | 2.61 | \|Q | V | \| | \| |
| 4+ 0 | 0.1766 | 2.74 | \|Q | V | \| | \| |
| 4+ 1 | 0.1818 | 3.81 | \| Q \|V | \| | \| |
| 4+ 2 | 0.1885 | 4.88 | \| \|Q | \| | \| |
| 4+ 3 | 0.1967 | 5.96 | \| \| V Q | \| | \| |
| 4+ 4 | 0.2064 | 7.03 | \| \| V Q | \| | \| |
| 4+ 5 | 0.2176 | 8.10 | \| \| V \| Q | \| |
| 4+ 6 | 0.2302 | 9.17 | \| \| V \| | Q |
| 4+ 7 | 0.2411 | 7.90 | \| \| V \| Q | \| |
| 4+ 8 | 0.2502 | 6.63 | \| \| QV\| | \| |
| 4+ 9 | 0.2576 | 5.37 | \| \| Q V | \| |
| 4+10 | 0.2633 | 4.10 | \| Q \| V | \| |
| 4+11 | 0.2672 | 2.83 | \| Q \| \|V | \| |
| 4+12 | 0.2693 | 1.56 | \| Q \| \|V | \| |
| 4+13 | 0.2713 | 1.47 | \| Q \| \|V | \| |
| 4+14 | 0.2733 | 1.39 | \| Q \| \|V | \| |
| 4+15 | 0.2750 | 1.30 | \| Q \| \| V | \| |
| 4+16 | 0.2767 | 1.21 | \| Q \| \| V | \| |
| 4+17 | 0.2783 | 1.13 | \| Q \| \| V | \| |
| 4+18 | 0.2797 | 1.04 | \| Q \| \| V | \| |
| 4+19 | 0.2811 | 1.00 | \| Q \| \| V | \| |
| 4+20 | 0.2824 | 0.97 | \| Q \| \| V | \| |
| 4+21 | 0.2837 | 0.93 | \| Q \| \| V | \| |
| 4+22 | 0.2849 | 0.89 | \| Q \| \| V | \| |
| 4+23 | 0.2861 | 0.85 | \| Q \| \| V | \| |
| 4+24 | 0.2872 | 0.82 | \| Q \| \| V | \| |
| 4+25 | 0.2883 | 0.79 | \| Q \| \| V | \| |
| 4+26 | 0.2894 | 0.77 | \| Q \| \| V | \| |
| 4+27 | 0.2904 | 0.75 | \| Q \| \| V | \| |
| 4+28 | 0.2914 | 0.73 | \| Q \| \| V | \| |
| 4+29 | 0.2924 | 0.71 | \| Q \| \| V | \| |
| 4+30 | 0.2933 | 0.68 | \| Q \| \| V | \| |
| 4+31 | 0.2943 | 0.67 | \| Q \| \| V | \| |
| 4+32 | 0.2952 | 0.65 | \| Q \| \| V | \| |
| 4+33 | 0.2960 | 0.64 | \| Q \| \| V | \| |
| 4+34 | 0.2969 | 0.62 | \| Q \| \| V | \| |
| 4+35 | 0.2977 | 0.61 | \| Q \| \| V | \| |
| 4+36 | 0.2986 | 0.59 | \| Q \| \| V | \| |
| 4+37 | 0.2994 | 0.58 | \| Q \| \| V | \| |
| 4+38 | 0.3002 | 0.57 | \| Q \| \| \| V | \| |
| 4+39 | 0.3009 | 0.56 | \| Q \| \| \| V | \| |
| 4+40 | 0.3017 | 0.55 | \| Q \| \| \| V | \| |
| 4+41 | 0.3024 | 0.54 | \| Q \| \| \| V | \| |

```
4+42      0.3032      0.53  | Q      |        |        |    V    |
4+43      0.3039      0.52  | Q      |        |        |    V    |
4+44      0.3046      0.51  | Q      |        |        |    V    |
4+45      0.3053      0.51  | Q      |        |        |    V    |
4+46      0.3060      0.50  | Q      |        |        |    V    |
4+47      0.3066      0.49  | Q      |        |        |    V    |
4+48      0.3073      0.48  | Q      |        |        |    V    |
4+49      0.3080      0.48  | Q      |        |        |    V    |
4+50      0.3086      0.47  | Q      |        |        |     V   |
4+51      0.3092      0.46  | Q      |        |        |     V   |
4+52      0.3099      0.46  |Q       |        |        |     V   |
4+53      0.3105      0.45  |Q       |        |        |     V   |
4+54      0.3111      0.44  |Q       |        |        |     V   |
4+55      0.3117      0.44  |Q       |        |        |     V   |
4+56      0.3123      0.43  |Q       |        |        |     V   |
4+57      0.3129      0.43  |Q       |        |        |     V   |
4+58      0.3135      0.42  |Q       |        |        |     V   |
4+59      0.3140      0.42  |Q       |        |        |     V   |
5+ 0      0.3146      0.41  |Q       |        |        |     V   |
5+ 1      0.3152      0.41  |Q       |        |        |     V   |
5+ 2      0.3157      0.40  |Q       |        |        |     V   |
5+ 3      0.3163      0.40  |Q       |        |        |     V   |
5+ 4      0.3168      0.39  |Q       |        |        |     V   |
5+ 5      0.3173      0.39  |Q       |        |        |      V  |
5+ 6      0.3179      0.38  |Q       |        |        |      V  |
5+ 7      0.3184      0.38  |Q       |        |        |      V  |
5+ 8      0.3189      0.38  |Q       |        |        |      V  |
5+ 9      0.3194      0.37  |Q       |        |        |      V  |
5+10      0.3199      0.37  |Q       |        |        |      V  |
5+11      0.3204      0.37  |Q       |        |        |      V  |
5+12      0.3209      0.36  |Q       |        |        |      V  |
5+13      0.3214      0.36  |Q       |        |        |      V  |
5+14      0.3219      0.36  |Q       |        |        |      V  |
5+15      0.3224      0.35  |Q       |        |        |      V  |
5+16      0.3229      0.35  |Q       |        |        |      V  |
5+17      0.3234      0.35  |Q       |        |        |      V  |
5+18      0.3238      0.34  |Q       |        |        |      V  |
5+19      0.3243      0.34  |Q       |        |        |      V  |
5+20      0.3248      0.34  |Q       |        |        |      V  |
5+21      0.3252      0.33  |Q       |        |        |      V  |
5+22      0.3257      0.33  |Q       |        |        |      V  |
5+23      0.3261      0.33  |Q       |        |        |       V |
5+24      0.3266      0.33  |Q       |        |        |       V |
5+25      0.3270      0.32  |Q       |        |        |       V |
5+26      0.3275      0.32  |Q       |        |        |       V |
5+27      0.3279      0.32  |Q       |        |        |       V |
5+28      0.3283      0.32  |Q       |        |        |       V |
5+29      0.3288      0.31  |Q       |        |        |       V |
5+30      0.3292      0.31  |Q       |        |        |       V |
5+31      0.3296      0.31  |Q       |        |        |       V |
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

```
    5+32       0.3300      0.31  |Q        |         |         |        V |
    5+33       0.3305      0.30  |Q        |         |         |        V |
    5+34       0.3309      0.30  |Q        |         |         |        V |
    5+35       0.3313      0.30  |Q        |         |         |        V |
    5+36       0.3317      0.30  |Q        |         |         |        V |
    5+37       0.3321      0.29  |Q        |         |         |        V |
    5+38       0.3325      0.29  |Q        |         |         |        V |
    5+39       0.3329      0.29  |Q        |         |         |        V |
    5+40       0.3333      0.29  |Q        |         |         |        V |
    5+41       0.3337      0.29  |Q        |         |         |        V |
    5+42       0.3341      0.28  |Q        |         |         |        V |
    5+43       0.3345      0.28  |Q        |         |         |         V|
    5+44       0.3349      0.28  |Q        |         |         |         V|
    5+45       0.3353      0.28  |Q        |         |         |         V|
    5+46       0.3356      0.28  |Q        |         |         |         V|
    5+47       0.3360      0.28  |Q        |         |         |         V|
    5+48       0.3364      0.27  |Q        |         |         |         V|
    5+49       0.3368      0.27  |Q        |         |         |         V|
    5+50       0.3371      0.27  |Q        |         |         |         V|
    5+51       0.3375      0.27  |Q        |         |         |         V|
    5+52       0.3379      0.27  |Q        |         |         |         V|
    5+53       0.3383      0.27  |Q        |         |         |         V|
    5+54       0.3386      0.26  |Q        |         |         |         V|
    5+55       0.3390      0.26  |Q        |         |         |         V|
    5+56       0.3393      0.26  |Q        |         |         |         V|
    5+57       0.3397      0.26  |Q        |         |         |         V|
    5+58       0.3401      0.26  |Q        |         |         |         V|
    5+59       0.3404      0.26  |Q        |         |         |         V|
    6+ 0       0.3408      0.26  |Q        |         |         |         V|
    6+ 1       0.3411      0.25  |Q        |         |         |         V|
    6+ 2       0.3415      0.25  |Q        |         |         |         V|
    6+ 3       0.3418      0.25  |Q        |         |         |         V|
    6+ 4       0.3421      0.25  |Q        |         |         |         V|
    6+ 5       0.3425      0.25  |Q        |         |         |         V|
    6+ 6       0.3428      0.25  |Q        |         |         |          V
---------------------------------------------------------------------------

    End of computations, total study area =          3.005 (Ac.)
```

18005 Cottonwood Avenue
Post-Development Condition
10-year Storm Event

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: 03/03/20
---
18005 Cottonwood Avenue
Post Development-User Defined
10-year Storm Event
File:18005postdevuser10yr.rd3
---
 *********   Hydrology Study Control Information **********

---

Program License Serial Number 6332

---
Rational hydrology study storm event year is    10.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  1.700
24 hour precipitation(inches) =  2.900
P6/P24 =    58.6%
San Diego hydrology manual 'C' values used

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
User specified 'C' value of 0.056 given for subarea
Rainfall intensity (I) =      0.542(In/Hr) for a    10.0 year storm
User specified values are as follows:
TC = 132.00 min.  Rain intensity =       0.54(In/Hr)
Total area =        3.005(Ac.)  Total runoff =     0.091(CFS)
End of computations, total study area =           3.005 (Ac.)

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: 03/03/20
---
18005 Cottonwood Avenue
Post Development-User Defined
10-year Storm Event
File:18005postdevuser10yr.rd3
---
 *********   Hydrology Study Control Information **********

---

Program License Serial Number 6332

---
Rational hydrology study storm event year is    10.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  1.700
24 hour precipitation(inches) =  2.900
P6/P24 =    58.6%
San Diego hydrology manual 'C' values used

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
User specified 'C' value of 0.056 given for subarea
Rainfall intensity (I) =      0.542(In/Hr) for a    10.0 year storm
User specified values are as follows:
TC = 132.00 min.  Rain intensity =       0.54(In/Hr)
Total area =        3.005(Ac.)  Total runoff =     0.091(CFS)
End of computations, total study area =           3.005 (Ac.)

```
                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: 02/21/20
------------------------------------------------------------------------
18005 Cottonwood Ave
PRE-DEVELOPED CONDITION
50yr Storm Event
FILE: 18005pre50yr.RSD3
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6332

------------------------------------------------------------------------
Rational hydrology study storm event year is    50.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.300
24 hour precipitation(inches) =  4.500
P6/P24 =    51.1%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  355.100(Ft.)
Lowest elevation =  354.850(Ft.)
Elevation difference =    0.250(Ft.) Slope =  0.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
```

```
for the top area slope value of   0.50 %, in a development type of
 24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   6.25 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7100)*(  50.000^.5)/(   0.500^(1/3)]=   6.25
Rainfall intensity (I) =      5.245(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.710
Subarea runoff =      0.056(CFS)
Total initial stream area =        0.015(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      3.430(CFS)
Depth of flow =   0.295(Ft.), Average velocity =   1.313(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2             15.00              0.00
        3             30.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      3.430(CFS)
  '     '        flow top width =     17.709(Ft.)
  '     '    velocity=    1.313(Ft/s)
  '     '        area =      2.613(Sq.Ft)
  '     '        Froude number =     0.602

Upstream point elevation =   354.850(Ft.)
Downstream point elevation =   353.530(Ft.)
Flow length =   586.000(Ft.)
Travel time  =    7.44 min.
Time of concentration =   13.70 min.
Depth of flow =   0.295(Ft.)
Average velocity =   1.313(Ft/s)
Total irregular channel flow =     3.430(CFS)
Irregular channel normal depth above invert elev. =   0.295(Ft.)
Average velocity of channel(s) =   1.313(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.164(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
```

```
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      3.164(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      2.134
Subarea runoff =      6.694(CFS) for      2.990(Ac.)
Total runoff =      6.750(CFS)  Total area =       3.005(Ac.)
Depth of flow =   0.380(Ft.), Average velocity =   1.555(Ft/s)
End of computations, total study area =           3.005 (Ac.)
```

18005 Cottonwood Avenue
Pre-Development Condition
50-year Storm Event

```
                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: 02/20/20
--------------------------------------------------------------------------
18005 Cottonwood Avenue
Post Development
50-year Storm Event
File:18005postdev50yr.rd3
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6332

--------------------------------------------------------------------------
Rational hydrology study storm event year is    50.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.300
24 hour precipitation(inches) =  4.500
P6/P24 =    51.1%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  356.920(Ft.)
Lowest elevation =  356.280(Ft.)
Elevation difference =    0.640(Ft.) Slope =  1.280 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
```

```
for the top area slope value of   1.28 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.60 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.280^(1/3)]=   3.60
Calculated TC of    3.596 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.253(CFS)
Total initial stream area =        0.051(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.021(CFS)
Depth of flow =   0.244(Ft.), Average velocity =   3.358(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.021(CFS)
  '     '        flow top width =      1.489(Ft.)
  '     '    velocity=    3.358(Ft/s)
  '     '        area =      0.304(Sq.Ft)
  '     '        Froude number =     1.309

Upstream point elevation =   356.280(Ft.)
Downstream point elevation =   354.050(Ft.)
Flow length =   222.000(Ft.)
Travel time  =    1.10 min.
Time of concentration =    4.70 min.
Depth of flow =   0.244(Ft.)
Average velocity =   3.358(Ft/s)
Total irregular channel flow =     1.021(CFS)
Irregular channel normal depth above invert elev. =   0.244(Ft.)
Average velocity of channel(s) =   3.358(Ft/s)
 Adding area flow to channel
Calculated TC of    4.698 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.295
Subarea runoff =      1.535(CFS) for      0.309(Ac.)
Total runoff =      1.789(CFS)  Total area =       0.360(Ac.)
Depth of flow =   0.335(Ft.), Average velocity =   4.000(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.684(Ft.), Average velocity =   1.911(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              2.00              0.00
        3              4.00              1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =      1.789(CFS)
  '     '        flow top width =      2.737(Ft.)
  '     '    velocity=    1.911(Ft/s)
  '     '        area =      0.936(Sq.Ft)
  '     '        Froude number =     0.576

Upstream point elevation =   354.050(Ft.)
Downstream point elevation =   353.490(Ft.)
Flow length =    57.000(Ft.)
Travel time  =    0.50 min.
Time of concentration =    5.19 min.
Depth of flow =   0.684(Ft.)
Average velocity =   1.911(Ft/s)
Total irregular channel flow =     1.789(CFS)
Irregular channel normal depth above invert elev. =   0.684(Ft.)
Average velocity of channel(s) =   1.911(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
```

```
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________
Upstream point/station elevation =   351.890(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =    18.00(Ft.) Slope =   0.0067  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.789(CFS)
Given pipe size =      8.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.886(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.394(Ft.)
 Minor friction loss =      0.612(Ft.)  K-factor =   1.50
Pipe flow velocity =      5.12(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     5.25 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
_____________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.360(Ac.)
Runoff from this stream =      1.789(CFS)
Time of concentration =    5.25 min.
Rainfall intensity =     5.870(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
_____________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   55.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  354.400(Ft.)
Elevation difference =    1.100(Ft.) Slope =  2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.46 minutes
```

```
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   2.000^(1/3)]=   3.46
Calculated TC of    3.464 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.234(CFS)
Total initial stream area =        0.047(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.571(CFS)
Depth of flow =   0.175(Ft.), Average velocity =   2.773(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.571(CFS)
  '     '        flow top width =      1.351(Ft.)
  '     '    velocity=    2.773(Ft/s)
  '     '        area =      0.206(Sq.Ft)
  '     '        Froude number =     1.251

Upstream point elevation =   354.400(Ft.)
Downstream point elevation =   353.980(Ft.)
Flow length =    42.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.72 min.
Depth of flow =   0.175(Ft.)
Average velocity =   2.773(Ft/s)
Total irregular channel flow =     0.571(CFS)
Irregular channel normal depth above invert elev. =   0.175(Ft.)
Average velocity of channel(s) =   2.773(Ft/s)
 Adding area flow to channel
Calculated TC of    3.717 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.150
Subarea runoff =      0.676(CFS) for      0.136(Ac.)
Total runoff =      0.909(CFS)  Total area =       0.183(Ac.)
Depth of flow =   0.229(Ft.), Average velocity =   3.230(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   352.300(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =   105.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.909(CFS)
Given pipe size =      8.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.222(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.594(Ft.)
 Minor friction loss =      0.158(Ft.)  K-factor =   1.50
Pipe flow velocity =      2.61(Ft/s)
Travel time through pipe =    0.67 min.
Time of concentration (TC) =     4.39 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.183(Ac.)
Runoff from this stream =      0.909(CFS)
Time of concentration =    4.39 min.
Rainfall intensity =     6.060(In/Hr)
Summary of stream data:

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


1        1.789      5.25                5.870
2        0.909      4.39                6.060
Qmax(1) =
           1.000 *    1.000 *     1.789) +
```

```
           0.969 *    1.000 *     0.909) + =       2.670
Qmax(2) =
           1.000 *    0.835 *     1.789) +
           1.000 *    1.000 *     0.909) + =       2.404

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.789       0.909
Maximum flow rates at confluence using above data:
        2.670        2.404
Area of streams before confluence:
        0.360        0.183
Results of confluence:
Total flow rate =      2.670(CFS)
Time of concentration =     5.253 min.
Effective stream area after confluence =      0.543(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.770(Ft.)
Downstream point/station elevation =   351.310(Ft.)
Pipe length  =    52.00(Ft.) Slope =   0.0088  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.670(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.670(CFS)
Normal flow depth in pipe =    8.10(In.)
Flow top width inside pipe =   11.24(In.)
Critical Depth =    8.41(In.)
Pipe flow velocity =      4.74(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     5.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.310(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    96.00(Ft.) Slope =   0.0011  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.670(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.670(CFS)
Normal flow depth in pipe =   11.64(In.)
Flow top width inside pipe =   17.21(In.)
Critical Depth =    7.44(In.)
Pipe flow velocity =      2.21(Ft/s)
```

```
Travel time through pipe =    0.72 min.
Time of concentration (TC) =     6.16 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.543(Ac.)
Runoff from this stream =      2.670(CFS)
Time of concentration =    6.16 min.
Rainfall intensity =     5.297(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   36.000(Ft.)
Highest elevation =  356.520(Ft.)
Lowest elevation =  356.150(Ft.)
Elevation difference =    0.370(Ft.) Slope =  1.028 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.03 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.87 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.028^(1/3)]=   3.87
Calculated TC of    3.868 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.144(CFS)
Total initial stream area =        0.029(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 =      1.990(CFS)
Depth of flow =   0.370(Ft.), Average velocity =   3.627(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              2.00              0.00
        3              4.00              0.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =      1.990(CFS)
  '     '        flow top width =      2.963(Ft.)
  '     '    velocity=    3.627(Ft/s)
  '     '        area =      0.549(Sq.Ft)
  '     '        Froude number =     1.485

Upstream point elevation =   356.150(Ft.)
Downstream point elevation =   354.740(Ft.)
Flow length =   142.000(Ft.)
Travel time  =    0.65 min.
Time of concentration =    4.52 min.
Depth of flow =   0.370(Ft.)
Average velocity =   3.627(Ft/s)
Total irregular channel flow =     1.990(CFS)
Irregular channel normal depth above invert elev. =   0.370(Ft.)
Average velocity of channel(s) =   3.627(Ft/s)
 Adding area flow to channel
Calculated TC of    4.521 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.633
Subarea runoff =      3.692(CFS) for      0.743(Ac.)
Total runoff =      3.836(CFS)  Total area =       0.772(Ac.)
Depth of flow =   0.474(Ft.), Average velocity =   4.273(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      107.000
```

```
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________
Upstream point/station elevation =   351.300(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    10.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.836(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.572(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.116(Ft.)
 Minor friction loss =      0.556(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.88(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     4.55 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
_____________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.772(Ac.)
Runoff from this stream =      3.836(CFS)
Time of concentration =    4.55 min.
Rainfall intensity =     6.060(In/Hr)
Summary of stream data:

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


1        2.670      6.16                5.297
2        3.836      4.55                6.060
Qmax(1) =
           1.000 *    1.000 *     2.670) +
           0.874 *    1.000 *     3.836) + =       6.023
Qmax(2) =
           1.000 *    0.739 *     2.670) +
           1.000 *    1.000 *     3.836) + =       5.810

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.670       3.836
Maximum flow rates at confluence using above data:
        6.023        5.810
Area of streams before confluence:
        0.543        0.772
Results of confluence:
Total flow rate =      6.023(CFS)
```

18005 Cottonwood Avenue
Post-Development Condition
50-year Storm Event

```
Time of concentration =     6.161 min.
Effective stream area after confluence =      1.315(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.200(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =    88.00(Ft.) Slope =   0.0108  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.023(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     2.933(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      2.514(Ft.)
 Minor friction loss =      1.370(Ft.)  K-factor =   1.50
Pipe flow velocity =      7.67(Ft/s)
Travel time through pipe =    0.19 min.
Time of concentration (TC) =     6.35 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.315(Ac.)
Runoff from this stream =      6.023(CFS)
Time of concentration =    6.35 min.
Rainfall intensity =     5.193(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   43.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  355.140(Ft.)
Elevation difference =    0.360(Ft.) Slope =  0.837 %
```

```
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   0.84 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.14 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   0.837^(1/3)]=   4.14
Calculated TC of    4.143 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.075(CFS)
Total initial stream area =        0.015(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.293(CFS)
Depth of flow =   0.190(Ft.), Average velocity =   1.298(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.293(CFS)
  '     '        flow top width =      1.380(Ft.)
  '     '    velocity=    1.298(Ft/s)
  '     '        area =      0.226(Sq.Ft)
  '     '        Froude number =     0.565

Upstream point elevation =   355.140(Ft.)
Downstream point elevation =   354.870(Ft.)
Flow length =   135.000(Ft.)
Travel time  =    1.73 min.
Time of concentration =    5.88 min.
Depth of flow =   0.190(Ft.)
Average velocity =   1.298(Ft/s)
Total irregular channel flow =     0.293(CFS)
Irregular channel normal depth above invert elev. =   0.190(Ft.)
Average velocity of channel(s) =   1.298(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.461(In/Hr) for a    50.0 year storm
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      5.461(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.084
Subarea runoff =      0.387(CFS) for      0.088(Ac.)
Total runoff =      0.461(CFS)  Total area =       0.103(Ac.)
Depth of flow =   0.246(Ft.), Average velocity =   1.504(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   352.700(Ft.)
Downstream point/station elevation =   351.760(Ft.)
Pipe length  =    94.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.461(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.461(CFS)
Normal flow depth in pipe =    2.92(In.)
Flow top width inside pipe =   10.29(In.)
Critical Depth =    3.38(In.)
Pipe flow velocity =      3.13(Ft/s)
Travel time through pipe =    0.50 min.
Time of concentration (TC) =     6.38 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      404.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      5.180(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.38 min.
Rainfall intensity =      5.180(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
```

```
(Q=KCIA) is C = 0.820  CA =      0.173
Subarea runoff =      0.435(CFS) for      0.108(Ac.)
Total runoff =      0.896(CFS)  Total area =       0.211(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________________
Upstream point/station elevation =   351.760(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =   145.00(Ft.) Slope =   0.0104  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.896(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.896(CFS)
Normal flow depth in pipe =    4.06(In.)
Flow top width inside pipe =   11.36(In.)
Critical Depth =    4.75(In.)
Pipe flow velocity =      3.83(Ft/s)
Travel time through pipe =    0.63 min.
Time of concentration (TC) =     7.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      405.000 to Point/Station      405.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Rainfall intensity (I) =      4.874(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     7.01 min.
Rainfall intensity =      4.874(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.233
Subarea runoff =      0.239(CFS) for      0.073(Ac.)
Total runoff =      1.135(CFS)  Total area =       0.284(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.284(Ac.)
```

```
Runoff from this stream =      1.135(CFS)
Time of concentration =    7.01 min.
Rainfall intensity =     4.874(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  356.260(Ft.)
Lowest elevation =  355.760(Ft.)
Elevation difference =    0.500(Ft.) Slope =  1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.90 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.000^(1/3)]=   3.90
Calculated TC of    3.904 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.243(CFS)
Total initial stream area =        0.049(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.983(CFS)
Depth of flow =   0.370(Ft.), Average velocity =   3.615(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              2.00              0.00
        3              4.00              0.50
```

```
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      1.983(CFS)
  '     '        flow top width =      2.962(Ft.)
  '     '    velocity=    3.615(Ft/s)
  '     '        area =      0.548(Sq.Ft)
  '     '        Froude number =     1.481

Upstream point elevation =   355.760(Ft.)
Downstream point elevation =   355.000(Ft.)
Flow length =    77.000(Ft.)
Travel time  =    0.35 min.
Time of concentration =    4.26 min.
Depth of flow =   0.370(Ft.)
Average velocity =   3.615(Ft/s)
Total irregular channel flow =     1.983(CFS)
Irregular channel normal depth above invert elev. =   0.370(Ft.)
Average velocity of channel(s) =   3.615(Ft/s)
 Adding area flow to channel
Calculated TC of    4.259 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.060(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.060(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.614
Subarea runoff =      3.478(CFS) for      0.700(Ac.)
Total runoff =      3.722(CFS)  Total area =       0.749(Ac.)
Depth of flow =   0.469(Ft.), Average velocity =   4.232(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      503.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   349.650(Ft.)
Downstream point/station elevation =   349.350(Ft.)
Pipe length  =   148.00(Ft.) Slope =   0.0020  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.722(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     3.722(CFS)
Normal flow depth in pipe =   12.04(In.)
Flow top width inside pipe =   16.95(In.)
```

```
Critical Depth =    8.85(In.)
Pipe flow velocity =      2.96(Ft/s)
Travel time through pipe =    0.83 min.
Time of concentration (TC) =     5.09 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.749(Ac.)
Runoff from this stream =      3.722(CFS)
Time of concentration =    5.09 min.
Rainfall intensity =     5.990(In/Hr)
Summary of stream data:

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


1        6.023      6.35                5.193
2        1.135      7.01                4.874
3        3.722      5.09                5.990
Qmax(1) =
           1.000 *    1.000 *     6.023) +
           1.000 *    0.906 *     1.135) +
           0.867 *    1.000 *     3.722) + =      10.278
Qmax(2) =
           0.939 *    1.000 *     6.023) +
           1.000 *    1.000 *     1.135) +
           0.814 *    1.000 *     3.722) + =       9.817
Qmax(3) =
           1.000 *    0.801 *     6.023) +
           1.000 *    0.727 *     1.135) +
           1.000 *    1.000 *     3.722) + =       9.374

Total of 3 streams to confluence:
Flow rates before confluence point:
       6.023       1.135       3.722
Maximum flow rates at confluence using above data:
       10.278        9.817        9.374
Area of streams before confluence:
        1.315        0.284        0.749
Results of confluence:
Total flow rate =     10.278(CFS)
Time of concentration =     6.352 min.
Effective stream area after confluence =      2.348(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      601.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      5.193(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
The area added to the existing stream causes a
a lower flow rate of Q =     10.194(CFS)
therefore the upstream flow rate of Q =     10.278(CFS) is being used
Time of concentration =     6.35 min.
Rainfall intensity =      5.193(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      1.963
Subarea runoff =      0.000(CFS) for      0.046(Ac.)
Total runoff =     10.278(CFS)  Total area =       2.394(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      5.193(In/Hr) for a    50.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.35 min.
Rainfall intensity =      5.193(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.244
Subarea runoff =      1.377(CFS) for      0.343(Ac.)
Total runoff =     11.655(CFS)  Total area =       2.737(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      5.193(In/Hr) for a    50.0 year storm
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.35 min.
Rainfall intensity =      5.193(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.464
Subarea runoff =      1.141(CFS) for      0.268(Ac.)
Total runoff =     12.796(CFS)  Total area =       3.005(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   350.590(Ft.)
Downstream point/station elevation =   350.530(Ft.)
Pipe length  =    12.10(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.796(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     7.683(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.560(Ft.)
 Minor friction loss =      6.183(Ft.)  K-factor =   1.50
Pipe flow velocity =     16.29(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     6.36 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** 6 HOUR HYDROGRAPH ****
________________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =   6.36
Basin Area =     3.00 Acres
6 Hour Rainfall =  2.300 Inches
Runoff Coefficient =  0.820
Peak Discharge =    12.80 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
```

| | |
|---|---|
| 6 | 0.338 |
| 12 | 0.342 |
| 18 | 0.349 |
| 24 | 0.353 |
| 30 | 0.362 |
| 36 | 0.366 |
| 42 | 0.376 |
| 48 | 0.380 |
| 54 | 0.391 |
| 60 | 0.396 |
| 66 | 0.407 |
| 72 | 0.413 |
| 78 | 0.426 |
| 84 | 0.433 |
| 90 | 0.447 |
| 96 | 0.455 |
| 102 | 0.471 |
| 108 | 0.480 |
| 114 | 0.499 |
| 120 | 0.509 |
| 126 | 0.531 |
| 132 | 0.543 |
| 138 | 0.569 |
| 144 | 0.584 |
| 150 | 0.615 |
| 156 | 0.633 |
| 162 | 0.672 |
| 168 | 0.694 |
| 174 | 0.744 |
| 180 | 0.773 |
| 186 | 0.840 |
| 192 | 0.880 |
| 198 | 0.976 |
| 204 | 1.035 |
| 210 | 1.186 |
| 216 | 1.286 |
| 222 | 1.572 |
| 228 | 1.790 |
| 234 | 2.629 |
| 240 | 3.704 |
| 246 | 12.796 |
| 252 | 2.108 |
| 258 | 1.411 |
| 264 | 1.104 |
| 270 | 0.924 |
| 276 | 0.805 |
| 282 | 0.718 |
| 288 | 0.651 |
| 294 | 0.599 |
| 300 | 0.556 |

| | |
|---|---|
| 306 | 0.520 |
| 312 | 0.489 |
| 318 | 0.463 |
| 324 | 0.440 |
| 330 | 0.420 |
| 336 | 0.402 |
| 342 | 0.385 |
| 348 | 0.371 |
| 354 | 0.358 |
| 360 | 0.345 |
| 366 | 0.334 |

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

6 - H O U R  S T O R M

R u n o f f  H y d r o g r a p h

---

Hydrograph in 1 Minute intervals ((CFS))

---

| Time(h+m) | Volume Ac.Ft | Q(CFS) | 0 | 3.2 | 6.4 | 9.6 | 12.8 |
|---|---|---|---|---|---|---|---|
| 0+ 0 | 0.0000 | 0.00 | Q | | | | |
| 0+ 1 | 0.0001 | 0.06 | Q | | | | |
| 0+ 2 | 0.0002 | 0.11 | Q | | | | |
| 0+ 3 | 0.0005 | 0.17 | Q | | | | |
| 0+ 4 | 0.0008 | 0.23 | Q | | | | |
| 0+ 5 | 0.0012 | 0.28 | Q | | | | |
| 0+ 6 | 0.0016 | 0.34 | VQ | | | | |
| 0+ 7 | 0.0021 | 0.34 | VQ | | | | |
| 0+ 8 | 0.0026 | 0.34 | VQ | | | | |
| 0+ 9 | 0.0030 | 0.34 | VQ | | | | |
| 0+10 | 0.0035 | 0.34 | VQ | | | | |
| 0+11 | 0.0040 | 0.34 | VQ | | | | |
| 0+12 | 0.0044 | 0.34 | VQ | | | | |
| 0+13 | 0.0049 | 0.34 | VQ | | | | |
| 0+14 | 0.0054 | 0.34 | VQ | | | | |
| 0+15 | 0.0059 | 0.35 | VQ | | | | |
| 0+16 | 0.0063 | 0.35 | VQ | | | | |
| 0+17 | 0.0068 | 0.35 | VQ | | | | |
| 0+18 | 0.0073 | 0.35 | VQ | | | | |
| 0+19 | 0.0078 | 0.35 | VQ | | | | |
| 0+20 | 0.0083 | 0.35 | VQ | | | | |
| 0+21 | 0.0087 | 0.35 | VQ | | | | |
| 0+22 | 0.0092 | 0.35 | VQ | | | | |
| 0+23 | 0.0097 | 0.35 | VQ | | | | |
| 0+24 | 0.0102 | 0.35 | VQ | | | | |
| 0+25 | 0.0107 | 0.35 | VQ | | | | |
| 0+26 | 0.0112 | 0.36 | VQ | | | | |
| 0+27 | 0.0117 | 0.36 | \|Q | | | | |
| 0+28 | 0.0122 | 0.36 | \|Q | | | | |
| 0+29 | 0.0127 | 0.36 | \|Q | | | | |

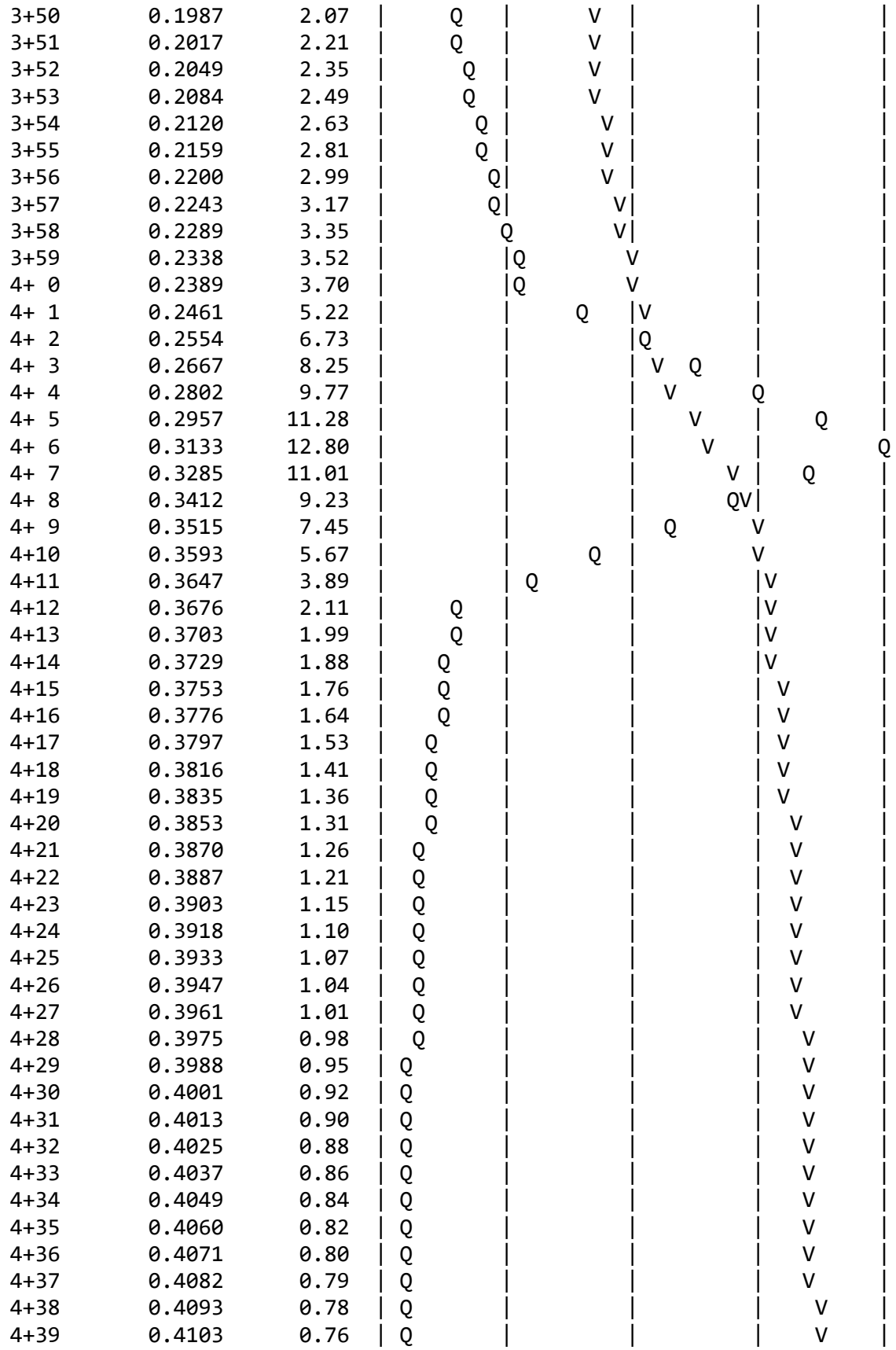
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0+30 | 0.0132 | 0.36 | Q | | | | |
| 0+31 | 0.0137 | 0.36 | Q | | | | |
| 0+32 | 0.0142 | 0.36 | Q | | | | |
| 0+33 | 0.0147 | 0.36 | Q | | | | |
| 0+34 | 0.0152 | 0.36 | Q | | | | |
| 0+35 | 0.0157 | 0.37 | Q | | | | |
| 0+36 | 0.0162 | 0.37 | Q | | | | |
| 0+37 | 0.0167 | 0.37 | Q | | | | |
| 0+38 | 0.0172 | 0.37 | Q | | | | |
| 0+39 | 0.0177 | 0.37 | Q | | | | |
| 0+40 | 0.0182 | 0.37 | Q | | | | |
| 0+41 | 0.0187 | 0.37 | Q | | | | |
| 0+42 | 0.0192 | 0.38 | Q | | | | |
| 0+43 | 0.0198 | 0.38 | Q | | | | |
| 0+44 | 0.0203 | 0.38 | Q | | | | |
| 0+45 | 0.0208 | 0.38 | Q | | | | |
| 0+46 | 0.0213 | 0.38 | Q | | | | |
| 0+47 | 0.0219 | 0.38 | Q | | | | |
| 0+48 | 0.0224 | 0.38 | Q | | | | |
| 0+49 | 0.0229 | 0.38 | Q | | | | |
| 0+50 | 0.0234 | 0.38 | QV | | | | |
| 0+51 | 0.0240 | 0.39 | QV | | | | |
| 0+52 | 0.0245 | 0.39 | QV | | | | |
| 0+53 | 0.0250 | 0.39 | QV | | | | |
| 0+54 | 0.0256 | 0.39 | QV | | | | |
| 0+55 | 0.0261 | 0.39 | QV | | | | |
| 0+56 | 0.0267 | 0.39 | QV | | | | |
| 0+57 | 0.0272 | 0.39 | QV | | | | |
| 0+58 | 0.0277 | 0.39 | QV | | | | |
| 0+59 | 0.0283 | 0.40 | QV | | | | |
| 1+ 0 | 0.0288 | 0.40 | QV | | | | |
| 1+ 1 | 0.0294 | 0.40 | QV | | | | |
| 1+ 2 | 0.0299 | 0.40 | QV | | | | |
| 1+ 3 | 0.0305 | 0.40 | QV | | | | |
| 1+ 4 | 0.0310 | 0.40 | QV | | | | |
| 1+ 5 | 0.0316 | 0.41 | QV | | | | |
| 1+ 6 | 0.0322 | 0.41 | QV | | | | |
| 1+ 7 | 0.0327 | 0.41 | QV | | | | |
| 1+ 8 | 0.0333 | 0.41 | QV | | | | |
| 1+ 9 | 0.0338 | 0.41 | QV | | | | |
| 1+10 | 0.0344 | 0.41 | QV | | | | |
| 1+11 | 0.0350 | 0.41 | QV | | | | |
| 1+12 | 0.0356 | 0.41 | Q V | | | | |
| 1+13 | 0.0361 | 0.42 | Q V | | | | |
| 1+14 | 0.0367 | 0.42 | Q V | | | | |
| 1+15 | 0.0373 | 0.42 | Q V | | | | |
| 1+16 | 0.0379 | 0.42 | Q V | | | | |
| 1+17 | 0.0384 | 0.42 | Q V | | | | |
| 1+18 | 0.0390 | 0.43 | Q V | | | | |
| 1+19 | 0.0396 | 0.43 | Q V | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1+20 | 0.0402 | 0.43 | \|Q V | \| | \| | \| | \| |
| 1+21 | 0.0408 | 0.43 | \|Q V | \| | \| | \| | \| |
| 1+22 | 0.0414 | 0.43 | \|Q V | \| | \| | \| | \| |
| 1+23 | 0.0420 | 0.43 | \|Q V | \| | \| | \| | \| |
| 1+24 | 0.0426 | 0.43 | \|Q V | \| | \| | \| | \| |
| 1+25 | 0.0432 | 0.44 | \|Q V | \| | \| | \| | \| |
| 1+26 | 0.0438 | 0.44 | \|Q V | \| | \| | \| | \| |
| 1+27 | 0.0444 | 0.44 | \|Q V | \| | \| | \| | \| |
| 1+28 | 0.0450 | 0.44 | \|Q V | \| | \| | \| | \| |
| 1+29 | 0.0456 | 0.44 | \|Q V | \| | \| | \| | \| |
| 1+30 | 0.0462 | 0.45 | \|Q V | \| | \| | \| | \| |
| 1+31 | 0.0468 | 0.45 | \|Q  V | \| | \| | \| | \| |
| 1+32 | 0.0475 | 0.45 | \|Q  V | \| | \| | \| | \| |
| 1+33 | 0.0481 | 0.45 | \|Q  V | \| | \| | \| | \| |
| 1+34 | 0.0487 | 0.45 | \|Q  V | \| | \| | \| | \| |
| 1+35 | 0.0493 | 0.45 | \|Q  V | \| | \| | \| | \| |
| 1+36 | 0.0500 | 0.46 | \|Q  V | \| | \| | \| | \| |
| 1+37 | 0.0506 | 0.46 | \|Q  V | \| | \| | \| | \| |
| 1+38 | 0.0512 | 0.46 | \|Q  V | \| | \| | \| | \| |
| 1+39 | 0.0519 | 0.46 | \|Q  V | \| | \| | \| | \| |
| 1+40 | 0.0525 | 0.47 | \|Q  V | \| | \| | \| | \| |
| 1+41 | 0.0532 | 0.47 | \|Q  V | \| | \| | \| | \| |
| 1+42 | 0.0538 | 0.47 | \|Q  V | \| | \| | \| | \| |
| 1+43 | 0.0545 | 0.47 | \|Q  V | \| | \| | \| | \| |
| 1+44 | 0.0551 | 0.47 | \|Q  V | \| | \| | \| | \| |
| 1+45 | 0.0558 | 0.48 | \|Q  V | \| | \| | \| | \| |
| 1+46 | 0.0564 | 0.48 | \|Q  V | \| | \| | \| | \| |
| 1+47 | 0.0571 | 0.48 | \|Q  V | \| | \| | \| | \| |
| 1+48 | 0.0577 | 0.48 | \|Q  V | \| | \| | \| | \| |
| 1+49 | 0.0584 | 0.48 | \|Q   V | \| | \| | \| | \| |
| 1+50 | 0.0591 | 0.49 | \|Q   V | \| | \| | \| | \| |
| 1+51 | 0.0598 | 0.49 | \|Q   V | \| | \| | \| | \| |
| 1+52 | 0.0604 | 0.49 | \|Q   V | \| | \| | \| | \| |
| 1+53 | 0.0611 | 0.50 | \|Q   V | \| | \| | \| | \| |
| 1+54 | 0.0618 | 0.50 | \|Q   V | \| | \| | \| | \| |
| 1+55 | 0.0625 | 0.50 | \|Q   V | \| | \| | \| | \| |
| 1+56 | 0.0632 | 0.50 | \|Q   V | \| | \| | \| | \| |
| 1+57 | 0.0639 | 0.50 | \|Q   V | \| | \| | \| | \| |
| 1+58 | 0.0646 | 0.51 | \|Q   V | \| | \| | \| | \| |
| 1+59 | 0.0653 | 0.51 | \|Q   V | \| | \| | \| | \| |
| 2+ 0 | 0.0660 | 0.51 | \|Q   V | \| | \| | \| | \| |
| 2+ 1 | 0.0667 | 0.51 | \|Q   V | \| | \| | \| | \| |
| 2+ 2 | 0.0674 | 0.52 | \|Q   V | \| | \| | \| | \| |
| 2+ 3 | 0.0681 | 0.52 | \|Q   V | \| | \| | \| | \| |
| 2+ 4 | 0.0688 | 0.52 | \|Q   V | \| | \| | \| | \| |
| 2+ 5 | 0.0696 | 0.53 | \|Q   V | \| | \| | \| | \| |
| 2+ 6 | 0.0703 | 0.53 | \|Q    V | \| | \| | \| | \| |
| 2+ 7 | 0.0710 | 0.53 | \|Q    V | \| | \| | \| | \| |
| 2+ 8 | 0.0718 | 0.54 | \|Q    V | \| | \| | \| | \| |
| 2+ 9 | 0.0725 | 0.54 | \|Q    V | \| | \| | \| | \| |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2+10 | 0.0732 | 0.54 | Q | V | | | |
| 2+11 | 0.0740 | 0.54 | Q | V | | | |
| 2+12 | 0.0747 | 0.54 | Q | V | | | |
| 2+13 | 0.0755 | 0.55 | Q | V | | | |
| 2+14 | 0.0763 | 0.55 | Q | V | | | |
| 2+15 | 0.0770 | 0.56 | Q | V | | | |
| 2+16 | 0.0778 | 0.56 | Q | V | | | |
| 2+17 | 0.0786 | 0.56 | Q | V | | | |
| 2+18 | 0.0794 | 0.57 | Q | V | | | |
| 2+19 | 0.0801 | 0.57 | Q | V | | | |
| 2+20 | 0.0809 | 0.57 | Q | V | | | |
| 2+21 | 0.0817 | 0.58 | Q | V | | | |
| 2+22 | 0.0825 | 0.58 | Q | V | | | |
| 2+23 | 0.0833 | 0.58 | Q | V | | | |
| 2+24 | 0.0841 | 0.58 | Q | V | | | |
| 2+25 | 0.0849 | 0.59 | Q | V | | | |
| 2+26 | 0.0858 | 0.59 | Q | V | | | |
| 2+27 | 0.0866 | 0.60 | Q | V | | | |
| 2+28 | 0.0874 | 0.60 | Q | V | | | |
| 2+29 | 0.0883 | 0.61 | Q | V | | | |
| 2+30 | 0.0891 | 0.62 | Q | V | | | |
| 2+31 | 0.0900 | 0.62 | Q | V | | | |
| 2+32 | 0.0908 | 0.62 | Q | V | | | |
| 2+33 | 0.0917 | 0.62 | Q | V | | | |
| 2+34 | 0.0925 | 0.63 | Q | V | | | |
| 2+35 | 0.0934 | 0.63 | Q | V | | | |
| 2+36 | 0.0943 | 0.63 | Q | V | | | |
| 2+37 | 0.0952 | 0.64 | Q | V | | | |
| 2+38 | 0.0960 | 0.65 | Q | V | | | |
| 2+39 | 0.0969 | 0.65 | Q | V | | | |
| 2+40 | 0.0978 | 0.66 | Q | V | | | |
| 2+41 | 0.0988 | 0.67 | Q | V | | | |
| 2+42 | 0.0997 | 0.67 | Q | V | | | |
| 2+43 | 0.1006 | 0.68 | Q | V | | | |
| 2+44 | 0.1016 | 0.68 | Q | V | | | |
| 2+45 | 0.1025 | 0.68 | Q | V | | | |
| 2+46 | 0.1034 | 0.69 | Q | V | | | |
| 2+47 | 0.1044 | 0.69 | Q | V | | | |
| 2+48 | 0.1053 | 0.69 | Q | V | | | |
| 2+49 | 0.1063 | 0.70 | Q | V | | | |
| 2+50 | 0.1073 | 0.71 | Q | V | | | |
| 2+51 | 0.1083 | 0.72 | Q | V | | | |
| 2+52 | 0.1093 | 0.73 | Q | V | | | |
| 2+53 | 0.1103 | 0.74 | Q | V | | | |
| 2+54 | 0.1113 | 0.74 | Q | V | | | |
| 2+55 | 0.1124 | 0.75 | Q | V | | | |
| 2+56 | 0.1134 | 0.75 | Q | V | | | |
| 2+57 | 0.1144 | 0.76 | Q | V | | | |
| 2+58 | 0.1155 | 0.76 | Q | V | | | |
| 2+59 | 0.1165 | 0.77 | Q | V | | | |

```
3+ 0       0.1176      0.77  | Q       V         |          |          |
3+ 1       0.1187      0.78  | Q       V         |          |          |
3+ 2       0.1198      0.80  | Q       V         |          |          |
3+ 3       0.1209      0.81  | Q       V         |          |          |
3+ 4       0.1220      0.82  | Q       V         |          |          |
3+ 5       0.1232      0.83  | Q       V         |          |          |
3+ 6       0.1243      0.84  | Q       V         |          |          |
3+ 7       0.1255      0.85  | Q       V         |          |          |
3+ 8       0.1267      0.85  | Q       V         |          |          |
3+ 9       0.1278      0.86  | Q       V         |          |          |
3+10       0.1290      0.87  | Q       |V        |          |          |
3+11       0.1302      0.87  | Q       |V        |          |          |
3+12       0.1315      0.88  | Q       |V        |          |          |
3+13       0.1327      0.90  | Q       |V        |          |          |
3+14       0.1339      0.91  | Q       |V        |          |          |
3+15       0.1352      0.93  | Q       |V        |          |          |
3+16       0.1365      0.94  | Q       |V        |          |          |
3+17       0.1378      0.96  | Q       |V        |          |          |
3+18       0.1392      0.98  |  Q      |V        |          |          |
3+19       0.1405      0.99  |  Q      | V       |          |          |
3+20       0.1419      1.00  |  Q      | V       |          |          |
3+21       0.1433      1.01  |  Q      | V       |          |          |
3+22       0.1447      1.01  |  Q      | V       |          |          |
3+23       0.1461      1.02  |  Q      | V       |          |          |
3+24       0.1475      1.03  |  Q      | V       |          |          |
3+25       0.1490      1.06  |  Q      | V       |          |          |
3+26       0.1505      1.09  |  Q      | V       |          |          |
3+27       0.1520      1.11  |  Q      |  V      |          |          |
3+28       0.1536      1.14  |  Q      |  V      |          |          |
3+29       0.1552      1.16  |  Q      |  V      |          |          |
3+30       0.1568      1.19  |  Q      |  V      |          |          |
3+31       0.1585      1.20  |  Q      |  V      |          |          |
3+32       0.1602      1.22  |  Q      |  V      |          |          |
3+33       0.1619      1.24  |  Q      |  V      |          |          |
3+34       0.1636      1.25  |  Q      |   V     |          |          |
3+35       0.1653      1.27  |  Q      |   V     |          |          |
3+36       0.1671      1.29  |   Q     |   V     |          |          |
3+37       0.1689      1.33  |   Q     |   V     |          |          |
3+38       0.1708      1.38  |   Q     |   V     |          |          |
3+39       0.1728      1.43  |   Q     |   V     |          |          |
3+40       0.1748      1.48  |   Q     |   V     |          |          |
3+41       0.1769      1.52  |   Q     |    V    |          |          |
3+42       0.1791      1.57  |   Q     |    V    |          |          |
3+43       0.1813      1.61  |    Q    |    V    |          |          |
3+44       0.1836      1.64  |    Q    |    V    |          |          |
3+45       0.1859      1.68  |    Q    |    V    |          |          |
3+46       0.1883      1.72  |    Q    |     V   |          |          |
3+47       0.1907      1.75  |    Q    |     V   |          |          |
3+48       0.1931      1.79  |    Q    |     V   |          |          |
3+49       0.1958      1.93  |     Q   |     V   |          |          |
```

18005 Cottonwood Avenue
Post-Development Condition
50-year Storm Event



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3+50 | 0.1987 | 2.07 | | Q | | V | | |
| 3+51 | 0.2017 | 2.21 | | Q | | V | | |
| 3+52 | 0.2049 | 2.35 | | Q | | V | | |
| 3+53 | 0.2084 | 2.49 | | Q | | V | | |
| 3+54 | 0.2120 | 2.63 | | Q | | V | | |
| 3+55 | 0.2159 | 2.81 | | Q | | V | | |
| 3+56 | 0.2200 | 2.99 | | Q | | V | | |
| 3+57 | 0.2243 | 3.17 | | Q | | V | | |
| 3+58 | 0.2289 | 3.35 | | Q | | V | | |
| 3+59 | 0.2338 | 3.52 | | Q | | V | | |
| 4+ 0 | 0.2389 | 3.70 | | Q | | V | | |
| 4+ 1 | 0.2461 | 5.22 | | Q | V | | | |
| 4+ 2 | 0.2554 | 6.73 | | Q | | | | |
| 4+ 3 | 0.2667 | 8.25 | | Q | V | | | |
| 4+ 4 | 0.2802 | 9.77 | | Q | V | | | |
| 4+ 5 | 0.2957 | 11.28 | | Q | V | | | |
| 4+ 6 | 0.3133 | 12.80 | | Q | V | | | |
| 4+ 7 | 0.3285 | 11.01 | | Q | V | | | |
| 4+ 8 | 0.3412 | 9.23 | | Q | V | | | |
| 4+ 9 | 0.3515 | 7.45 | | Q | V | | | |
| 4+10 | 0.3593 | 5.67 | | Q | V | | | |
| 4+11 | 0.3647 | 3.89 | | Q | V | | | |
| 4+12 | 0.3676 | 2.11 | | Q | V | | | |
| 4+13 | 0.3703 | 1.99 | | Q | V | | | |
| 4+14 | 0.3729 | 1.88 | | Q | V | | | |
| 4+15 | 0.3753 | 1.76 | | Q | V | | | |
| 4+16 | 0.3776 | 1.64 | | Q | V | | | |
| 4+17 | 0.3797 | 1.53 | | Q | V | | | |
| 4+18 | 0.3816 | 1.41 | | Q | V | | | |
| 4+19 | 0.3835 | 1.36 | | Q | V | | | |
| 4+20 | 0.3853 | 1.31 | | Q | V | | | |
| 4+21 | 0.3870 | 1.26 | | Q | V | | | |
| 4+22 | 0.3887 | 1.21 | | Q | V | | | |
| 4+23 | 0.3903 | 1.15 | | Q | V | | | |
| 4+24 | 0.3918 | 1.10 | | Q | V | | | |
| 4+25 | 0.3933 | 1.07 | | Q | V | | | |
| 4+26 | 0.3947 | 1.04 | | Q | V | | | |
| 4+27 | 0.3961 | 1.01 | | Q | V | | | |
| 4+28 | 0.3975 | 0.98 | | Q | V | | | |
| 4+29 | 0.3988 | 0.95 | | Q | V | | | |
| 4+30 | 0.4001 | 0.92 | | Q | V | | | |
| 4+31 | 0.4013 | 0.90 | | Q | V | | | |
| 4+32 | 0.4025 | 0.88 | | Q | V | | | |
| 4+33 | 0.4037 | 0.86 | | Q | V | | | |
| 4+34 | 0.4049 | 0.84 | | Q | V | | | |
| 4+35 | 0.4060 | 0.82 | | Q | V | | | |
| 4+36 | 0.4071 | 0.80 | | Q | V | | | |
| 4+37 | 0.4082 | 0.79 | | Q | V | | | |
| 4+38 | 0.4093 | 0.78 | | Q | V | | | |
| 4+39 | 0.4103 | 0.76 | | Q | V | | | |

18005 Cottonwood Avenue
Post-Development Condition
50-year Storm Event

```
4+40       0.4114      0.75  | Q       |         |         |    V    |
4+41       0.4124      0.73  | Q       |         |         |    V    |
4+42       0.4134      0.72  | Q       |         |         |    V    |
4+43       0.4143      0.71  | Q       |         |         |    V    |
4+44       0.4153      0.70  | Q       |         |         |    V    |
4+45       0.4162      0.68  | Q       |         |         |    V    |
4+46       0.4172      0.67  | Q       |         |         |    V    |
4+47       0.4181      0.66  | Q       |         |         |    V    |
4+48       0.4190      0.65  | Q       |         |         |    V    |
4+49       0.4199      0.64  | Q       |         |         |    V    |
4+50       0.4207      0.63  |Q        |         |         |     V   |
4+51       0.4216      0.63  |Q        |         |         |     V   |
4+52       0.4224      0.62  |Q        |         |         |     V   |
4+53       0.4233      0.61  |Q        |         |         |     V   |
4+54       0.4241      0.60  |Q        |         |         |     V   |
4+55       0.4249      0.59  |Q        |         |         |     V   |
4+56       0.4257      0.58  |Q        |         |         |     V   |
4+57       0.4265      0.58  |Q        |         |         |     V   |
4+58       0.4273      0.57  |Q        |         |         |     V   |
4+59       0.4281      0.56  |Q        |         |         |     V   |
5+ 0       0.4288      0.56  |Q        |         |         |     V   |
5+ 1       0.4296      0.55  |Q        |         |         |     V   |
5+ 2       0.4303      0.54  |Q        |         |         |     V   |
5+ 3       0.4311      0.54  |Q        |         |         |     V   |
5+ 4       0.4318      0.53  |Q        |         |         |     V   |
5+ 5       0.4325      0.53  |Q        |         |         |      V  |
5+ 6       0.4333      0.52  |Q        |         |         |      V  |
5+ 7       0.4340      0.51  |Q        |         |         |      V  |
5+ 8       0.4347      0.51  |Q        |         |         |      V  |
5+ 9       0.4354      0.50  |Q        |         |         |      V  |
5+10       0.4361      0.50  |Q        |         |         |      V  |
5+11       0.4367      0.49  |Q        |         |         |      V  |
5+12       0.4374      0.49  |Q        |         |         |      V  |
5+13       0.4381      0.48  |Q        |         |         |      V  |
5+14       0.4387      0.48  |Q        |         |         |      V  |
5+15       0.4394      0.48  |Q        |         |         |      V  |
5+16       0.4400      0.47  |Q        |         |         |      V  |
5+17       0.4407      0.47  |Q        |         |         |      V  |
5+18       0.4413      0.46  |Q        |         |         |      V  |
5+19       0.4420      0.46  |Q        |         |         |      V  |
5+20       0.4426      0.46  |Q        |         |         |      V  |
5+21       0.4432      0.45  |Q        |         |         |      V  |
5+22       0.4438      0.45  |Q        |         |         |       V |
5+23       0.4444      0.44  |Q        |         |         |       V |
5+24       0.4450      0.44  |Q        |         |         |       V |
5+25       0.4456      0.44  |Q        |         |         |       V |
5+26       0.4462      0.43  |Q        |         |         |       V |
5+27       0.4468      0.43  |Q        |         |         |       V |
5+28       0.4474      0.43  |Q        |         |         |       V |
5+29       0.4480      0.42  |Q        |         |         |       V |
```

18005 Cottonwood Avenue
Post-Development Condition
50-year Storm Event

```
    5+30       0.4486      0.42  |Q        |         |         |       V |
    5+31       0.4492      0.42  |Q        |         |         |       V |
    5+32       0.4497      0.41  |Q        |         |         |       V |
    5+33       0.4503      0.41  |Q        |         |         |       V |
    5+34       0.4509      0.41  |Q        |         |         |       V |
    5+35       0.4514      0.40  |Q        |         |         |       V |
    5+36       0.4520      0.40  |Q        |         |         |       V |
    5+37       0.4525      0.40  |Q        |         |         |       V |
    5+38       0.4531      0.40  |Q        |         |         |       V |
    5+39       0.4536      0.39  |Q        |         |         |       V |
    5+40       0.4541      0.39  |Q        |         |         |       V |
    5+41       0.4547      0.39  |Q        |         |         |       V |
    5+42       0.4552      0.39  |Q        |         |         |       V |
    5+43       0.4557      0.38  |Q        |         |         |        V|
    5+44       0.4563      0.38  |Q        |         |         |        V|
    5+45       0.4568      0.38  |Q        |         |         |        V|
    5+46       0.4573      0.38  |Q        |         |         |        V|
    5+47       0.4578      0.37  |Q        |         |         |        V|
    5+48       0.4583      0.37  |Q        |         |         |        V|
    5+49       0.4588      0.37  |Q        |         |         |        V|
    5+50       0.4593      0.37  |Q        |         |         |        V|
    5+51       0.4598      0.36  |Q        |         |         |        V|
    5+52       0.4603      0.36  |Q        |         |         |        V|
    5+53       0.4608      0.36  |Q        |         |         |        V|
    5+54       0.4613      0.36  |Q        |         |         |        V|
    5+55       0.4618      0.36  |Q        |         |         |        V|
    5+56       0.4623      0.35  |Q        |         |         |        V|
    5+57       0.4628      0.35  |Q        |         |         |        V|
    5+58       0.4633      0.35  |Q        |         |         |        V|
    5+59       0.4637      0.35  |Q        |         |         |        V|
    6+ 0       0.4642      0.35  |Q        |         |         |        V|
    6+ 1       0.4647      0.34  |Q        |         |         |        V|
    6+ 2       0.4652      0.34  |Q        |         |         |        V|
    6+ 3       0.4656      0.34  |Q        |         |         |        V|
    6+ 4       0.4661      0.34  |Q        |         |         |        V|
    6+ 5       0.4666      0.34  |Q        |         |         |        V|
    6+ 6       0.4670      0.33  |Q        |         |         |         V
---------------------------------------------------------------------------

    End of computations, total study area =          3.005 (Ac.)
```

18005 Cottonwood Avenue
Post-Development Condition
50-year Storm Event

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: 03/03/20
---
18005 Cottonwood Avenue
Post-Development-User Defined
50-year Storm Event
File:18005postdevuser50yr.rd3
---
 *********   Hydrology Study Control Information **********

---

Program License Serial Number 6332

---
Rational hydrology study storm event year is    50.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.300
24 hour precipitation(inches) =  4.500
P6/P24 =    51.1%
San Diego hydrology manual 'C' values used

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
User specified 'C' value of 0.156 given for subarea
Rainfall intensity (I) =      1.536(In/Hr) for a    50.0 year storm
User specified values are as follows:
TC =  42.00 min.  Rain intensity =       1.54(In/Hr)
Total area =        3.005(Ac.)  Total runoff =     0.722(CFS)
End of computations, total study area =           3.005 (Ac.)

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: 09/05/18

---

18005 Cottonwood Ave
PRE-DEVELOPED CONDITION
100-year flows
FILE: 18005pre.RSD3

---

********* 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) = 2.500
24 hour precipitation(inches) = 4.500
P6/P24 = 55.6%
San Diego hydrology manual 'C' values used

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL ]
(24.0 DU/A or Less )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Initial subarea total flow distance = 50.000(Ft.)
Highest elevation = 355.100(Ft.)
Lowest elevation = 354.850(Ft.)
Elevation difference = 0.250(Ft.) Slope = 0.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of 0.50 %, in a development type of
24.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.25 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7100)*( 50.000^.5)/( 0.500^(1/3)]= 6.25
Rainfall intensity (I) = 5.701(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.710
Subarea runoff = 0.061(CFS)
Total initial stream area = 0.015(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station 2.000 to Point/Station 3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 3.757(CFS)
Depth of flow = 0.305(Ft.), Average velocity = 1.343(Ft/s)
******* Irregular Channel Data ***********

---

Information entered for subchannel number 1 :

```
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2             15.00              0.00
       3             30.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      3.757(CFS)
  '     '       flow top width =     18.324(Ft.)
  '     '    velocity=    1.343(Ft/s)
  '     '       area =      2.798(Sq.Ft)
  '     '       Froude number =     0.606

Upstream point elevation =   354.850(Ft.)
Downstream point elevation =   353.530(Ft.)
Flow length =   586.000(Ft.)
Travel time  =    7.27 min.
Time of concentration =   13.53 min.
Depth of flow =   0.305(Ft.)
Average velocity =   1.343(Ft/s)
Total irregular channel flow =     3.757(CFS)
Irregular channel normal depth above invert elev. =   0.305(Ft.)
Average velocity of channel(s) =   1.343(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      3.466(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.710
Rainfall intensity =      3.466(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.710  CA =      2.134
Subarea runoff =      7.335(CFS) for      2.990(Ac.)
Total runoff =      7.396(CFS)       Total area =       3.005(Ac.)
Depth of flow =   0.394(Ft.), Average velocity =   1.590(Ft/s)
End of computations, total study area =           3.005 (Ac.)
```

```
                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: 02/25/20
------------------------------------------------------------------------
18005 Cottonwood Avenue
Post Development
100-year Storm Event
File:18005postdev.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) =  2.500
24 hour precipitation(inches) =  5.000
P6/P24 =    50.0%
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 = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   50.000(Ft.)
Highest elevation =  356.920(Ft.)
Lowest elevation =  356.280(Ft.)
Elevation difference =    0.640(Ft.) Slope =  1.280 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
```

```
for the top area slope value of   1.28 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.60 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.280^(1/3)]=   3.60
Calculated TC of    3.596 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.275(CFS)
Total initial stream area =        0.051(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.110(CFS)
Depth of flow =   0.256(Ft.), Average velocity =   3.448(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      1.110(CFS)
  '     '        flow top width =      1.512(Ft.)
  '     '    velocity=    3.448(Ft/s)
  '     '        area =      0.322(Sq.Ft)
  '     '        Froude number =     1.317

Upstream point elevation =   356.280(Ft.)
Downstream point elevation =   354.050(Ft.)
Flow length =   222.000(Ft.)
Travel time  =    1.07 min.
Time of concentration =    4.67 min.
Depth of flow =   0.256(Ft.)
Average velocity =   3.448(Ft/s)
Total irregular channel flow =     1.110(CFS)
Irregular channel normal depth above invert elev. =   0.256(Ft.)
Average velocity of channel(s) =   3.448(Ft/s)
 Adding area flow to channel
Calculated TC of    4.669 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.295
Subarea runoff =      1.669(CFS) for      0.309(Ac.)
Total runoff =      1.944(CFS)  Total area =       0.360(Ac.)
Depth of flow =   0.351(Ft.), Average velocity =   4.102(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.706(Ft.), Average velocity =   1.951(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              2.00              0.00
        3              4.00              1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =      1.944(CFS)
  '     '        flow top width =      2.824(Ft.)
  '     '    velocity=    1.951(Ft/s)
  '     '        area =      0.997(Sq.Ft)
  '     '        Froude number =     0.579

Upstream point elevation =   354.050(Ft.)
Downstream point elevation =   353.490(Ft.)
Flow length =    57.000(Ft.)
Travel time  =    0.49 min.
Time of concentration =    5.16 min.
Depth of flow =   0.706(Ft.)
Average velocity =   1.951(Ft/s)
Total irregular channel flow =     1.944(CFS)
Irregular channel normal depth above invert elev. =   0.706(Ft.)
Average velocity of channel(s) =   1.951(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      105.000
```

```
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________
Upstream point/station elevation =   351.890(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =    18.00(Ft.) Slope =   0.0067  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.944(CFS)
Given pipe size =      8.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.069(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.466(Ft.)
 Minor friction loss =      0.723(Ft.)  K-factor =   1.50
Pipe flow velocity =      5.57(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     5.21 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
_____________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.360(Ac.)
Runoff from this stream =      1.944(CFS)
Time of concentration =    5.21 min.
Rainfall intensity =     6.415(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** INITIAL AREA EVALUATION ****
_____________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   55.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  354.400(Ft.)
Elevation difference =    1.100(Ft.) Slope =  2.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.46 minutes
```

```
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   2.000^(1/3)]=   3.46
Calculated TC of    3.464 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.254(CFS)
Total initial stream area =        0.047(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      202.000 to Point/Station      203.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.621(CFS)
Depth of flow =   0.184(Ft.), Average velocity =   2.851(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      0.621(CFS)
  '     '        flow top width =      1.368(Ft.)
  '     '    velocity=    2.851(Ft/s)
  '     '        area =      0.218(Sq.Ft)
  '     '        Froude number =     1.259

Upstream point elevation =   354.400(Ft.)
Downstream point elevation =   353.980(Ft.)
Flow length =    42.000(Ft.)
Travel time  =    0.25 min.
Time of concentration =    3.71 min.
Depth of flow =   0.184(Ft.)
Average velocity =   2.851(Ft/s)
Total irregular channel flow =     0.621(CFS)
Irregular channel normal depth above invert elev. =   0.184(Ft.)
Average velocity of channel(s) =   2.851(Ft/s)
 Adding area flow to channel
Calculated TC of    3.710 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
```

```
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.150
Subarea runoff =      0.735(CFS) for      0.136(Ac.)
Total runoff =      0.988(CFS)  Total area =       0.183(Ac.)
Depth of flow =   0.240(Ft.), Average velocity =   3.318(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   352.300(Ft.)
Downstream point/station elevation =   351.770(Ft.)
Pipe length  =   105.00(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.988(CFS)
Given pipe size =      8.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     0.359(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.702(Ft.)
 Minor friction loss =      0.187(Ft.)  K-factor =   1.50
Pipe flow velocity =      2.83(Ft/s)
Travel time through pipe =    0.62 min.
Time of concentration (TC) =     4.33 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.183(Ac.)
Runoff from this stream =      0.988(CFS)
Time of concentration =    4.33 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:

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


1        1.944      5.21                6.415
2        0.988      4.33                6.587
Qmax(1) =
           1.000 *    1.000 *     1.944) +
```

```
           0.974 *    1.000 *     0.988) + =       2.907
Qmax(2) =
           1.000 *    0.831 *     1.944) +
           1.000 *    1.000 *     0.988) + =       2.604

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.944       0.988
Maximum flow rates at confluence using above data:
        2.907        2.604
Area of streams before confluence:
        0.360        0.183
Results of confluence:
Total flow rate =      2.907(CFS)
Time of concentration =     5.209 min.
Effective stream area after confluence =      0.543(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      106.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.770(Ft.)
Downstream point/station elevation =   351.310(Ft.)
Pipe length  =    52.00(Ft.) Slope =   0.0088  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.907(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.907(CFS)
Normal flow depth in pipe =    8.64(In.)
Flow top width inside pipe =   10.78(In.)
Critical Depth =    8.77(In.)
Pipe flow velocity =      4.80(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     5.39 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.310(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    96.00(Ft.) Slope =   0.0011  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.907(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.907(CFS)
Normal flow depth in pipe =   12.38(In.)
Flow top width inside pipe =   16.69(In.)
Critical Depth =    7.78(In.)
Pipe flow velocity =      2.24(Ft/s)
```

```
Travel time through pipe =    0.71 min.
Time of concentration (TC) =     6.10 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.543(Ac.)
Runoff from this stream =      2.907(CFS)
Time of concentration =    6.10 min.
Rainfall intensity =     5.792(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   36.000(Ft.)
Highest elevation =  356.520(Ft.)
Lowest elevation =  356.150(Ft.)
Elevation difference =    0.370(Ft.) Slope =  1.028 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.03 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.87 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.028^(1/3)]=   3.87
Calculated TC of    3.868 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.157(CFS)
Total initial stream area =        0.029(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 =      2.163(CFS)
Depth of flow =   0.382(Ft.), Average velocity =   3.703(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              2.00              0.00
        3              4.00              0.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =      2.163(CFS)
  '     '        flow top width =      3.057(Ft.)
  '     '    velocity=    3.703(Ft/s)
  '     '        area =      0.584(Sq.Ft)
  '     '        Froude number =     1.493

Upstream point elevation =   356.150(Ft.)
Downstream point elevation =   354.740(Ft.)
Flow length =   142.000(Ft.)
Travel time  =    0.64 min.
Time of concentration =    4.51 min.
Depth of flow =   0.382(Ft.)
Average velocity =   3.703(Ft/s)
Total irregular channel flow =     2.163(CFS)
Irregular channel normal depth above invert elev. =   0.382(Ft.)
Average velocity of channel(s) =   3.703(Ft/s)
 Adding area flow to channel
Calculated TC of    4.507 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.633
Subarea runoff =      4.013(CFS) for      0.743(Ac.)
Total runoff =      4.170(CFS)  Total area =       0.772(Ac.)
Depth of flow =   0.489(Ft.), Average velocity =   4.363(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      303.000
```

```
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________
Calculated TC of    4.507 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     4.51 min.
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.812
Subarea runoff =      1.177(CFS) for      0.218(Ac.)
Total runoff =      5.347(CFS)  Total area =       0.990(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      107.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________
Upstream point/station elevation =   351.300(Ft.)
Downstream point/station elevation =   351.200(Ft.)
Pipe length  =    10.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.347(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.205(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      0.225(Ft.)
 Minor friction loss =      1.080(Ft.)  K-factor =   1.50
Pipe flow velocity =      6.81(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     4.53 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      107.000
**** CONFLUENCE OF MINOR STREAMS ****
_____________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.990(Ac.)
Runoff from this stream =      5.347(CFS)
Time of concentration =    4.53 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:
```

18005 Cottonwood Avenue
Post-Development Condition
100-year Storm Event

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


1        2.907      6.10                5.792
2        5.347      4.53                6.587
Qmax(1) =
           1.000 *    1.000 *     2.907) +
           0.879 *    1.000 *     5.347) + =       7.609
Qmax(2) =
           1.000 *    0.743 *     2.907) +
           1.000 *    1.000 *     5.347) + =       7.506

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.907       5.347
Maximum flow rates at confluence using above data:
        7.609        7.506
Area of streams before confluence:
        0.543        0.990
Results of confluence:
Total flow rate =      7.609(CFS)
Time of concentration =     6.103 min.
Effective stream area after confluence =      1.533(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   351.200(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =    88.00(Ft.) Slope =   0.0108  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.609(CFS)
Given pipe size =     12.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     5.249(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      4.013(Ft.)
 Minor friction loss =      2.186(Ft.)  K-factor =   1.50
Pipe flow velocity =      9.69(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =     6.25 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
```

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.533(Ac.)
Runoff from this stream =      7.609(CFS)
Time of concentration =    6.25 min.
Rainfall intensity =     5.701(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   43.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  355.140(Ft.)
Elevation difference =    0.360(Ft.) Slope =  0.837 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   0.84 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.14 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   0.837^(1/3)]=   4.14
Calculated TC of    4.143 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.081(CFS)
Total initial stream area =        0.015(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.319(CFS)
Depth of flow =   0.199(Ft.), Average velocity =   1.334(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
```

```
        2              1.00              0.50
        3              2.00              0.00
        4              3.00              0.00
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      0.319(CFS)
  '     '        flow top width =      1.398(Ft.)
  '     '    velocity=    1.334(Ft/s)
  '     '        area =      0.239(Sq.Ft)
  '     '        Froude number =     0.569

Upstream point elevation =   355.140(Ft.)
Downstream point elevation =   354.870(Ft.)
Flow length =   135.000(Ft.)
Travel time  =    1.69 min.
Time of concentration =    5.83 min.
Depth of flow =   0.199(Ft.)
Average velocity =   1.334(Ft/s)
Total irregular channel flow =     0.319(CFS)
Irregular channel normal depth above invert elev. =   0.199(Ft.)
Average velocity of channel(s) =   1.334(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      5.966(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      5.966(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.084
Subarea runoff =      0.423(CFS) for      0.088(Ac.)
Total runoff =      0.504(CFS)  Total area =       0.103(Ac.)
Depth of flow =   0.259(Ft.), Average velocity =   1.547(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      404.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   352.700(Ft.)
Downstream point/station elevation =   351.760(Ft.)
Pipe length  =    94.00(Ft.) Slope =   0.0100  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.504(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.504(CFS)
Normal flow depth in pipe =    3.05(In.)
```

```
Flow top width inside pipe =   10.45(In.)
Critical Depth =    3.53(In.)
Pipe flow velocity =      3.21(Ft/s)
Travel time through pipe =    0.49 min.
Time of concentration (TC) =     6.32 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      404.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Rainfall intensity (I) =      5.664(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.32 min.
Rainfall intensity =      5.664(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.173
Subarea runoff =      0.476(CFS) for      0.108(Ac.)
Total runoff =      0.980(CFS)  Total area =       0.211(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      404.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________________
Upstream point/station elevation =   351.760(Ft.)
Downstream point/station elevation =   350.250(Ft.)
Pipe length  =   145.00(Ft.) Slope =   0.0104  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.980(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     0.980(CFS)
Normal flow depth in pipe =    4.25(In.)
Flow top width inside pipe =   11.48(In.)
Critical Depth =    4.99(In.)
Pipe flow velocity =      3.93(Ft/s)
Travel time through pipe =    0.62 min.
Time of concentration (TC) =     6.93 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      405.000 to Point/Station      405.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
```

```
Rainfall intensity (I) =      5.335(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.93 min.
Rainfall intensity =      5.335(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.233
Subarea runoff =      0.262(CFS) for      0.073(Ac.)
Total runoff =      1.242(CFS)  Total area =       0.284(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.284(Ac.)
Runoff from this stream =      1.242(CFS)
Time of concentration =    6.93 min.
Rainfall intensity =     5.335(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   70.000(Ft.)
Highest elevation =  355.500(Ft.)
Lowest elevation =  355.490(Ft.)
Elevation difference =    0.010(Ft.) Slope =  0.014 %
Top of Initial Area Slope adjusted by User to  1.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   1.00 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
```

```
Initial Area Time of Concentration =   3.90 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   1.000^(1/3)]=   3.90
Calculated TC of    3.904 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.254(CFS)
Total initial stream area =        0.047(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.245(CFS)
Depth of flow =   0.156(Ft.), Average velocity =   4.812(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.50
        2              1.00              0.50
        3              2.00              0.00
        4              3.50              0.00
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =      1.245(CFS)
  '     '        flow top width =      1.812(Ft.)
  '     '    velocity=    4.812(Ft/s)
  '     '        area =      0.259(Sq.Ft)
  '     '        Froude number =     2.244

Upstream point elevation =   355.490(Ft.)
Downstream point elevation =   354.880(Ft.)
Flow length =    25.000(Ft.)
Travel time  =    0.09 min.
Time of concentration =    3.99 min.
Depth of flow =   0.156(Ft.)
Average velocity =   4.812(Ft/s)
Total irregular channel flow =     1.245(CFS)
Irregular channel normal depth above invert elev. =   0.156(Ft.)
Average velocity of channel(s) =   4.812(Ft/s)
 Adding area flow to channel
Calculated TC of    3.991 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.339
Subarea runoff =      1.982(CFS) for      0.367(Ac.)
Total runoff =      2.236(CFS)  Total area =       0.414(Ac.)
Depth of flow =   0.220(Ft.), Average velocity =   5.903(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      503.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   349.650(Ft.)
Downstream point/station elevation =   349.350(Ft.)
Pipe length  =   148.00(Ft.) Slope =   0.0020  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.236(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.236(CFS)
Normal flow depth in pipe =    8.71(In.)
Flow top width inside pipe =   17.99(In.)
Critical Depth =    6.78(In.)
Pipe flow velocity =      2.64(Ft/s)
Travel time through pipe =    0.93 min.
Time of concentration (TC) =     4.93 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.414(Ac.)
Runoff from this stream =      2.236(CFS)
Time of concentration =    4.93 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:

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


1        7.609      6.25                5.701
2        1.242      6.93                5.335
3        2.236      4.93                6.587
Qmax(1) =
```

18005 Cottonwood Avenue
Post-Development Condition
100-year Storm Event

```
           1.000 *    1.000 *     7.609) +
           1.000 *    0.902 *     1.242) +
           0.866 *    1.000 *     2.236) + =      10.666
Qmax(2) =
           0.936 *    1.000 *     7.609) +
           1.000 *    1.000 *     1.242) +
           0.810 *    1.000 *     2.236) + =      10.174
Qmax(3) =
           1.000 *    0.788 *     7.609) +
           1.000 *    0.710 *     1.242) +
           1.000 *    1.000 *     2.236) + =       9.111

Total of 3 streams to confluence:
Flow rates before confluence point:
       7.609       1.242       2.236
Maximum flow rates at confluence using above data:
       10.666       10.174        9.111
Area of streams before confluence:
        1.533        0.284        0.414
Results of confluence:
Total flow rate =     10.666(CFS)
Time of concentration =     6.254 min.
Effective stream area after confluence =      2.231(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      601.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      5.701(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
The area added to the existing stream causes a
a lower flow rate of Q =     10.645(CFS)
therefore the upstream flow rate of Q =     10.666(CFS) is being used
Time of concentration =     6.25 min.
Rainfall intensity =      5.701(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      1.867
Subarea runoff =      0.000(CFS) for      0.046(Ac.)
Total runoff =     10.666(CFS)  Total area =       2.277(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Rainfall intensity (I) =      5.701(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.25 min.
Rainfall intensity =      5.701(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.139
Subarea runoff =      1.527(CFS) for      0.331(Ac.)
Total runoff =     12.193(CFS)  Total area =       2.608(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      108.000
**** SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Rainfall intensity (I) =      5.701(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     6.25 min.
Rainfall intensity =      5.701(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      2.464
Subarea runoff =      1.856(CFS) for      0.397(Ac.)
Total runoff =     14.049(CFS)  Total area =       3.005(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      109.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____________________________________________________________________________
Upstream point/station elevation =   350.590(Ft.)
Downstream point/station elevation =   350.530(Ft.)
Pipe length  =    12.10(Ft.) Slope =   0.0050  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.049(CFS)
Given pipe size =     12.00(In.)
```

```
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     9.273(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      1.881(Ft.)
 Minor friction loss =      7.453(Ft.)  K-factor =   1.50
Pipe flow velocity =     17.89(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     6.27 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** 6 HOUR HYDROGRAPH ****
________________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =   6.27
Basin Area =     3.00 Acres
6 Hour Rainfall =  2.500 Inches
Runoff Coefficient =  0.820
Peak Discharge =    14.05 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
       6               0.367
       12               0.371
       18               0.380
       24               0.384
       30               0.393
       36               0.398
       42               0.408
       48               0.414
       54               0.425
       60               0.431
       66               0.443
       72               0.449
       78               0.463
       84               0.471
       90               0.486
       96               0.495
       102               0.512
       108               0.522
       114               0.542
       120               0.553
       126               0.577
       132               0.590
       138               0.619
       144               0.634
       150               0.669
```

```
            156              0.688
            162              0.730
            168              0.754
            174              0.809
            180              0.840
            186              0.913
            192              0.956
            198              1.060
            204              1.125
            210              1.289
            216              1.398
            222              1.708
            228              1.946
            234              2.857
            240              4.026
            246             14.049
            252              2.292
            258              1.533
            264              1.200
            270              1.005
            276              0.875
            282              0.780
            288              0.708
            294              0.651
            300              0.604
            306              0.565
            312              0.532
            318              0.503
            324              0.478
            330              0.456
            336              0.437
            342              0.419
            348              0.403
            354              0.389
            360              0.375
            366              0.363
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        6 - H O U R    S T O R M
                   R u n o f f     H y d r o g r a p h
     ----------------------------------------------------------------------
                Hydrograph in   1   Minute intervals ((CFS))

     ----------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        3.5       7.0      10.5      14.0
----------------------------------------------------------------------
  0+ 0       0.0000      0.00  Q         |         |         |         |
  0+ 1       0.0001      0.06  Q         |         |         |         |
  0+ 2       0.0003      0.12  Q         |         |         |         |
  0+ 3       0.0005      0.18  Q         |         |         |         |
  0+ 4       0.0008      0.24  Q         |         |         |         |
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0+ 5 | 0.0013 | 0.31 | Q | \| | \| | \| | \| |
| 0+ 6 | 0.0018 | 0.37 | VQ | \| | \| | \| | \| |
| 0+ 7 | 0.0023 | 0.37 | VQ | \| | \| | \| | \| |
| 0+ 8 | 0.0028 | 0.37 | VQ | \| | \| | \| | \| |
| 0+ 9 | 0.0033 | 0.37 | VQ | \| | \| | \| | \| |
| 0+10 | 0.0038 | 0.37 | VQ | \| | \| | \| | \| |
| 0+11 | 0.0043 | 0.37 | VQ | \| | \| | \| | \| |
| 0+12 | 0.0048 | 0.37 | VQ | \| | \| | \| | \| |
| 0+13 | 0.0053 | 0.37 | VQ | \| | \| | \| | \| |
| 0+14 | 0.0059 | 0.37 | VQ | \| | \| | \| | \| |
| 0+15 | 0.0064 | 0.38 | VQ | \| | \| | \| | \| |
| 0+16 | 0.0069 | 0.38 | VQ | \| | \| | \| | \| |
| 0+17 | 0.0074 | 0.38 | VQ | \| | \| | \| | \| |
| 0+18 | 0.0079 | 0.38 | VQ | \| | \| | \| | \| |
| 0+19 | 0.0085 | 0.38 | VQ | \| | \| | \| | \| |
| 0+20 | 0.0090 | 0.38 | VQ | \| | \| | \| | \| |
| 0+21 | 0.0095 | 0.38 | VQ | \| | \| | \| | \| |
| 0+22 | 0.0100 | 0.38 | VQ | \| | \| | \| | \| |
| 0+23 | 0.0106 | 0.38 | VQ | \| | \| | \| | \| |
| 0+24 | 0.0111 | 0.38 | VQ | \| | \| | \| | \| |
| 0+25 | 0.0116 | 0.39 | VQ | \| | \| | \| | \| |
| 0+26 | 0.0122 | 0.39 | VQ | \| | \| | \| | \| |
| 0+27 | 0.0127 | 0.39 | VQ | \| | \| | \| | \| |
| 0+28 | 0.0132 | 0.39 | \|Q | \| | \| | \| | \| |
| 0+29 | 0.0138 | 0.39 | \|Q | \| | \| | \| | \| |
| 0+30 | 0.0143 | 0.39 | \|Q | \| | \| | \| | \| |
| 0+31 | 0.0149 | 0.39 | \|Q | \| | \| | \| | \| |
| 0+32 | 0.0154 | 0.39 | \|Q | \| | \| | \| | \| |
| 0+33 | 0.0159 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+34 | 0.0165 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+35 | 0.0170 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+36 | 0.0176 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+37 | 0.0181 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+38 | 0.0187 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+39 | 0.0192 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+40 | 0.0198 | 0.40 | \|Q | \| | \| | \| | \| |
| 0+41 | 0.0204 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+42 | 0.0209 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+43 | 0.0215 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+44 | 0.0221 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+45 | 0.0226 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+46 | 0.0232 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+47 | 0.0238 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+48 | 0.0243 | 0.41 | \|Q | \| | \| | \| | \| |
| 0+49 | 0.0249 | 0.42 | \|Q | \| | \| | \| | \| |
| 0+50 | 0.0255 | 0.42 | \|QV | \| | \| | \| | \| |
| 0+51 | 0.0260 | 0.42 | \|QV | \| | \| | \| | \| |
| 0+52 | 0.0266 | 0.42 | \|QV | \| | \| | \| | \| |
| 0+53 | 0.0272 | 0.42 | \|QV | \| | \| | \| | \| |
| 0+54 | 0.0278 | 0.42 | \|QV | \| | \| | \| | \| |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0+55 | 0.0284 | 0.43 | QV | | | | |
| 0+56 | 0.0290 | 0.43 | QV | | | | |
| 0+57 | 0.0296 | 0.43 | QV | | | | |
| 0+58 | 0.0301 | 0.43 | QV | | | | |
| 0+59 | 0.0307 | 0.43 | QV | | | | |
| 1+ 0 | 0.0313 | 0.43 | QV | | | | |
| 1+ 1 | 0.0319 | 0.43 | QV | | | | |
| 1+ 2 | 0.0325 | 0.43 | QV | | | | |
| 1+ 3 | 0.0331 | 0.44 | QV | | | | |
| 1+ 4 | 0.0337 | 0.44 | QV | | | | |
| 1+ 5 | 0.0343 | 0.44 | QV | | | | |
| 1+ 6 | 0.0349 | 0.44 | QV | | | | |
| 1+ 7 | 0.0356 | 0.44 | QV | | | | |
| 1+ 8 | 0.0362 | 0.45 | QV | | | | |
| 1+ 9 | 0.0368 | 0.45 | QV | | | | |
| 1+10 | 0.0374 | 0.45 | QV | | | | |
| 1+11 | 0.0380 | 0.45 | QV | | | | |
| 1+12 | 0.0386 | 0.45 | Q V | | | | |
| 1+13 | 0.0393 | 0.45 | Q V | | | | |
| 1+14 | 0.0399 | 0.45 | Q V | | | | |
| 1+15 | 0.0405 | 0.46 | Q V | | | | |
| 1+16 | 0.0411 | 0.46 | Q V | | | | |
| 1+17 | 0.0418 | 0.46 | Q V | | | | |
| 1+18 | 0.0424 | 0.46 | Q V | | | | |
| 1+19 | 0.0431 | 0.46 | Q V | | | | |
| 1+20 | 0.0437 | 0.47 | Q V | | | | |
| 1+21 | 0.0443 | 0.47 | Q V | | | | |
| 1+22 | 0.0450 | 0.47 | Q V | | | | |
| 1+23 | 0.0456 | 0.47 | Q V | | | | |
| 1+24 | 0.0463 | 0.47 | Q V | | | | |
| 1+25 | 0.0469 | 0.47 | Q V | | | | |
| 1+26 | 0.0476 | 0.48 | Q V | | | | |
| 1+27 | 0.0483 | 0.48 | Q V | | | | |
| 1+28 | 0.0489 | 0.48 | Q V | | | | |
| 1+29 | 0.0496 | 0.48 | Q V | | | | |
| 1+30 | 0.0503 | 0.49 | Q V | | | | |
| 1+31 | 0.0509 | 0.49 | Q  V | | | | |
| 1+32 | 0.0516 | 0.49 | Q  V | | | | |
| 1+33 | 0.0523 | 0.49 | Q  V | | | | |
| 1+34 | 0.0530 | 0.49 | Q  V | | | | |
| 1+35 | 0.0536 | 0.49 | Q  V | | | | |
| 1+36 | 0.0543 | 0.49 | Q  V | | | | |
| 1+37 | 0.0550 | 0.50 | Q  V | | | | |
| 1+38 | 0.0557 | 0.50 | Q  V | | | | |
| 1+39 | 0.0564 | 0.50 | Q  V | | | | |
| 1+40 | 0.0571 | 0.51 | Q  V | | | | |
| 1+41 | 0.0578 | 0.51 | Q  V | | | | |
| 1+42 | 0.0585 | 0.51 | Q  V | | | | |
| 1+43 | 0.0592 | 0.51 | Q  V | | | | |
| 1+44 | 0.0599 | 0.52 | Q  V | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1+45 | 0.0606 | 0.52 | \|Q V \| | \| | \| | \| |
| 1+46 | 0.0613 | 0.52 | \|Q V \| | \| | \| | \| |
| 1+47 | 0.0620 | 0.52 | \|Q V \| | \| | \| | \| |
| 1+48 | 0.0628 | 0.52 | \|Q V \| | \| | \| | \| |
| 1+49 | 0.0635 | 0.53 | \|Q V \| | \| | \| | \| |
| 1+50 | 0.0642 | 0.53 | \|Q V \| | \| | \| | \| |
| 1+51 | 0.0650 | 0.53 | \|Q V \| | \| | \| | \| |
| 1+52 | 0.0657 | 0.54 | \|Q V \| | \| | \| | \| |
| 1+53 | 0.0664 | 0.54 | \|Q V \| | \| | \| | \| |
| 1+54 | 0.0672 | 0.54 | \|Q V \| | \| | \| | \| |
| 1+55 | 0.0679 | 0.54 | \|Q V \| | \| | \| | \| |
| 1+56 | 0.0687 | 0.55 | \|Q V \| | \| | \| | \| |
| 1+57 | 0.0694 | 0.55 | \|Q V \| | \| | \| | \| |
| 1+58 | 0.0702 | 0.55 | \|Q V \| | \| | \| | \| |
| 1+59 | 0.0710 | 0.55 | \|Q V \| | \| | \| | \| |
| 2+ 0 | 0.0717 | 0.55 | \|Q V \| | \| | \| | \| |
| 2+ 1 | 0.0725 | 0.56 | \|Q V \| | \| | \| | \| |
| 2+ 2 | 0.0733 | 0.56 | \|Q V \| | \| | \| | \| |
| 2+ 3 | 0.0740 | 0.57 | \|Q V \| | \| | \| | \| |
| 2+ 4 | 0.0748 | 0.57 | \|Q V \| | \| | \| | \| |
| 2+ 5 | 0.0756 | 0.57 | \|Q V \| | \| | \| | \| |
| 2+ 6 | 0.0764 | 0.58 | \|Q V \| | \| | \| | \| |
| 2+ 7 | 0.0772 | 0.58 | \|Q V \| | \| | \| | \| |
| 2+ 8 | 0.0780 | 0.58 | \|Q V \| | \| | \| | \| |
| 2+ 9 | 0.0788 | 0.58 | \|Q V \| | \| | \| | \| |
| 2+10 | 0.0796 | 0.59 | \|Q V \| | \| | \| | \| |
| 2+11 | 0.0804 | 0.59 | \|Q V \| | \| | \| | \| |
| 2+12 | 0.0812 | 0.59 | \|Q V \| | \| | \| | \| |
| 2+13 | 0.0821 | 0.60 | \|Q V \| | \| | \| | \| |
| 2+14 | 0.0829 | 0.60 | \|Q V \| | \| | \| | \| |
| 2+15 | 0.0837 | 0.60 | \|Q V \| | \| | \| | \| |
| 2+16 | 0.0846 | 0.61 | \|Q V \| | \| | \| | \| |
| 2+17 | 0.0854 | 0.61 | \|Q V \| | \| | \| | \| |
| 2+18 | 0.0863 | 0.62 | \|Q V \| | \| | \| | \| |
| 2+19 | 0.0871 | 0.62 | \|Q V \| | \| | \| | \| |
| 2+20 | 0.0880 | 0.62 | \|Q V \| | \| | \| | \| |
| 2+21 | 0.0888 | 0.63 | \|Q V \| | \| | \| | \| |
| 2+22 | 0.0897 | 0.63 | \|Q V \| | \| | \| | \| |
| 2+23 | 0.0906 | 0.63 | \|Q V \| | \| | \| | \| |
| 2+24 | 0.0914 | 0.63 | \|Q V \| | \| | \| | \| |
| 2+25 | 0.0923 | 0.64 | \|Q V \| | \| | \| | \| |
| 2+26 | 0.0932 | 0.65 | \|Q V \| | \| | \| | \| |
| 2+27 | 0.0941 | 0.65 | \|Q V \| | \| | \| | \| |
| 2+28 | 0.0950 | 0.66 | \|Q V \| | \| | \| | \| |
| 2+29 | 0.0959 | 0.66 | \|Q V \| | \| | \| | \| |
| 2+30 | 0.0969 | 0.67 | \|Q V \| | \| | \| | \| |
| 2+31 | 0.0978 | 0.67 | \|Q V \| | \| | \| | \| |
| 2+32 | 0.0987 | 0.67 | \|Q V \| | \| | \| | \| |
| 2+33 | 0.0996 | 0.68 | \|Q V \| | \| | \| | \| |
| 2+34 | 0.1006 | 0.68 | \|Q V \| | \| | \| | \| |

```
2+35      0.1015      0.68  |Q     V  |          |          |          |
2+36      0.1025      0.69  |Q      V |          |          |          |
2+37      0.1034      0.69  |Q      V |          |          |          |
2+38      0.1044      0.70  |Q      V |          |          |          |
2+39      0.1054      0.71  | Q     V |          |          |          |
2+40      0.1064      0.72  | Q     V |          |          |          |
2+41      0.1074      0.72  | Q     V |          |          |          |
2+42      0.1084      0.73  | Q     V |          |          |          |
2+43      0.1094      0.73  | Q     V |          |          |          |
2+44      0.1104      0.74  | Q     V |          |          |          |
2+45      0.1114      0.74  | Q     V |          |          |          |
2+46      0.1124      0.75  | Q     V |          |          |          |
2+47      0.1135      0.75  | Q     V |          |          |          |
2+48      0.1145      0.75  | Q      V|          |          |          |
2+49      0.1156      0.76  | Q      V|          |          |          |
2+50      0.1166      0.77  | Q      V|          |          |          |
2+51      0.1177      0.78  | Q      V|          |          |          |
2+52      0.1188      0.79  | Q      V|          |          |          |
2+53      0.1199      0.80  | Q      V|          |          |          |
2+54      0.1210      0.81  | Q      V|          |          |          |
2+55      0.1221      0.81  | Q      V|          |          |          |
2+56      0.1233      0.82  | Q      V|          |          |          |
2+57      0.1244      0.82  | Q      V|          |          |          |
2+58      0.1255      0.83  | Q      V|          |          |          |
2+59      0.1267      0.83  | Q      V|          |          |          |
3+ 0      0.1278      0.84  | Q       V          |          |          |
3+ 1      0.1290      0.85  | Q       V          |          |          |
3+ 2      0.1302      0.86  | Q       V          |          |          |
3+ 3      0.1314      0.88  | Q       V          |          |          |
3+ 4      0.1326      0.89  | Q       V          |          |          |
3+ 5      0.1339      0.90  | Q       V          |          |          |
3+ 6      0.1351      0.91  | Q       V          |          |          |
3+ 7      0.1364      0.92  | Q       V          |          |          |
3+ 8      0.1377      0.93  | Q       V          |          |          |
3+ 9      0.1390      0.93  | Q       V          |          |          |
3+10      0.1403      0.94  | Q       |V          |          |          |
3+11      0.1416      0.95  | Q       |V          |          |          |
3+12      0.1429      0.96  | Q       |V          |          |          |
3+13      0.1442      0.97  | Q       |V          |          |          |
3+14      0.1456      0.99  | Q       |V          |          |          |
3+15      0.1470      1.01  | Q       |V          |          |          |
3+16      0.1484      1.03  | Q       |V          |          |          |
3+17      0.1498      1.04  | Q       |V          |          |          |
3+18      0.1513      1.06  |  Q      |V          |          |          |
3+19      0.1528      1.07  |  Q      | V         |          |          |
3+20      0.1543      1.08  |  Q      | V         |          |          |
3+21      0.1558      1.09  |  Q      | V         |          |          |
3+22      0.1573      1.10  |  Q      | V         |          |          |
3+23      0.1588      1.11  |  Q      | V         |          |          |
3+24      0.1604      1.12  |  Q      | V         |          |          |
```

```
3+25       0.1619      1.15  |  Q      | V       |         |          |
3+26       0.1636      1.18  |  Q      | V       |         |          |
3+27       0.1652      1.21  |  Q      | V       |         |          |
3+28       0.1669      1.23  |  Q      |  V      |         |          |
3+29       0.1687      1.26  |  Q      |  V      |         |          |
3+30       0.1705      1.29  |  Q      |  V      |         |          |
3+31       0.1723      1.31  |  Q      |  V      |         |          |
3+32       0.1741      1.33  |  Q      |  V      |         |          |
3+33       0.1759      1.34  |  Q      |  V      |         |          |
3+34       0.1778      1.36  |  Q      |  V      |         |          |
3+35       0.1797      1.38  |  Q      |   V     |         |          |
3+36       0.1816      1.40  |  Q      |   V     |         |          |
3+37       0.1836      1.45  |   Q     |   V     |         |          |
3+38       0.1857      1.50  |   Q     |   V     |         |          |
3+39       0.1878      1.55  |   Q     |   V     |         |          |
3+40       0.1900      1.60  |   Q     |   V     |         |          |
3+41       0.1923      1.66  |   Q     |    V    |         |          |
3+42       0.1947      1.71  |   Q     |    V    |         |          |
3+43       0.1971      1.75  |   Q     |    V    |         |          |
3+44       0.1995      1.79  |    Q    |    V    |         |          |
3+45       0.2021      1.83  |    Q    |    V    |         |          |
3+46       0.2046      1.87  |    Q    |     V   |         |          |
3+47       0.2073      1.91  |    Q    |     V   |         |          |
3+48       0.2099      1.95  |    Q    |     V   |         |          |
3+49       0.2128      2.10  |    Q    |     V   |         |          |
3+50       0.2159      2.25  |     Q   |     V   |         |          |
3+51       0.2192      2.40  |     Q   |      V  |         |          |
3+52       0.2228      2.55  |      Q  |      V  |         |          |
3+53       0.2265      2.71  |      Q  |      V  |         |          |
3+54       0.2304      2.86  |       Q |       V |         |          |
3+55       0.2346      3.05  |       Q |       V |         |          |
3+56       0.2391      3.25  |        Q|       V |         |          |
3+57       0.2438      3.44  |        Q|        V|         |          |
3+58       0.2488      3.64  |         Q       V|         |          |
3+59       0.2541      3.83  |         Q       V|         |          |
4+ 0       0.2597      4.03  |          |Q       V        |          |
4+ 1       0.2675      5.70  |          |     Q   |V       |          |
4+ 2       0.2777      7.37  |          |         QV       |          |
4+ 3       0.2901      9.04  |          |          | V  Q  |          |
4+ 4       0.3049     10.71  |          |          |  V     Q         |
4+ 5       0.3219     12.38  |          |          |    V   |    Q     |
4+ 6       0.3413     14.05  |          |          |     V  |         Q|
4+ 7       0.3579     12.09  |          |          |       V|   Q      |
4+ 8       0.3719     10.13  |          |          |       QV|          |
4+ 9       0.3831      8.17  |          |          |  Q      V          |
4+10       0.3917      6.21  |          |      Q   |         V          |
4+11       0.3975      4.25  |          | Q        |         |V         |
4+12       0.4007      2.29  |     Q    |          |         |V         |
4+13       0.4037      2.17  |     Q    |          |         |V         |
4+14       0.4065      2.04  |    Q     |          |         |V         |
```

```
4+15      0.4091      1.91  |    Q    |         |         | V       |
4+16      0.4116      1.79  |    Q    |         |         | V       |
4+17      0.4139      1.66  |   Q     |         |         | V       |
4+18      0.4160      1.53  |   Q     |         |         | V       |
4+19      0.4180      1.48  |   Q     |         |         | V       |
4+20      0.4200      1.42  |   Q     |         |         |  V      |
4+21      0.4218      1.37  |  Q      |         |         |  V      |
4+22      0.4236      1.31  |  Q      |         |         |  V      |
4+23      0.4254      1.26  |  Q      |         |         |  V      |
4+24      0.4270      1.20  |  Q      |         |         |  V      |
4+25      0.4286      1.17  |  Q      |         |         |  V      |
4+26      0.4302      1.13  |  Q      |         |         |  V      |
4+27      0.4317      1.10  |  Q      |         |         |  V      |
4+28      0.4332      1.07  |  Q      |         |         |   V     |
4+29      0.4346      1.04  | Q       |         |         |   V     |
4+30      0.4360      1.00  | Q       |         |         |   V     |
4+31      0.4374      0.98  | Q       |         |         |   V     |
4+32      0.4387      0.96  | Q       |         |         |   V     |
4+33      0.4400      0.94  | Q       |         |         |   V     |
4+34      0.4412      0.92  | Q       |         |         |   V     |
4+35      0.4425      0.90  | Q       |         |         |   V     |
4+36      0.4437      0.87  | Q       |         |         |   V     |
4+37      0.4449      0.86  | Q       |         |         |   V     |
4+38      0.4460      0.84  | Q       |         |         |    V    |
4+39      0.4472      0.83  | Q       |         |         |    V    |
4+40      0.4483      0.81  | Q       |         |         |    V    |
4+41      0.4494      0.80  | Q       |         |         |    V    |
4+42      0.4505      0.78  | Q       |         |         |    V    |
4+43      0.4515      0.77  | Q       |         |         |    V    |
4+44      0.4526      0.76  | Q       |         |         |    V    |
4+45      0.4536      0.74  | Q       |         |         |    V    |
4+46      0.4546      0.73  | Q       |         |         |    V    |
4+47      0.4556      0.72  | Q       |         |         |    V    |
4+48      0.4566      0.71  | Q       |         |         |    V    |
4+49      0.4575      0.70  |Q        |         |         |    V    |
4+50      0.4585      0.69  |Q        |         |         |     V   |
4+51      0.4594      0.68  |Q        |         |         |     V   |
4+52      0.4603      0.67  |Q        |         |         |     V   |
4+53      0.4612      0.66  |Q        |         |         |     V   |
4+54      0.4621      0.65  |Q        |         |         |     V   |
4+55      0.4630      0.64  |Q        |         |         |     V   |
4+56      0.4639      0.64  |Q        |         |         |     V   |
4+57      0.4648      0.63  |Q        |         |         |     V   |
4+58      0.4656      0.62  |Q        |         |         |     V   |
4+59      0.4665      0.61  |Q        |         |         |     V   |
5+ 0      0.4673      0.60  |Q        |         |         |     V   |
5+ 1      0.4681      0.60  |Q        |         |         |     V   |
5+ 2      0.4689      0.59  |Q        |         |         |     V   |
5+ 3      0.4697      0.58  |Q        |         |         |     V   |
5+ 4      0.4705      0.58  |Q        |         |         |     V   |
```

18005 Cottonwood Avenue
Post-Development Condition
100-year Storm Event

```
5+ 5       0.4713      0.57  |Q        |         |         |       V  |
5+ 6       0.4721      0.57  |Q        |         |         |       V  |
5+ 7       0.4729      0.56  |Q        |         |         |       V  |
5+ 8       0.4736      0.55  |Q        |         |         |       V  |
5+ 9       0.4744      0.55  |Q        |         |         |       V  |
5+10       0.4751      0.54  |Q        |         |         |       V  |
5+11       0.4759      0.54  |Q        |         |         |       V  |
5+12       0.4766      0.53  |Q        |         |         |       V  |
5+13       0.4773      0.53  |Q        |         |         |       V  |
5+14       0.4780      0.52  |Q        |         |         |       V  |
5+15       0.4788      0.52  |Q        |         |         |       V  |
5+16       0.4795      0.51  |Q        |         |         |       V  |
5+17       0.4802      0.51  |Q        |         |         |       V  |
5+18       0.4809      0.50  |Q        |         |         |       V  |
5+19       0.4815      0.50  |Q        |         |         |       V  |
5+20       0.4822      0.49  |Q        |         |         |       V  |
5+21       0.4829      0.49  |Q        |         |         |       V  |
5+22       0.4836      0.49  |Q        |         |         |        V |
5+23       0.4842      0.48  |Q        |         |         |        V |
5+24       0.4849      0.48  |Q        |         |         |        V |
5+25       0.4855      0.47  |Q        |         |         |        V |
5+26       0.4862      0.47  |Q        |         |         |        V |
5+27       0.4868      0.47  |Q        |         |         |        V |
5+28       0.4875      0.46  |Q        |         |         |        V |
5+29       0.4881      0.46  |Q        |         |         |        V |
5+30       0.4887      0.46  |Q        |         |         |        V |
5+31       0.4894      0.45  |Q        |         |         |        V |
5+32       0.4900      0.45  |Q        |         |         |        V |
5+33       0.4906      0.45  |Q        |         |         |        V |
5+34       0.4912      0.44  |Q        |         |         |        V |
5+35       0.4918      0.44  |Q        |         |         |        V |
5+36       0.4924      0.44  |Q        |         |         |        V |
5+37       0.4930      0.43  |Q        |         |         |        V |
5+38       0.4936      0.43  |Q        |         |         |        V |
5+39       0.4942      0.43  |Q        |         |         |        V |
5+40       0.4948      0.42  |Q        |         |         |        V |
5+41       0.4954      0.42  |Q        |         |         |        V |
5+42       0.4959      0.42  |Q        |         |         |        V |
5+43       0.4965      0.42  |Q        |         |         |         V|
5+44       0.4971      0.41  |Q        |         |         |         V|
5+45       0.4977      0.41  |Q        |         |         |         V|
5+46       0.4982      0.41  |Q        |         |         |         V|
5+47       0.4988      0.41  |Q        |         |         |         V|
5+48       0.4993      0.40  |Q        |         |         |         V|
5+49       0.4999      0.40  |Q        |         |         |         V|
5+50       0.5004      0.40  |Q        |         |         |         V|
5+51       0.5010      0.40  |Q        |         |         |         V|
5+52       0.5015      0.39  |Q        |         |         |         V|
5+53       0.5021      0.39  |Q        |         |         |         V|
5+54       0.5026      0.39  |Q        |         |         |         V|
```

```
    5+55       0.5031      0.39  |Q        |         |         |        V|
    5+56       0.5036      0.38  |Q        |         |         |        V|
    5+57       0.5042      0.38  |Q        |         |         |        V|
    5+58       0.5047      0.38  |Q        |         |         |        V|
    5+59       0.5052      0.38  |Q        |         |         |        V|
    6+ 0       0.5057      0.38  |Q        |         |         |        V|
    6+ 1       0.5063      0.37  |Q        |         |         |        V|
    6+ 2       0.5068      0.37  |Q        |         |         |        V|
    6+ 3       0.5073      0.37  |Q        |         |         |        V|
    6+ 4       0.5078      0.37  |Q        |         |         |        V|
    6+ 5       0.5083      0.37  |Q        |         |         |        V|
    6+ 6       0.5088      0.36  |Q        |         |         |         V
-------------------------------------------------------------------------

        End of computations, total study area =          3.005 (Ac.)
```

```
                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: 03/03/20
--------------------------------------------------------------------------
18005 Cottonwood Avenue
Post Development-User Defined
100-year Storm Event
File:18005postdevuser.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) =  2.500
24 hour precipitation(inches) =  5.000
P6/P24 =    50.0%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      109.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
__________________________________________________________________________
User specified 'C' value of 0.173 given for subarea
Rainfall intensity (I) =      2.883(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  18.00 min.  Rain intensity =       2.88(In/Hr)
Total area =        3.005(Ac.)  Total runoff =     1.498(CFS)
End of computations, total study area =           3.005 (Ac.)
```

# ATTACHMENT 4

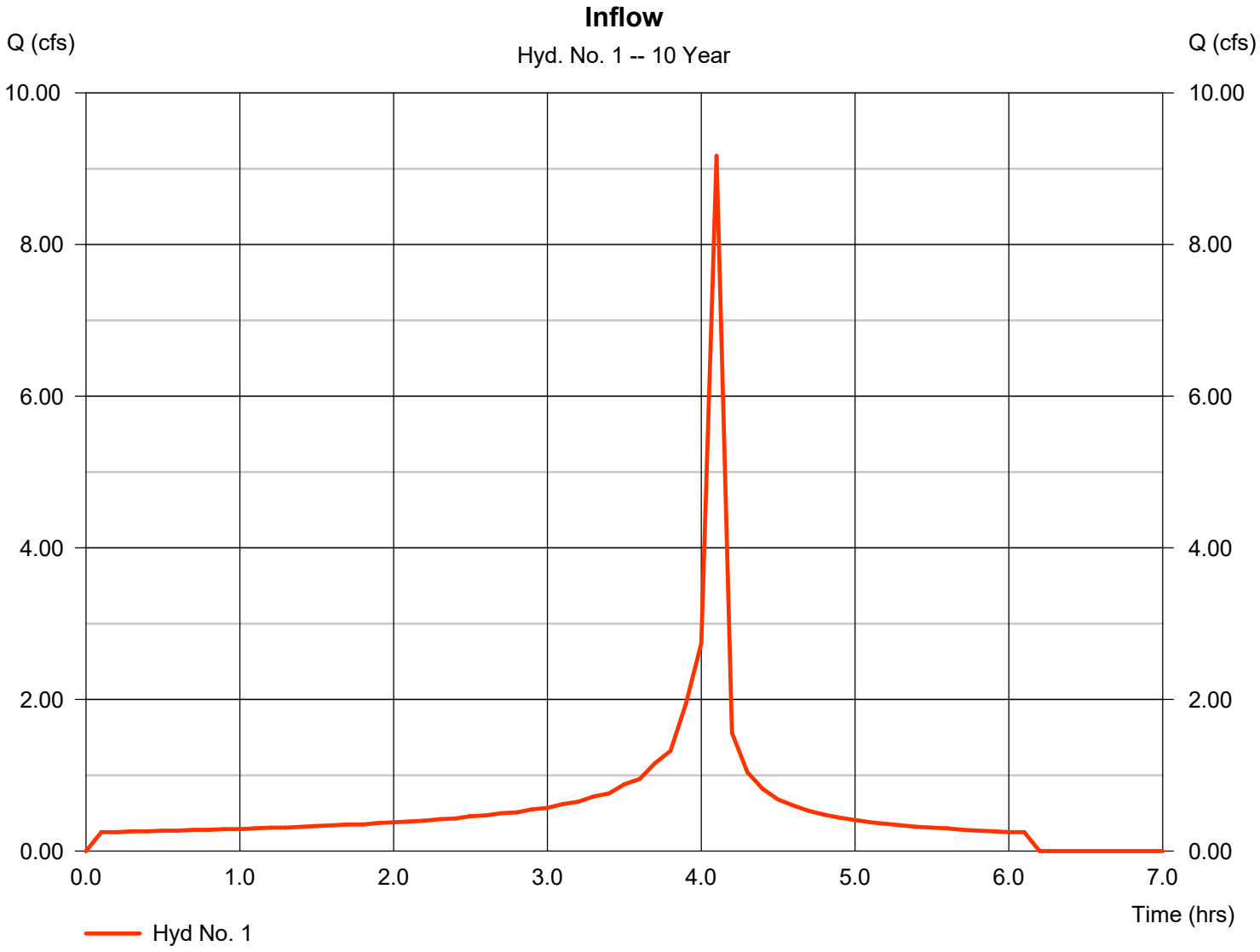
# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 03 / 3 / 2020

## Hyd. No. 1

Inflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 9.170 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 4.10 hrs |
| Time interval | = 6 min | Hyd. volume | = 14,958 cuft |



# Hydrograph Report

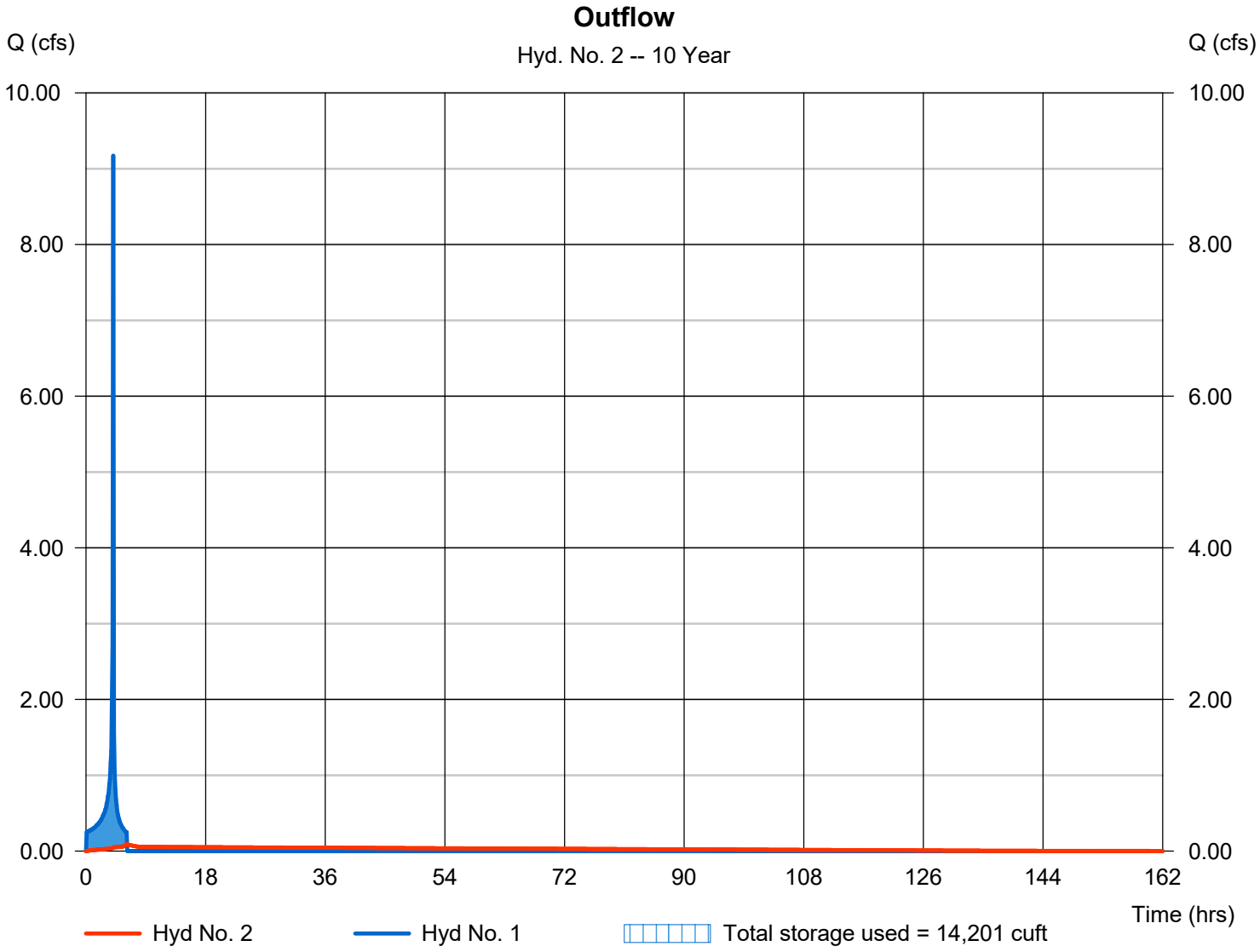
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 03 / 3 / 2020

## Hyd. No. 2

Outflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Reservoir | Peak discharge | = 0.091 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 6.20 hrs |
| Time interval | = 6 min | Hyd. volume | = 14,897 cuft |
| Inflow hyd. No. | = 1 - Inflow | Max. Elevation | = 350.99 ft |
| Reservoir name | = 4' vault | Max. Storage | = 14,201 cuft |

Storage Indication method used.



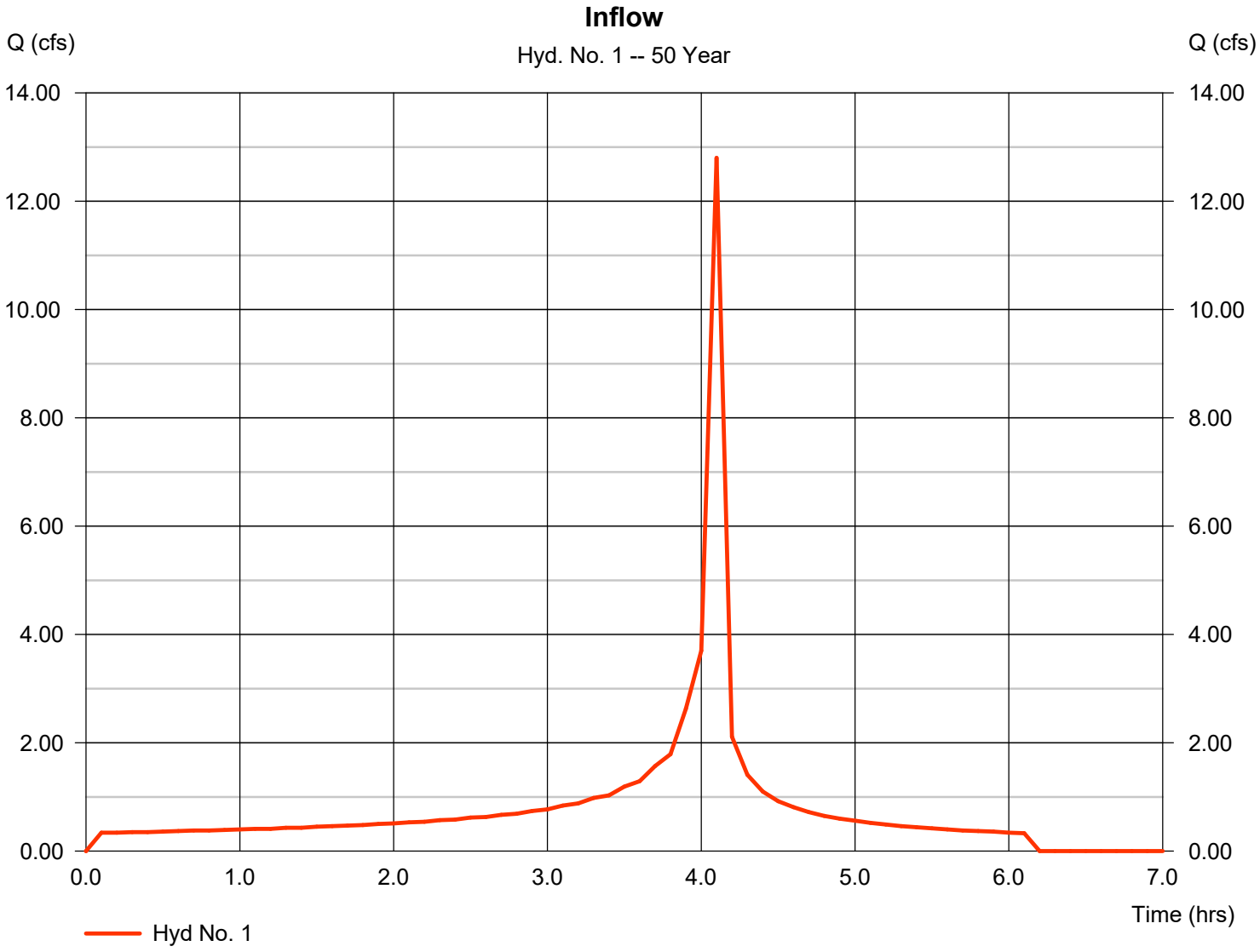
# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 03 / 3 / 2020

## Hyd. No. 1

Inflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 12.80 cfs |
| Storm frequency | = 50 yrs | Time to peak | = 4.10 hrs |
| Time interval | = 6 min | Hyd. volume | = 20,390 cuft |



# Hydrograph Report

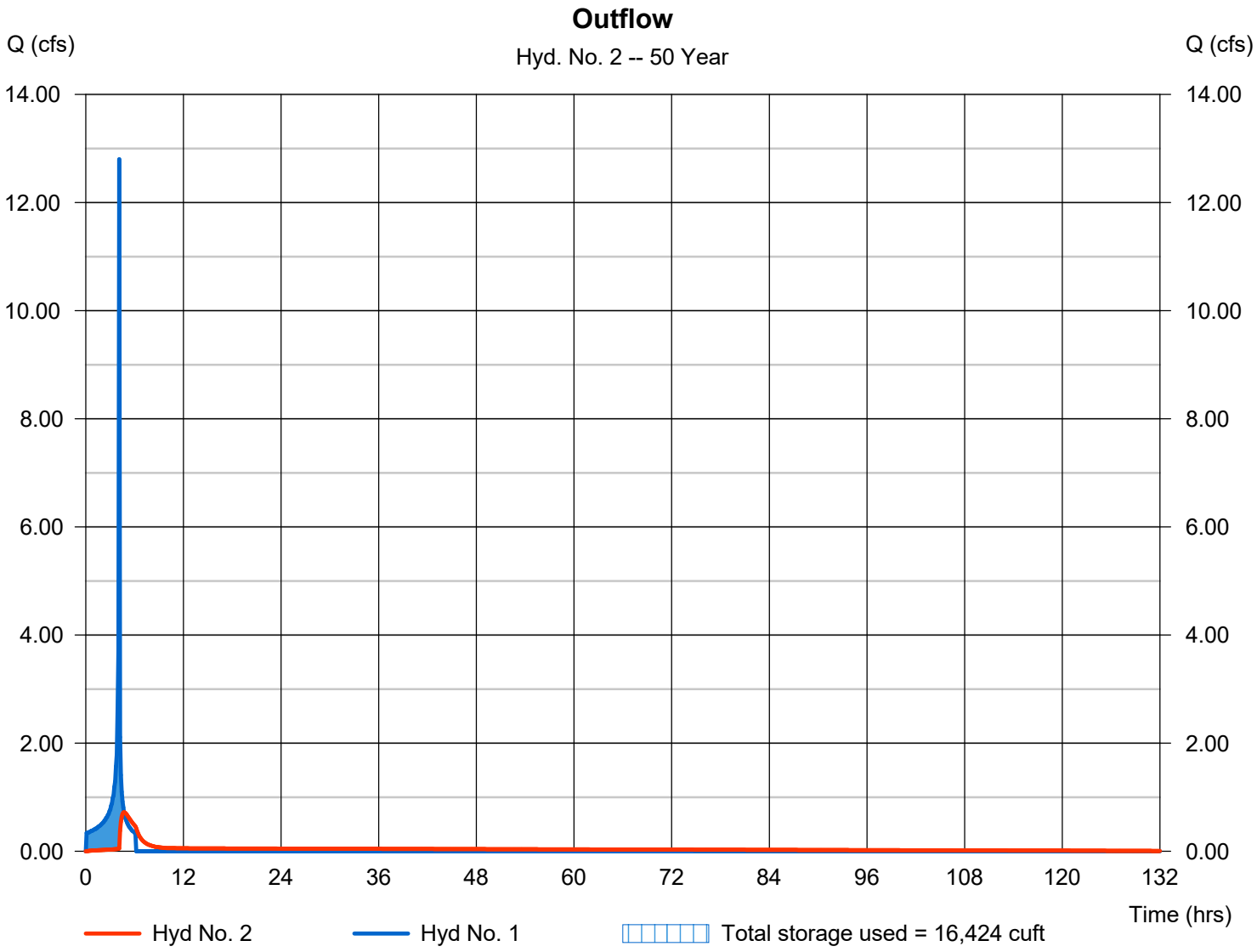
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 03 / 3 / 2020

## Hyd. No. 2

Outflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Reservoir | Peak discharge | = 0.722 cfs |
| Storm frequency | = 50 yrs | Time to peak | = 4.70 hrs |
| Time interval | = 6 min | Hyd. volume | = 20,330 cuft |
| Inflow hyd. No. | = 1 - Inflow | Max. Elevation | = 351.31 ft |
| Reservoir name | = 4' vault | Max. Storage | = 16,424 cuft |

Storage Indication method used.



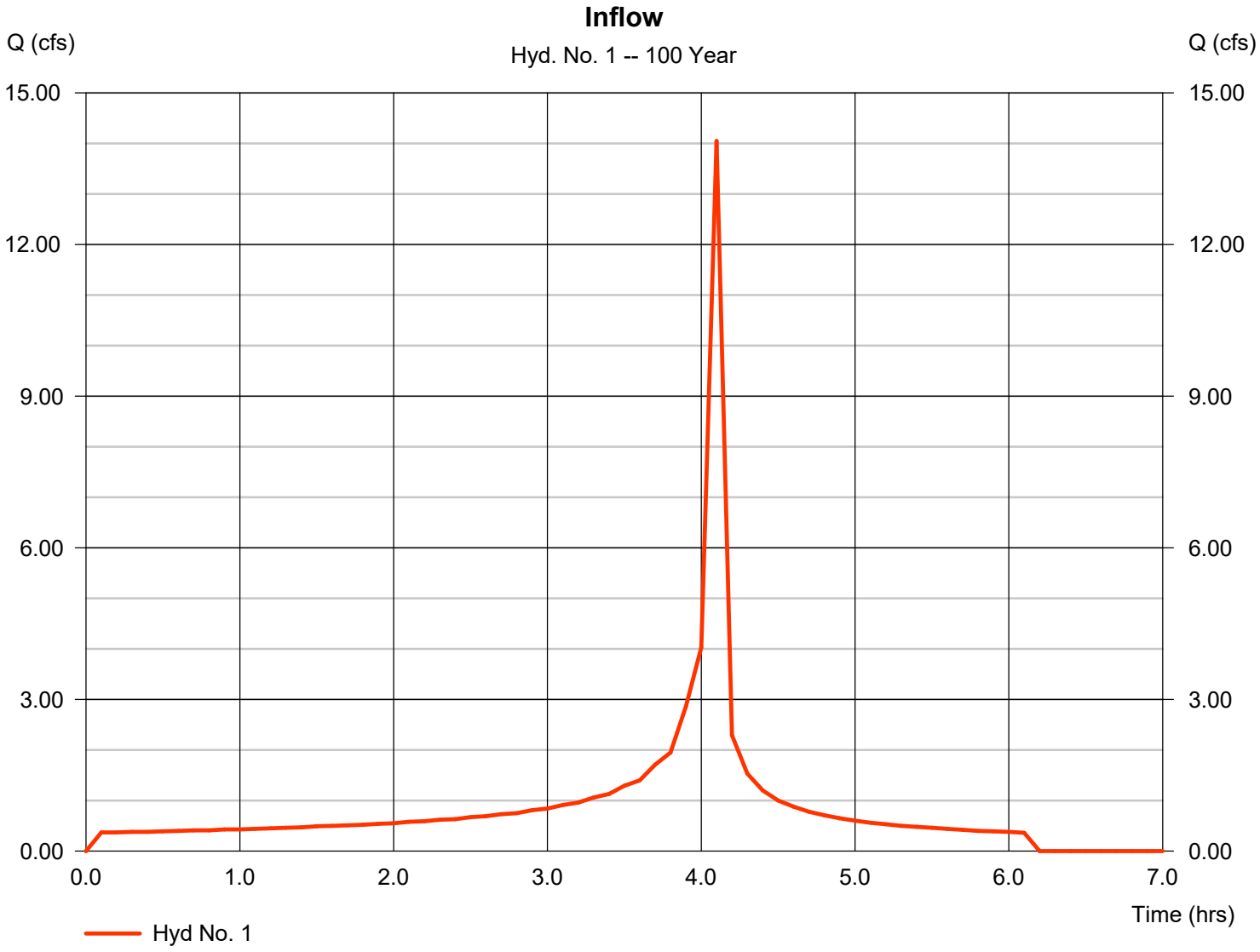
# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Wednesday, 02 / 26 / 2020

## Hyd. No. 1

Inflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Manual | Peak discharge | = 14.05 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 4.10 hrs |
| Time interval | = 6 min | Hyd. volume | = 22,219 cuft |



# Hydrograph Report

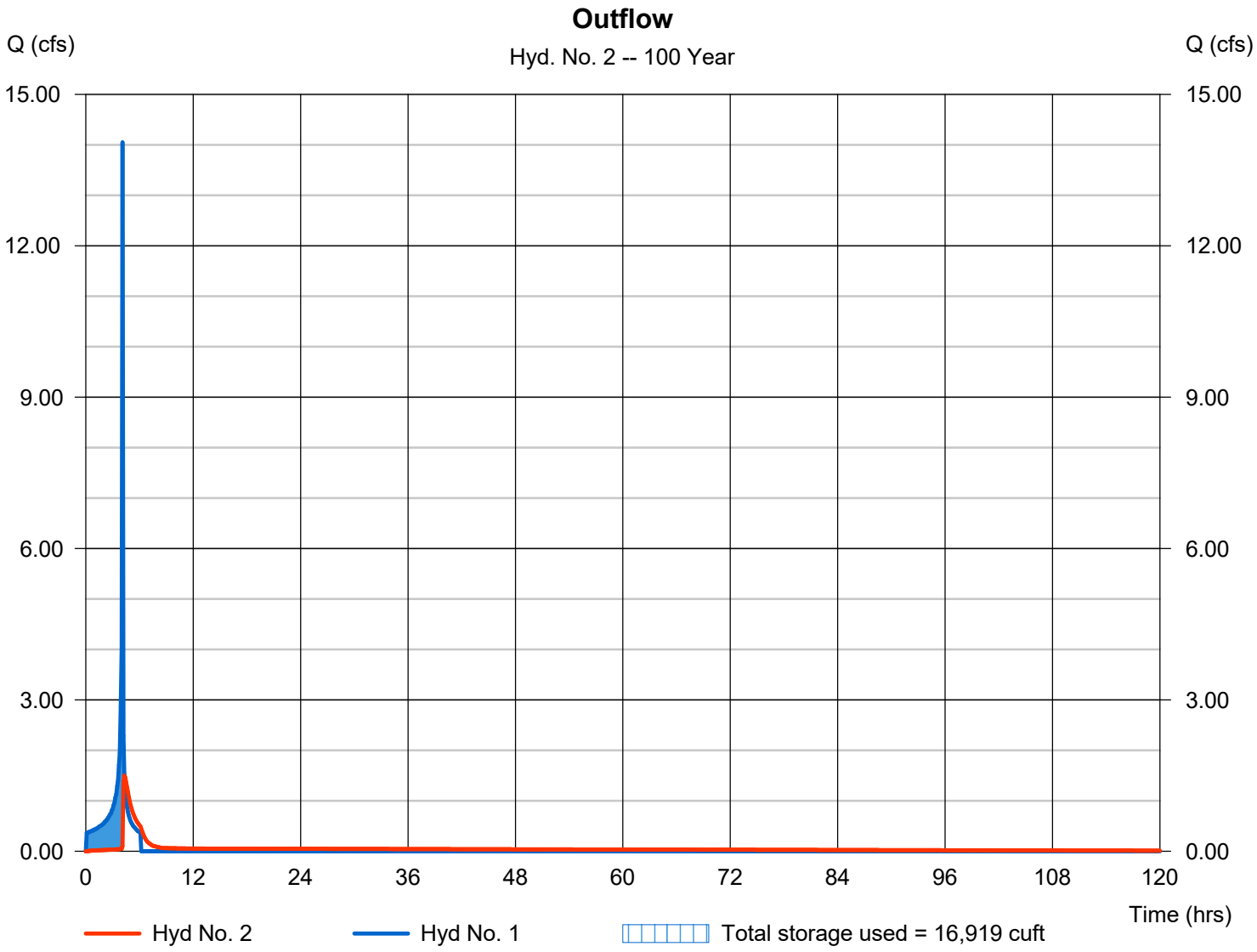
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 03 / 3 / 2020

## Hyd. No. 2

Outflow

| | | | |
|---|---|---|---|
| Hydrograph type | = Reservoir | Peak discharge | = 1.498 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 4.30 hrs |
| Time interval | = 6 min | Hyd. volume | = 22,158 cuft |
| Inflow hyd. No. | = 1 - Inflow | Max. Elevation | = 351.38 ft |
| Reservoir name | = 4' vault | Max. Storage | = 16,919 cuft |

Storage Indication method used.



## CALCULATION AFTER THE DETENTION STRUCTURE

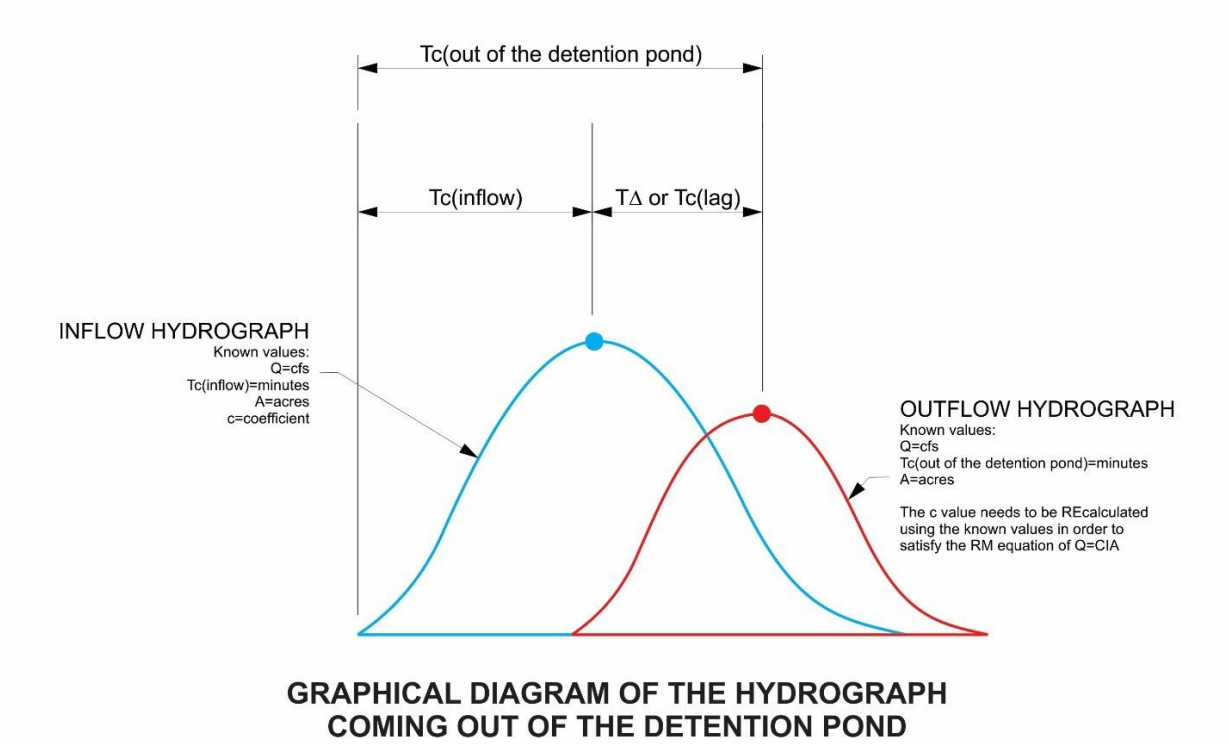
The purpose of the detention structure is to alter the peak flow and or time to peak of a given storm so it will not have a negative impact on the downstream facilities. There are different methods on how to use the resulting values of the outflow hydrograph.

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(outflow). In this interpretation, we will get a Tc that will not match the value of the $Tc_{(out\ of\ the\ detention\ structure)}$ 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 $Tc_{(out\ of\ the\ detention\ structure)}$. 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 TΔ 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 = cfs
- $Tc_{(\text{out of the detention structure})}$ = minutes
- A = acres
- *Please note that c=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 $Tc_{(\text{out of the detention structure})}$ 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 this stage: Q = CIA  I = $7.44P_6D^{-0.645}$

Where:

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

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

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

(minutes) $Tc_{(\text{out of the detention structure})} = Tc_{(\text{inflow})} + T\Delta$ (minutes)
$P_6$ = 6 hour precipitation (inches), known value.
I = intensity (inches/hour), calculated based on the value of $Tc_{(\text{out of the detention structure})}$
A = tributary area of the detention structure (acres),
known value $C_{(\text{outflow})}$ = runoff coefficient (unitless),
value to be solved

# 100 Year

| CALCULATIONS For Nodes 101 to 109; BMP-A | | | |
|---|---|---|---|
| **LINE** | **ITEM** | **AT THE OUTFLOW OF NODE 109** | **REMARKS** |
| 1 | P6 inch | 2.5 | KNOWN VALUE |
| 2 | TC (inflow) mins | 6 | KNOWN VALUE |
| 3 | TC (lag) mins | 12 | FROM THE OUTFLOW HYDROGRAPH |
| 4 | TC (ouflow) mins | 18 | LINE 2+3 |
| 5 | I inches/hour | 2.883 | FROM THE INTENSITY FORMULA |
| 6 | Q(outflow) | 1.498 | KNOWN VALUE |
| 7 | A (inflow=outflow) | 3.005 | KNOWN VALUE |
| 8 | c(inflow) | 0.85 | KNOWN VALUE FROM THE CONTRIBUTING BASIN(S) |
| 9 | c(outflow) | 0.173 | CALCULATED FROM C=Q/IA |

# 50 Year

| CALCULATIONS For Nodes 101 to 109; BMP-A | | | |
|---|---|---|---|
| **LINE** | **ITEM** | **AT THE OUTFLOW OF NODE 109** | **REMARKS** |
| 1 | P6 inch | 2.3 | KNOWN VALUE |
| 2 | TC (inflow) mins | 6 | KNOWN VALUE |
| 3 | TC (lag) mins | 36 | FROM THE OUTFLOW HYDROGRAPH |
| 4 | TC (ouflow) mins | 42 | LINE 2+3 |
| 5 | I inches/hour | 1.536 | FROM THE INTENSITY FORMULA |
| 6 | Q(outflow) | 0.722 | KNOWN VALUE |
| 7 | A (inflow=outflow) | 3.005 | KNOWN VALUE |
| 8 | c(inflow) | 0.85 | KNOWN VALUE FROM THE CONTRIBUTING BASIN(S) |
| 9 | c(outflow) | 0.156 | CALCULATED FROM C=Q/IA |

# 10 Year

| CALCULATIONS For Nodes 101 to 109; BMP-A | | | |
|---|---|---|---|
| LINE | ITEM | AT THE OUTFLOW OF NODE 109 | REMARKS |
| 1 | P6 inch | 1.7 | KNOWN VALUE |
| 2 | TC (inflow) mins | 6 | KNOWN VALUE |
| 3 | TC (lag) mins | 126 | FROM THE OUTFLOW HYDROGRAPH |
| 4 | TC (ouflow) mins | 132 | LINE 2+3 |
| 5 | I inches/hour | 0.542 | FROM THE INTENSITY FORMULA |
| 6 | Q(outflow) | 0.091 | KNOWN VALUE |
| 7 | A (inflow=outflow) | 3.005 | KNOWN VALUE |
| 8 | c(inflow) | 0.85 | KNOWN VALUE FROM THE CONTRIBUTING BASIN(S) |
| 9 | c(outflow) | 0.056 | 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, Tc 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 $Tc_{(\text{out of the detention structure})}$, 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, Tc 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