K&S ENGINEERING, INC.
Planning Engineering Surveying

Preliminary Drainage Study

For

Airway Logistics Center

PTS#665589

Prepared for:

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October 6, 2020

K&S JN 19-045

Kamal S. Sweis RCE 48592

10/06/20
Date

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1 VICINITY MAP

2 INTRODUCTION

THE PROJECT SITE IS LOCATED SOUTH OF THE INTERSECTION OF CENTURION STREET AND AIRWAY ROAD IN OTAY MESA.

THE PROJECT CONSISTS OF GRADING AND DRAINAGE IMPROVEMENTS FOR ONE INDUSTRIAL BUILDING WITH LOADING DOCKS, PARKING, LANDSCAPING, STORM DRAINS AND ONE BIOFILTRATION BMP FOR POLLUTANT CONTROL, HYDROMODIFICATION AND PEAK FLOW DETENTION PURPOSES.

THE SUBJECT REPORT REFLECTS THE PROPOSED PRECISE GRADING AND DRAINAGE AS SHOWN ON PRELIMINARY GRADING PLAN DRAWING PTS# 665589

3 PURPOSE OF THIS STUDY

THE PURPOSE OF THIS STUDY IS TO DETERMINE THE PROPOSED PEAK FLOWS PRODUCED BY THE PROPOSED DEVELOPMENT PROJECT FOR THE 5, 10, 25 AND 50 YEAR STORM EVENTS AS SHOWN ON THE GRADING PLAN FOR THE BADIEE DEVELOPMENT AS WELL AS TO DETERMINE THE PROPOSED PIPE AND INLET SIZES.

MOREOVER, THE PROPOSED PROJECT IS NOT IN THE CLOSE VICINITY OF NAVIGABLE WATERS OR WETLAND. THE PROPOSED CONSTRUCTION AND ANY ASSOCIATED RUNOFF WILL NOT RESULT INTO NAVIGABLE WATERS AND THEREFORE EXEMPT FROM THE REGIONAL WATER QUALITY CONTROL BOARD UNDER FEDERAL CLEAN WATER ACT (CWA) SECTION 401 OR 404.

4 PROJECT INFORMATION

4.1 EXISTING CONDITION

THE EXISTING SITE CONSISTS OF ONE NATURAL LOT. PERCENT IMPERVIOUS FOR THE EXISTING LOT IS 0.45. THE EXISTING SITE CURRENTLY DRAINS TO ONE LOCATION. Q(50) AT NODE 50 IS 21.5 CFS.

4.2 PROPOSED CONDITION

THE PROPOSED LAND USE WILL BE INDUSTRIAL. A RUNOFF COEFFICIENT OF 0.88 WAS USED TO DETERMINE THE PROPOSED RUNOFF FLOWS. THE PROPOSED UNDETAINED Q(50) AT NODE 30 IS 39.2 CFS.

4.3 OFFSITE HYDROLOGY

OFFSITE DRAINAGE ENTERS THE SITE FROM THE EAST FROM AN EXISTING TRUCK PARKING AT TWO CONCENTRATED POINTS. AT ONE LOCATION 23.88 CFS DRAIN INTO THE PROJECT SITE. AT A SECOND LOCATION 21.63 CFS ARE ALSO ACCEPTED BY THE SITE. THESE FLOWS ARE NATURALLY CONVEYED ACROSS THE SITE FROM WEST TO EAST.

USER DEFINED FLOW VALUES WERE USED IN THE HYDROLOGY SOFTWARE.

4.4 DETENTION BASIN METHODOLOGY

SEE SECTION 8 FOR DETENTION BASIN CALCULATIONS. ONE DETENTION BASIN WAS DESIGNED FOR THIS PROJECT USING THE JANUARY 2017 CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL.

THE PURPOSE OF THIS BASIN IS TO TEMPORARILY STORE THE INCREASED RUNOFF AND RELEASE IT AT A RATE EQUAL OR LESS THAN THE EXISTING. HYDROGRAPHS WERE DETERMINED USING THE RATIONAL METHOD DESIGN STORM HYDROGRAPH METHOD. THE DETENTION BASIN SIZE WAS DETERMINED USING THE SINGLE

HYDROGRAPH PROCEDURE AND BY ROUTING THE 5, 10, 25 AND 50-YEAR STORM EVENTS HYDROGRAPHS. THE OUTLET STRUCTURE HAS BEEN SIZED TO DRAIN THE BASIN WITHIN 96 HOURS. ALSO, THIS DETENTION BASIN IS BEING USED IN CONJUNCTION WITH WATER QUALITY TREATMENT AND HYDROMODIFICATION FLOW CONTROL. THE PEAK FLOW ANALYSIS ASSUMMES THAT THE BOTTOM OF THE DETENTION BASIN IS THE WATER QUALITY WATER SURFACE ELEVATON. THE TOP OF THE EMBANKMENT HAS A 1 FOOT FREEBOARD ABOVE THE MAXIMUM WATER SURFACE ELEVATION.

4.5 SUMMARY

IN SHORT, IN ORDER TO MITIGATE THE INCREASED RUNOFF FROM THE EXISTING TO THE PROPOSED CONDITION, A DETENTION BASIN IS PROPOSED IN COMPLIANCE WITH THE OTAY MESA COMUNITY PLAN. PROPOSED FLOWS AFTER ROUTING ARE SMALLER THAN THE EXISTING ONES. ALSO, ULTIMATE RATIONAL METHOD FLOWS WERE USED TO SIZE THE PERMANENT DRAINAGE STRUCTURES PROPOSED BY THIS DEVELOPMENT; THEREFORE, THE PROJECT WOULD NOT CREATE OR CONTRIBUTE RUNOFF WATER WICH WOUL EXCEED THE CAPACIOTY OF ANY EXISTING OR PLANNED STORM WATER DRAINAGE SYSTEM, AND WILL NOT EXPOSED PEOPLE OR STRUCTURE TO A SIGNIFICANT RISK OF LOSS, INJURY OR DEATH INVOLVING FLOODING AS A RESULT OF THE FAILURE OF A LEVEE OR DAM.

THE PROJECT WILL MAINTAIN THE EXISTING DRAINAGE PATERN OF THE SITE AND WILL NOT RESULT IN ANY EROSION OR SILTATION. ALSO, THE PROJECT WILL NOT RESULT IN IN FLOODING ONSITE OR OFFSITE DUE TO THE INSTALLATION OF PEAK FLOW DETENTION BASINS. NO ADVERSE IMPACT WILL OCCUR TO THE DOWNSTREAM PROPERTIES AS RESULT OF THE PROPOSED DEVELOPMENT SINCE THE PROPOSED ARE BEING MITIGATED ON-SITE.

THE FOLLOWING TABLE SUMMARIZES THE EXISTING AND PROPOSED PEAK FLOW RATES FOR THE 5, 10, 50 & 100-YEAR STORM EVENTS AT THE ULTIMATE POINT OF DISCHARGE.PEAK RATIONAL METHOD FLOWS WERE USED TO SIZE ALL DRAINAGE STRUCTURES SUCH AS BROW DITCH, CURB INLETS AND STORM DRAIN PIPES AND DETENTION BASIN STRUCTURES.

PEAK FLOW SUMMARY TABLE

STORM EVENT	EXISTING CONDITION (cfs)	PROPOSED CONDITION BEFORE DETENTION (cfs)	PROPOSED CONDITION AFTER DETENTION (cfs)	RUNOFF RELEASED (ft3)	BASIN VOLUME REQUIRED (ft3)	DETENTION TIME (min)
5-Yr	**15.3**	**27.5**	**14.1**	**57,825**	**11,991**	**1,980**
10-Yr	**17.6**	**31.8**	**14.9**	**60,716**	**13,182**	**1,980**
25-Yr	**19.1**	**34.7**	**16.5**	**73,107**	**15,870**	**1,992**
50-Yr	**21.5**	**39.2**	**17.9**	**83,020**	**18,518**	**1,992**
100-Yr	**22.5**	**41.2**	**20.7**	**92,933**	**21,890**	**1,992**

5. DESIGN CRITERIA AND METHODOLOGY

THIS REPORT WAS PREPARED USING THE CITY OF SAN DIEGO TRANSPORTATION AND STORMWATER DESIGN MANUAL, JANUARY 2017 EDITION.

THE PROPOSED STORM FLOW WERE DETERMINED USING THE RATIONAL METHOD HYDROLOGY PROGRAM CIVILCADD/CIVILDESIGN WHICH IS BASED ON THE CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL DATED 1984. SEE SECTION 4 FOR HYDROLOGY DESIGN MODELS. THE PIPES WERE SIZED USING THE 50 YEAR STORM EVENT. ALSO, INLETS WERE SIZED USING ATTACHED PLATE 2.6-0658

6. HYDROLOGY DESIGN MODELS

A. *DESIGN METHODS*

THE RATIONAL METHOD IS USED IN THIS HYDROLOGY STUDY; THE RATIONAL FORMULA IS AS FOLLOWS:

Q = CIA, WHERE : Q= PEAK DISCHARGE IN CUBIC FEET/SECOND *

C = RUNOFF COEFFICIENT (DIMENSIONLESS)

I = RAINFALL INTENSITY IN INCHES/HOUR

A = TRIBUTARY DRAINAGE AREA IN ACRES

*1 ACRE INCHES/HOUR = 1.008 CUBIC FEET/SEC

THE OVERLAND METHOD IS ALSO USED IN THIS HYDROLOGY STUDY;

THE URBAN AREAS OVERLAND FORMULA IS AS FOLLOWS:

$T=[1.8(1.1-C)(L)^{(.5)})]/[S(100)]^{.333}$

L = LENGTH OF WATERSHED

C = COEFFICIENT OF RUNOFF

T = TIME IN MINUTES

S = DIFFERENCE IN ELEVATION DIVIDED BY DE LENGTH OF WATERSHED

B. *DESIGN CRITERIA*

- FREQUENCY 50 YEAR STORM.
- RAIN FALL INTENSITY PER CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017.

C. *REFERENCES*

- CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017.
- COUNTY OF SAN DIEGO HYDROLOGY MANUAL, JUNE 2003
- HAND BOOK OF HYDRAULICS BY BRATER & KING, SIXTH EDITION.

ENGINEERING & DEVELOPMENT department

NOTICE

CITY OF SAN DIEGO • 1222 FIRST AVENUE, SAN DIEGO, CALIFORNIA 92101

DATE: August 7, 1987

TO: All Private Engineers

FROM: Subdivision Engineer

SUBJECT: DRAINAGE REQUIREMENTS FOR DEVELOPMENTS IN OTAY MESA

In order to minimize the effects of increased storm water runoff in Mexico, due to development of property in Otay Mesa, all property in Otay Mesa that is within the water shed that drains into Mexico, shall be developed with the following requirements:

1. Each property owner shall provide storm water detention facilities so that there will be no increase in the rate of runoff due to development of the property.

2. The detention facilities shall be designed so that the rate of runoff from the property will not be greater after development than it was before development for a 5 year, 10 year, 25 year and 50 year storm.

3. All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q_{100} (existing). Other facilities, except the major channel referred to in paragraph 5, may be designed for Q_{50} (existing).

4. The Drainage Design Manual shall be used as guidelines for design of drainage facilities and computing design discharges.

5. The City Engineer's Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican Border. The preliminary design will include the design "Q" (Q_{100} existing), the invert grade, and the water surface elevation at the major road crossings.

C. R. LOCHHEAD
Subdivision Engineer

7 HYDROLOGY CALCULATIONS

7.1 RATIONAL METHOD CALCULATIONS

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149
2	21.630	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.532(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 15.312(CFS) for 13.440(Ac.)
Total runoff = 60.822(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592
2	21.630	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.913(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 17.620(CFS) for 13.440(Ac.)
Total runoff = 63.130(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845
2	21.630	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.163(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 19.131(CFS) for 13.440(Ac.)
Total runoff = 64.641(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265
2	21.630	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.557(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 21.511(CFS) for 13.440(Ac.)
Total runoff = 67.021(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 07/17/20

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

Program License Serial Number 4035

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.39(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

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

1 23.880 5.00 4.389
Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.39(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.389
2	21.630	5.00	4.389

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:

```
      45.510       45.510
Area of streams before confluence:
       7.570       16.520
Results of confluence:
Total flow rate =     45.510(CFS)
Time of concentration =     5.000 min.
Effective stream area after confluence =     24.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____________________________________________________________________________
Upstream point elevation =   481.200(Ft.)
Downstream point elevation =   474.600(Ft.)
Channel length thru subarea  =   475.000(Ft.)
Channel base width           =    0.000(Ft.)
Slope or 'Z' of left channel bank =  80.000
Slope or 'Z' of right channel bank =  80.000
Estimated mean flow rate at midpoint of channel =     58.205(CFS)
Manning's 'N'    = 0.023
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     58.205(CFS)
Depth of flow =   0.493(Ft.), Average velocity =   2.994(Ft/s)
Channel flow top width =   78.876(Ft.)
Flow Velocity =    2.99(Ft/s)
Travel time  =    2.64 min.
Time of concentration =    7.64 min.
Critical depth =      0.504(Ft.)
 Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      3.722(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     22.509(CFS) for   13.440(Ac.)
Total runoff =     68.019(CFS)          Total area =       37.53(Ac.)
End of computations, total study area =          37.530 (Ac.)
```

WEIGHTED RUNOFF COEFFICIENT
PROPOSED CONDITION

$$C_W = \frac{A_I C_I + A_P C_P}{A_T}$$

$$C_W = \frac{(513{,}735)\ (0.95)\ +(71{,}872)\ (0.45)}{585{,}607} \qquad C_W = 0.88$$

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.208(CFS) for 0.120(Ac.)
Total runoff = 24.088(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.088(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829

Qmax(1) =
1.000 * 1.000 * 24.088) + = 24.088

Total of 1 streams to confluence:
Flow rates before confluence point:
24.088
Maximum flow rates at confluence using above data:
24.088
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.088(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.261(CFS) for 0.150(Ac.)

Total runoff = 21.891(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.891(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.912(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.287(Ft.)
Minor friction loss = 0.905(Ft.) K-factor = 1.20
Pipe flow velocity = 6.97(Ft/s)
Travel time through pipe = 1.10 min.
Time of concentration (TC) = 15.88 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.891(CFS)
Time of concentration = 15.88 min.
Rainfall intensity = 1.765(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829
2	21.891	15.88	1.765

Qmax(1) =
1.000 * 1.000 * 24.088) +
1.000 * 0.931 * 21.891) + = 44.469
Qmax(2) =
0.965 * 1.000 * 24.088) +
1.000 * 1.000 * 21.891) + = 45.135

Total of 2 streams to confluence:
Flow rates before confluence point:
24.088 21.891
Maximum flow rates at confluence using above data:
44.469 45.135
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.135(CFS)
Time of concentration = 15.875 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.135(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.045(CFS)
Normal flow depth in pipe = 16.29(In.)
Flow top width inside pipe = 22.41(In.)
Critical Depth = 16.78(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.59 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 28.13(In.)
Flow top width inside pipe = 29.76(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 27.75(In.)
Flow top width inside pipe = 30.26(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 2.989(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.605(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.605(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.605(CFS)
Normal flow depth in pipe = 4.29(In.)
Flow top width inside pipe = 9.90(In.)
Critical Depth = 4.09(In.)
Pipe flow velocity = 2.70(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 6.81 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.81 min.
Rainfall intensity = 2.684(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.031(CFS) for 0.860(Ac.)
Total runoff = 2.636(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 7.64 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.18(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.86(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 8.48 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.23(In.)
Flow top width inside pipe = 14.93(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.82(Ft/s)
Travel time through pipe = 0.20 min.
Time of concentration (TC) = 8.68 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.276(CFS) for 0.610(Ac.)
Total runoff = 3.912(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.167(CFS) for 0.080(Ac.)
Total runoff = 4.079(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.042(CFS) for 0.020(Ac.)
Total runoff = 4.121(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.121(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.121(CFS)
Normal flow depth in pipe = 9.69(In.)
Flow top width inside pipe = 17.95(In.)
Critical Depth = 9.32(In.)
Pipe flow velocity = 4.24(Ft/s)
Travel time through pipe = 0.10 min.
Time of concentration (TC) = 8.78 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.494(CFS) for 1.680(Ac.)
Total runoff = 7.615(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.931(CFS) for 1.890(Ac.)
Total runoff = 11.546(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.

Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.388(CFS) for 2.110(Ac.)
Total runoff = 15.934(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.431(CFS) for 1.650(Ac.)
Total runoff = 19.365(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.099(CFS) for 1.490(Ac.)
Total runoff = 22.464(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.373(CFS) for 0.660(Ac.)
Total runoff = 23.837(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 23.837(CFS)
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363

Qmax(1) =

1.000 * 1.000 * 23.837) + = 23.837

Total of 1 main streams to confluence:
Flow rates before confluence point:
23.837
Maximum flow rates at confluence using above data:
23.837
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 23.837(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.637(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.637(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.637(CFS)
Normal flow depth in pipe = 4.49(In.)
Flow top width inside pipe = 9.95(In.)
Critical Depth = 4.21(In.)
Pipe flow velocity = 2.69(Ft/s)
Travel time through pipe = 1.44 min.
Time of concentration (TC) = 6.44 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.44 min.
Rainfall intensity = 2.761(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.802(CFS) for 0.330(Ac.)
Total runoff = 1.439(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.439(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.439(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 11.96(In.)
Critical Depth = 6.10(In.)
Pipe flow velocity = 3.33(Ft/s)
Travel time through pipe = 2.08 min.
Time of concentration (TC) = 8.53 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.439(CFS)
Time of concentration = 8.53 min.
Rainfall intensity = 2.397(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) + = 25.255
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) + = 24.600

Total of 2 main streams to confluence:
Flow rates before confluence point:
23.837 1.439
Maximum flow rates at confluence using above data:
25.255 24.600
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 25.255(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 2.964(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.391(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.391(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.196(CFS)
Normal flow depth in pipe = 2.98(In.)
Flow top width inside pipe = 6.00(In.)
Critical Depth = 2.66(In.)
Pipe flow velocity = 2.02(Ft/s)
Travel time through pipe = 2.07 min.
Time of concentration (TC) = 7.68 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.68 min.
Rainfall intensity = 2.525(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.467(CFS) for 0.660(Ac.)
Total runoff = 1.858(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.858(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 1.858(CFS)
Normal flow depth in pipe = 6.66(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 6.50(In.)
Pipe flow velocity = 3.53(Ft/s)
Travel time through pipe = 1.89 min.
Time of concentration (TC) = 9.57 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.398(CFS) for 0.200(Ac.)
Total runoff = 2.256(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.159(CFS) for 0.080(Ac.)
Total runoff = 2.416(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.416(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.416(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 14.86(In.)
Critical Depth = 7.46(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.63 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.416(CFS)
Time of concentration = 9.63 min.
Rainfall intensity = 2.258(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397
3	2.416	9.63	2.258

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) +
1.000 * 0.912 * 2.416) + = 27.458
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) +
1.000 * 0.886 * 2.416) + = 26.740
Qmax(3) =
0.955 * 1.000 * 23.837) +
0.942 * 1.000 * 1.439) +
1.000 * 1.000 * 2.416) + = 26.544

Total of 3 main streams to confluence:
Flow rates before confluence point:
23.837 1.439 2.416
Maximum flow rates at confluence using above data:
27.458 26.740 26.544
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 27.458(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.554(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.243(CFS) for 0.120(Ac.)
Total runoff = 24.123(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.123(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135

Qmax(1) =
1.000 * 1.000 * 24.123) + = 24.123

Total of 1 streams to confluence:
Flow rates before confluence point:
24.123
Maximum flow rates at confluence using above data:
24.123
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.123(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.304(CFS) for 0.150(Ac.)

Total runoff = 21.934(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.934(CFS)
Given pipe size = 24.00(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 = 4.304(Ft.)
Minor friction loss = 0.908(Ft.) K-factor = 1.20
Pipe flow velocity = 6.98(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.934(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.063(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135
2	21.934	15.87	2.063

Qmax(1) =
1.000 * 1.000 * 24.123) +
1.000 * 0.931 * 21.934) + = 44.547
Qmax(2) =
0.966 * 1.000 * 24.123) +
1.000 * 1.000 * 21.934) + = 45.247

Total of 2 streams to confluence:
Flow rates before confluence point:
24.123 21.934
Maximum flow rates at confluence using above data:
44.547 45.247
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.247(CFS)
Time of concentration = 15.873 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.247(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.082(CFS)
Normal flow depth in pipe = 16.31(In.)
Flow top width inside pipe = 22.40(In.)
Critical Depth = 16.80(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 28.22(In.)
Flow top width inside pipe = 29.64(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 27.84(In.)
Flow top width inside pipe = 30.14(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.416(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.691(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.691(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.691(CFS)
Normal flow depth in pipe = 4.63(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.39(In.)
Pipe flow velocity = 2.80(Ft/s)
Travel time through pipe = 1.24 min.
Time of concentration (TC) = 6.76 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.76 min.
Rainfall intensity = 3.091(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.339(CFS) for 0.860(Ac.)
Total runoff = 3.030(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.94(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.97(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 7.57 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.93(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.98(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 8.39 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.99(In.)
Flow top width inside pipe = 14.70(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.95(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.58 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.480(CFS) for 0.610(Ac.)
Total runoff = 4.511(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.194(CFS) for 0.080(Ac.)
Total runoff = 4.705(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.049(CFS) for 0.020(Ac.)
Total runoff = 4.753(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.753(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.753(CFS)
Normal flow depth in pipe = 10.61(In.)
Flow top width inside pipe = 17.71(In.)
Critical Depth = 10.05(In.)
Pipe flow velocity = 4.39(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.67 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.056(CFS) for 1.680(Ac.)
Total runoff = 8.809(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.563(CFS) for 1.890(Ac.)
Total runoff = 13.372(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.

Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.094(CFS) for 2.110(Ac.)
Total runoff = 18.466(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.984(CFS) for 1.650(Ac.)
Total runoff = 22.450(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.597(CFS) for 1.490(Ac.)
Total runoff = 26.047(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.593(CFS) for 0.660(Ac.)
Total runoff = 27.641(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 27.641(CFS)
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743

Qmax(1) =

1.000 * 1.000 * 27.641) + = 27.641

Total of 1 main streams to confluence:
Flow rates before confluence point:
27.641
Maximum flow rates at confluence using above data:
27.641
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 27.641(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.727(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.727(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.727(CFS)
Normal flow depth in pipe = 4.84(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.51(In.)
Pipe flow velocity = 2.78(Ft/s)
Travel time through pipe = 1.40 min.
Time of concentration (TC) = 6.40 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.40 min.
Rainfall intensity = 3.177(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.922(CFS) for 0.330(Ac.)
Total runoff = 1.650(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.650(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.650(CFS)
Normal flow depth in pipe = 7.05(In.)
Flow top width inside pipe = 11.81(In.)
Critical Depth = 6.55(In.)
Pipe flow velocity = 3.43(Ft/s)
Travel time through pipe = 2.02 min.
Time of concentration (TC) = 8.42 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.650(CFS)
Time of concentration = 8.42 min.
Rainfall intensity = 2.783(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) + = 29.267
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) + = 28.475

Total of 2 main streams to confluence:
Flow rates before confluence point:
27.641 1.650
Maximum flow rates at confluence using above data:
29.267 28.475
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 29.267(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.388(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.447(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.447(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.224(CFS)
Normal flow depth in pipe = 3.22(In.)
Flow top width inside pipe = 5.98(In.)
Critical Depth = 2.85(In.)
Pipe flow velocity = 2.08(Ft/s)
Travel time through pipe = 2.00 min.
Time of concentration (TC) = 7.62 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.62 min.
Rainfall intensity = 2.918(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.695(CFS) for 0.660(Ac.)
Total runoff = 2.142(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.142(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.142(CFS)
Normal flow depth in pipe = 7.22(In.)
Flow top width inside pipe = 14.99(In.)
Critical Depth = 7.01(In.)
Pipe flow velocity = 3.67(Ft/s)
Travel time through pipe = 1.82 min.
Time of concentration (TC) = 9.44 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.464(CFS) for 0.200(Ac.)
Total runoff = 2.606(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.186(CFS) for 0.080(Ac.)
Total runoff = 2.791(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.791(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.791(CFS)
Normal flow depth in pipe = 7.03(In.)
Flow top width inside pipe = 14.97(In.)
Critical Depth = 8.05(In.)
Pipe flow velocity = 4.94(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.49 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.791(CFS)
Time of concentration = 9.49 min.
Rainfall intensity = 2.629(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783
3	2.791	9.49	2.629

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) +
1.000 * 0.914 * 2.791) + = 31.817
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) +
1.000 * 0.887 * 2.791) + = 30.950
Qmax(3) =
0.958 * 1.000 * 27.641) +
0.945 * 1.000 * 1.650) +
1.000 * 1.000 * 2.791) + = 30.836

Total of 3 main streams to confluence:
Flow rates before confluence point:
27.641 1.650 2.791
Maximum flow rates at confluence using above data:
31.817 30.950 30.836
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 31.817(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.632(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.270(CFS) for 0.120(Ac.)
Total runoff = 24.150(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.150(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372

Qmax(1) =
1.000 * 1.000 * 24.150) + = 24.150

Total of 1 streams to confluence:
Flow rates before confluence point:
24.150
Maximum flow rates at confluence using above data:
24.150
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.150(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.338(CFS) for 0.150(Ac.)

Total runoff = 21.968(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.968(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.949(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.317(Ft.)
Minor friction loss = 0.911(Ft.) K-factor = 1.20
Pipe flow velocity = 6.99(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.968(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.297(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372
2	21.968	15.87	2.297

Qmax(1) =
1.000 * 1.000 * 24.150) +
1.000 * 0.931 * 21.968) + = 44.608
Qmax(2) =
0.969 * 1.000 * 24.150) +
1.000 * 1.000 * 21.968) + = 45.359

Total of 2 streams to confluence:
Flow rates before confluence point:
24.150 21.968
Maximum flow rates at confluence using above data:
44.608 45.359
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.359(CFS)
Time of concentration = 15.872 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.359(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.120(CFS)
Normal flow depth in pipe = 16.34(In.)
Flow top width inside pipe = 22.38(In.)
Critical Depth = 16.82(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 28.27(In.)
Flow top width inside pipe = 29.57(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 27.89(In.)
Flow top width inside pipe = 30.08(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.668(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.742(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.742(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.742(CFS)
Normal flow depth in pipe = 4.82(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.55(In.)
Pipe flow velocity = 2.85(Ft/s)
Travel time through pipe = 1.22 min.
Time of concentration (TC) = 6.74 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.74 min.
Rainfall intensity = 3.347(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.533(CFS) for 0.860(Ac.)
Total runoff = 3.275(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.41(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.04(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.40(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.05(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 8.34 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.47(In.)
Flow top width inside pipe = 14.47(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.01(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.618(CFS) for 0.610(Ac.)
Total runoff = 4.893(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.212(CFS) for 0.080(Ac.)
Total runoff = 5.106(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.053(CFS) for 0.020(Ac.)
Total runoff = 5.159(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.159(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.159(CFS)
Normal flow depth in pipe = 11.19(In.)
Flow top width inside pipe = 17.46(In.)
Critical Depth = 10.49(In.)
Pipe flow velocity = 4.47(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.62 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.436(CFS) for 1.680(Ac.)
Total runoff = 9.595(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.990(CFS) for 1.890(Ac.)
Total runoff = 14.585(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.

Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.571(CFS) for 2.110(Ac.)
Total runoff = 20.156(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.357(CFS) for 1.650(Ac.)
Total runoff = 24.513(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.934(CFS) for 1.490(Ac.)
Total runoff = 28.447(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.743(CFS) for 0.660(Ac.)
Total runoff = 30.190(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 30.190(CFS)
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000

Qmax(1) =

```
            1.000 *    1.000 *    30.190) + =      30.190

Total of 1 main streams to confluence:
Flow rates before confluence point:
     30.190
Maximum flow rates at confluence using above data:
      30.190
Area of streams before confluence:
      11.280


Results of confluence:
Total flow rate =     30.190(CFS)
Time of concentration =     8.617 min.
Effective stream area after confluence  =     11.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
_____________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 100.000^.5)/(   0.500^(1/3)]=   4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      3.845(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.778(CFS)
Total initial stream area =        0.230(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________________
Upstream point/station elevation =   482.250(Ft.)
Downstream point/station elevation =   481.100(Ft.)
Pipe length  =   233.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.778(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.778(CFS)
Normal flow depth in pipe =    5.03(In.)
Flow top width inside pipe =   10.00(In.)
Critical Depth =    4.68(In.)
Pipe flow velocity =      2.83(Ft/s)
Travel time through pipe =    1.37 min.
Time of concentration (TC) =     6.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
```

Time of concentration = 6.37 min.
Rainfall intensity = 3.433(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.997(CFS) for 0.330(Ac.)
Total runoff = 1.775(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.775(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.775(CFS)
Normal flow depth in pipe = 7.41(In.)
Flow top width inside pipe = 11.67(In.)
Critical Depth = 6.80(In.)
Pipe flow velocity = 3.49(Ft/s)
Travel time through pipe = 1.99 min.
Time of concentration (TC) = 8.36 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.775(CFS)
Time of concentration = 8.36 min.
Rainfall intensity = 3.041(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) + = 31.942
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) + = 31.062

Total of 2 main streams to confluence:
Flow rates before confluence point:
30.190 1.775
Maximum flow rates at confluence using above data:
31.942 31.062
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 31.942(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.640(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.480(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.480(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.240(CFS)
Normal flow depth in pipe = 3.38(In.)
Flow top width inside pipe = 5.95(In.)
Critical Depth = 2.96(In.)
Pipe flow velocity = 2.12(Ft/s)
Travel time through pipe = 1.97 min.
Time of concentration (TC) = 7.58 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.58 min.
Rainfall intensity = 3.175(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.844(CFS) for 0.660(Ac.)
Total runoff = 2.324(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.324(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.324(CFS)
Normal flow depth in pipe = 7.57(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 7.31(In.)
Pipe flow velocity = 3.74(Ft/s)
Travel time through pipe = 1.79 min.
Time of concentration (TC) = 9.37 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.509(CFS) for 0.200(Ac.)
Total runoff = 2.833(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.204(CFS) for 0.080(Ac.)
Total runoff = 3.037(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.037(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.037(CFS)
Normal flow depth in pipe = 7.38(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 8.41(In.)
Pipe flow velocity = 5.05(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.42 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.037(CFS)
Time of concentration = 9.42 min.
Rainfall intensity = 2.886(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041
3	3.037	9.42	2.886

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) +
1.000 * 0.915 * 3.037) + = 34.720
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) +
1.000 * 0.888 * 3.037) + = 33.758
Qmax(3) =
0.962 * 1.000 * 30.190) +
0.949 * 1.000 * 1.775) +
1.000 * 1.000 * 3.037) + = 33.763

Total of 3 main streams to confluence:
Flow rates before confluence point:
30.190 1.775 3.037
Maximum flow rates at confluence using above data:
34.720 33.758 33.763
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 34.720(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.677(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.310(CFS) for 0.120(Ac.)
Total runoff = 24.190(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.190(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724

Qmax(1) =
1.000 * 1.000 * 24.190) + = 24.190

Total of 1 streams to confluence:
Flow rates before confluence point:
24.190
Maximum flow rates at confluence using above data:
24.190
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.190(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.388(CFS) for 0.150(Ac.)

Total runoff = 22.018(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.018(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.972(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.337(Ft.)
Minor friction loss = 0.915(Ft.) K-factor = 1.20
Pipe flow velocity = 7.01(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.018(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.643(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724
2	22.018	15.87	2.643

Qmax(1) =
1.000 * 1.000 * 24.190) +
1.000 * 0.931 * 22.018) + = 44.697
Qmax(2) =
0.971 * 1.000 * 24.190) +
1.000 * 1.000 * 22.018) + = 45.495

Total of 2 streams to confluence:
Flow rates before confluence point:
24.190 22.018
Maximum flow rates at confluence using above data:
44.697 45.495
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.495(CFS)
Time of concentration = 15.869 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.495(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.165(CFS)
Normal flow depth in pipe = 16.38(In.)
Flow top width inside pipe = 22.34(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 28.36(In.)
Flow top width inside pipe = 29.44(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 27.98(In.)
Flow top width inside pipe = 29.95(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.081(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.826(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.826(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.826(CFS)
Normal flow depth in pipe = 5.13(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.82(In.)
Pipe flow velocity = 2.93(Ft/s)
Travel time through pipe = 1.18 min.
Time of concentration (TC) = 6.71 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.71 min.
Rainfall intensity = 3.755(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.842(CFS) for 0.860(Ac.)
Total runoff = 3.668(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.20(In.)
Flow top width inside pipe = 14.00(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 7.49 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.17(In.)
Flow top width inside pipe = 14.02(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.14(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.27 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.27(In.)
Flow top width inside pipe = 13.94(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.10(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.45 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.832(CFS) for 0.610(Ac.)
Total runoff = 5.500(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.240(CFS) for 0.080(Ac.)
Total runoff = 5.740(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.060(CFS) for 0.020(Ac.)
Total runoff = 5.800(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.800(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.800(CFS)
Normal flow depth in pipe = 12.14(In.)
Flow top width inside pipe = 16.87(In.)
Critical Depth = 11.15(In.)
Pipe flow velocity = 4.57(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.54 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.025(CFS) for 1.680(Ac.)
Total runoff = 10.825(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.653(CFS) for 1.890(Ac.)
Total runoff = 16.478(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.

Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.311(CFS) for 2.110(Ac.)
Total runoff = 22.789(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.935(CFS) for 1.650(Ac.)
Total runoff = 27.724(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.457(CFS) for 1.490(Ac.)
Total runoff = 32.181(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.974(CFS) for 0.660(Ac.)
Total runoff = 34.155(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 34.155(CFS)
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399

Qmax(1) =

1.000 * 1.000 * 34.155) + = 34.155

Total of 1 main streams to confluence:
Flow rates before confluence point:
34.155
Maximum flow rates at confluence using above data:
34.155
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 34.155(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.863(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.863(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.863(CFS)
Normal flow depth in pipe = 5.36(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.93(In.)
Pipe flow velocity = 2.90(Ft/s)
Travel time through pipe = 1.34 min.
Time of concentration (TC) = 6.34 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.34 min.
Rainfall intensity = 3.847(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.117(CFS) for 0.330(Ac.)
Total runoff = 1.980(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.980(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.980(CFS)
Normal flow depth in pipe = 7.99(In.)
Flow top width inside pipe = 11.32(In.)
Critical Depth = 7.21(In.)
Pipe flow velocity = 3.57(Ft/s)
Travel time through pipe = 1.94 min.
Time of concentration (TC) = 8.28 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.980(CFS)
Time of concentration = 8.28 min.
Rainfall intensity = 3.442(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) + = 36.110
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) + = 35.086

Total of 2 main streams to confluence:
Flow rates before confluence point:
34.155 1.980
Maximum flow rates at confluence using above data:
36.110 35.086
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 36.110(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.052(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.535(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.535(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.267(CFS)
Normal flow depth in pipe = 3.61(In.)
Flow top width inside pipe = 5.87(In.)
Critical Depth = 3.13(In.)
Pipe flow velocity = 2.17(Ft/s)
Travel time through pipe = 1.92 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.54 min.
Rainfall intensity = 3.578(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.078(CFS) for 0.660(Ac.)
Total runoff = 2.613(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.613(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.613(CFS)
Normal flow depth in pipe = 8.12(In.)
Flow top width inside pipe = 14.95(In.)
Critical Depth = 7.77(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 1.74 min.
Time of concentration (TC) = 9.27 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.579(CFS) for 0.200(Ac.)
Total runoff = 3.192(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.232(CFS) for 0.080(Ac.)
Total runoff = 3.423(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.423(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.423(CFS)
Normal flow depth in pipe = 7.92(In.)
Flow top width inside pipe = 14.98(In.)
Critical Depth = 8.95(In.)
Pipe flow velocity = 5.20(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.32 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.423(CFS)
Time of concentration = 9.32 min.
Rainfall intensity = 3.282(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442
3	3.423	9.32	3.282

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) +
1.000 * 0.917 * 3.423) + = 39.248
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) +
1.000 * 0.889 * 3.423) + = 38.127
Qmax(3) =
0.966 * 1.000 * 34.155) +
0.953 * 1.000 * 1.980) +
1.000 * 1.000 * 3.423) + = 38.288

Total of 3 main streams to confluence:
Flow rates before confluence point:
34.155 1.980 3.423
Maximum flow rates at confluence using above data:
39.248 38.127 38.288
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 39.248(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.751(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 07/18/20

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

Program License Serial Number 4035

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.922(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.92(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.333(CFS) for 0.120(Ac.)
Total runoff = 24.213(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.213(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.213	14.78	2.922

Qmax(1) =
1.000 * 1.000 * 24.213) + = 24.213

Total of 1 streams to confluence:
Flow rates before confluence point:
24.213
Maximum flow rates at confluence using above data:
24.213
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.213(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.922(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.92(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.416(CFS) for 0.150(Ac.)

Total runoff = 22.046(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.046(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.986(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.348(Ft.)
Minor friction loss = 0.918(Ft.) K-factor = 1.20
Pipe flow velocity = 7.02(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.046(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.842(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.213	14.78	2.922
2	22.046	15.87	2.842

Qmax(1) =
1.000 * 1.000 * 24.213) +
1.000 * 0.931 * 22.046) + = 44.748
Qmax(2) =
0.973 * 1.000 * 24.213) +
1.000 * 1.000 * 22.046) + = 45.599

Total of 2 streams to confluence:
Flow rates before confluence point:
24.213 22.046
Maximum flow rates at confluence using above data:
44.748 45.599
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.599(CFS)
Time of concentration = 15.868 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.599(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.200(CFS)
Normal flow depth in pipe = 16.41(In.)
Flow top width inside pipe = 22.32(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.599(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.599(CFS)
Normal flow depth in pipe = 28.41(In.)
Flow top width inside pipe = 29.37(In.)
Critical Depth = 26.41(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.599(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.599(CFS)
Normal flow depth in pipe = 28.03(In.)
Flow top width inside pipe = 29.89(In.)
Critical Depth = 26.41(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.12 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.215(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.853(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.853(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.853(CFS)
Normal flow depth in pipe = 5.24(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.90(In.)
Pipe flow velocity = 2.95(Ft/s)
Travel time through pipe = 1.17 min.
Time of concentration (TC) = 6.70 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.70 min.
Rainfall intensity = 3.911(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.960(CFS) for 0.860(Ac.)
Total runoff = 3.813(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.50(In.)
Flow top width inside pipe = 13.75(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.16(Ft/s)
Travel time through pipe = 0.77 min.
Time of concentration (TC) = 7.47 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.48(In.)
Flow top width inside pipe = 13.77(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.17(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.25 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.57(In.)
Flow top width inside pipe = 13.69(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.43 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.927(CFS) for 0.610(Ac.)
Total runoff = 5.740(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.253(CFS) for 0.080(Ac.)
Total runoff = 5.993(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.063(CFS) for 0.020(Ac.)
Total runoff = 6.056(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.056(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 6.056(CFS)
Normal flow depth in pipe = 12.54(In.)
Flow top width inside pipe = 16.55(In.)
Critical Depth = 11.40(In.)
Pipe flow velocity = 4.61(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.286(CFS) for 1.680(Ac.)
Total runoff = 11.342(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.947(CFS) for 1.890(Ac.)
Total runoff = 17.289(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.

Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.640(CFS) for 2.110(Ac.)
Total runoff = 23.929(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.192(CFS) for 1.650(Ac.)
Total runoff = 29.121(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.689(CFS) for 1.490(Ac.)
Total runoff = 33.810(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.077(CFS) for 0.660(Ac.)
Total runoff = 35.886(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 35.886(CFS)
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576

Qmax(1) =

1.000 * 1.000 * 35.886) + = 35.886

Total of 1 main streams to confluence:
Flow rates before confluence point:
35.886
Maximum flow rates at confluence using above data:
35.886
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 35.886(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.888(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.888(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.888(CFS)
Normal flow depth in pipe = 5.45(In.)
Flow top width inside pipe = 9.96(In.)
Critical Depth = 5.01(In.)
Pipe flow velocity = 2.92(Ft/s)
Travel time through pipe = 1.33 min.
Time of concentration (TC) = 6.33 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.33 min.
Rainfall intensity = 3.997(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.161(CFS) for 0.330(Ac.)
Total runoff = 2.049(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.049(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 2.049(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 11.17(In.)
Critical Depth = 7.33(In.)
Pipe flow velocity = 3.59(Ft/s)
Travel time through pipe = 1.93 min.
Time of concentration (TC) = 8.26 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 2.049(CFS)
Time of concentration = 8.26 min.
Rainfall intensity = 3.617(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576
2	2.049	8.26	3.617

Qmax(1) =
1.000 * 1.000 * 35.886) +
0.989 * 1.000 * 2.049) + = 37.912
Qmax(2) =
1.000 * 0.969 * 35.886) +
1.000 * 1.000 * 2.049) + = 36.835

Total of 2 main streams to confluence:
Flow rates before confluence point:
35.886 2.049
Maximum flow rates at confluence using above data:
37.912 36.835
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 37.912(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.188(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.553(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.553(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.276(CFS)
Normal flow depth in pipe = 3.68(In.)
Flow top width inside pipe = 5.84(In.)
Critical Depth = 3.18(In.)
Pipe flow velocity = 2.18(Ft/s)
Travel time through pipe = 1.91 min.
Time of concentration (TC) = 7.52 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.52 min.
Rainfall intensity = 3.744(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.174(CFS) for 0.660(Ac.)
Total runoff = 2.727(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.727(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.727(CFS)
Normal flow depth in pipe = 8.34(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 7.96(In.)
Pipe flow velocity = 3.89(Ft/s)
Travel time through pipe = 1.72 min.
Time of concentration (TC) = 9.24 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.24 min.
Rainfall intensity = 3.472(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.611(CFS) for 0.200(Ac.)
Total runoff = 3.338(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.24 min.
Rainfall intensity = 3.472(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.244(CFS) for 0.080(Ac.)
Total runoff = 3.583(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.583(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.583(CFS)
Normal flow depth in pipe = 8.14(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 9.18(In.)
Pipe flow velocity = 5.26(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.29 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.583(CFS)
Time of concentration = 9.29 min.
Rainfall intensity = 3.465(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576
2	2.049	8.26	3.617
3	3.583	9.29	3.465

Qmax(1) =
1.000 * 1.000 * 35.886) +
0.989 * 1.000 * 2.049) +
1.000 * 0.917 * 3.583) + = 41.199
Qmax(2) =
1.000 * 0.969 * 35.886) +
1.000 * 1.000 * 2.049) +
1.000 * 0.889 * 3.583) + = 40.021
Qmax(3) =
0.969 * 1.000 * 35.886) +
0.958 * 1.000 * 2.049) +
1.000 * 1.000 * 3.583) + = 40.323

Total of 3 main streams to confluence:
Flow rates before confluence point:
35.886 2.049 3.583
Maximum flow rates at confluence using above data:
41.199 40.021 40.323
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 41.199(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.772(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

RIPRAPs Manning Pipe,

Calculator Given Input Data:

Shape ..... Circular
Solving for ..... Depth of Flow
Diameter ..... 15.0000 in
Flowrate ..... 5.5800 cfs
Slope ..... 0.2669 ft/ft
Manning's n 0.0130

Computed Results:

Depth ..... 4.1492 in
Area 1.2272 ft2
Wetted Area 0.2765 ft2
Wetted Perimeter ..... 16.6146 in
Perimeter ..... 47.1239 in
Velocity ..... 20.1781 fps
Hydraulic Radius ..... 2.3968 in
Percent Full ..... 27.6613 %
Full flow Flowrate ..... 33.3728 cfs
Full flow velocity ..... 27.1946 fps

Critical Information

Critical depth ..... 11.8384 in
Critical slope ..... 0.0072 ft/ft
Critical velocity ..... 5.2369 fps
Critical area 1.0655 ft2
Critical perimeter ..... 32.2388 in
Critical hydraulic radius ..... 4.7593 in
Critical top width ..... 15.0000 in
Specific energy ..... 6.6732 ft
Minimum energy ..... 1.4798 ft
Froude number 7.1537
Flow condition ..... Supercritical

Manning Pipe Calculator

Given Input Data:

- Shape ..... Circular
- Solving for ..... Depth of Flow
- Diameter ..... 15.0000 in
- Flowrate ..... 6.2800 cfs
- Slope ..... 0.0181 ft/ft
- Manning's n 0.0130

Computed Results:

- Depth ..... 9.4474 in
- Area 1.2272 ft2
- Wetted Area 0.8141 ft2
- Wetted Perimeter ..... 27.5018 in
- Perimeter ..... 47.1239 in
- Velocity ..... 7.7137 fps
- Hydraulic Radius ..... 4.2629 in
- Percent Full ..... 62.9824 %
- Full flow Flowrate ..... 8.6908 cfs
- Full flow velocity ..... 7.0819 fps

Critical Information

- Critical depth ..... 12.6769 in
- Critical slope ..... 0.0075 ft/ft
- Critical velocity ..... 5.4473 fps
- Critical area 1.1529 ft2
- Critical perimeter ..... 33.9158 in
- Critical hydraulic radius ..... 4.8948 in
- Critical top width ..... 15.0000 in
- Specific energy ..... 1.7121 ft
- Minimum energy ..... 1.5846 ft
- Froude number 1.6893
- Flow condition ..... Supercritical

Manning Pipe Calculator

Given Input Data:

- Shape ..... Circular
- Solving for ..... Depth of Flow
- Diameter ..... 15.0000 in
- Flowrate ..... 7.0500 cfs
- Slope ..... 0.2700 ft/ft
- Manning's n 0.0130

Computed Results:

- Depth ..... 4.6662 in
- Area 1.2272 ft2
- Wetted Area 0.3256 ft2
- Wetted Perimeter ..... 17.7500 in
- Perimeter ..... 47.1239 in
- Velocity ..... 21.6533 fps
- Hydraulic Radius ..... 2.6414 in
- Percent Full ..... 31.1079 %
- Full flow Flowrate ..... 33.5661 cfs
- Full flow velocity ..... 27.3521 fps

Critical Information

- Critical depth ..... 13.5640 in
- Critical slope ..... 0.0078 ft/ft
- Critical velocity ..... 5.6615 fps
- Critical area 1.2453 ft2
- Critical perimeter ..... 35.6900 in
- Critical hydraulic radius ..... 5.0243 in
- Critical top width ..... 15.0000 in
- Specific energy ..... 7.6752 ft
- Minimum energy ..... 1.6955 ft
- Froude number 7.1973
- Flow condition ..... Supercritical

Manning Pipe Calculator

Given Input Data:

- Shape ..... Circular
- Solving for ..... Depth of Flow
- Diameter ..... 15.0000 in
- Flowrate ..... 5.4800 cfs
- Slope ..... 0.2700 ft/ft
- Manning's n 0.0130

Computed Results:

- Depth ..... 4.0990 in
- Area 1.2272 ft2
- Wetted Area 0.2719 ft2
- Wetted Perimeter ..... 16.5022 in
- Perimeter ..... 47.1239 in
- Velocity ..... 20.1569 fps
- Hydraulic Radius ..... 2.3724 in
- Percent Full ..... 27.3266 %
- Full flow Flowrate ..... 33.5661 cfs
- Full flow velocity ..... 27.3521 fps

Critical Information

- Critical depth ..... 11.7158 in
- Critical slope ..... 0.0072 ft/ft
- Critical velocity ..... 5.2055 fps
- Critical area 1.0527 ft2
- Critical perimeter ..... 31.9936 in
- Critical hydraulic radius ..... 4.7383 in
- Critical top width ..... 15.0000 in
- Specific energy ..... 6.6557 ft
- Minimum energy ..... 1.4645 ft
- Froude number 7.1937
- Flow condition ..... Supercritical

Manning Pipe Calculator

Given Input Data:

- Shape ..... Circular
- Solving for ..... Depth of Flow
- Diameter ..... 15.0000 in
- Flowrate ..... 4.9500 cfs
- Slope ..... 0.0173 ft/ft
- Manning's n 0.0130

Computed Results:

- Depth ..... 8.2229 in
- Area 1.2272 ft2
- Wetted Area 0.6888 ft2
- Wetted Perimeter ..... 25.0099 in
- Perimeter ..... 47.1239 in
- Velocity ..... 7.1867 fps
- Hydraulic Radius ..... 3.9658 in
- Percent Full ..... 54.8191 %
- Full flow Flowrate ..... 8.4965 cfs
- Full flow velocity ..... 6.9236 fps

Critical Information

- Critical depth ..... 11.0532 in
- Critical slope ..... 0.0069 ft/ft
- Critical velocity ..... 5.0319 fps
- Critical area 0.9837 ft2
- Critical perimeter ..... 30.6684 in
- Critical hydraulic radius ..... 4.6189 in
- Critical top width ..... 15.0000 in
- Specific energy ..... 1.4879 ft
- Minimum energy ..... 1.3817 ft
- Froude number 1.7071
- Flow condition ..... Supercritical

8. DETENTION BASIN CALCULATIONS

TECHNICAL MEMORANDUM:

Peak Flow Analysis of Extreme Events: 5 yr, 10 yr, 25 yr, 50 yr and 100 yr Storms. Baidee Project, San Diego, CA

Prepared For:

K&S Engineering.

June 26, 2020. Revised: July 19, 2020; August 11, 2020.

Prepared by:

Luis Parra, PhD, CPSWQ, ToR, D.WRE.
R.C.E. 66377

Dr. Luis Parra, PhD, PE, CFM

Telephone: (951) 774-6474

TECHNICAL MEMORANDUM

TO: K&S Engineering

FROM: Luis Parra, PhD, PE, CPSWQ, ToR, D.WRE, CFM.

DATE: June 26, 2020. Revised: August 11, 2020.

RE: Peak Flow Analysis of Extreme Events: 5, 10, 25, 50 and 100 year Storms. Baidee Project, San Diego, CA.

1. INTRODUCTION

The purpose of this report is to establish a comparison between pre and post-development peak flows for the Baidee Project to prove that the proposed development does not increase the 5, 10, 25, 50 and 100 year peak flows after development because the peaks are mitigated below pre-development values via routing of the corresponding hydrographs in the designed BMP facility.

2. CHARACTERISTICS OF THE PROJECT AND ASSUMPTIONS FOR THE MODEL

The Baidee Project is a proposed industrial/commercial development with associated buildings, parking lots and landscape that drains to a single point of discharge along the east boundary.

Prior to draining out, runoff will be captured and routed into a BMP that is composed of 2 portions (see details of the BMP in the SWQMP), and from there runoff is routed and discharged.

The following is a list of the assumptions made to determine the pre and post-development peak flows, and the routing methodology:

- Pre and post-development peak flows will be determined with CIVILCADD/CIVIL DESIGN. Information tied to this program (soil type, elevations, C coefficients, precipitation intensity, etc) are either embedded in the program or added based upon characteristics gathered from other technical reports and for the grading plans. Pre and post-development results from CIVIL DESIGN are included in the appendices.
- From comparison purposes, the peak flow will be analyzed at the 13.44 acre area in pre-development conditions, corresponding to the 12.93 acre in post-development conditions (the 0.51 acre difference corresponds to a small area that cannot drain to the BMP). To establish a fair comparison, the peak flow of the 12.93 acre area will be assigned to the 0.51 acre area in a proportional matter, so that the peak flow of the 0.51 acre can be added into the analysis.
- In order to determine the peak flow after routing a hydrograph needs to be established. The Rick Engineering Rat-Hydro program will be used to define a 6 hr storm hydrograph such that

the peak flow is preserved, the C coefficient is used, the 6 hour rainfall is also used (from NOAA data), and the time of concentration is considered for time interval and hydrograph definition. RAT HYDRO information is included in the appendices (data entry, and results)

- The hydrograph will be then routed using Modified Puls. An elevation vs volume vs discharge tables will be used. That information is gathered from the hydromodification report so that the peak flow, volume and elevation equivalence is identical than the one used for hydromodification compliance. The Elevation vs Volume vs Discharge Table is included in the appendices.
- The initial elevation for routing purposes will be equivalent to invert elevation of the lowest surface outlet. The discharge at the first time interval will not be zero, but defined as a function of the discharge of the LID orifices. In other words, as soon as the routing process starts, the discharge via LID orifice will be included in the analysis so that the released peak flow is not underestimated. Routing result tables prepared with Excel are included in the appendices. The inflow hydrograph for those routing tables is the one defined with RAT Hydro
- Finally, the total peak flow after routing is the combination of the routed peak flow (i.e. the peak of 12.93 acres, routed) plus the proportional peak flow for the remaining 0.51 acres. This peak flow should be less than the pre-development peak flow obtained for the corresponding 13.44 acres analyzed.

3. RESULTS

Table 1 shows the peak flows obtained in pre-development conditions, as well as in post-development conditions before routing. In addition, routed peak flows are included, plus the assigned peak of the remaining 0.51 acre area, as well as the total post-development peak flow. Finally, a change in peak flow (ΔQ) is included, showing that pre – post is always a positive number, implying that pre-development peak flows are higher than post-development peak flows for all storms analyzed.

TABLE 1: PEAK FLOW RESULTS

	Pre peaks	Post-dev. Peak flows				Change
Return Period	$Q_{TOT,PRE}$ (1)	$Q_{unrouted}$ (2)	Q_{routed} (2)	Q_{remain} (3)	$Q_{TOT,POST}$ (4)	ΔQ (5)
5	15.31	27.46	13.57	1.08	13.75	1.56
10	17.62	31.82	14.41	1.26	14.60	3.02
25	19.13	34.72	16.13	1.37	16.35	2.78
50	21.51	39.25	17.59	1.55	17.85	3.66
100	22.51	41.20	21.65	1.63	21.96	0.55

(1) Pre-dev peak for an area of 13.44 acres

(2) Post-dev peaks for an area of 12.93 acres (before and after the routing calculation)

(3) Post-dev peak for the remaining 0.51 acre

(4) Post-dev. peak for the entire 13.44 acre area. It is not equal to $Q_{routed} + Q_{remain}$ as the peaks are not simultaneous (largest total from adding both hydrographs used). $Q_{TOT,POST} = Q_{routed} + Q_{remain}$ one Δt later, proportional to RatHydro value after peak

(5) Change in peak flow: Pre-dev – Post-dev peak flow.

In addition to the results related to peak flow, results shown in Table 2 are included for the proposed detention basin, with every column defined as follows:

- Existing runoff: It refers to (a) total volume of runoff and (b) peak flow of the runoff of existing conditions for the storm analyzed (6-hr, N-yr Return Period, with N = 5, 10, 25, 50 & 100)
- Proposed runoff: It refers to (a) total volume of runoff and (b) peak flow of the runoff of developed conditions for the storm analyzed (6-hr, N-yr Return Period, with N = 5, 10, 25, 50 & 100)
- Runoff Detained: portion of proposed runoff volume that has been detained which is approximately 96.2% of the total runoff as 96.2% of the contributing area (12.93 acres out of 13.44 acres) contribute to the detention basin.
- Runoff Released: runoff released is equal to runoff detained because no infiltration is considered. Therefore, the inflow hydrograph simply transform and changes shape so that its peak flow is reduced, and its released time is increased, but the volume remains the same (volume only reduces when infiltration / evapotranspiration is considered). For purposes of extreme event routing using Modified Puls, evapotranspiration is not considered because the system is assumed saturated at t = 0 min.
- Basin Volume Required: we are interpreting this value as the maximum volume reached during the routing process at each storm less the initial volume at t=0 (because the basin is full to the invert of the lowest surface outlet). For example, a smaller volume is required for routing a 6 hour - 5 year storm, than for routing a 6 hour - 25 year storm event. The basin Volume Provided is larger than the largest basin volume required because there is always a free-board, even for the largest storm analyzed (6 hour – 100 year).
- Maximum BMP elevation: Maximum elevation the water reaches during the routing (ft)
- Detention Time (min): There are 2 detention times considered: (a) time that passes between the inlet and the outlet peak flow (or the lag between the occurrence of the peak flow in the inflow hydrograph and the peak flow in the outflow hydrograph); and (b) time the entire hydrograph is detained (time it takes for the basin to get empty, or time at which the basin reaches a discharge of 0.01 cfs).

TABLE 2: ROUTING: DETAILED RESULTS

Storm	Existing Runoff		Proposed Runoff		Runoff Retained = Released (ft^3)	Basin Vol Required (ft^3)(1)	Max(2). BMP Elev (ft)	Lag time (min)	Detention time (hours)
	Volume (ft^3)	Peak (cfs)	Volume (ft^3)	Peak (cfs)					
6hr, 5yr	30736	15.31	60106	15.19	57825	12,397	480.54	9	36.3
6hr, 10yr	32273	17.62	63111	16.15	60716	13,587	480.61	9	36.3
6hr, 25yr	38859	19.13	75991	17.87	73107	16,274	480.77	9	36.3
6hr, 50yr	44128	21.51	86295	19.46	83020	18,853	480.92	9	36.2
6hr,100yr	49397	22.51	96599	22.40	92933	21,982	481.10	9	36.2

(1): Volume required for routing (max volume in routing) above the volume of the BMP at the invert of lowest surface outlet (slot) = 29,802 ft^3. Volume provided above invert of slot = 38,454 cu-ft.

(2): Crest elevation of BMP = 482.50. Invert of slot: 479.75.

4. CONCLUSIONS

This report demonstrates that all peak flows analyzed (5 year, 10 year, 25 year, 50 year and 100 year peak flows) will be reduced below pre-development levels by the development due to the design of a BMP that provides water quality, hydromodification and flood control capabilities.

5. APPENDICES

- NOAA Precipitation Values
- CIVILCASS/CIVIL DESIGN Results (Pre & Post Development; 5, 10, 25, 50 & 100 yr Return Periods)
- RatHydro Hydrographs (Post-Development, 5, 10, 25, 50 and 100 Year Return Period)
- Elevation – Volume – Discharge Table
- Modified Puls Routing (Post-Development, 5, 10, 25, 50 and 100 Year Return Period)

NOAA PRECIPITATION DATA

NOAA Atlas 14, Volume 6, Version 2
Location name: San Diego, California, USA*
Latitude: 32.5574°, Longitude: -116.9646°
Elevation: 470.11 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.104** (0.087-0.125)	**0.130** (0.108-0.157)	**0.166** (0.138-0.201)	**0.196** (0.162-0.240)	**0.240** (0.191-0.304)	**0.275** (0.215-0.356)	**0.312** (0.238-0.414)	**0.352** (0.261-0.481)	**0.409** (0.290-0.584)	**0.456** (0.312-0.673)
10-min	**0.149** (0.124-0.179)	**0.186** (0.155-0.225)	**0.237** (0.198-0.288)	**0.281** (0.232-0.344)	**0.344** (0.274-0.435)	**0.394** (0.308-0.510)	**0.448** (0.341-0.594)	**0.505** (0.374-0.690)	**0.587** (0.416-0.837)	**0.653** (0.447-0.965)
15-min	**0.180** (0.150-0.217)	**0.225** (0.188-0.272)	**0.287** (0.239-0.348)	**0.340** (0.281-0.416)	**0.416** (0.332-0.526)	**0.477** (0.372-0.617)	**0.541** (0.412-0.718)	**0.611** (0.452-0.834)	**0.710** (0.503-1.01)	**0.790** (0.540-1.17)
30-min	**0.252** (0.211-0.304)	**0.316** (0.264-0.382)	**0.403** (0.336-0.489)	**0.477** (0.394-0.584)	**0.584** (0.466-0.739)	**0.669** (0.523-0.866)	**0.760** (0.579-1.01)	**0.857** (0.634-1.17)	**0.996** (0.706-1.42)	**1.11** (0.758-1.64)
60-min	**0.349** (0.292-0.421)	**0.437** (0.365-0.528)	**0.557** (0.464-0.676)	**0.660** (0.545-0.808)	**0.807** (0.644-1.02)	**0.926** (0.723-1.20)	**1.05** (0.800-1.40)	**1.19** (0.877-1.62)	**1.38** (0.976-1.96)	**1.53** (1.05-2.27)
2-hr	**0.486** (0.406-0.587)	**0.609** (0.509-0.737)	**0.776** (0.646-0.941)	**0.914** (0.755-1.12)	**1.11** (0.884-1.40)	**1.26** (0.985-1.63)	**1.42** (1.08-1.88)	**1.59** (1.17-2.17)	**1.82** (1.29-2.60)	**2.01** (1.37-2.96)
3-hr	**0.596** (0.498-0.719)	**0.749** (0.625-0.905)	**0.952** (0.793-1.16)	**1.12** (0.926-1.37)	**1.36** (1.08-1.72)	**1.54** (1.20-1.99)	**1.73** (1.31-2.29)	**1.92** (1.42-2.63)	**2.19** (1.56-3.13)	**2.41** (1.65-3.56)
6-hr	**0.778** (0.651-0.940)	**0.981** (0.819-1.19)	**1.25** (1.04-1.51)	**1.47** (1.21-1.80)	**1.77** (1.41-2.24)	**2.01** (1.57-2.59)	**2.25** (1.71-2.98)	**2.50** (1.85-3.41)	**2.84** (2.01-4.04)	**3.11** (2.12-4.59)
12-hr	**0.998** (0.835-1.21)	**1.26** (1.05-1.52)	**1.60** (1.34-1.94)	**1.89** (1.56-2.31)	**2.28** (1.82-2.88)	**2.58** (2.02-3.34)	**2.89** (2.20-3.84)	**3.22** (2.38-4.39)	**3.66** (2.60-5.22)	**4.01** (2.75-5.93)
24-hr	**1.27** (1.11-1.48)	**1.61** (1.40-1.87)	**2.05** (1.79-2.40)	**2.42** (2.10-2.86)	**2.93** (2.46-3.56)	**3.33** (2.75-4.12)	**3.74** (3.02-4.73)	**4.17** (3.28-5.41)	**4.76** (3.61-6.40)	**5.22** (3.84-7.25)
2-day	**1.58** (1.38-1.84)	**2.03** (1.77-2.37)	**2.62** (2.28-3.07)	**3.11** (2.69-3.66)	**3.77** (3.17-4.58)	**4.29** (3.54-5.30)	**4.81** (3.88-6.09)	**5.36** (4.22-6.95)	**6.11** (4.63-8.23)	**6.70** (4.92-9.30)
3-day	**1.76** (1.54-2.06)	**2.29** (2.00-2.67)	**2.97** (2.59-3.48)	**3.53** (3.06-4.17)	**4.30** (3.61-5.22)	**4.89** (4.03-6.05)	**5.49** (4.43-6.94)	**6.11** (4.81-7.92)	**6.95** (5.27-9.36)	**7.61** (5.59-10.6)
4-day	**1.91** (1.67-2.23)	**2.49** (2.18-2.91)	**3.25** (2.84-3.81)	**3.87** (3.35-4.57)	**4.72** (3.96-5.73)	**5.37** (4.43-6.64)	**6.03** (4.86-7.62)	**6.71** (5.28-8.70)	**7.63** (5.78-10.3)	**8.35** (6.13-11.6)
7-day	**2.22** (1.94-2.59)	**2.89** (2.53-3.38)	**3.78** (3.30-4.43)	**4.51** (3.90-5.31)	**5.50** (4.62-6.68)	**6.26** (5.16-7.75)	**7.04** (5.68-8.90)	**7.84** (6.17-10.2)	**8.93** (6.77-12.0)	**9.78** (7.19-13.6)
10-day	**2.42** (2.12-2.83)	**3.16** (2.76-3.69)	**4.14** (3.61-4.84)	**4.93** (4.27-5.81)	**6.01** (5.05-7.30)	**6.84** (5.64-8.47)	**7.69** (6.21-9.73)	**8.57** (6.74-11.1)	**9.76** (7.40-13.1)	**10.7** (7.85-14.8)
20-day	**2.93** (2.57-3.42)	**3.86** (3.37-4.50)	**5.05** (4.41-5.92)	**6.02** (5.21-7.10)	**7.32** (6.15-8.89)	**8.31** (6.85-10.3)	**9.31** (7.51-11.8)	**10.3** (8.13-13.4)	**11.7** (8.87-15.7)	**12.8** (9.37-17.7)
30-day	**3.52** (3.08-4.11)	**4.65** (4.06-5.43)	**6.09** (5.31-7.13)	**7.24** (6.27-8.54)	**8.77** (7.37-10.7)	**9.92** (8.18-12.3)	**11.1** (8.94-14.0)	**12.2** (9.63-15.9)	**13.8** (10.4-18.6)	**15.0** (11.0-20.8)
45-day	**4.14** (3.62-4.83)	**5.47** (4.78-6.38)	**7.14** (6.23-8.36)	**8.46** (7.32-9.98)	**10.2** (8.56-12.4)	**11.5** (9.46-14.2)	**12.7** (10.3-16.1)	**14.0** (11.0-18.2)	**15.7** (11.9-21.1)	**16.9** (12.4-23.5)
60-day	**4.83** (4.23-5.63)	**6.36** (5.56-7.43)	**8.28** (7.21-9.69)	**9.77** (8.45-11.5)	**11.7** (9.83-14.2)	**13.1** (10.8-16.2)	**14.5** (11.7-18.3)	**15.9** (12.5-20.6)	**17.6** (13.4-23.7)	**18.9** (13.9-26.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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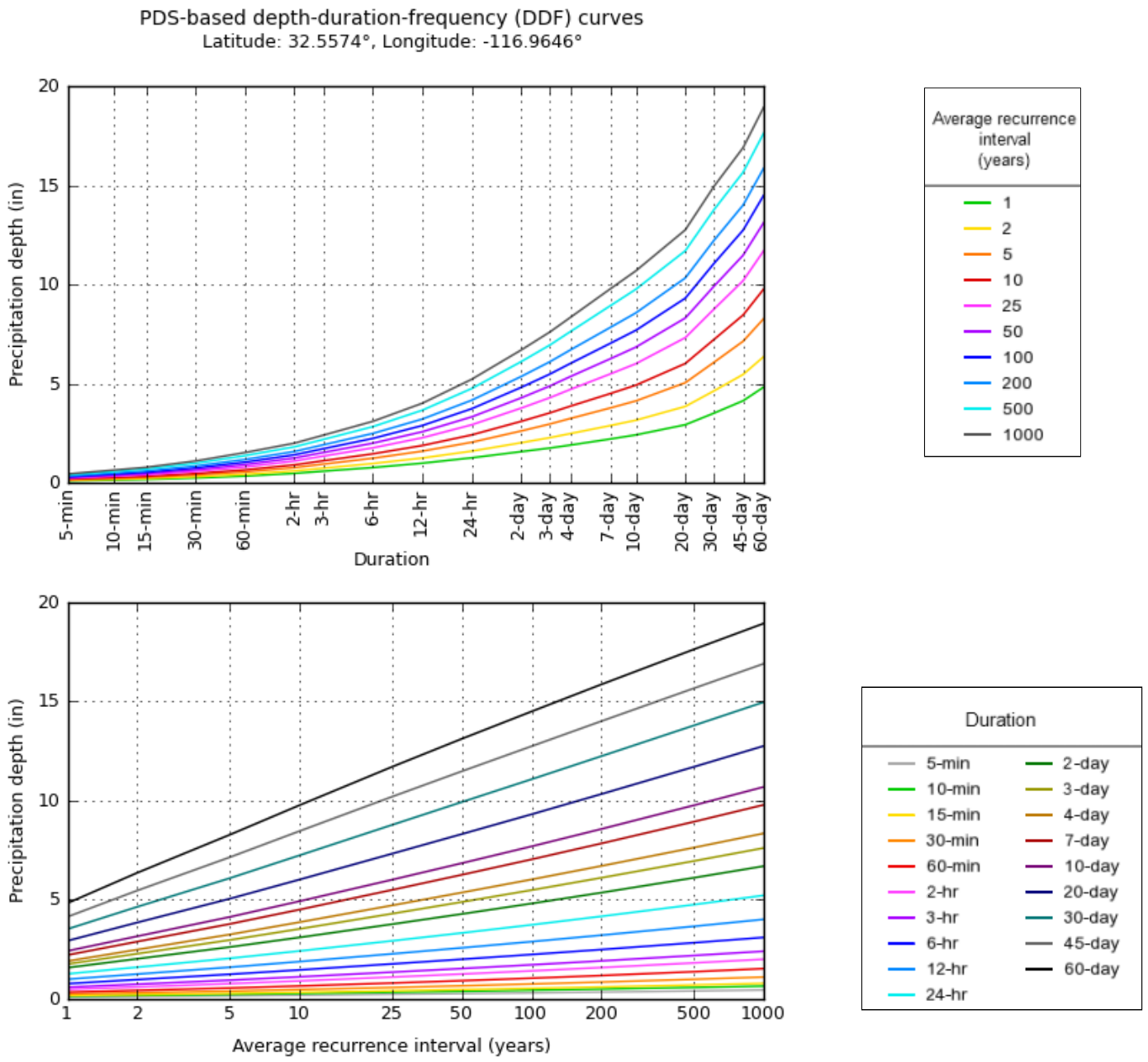
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon May 18 18:40:52 2020

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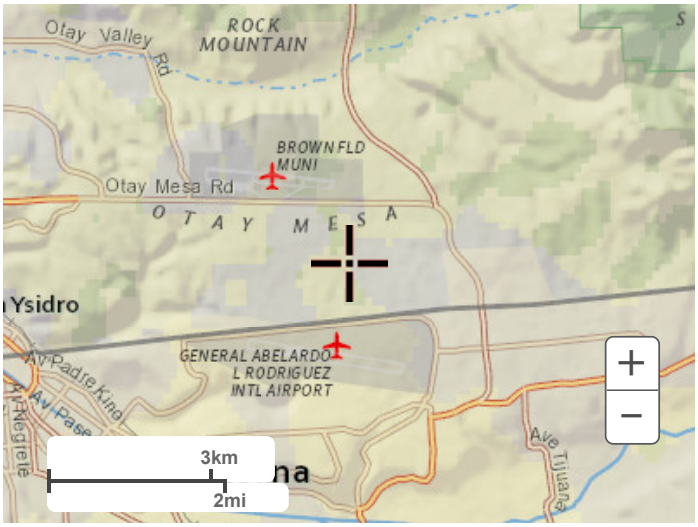
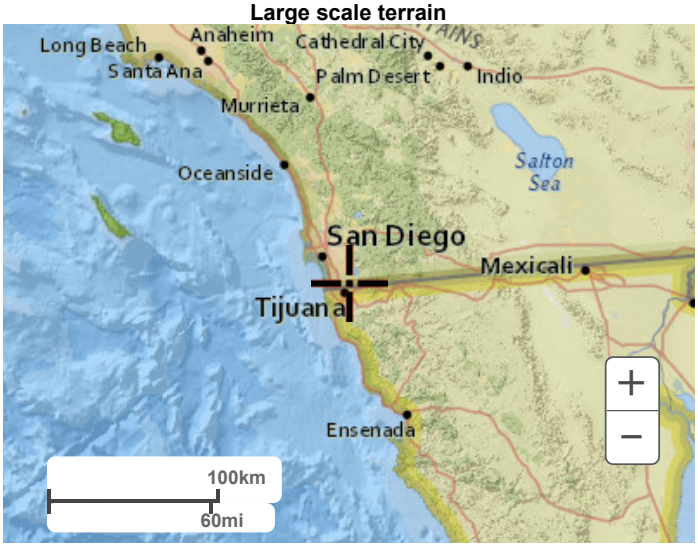
Maps & aerials

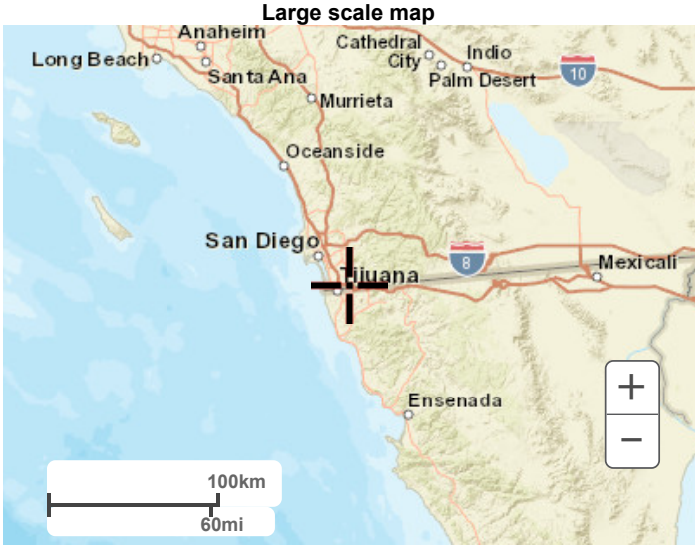
Small scale terrain



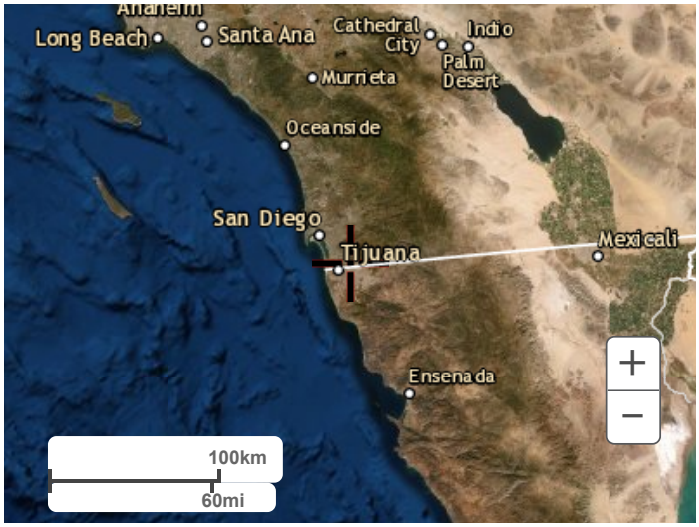
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

5 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149
2	21.630	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.532(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 15.312(CFS) for 13.440(Ac.)
Total runoff = 60.822(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

10 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592
2	21.630	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.913(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 17.620(CFS) for 13.440(Ac.)
Total runoff = 63.130(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

25 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845
2	21.630	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.163(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 19.131(CFS) for 13.440(Ac.)
Total runoff = 64.641(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

50 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265
2	21.630	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.557(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 21.511(CFS) for 13.440(Ac.)
Total runoff = 67.021(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

100 Year, Pre-Development Conditions

EXISTING 100 YEAR HYDROLOGY

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 07/18/20

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

Program License Serial Number 4035

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.39(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.389

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880

```
Maximum flow rates at confluence using above data:
       23.880
Area of streams before confluence:
        7.570
Results of confluence:
Total flow rate =     23.880(CFS)
Time of concentration =     5.000 min.
Effective stream area after confluence =      7.570(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
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
[INDUSTRIAL area type                         ]
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       4.39(In/Hr)
Total area =       16.520(Ac.)  Total runoff =    21.630(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     16.520(Ac.)
Runoff from this stream =     21.630(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.389(In/Hr)
Summary of stream data:

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


1       23.880      5.00           4.389
2       21.630      5.00           4.389
Qmax(1) =
          1.000 *    1.000 *    23.880) +
          1.000 *    1.000 *    21.630) + =      45.510
Qmax(2) =
          1.000 *    1.000 *    23.880) +
          1.000 *    1.000 *    21.630) + =      45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
      23.880      21.630
Maximum flow rates at confluence using above data:
       45.510       45.510
Area of streams before confluence:
        7.570       16.520
Results of confluence:
Total flow rate =     45.510(CFS)
Time of concentration =     5.000 min.
Effective stream area after confluence =     24.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station       50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =   481.200(Ft.)
```

```
Downstream point elevation =   474.600(Ft.)
Channel length thru subarea  =   475.000(Ft.)
Channel base width  =    0.000(Ft.)
Slope or 'Z' of left channel bank =  80.000
Slope or 'Z' of right channel bank =  80.000
Estimated mean flow rate at midpoint of channel =     58.205(CFS)
Manning's 'N'    = 0.023
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     58.205(CFS)
Depth of flow =   0.493(Ft.), Average velocity =   2.994(Ft/s)
Channel flow top width =   78.876(Ft.)
Flow Velocity =    2.99(Ft/s)
Travel time  =    2.64 min.
Time of concentration =    7.64 min.
Critical depth =      0.504(Ft.)
 Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      3.722(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     22.509(CFS) for   13.440(Ac.)
Total runoff =     68.019(CFS)   Total area =       37.53(Ac.)
End of computations, total study area =          37.530 (Ac.)
```

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

5 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.208(CFS) for 0.120(Ac.)
Total runoff = 24.088(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.088(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829

Qmax(1) =
1.000 * 1.000 * 24.088) + = 24.088

Total of 1 streams to confluence:
Flow rates before confluence point:
24.088
Maximum flow rates at confluence using above data:
24.088
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.088(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.261(CFS) for 0.150(Ac.)

Total runoff = 21.891(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.891(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.912(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.287(Ft.)
Minor friction loss = 0.905(Ft.) K-factor = 1.20
Pipe flow velocity = 6.97(Ft/s)
Travel time through pipe = 1.10 min.
Time of concentration (TC) = 15.88 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.891(CFS)
Time of concentration = 15.88 min.
Rainfall intensity = 1.765(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829
2	21.891	15.88	1.765

Qmax(1) =
1.000 * 1.000 * 24.088) +
1.000 * 0.931 * 21.891) + = 44.469
Qmax(2) =
0.965 * 1.000 * 24.088) +
1.000 * 1.000 * 21.891) + = 45.135

Total of 2 streams to confluence:
Flow rates before confluence point:
24.088 21.891
Maximum flow rates at confluence using above data:
44.469 45.135
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.135(CFS)
Time of concentration = 15.875 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.135(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.045(CFS)
Normal flow depth in pipe = 16.29(In.)
Flow top width inside pipe = 22.41(In.)
Critical Depth = 16.78(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.59 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 28.13(In.)
Flow top width inside pipe = 29.76(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 27.75(In.)
Flow top width inside pipe = 30.26(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 2.989(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.605(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.605(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.605(CFS)
Normal flow depth in pipe = 4.29(In.)
Flow top width inside pipe = 9.90(In.)
Critical Depth = 4.09(In.)
Pipe flow velocity = 2.70(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 6.81 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.81 min.
Rainfall intensity = 2.684(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.031(CFS) for 0.860(Ac.)
Total runoff = 2.636(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 7.64 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.18(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.86(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 8.48 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.23(In.)
Flow top width inside pipe = 14.93(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.82(Ft/s)
Travel time through pipe = 0.20 min.
Time of concentration (TC) = 8.68 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.276(CFS) for 0.610(Ac.)
Total runoff = 3.912(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.167(CFS) for 0.080(Ac.)
Total runoff = 4.079(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.042(CFS) for 0.020(Ac.)
Total runoff = 4.121(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.121(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.121(CFS)
Normal flow depth in pipe = 9.69(In.)
Flow top width inside pipe = 17.95(In.)
Critical Depth = 9.32(In.)
Pipe flow velocity = 4.24(Ft/s)
Travel time through pipe = 0.10 min.
Time of concentration (TC) = 8.78 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.494(CFS) for 1.680(Ac.)
Total runoff = 7.615(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.931(CFS) for 1.890(Ac.)
Total runoff = 11.546(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.

Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.388(CFS) for 2.110(Ac.)
Total runoff = 15.934(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.431(CFS) for 1.650(Ac.)
Total runoff = 19.365(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.099(CFS) for 1.490(Ac.)
Total runoff = 22.464(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.373(CFS) for 0.660(Ac.)
Total runoff = 23.837(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 23.837(CFS)
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363

Qmax(1) =

1.000 * 1.000 * 23.837) + = 23.837

Total of 1 main streams to confluence:
Flow rates before confluence point:
23.837
Maximum flow rates at confluence using above data:
23.837
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 23.837(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.637(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.637(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.637(CFS)
Normal flow depth in pipe = 4.49(In.)
Flow top width inside pipe = 9.95(In.)
Critical Depth = 4.21(In.)
Pipe flow velocity = 2.69(Ft/s)
Travel time through pipe = 1.44 min.
Time of concentration (TC) = 6.44 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.44 min.
Rainfall intensity = 2.761(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.802(CFS) for 0.330(Ac.)
Total runoff = 1.439(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.439(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.439(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 11.96(In.)
Critical Depth = 6.10(In.)
Pipe flow velocity = 3.33(Ft/s)
Travel time through pipe = 2.08 min.
Time of concentration (TC) = 8.53 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.439(CFS)
Time of concentration = 8.53 min.
Rainfall intensity = 2.397(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) + = 25.255
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) + = 24.600

Total of 2 main streams to confluence:
Flow rates before confluence point:
23.837 1.439
Maximum flow rates at confluence using above data:
25.255 24.600
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 25.255(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 2.964(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.391(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.391(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.196(CFS)
Normal flow depth in pipe = 2.98(In.)
Flow top width inside pipe = 6.00(In.)
Critical Depth = 2.66(In.)
Pipe flow velocity = 2.02(Ft/s)
Travel time through pipe = 2.07 min.
Time of concentration (TC) = 7.68 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.68 min.
Rainfall intensity = 2.525(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.467(CFS) for 0.660(Ac.)
Total runoff = 1.858(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.858(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 1.858(CFS)
Normal flow depth in pipe = 6.66(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 6.50(In.)
Pipe flow velocity = 3.53(Ft/s)
Travel time through pipe = 1.89 min.
Time of concentration (TC) = 9.57 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.398(CFS) for 0.200(Ac.)
Total runoff = 2.256(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.159(CFS) for 0.080(Ac.)
Total runoff = 2.416(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.416(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.416(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 14.86(In.)
Critical Depth = 7.46(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.63 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.416(CFS)
Time of concentration = 9.63 min.
Rainfall intensity = 2.258(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397
3	2.416	9.63	2.258

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) +
1.000 * 0.912 * 2.416) + = 27.458
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) +
1.000 * 0.886 * 2.416) + = 26.740
Qmax(3) =
0.955 * 1.000 * 23.837) +
0.942 * 1.000 * 1.439) +
1.000 * 1.000 * 2.416) + = 26.544

Total of 3 main streams to confluence:
Flow rates before confluence point:
23.837 1.439 2.416
Maximum flow rates at confluence using above data:
27.458 26.740 26.544
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 27.458(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.554(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

10 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.243(CFS) for 0.120(Ac.)
Total runoff = 24.123(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.123(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135

Qmax(1) =
1.000 * 1.000 * 24.123) + = 24.123

Total of 1 streams to confluence:
Flow rates before confluence point:
24.123
Maximum flow rates at confluence using above data:
24.123
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.123(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.304(CFS) for 0.150(Ac.)

Total runoff = 21.934(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.934(CFS)
Given pipe size = 24.00(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 = 4.304(Ft.)
Minor friction loss = 0.908(Ft.) K-factor = 1.20
Pipe flow velocity = 6.98(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.934(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.063(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135
2	21.934	15.87	2.063

Qmax(1) =
1.000 * 1.000 * 24.123) +
1.000 * 0.931 * 21.934) + = 44.547
Qmax(2) =
0.966 * 1.000 * 24.123) +
1.000 * 1.000 * 21.934) + = 45.247

Total of 2 streams to confluence:
Flow rates before confluence point:
24.123 21.934
Maximum flow rates at confluence using above data:
44.547 45.247
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.247(CFS)
Time of concentration = 15.873 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.247(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.082(CFS)
Normal flow depth in pipe = 16.31(In.)
Flow top width inside pipe = 22.40(In.)
Critical Depth = 16.80(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 28.22(In.)
Flow top width inside pipe = 29.64(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 27.84(In.)
Flow top width inside pipe = 30.14(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.416(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.691(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.691(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.691(CFS)
Normal flow depth in pipe = 4.63(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.39(In.)
Pipe flow velocity = 2.80(Ft/s)
Travel time through pipe = 1.24 min.
Time of concentration (TC) = 6.76 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.76 min.
Rainfall intensity = 3.091(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.339(CFS) for 0.860(Ac.)
Total runoff = 3.030(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.94(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.97(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 7.57 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.93(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.98(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 8.39 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.99(In.)
Flow top width inside pipe = 14.70(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.95(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.58 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.480(CFS) for 0.610(Ac.)
Total runoff = 4.511(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.194(CFS) for 0.080(Ac.)
Total runoff = 4.705(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.049(CFS) for 0.020(Ac.)
Total runoff = 4.753(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.753(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.753(CFS)
Normal flow depth in pipe = 10.61(In.)
Flow top width inside pipe = 17.71(In.)
Critical Depth = 10.05(In.)
Pipe flow velocity = 4.39(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.67 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.056(CFS) for 1.680(Ac.)
Total runoff = 8.809(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.563(CFS) for 1.890(Ac.)
Total runoff = 13.372(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.

Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.094(CFS) for 2.110(Ac.)
Total runoff = 18.466(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.984(CFS) for 1.650(Ac.)
Total runoff = 22.450(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.597(CFS) for 1.490(Ac.)
Total runoff = 26.047(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.593(CFS) for 0.660(Ac.)
Total runoff = 27.641(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 27.641(CFS)
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743

Qmax(1) =

1.000 * 1.000 * 27.641) + = 27.641

Total of 1 main streams to confluence:
Flow rates before confluence point:
27.641
Maximum flow rates at confluence using above data:
27.641
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 27.641(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.727(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.727(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.727(CFS)
Normal flow depth in pipe = 4.84(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.51(In.)
Pipe flow velocity = 2.78(Ft/s)
Travel time through pipe = 1.40 min.
Time of concentration (TC) = 6.40 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.40 min.
Rainfall intensity = 3.177(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.922(CFS) for 0.330(Ac.)
Total runoff = 1.650(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.650(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.650(CFS)
Normal flow depth in pipe = 7.05(In.)
Flow top width inside pipe = 11.81(In.)
Critical Depth = 6.55(In.)
Pipe flow velocity = 3.43(Ft/s)
Travel time through pipe = 2.02 min.
Time of concentration (TC) = 8.42 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.650(CFS)
Time of concentration = 8.42 min.
Rainfall intensity = 2.783(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) + = 29.267
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) + = 28.475

Total of 2 main streams to confluence:
Flow rates before confluence point:
27.641 1.650
Maximum flow rates at confluence using above data:
29.267 28.475
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 29.267(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.388(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.447(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.447(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.224(CFS)
Normal flow depth in pipe = 3.22(In.)
Flow top width inside pipe = 5.98(In.)
Critical Depth = 2.85(In.)
Pipe flow velocity = 2.08(Ft/s)
Travel time through pipe = 2.00 min.
Time of concentration (TC) = 7.62 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.62 min.
Rainfall intensity = 2.918(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.695(CFS) for 0.660(Ac.)
Total runoff = 2.142(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.142(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.142(CFS)
Normal flow depth in pipe = 7.22(In.)
Flow top width inside pipe = 14.99(In.)
Critical Depth = 7.01(In.)
Pipe flow velocity = 3.67(Ft/s)
Travel time through pipe = 1.82 min.
Time of concentration (TC) = 9.44 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.464(CFS) for 0.200(Ac.)
Total runoff = 2.606(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.186(CFS) for 0.080(Ac.)
Total runoff = 2.791(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.791(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.791(CFS)
Normal flow depth in pipe = 7.03(In.)
Flow top width inside pipe = 14.97(In.)
Critical Depth = 8.05(In.)
Pipe flow velocity = 4.94(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.49 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.791(CFS)
Time of concentration = 9.49 min.
Rainfall intensity = 2.629(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783
3	2.791	9.49	2.629

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) +
1.000 * 0.914 * 2.791) + = 31.817
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) +
1.000 * 0.887 * 2.791) + = 30.950
Qmax(3) =
0.958 * 1.000 * 27.641) +
0.945 * 1.000 * 1.650) +
1.000 * 1.000 * 2.791) + = 30.836

Total of 3 main streams to confluence:
Flow rates before confluence point:
27.641 1.650 2.791
Maximum flow rates at confluence using above data:
31.817 30.950 30.836
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 31.817(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.632(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

25 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.270(CFS) for 0.120(Ac.)
Total runoff = 24.150(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.150(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372

Qmax(1) =
1.000 * 1.000 * 24.150) + = 24.150

Total of 1 streams to confluence:
Flow rates before confluence point:
24.150
Maximum flow rates at confluence using above data:
24.150
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.150(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.338(CFS) for 0.150(Ac.)

Total runoff = 21.968(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.968(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.949(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.317(Ft.)
Minor friction loss = 0.911(Ft.) K-factor = 1.20
Pipe flow velocity = 6.99(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.968(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.297(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372
2	21.968	15.87	2.297

Qmax(1) =
1.000 * 1.000 * 24.150) +
1.000 * 0.931 * 21.968) + = 44.608
Qmax(2) =
0.969 * 1.000 * 24.150) +
1.000 * 1.000 * 21.968) + = 45.359

Total of 2 streams to confluence:
Flow rates before confluence point:
24.150 21.968
Maximum flow rates at confluence using above data:
44.608 45.359
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.359(CFS)
Time of concentration = 15.872 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.359(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.120(CFS)
Normal flow depth in pipe = 16.34(In.)
Flow top width inside pipe = 22.38(In.)
Critical Depth = 16.82(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 28.27(In.)
Flow top width inside pipe = 29.57(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 27.89(In.)
Flow top width inside pipe = 30.08(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.668(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.742(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.742(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.742(CFS)
Normal flow depth in pipe = 4.82(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.55(In.)
Pipe flow velocity = 2.85(Ft/s)
Travel time through pipe = 1.22 min.
Time of concentration (TC) = 6.74 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.74 min.
Rainfall intensity = 3.347(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.533(CFS) for 0.860(Ac.)
Total runoff = 3.275(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.41(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.04(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.40(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.05(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 8.34 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.47(In.)
Flow top width inside pipe = 14.47(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.01(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.618(CFS) for 0.610(Ac.)
Total runoff = 4.893(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.212(CFS) for 0.080(Ac.)
Total runoff = 5.106(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.053(CFS) for 0.020(Ac.)
Total runoff = 5.159(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.159(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.159(CFS)
Normal flow depth in pipe = 11.19(In.)
Flow top width inside pipe = 17.46(In.)
Critical Depth = 10.49(In.)
Pipe flow velocity = 4.47(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.62 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.436(CFS) for 1.680(Ac.)
Total runoff = 9.595(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.990(CFS) for 1.890(Ac.)
Total runoff = 14.585(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.

Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.571(CFS) for 2.110(Ac.)
Total runoff = 20.156(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.357(CFS) for 1.650(Ac.)
Total runoff = 24.513(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.934(CFS) for 1.490(Ac.)
Total runoff = 28.447(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.743(CFS) for 0.660(Ac.)
Total runoff = 30.190(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 30.190(CFS)
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000

Qmax(1) =

```
            1.000 *    1.000 *    30.190) + =      30.190

Total of 1 main streams to confluence:
Flow rates before confluence point:
     30.190
Maximum flow rates at confluence using above data:
      30.190
Area of streams before confluence:
      11.280


Results of confluence:
Total flow rate =     30.190(CFS)
Time of concentration =     8.617 min.
Effective stream area after confluence  =     11.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
_____________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 100.000^.5)/(   0.500^(1/3)]=   4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      3.845(In/Hr) for a    25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.778(CFS)
Total initial stream area =        0.230(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____________________________________________________________________________
Upstream point/station elevation =   482.250(Ft.)
Downstream point/station elevation =   481.100(Ft.)
Pipe length  =   233.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.778(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.778(CFS)
Normal flow depth in pipe =    5.03(In.)
Flow top width inside pipe =   10.00(In.)
Critical Depth =    4.68(In.)
Pipe flow velocity =      2.83(Ft/s)
Travel time through pipe =    1.37 min.
Time of concentration (TC) =     6.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
```

Time of concentration = 6.37 min.
Rainfall intensity = 3.433(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.997(CFS) for 0.330(Ac.)
Total runoff = 1.775(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.775(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.775(CFS)
Normal flow depth in pipe = 7.41(In.)
Flow top width inside pipe = 11.67(In.)
Critical Depth = 6.80(In.)
Pipe flow velocity = 3.49(Ft/s)
Travel time through pipe = 1.99 min.
Time of concentration (TC) = 8.36 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.775(CFS)
Time of concentration = 8.36 min.
Rainfall intensity = 3.041(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) + = 31.942
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) + = 31.062

Total of 2 main streams to confluence:
Flow rates before confluence point:
30.190 1.775
Maximum flow rates at confluence using above data:
31.942 31.062
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 31.942(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.640(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.480(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.480(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.240(CFS)
Normal flow depth in pipe = 3.38(In.)
Flow top width inside pipe = 5.95(In.)
Critical Depth = 2.96(In.)
Pipe flow velocity = 2.12(Ft/s)
Travel time through pipe = 1.97 min.
Time of concentration (TC) = 7.58 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.58 min.
Rainfall intensity = 3.175(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.844(CFS) for 0.660(Ac.)
Total runoff = 2.324(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.324(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.324(CFS)
Normal flow depth in pipe = 7.57(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 7.31(In.)
Pipe flow velocity = 3.74(Ft/s)
Travel time through pipe = 1.79 min.
Time of concentration (TC) = 9.37 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.509(CFS) for 0.200(Ac.)
Total runoff = 2.833(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.204(CFS) for 0.080(Ac.)
Total runoff = 3.037(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.037(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.037(CFS)
Normal flow depth in pipe = 7.38(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 8.41(In.)
Pipe flow velocity = 5.05(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.42 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.037(CFS)
Time of concentration = 9.42 min.
Rainfall intensity = 2.886(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041
3	3.037	9.42	2.886

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) +
1.000 * 0.915 * 3.037) + = 34.720
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) +
1.000 * 0.888 * 3.037) + = 33.758
Qmax(3) =
0.962 * 1.000 * 30.190) +
0.949 * 1.000 * 1.775) +
1.000 * 1.000 * 3.037) + = 33.763

Total of 3 main streams to confluence:
Flow rates before confluence point:
30.190 1.775 3.037
Maximum flow rates at confluence using above data:
34.720 33.758 33.763
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 34.720(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.677(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

50 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

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

Program License Serial Number 6303

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.310(CFS) for 0.120(Ac.)
Total runoff = 24.190(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.190(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724

Qmax(1) =
1.000 * 1.000 * 24.190) + = 24.190

Total of 1 streams to confluence:
Flow rates before confluence point:
24.190
Maximum flow rates at confluence using above data:
24.190
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.190(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
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
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****
_____
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
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.388(CFS) for 0.150(Ac.)

Total runoff = 22.018(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.018(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.972(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.337(Ft.)
Minor friction loss = 0.915(Ft.) K-factor = 1.20
Pipe flow velocity = 7.01(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.018(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.643(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724
2	22.018	15.87	2.643

Qmax(1) =
1.000 * 1.000 * 24.190) +
1.000 * 0.931 * 22.018) + = 44.697
Qmax(2) =
0.971 * 1.000 * 24.190) +
1.000 * 1.000 * 22.018) + = 45.495

Total of 2 streams to confluence:
Flow rates before confluence point:
24.190 22.018
Maximum flow rates at confluence using above data:
44.697 45.495
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.495(CFS)
Time of concentration = 15.869 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.495(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.165(CFS)
Normal flow depth in pipe = 16.38(In.)
Flow top width inside pipe = 22.34(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 28.36(In.)
Flow top width inside pipe = 29.44(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 27.98(In.)
Flow top width inside pipe = 29.95(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.081(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.826(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.826(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.826(CFS)
Normal flow depth in pipe = 5.13(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.82(In.)
Pipe flow velocity = 2.93(Ft/s)
Travel time through pipe = 1.18 min.
Time of concentration (TC) = 6.71 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.71 min.
Rainfall intensity = 3.755(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.842(CFS) for 0.860(Ac.)
Total runoff = 3.668(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.20(In.)
Flow top width inside pipe = 14.00(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 7.49 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.17(In.)
Flow top width inside pipe = 14.02(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.14(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.27 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.27(In.)
Flow top width inside pipe = 13.94(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.10(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.45 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.832(CFS) for 0.610(Ac.)
Total runoff = 5.500(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.240(CFS) for 0.080(Ac.)
Total runoff = 5.740(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.060(CFS) for 0.020(Ac.)
Total runoff = 5.800(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.800(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.800(CFS)
Normal flow depth in pipe = 12.14(In.)
Flow top width inside pipe = 16.87(In.)
Critical Depth = 11.15(In.)
Pipe flow velocity = 4.57(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.54 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.025(CFS) for 1.680(Ac.)
Total runoff = 10.825(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.653(CFS) for 1.890(Ac.)
Total runoff = 16.478(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.

Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.311(CFS) for 2.110(Ac.)
Total runoff = 22.789(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.935(CFS) for 1.650(Ac.)
Total runoff = 27.724(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.457(CFS) for 1.490(Ac.)
Total runoff = 32.181(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.974(CFS) for 0.660(Ac.)
Total runoff = 34.155(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 34.155(CFS)
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399

Qmax(1) =

1.000 * 1.000 * 34.155) + = 34.155

Total of 1 main streams to confluence:
Flow rates before confluence point:
34.155
Maximum flow rates at confluence using above data:
34.155
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 34.155(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.863(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.863(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.863(CFS)
Normal flow depth in pipe = 5.36(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.93(In.)
Pipe flow velocity = 2.90(Ft/s)
Travel time through pipe = 1.34 min.
Time of concentration (TC) = 6.34 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.34 min.
Rainfall intensity = 3.847(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.117(CFS) for 0.330(Ac.)
Total runoff = 1.980(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.980(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.980(CFS)
Normal flow depth in pipe = 7.99(In.)
Flow top width inside pipe = 11.32(In.)
Critical Depth = 7.21(In.)
Pipe flow velocity = 3.57(Ft/s)
Travel time through pipe = 1.94 min.
Time of concentration (TC) = 8.28 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.980(CFS)
Time of concentration = 8.28 min.
Rainfall intensity = 3.442(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) + = 36.110
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) + = 35.086

Total of 2 main streams to confluence:
Flow rates before confluence point:
34.155 1.980
Maximum flow rates at confluence using above data:
36.110 35.086
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 36.110(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.052(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.535(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.535(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.267(CFS)
Normal flow depth in pipe = 3.61(In.)
Flow top width inside pipe = 5.87(In.)
Critical Depth = 3.13(In.)
Pipe flow velocity = 2.17(Ft/s)
Travel time through pipe = 1.92 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.54 min.
Rainfall intensity = 3.578(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.078(CFS) for 0.660(Ac.)
Total runoff = 2.613(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.613(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.613(CFS)
Normal flow depth in pipe = 8.12(In.)
Flow top width inside pipe = 14.95(In.)
Critical Depth = 7.77(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 1.74 min.
Time of concentration (TC) = 9.27 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.579(CFS) for 0.200(Ac.)
Total runoff = 3.192(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
_____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.232(CFS) for 0.080(Ac.)
Total runoff = 3.423(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
_____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.423(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.423(CFS)
Normal flow depth in pipe = 7.92(In.)
Flow top width inside pipe = 14.98(In.)
Critical Depth = 8.95(In.)
Pipe flow velocity = 5.20(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.32 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.423(CFS)
Time of concentration = 9.32 min.
Rainfall intensity = 3.282(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442
3	3.423	9.32	3.282

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) +
1.000 * 0.917 * 3.423) + = 39.248
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) +
1.000 * 0.889 * 3.423) + = 38.127
Qmax(3) =
0.966 * 1.000 * 34.155) +
0.953 * 1.000 * 1.980) +
1.000 * 1.000 * 3.423) + = 38.288

Total of 3 main streams to confluence:
Flow rates before confluence point:
34.155 1.980 3.423
Maximum flow rates at confluence using above data:
39.248 38.127 38.288
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 39.248(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.751(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

100 Year, Post-Development Conditions

100 YEAR HYDROLOGY

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            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
       Rational Hydrology Study        Date: 07/18/20
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4035

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
__________________________________________________________________________
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
[INDUSTRIAL area type                        ]
Rainfall intensity (I) =      2.922(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  14.78 min.  Rain intensity =       2.92(In/Hr)
Total area =        7.570(Ac.)  Total runoff =    23.880(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** SUBAREA FLOW ADDITION ****
__________________________________________________________________________
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
[INDUSTRIAL area type                        ]
Time of concentration =    14.78 min.
Rainfall intensity =      2.922(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.333(CFS) for    0.120(Ac.)
Total runoff =     24.213(CFS)   Total area =        7.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
__________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.690(Ac.)
```

```
Runoff from this stream =     24.213(CFS)
Time of concentration =   14.78 min.
Rainfall intensity =     2.922(In/Hr)
Summary of stream data:

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


1       24.213     14.78           2.922
Qmax(1) =
          1.000 *    1.000 *    24.213) + =      24.213

Total of 1 streams to confluence:
Flow rates before confluence point:
      24.213
Maximum flow rates at confluence using above data:
       24.213
Area of streams before confluence:
        7.690
Results of confluence:
Total flow rate =     24.213(CFS)
Time of concentration =    14.780 min.
Effective stream area after confluence =      7.690(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
________________________________________________________________________
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
[INDUSTRIAL area type                         ]
Rainfall intensity (I) =      2.922(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  14.78 min.  Rain intensity =       2.92(In/Hr)
Total area =       16.520(Ac.)  Total runoff =    21.630(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
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
[INDUSTRIAL area type                         ]
Time of concentration =    14.78 min.
Rainfall intensity =      2.922(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.416(CFS) for    0.150(Ac.)
Total runoff =     22.046(CFS)   Total area =       16.67(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   481.280(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =   458.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.046(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
```

```
The approximate hydraulic grade line above the pipe invert is
     2.986(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      4.348(Ft.)
 Minor friction loss =      0.918(Ft.)  K-factor =   1.20
Pipe flow velocity =      7.02(Ft/s)
Travel time through pipe =    1.09 min.
Time of concentration (TC) =    15.87 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     16.670(Ac.)
Runoff from this stream =     22.046(CFS)
Time of concentration =   15.87 min.
Rainfall intensity =     2.842(In/Hr)
Summary of stream data:

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


1       24.213     14.78           2.922
2       22.046     15.87           2.842
Qmax(1) =
          1.000 *    1.000 *    24.213) +
          1.000 *    0.931 *    22.046) + =      44.748
Qmax(2) =
          0.973 *    1.000 *    24.213) +
          1.000 *    1.000 *    22.046) + =      45.599

Total of 2 streams to confluence:
Flow rates before confluence point:
      24.213      22.046
Maximum flow rates at confluence using above data:
       44.748       45.599
Area of streams before confluence:
        7.690       16.670
Results of confluence:
Total flow rate =     45.599(CFS)
Time of concentration =    15.868 min.
Effective stream area after confluence =     24.360(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   478.200(Ft.)
Downstream point/station elevation =   476.260(Ft.)
Pipe length  =   283.00(Ft.)   Manning's N = 0.013
No. of pipes = 3  Required pipe flow  =    45.599(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    15.200(CFS)
Normal flow depth in pipe =   16.41(In.)
Flow top width inside pipe =   22.32(In.)
Critical Depth =   16.86(In.)
Pipe flow velocity =      6.64(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =    16.58 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
```

```
Upstream point/station elevation =   476.260(Ft.)
Downstream point/station elevation =   475.150(Ft.)
Pipe length  =   221.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    45.599(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    45.599(CFS)
Normal flow depth in pipe =   28.41(In.)
Flow top width inside pipe =   29.37(In.)
Critical Depth =   26.41(In.)
Pipe flow velocity =      7.62(Ft/s)
Travel time through pipe =    0.48 min.
Time of concentration (TC) =    17.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station       50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   475.150(Ft.)
Downstream point/station elevation =   475.000(Ft.)
Pipe length  =    29.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    45.599(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    45.599(CFS)
Normal flow depth in pipe =   28.03(In.)
Flow top width inside pipe =   29.89(In.)
Critical Depth =   26.41(In.)
Pipe flow velocity =      7.72(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    17.12 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        8.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =   98.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.350(Ft.)
Elevation difference =    0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(  98.000^.5)/( 0.357^(1/3)]=   5.53
Rainfall intensity (I) =      4.215(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.853(CFS)
Total initial stream area =        0.230(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   482.350(Ft.)
Downstream point/station elevation =   481.270(Ft.)
Pipe length  =   208.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.853(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.853(CFS)
Normal flow depth in pipe =    5.24(In.)
Flow top width inside pipe =    9.99(In.)
Critical Depth =    4.90(In.)
Pipe flow velocity =      2.95(Ft/s)
Travel time through pipe =    1.17 min.
```

```
Time of concentration (TC) =     6.70 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        9.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     6.70 min.
Rainfall intensity =      3.911(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.960(CFS) for    0.860(Ac.)
Total runoff =      3.813(CFS)   Total area =        1.09(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   481.270(Ft.)
Downstream point/station elevation =   480.310(Ft.)
Pipe length  =   193.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.50(In.)
Flow top width inside pipe =   13.75(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.16(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     7.47 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   480.310(Ft.)
Downstream point/station elevation =   479.340(Ft.)
Pipe length  =   194.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.48(In.)
Flow top width inside pipe =   13.77(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.17(Ft/s)
Travel time through pipe =    0.78 min.
Time of concentration (TC) =     8.25 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   479.340(Ft.)
Downstream point/station elevation =   479.120(Ft.)
Pipe length  =    45.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.57(In.)
Flow top width inside pipe =   13.69(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.13(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     8.43 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      1.927(CFS) for    0.610(Ac.)
Total runoff =      5.740(CFS)   Total area =        1.70(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.253(CFS) for    0.080(Ac.)
Total runoff =      5.993(CFS)   Total area =        1.78(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.063(CFS) for    0.020(Ac.)
Total runoff =      6.056(CFS)   Total area =        1.80(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   479.120(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.056(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     6.056(CFS)
Normal flow depth in pipe =   12.54(In.)
Flow top width inside pipe =   16.55(In.)
Critical Depth =   11.40(In.)
Pipe flow velocity =      4.61(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     8.52 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.286(CFS) for    1.680(Ac.)
Total runoff =     11.342(CFS)   Total area =        3.48(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.947(CFS) for    1.890(Ac.)
Total runoff =     17.289(CFS)   Total area =        5.37(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      6.640(CFS) for    2.110(Ac.)
Total runoff =     23.929(CFS)   Total area =        7.48(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.192(CFS) for    1.650(Ac.)
Total runoff =     29.121(CFS)   Total area =        9.13(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      4.689(CFS) for    1.490(Ac.)
Total runoff =     33.810(CFS)   Total area =       10.62(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.077(CFS) for    0.660(Ac.)
Total runoff =     35.886(CFS)   Total area =       11.28(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
----------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
```

```
Stream flow area =     11.280(Ac.)
Runoff from this stream =     35.886(CFS)
Time of concentration =    8.52 min.
Rainfall intensity =     3.576(In/Hr)
Summary of stream data:

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


1       35.886      8.52           3.576
Qmax(1) =
          1.000 *    1.000 *    35.886) + =      35.886

Total of 1 main streams to confluence:
Flow rates before confluence point:
      35.886
Maximum flow rates at confluence using above data:
       35.886
Area of streams before confluence:
       11.280


Results of confluence:
Total flow rate =     35.886(CFS)
Time of concentration =     8.522 min.
Effective stream area after confluence  =     11.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 100.000^.5)/(   0.500^(1/3)]=   4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.888(CFS)
Total initial stream area =        0.230(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   482.250(Ft.)
Downstream point/station elevation =   481.100(Ft.)
Pipe length  =   233.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.888(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.888(CFS)
Normal flow depth in pipe =    5.45(In.)
Flow top width inside pipe =    9.96(In.)
Critical Depth =    5.01(In.)
Pipe flow velocity =      2.92(Ft/s)
Travel time through pipe =    1.33 min.
Time of concentration (TC) =     6.33 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     6.33 min.
Rainfall intensity =      3.997(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      1.161(CFS) for    0.330(Ac.)
Total runoff =      2.049(CFS)   Total area =        0.56(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------------
Upstream point/station elevation =   481.100(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =   416.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.049(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.049(CFS)
Normal flow depth in pipe =    8.19(In.)
Flow top width inside pipe =   11.17(In.)
Critical Depth =    7.33(In.)
Pipe flow velocity =      3.59(Ft/s)
Travel time through pipe =    1.93 min.
Time of concentration (TC) =     8.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
----------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      0.560(Ac.)
Runoff from this stream =      2.049(CFS)
Time of concentration =    8.26 min.
Rainfall intensity =     3.617(In/Hr)
Summary of stream data:

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


1       35.886      8.52           3.576
2        2.049      8.26           3.617
Qmax(1) =
          1.000 *    1.000 *    35.886) +
          0.989 *    1.000 *     2.049) + =      37.912
Qmax(2) =
          1.000 *    0.969 *    35.886) +
          1.000 *    1.000 *     2.049) + =      36.835

Total of 2 main streams to confluence:
Flow rates before confluence point:
      35.886       2.049
Maximum flow rates at confluence using above data:
       37.912       36.835
Area of streams before confluence:
       11.280        0.560


Results of confluence:
Total flow rate =     37.912(CFS)
Time of concentration =     8.522 min.
```

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Effective stream area after confluence  =     11.840(Ac.)


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Process from Point/Station       18.000 to Point/Station       19.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  128.000(Ft.)
Highest elevation =  484.850(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 128.000^.5)/( 0.508^(1/3)]=   5.62
Rainfall intensity (I) =      4.188(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.553(CFS)
Total initial stream area =        0.150(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       19.000 to Point/Station       20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   482.400(Ft.)
Downstream point/station elevation =   481.150(Ft.)
Pipe length  =   250.00(Ft.)   Manning's N = 0.013
No. of pipes = 2  Required pipe flow  =     0.553(CFS)
Given pipe size =      6.00(In.)
Calculated individual pipe flow  =     0.276(CFS)
Normal flow depth in pipe =    3.68(In.)
Flow top width inside pipe =    5.84(In.)
Critical Depth =    3.18(In.)
Pipe flow velocity =      2.18(Ft/s)
Travel time through pipe =    1.91 min.
Time of concentration (TC) =     7.52 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       19.000 to Point/Station       20.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.880 given for subarea
Time of concentration =     7.52 min.
Rainfall intensity =      3.744(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.174(CFS) for    0.660(Ac.)
Total runoff =      2.727(CFS)   Total area =        0.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   481.150(Ft.)
Downstream point/station elevation =   479.140(Ft.)
Pipe length  =   401.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.727(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     2.727(CFS)
Normal flow depth in pipe =    8.34(In.)
Flow top width inside pipe =   14.90(In.)
Critical Depth =    7.96(In.)
Pipe flow velocity =      3.89(Ft/s)
Travel time through pipe =    1.72 min.
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```
Time of concentration (TC) =     9.24 min.


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Process from Point/Station       20.000 to Point/Station       21.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     9.24 min.
Rainfall intensity =      3.472(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.611(CFS) for    0.200(Ac.)
Total runoff =      3.338(CFS)   Total area =        1.01(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     9.24 min.
Rainfall intensity =      3.472(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.244(CFS) for    0.080(Ac.)
Total runoff =      3.583(CFS)   Total area =        1.09(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   479.140(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =    15.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.583(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.583(CFS)
Normal flow depth in pipe =    8.14(In.)
Flow top width inside pipe =   14.94(In.)
Critical Depth =    9.18(In.)
Pipe flow velocity =      5.26(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     9.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.090(Ac.)
Runoff from this stream =      3.583(CFS)
Time of concentration =    9.29 min.
Rainfall intensity =     3.465(In/Hr)
Summary of stream data:

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


1       35.886      8.52           3.576
2        2.049      8.26           3.617
3        3.583      9.29           3.465
Qmax(1) =
          1.000 *    1.000 *    35.886) +
          0.989 *    1.000 *     2.049) +
```

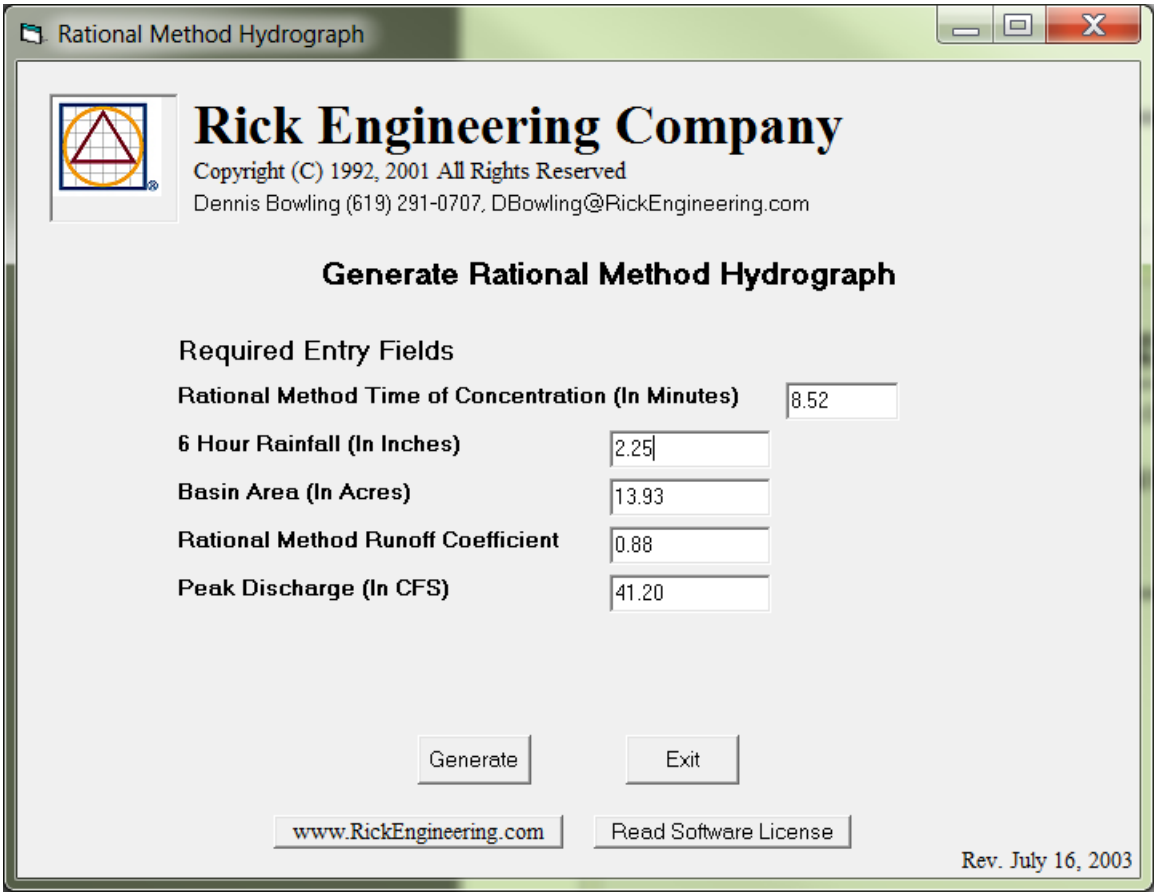
```
          1.000 *    0.917 *     3.583) + =      41.199
Qmax(2) =
          1.000 *    0.969 *    35.886) +
          1.000 *    1.000 *     2.049) +
          1.000 *    0.889 *     3.583) + =      40.021
Qmax(3) =
          0.969 *    1.000 *    35.886) +
          0.958 *    1.000 *     2.049) +
          1.000 *    1.000 *     3.583) + =      40.323

Total of 3 main streams to confluence:
Flow rates before confluence point:
      35.886       2.049       3.583
Maximum flow rates at confluence using above data:
       41.199       40.021       40.323
Area of streams before confluence:
       11.280        0.560        1.090


Results of confluence:
Total flow rate =     41.199(CFS)
Time of concentration =     8.522 min.
Effective stream area after confluence  =     12.930(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       41.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =  485.000(Ft.)
Lowest elevation =  476.800(Ft.)
Elevation difference =    8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 110.000^.5)/(   7.455^(1/3)]=   2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.772(CFS)
Total initial stream area =        0.200(Ac.)
End of computations, total study area =          37.490 (Ac.)
```

RAT HYDRO (Information and Results)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Rick Engineering Company
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Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.52
6 Hour Rainfall (In Inches)
2.25
Basin Area (In Acres)
13.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
41.20
Generate
Exit
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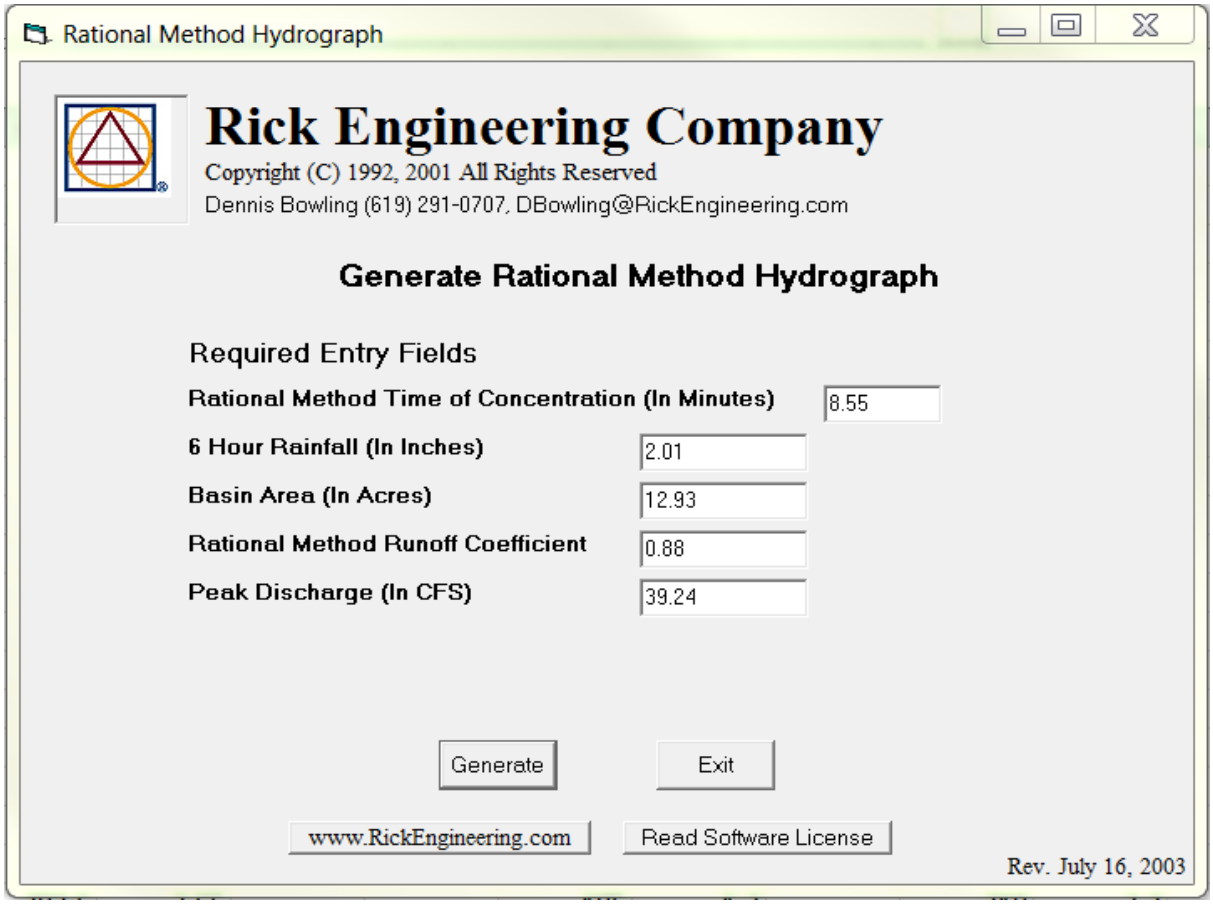
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Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.55
6 Hour Rainfall (In Inches)
2.01
Basin Area (In Acres)
12.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
39.24
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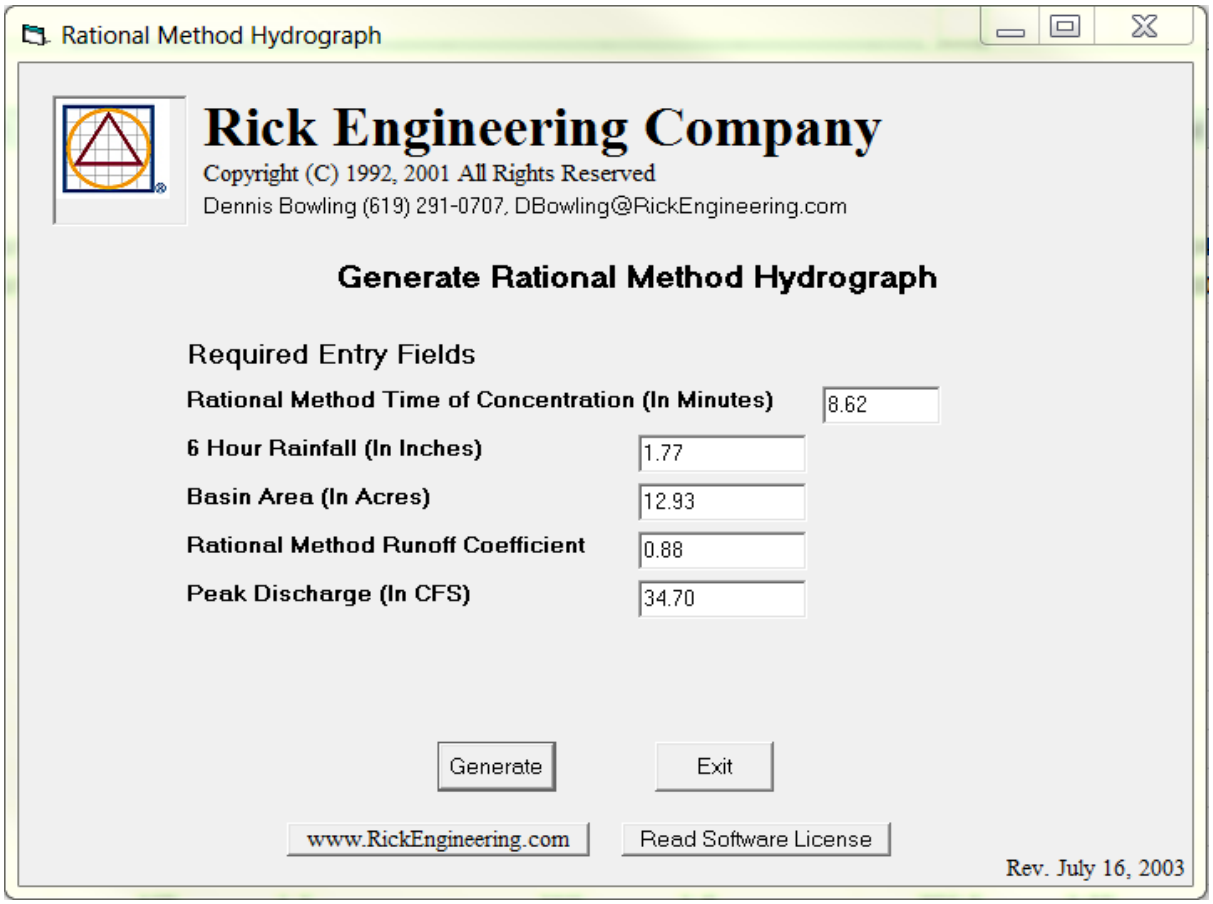
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Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.62
6 Hour Rainfall (In Inches)
1.77
Basin Area (In Acres)
12.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
34.70
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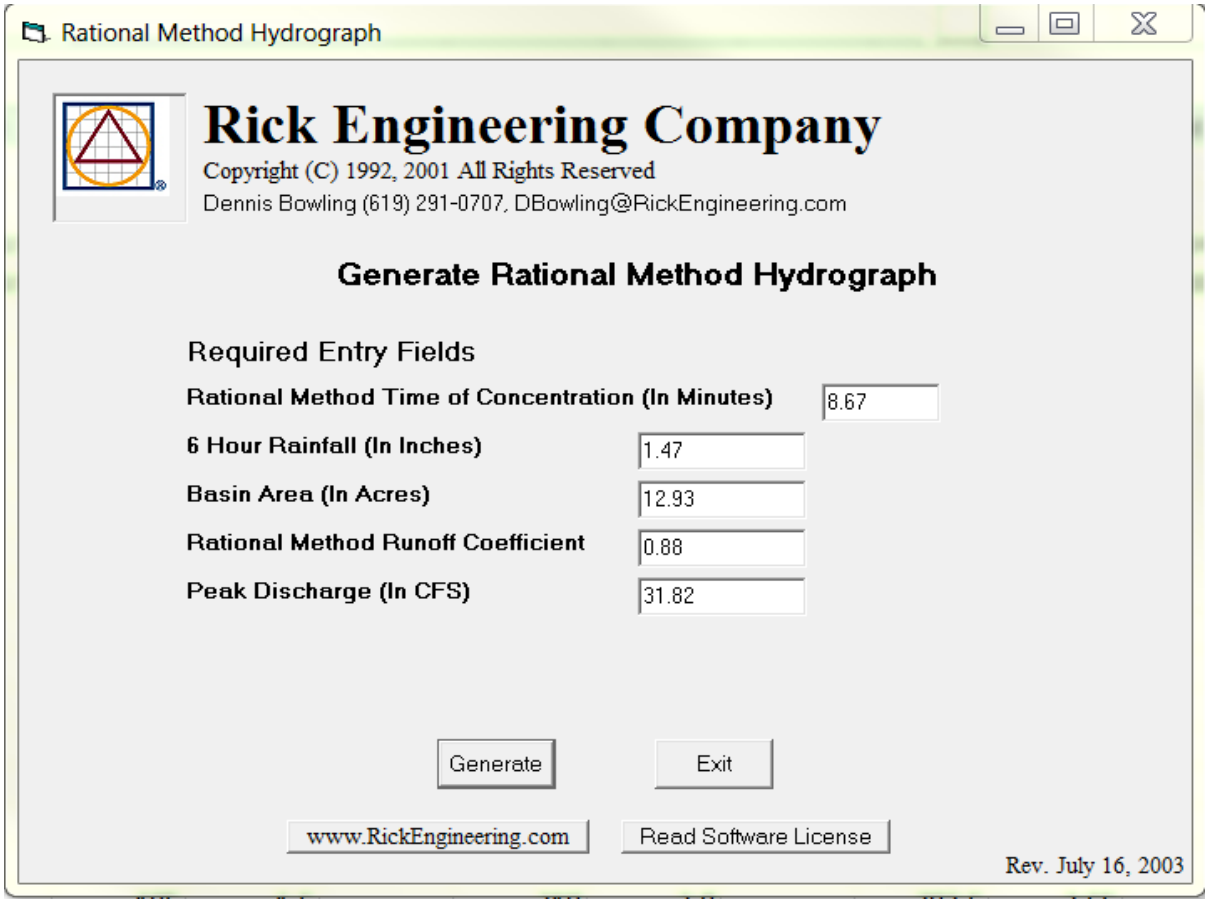
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Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.67
6 Hour Rainfall (In Inches)
1.47
Basin Area (In Acres)
12.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
31.82
Generate
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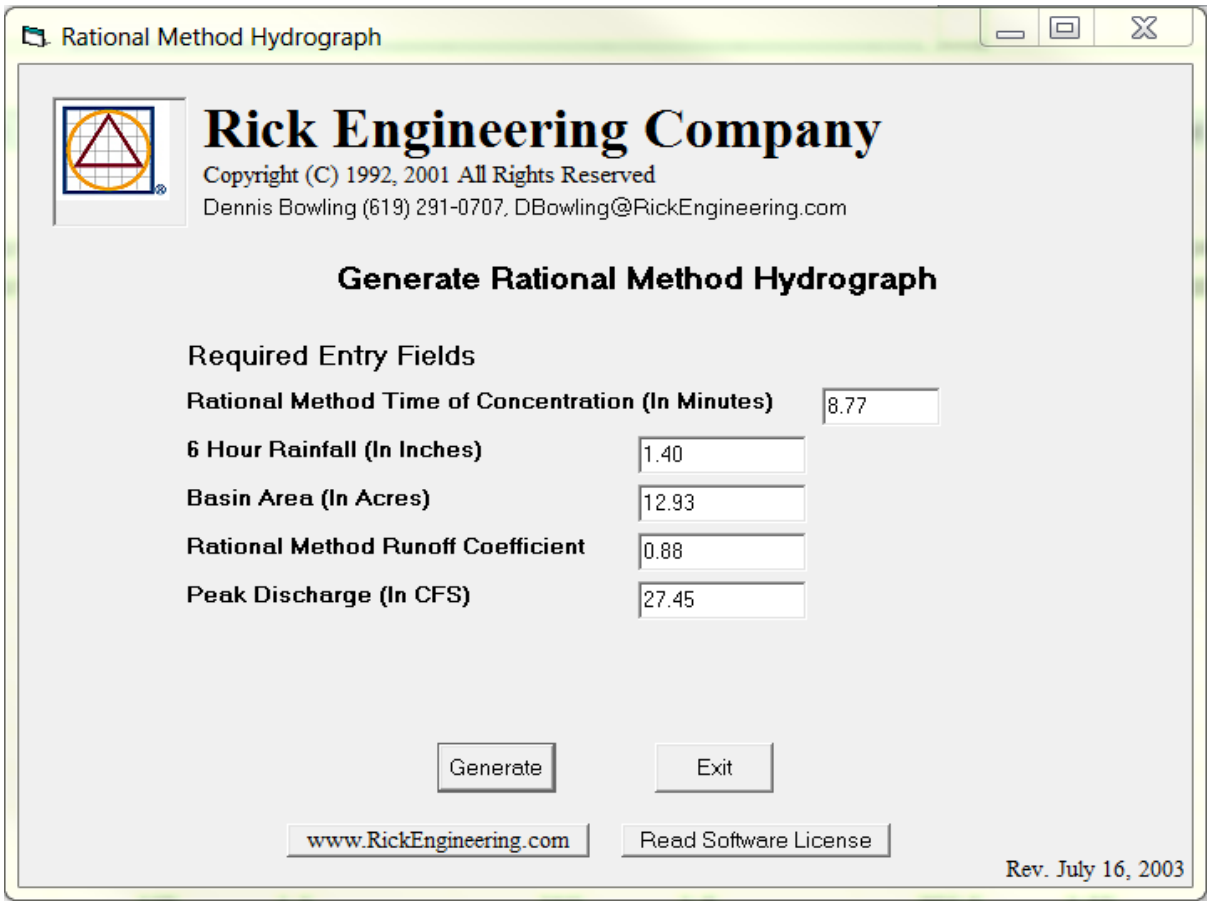
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Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.77
6 Hour Rainfall (In Inches)
1.40
Basin Area (In Acres)
12.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
27.45
Generate
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RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.4 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 27.45 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1
TIME (MIN) = 27	DISCHARGE (CFS) = 1
TIME (MIN) = 36	DISCHARGE (CFS) = 1
TIME (MIN) = 45	DISCHARGE (CFS) = 1
TIME (MIN) = 54	DISCHARGE (CFS) = 1.1
TIME (MIN) = 63	DISCHARGE (CFS) = 1.1
TIME (MIN) = 72	DISCHARGE (CFS) = 1.1
TIME (MIN) = 81	DISCHARGE (CFS) = 1.2
TIME (MIN) = 90	DISCHARGE (CFS) = 1.2
TIME (MIN) = 99	DISCHARGE (CFS) = 1.3
TIME (MIN) = 108	DISCHARGE (CFS) = 1.3
TIME (MIN) = 117	DISCHARGE (CFS) = 1.4
TIME (MIN) = 126	DISCHARGE (CFS) = 1.5
TIME (MIN) = 135	DISCHARGE (CFS) = 1.5
TIME (MIN) = 144	DISCHARGE (CFS) = 1.6
TIME (MIN) = 153	DISCHARGE (CFS) = 1.7
TIME (MIN) = 162	DISCHARGE (CFS) = 1.8
TIME (MIN) = 171	DISCHARGE (CFS) = 1.9
TIME (MIN) = 180	DISCHARGE (CFS) = 2.1
TIME (MIN) = 189	DISCHARGE (CFS) = 2.2
TIME (MIN) = 198	DISCHARGE (CFS) = 2.6
TIME (MIN) = 207	DISCHARGE (CFS) = 2.8
TIME (MIN) = 216	DISCHARGE (CFS) = 3.4
TIME (MIN) = 225	DISCHARGE (CFS) = 3.9
TIME (MIN) = 234	DISCHARGE (CFS) = 5.7
TIME (MIN) = 243	DISCHARGE (CFS) = 9.3
TIME (MIN) = 252	DISCHARGE (CFS) = 27.45
TIME (MIN) = 261	DISCHARGE (CFS) = 4.6
TIME (MIN) = 270	DISCHARGE (CFS) = 3.1
TIME (MIN) = 279	DISCHARGE (CFS) = 2.4
TIME (MIN) = 288	DISCHARGE (CFS) = 2
TIME (MIN) = 297	DISCHARGE (CFS) = 1.7
TIME (MIN) = 306	DISCHARGE (CFS) = 1.6
TIME (MIN) = 315	DISCHARGE (CFS) = 1.4
TIME (MIN) = 324	DISCHARGE (CFS) = 1.3
TIME (MIN) = 333	DISCHARGE (CFS) = 1.2
TIME (MIN) = 342	DISCHARGE (CFS) = 1.1
TIME (MIN) = 351	DISCHARGE (CFS) = 1.1
TIME (MIN) = 360	DISCHARGE (CFS) = 1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.47 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 31.82 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1
TIME (MIN) = 27	DISCHARGE (CFS) = 1
TIME (MIN) = 36	DISCHARGE (CFS) = 1.1
TIME (MIN) = 45	DISCHARGE (CFS) = 1.1
TIME (MIN) = 54	DISCHARGE (CFS) = 1.1
TIME (MIN) = 63	DISCHARGE (CFS) = 1.2
TIME (MIN) = 72	DISCHARGE (CFS) = 1.2
TIME (MIN) = 81	DISCHARGE (CFS) = 1.2
TIME (MIN) = 90	DISCHARGE (CFS) = 1.3
TIME (MIN) = 99	DISCHARGE (CFS) = 1.3
TIME (MIN) = 108	DISCHARGE (CFS) = 1.4
TIME (MIN) = 117	DISCHARGE (CFS) = 1.4
TIME (MIN) = 126	DISCHARGE (CFS) = 1.5
TIME (MIN) = 135	DISCHARGE (CFS) = 1.6
TIME (MIN) = 144	DISCHARGE (CFS) = 1.7
TIME (MIN) = 153	DISCHARGE (CFS) = 1.8
TIME (MIN) = 162	DISCHARGE (CFS) = 1.9
TIME (MIN) = 171	DISCHARGE (CFS) = 2
TIME (MIN) = 180	DISCHARGE (CFS) = 2.2
TIME (MIN) = 189	DISCHARGE (CFS) = 2.4
TIME (MIN) = 198	DISCHARGE (CFS) = 2.7
TIME (MIN) = 207	DISCHARGE (CFS) = 2.9
TIME (MIN) = 216	DISCHARGE (CFS) = 3.6
TIME (MIN) = 225	DISCHARGE (CFS) = 4.1
TIME (MIN) = 234	DISCHARGE (CFS) = 6
TIME (MIN) = 243	DISCHARGE (CFS) = 6.8
TIME (MIN) = 252	DISCHARGE (CFS) = 31.82
TIME (MIN) = 261	DISCHARGE (CFS) = 4.8
TIME (MIN) = 270	DISCHARGE (CFS) = 3.2
TIME (MIN) = 279	DISCHARGE (CFS) = 2.5
TIME (MIN) = 288	DISCHARGE (CFS) = 2.1
TIME (MIN) = 297	DISCHARGE (CFS) = 1.8
TIME (MIN) = 306	DISCHARGE (CFS) = 1.6
TIME (MIN) = 315	DISCHARGE (CFS) = 1.5
TIME (MIN) = 324	DISCHARGE (CFS) = 1.4
TIME (MIN) = 333	DISCHARGE (CFS) = 1.3
TIME (MIN) = 342	DISCHARGE (CFS) = 1.2
TIME (MIN) = 351	DISCHARGE (CFS) = 1.1
TIME (MIN) = 360	DISCHARGE (CFS) = 1.1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.77 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 34.7 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.2
TIME (MIN) = 27	DISCHARGE (CFS) = 1.2
TIME (MIN) = 36	DISCHARGE (CFS) = 1.3
TIME (MIN) = 45	DISCHARGE (CFS) = 1.3
TIME (MIN) = 54	DISCHARGE (CFS) = 1.4
TIME (MIN) = 63	DISCHARGE (CFS) = 1.4
TIME (MIN) = 72	DISCHARGE (CFS) = 1.5
TIME (MIN) = 81	DISCHARGE (CFS) = 1.5
TIME (MIN) = 90	DISCHARGE (CFS) = 1.6
TIME (MIN) = 99	DISCHARGE (CFS) = 1.6
TIME (MIN) = 108	DISCHARGE (CFS) = 1.7
TIME (MIN) = 117	DISCHARGE (CFS) = 1.7
TIME (MIN) = 126	DISCHARGE (CFS) = 1.8
TIME (MIN) = 135	DISCHARGE (CFS) = 1.9
TIME (MIN) = 144	DISCHARGE (CFS) = 2
TIME (MIN) = 153	DISCHARGE (CFS) = 2.1
TIME (MIN) = 162	DISCHARGE (CFS) = 2.3
TIME (MIN) = 171	DISCHARGE (CFS) = 2.4
TIME (MIN) = 180	DISCHARGE (CFS) = 2.7
TIME (MIN) = 189	DISCHARGE (CFS) = 2.8
TIME (MIN) = 198	DISCHARGE (CFS) = 3.2
TIME (MIN) = 207	DISCHARGE (CFS) = 3.5
TIME (MIN) = 216	DISCHARGE (CFS) = 4.3
TIME (MIN) = 225	DISCHARGE (CFS) = 4.9
TIME (MIN) = 234	DISCHARGE (CFS) = 7.2
TIME (MIN) = 243	DISCHARGE (CFS) = 11.8
TIME (MIN) = 252	DISCHARGE (CFS) = 34.7
TIME (MIN) = 261	DISCHARGE (CFS) = 5.8
TIME (MIN) = 270	DISCHARGE (CFS) = 3.9
TIME (MIN) = 279	DISCHARGE (CFS) = 3
TIME (MIN) = 288	DISCHARGE (CFS) = 2.5
TIME (MIN) = 297	DISCHARGE (CFS) = 2.2
TIME (MIN) = 306	DISCHARGE (CFS) = 2
TIME (MIN) = 315	DISCHARGE (CFS) = 1.8
TIME (MIN) = 324	DISCHARGE (CFS) = 1.6
TIME (MIN) = 333	DISCHARGE (CFS) = 1.5
TIME (MIN) = 342	DISCHARGE (CFS) = 1.4
TIME (MIN) = 351	DISCHARGE (CFS) = 1.3
TIME (MIN) = 360	DISCHARGE (CFS) = 1.3
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.01 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 39.24 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.4
TIME (MIN) = 27	DISCHARGE (CFS) = 1.4
TIME (MIN) = 36	DISCHARGE (CFS) = 1.5
TIME (MIN) = 45	DISCHARGE (CFS) = 1.5
TIME (MIN) = 54	DISCHARGE (CFS) = 1.6
TIME (MIN) = 63	DISCHARGE (CFS) = 1.6
TIME (MIN) = 72	DISCHARGE (CFS) = 1.7
TIME (MIN) = 81	DISCHARGE (CFS) = 1.7
TIME (MIN) = 90	DISCHARGE (CFS) = 1.8
TIME (MIN) = 99	DISCHARGE (CFS) = 1.8
TIME (MIN) = 108	DISCHARGE (CFS) = 1.9
TIME (MIN) = 117	DISCHARGE (CFS) = 2
TIME (MIN) = 126	DISCHARGE (CFS) = 2.1
TIME (MIN) = 135	DISCHARGE (CFS) = 2.2
TIME (MIN) = 144	DISCHARGE (CFS) = 2.3
TIME (MIN) = 153	DISCHARGE (CFS) = 2.4
TIME (MIN) = 162	DISCHARGE (CFS) = 2.6
TIME (MIN) = 171	DISCHARGE (CFS) = 2.7
TIME (MIN) = 180	DISCHARGE (CFS) = 3
TIME (MIN) = 189	DISCHARGE (CFS) = 3.2
TIME (MIN) = 198	DISCHARGE (CFS) = 3.7
TIME (MIN) = 207	DISCHARGE (CFS) = 4
TIME (MIN) = 216	DISCHARGE (CFS) = 4.9
TIME (MIN) = 225	DISCHARGE (CFS) = 5.6
TIME (MIN) = 234	DISCHARGE (CFS) = 8.2
TIME (MIN) = 243	DISCHARGE (CFS) = 13.5
TIME (MIN) = 252	DISCHARGE (CFS) = 39.24
TIME (MIN) = 261	DISCHARGE (CFS) = 6.6
TIME (MIN) = 270	DISCHARGE (CFS) = 4.4
TIME (MIN) = 279	DISCHARGE (CFS) = 3.4
TIME (MIN) = 288	DISCHARGE (CFS) = 2.9
TIME (MIN) = 297	DISCHARGE (CFS) = 2.5
TIME (MIN) = 306	DISCHARGE (CFS) = 2.2
TIME (MIN) = 315	DISCHARGE (CFS) = 2
TIME (MIN) = 324	DISCHARGE (CFS) = 1.9
TIME (MIN) = 333	DISCHARGE (CFS) = 1.7
TIME (MIN) = 342	DISCHARGE (CFS) = 1.6
TIME (MIN) = 351	DISCHARGE (CFS) = 1.5
TIME (MIN) = 360	DISCHARGE (CFS) = 1.4
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 7/19/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.25 INCHES
BASIN AREA 13.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 41.2 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.7
TIME (MIN) = 27	DISCHARGE (CFS) = 1.7
TIME (MIN) = 36	DISCHARGE (CFS) = 1.8
TIME (MIN) = 45	DISCHARGE (CFS) = 1.8
TIME (MIN) = 54	DISCHARGE (CFS) = 1.9
TIME (MIN) = 63	DISCHARGE (CFS) = 1.9
TIME (MIN) = 72	DISCHARGE (CFS) = 2
TIME (MIN) = 81	DISCHARGE (CFS) = 2
TIME (MIN) = 90	DISCHARGE (CFS) = 2.1
TIME (MIN) = 99	DISCHARGE (CFS) = 2.2
TIME (MIN) = 108	DISCHARGE (CFS) = 2.3
TIME (MIN) = 117	DISCHARGE (CFS) = 2.4
TIME (MIN) = 126	DISCHARGE (CFS) = 2.5
TIME (MIN) = 135	DISCHARGE (CFS) = 2.6
TIME (MIN) = 144	DISCHARGE (CFS) = 2.8
TIME (MIN) = 153	DISCHARGE (CFS) = 2.9
TIME (MIN) = 162	DISCHARGE (CFS) = 3.1
TIME (MIN) = 171	DISCHARGE (CFS) = 3.3
TIME (MIN) = 180	DISCHARGE (CFS) = 3.7
TIME (MIN) = 189	DISCHARGE (CFS) = 3.9
TIME (MIN) = 198	DISCHARGE (CFS) = 4.4
TIME (MIN) = 207	DISCHARGE (CFS) = 4.8
TIME (MIN) = 216	DISCHARGE (CFS) = 5.9
TIME (MIN) = 225	DISCHARGE (CFS) = 6.7
TIME (MIN) = 234	DISCHARGE (CFS) = 9.8
TIME (MIN) = 243	DISCHARGE (CFS) = 22.4
TIME (MIN) = 252	DISCHARGE (CFS) = 41.2
TIME (MIN) = 261	DISCHARGE (CFS) = 7.9
TIME (MIN) = 270	DISCHARGE (CFS) = 5.3
TIME (MIN) = 279	DISCHARGE (CFS) = 4.1
TIME (MIN) = 288	DISCHARGE (CFS) = 3.5
TIME (MIN) = 297	DISCHARGE (CFS) = 3
TIME (MIN) = 306	DISCHARGE (CFS) = 2.7
TIME (MIN) = 315	DISCHARGE (CFS) = 2.4
TIME (MIN) = 324	DISCHARGE (CFS) = 2.2
TIME (MIN) = 333	DISCHARGE (CFS) = 2.1
TIME (MIN) = 342	DISCHARGE (CFS) = 1.9
TIME (MIN) = 351	DISCHARGE (CFS) = 1.8
TIME (MIN) = 360	DISCHARGE (CFS) = 1.7
TIME (MIN) = 369	DISCHARGE (CFS) = 0

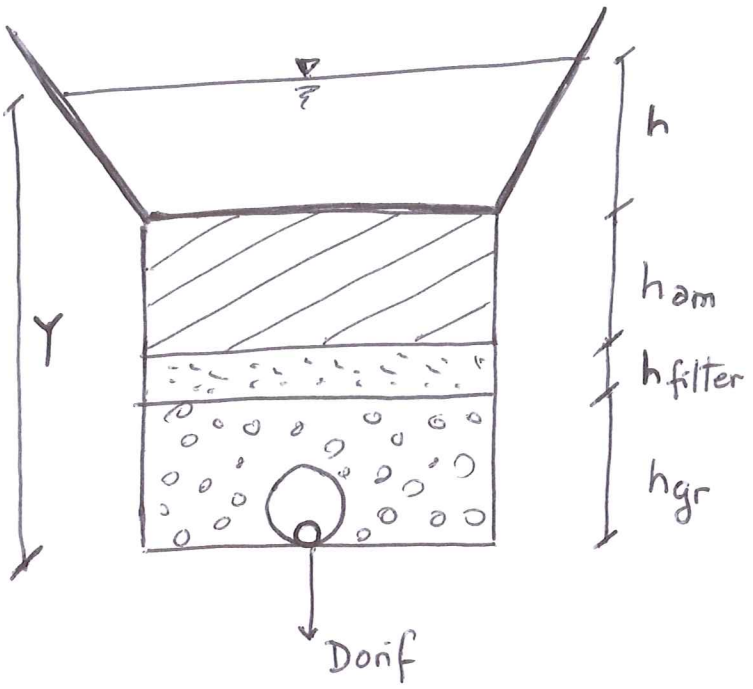
ELEVATION vs DISCHARGE vs VOLUME TABLE

Elevation vs Discharge vs Volume for Overall BMP

(measured from invert of low-flow orifice)

h (ft)	$Q_{orif+soil}$ (cfs)	Q_{Slot} (cfs)	Q_{emer} (cfs)	Q_{TOT} (cfs)	Vol (ft^3)
0.00	0.000	0	0	**0.00**	**0**
0.25	0.112	0	0	**0.11**	**1430**
0.50	0.212	0	0	**0.21**	**2886**
0.75	0.279	0	0	**0.28**	**4370**
1.00	0.332	0	0	**0.33**	**5880**
1.25	0.378	0	0	**0.38**	**7416**
1.50	0.418	0	0	**0.42**	**8980**
1.75	0.456	0	0	**0.46**	**10570**
2.00	0.479	0	0	**0.48**	**11782**
2.25	0.500	0	0	**0.50**	**13015**
2.50	0.519	0	0	**0.52**	**14268**
2.75	0.537	0	0	**0.54**	**15541**
3.00	0.554	0	0	**0.55**	**16833**
3.25	0.569	0	0	**0.57**	**18146**
3.50	0.584	0	0	**0.58**	**19479**
3.75	0.598	0	0	**0.60**	**20832**
4.00	0.621	0	0	**0.62**	**22506**
4.25	0.644	0	0	**0.64**	**26097**
4.50	0.665	0	0	**0.67**	**29802**
4.58	0.672	0.534	0	**1.21**	**31062**
4.67	0.679	1.512	0	**2.19**	**32335**
4.75	0.686	2.777	0	**3.46**	**33620**
4.83	0.693	4.276	0	**4.97**	**34918**
4.92	0.700	5.975	0	**6.68**	**36229**
5.00	0.707	7.855	0	**8.56**	**37552**
5.08	0.714	9.898	0	**10.61**	**38888**
5.17	0.720	11.323	0	**12.04**	**40236**
5.25	0.727	12.404	0	**13.13**	**41597**
5.33	0.734	13.397	0	**14.13**	**42971**
5.42	0.740	14.322	0	**15.06**	**44358**
5.50	0.747	15.191	0	**15.94**	**45757**
5.58	0.753	16.013	0	**16.77**	**47168**
5.67	0.760	16.794	0	**17.55**	**48592**
5.75	0.766	17.541	0	**18.31**	**50029**
5.83	0.772	18.257	1.790	**20.82**	**51479**
5.92	0.778	18.947	5.062	**24.79**	**52941**
6.00	0.785	19.612	9.300	**29.70**	**54415**
6.08	0.791	20.255	14.318	**35.36**	**55903**
6.17	0.797	20.878	20.010	**41.69**	**57403**
6.25	0.803	21.484	26.304	**48.59**	**58915**
6.33	0.809	22.072	33.147	**56.03**	**60440**
6.42	0.815	22.646	40.498	**63.96**	**61978**
6.50	0.821	23.205	48.324	**72.35**	**63529**
6.58	0.827	23.751	56.598	**81.18**	**65092**
6.67	0.833	24.285	65.297	**90.41**	**66667**
6.75	0.839	24.807	74.400	**100.05**	**68256**

Discharge thru orifice with energy losses in Amended Soil (getting $Q_{orif+soil} = Q$).



Assumptions:

- Friction loss thru French Drain is negligible
- Energy loss on filter layer & gravel layer is negligible compared to that of amended soil.

Δh: loss by flow thru amended soil.

fi: Infiltration thru amended soil.

Solving problem:

Darcy's law flow = orifice equation flow (including losses)

$$(1)\quad Q = fi \cdot \frac{\Delta h}{ham} \cdot A_{BMP} = cg \cdot \frac{\pi D_o^2}{4} \sqrt{2g\left(h_{gr} + h_{filter} + ham + h - \Delta h - Dorif/2\right)}$$

Δh: becomes a quadratic eq. with a solution.

Once Δh is known, Q is obtained (Q = flow thru orifice).

Scenarios:

(a): $Y \le h_{gr} + h_{filter}$: Use orifice equation.

(b): $h_{gr} + h_{filter} < Y \le ham + h_{filter} + h_{gr}$: Use (1) with $h = 0$

and $ham + h_{gr} + h_{filter} = Y$

(c) $Y > ham + h_{filter} + h_{gr}$: use (1) as given.

Discharge thru Slot. (Q_{slot})

$$Q_{slot} = 3.1 \cdot (h_{slot})^{1.5} \cdot B$$

h_{slot} = Elevation over slot invert when $h_{slot} \leq 0.5$ ft

(Slot dimensions: $H = 0.5$ ft; $B = 7.17$ ft
$B = 86''$)

When $h_{slot} \geq H$ then:

$$Q_{slot} = MIN\left[3.1 \cdot (h_{slot})^{1.5} \cdot B,\ 0.61 \cdot B \cdot H \cdot \sqrt{2g\left(h_{slot} - \frac{H}{2}\right)} \right]$$

Note: Per HMP Document, all slots are combined
(B = 63" North + 23" South = 86" = 7.17 ft; H = 0.5 ft in all cases).

Discharge thru Weir. (Q_{emer})

$$Q_{emerg} = 3.1 \cdot (h_{emer})^{1.5} \cdot B_{emer}$$

h_{emer} = Elevation over risers invert (risers of North & South at same elevation)

$B_{emer} = 16'$ (North) $+ 8'$ (South) $= 24'$.

Note: Per HMP Document, emergency overflows (N & S) are combined.

ROUTING RESULTS (100, 50, 25, 10 and 5 yr Storms)

MODIFIED PULS

RESULTS: Routing of 6 hr - 5 yr Total Hydrograph in BMP-1

Max outflow: 13.57 cfs

Max elevation in pond: 5.29 ft (Elevation)

Vol-out: 86821 cu-ft

h_{max} over surface: 1.54 ft

initial elev: 4.50 ft

Peak flow in: 27.450 cfs

Vol in: 57051 cu-ft

Pond Storm: 6 hr - 5 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.00	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.00	2.00	0.000	0.0	109.98	111.38	0.700	29883	4.505
0.45	1.00	2.00	0.000	0.0	110.45	111.98	0.762	30028	4.515
0.60	1.00	2.00	0.000	0.0	110.83	112.45	0.812	30143	4.523
0.75	1.00	2.10	0.000	0.0	111.13	112.83	0.851	30234	4.529
0.90	1.10	2.20	0.000	0.0	111.44	113.23	0.892	30330	4.535
1.05	1.10	2.20	0.000	0.0	111.77	113.64	0.936	30431	4.542
1.20	1.10	2.30	0.000	0.0	112.03	113.97	0.970	30510	4.547
1.35	1.20	2.40	0.000	0.0	112.32	114.33	1.007	30598	4.553
1.50	1.20	2.50	0.000	0.0	112.62	114.72	1.047	30691	4.559
1.65	1.30	2.60	0.000	0.0	112.94	115.12	1.089	30789	4.565
1.80	1.30	2.70	0.000	0.0	113.28	115.54	1.133	30891	4.572
1.95	1.40	2.90	0.000	0.0	113.62	115.98	1.178	30996	4.579
2.10	1.50	3.00	0.000	0.0	114.01	116.52	1.253	31122	4.587
2.25	1.50	3.10	0.000	0.0	114.34	117.01	1.339	31232	4.594
2.40	1.60	3.30	0.000	0.0	114.61	117.44	1.412	31327	4.601
2.55	1.70	3.50	0.000	0.0	114.93	117.91	1.494	31433	4.608
2.70	1.80	3.70	0.000	0.0	115.26	118.43	1.582	31548	4.615
2.85	1.90	4.00	0.000	0.0	115.61	118.96	1.675	31667	4.623
3.00	2.10	4.30	0.000	0.0	116.04	119.61	1.787	31812	4.632
3.15	2.20	4.80	0.000	0.0	116.51	120.34	1.913	31974	4.643
3.30	2.60	5.40	0.000	0.0	117.15	121.31	2.081	32192	4.657
3.45	2.80	6.20	0.000	0.0	117.91	122.55	2.318	32463	4.675
3.60	3.40	7.30	0.000	0.0	118.82	124.11	2.648	32796	4.697
3.75	3.90	9.60	0.000	0.0	119.98	126.12	3.070	33223	4.724
3.90	5.70	15.00	0.000	0.0	121.89	129.58	3.844	33948	4.771
4.05	9.30	36.75	0.000	0.0	125.60	136.89	5.644	35436	4.866
4.20	27.45	32.05	0.000	0.0	137.81	162.35	12.271	40522	5.184
4.35	4.60	7.70	0.000	0.0	142.72	169.86	13.568	42199	5.286
4.50	3.10	5.50	0.000	0.0	131.67	150.42	9.376	38083	5.033
4.65	2.40	4.40	0.000	0.0	125.74	137.17	5.717	35492	4.870
4.80	2.00	3.70	0.000	0.0	122.18	130.14	3.977	34063	4.778
4.95	1.70	3.30	0.000	0.0	119.84	125.88	3.021	33173	4.721
5.10	1.60	3.00	0.000	0.0	118.26	123.14	2.442	32589	4.683
5.25	1.40	2.70	0.000	0.0	117.11	121.26	2.071	32180	4.657
5.40	1.30	2.50	0.000	0.0	116.17	119.81	1.822	31858	4.635
5.55	1.20	2.30	0.000	0.0	115.42	118.67	1.624	31602	4.619
5.70	1.10	2.20	0.000	0.0	114.80	117.72	1.461	31390	4.605
5.85	1.10	2.10	0.000	0.0	114.33	117.00	1.336	31229	4.594
6.00	1.00	1.00	0.000	0.0	113.95	116.43	1.237	31101	4.586
6.15	0.00	0.00	0.000	0.0	112.81	114.95	1.072	30748	4.563
6.30	0.00	0.00	0.000	0.0	111.11	112.81	0.849	30229	4.528
6.45	0.00	0.00	0.000	0.0	109.77	111.11	0.672	29818	4.501
6.60	0.00	0.00	0.000	0.0	108.44	109.77	0.663	29458	4.477
6.75	0.00	0.00	0.000	0.0	107.12	108.44	0.661	29100	4.453
6.90	0.00	0.00	0.000	0.0	105.80	107.12	0.659	28744	4.429

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	104.49	105.80	0.657	28389	4.405
7.20	0.00	0.00	0.000	0.0	103.18	104.49	0.655	28034	4.381
7.35	0.00	0.00	0.000	0.0	101.87	103.18	0.653	27681	4.357
7.50	0.00	0.00	0.000	0.0	100.57	101.87	0.651	27329	4.333
7.65	0.00	0.00	0.000	0.0	99.27	100.57	0.649	26979	4.309
7.80	0.00	0.00	0.000	0.0	97.98	99.27	0.647	26629	4.286
7.95	0.00	0.00	0.000	0.0	96.69	97.98	0.645	26280	4.262
8.10	0.00	0.00	0.000	0.0	95.40	96.69	0.642	25933	4.239
8.25	0.00	0.00	0.000	0.0	94.12	95.40	0.640	25586	4.214
8.40	0.00	0.00	0.000	0.0	92.85	94.12	0.638	25241	4.190
8.55	0.00	0.00	0.000	0.0	91.58	92.85	0.636	24897	4.166
8.70	0.00	0.00	0.000	0.0	90.31	91.58	0.634	24554	4.143
8.85	0.00	0.00	0.000	0.0	89.04	90.31	0.632	24213	4.119
9.00	0.00	0.00	0.000	0.0	87.79	89.04	0.630	23872	4.095
9.15	0.00	0.00	0.000	0.0	86.53	87.79	0.627	23533	4.071
9.30	0.00	0.00	0.000	0.0	85.28	86.53	0.625	23194	4.048
9.45	0.00	0.00	0.000	0.0	84.03	85.28	0.623	22857	4.024
9.60	0.00	0.00	0.000	0.0	82.79	84.03	0.621	22521	4.001
9.75	0.00	0.00	0.000	0.0	81.56	82.79	0.617	22187	3.952
9.90	0.00	0.00	0.000	0.0	80.33	81.56	0.612	21855	3.903
10.05	0.00	0.00	0.000	0.0	79.12	80.33	0.607	21526	3.854
10.20	0.00	0.00	0.000	0.0	77.91	79.12	0.603	21199	3.805
10.35	0.00	0.00	0.000	0.0	76.72	77.91	0.598	20875	3.756
10.50	0.00	0.00	0.000	0.0	75.53	76.72	0.595	20553	3.698
10.65	0.00	0.00	0.000	0.0	74.34	75.53	0.592	20232	3.639
10.80	0.00	0.00	0.000	0.0	73.17	74.34	0.588	19914	3.580
10.95	0.00	0.00	0.000	0.0	72.00	73.17	0.585	19597	3.522
11.10	0.00	0.00	0.000	0.0	70.83	72.00	0.582	19282	3.463
11.25	0.00	0.00	0.000	0.0	69.68	70.83	0.578	18969	3.404
11.40	0.00	0.00	0.000	0.0	68.53	69.68	0.575	18657	3.346
11.55	0.00	0.00	0.000	0.0	67.38	68.53	0.571	18348	3.288
11.70	0.00	0.00	0.000	0.0	66.25	67.38	0.568	18040	3.230
11.85	0.00	0.00	0.000	0.0	65.12	66.25	0.564	17734	3.172
12.00	0.00	0.00	0.000	0.0	64.00	65.12	0.561	17431	3.114
12.15	0.00	0.00	0.000	0.0	62.88	64.00	0.557	17129	3.056
12.30	0.00	0.00	0.000	0.0	61.78	62.88	0.553	16829	2.999
12.45	0.00	0.00	0.000	0.0	60.68	61.78	0.550	16531	2.942
12.60	0.00	0.00	0.000	0.0	59.59	60.68	0.546	16236	2.884
12.75	0.00	0.00	0.000	0.0	58.50	59.59	0.542	15942	2.828
12.90	0.00	0.00	0.000	0.0	57.43	58.50	0.538	15650	2.771
13.05	0.00	0.00	0.000	0.0	56.36	57.43	0.534	15361	2.715
13.20	0.00	0.00	0.000	0.0	55.30	56.36	0.530	15073	2.658
13.35	0.00	0.00	0.000	0.0	54.24	55.30	0.526	14788	2.602
13.50	0.00	0.00	0.000	0.0	53.20	54.24	0.522	14505	2.547
13.65	0.00	0.00	0.000	0.0	52.16	53.20	0.518	14224	2.491
13.80	0.00	0.00	0.000	0.0	51.14	52.16	0.514	13945	2.436
13.95	0.00	0.00	0.000	0.0	50.12	51.14	0.510	13669	2.380
14.10	0.00	0.00	0.000	0.0	49.11	50.12	0.505	13395	2.326
14.25	0.00	0.00	0.000	0.0	48.10	49.11	0.501	13123	2.272
14.40	0.00	0.00	0.000	0.0	47.11	48.10	0.497	12854	2.217
14.55	0.00	0.00	0.000	0.0	46.12	47.11	0.492	12586	2.163
14.70	0.00	0.00	0.000	0.0	45.15	46.12	0.488	12322	2.109

MODIFIED PULS

RESULTS: Routing of 6 hr - 10 yr Total Hydrograph in BMP-1

Max outflow: 14.41 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.36 ft (Elevation) — Peak flow in: 31.820 cfs

Vol-out: 89559 cu-ft — Vol in: 59789 cu-ft

h_{max} over surface: 1.61 ft

Pond Storm: 6 hr - 10 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.00	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.00	2.00	0.000	0.0	109.98	111.38	0.700	29883	4.505
0.45	1.00	2.10	0.000	0.0	110.45	111.98	0.762	30028	4.515
0.60	1.10	2.20	0.000	0.0	110.91	112.55	0.822	30167	4.524
0.75	1.10	2.20	0.000	0.0	111.35	113.11	0.880	30301	4.533
0.90	1.10	2.30	0.000	0.0	111.70	113.55	0.926	30408	4.540
1.05	1.20	2.40	0.000	0.0	112.05	114.00	0.972	30516	4.547
1.20	1.20	2.20	0.000	0.0	112.41	114.45	1.020	30627	4.555
1.35	1.00	2.30	0.000	0.0	112.54	114.61	1.036	30665	4.557
1.50	1.30	2.60	0.000	0.0	112.72	114.84	1.060	30720	4.561
1.65	1.30	2.70	0.000	0.0	113.10	115.32	1.110	30837	4.568
1.80	1.40	2.80	0.000	0.0	113.48	115.80	1.160	30953	4.576
1.95	1.40	2.90	0.000	0.0	113.86	116.28	1.212	31068	4.584
2.10	1.50	3.10	0.000	0.0	114.17	116.76	1.294	31175	4.591
2.25	1.60	3.30	0.000	0.0	114.50	117.27	1.382	31289	4.598
2.40	1.70	3.50	0.000	0.0	114.85	117.80	1.475	31409	4.606
2.55	1.80	3.70	0.000	0.0	115.21	118.35	1.570	31532	4.614
2.70	1.90	3.90	0.000	0.0	115.58	118.91	1.667	31657	4.622
2.85	2.00	4.20	0.000	0.0	115.95	119.48	1.765	31783	4.631
3.00	2.20	4.60	0.000	0.0	116.39	120.15	1.880	31933	4.640
3.15	2.40	5.10	0.000	0.0	116.94	120.99	2.025	32120	4.653
3.30	2.70	5.60	0.000	0.0	117.62	122.04	2.210	32354	4.668
3.45	2.90	6.50	0.000	0.0	118.30	123.22	2.459	32605	4.684
3.60	3.60	7.70	0.000	0.0	119.22	124.80	2.793	32942	4.706
3.75	4.10	10.10	0.000	0.0	120.44	126.92	3.239	33393	4.735
3.90	6.00	12.80	0.000	0.0	122.39	130.54	4.073	34146	4.784
4.05	6.80	38.62	0.000	0.0	124.79	135.19	5.202	35097	4.845
4.20	31.82	36.62	0.000	0.0	138.49	163.41	12.459	40756	5.198
4.35	4.80	8.00	0.000	0.0	146.29	175.11	14.412	43389	5.358
4.50	3.20	5.70	0.000	0.0	133.27	154.29	10.508	38820	5.079
4.65	2.50	4.60	0.000	0.0	126.60	138.97	6.185	35852	4.893
4.80	2.10	3.90	0.000	0.0	122.74	131.20	4.231	34282	4.792
4.95	1.80	3.40	0.000	0.0	120.28	126.64	3.180	33334	4.731
5.10	1.60	3.10	0.000	0.0	118.57	123.68	2.556	32703	4.691
5.25	1.50	2.90	0.000	0.0	117.38	121.67	2.142	32272	4.663
5.40	1.40	2.70	0.000	0.0	116.48	120.28	1.903	31962	4.642
5.55	1.30	2.50	0.000	0.0	115.75	119.18	1.712	31715	4.626
5.70	1.20	2.30	0.000	0.0	115.15	118.25	1.552	31509	4.613
5.85	1.10	2.20	0.000	0.0	114.62	117.45	1.413	31329	4.601
6.00	1.10	1.10	0.000	0.0	114.21	116.82	1.305	31189	4.592
6.15	0.00	0.00	0.000	0.0	113.09	115.31	1.109	30834	4.568
6.30	0.00	0.00	0.000	0.0	111.34	113.09	0.878	30298	4.533
6.45	0.00	0.00	0.000	0.0	109.94	111.34	0.696	29873	4.505
6.60	0.00	0.00	0.000	0.0	108.62	109.94	0.663	29506	4.480
6.75	0.00	0.00	0.000	0.0	107.29	108.62	0.661	29148	4.456
6.90	0.00	0.00	0.000	0.0	105.98	107.29	0.659	28791	4.432

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	104.66	105.98	0.657	28436	4.408
7.20	0.00	0.00	0.000	0.0	103.35	104.66	0.655	28082	4.384
7.35	0.00	0.00	0.000	0.0	102.04	103.35	0.653	27728	4.360
7.50	0.00	0.00	0.000	0.0	100.74	102.04	0.651	27376	4.336
7.65	0.00	0.00	0.000	0.0	99.45	100.74	0.649	27025	4.313
7.80	0.00	0.00	0.000	0.0	98.15	99.45	0.647	26676	4.289
7.95	0.00	0.00	0.000	0.0	96.86	98.15	0.645	26327	4.266
8.10	0.00	0.00	0.000	0.0	95.58	96.86	0.643	25979	4.242
8.25	0.00	0.00	0.000	0.0	94.29	95.58	0.641	25633	4.218
8.40	0.00	0.00	0.000	0.0	93.02	94.29	0.638	25287	4.194
8.55	0.00	0.00	0.000	0.0	91.75	93.02	0.636	24943	4.170
8.70	0.00	0.00	0.000	0.0	90.48	91.75	0.634	24600	4.146
8.85	0.00	0.00	0.000	0.0	89.21	90.48	0.632	24258	4.122
9.00	0.00	0.00	0.000	0.0	87.95	89.21	0.630	23918	4.098
9.15	0.00	0.00	0.000	0.0	86.70	87.95	0.628	23578	4.075
9.30	0.00	0.00	0.000	0.0	85.45	86.70	0.626	23240	4.051
9.45	0.00	0.00	0.000	0.0	84.20	85.45	0.623	22902	4.028
9.60	0.00	0.00	0.000	0.0	82.96	84.20	0.621	22566	4.004
9.75	0.00	0.00	0.000	0.0	81.72	82.96	0.617	22232	3.959
9.90	0.00	0.00	0.000	0.0	80.50	81.72	0.613	21900	3.909
10.05	0.00	0.00	0.000	0.0	79.28	80.50	0.608	21570	3.860
10.20	0.00	0.00	0.000	0.0	78.07	79.28	0.604	21243	3.811
10.35	0.00	0.00	0.000	0.0	76.88	78.07	0.599	20918	3.763
10.50	0.00	0.00	0.000	0.0	75.69	76.88	0.595	20596	3.706
10.65	0.00	0.00	0.000	0.0	74.50	75.69	0.592	20275	3.647
10.80	0.00	0.00	0.000	0.0	73.32	74.50	0.589	19956	3.588
10.95	0.00	0.00	0.000	0.0	72.15	73.32	0.586	19639	3.530
11.10	0.00	0.00	0.000	0.0	70.99	72.15	0.582	19324	3.471
11.25	0.00	0.00	0.000	0.0	69.83	70.99	0.579	19010	3.412
11.40	0.00	0.00	0.000	0.0	68.68	69.83	0.575	18699	3.354
11.55	0.00	0.00	0.000	0.0	67.54	68.68	0.572	18389	3.296
11.70	0.00	0.00	0.000	0.0	66.40	67.54	0.568	18081	3.238
11.85	0.00	0.00	0.000	0.0	65.27	66.40	0.565	17775	3.179
12.00	0.00	0.00	0.000	0.0	64.15	65.27	0.561	17471	3.121
12.15	0.00	0.00	0.000	0.0	63.03	64.15	0.558	17169	3.064
12.30	0.00	0.00	0.000	0.0	61.92	63.03	0.554	16869	3.007
12.45	0.00	0.00	0.000	0.0	60.82	61.92	0.550	16571	2.949
12.60	0.00	0.00	0.000	0.0	59.73	60.82	0.546	16275	2.892
12.75	0.00	0.00	0.000	0.0	58.65	59.73	0.542	15981	2.835
12.90	0.00	0.00	0.000	0.0	57.57	58.65	0.539	15689	2.779
13.05	0.00	0.00	0.000	0.0	56.50	57.57	0.535	15399	2.722
13.20	0.00	0.00	0.000	0.0	55.44	56.50	0.531	15112	2.666
13.35	0.00	0.00	0.000	0.0	54.38	55.44	0.527	14826	2.610
13.50	0.00	0.00	0.000	0.0	53.34	54.38	0.523	14543	2.554
13.65	0.00	0.00	0.000	0.0	52.30	53.34	0.519	14261	2.499
13.80	0.00	0.00	0.000	0.0	51.27	52.30	0.515	13982	2.443
13.95	0.00	0.00	0.000	0.0	50.25	51.27	0.510	13706	2.388
14.10	0.00	0.00	0.000	0.0	49.24	50.25	0.506	13431	2.333
14.25	0.00	0.00	0.000	0.0	48.24	49.24	0.502	13159	2.279
14.40	0.00	0.00	0.000	0.0	47.24	48.24	0.497	12889	2.225
14.55	0.00	0.00	0.000	0.0	46.26	47.24	0.493	12622	2.170
14.70	0.00	0.00	0.000	0.0	45.28	46.26	0.488	12357	2.117

MODIFIED PULS

RESULTS: Routing of 6 hr - 25 yr Total Hydrograph in BMP-1

Max outflow: 16.13 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.52 ft (Elevation) — Peak flow in: 34.700 cfs

Vol-out: 101751 cu-ft — Vol in: 71982 cu-ft

h_{max} over surface: 1.77 ft

Pond Storm: 6 hr - 25 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.20	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.20	2.40	0.000	0.0	110.14	111.58	0.721	29931	4.509
0.45	1.20	2.50	0.000	0.0	110.89	112.54	0.820	30163	4.524
0.60	1.30	2.60	0.000	0.0	111.57	113.39	0.910	30371	4.538
0.75	1.30	2.70	0.000	0.0	112.19	114.17	0.991	30560	4.550
0.90	1.40	2.80	0.000	0.0	112.76	114.89	1.066	30733	4.562
1.05	1.40	2.90	0.000	0.0	113.29	115.56	1.135	30895	4.572
1.20	1.50	3.00	0.000	0.0	113.79	116.19	1.201	31048	4.582
1.35	1.50	3.10	0.000	0.0	114.19	116.79	1.300	31182	4.591
1.50	1.60	3.20	0.000	0.0	114.52	117.29	1.386	31294	4.599
1.65	1.60	3.30	0.000	0.0	114.80	117.72	1.460	31390	4.605
1.80	1.70	3.40	0.000	0.0	115.05	118.10	1.526	31474	4.610
1.95	1.70	3.50	0.000	0.0	115.27	118.45	1.586	31552	4.615
2.10	1.80	3.70	0.000	0.0	115.49	118.77	1.643	31625	4.620
2.25	1.90	3.90	0.000	0.0	115.76	119.19	1.714	31718	4.626
2.40	2.00	4.10	0.000	0.0	116.07	119.66	1.796	31823	4.633
2.55	2.10	4.40	0.000	0.0	116.40	120.17	1.884	31937	4.641
2.70	2.30	4.70	0.000	0.0	116.82	120.80	1.993	32078	4.650
2.85	2.40	5.10	0.000	0.0	117.28	121.52	2.116	32238	4.660
3.00	2.70	5.50	0.000	0.0	117.82	122.38	2.283	32427	4.673
3.15	2.80	6.00	0.000	0.0	118.36	123.32	2.480	32626	4.686
3.30	3.20	6.70	0.000	0.0	118.96	124.36	2.699	32848	4.700
3.45	3.50	7.80	0.000	0.0	119.71	125.66	2.974	33125	4.718
3.60	4.30	9.20	0.000	0.0	120.78	127.51	3.364	33520	4.744
3.75	4.90	12.10	0.000	0.0	122.10	129.98	3.941	34032	4.776
3.90	7.20	19.00	0.000	0.0	124.31	134.20	4.947	34899	4.832
4.05	11.80	46.50	0.000	0.0	128.59	143.31	7.357	36707	4.947
4.20	34.70	40.50	0.000	0.0	146.28	175.09	14.409	43385	5.358
4.35	5.80	9.70	0.000	0.0	154.53	186.78	16.125	46076	5.519
4.50	3.90	6.90	0.000	0.0	139.02	164.23	12.604	40938	5.210
4.65	3.00	5.50	0.000	0.0	129.75	145.92	8.082	37216	4.979
4.80	2.50	4.70	0.000	0.0	124.82	135.25	5.218	35110	4.846
4.95	2.20	4.20	0.000	0.0	121.86	129.52	3.830	33936	4.770
5.10	2.00	3.80	0.000	0.0	119.94	126.06	3.058	33210	4.723
5.25	1.80	3.40	0.000	0.0	118.60	123.74	2.569	32717	4.691
5.40	1.60	3.10	0.000	0.0	117.60	122.00	2.203	32346	4.667
5.55	1.50	2.90	0.000	0.0	116.75	120.70	1.975	32055	4.648
5.70	1.40	2.70	0.000	0.0	116.06	119.65	1.794	31821	4.633
5.85	1.30	2.60	0.000	0.0	115.48	118.76	1.640	31623	4.620
6.00	1.30	1.30	0.000	0.0	115.03	118.08	1.523	31471	4.610
6.15	0.00	0.00	0.000	0.0	113.89	116.33	1.221	31081	4.585
6.30	0.00	0.00	0.000	0.0	111.97	113.89	0.962	30491	4.546
6.45	0.00	0.00	0.000	0.0	110.45	111.97	0.762	30026	4.515
6.60	0.00	0.00	0.000	0.0	109.12	110.45	0.664	29641	4.489
6.75	0.00	0.00	0.000	0.0	107.79	109.12	0.662	29283	4.465
6.90	0.00	0.00	0.000	0.0	106.47	107.79	0.660	28926	4.441

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	105.16	106.47	0.658	28570	4.417
7.20	0.00	0.00	0.000	0.0	103.85	105.16	0.656	28215	4.393
7.35	0.00	0.00	0.000	0.0	102.54	103.85	0.654	27862	4.369
7.50	0.00	0.00	0.000	0.0	101.23	102.54	0.652	27509	4.345
7.65	0.00	0.00	0.000	0.0	99.93	101.23	0.650	27158	4.322
7.80	0.00	0.00	0.000	0.0	98.64	99.93	0.648	26807	4.298
7.95	0.00	0.00	0.000	0.0	97.35	98.64	0.646	26458	4.274
8.10	0.00	0.00	0.000	0.0	96.06	97.35	0.644	26110	4.251
8.25	0.00	0.00	0.000	0.0	94.78	96.06	0.641	25763	4.227
8.40	0.00	0.00	0.000	0.0	93.50	94.78	0.639	25417	4.203
8.55	0.00	0.00	0.000	0.0	92.23	93.50	0.637	25073	4.179
8.70	0.00	0.00	0.000	0.0	90.96	92.23	0.635	24729	4.155
8.85	0.00	0.00	0.000	0.0	89.69	90.96	0.633	24387	4.131
9.00	0.00	0.00	0.000	0.0	88.43	89.69	0.631	24046	4.107
9.15	0.00	0.00	0.000	0.0	87.17	88.43	0.629	23706	4.084
9.30	0.00	0.00	0.000	0.0	85.92	87.17	0.626	23367	4.060
9.45	0.00	0.00	0.000	0.0	84.67	85.92	0.624	23030	4.036
9.60	0.00	0.00	0.000	0.0	83.43	84.67	0.622	22693	4.013
9.75	0.00	0.00	0.000	0.0	82.19	83.43	0.619	22358	3.978
9.90	0.00	0.00	0.000	0.0	80.96	82.19	0.614	22025	3.928
10.05	0.00	0.00	0.000	0.0	79.74	80.96	0.610	21694	3.879
10.20	0.00	0.00	0.000	0.0	78.53	79.74	0.605	21366	3.830
10.35	0.00	0.00	0.000	0.0	77.33	78.53	0.601	21041	3.781
10.50	0.00	0.00	0.000	0.0	76.13	77.33	0.597	20717	3.729
10.65	0.00	0.00	0.000	0.0	74.95	76.13	0.593	20396	3.669
10.80	0.00	0.00	0.000	0.0	73.77	74.95	0.590	20076	3.610
10.95	0.00	0.00	0.000	0.0	72.59	73.77	0.587	19759	3.552
11.10	0.00	0.00	0.000	0.0	71.43	72.59	0.583	19443	3.493
11.25	0.00	0.00	0.000	0.0	70.27	71.43	0.580	19129	3.434
11.40	0.00	0.00	0.000	0.0	69.11	70.27	0.577	18816	3.376
11.55	0.00	0.00	0.000	0.0	67.97	69.11	0.573	18506	3.317
11.70	0.00	0.00	0.000	0.0	66.83	67.97	0.570	18197	3.260
11.85	0.00	0.00	0.000	0.0	65.70	66.83	0.566	17891	3.201
12.00	0.00	0.00	0.000	0.0	64.57	65.70	0.562	17586	3.143
12.15	0.00	0.00	0.000	0.0	63.45	64.57	0.559	17283	3.086
12.30	0.00	0.00	0.000	0.0	62.34	63.45	0.555	16982	3.028
12.45	0.00	0.00	0.000	0.0	61.24	62.34	0.552	16683	2.971
12.60	0.00	0.00	0.000	0.0	60.14	61.24	0.548	16387	2.914
12.75	0.00	0.00	0.000	0.0	59.06	60.14	0.544	16092	2.857
12.90	0.00	0.00	0.000	0.0	57.98	59.06	0.540	15799	2.800
13.05	0.00	0.00	0.000	0.0	56.90	57.98	0.536	15508	2.744
13.20	0.00	0.00	0.000	0.0	55.84	56.90	0.532	15220	2.687
13.35	0.00	0.00	0.000	0.0	54.78	55.84	0.528	14934	2.631
13.50	0.00	0.00	0.000	0.0	53.73	54.78	0.524	14649	2.575
13.65	0.00	0.00	0.000	0.0	52.69	53.73	0.520	14367	2.520
13.80	0.00	0.00	0.000	0.0	51.66	52.69	0.516	14088	2.464
13.95	0.00	0.00	0.000	0.0	50.64	51.66	0.512	13810	2.409
14.10	0.00	0.00	0.000	0.0	49.62	50.64	0.508	13535	2.354
14.25	0.00	0.00	0.000	0.0	48.61	49.62	0.503	13262	2.299
14.40	0.00	0.00	0.000	0.0	47.62	48.61	0.499	12991	2.245
14.55	0.00	0.00	0.000	0.0	46.63	47.62	0.495	12723	2.191
14.70	0.00	0.00	0.000	0.0	45.65	46.63	0.490	12457	2.137

MODIFIED PULS

RESULTS: Routing of 6 hr - 50 yr Total Hydrograph in BMP-1

Max outflow: 17.59 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.67 ft (Elevation) — Peak flow in: 39.240 cfs

Vol-out: 111655 cu-ft — Vol in: 81886 cu-ft

h_{max} over surface: 1.92 ft

Pond Storm: 6 hr - 50 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.40	0.00	0.0	110.38		0.00	29802	4.500
0.30	1.40	2.80	0.000	0.0	110.29	111.78	0.74	29979	4.512
0.45	1.40	2.90	0.000	0.0	111.34	113.09	0.88	30298	4.533
0.60	1.50	3.00	0.000	0.0	112.24	114.24	1.00	30575	4.551
0.75	1.50	3.10	0.000	0.0	113.04	115.24	1.10	30818	4.567
0.90	1.60	3.20	0.000	0.0	113.75	116.14	1.20	31035	4.582
1.05	1.60	3.30	0.000	0.0	114.29	116.95	1.33	31218	4.594
1.20	1.70	3.40	0.000	0.0	114.72	117.59	1.44	31362	4.603
1.35	1.70	3.50	0.000	0.0	115.06	118.12	1.53	31479	4.611
1.50	1.80	3.60	0.000	0.0	115.35	118.56	1.61	31577	4.617
1.65	1.80	3.70	0.000	0.0	115.60	118.95	1.67	31664	4.623
1.80	1.90	3.90	0.000	0.0	115.83	119.30	1.73	31743	4.628
1.95	2.00	4.10	0.000	0.0	116.12	119.73	1.81	31840	4.634
2.10	2.10	4.30	0.000	0.0	116.43	120.22	1.89	31948	4.641
2.25	2.20	4.50	0.000	0.0	116.77	120.73	1.98	32063	4.649
2.40	2.30	4.70	0.000	0.0	117.12	121.27	2.07	32183	4.657
2.55	2.40	5.00	0.000	0.0	117.48	121.82	2.17	32307	4.665
2.70	2.60	5.30	0.000	0.0	117.88	122.48	2.30	32449	4.674
2.85	2.70	5.70	0.000	0.0	118.28	123.18	2.45	32596	4.684
3.00	3.00	6.20	0.000	0.0	118.74	123.98	2.62	32767	4.695
3.15	3.20	6.90	0.000	0.0	119.30	124.94	2.82	32972	4.708
3.30	3.70	7.70	0.000	0.0	120.02	126.20	3.09	33239	4.725
3.45	4.00	8.90	0.000	0.0	120.91	127.72	3.41	33565	4.746
3.60	4.90	10.50	0.000	0.0	122.01	129.81	3.90	33995	4.774
3.75	5.60	13.80	0.000	0.0	123.42	132.51	4.54	34551	4.810
3.90	8.20	21.70	0.000	0.0	125.76	137.22	5.73	35503	4.871
4.05	13.50	52.74	0.000	0.0	130.44	147.46	8.51	37517	4.998
4.20	39.24	45.84	0.000	0.0	151.95	183.18	15.62	45242	5.469
4.35	6.60	11.00	0.000	0.0	162.61	197.79	17.59	48654	5.670
4.50	4.40	7.80	0.000	0.0	145.25	173.61	14.18	43047	5.338
4.65	3.40	6.30	0.000	0.0	132.76	153.05	10.15	38584	5.064
4.80	2.90	5.40	0.000	0.0	126.64	139.06	6.21	35870	4.894
4.95	2.50	4.70	0.000	0.0	123.18	132.04	4.43	34455	4.804
5.10	2.20	4.20	0.000	0.0	121.00	127.88	3.44	33598	4.749
5.25	2.00	3.90	0.000	0.0	119.44	125.20	2.88	33026	4.712
5.40	1.90	3.60	0.000	0.0	118.37	123.34	2.49	32632	4.686
5.55	1.70	3.30	0.000	0.0	117.58	121.97	2.20	32340	4.667
5.70	1.60	3.10	0.000	0.0	116.87	120.88	2.01	32096	4.651
5.85	1.50	2.90	0.000	0.0	116.27	119.97	1.85	31892	4.638
6.00	1.40	1.40	0.000	0.0	115.75	119.17	1.71	31714	4.626
6.15	0.00	0.00	0.000	0.0	114.42	117.15	1.36	31262	4.596
6.30	0.00	0.00	0.000	0.0	112.39	114.42	1.02	30620	4.554
6.45	0.00	0.00	0.000	0.0	110.78	112.39	0.81	30128	4.522
6.60	0.00	0.00	0.000	0.0	109.45	110.78	0.66	29731	4.495
6.75	0.00	0.00	0.000	0.0	108.12	109.45	0.66	29373	4.471
6.90	0.00	0.00	0.000	0.0	106.80	108.12	0.66	29015	4.447

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	105.49	106.80	0.66	28659	4.423
7.20	0.00	0.00	0.000	0.0	104.17	105.49	0.66	28304	4.399
7.35	0.00	0.00	0.000	0.0	102.87	104.17	0.65	27950	4.375
7.50	0.00	0.00	0.000	0.0	101.56	102.87	0.65	27597	4.351
7.65	0.00	0.00	0.000	0.0	100.26	101.56	0.65	27246	4.328
7.80	0.00	0.00	0.000	0.0	98.96	100.26	0.65	26895	4.304
7.95	0.00	0.00	0.000	0.0	97.67	98.96	0.65	26546	4.280
8.10	0.00	0.00	0.000	0.0	96.38	97.67	0.64	26197	4.257
8.25	0.00	0.00	0.000	0.0	95.10	96.38	0.64	25850	4.233
8.40	0.00	0.00	0.000	0.0	93.82	95.10	0.64	25504	4.209
8.55	0.00	0.00	0.000	0.0	92.54	93.82	0.64	25159	4.185
8.70	0.00	0.00	0.000	0.0	91.27	92.54	0.64	24815	4.161
8.85	0.00	0.00	0.000	0.0	90.01	91.27	0.63	24473	4.137
9.00	0.00	0.00	0.000	0.0	88.74	90.01	0.63	24131	4.113
9.15	0.00	0.00	0.000	0.0	87.49	88.74	0.63	23791	4.089
9.30	0.00	0.00	0.000	0.0	86.23	87.49	0.63	23452	4.066
9.45	0.00	0.00	0.000	0.0	84.98	86.23	0.62	23114	4.042
9.60	0.00	0.00	0.000	0.0	83.74	84.98	0.62	22777	4.019
9.75	0.00	0.00	0.000	0.0	82.50	83.74	0.62	22442	3.990
9.90	0.00	0.00	0.000	0.0	81.27	82.50	0.62	22108	3.941
10.05	0.00	0.00	0.000	0.0	80.04	81.27	0.61	21777	3.891
10.20	0.00	0.00	0.000	0.0	78.83	80.04	0.61	21448	3.842
10.35	0.00	0.00	0.000	0.0	77.63	78.83	0.60	21122	3.793
10.50	0.00	0.00	0.000	0.0	76.43	77.63	0.60	20798	3.744
10.65	0.00	0.00	0.000	0.0	75.24	76.43	0.59	20476	3.684
10.80	0.00	0.00	0.000	0.0	74.06	75.24	0.59	20156	3.625
10.95	0.00	0.00	0.000	0.0	72.89	74.06	0.59	19838	3.566
11.10	0.00	0.00	0.000	0.0	71.72	72.89	0.58	19522	3.508
11.25	0.00	0.00	0.000	0.0	70.56	71.72	0.58	19207	3.449
11.40	0.00	0.00	0.000	0.0	69.40	70.56	0.58	18894	3.390
11.55	0.00	0.00	0.000	0.0	68.25	69.40	0.57	18584	3.332
11.70	0.00	0.00	0.000	0.0	67.11	68.25	0.57	18274	3.274
11.85	0.00	0.00	0.000	0.0	65.98	67.11	0.57	17967	3.216
12.00	0.00	0.00	0.000	0.0	64.85	65.98	0.56	17662	3.158
12.15	0.00	0.00	0.000	0.0	63.73	64.85	0.56	17359	3.100
12.30	0.00	0.00	0.000	0.0	62.62	63.73	0.56	17058	3.043
12.45	0.00	0.00	0.000	0.0	61.51	62.62	0.55	16758	2.985
12.60	0.00	0.00	0.000	0.0	60.42	61.51	0.55	16461	2.928
12.75	0.00	0.00	0.000	0.0	59.33	60.42	0.54	16166	2.871
12.90	0.00	0.00	0.000	0.0	58.25	59.33	0.54	15872	2.814
13.05	0.00	0.00	0.000	0.0	57.17	58.25	0.54	15581	2.758
13.20	0.00	0.00	0.000	0.0	56.10	57.17	0.53	15292	2.701
13.35	0.00	0.00	0.000	0.0	55.05	56.10	0.53	15005	2.645
13.50	0.00	0.00	0.000	0.0	54.00	55.05	0.53	14721	2.589
13.65	0.00	0.00	0.000	0.0	52.95	54.00	0.52	14438	2.533
13.80	0.00	0.00	0.000	0.0	51.92	52.95	0.52	14158	2.478
13.95	0.00	0.00	0.000	0.0	50.89	51.92	0.51	13879	2.422
14.10	0.00	0.00	0.000	0.0	49.88	50.89	0.51	13604	2.367
14.25	0.00	0.00	0.000	0.0	48.87	49.88	0.50	13330	2.313
14.40	0.00	0.00	0.000	0.0	47.87	48.87	0.50	13059	2.259
14.55	0.00	0.00	0.000	0.0	46.87	47.87	0.50	12790	2.204
14.70	0.00	0.00	0.000	0.0	45.89	46.87	0.491	12523	2.150

MODIFIED PULS

RESULTS: Routing of 6 hr - 100 yr Total Hydrograph in BMP-1

Max outflow: 21.65 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.85 ft (Elevation) — Peak flow in: 41.200 cfs

Vol-out: 128265 cu-ft — Vol in: 98496 cu-ft

h_{max} over surface: 2.10 ft

Pond Storm: 6 hr - 100 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.70	0.00	0.0	110.38		0.00	29802	4.500
0.30	1.70	3.40	0.000	0.0	110.53	112.08	0.77	30052	4.517
0.45	1.70	3.50	0.000	0.0	112.00	113.93	0.97	30501	4.546
0.60	1.80	3.60	0.000	0.0	113.24	115.50	1.13	30880	4.571
0.75	1.80	3.70	0.000	0.0	114.22	116.84	1.31	31194	4.592
0.90	1.90	3.80	0.000	0.0	114.93	117.92	1.50	31436	4.608
1.05	1.90	3.90	0.000	0.0	115.46	118.73	1.64	31616	4.620
1.20	2.00	4.00	0.000	0.0	115.87	119.36	1.74	31757	4.629
1.35	2.00	4.10	0.000	0.0	116.21	119.87	1.83	31871	4.636
1.50	2.10	4.30	0.000	0.0	116.49	120.31	1.91	31968	4.643
1.65	2.20	4.50	0.000	0.0	116.81	120.79	1.99	32076	4.650
1.80	2.30	4.70	0.000	0.0	117.15	121.31	2.08	32192	4.657
1.95	2.40	4.90	0.000	0.0	117.50	121.85	2.17	32312	4.665
2.10	2.50	5.10	0.000	0.0	117.83	122.40	2.29	32431	4.673
2.25	2.60	5.40	0.000	0.0	118.13	122.93	2.40	32543	4.680
2.40	2.80	5.70	0.000	0.0	118.48	123.53	2.53	32672	4.689
2.55	2.90	6.00	0.000	0.0	118.86	124.18	2.66	32811	4.698
2.70	3.10	6.40	0.000	0.0	119.25	124.86	2.80	32955	4.707
2.85	3.30	7.00	0.000	0.0	119.71	125.65	2.97	33123	4.718
3.00	3.70	7.60	0.000	0.0	120.32	126.71	3.19	33348	4.732
3.15	3.90	8.30	0.000	0.0	121.02	127.92	3.45	33606	4.749
3.30	4.40	9.20	0.000	0.0	121.75	129.32	3.78	33895	4.768
3.45	4.80	10.70	0.000	0.0	122.61	130.95	4.17	34231	4.789
3.60	5.90	12.60	0.000	0.0	123.84	133.31	4.73	34715	4.820
3.75	6.70	16.50	0.000	0.0	125.39	136.44	5.53	35347	4.861
3.90	9.80	32.20	0.000	0.0	127.96	141.89	6.96	36430	4.929
4.05	22.40	63.60	0.000	0.0	136.48	160.16	11.84	40047	5.155
4.20	41.20	49.10	0.000	0.0	164.34	200.08	17.87	49196	5.702
4.35	7.90	13.20	0.000	0.0	170.14	213.44	21.65	51784	5.851
4.50	5.30	9.40	0.000	0.0	152.06	183.34	15.64	45280	5.472
4.65	4.10	7.60	0.000	0.0	137.24	161.46	12.11	40325	5.172
4.80	3.50	6.50	0.000	0.0	129.27	144.84	7.78	37005	4.966
4.95	3.00	5.70	0.000	0.0	125.07	135.77	5.35	35213	4.852
5.10	2.70	5.10	0.000	0.0	122.51	130.77	4.13	34193	4.787
5.25	2.40	4.60	0.000	0.0	120.84	127.61	3.39	33541	4.745
5.40	2.20	4.30	0.000	0.0	119.59	125.44	2.93	33079	4.715
5.55	2.10	4.00	0.000	0.0	118.69	123.89	2.60	32747	4.693
5.70	1.90	3.70	0.000	0.0	117.99	122.69	2.35	32492	4.677
5.85	1.80	3.50	0.000	0.0	117.40	121.69	2.15	32278	4.663
6.00	1.70	1.70	0.000	0.0	116.88	120.90	2.01	32100	4.651
6.15	0.00	0.00	0.000	0.0	115.36	118.58	1.61	31582	4.617
6.30	0.00	0.00	0.000	0.0	113.13	115.36	1.11	30847	4.569
6.45	0.00	0.00	0.000	0.0	111.37	113.13	0.88	30308	4.533
6.60	0.00	0.00	0.000	0.0	109.97	111.37	0.70	29881	4.505
6.75	0.00	0.00	0.000	0.0	108.64	109.97	0.66	29513	4.480
6.90	0.00	0.00	0.000	0.0	107.32	108.64	0.66	29155	4.456

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	106.00	107.32	0.66	28798	4.432
7.20	0.00	0.00	0.000	0.0	104.69	106.00	0.66	28443	4.408
7.35	0.00	0.00	0.000	0.0	103.38	104.69	0.66	28089	4.384
7.50	0.00	0.00	0.000	0.0	102.07	103.38	0.65	27735	4.361
7.65	0.00	0.00	0.000	0.0	100.77	102.07	0.65	27383	4.337
7.80	0.00	0.00	0.000	0.0	99.47	100.77	0.65	27032	4.313
7.95	0.00	0.00	0.000	0.0	98.18	99.47	0.65	26682	4.289
8.10	0.00	0.00	0.000	0.0	96.89	98.18	0.64	26334	4.266
8.25	0.00	0.00	0.000	0.0	95.60	96.89	0.64	25986	4.242
8.40	0.00	0.00	0.000	0.0	94.32	95.60	0.64	25639	4.218
8.55	0.00	0.00	0.000	0.0	93.04	94.32	0.64	25294	4.194
8.70	0.00	0.00	0.000	0.0	91.77	93.04	0.64	24950	4.170
8.85	0.00	0.00	0.000	0.0	90.50	91.77	0.63	24607	4.146
9.00	0.00	0.00	0.000	0.0	89.24	90.50	0.63	24265	4.122
9.15	0.00	0.00	0.000	0.0	87.98	89.24	0.63	23924	4.099
9.30	0.00	0.00	0.000	0.0	86.72	87.98	0.63	23585	4.075
9.45	0.00	0.00	0.000	0.0	85.47	86.72	0.63	23246	4.052
9.60	0.00	0.00	0.000	0.0	84.22	85.47	0.62	22909	4.028
9.75	0.00	0.00	0.000	0.0	82.98	84.22	0.62	22573	4.005
9.90	0.00	0.00	0.000	0.0	81.75	82.98	0.62	22238	3.960
10.05	0.00	0.00	0.000	0.0	80.52	81.75	0.61	21906	3.910
10.20	0.00	0.00	0.000	0.0	79.30	80.52	0.61	21577	3.861
10.35	0.00	0.00	0.000	0.0	78.10	79.30	0.60	21249	3.812
10.50	0.00	0.00	0.000	0.0	76.90	78.10	0.60	20925	3.764
10.65	0.00	0.00	0.000	0.0	75.71	76.90	0.60	20602	3.707
10.80	0.00	0.00	0.000	0.0	74.52	75.71	0.59	20281	3.648
10.95	0.00	0.00	0.000	0.0	73.35	74.52	0.59	19962	3.589
11.10	0.00	0.00	0.000	0.0	72.17	73.35	0.59	19645	3.531
11.25	0.00	0.00	0.000	0.0	71.01	72.17	0.58	19330	3.472
11.40	0.00	0.00	0.000	0.0	69.85	71.01	0.58	19016	3.413
11.55	0.00	0.00	0.000	0.0	68.70	69.85	0.58	18705	3.355
11.70	0.00	0.00	0.000	0.0	67.56	68.70	0.57	18395	3.297
11.85	0.00	0.00	0.000	0.0	66.42	67.56	0.57	18087	3.239
12.00	0.00	0.00	0.000	0.0	65.29	66.42	0.56	17781	3.180
12.15	0.00	0.00	0.000	0.0	64.17	65.29	0.56	17477	3.123
12.30	0.00	0.00	0.000	0.0	63.05	64.17	0.56	17175	3.065
12.45	0.00	0.00	0.000	0.0	61.95	63.05	0.55	16875	3.008
12.60	0.00	0.00	0.000	0.0	60.85	61.95	0.55	16577	2.950
12.75	0.00	0.00	0.000	0.0	59.75	60.85	0.55	16281	2.893
12.90	0.00	0.00	0.000	0.0	58.67	59.75	0.54	15987	2.836
13.05	0.00	0.00	0.000	0.0	57.59	58.67	0.54	15695	2.780
13.20	0.00	0.00	0.000	0.0	56.52	57.59	0.53	15405	2.723
13.35	0.00	0.00	0.000	0.0	55.46	56.52	0.53	15117	2.667
13.50	0.00	0.00	0.000	0.0	54.40	55.46	0.53	14832	2.611
13.65	0.00	0.00	0.000	0.0	53.36	54.40	0.52	14548	2.555
13.80	0.00	0.00	0.000	0.0	52.32	53.36	0.52	14267	2.500
13.95	0.00	0.00	0.000	0.0	51.29	52.32	0.51	13988	2.444
14.10	0.00	0.00	0.000	0.0	50.27	51.29	0.51	13711	2.389
14.25	0.00	0.00	0.000	0.0	49.26	50.27	0.51	13437	2.334
14.40	0.00	0.00	0.000	0.0	48.26	49.26	0.50	13165	2.280
14.55	0.00	0.00	0.000	0.0	47.26	48.26	0.50	12895	2.226
14.70	0.00	0.00	0.000	0.0	46.27	47.26	0.493	12627	2.171

APPENDIX A – TABLES AND CHARTS

Ernest F. Brater and Horace Williams King

HANDBOOK OF HYDRAULICS

For the Solution of Hydraulic Engineering Problems

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

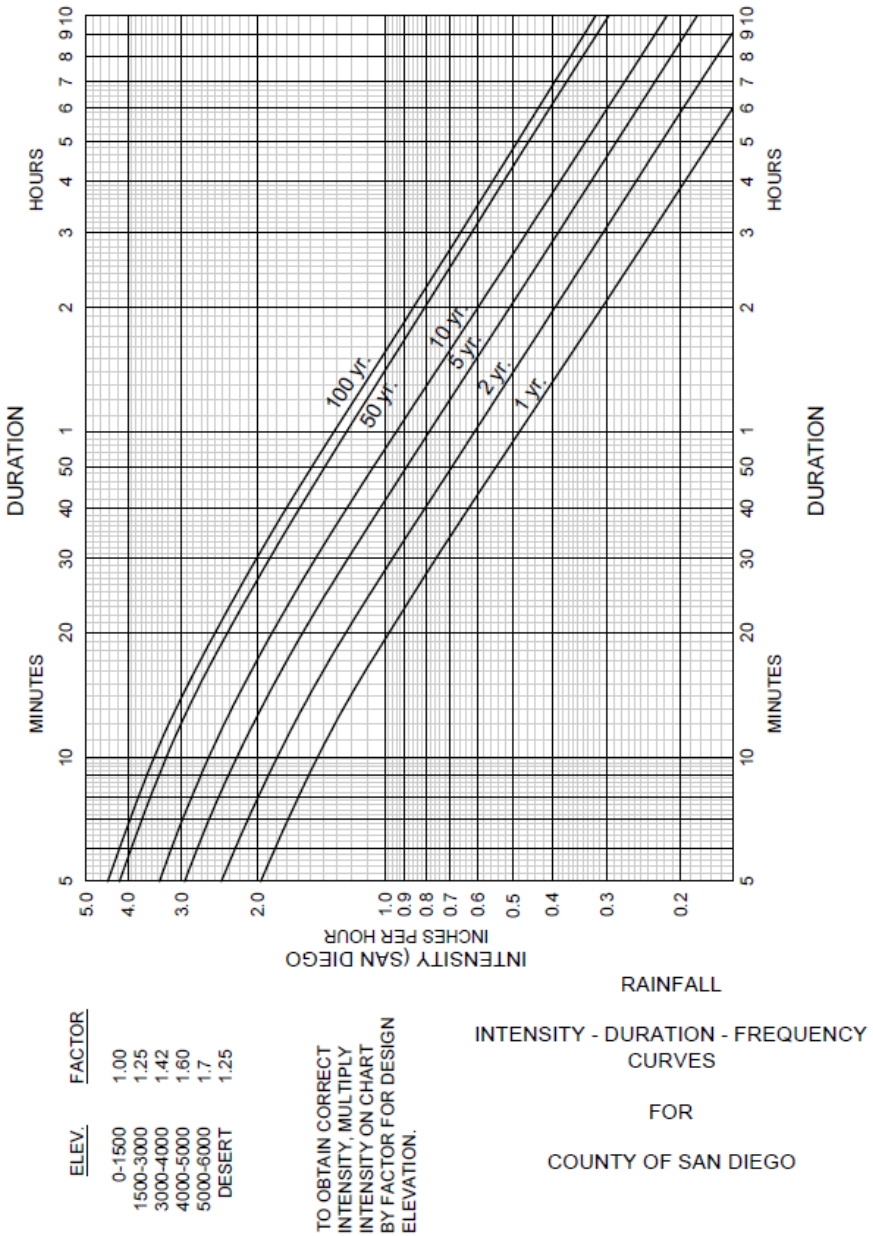


Figure A-1. Intensity-Duration-Frequency Design Chart

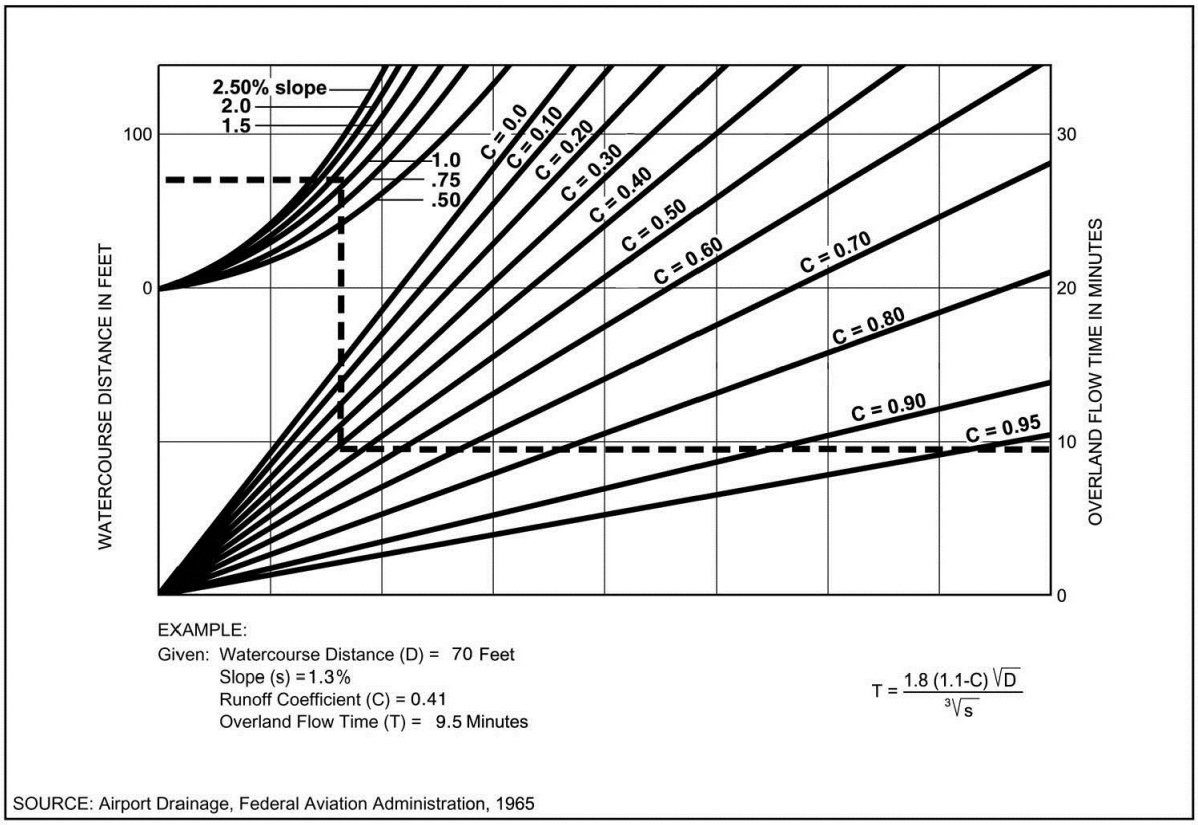


Figure A-4. Rational Formula – Overland Time of Flow Nomograph

Note: Use formula for watercourse distances in excess of 100 feet.

Table A-1. Runoff Coefficients for Rational Method

Land Use	Runoff Coefficient (C) Soil Type [1]
Residential:	
Single Family	0.55
Multi-Units	0.70
Mobile Homes	0.65
Rural (lots greater than ½ acre)	0.45
Commercial [2]	
80% Impervious	0.85
Industrial [2]	
90% Impervious	0.95

Note:
[1] Type D soil to be used for all areas.
[2] Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness = 50%
Tabulated imperviousness = 80%
Revised C = (50/80) x 0.85 = 0.53

The values in Table A–1 are typical for urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the City.

A.1.3. Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr.) for a duration equal to the T_c for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_c calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).

Appendix C

Manning Roughness Coefficients

The Manning roughness coefficient (n) is used to represent flow resistance in open-channel hydraulic computations. This Appendix offers a compilation of Manning roughness coefficients that may be used in the hydraulic design and evaluation of drainage facilities.

These values serve only as a basic guide. The procedure for selecting appropriate values for Manning roughness coefficient, especially in natural channel systems, is subjective and requires judgment and skill that is primarily developed through experience. For work where very accurate determination of water surface profile is necessary, the design engineer should consult the governing Agency to obtain data regarding roughness coefficient values applicable to specific streams. The design engineer may also examine Flood Insurance Study data, or one of several references for more specific information on determining roughness coefficient.

Table C-1. Average Manning Roughness Coefficients for Pavement and Gutters [1]

Material	Manning Roughness Coefficient (n)
Concrete Gutter [2]	0.015
Concrete Pavement Float Finish Broom Finish	 0.014 0.016
Concrete Gutter with Asphalt Pavement Smooth Finish Rough Texture	 0.013 0.015
Asphalt Pavement Smooth Finish Rough Texture	 0.013 0.016

Based on FHWA HEC-22.

[1] Based on materials and workmanship required by standard specifications.

[2] Increase roughness coefficient in gutters with mild slopes where sediment might accumulate by 0.020.

Table C-2. Average Manning Roughness Coefficients for Closed Conduits [1]

Conduit	Manning Roughness Coefficient (n)
Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x ½ inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D>=0.60	0.016
d/D<0.60	0.013
Fully Lined	0.013
3x1 inch Corrugations	0.027
6x2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

[1] Based on materials and workmanship required by standard specifications.

Table C-3. Average Manning Roughness Coefficients for Small Open Channels Conveying Less than 50 cfs[1]

Lining Type	Design Flow Depth		
	0 – 0.5 ft	0.5 – 2.0 ft	> 2.0 ft
Concrete (Poured)	0.015	0.013	0.013
Air Blown Concrete	0.023	0.019	0.016
Grouted Riprap	0.040	0.030	0.028
Stone Masonry	0.042	0.032	0.030
Soil Cement	0.025	0.022	0.020
Bare Soil	0.023	0.020	0.020
Rock Cut	0.045	0.035	0.025
Rock Riprap	Based on Rock Size (See Chapter 7, Section 7.6.17)		

[1] Based on materials and workmanship required by standard specifications.

Table C-4. Average Manning Roughness Coefficients for Larger Open Channels

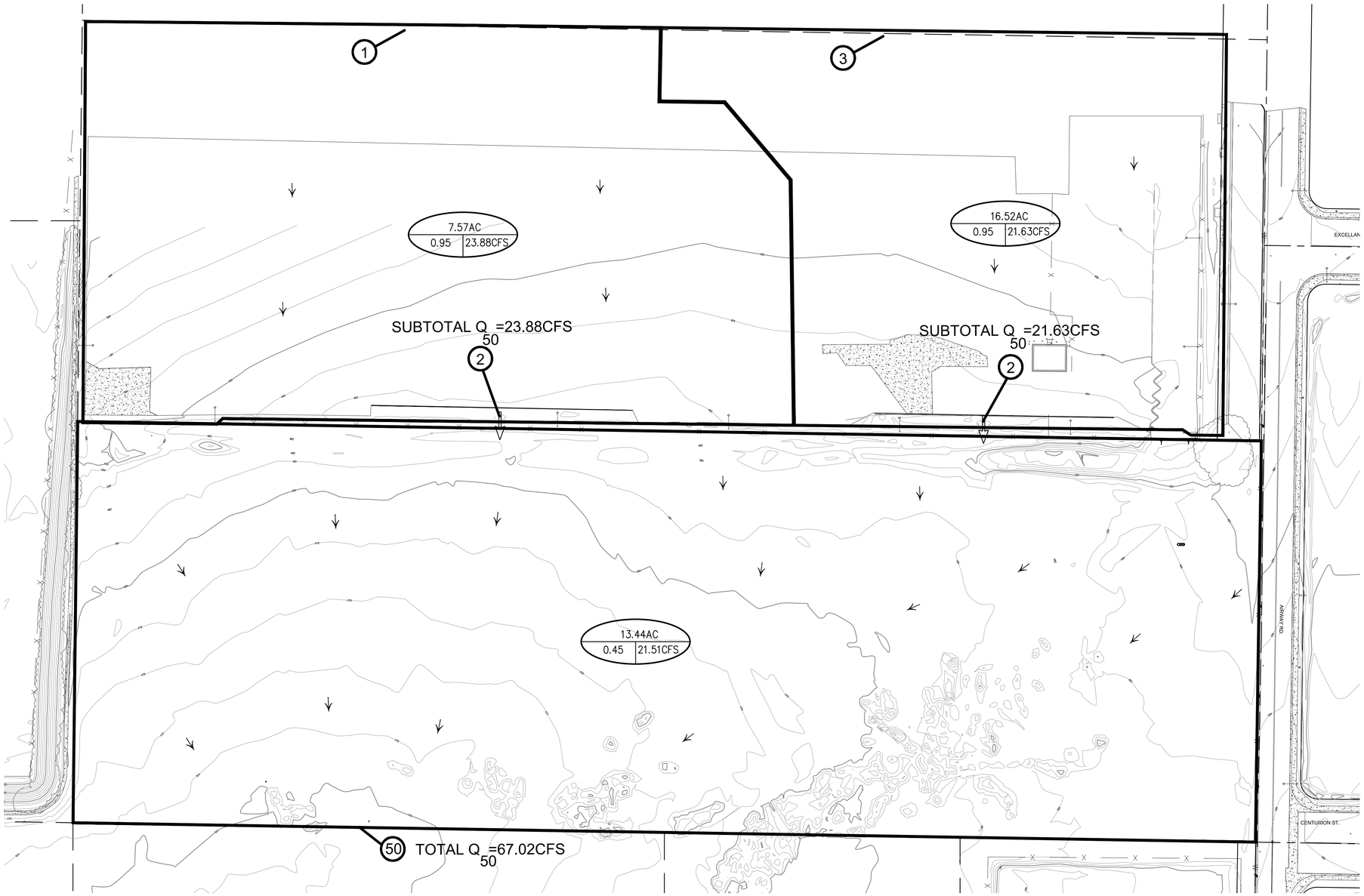
Channel	Manning Roughness Coefficient(n)
Unlined Channels Clay Loam Sand	 0.023 0.020
Lined Channels Grass Lined (well maintained) Grass Lined (not maintained)	 0.035 0.045
Wetland-Bottom Channels (New Channel)	0.023
Wetland-Bottom Channels (Mature Channel)	See Table A–5
Riprap-Lined Channels	See Chapter 7, Section 7.6.17
Concrete (Poured)	0.014
Air Blown Mortar (Gunite or Shotcrete)[1]	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018

[1] For air blown concrete, use n=0.012 (if troweled) and n=0.025 if purposely roughened.
Note: For channels with revetments or multiple lining types, use composite Manning roughness coefficient based on component lining materials.

Table C-5. Average Manning Roughness Coefficients for Natural Channels

Channel	Manning Roughness Coefficient (n)
Minor Streams (Surface Width at Flood Stage < 100 ft)	
Fairly Regular Section	
(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater than Weed Height	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase all above values by:	0.015
Irregular Section, with Pools, Slight Channel Meander	
Channels (A) through (E) above, Increase all Values by:	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	0.050
(A) Bottom, Gravel, Cobbles and Few Boulders	0.060
(B) Bottom, Cobbles with Large Boulders	
Flood Plains (Adjacent to Natural Streams)	
Pasture, No Brush	
(A) Short Grass	0.030
(B) High Grass	0.040
Cultivated Areas	
(A) No Crop	0.040
(B) Mature Row Crops	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees	0.060
Medium-to-Dense Brush	0.090
Dense Willows	0.170
Cleared Land with Tree Stumps, 100-150 per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches	0.140

APPENDIX B – DRAINAGE EXHIBIT



DRAINAGE LEGEND

AREA (acres) — 0.06AC

0.95 | 0.49CFS

COEFFICIENT FACTOR — 50 YR RUNOFF

NODE (1)

SHEET FLOW

DRAINAGE LIMIT

DRAINAGE STRUCTURE FLOW

0 30 60 120 180

GRAPHIC SCALE: 1" = 60'

IF PLAN SIZE IS LESS THAN 24"x36", THIS IS A REDUCED COPY. SCALE PLAN ACCORDINGLY.

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REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
NO. 48592
EXP 6-30-22
CIVIL
STATE OF CALIFORNIA

(REV 5/13/2019)

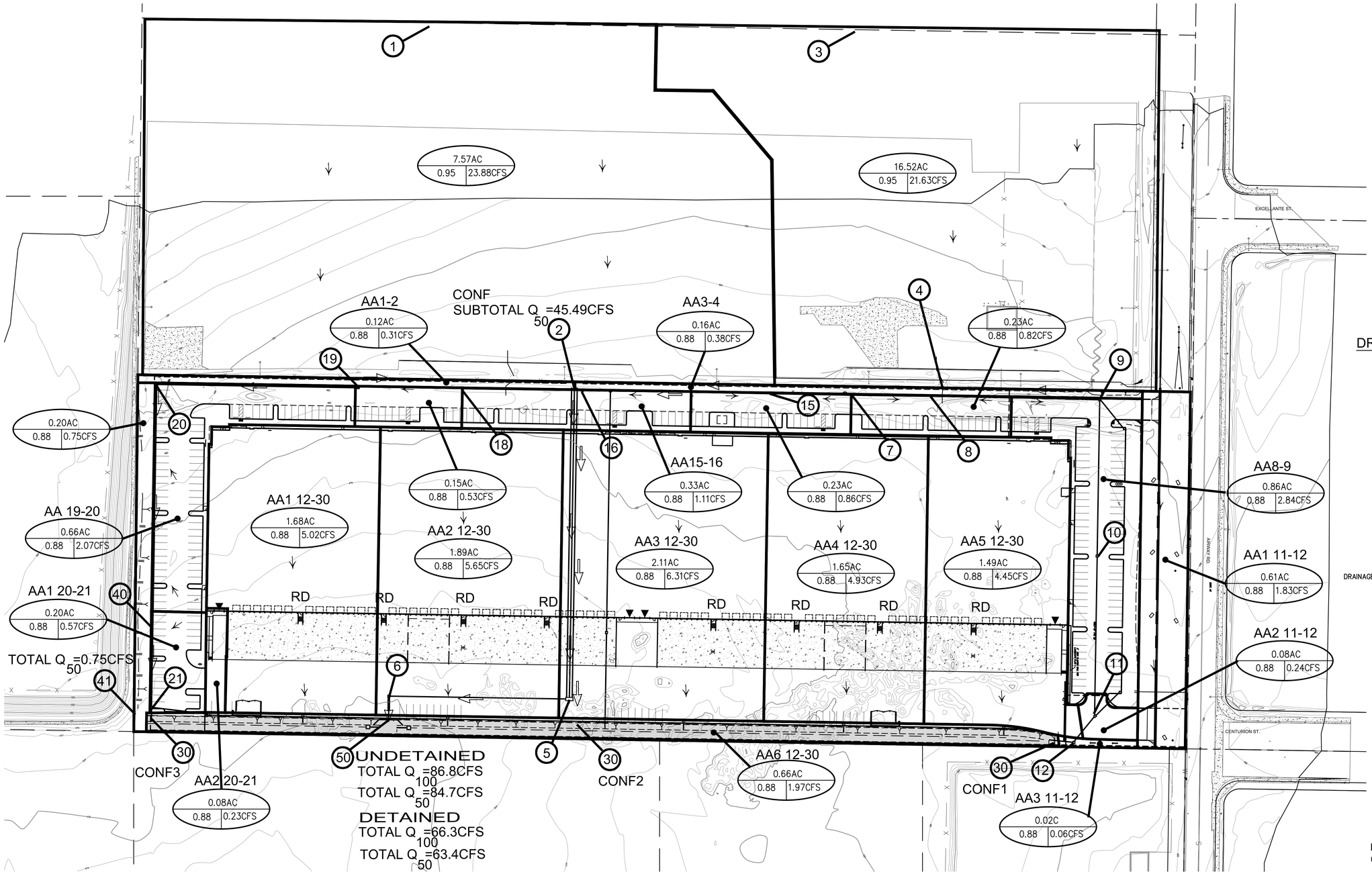
CITY OF SAN DIEGO

EXISTING HYDROLOGY PLAN FOR:

AIRWAY LOGISTICS CENTER

DRAWING NO. H1

SHEET 1 OF 2



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REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SHEET
NO.48592
EXP 6-30-22
CIVIL
STATE OF CALIFORNIA

CITY OF SAN DIEGO	DRAWING NO.
PROPOSED HYDROLOGY PLAN FOR: AIRWAY LOGISTICS CENTER	H2
	SHEET 2 OF 2