FUSCOE
ENGINEERING

PRELIMINARY
DRAINAGE STUDY

RANCHO CIELO PARCEL 'VC'
EA LOG NO. 86-06-026B

JUNE 2013
County of San Diego, California
TM 5440
LOT 109, TM 4229-4, Map No. 12764
prepared for:

Rancho Cielo Estates
PO Box 2303
Rancho Santa Fe, CA 92067

Fuscoe Engineering, Inc.
6390 Greenwich Drive, Suite 170
San Diego, California 92122
858.554.1500

www.fuscoe.com

Kenneth T. Kozlik, P.E.
Job # 02711-001-01

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Preliminary Drainage Study

For

Rancho Cielo Parcel 'VC'

County of San Diego, CA

Prepared under the Responsible Charge of:

7/24/13

Kenneth T. Kozlik, P.E. RCE 71883
Fuscoe Engineering, San Diego, Inc.
6390 Greenwich Dr., Suite 170
San Diego, CA 92122

Date:

EXP: 12-31-13

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REFERENCES

County Hydrology Manual (2003)

County of San Diego Standard Urban Stormwater Mitigation Plan (2011)

County of San Diego Drainage Design Manual (2005)

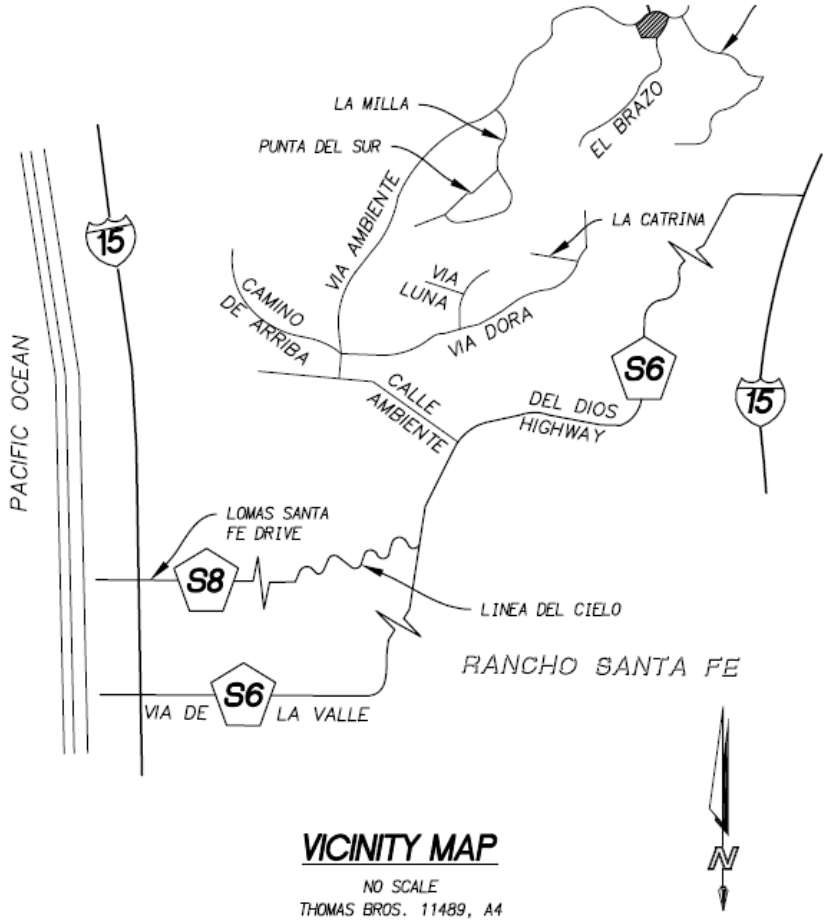
INTRODUCTION

PURPOSE

This Preliminary Drainage Study pertains to the proposed development of Rancho Cielo Parcel 'VC' to the west of the intersection of Via Ambiente and El Brazo. Its purpose is to present the design of the drainage facilities of the proposed project located in the County of San Diego, CA.

PROJECT DESCRIPTION

The proposed development of Rancho Cielo Parcel 'VC' consists of seven single family residential lots. A portion of the project site will be dedicated as an open space easement. The project area is located along Via Ambiente in the community of Rancho Cielo, to the north of Rancho Santa Fe, CA. Refer to the following Vicinity Map.



VICINITY MAP

NO SCALE
THOMAS BROS. 11489, A4

The project site is 5.59 acres. The existing site is characterized by a hilltop surrounded by steep slopes. Via Ambiente forms the northerly boundary of the project and El Brazo forms the easterly boundary. Low density residential development exists along a portion of the

westerly and southerly project boundary, while the remainder of the adjacent area is undeveloped. The proposed project will construct a driveway on Via Ambiente west of the intersection with El Brazo. The residential lots will be accessed via a private interior street on a cul-de-sac.

BASIN DESCRIPTION

Existing Conditions:

Due to the hilltop nature of the site, runoff from the project site splits into several drainage basins.

Basin 1 encompasses the majority of the southern portions of the site. This basin drains to a canyon onsite which drains to the south, conveying flows to the San Dieguito River.

Basin 2 consists of the easterly slope. Runoff from this basin is collected by an existing brow ditch leading to a Type 'F' inlet. This runoff is collected and piped through the existing 18" RCP storm drain and discharges east of El Brazo, a private street. These existing drainage facilities were constructed per TM 4229-2. The runoff then runs down a canyon east of El Brazo and eventually leads to the San Dieguito River. Refer to the Existing Hydrology Map included in the appendix.

Basin 3 is located along the northerly frontage of the project along Via Ambiente. Consisting of street drainage on Via Ambiente and runoff from the northerly slope, the basin leads to an existing catch basin near the intersection with El Brazo. The catch basin connects to an underground storm drain system which outlets to a canyon to the east of the intersection of Via Ambiente and El Brazo. This canyon flows southwest to a confluence with the San Dieguito River.

Please refer to the "Existing 100-Year Hydrology Exhibit" for a graphical depiction of these drainage patterns.

Proposed Conditions:

The proposed development will maintain the existing drainage patterns. The site will continue to be split among three drainage basins that all drain to San Dieguito River. Although the areas of the proposed drainage basins will not match the existing conditions exactly, there will be no diversion greater than one acre between basins.

The majority of the proposed development will occur in Basin 1, consisting of the new cul-de-sac and pads. A cross gutter near the project entrance will convey runoff from two lots and the private road to a bioretention basin Integrated Management Practice (IMP). The basin will discharge to the existing canyon within Basin 1. The remaining residential pads in Basin 1 will drain to their rear, where a bioretention IMP will be placed. Outflow from the bioretention IMPs will discharge at the toe of the slope and into the existing canyon.

The rest of the development will continue to drain to the existing storm drain facilities that outlet southeast of the intersection of Via Ambiente and El Brazo, and eventually lead to the San Dieguito River. Two residential lots are contained in Basin 2. Bioretention IMPs will be located on these lots, with the outflow from the bioretention basins discharging to concrete brow ditches and ultimately to the existing storm drain.

Please refer to the "Proposed 100-Year Hydrology Exhibit" for a graphical depiction of these drainage patterns.

METHODOLOGY

RUNOFF CALCULATIONS

The design criteria, as found in the County of San Diego Department of Public Works Flood Control Division Hydrology Manual, specifies the design runoff conditions within the San Diego County Flood Control District will be based on the 100-year storm frequency, as follows:

1.) Design for areas over 1 square mile will be based on the 100-year frequency storm.
2.) For areas under 1 square mile –
    a. The storm drain system shall be designed so that the combination of storm drain system capacity and overflow both inside and outside the right of way will be able to carry the 100 year frequency storm without damaging adjacent existing buildings or potential building sites.
    b. The storm drain system shall be designed so that the combination of storm drain system capacity and allowable street overflow will be able to carry the 50 year frequency storm without damaging adjacent property.
    c. Where a storm drain is required under headings 1 or 2 above, then as a minimum, the drain shall be designed to carry the 10-year frequency storm.
3.) Sump areas are to be designed for a sump capacity or outfall of a 100-year frequency storm.

Runoff produced on the project site will be calculated for the 100-year storm event using the methodology outlined in the San Diego County Hydrology Manual. Runoff will be calculated using the Rational Method, which is given by the following equation:

$Q = C \times I \times A$

Where:
Q = Flow rate in cubic feet per second (cfs)
C = Runoff coefficient
I = Rainfall Intensity in inches per hour (in/hr)
A = Drainage basin area in acres, (ac)

Soil Type – Hydrologic soil group D was assumed for all areas as this is the prevalent soil group near the project site as can be seen in the Soil Hydrologic Groups map provided in the appendix. Group D soils have very slow infiltration rates when thoroughly wetted. Consisting chiefly of clay soils with a high swelling potential, soils with a high permanent water table, soils with clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials, Group D soils have a very slow rate of water transmission.

Runoff Coefficient – In accordance with the County of San Diego standards, pervious areas were assigned a runoff coefficient of C= 0.35, based on the type D soils. Where a sub-basin consists of a mixture of pervious and impervious surfaces, a weighted runoff coefficient was calculated using the following equation, based on Section 3.1.2 of the manual:

C = 0.90 x (% Impervious) + 0.35 x (1 - % Impervious)

Since building footprints are not available due to the preliminary nature of this study, the impervious area on the building pads is based on the density of the proposed pads. The pads have a minimum size of 10,000 sf, giving a density of 4.3 du/ac. Per Table 3-1 of the manual, residential land uses at a density of 4.3 du/ac contain an average imperviousness of 30%. This imperviousness percentage is applied to the pad areas to determine the amount of impervious area on each lot. A summary of the runoff coefficient calculations are contained in the following table.

Condition	Nodes	Areas (ac)			% Impervious	Weighted C
		Total	Pervious	Impervious		
Existing	305-300	0.99	0.72	0.27	27	0.50
Proposed	305-3	0.90	0.52	0.38	42	0.58
	206-2	0.71	0.63	0.08	11	0.41
	70-68	0.06	0.011	0.049	82	0.80
	68-20	0.04	0.016	0.024	60	0.68
	20-35	0.29	0.08	0.21	72	0.75
	15-10	0.36	0.285	0.075	21	0.46
	38-1	1.95	1.81	0.14	7	0.39

Rainfall intensity was calculated using the following equation, which is given in the Manual:

$I = 7.44 \times P_6 \times (Tc^{-0.645})$

Where:
I = Rainfall Intensity in inches per hour (in/hr)
P_6 = Rainfall in inches for the 6-hour storm event
Tc = Time of concentration in minutes

Time of concentration was calculated for overland flow areas (sheet drainage) using the equation developed by the Federal Aviation Administration, which is given as:

$Tc = [1.8 \times (1.1 - C) \times (L^{1/2})] / (S^{1/3})$

Where:
Tc = Time of concentration in minutes
C = Runoff coefficient
L = Length of travel of runoff in feet
S = Slope in percent

The minimum time of concentration used for runoff calculations was based on Table 3-2 of the Manual. Relevant excerpts from the Manual are given in the appendix.

Time of travel in the drain and drainage channels was calculated using the Manning equation. For HDPE storm drains, a Manning "n" value of 0.012 was selected, while for RCP storm drains a Manning "n" value of 0.013 was used. For brow ditches, a Manning "n" of 0.015 was used.

To perform a node-link study, the total watershed area is divided into sub-areas which discharge at designated nodes.

The procedure for the sub-area summation model is as follows:

(1) Subdivide the watershed into an initial sub-area (generally 1 lot) and subsequent sub-areas, which are generally less than 10 acres in size. Assign upstream and downstream node numbers to each sub-area.
(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation.
(3) Using the initial T_c, determine the corresponding values of I. Then Q = CIA.
(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES-2004a computer sub-area menu is as follows:

SUBAREA HYDROLOGIC PROCESS

1. Confluence analysis at node.
2. Initial sub-area analysis (including time of concentration calculation).
3. Pipe flow travel time (computer estimated).
4. Pipe flow travel time (user specified).
5. Trapezoidal channel travel time.
6. Street flow analysis through sub-area.

7. User-specified information at node.
8. Addition of sub-area runoff to main line.
9. V-gutter flow through area.
10. Copy main stream data to memory bank
11. Confluence main stream data with a memory bank
12. Clear a memory bank

At the confluence point of two or more basins, the following procedure is used to combine peak flow rates to account for differences in the basin's times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1). If the collection streams have the same times of concentration, then the Q values are directly summed,

$$Q_p = Q_a + Q_b; T_p = T_a = T_b$$

(2). If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:

(i). The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q value is adjusted by a ratio of rainfall intensities.

$$Q_p = Q_b + Q_a (I_b/I_a); T_p = T_a$$

(ii). In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by a ratio of the T values.

$$Q_p = Q_b + Q_a (T_b/T_a); T_p = T_b$$

CALCULATIONS/RESULTS

EXISTING CONDITIONS

Calculations were performed on the existing drainage patterns on the project site to determine the current discharge during a storm event. These calculations were performed based on the 100-year 6 hour storm event. The following table summarizes the peak discharge for each storm event at the basin discharge points. Please refer to the Existing 100-Year Hydrology Exhibit, and the hydrology calculations can be found in Appendix 2.

Basin	Area (ac)	100-Year Storm	
		Q (cfs)	T_c (min)
1	3.7	8.8	6.5
2	1.1	2.7	5.9
3	1.0	4.4	4.6

PROPOSED CONDITIONS

To analyze the effects of the proposed development on the downstream channels and storm drain system, an analysis of the proposed storm drain system was performed. These calculations were also performed based on the 100-year 6 hour storm event. The following table lists the peak discharge for each storm event at the basin discharge points. As can be seen in the table, the peak discharge from all basins will decrease or stay the same. Please refer to the Proposed 100-Year Hydrology Exhibit, and the hydrology calculations can be found in Appendix 2.

Basin	Area (ac)	100-Year Storm	
		Q (cfs)	T_c (min)
1	3.9	8.8	9.8
2	1.0	2.6	8.1
3	0.9	4.5	4.6

Although the project increases impervious area on the site, and therefore the runoff coefficient, there is no increase in peak discharge in Basins 1 and 2, and an insignificant increase in Basin 3. This is due to a number of different factors. In Basin 1, total area is increased slightly, but the time of concentration is lengthened significantly. In Basin 2, total area is decreased slightly and the time of concentration is lengthened. In Basin 3, total area is decreased and very little of the development drains to this basin. The slight increase in peak flow in Basin 3 (0.1 cfs) is negligible as Basin 3 discharges directly to an existing storm drain system and the increase will not cause any increased flooding risk downstream. The lengthening of the time of concentration in Basins 1 and 2 is due to the grading of flat pads at the upper end of the basin. The flat slopes at the upper end of the basin lengthen the initial time of concentration and also reduce the overall fall through the basin. Due to the longer time of concentration, the rainfall intensity is reduced, which leads to the lower flow rates.

CONCLUSION

The storm drain system for Rancho Cielo Parcel 'VC' has been designed for the 100-year storm event. The increase in impervious area in the development is offset by the lengthening of the time of concentration due to the grading of flat pads at the upper reaches of the basins. The result is that the project will match or slightly decrease the 100-year peak flow in Basins 1 and 2, while slightly increasing the 100-year peak flow in Basin 3 which will cause negligible effects due to the runoff outfalling directly to an existing storm drain which has sufficient capacity. The following table summarizes the existing and proposed 100-year peak runoff for the drainage basins within the project site.

Basin	Existing Q(100) (cfs)	Proposed Q (100) (cfs)
1	8.8	8.8
2	2.7	2.6
3	4.4	4.5

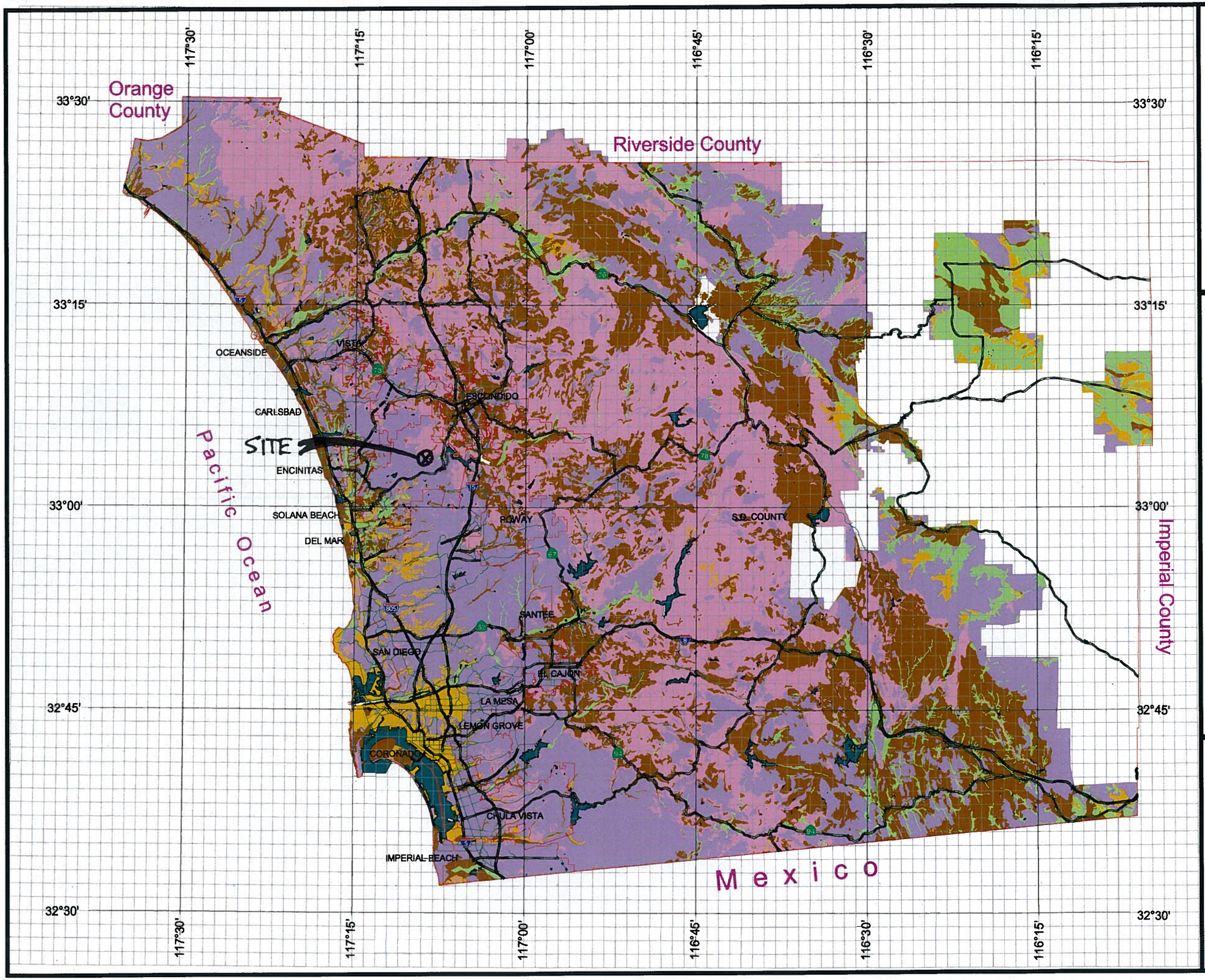
For discussions of the hydromodification and storm water quality aspects of the project, please refer to the Preliminary Hydromodification Management Study and the Storm Water Management Plan, respectively.

APPENDIX 1

Excerpts from County Hydrology Manual

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

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

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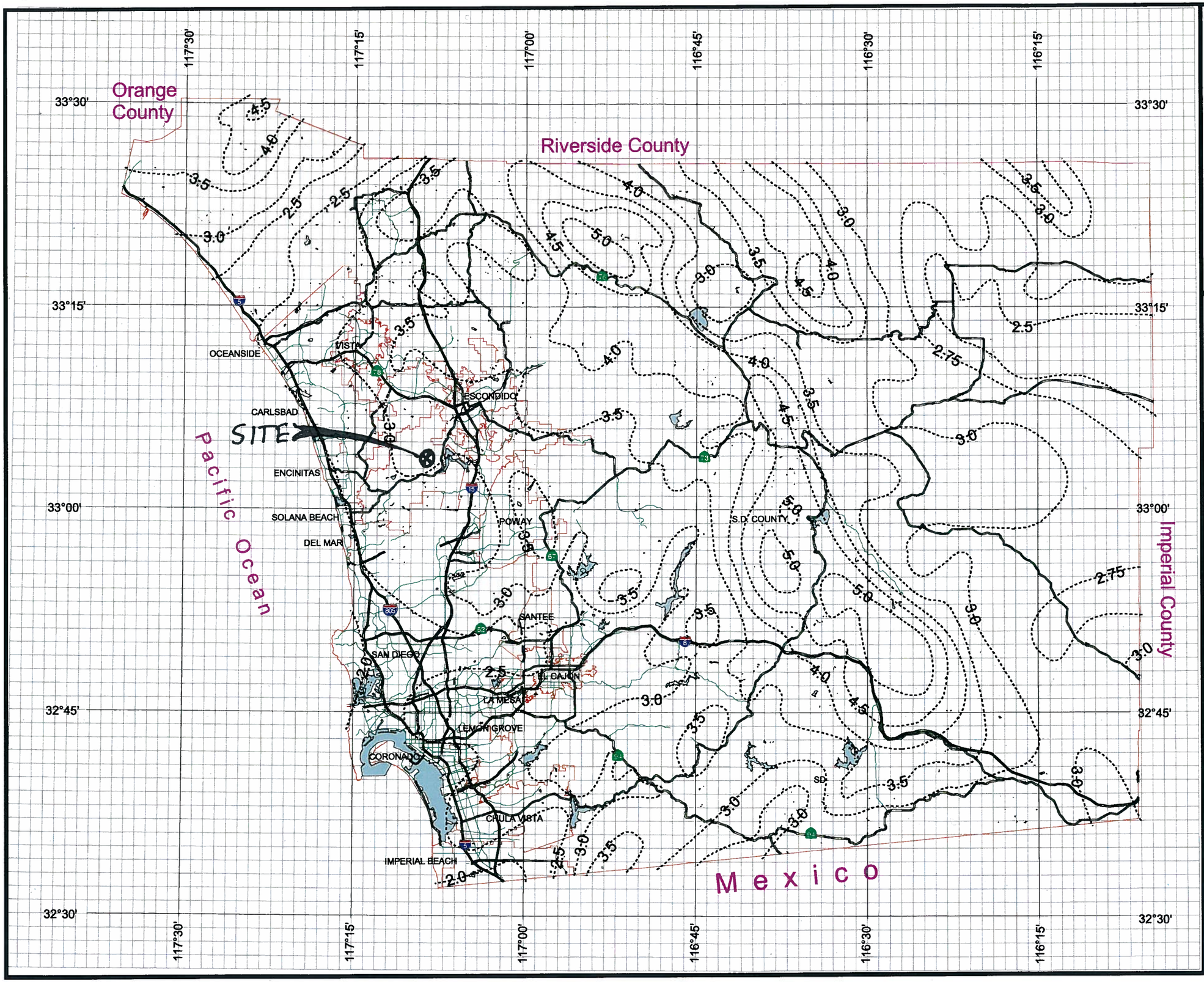
3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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N
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S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

SITE

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

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

33°30' 33°15' 33°00' 32°45' 32°30'

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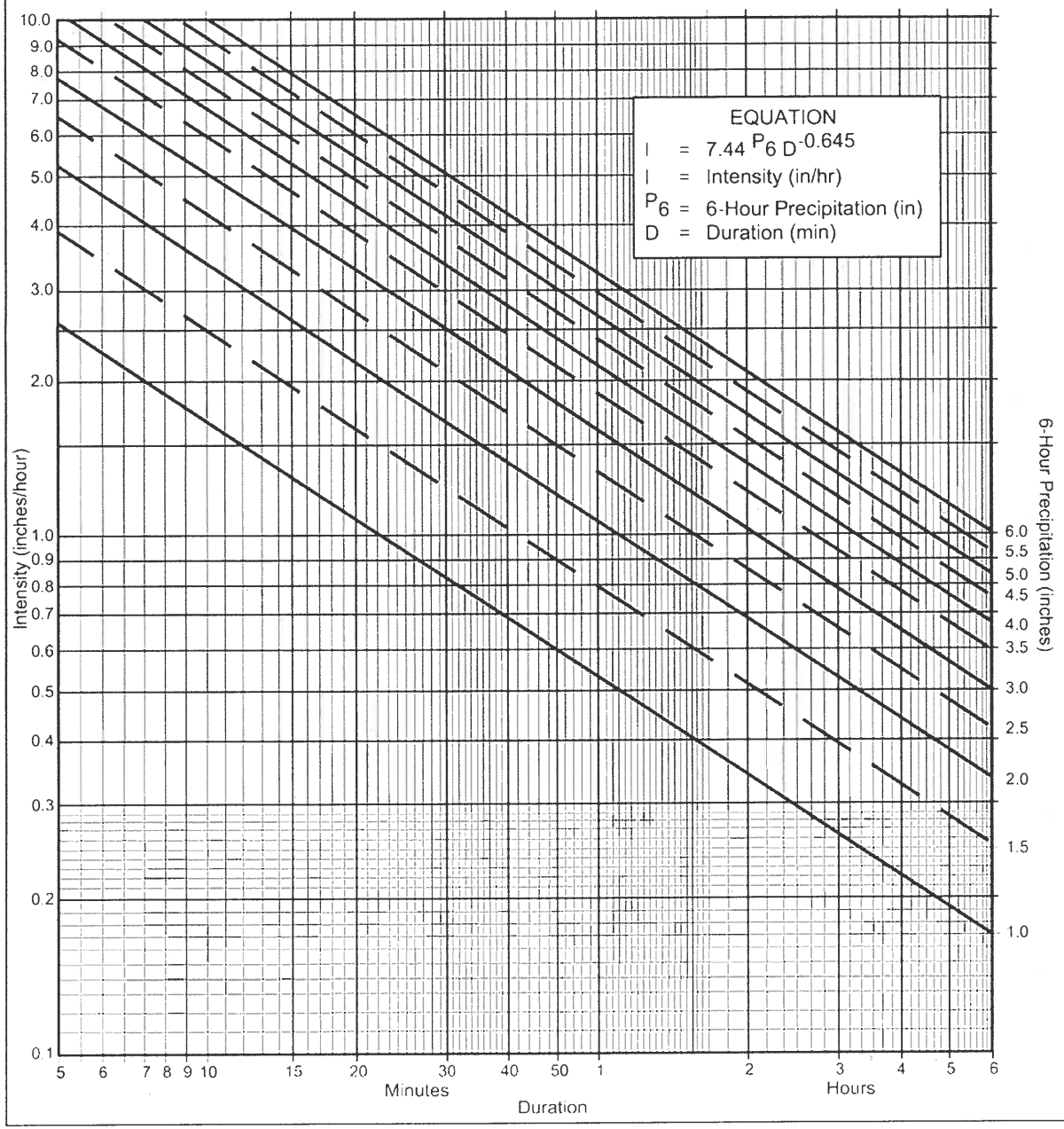
N W E S

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.1 in., P_{24} = 5.3, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted P_6(2) = 3.1 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

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

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

Intensity-Duration Design Chart - Template

FIGURE
3-1

APPENDIX 2

Hydrology Calculations

100-Year Storm

Existing Conditions

FUSCOE ENGINEERING
6390 Greenwich Drive, Suite 170
San Diego, California 92122
tel 858.554.1500 ◦ fax 858.597.0335
www.fuscoe.com

Job Name: Cielo

Date: Mar 2011

Job #: 2711.01a

Run Name: E-VC100.DAT
E-VC200.DAT
E-VC300.DAT

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	C Factor	Area (ac.)	Comments
310	305	2	1161.00	1160.00	55	0.63	0.05	
305	3	6	1160.00	1126.00	630	0.50	0.99	
220	215	2	1188.00	1169.00	55	0.35	0.05	
215	2	5	1169.00	1122.00	350			
215	2	8				0.35	0.64	
2	2	1						1 of 2
210	205	2	1188.00	1176.00	75	0.35	0.07	
205	2	5	1176.00	1122.00	300			
205	2	8				0.35	0.34	
2	2	1						2 of 2
25	20	2	1188.00	1176.00	60	0.35	0.06	
20	15	5	1176.00	1166.00	300			
20	15	8				0.35	0.33	
15	1	5	1166.00	1026.00	320			
1	1	1						1 of 2
10	5	2	1188.00	1173.00	65	0.35	0.07	
5	1	5	1173.00	1026.00	400			
5	1	8				0.35	3.24	
1	1	1						2 of 2

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2007 Advanced Engineering Software (aes)
            Ver. 3.0 Release Date: 06/01/2007  License ID 1355

                              Analysis prepared by:

                       FUSCOE ENGINEERING - SAN DIEGO, INC.
                         6390 GREENWICH DRIVE, SUITE 170
                           SAN DIEGO, CALIFORNIA 92122
                                 (858) 554-1500

 ************************** DESCRIPTION OF STUDY **************************
* CIELO - AREA V/C                                                        *
* EXISTING HYDROLOGY                                                      *
*                                                                         *
 ***************************************************************************

  FILE NAME: E-VC100.DAT
  TIME/DATE OF STUDY: 16:11 02/23/2011
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.100
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   18.0      1.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     20.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
```

```
 UPSTREAM ELEVATION(FEET) =   1188.00
 DOWNSTREAM ELEVATION(FEET) =   1176.00
 ELEVATION DIFFERENCE(FEET) =     12.00
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.854
 WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 SUBAREA RUNOFF(CFS) =      0.17
 TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.17

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     15.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1176.00  DOWNSTREAM(FEET) =   1166.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   300.00   CHANNEL SLOPE =  0.0333
 NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
 CHANNEL FLOW THRU SUBAREA(CFS) =       0.17
 FLOW VELOCITY(FEET/SEC) =   2.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   1.83   Tc(MIN.) =    6.68
 LONGEST FLOWPATH FROM NODE     25.00 TO NODE     15.00 =     360.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     15.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.776
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
 SUBAREA AREA(ACRES) =    0.33   SUBAREA RUNOFF(CFS) =    0.78
 TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       0.92
 TC(MIN.) =    6.68

****************************************************************************
 FLOW PROCESS FROM NODE     15.00 TO NODE      1.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1166.00  DOWNSTREAM(FEET) =   1026.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   320.00   CHANNEL SLOPE =  0.4375
 NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
 NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
 CHANNEL FLOW THRU SUBAREA(CFS) =       0.92
 FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   1.12   Tc(MIN.) =    7.80
 LONGEST FLOWPATH FROM NODE     25.00 TO NODE      1.00 =     680.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.00 TO NODE      1.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
```

```
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.80
  RAINFALL INTENSITY(INCH/HR) =   6.13
  TOTAL STREAM AREA(ACRES) =     0.39
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.92

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    65.00
  UPSTREAM ELEVATION(FEET) =   1188.00
  DOWNSTREAM ELEVATION(FEET) =   1173.00
  ELEVATION DIFFERENCE(FEET) =     15.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.052
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.113
  SUBAREA RUNOFF(CFS) =      0.20
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.20

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      1.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1173.00  DOWNSTREAM(FEET) =   1026.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   400.00   CHANNEL SLOPE =  0.3675
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.20
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.41   Tc(MIN.) =    6.46
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE      1.00 =     465.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      1.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.925
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    3.24   SUBAREA RUNOFF(CFS) =    7.85
  TOTAL AREA(ACRES) =        3.3   TOTAL RUNOFF(CFS) =       8.02
  TC(MIN.) =    6.46

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
```

```
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
================================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.46
  RAINFALL INTENSITY(INCH/HR) =   6.93
  TOTAL STREAM AREA(ACRES) =     3.31
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.02

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        0.92     7.80        6.129          0.39
      2        8.02     6.46        6.925          3.31

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        8.79     6.46       6.925
      2        8.03     7.80       6.129

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.79   Tc(MIN.) =    6.46
  TOTAL AREA(ACRES) =        3.7
  LONGEST FLOWPATH FROM NODE     25.00 TO NODE      1.00 =     680.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.7  TC(MIN.) =      6.46
  PEAK FLOW RATE(CFS)   =       8.79
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2007 Advanced Engineering Software (aes)
            Ver. 3.0 Release Date: 06/01/2007  License ID 1355

                              Analysis prepared by:

                       FUSCOE ENGINEERING - SAN DIEGO, INC.
                         6390 GREENWICH DRIVE, SUITE 170
                           SAN DIEGO, CALIFORNIA 92122
                                 (858) 554-1500

 ************************** DESCRIPTION OF STUDY **************************
* CIELO - AREA V/C                                                       *
* EXISTING HYDROLOGY                                                     *
*                                                                        *
 **************************************************************************

  FILE NAME: E-VC200.DAT
  TIME/DATE OF STUDY: 16:12 02/23/2011
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.100
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   18.0      1.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

**************************************************************************
  FLOW PROCESS FROM NODE    220.00 TO NODE    215.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
```

```
  UPSTREAM ELEVATION(FEET) =   1188.00
  DOWNSTREAM ELEVATION(FEET) =   1169.00
  ELEVATION DIFFERENCE(FEET) =     19.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.647
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.14
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.14

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE      2.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1169.00  DOWNSTREAM(FEET) =   1122.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   350.00   CHANNEL SLOPE =  0.1343
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.14
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.23   Tc(MIN.) =    5.88
  LONGEST FLOWPATH FROM NODE    220.00 TO NODE      2.00 =     405.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    215.00 TO NODE      2.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.359
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.64   SUBAREA RUNOFF(CFS) =    1.65
  TOTAL AREA(ACRES) =        0.7   TOTAL RUNOFF(CFS) =       1.78
  TC(MIN.) =    5.88

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      2.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.88
  RAINFALL INTENSITY(INCH/HR) =   7.36
  TOTAL STREAM AREA(ACRES) =     0.69
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.78

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    205.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =   1188.00
  DOWNSTREAM ELEVATION(FEET) =   1176.00
  ELEVATION DIFFERENCE(FEET) =     12.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.427
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.747
  SUBAREA RUNOFF(CFS) =      0.19
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.19

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE      2.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1176.00  DOWNSTREAM(FEET) =   1122.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   300.00   CHANNEL SLOPE =  0.1800
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.19
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =    6.48
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE      2.00 =     375.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE      2.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.909
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.34   SUBAREA RUNOFF(CFS) =    0.82
  TOTAL AREA(ACRES) =        0.4   TOTAL RUNOFF(CFS) =       0.99
  TC(MIN.) =    6.48

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      2.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.48
  RAINFALL INTENSITY(INCH/HR) =   6.91
  TOTAL STREAM AREA(ACRES) =     0.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.99

  ** CONFLUENCE DATA **
  STREAM     RUNOFF        Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        1.78     5.88        7.359          0.69
      2        0.99     6.48        6.909          0.41
```

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        2.68     5.88       7.359
      2        2.66     6.48       6.909

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.68   Tc(MIN.) =    5.88
  TOTAL AREA(ACRES) =        1.1
  LONGEST FLOWPATH FROM NODE    220.00 TO NODE      2.00 =     405.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.1  TC(MIN.) =      5.88
  PEAK FLOW RATE(CFS)   =       2.68
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
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              Ver. 3.0 Release Date: 06/01/2007  License ID 1355

                              Analysis prepared by:

                        FUSCOE ENGINEERING - SAN DIEGO, INC.
                          6390 GREENWICH DRIVE, SUITE 170
                            SAN DIEGO, CALIFORNIA 92122
                                  (858) 554-1500

 ************************** DESCRIPTION OF STUDY **************************
* EXISTING HYDROLOGY                                                      *
* CIELO - AREA V/C                                                        *
*                                                                         *
 ***************************************************************************

  FILE NAME: E-VC300.DAT
  TIME/DATE OF STUDY: 16:53 03/01/2011
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.100
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   18.0      1.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    310.00 TO NODE    305.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  UPSTREAM ELEVATION(FEET) =   1161.00
  DOWNSTREAM ELEVATION(FEET) =   1160.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.187
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
```

```
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.37
  TOTAL AREA(ACRES) =      0.05   TOTAL RUNOFF(CFS) =      0.37

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    300.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1160.00  DOWNSTREAM ELEVATION(FEET) = 1126.00
  STREET LENGTH(FEET) =   630.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.39
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    6.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.30
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.11
  STREET FLOW TRAVEL TIME(MIN.) =   2.44   Tc(MIN.) =    4.63
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.519
  SUBAREA AREA(ACRES) =    0.99      SUBAREA RUNOFF(CFS) =    4.04
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       4.41

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   8.86
  FLOW VELOCITY(FEET/SEC.) =  4.89   DEPTH*VELOCITY(FT*FT/SEC.) =   1.48
  LONGEST FLOWPATH FROM NODE    310.00 TO NODE    300.00 =     685.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.0  TC(MIN.) =      4.63
  PEAK FLOW RATE(CFS)   =       4.41
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

100-Year Storm

Proposed Conditions

Weighted Runoff Coefficient Calcs

C Values

Undeveloped	0.35
Pads	0.52
Pavement	0.9

Node to Node	Total Area (ac)	Pads (ac)	Pavement (ac)	Undeveloped (ac)	Impervious Area	Pervious Area	% Impervious	C based on %
305-3	0.9	0	0.38	0.52	0.380	0.520	0.42	0.58
206-2	0.71	0.26	0	0.45	0.078	0.632	0.11	0.41
70-68	0.06	0	0.049	0.011	0.049	0.011	0.82	0.80
68-20	0.04	0	0.024	0.016	0.024	0.016	0.60	0.68
20-35	0.29	0	0.21	0.08	0.210	0.080	0.72	0.75
15-10	0.36	0.25	0	0.11	0.075	0.285	0.21	0.46
38-1	1.95	0.48	0	1.47	0.144	1.806	0.07	0.39

FUSCOE ENGINEERING
6390 Greenwich Drive, Suite 170
San Diego, California 92122
tel 858.554.1500 ◦ fax 858.597.0335
www.fuscoe.com

Job Name: Cielo VC Date: Apr 2013

Job #: 2711.01a Run Name: VCPR.DAT

Node to Node		Code	Elev 1 (feet)	Elev 2 (feet)	Length (feet)	C Factor	Area (ac.)	Comments
310	305	2	1161.00	1160.00	55	0.90	0.03	
305	3	6	1160.00	1126.00	630	0.58	0.90	
210	208	2	1170.00	1168.40	80	0.52	0.08	
208	206	5	1168.40	1167.40	50			
208	206	8				0.52	0.18	
206	2	9	1164.00	1122.00	235	0.41	0.71	
70	68	2	1168.00	1166.80	100	0.80	0.06	
68	20	6	1166.80	1164.10	65	0.68	0.04	
20	20	1						1 of 2
30	25	2	1168.00	1166.40	80	0.52	0.14	
25	20	5	1166.40	1164.10	135			
25	20	8				0.52	0.25	
20	20	1						2 of 2
20	35	6	1164.10	1158.50	144	0.75	0.29	
35	15	3	1158.50	1157.50	17			
15	10	5	1157.50	1157.00	63			
15	10	8				0.46	0.36	
10	5	3	1154.50	1144.00	90			
5	1	5	1144.00	1026.00	235			
5	1	8				0.35	0.57	
1	1	1						1 of 2
45	40	2	1170.00	1168.40	80	0.52	0.09	
40	39	5	1168.40	1167.00	135			
40	39	8				0.52	0.17	
39	38	3	1164.00	1135.00	62			
38	1	5	1135.00	1072.00	235			
38	1	8				0.39	1.95	
1	1	1						2 of 2

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2010 Advanced Engineering Software (aes)
              Ver. 17.0 Release Date: 07/01/2010  License ID 1355

                              Analysis prepared by:

                                 Fuscoe Engineering, Inc.
                              6390 Greenwich Drive, Suite 170
                                   San Diego, CA 92122


 ************************** DESCRIPTION OF STUDY **************************
* RANCHO CIELO PARCEL VC                                                  *
* 100-YEAR HYDROLOGY PROPOSED CONDITIONS                                  *
* 04-12-13  02711-001-01                                                  *
 **************************************************************************

  FILE NAME: VCPR.DAT
  TIME/DATE OF STUDY: 14:06 04/12/2013
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.100
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   18.0      1.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

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

**************************************************************************
  FLOW PROCESS FROM NODE    310.00 TO NODE    305.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    55.00
  UPSTREAM ELEVATION(FEET) =   1161.00
  DOWNSTREAM ELEVATION(FEET) =   1160.00
  ELEVATION DIFFERENCE(FEET) =      1.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.187
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
```

```
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.22
  TOTAL AREA(ACRES) =      0.03   TOTAL RUNOFF(CFS) =      0.22

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE      3.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1160.00  DOWNSTREAM ELEVATION(FEET) = 1126.00
  STREET LENGTH(FEET) =   630.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.35
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    6.56
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.29
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.10
  STREET FLOW TRAVEL TIME(MIN.) =   2.45   Tc(MIN.) =    4.63
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.590
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    4.26
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       4.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   8.92
  FLOW VELOCITY(FEET/SEC.) =  4.91   DEPTH*VELOCITY(FT*FT/SEC.) =   1.50
  LONGEST FLOWPATH FROM NODE    310.00 TO NODE      3.00 =     685.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    208.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =   1170.00
  DOWNSTREAM ELEVATION(FEET) =   1168.40
  ELEVATION DIFFERENCE(FEET) =      1.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.412
```

```
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    80.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.336
  SUBAREA RUNOFF(CFS) =      0.26
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.26

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    206.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1168.40  DOWNSTREAM(FEET) =   1167.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =    50.00   CHANNEL SLOPE =  0.0200
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.26
  FLOW VELOCITY(FEET/SEC) =   2.12 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.39   Tc(MIN.) =    7.80
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    206.00 =     130.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    208.00 TO NODE    206.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.129
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5200
  SUBAREA AREA(ACRES) =    0.18   SUBAREA RUNOFF(CFS) =    0.57
  TOTAL AREA(ACRES) =       0.3   TOTAL RUNOFF(CFS) =       0.83
  TC(MIN.) =    7.80

****************************************************************************
  FLOW PROCESS FROM NODE    206.00 TO NODE      2.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   1164.00
  DOWNSTREAM NODE ELEVATION(FEET) =   1122.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   235.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.500
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.60
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.008
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.70
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  16.05
  AVERAGE FLOW DEPTH(FEET) =   0.50   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.24   Tc(MIN.) =    8.05
  SUBAREA AREA(ACRES) =    0.71       SUBAREA RUNOFF(CFS) =    1.75
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.439
  TOTAL AREA(ACRES) =        1.0         PEAK FLOW RATE(CFS) =       2.56

         NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL DEPTH
         IN A FLOWING-FULL GUTTER(NORMAL DEPTH = GUTTER HIKE)
```

```
  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.50   FLOOD WIDTH(FEET) =    3.00
  FLOW VELOCITY(FEET/SEC.) =  16.05   DEPTH*VELOCITY(FT*FT/SEC) =   8.02
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE      2.00 =     365.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      2.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     68.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .8000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1168.00
  DOWNSTREAM ELEVATION(FEET) =   1166.80
  ELEVATION DIFFERENCE(FEET) =      1.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.312
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    72.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.39
  TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.39

****************************************************************************
  FLOW PROCESS FROM NODE     68.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1166.80  DOWNSTREAM ELEVATION(FEET) = 1164.10
  STREET LENGTH(FEET) =    65.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.50
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.16
    HALFSTREET FLOOD WIDTH(FEET) =    1.50
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.84
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.60
  STREET FLOW TRAVEL TIME(MIN.) =   0.28   Tc(MIN.) =    4.59
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.168
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
```

```
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .6800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.752
  SUBAREA AREA(ACRES) =    0.04      SUBAREA RUNOFF(CFS) =    0.22
  TOTAL AREA(ACRES) =        0.1        PEAK FLOW RATE(CFS) =       0.61

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.18   HALFSTREET FLOOD WIDTH(FEET) =   2.62
  FLOW VELOCITY(FEET/SEC.) =  3.29   DEPTH*VELOCITY(FT*FT/SEC.) =   0.59
  LONGEST FLOWPATH FROM NODE     70.00 TO NODE     20.00 =     165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    4.59
  RAINFALL INTENSITY(INCH/HR) =   8.17
  TOTAL STREAM AREA(ACRES) =     0.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.61

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     25.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =   1168.00
  DOWNSTREAM ELEVATION(FEET) =   1166.40
  ELEVATION DIFFERENCE(FEET) =      1.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.412
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    80.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.336
  SUBAREA RUNOFF(CFS) =      0.46
  TOTAL AREA(ACRES) =      0.14   TOTAL RUNOFF(CFS) =      0.46

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     20.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1166.40  DOWNSTREAM(FEET) =   1164.10
  CHANNEL LENGTH THRU SUBAREA(FEET) =   135.00   CHANNEL SLOPE =  0.0170
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.46
  FLOW VELOCITY(FEET/SEC) =   1.96 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.15   Tc(MIN.) =    8.56
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.00 =     215.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     20.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.774
 *USER SPECIFIED(SUBAREA):
 RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.5200
 SUBAREA AREA(ACRES) =    0.25   SUBAREA RUNOFF(CFS) =    0.75
 TOTAL AREA(ACRES) =       0.4   TOTAL RUNOFF(CFS) =       1.17
 TC(MIN.) =    8.56

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.56
 RAINFALL INTENSITY(INCH/HR) =   5.77
 TOTAL STREAM AREA(ACRES) =     0.39
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.17

 ** CONFLUENCE DATA **
 STREAM     RUNOFF       Tc      INTENSITY      AREA
 NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1        0.61     4.59        8.168          0.10
     2        1.17     8.56        5.774          0.39

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM     RUNOFF      Tc      INTENSITY
 NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
     1        1.24     4.59       8.168
     2        1.61     8.56       5.774

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       1.61   Tc(MIN.) =    8.56
 TOTAL AREA(ACRES) =        0.5
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.00 =     215.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     35.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1164.10  DOWNSTREAM ELEVATION(FEET) = 1158.00
 STREET LENGTH(FEET) =   144.00   CURB HEIGHT(INCHES) =  6.0
 STREET HALFWIDTH(FEET) = 18.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   1.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.20
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
```

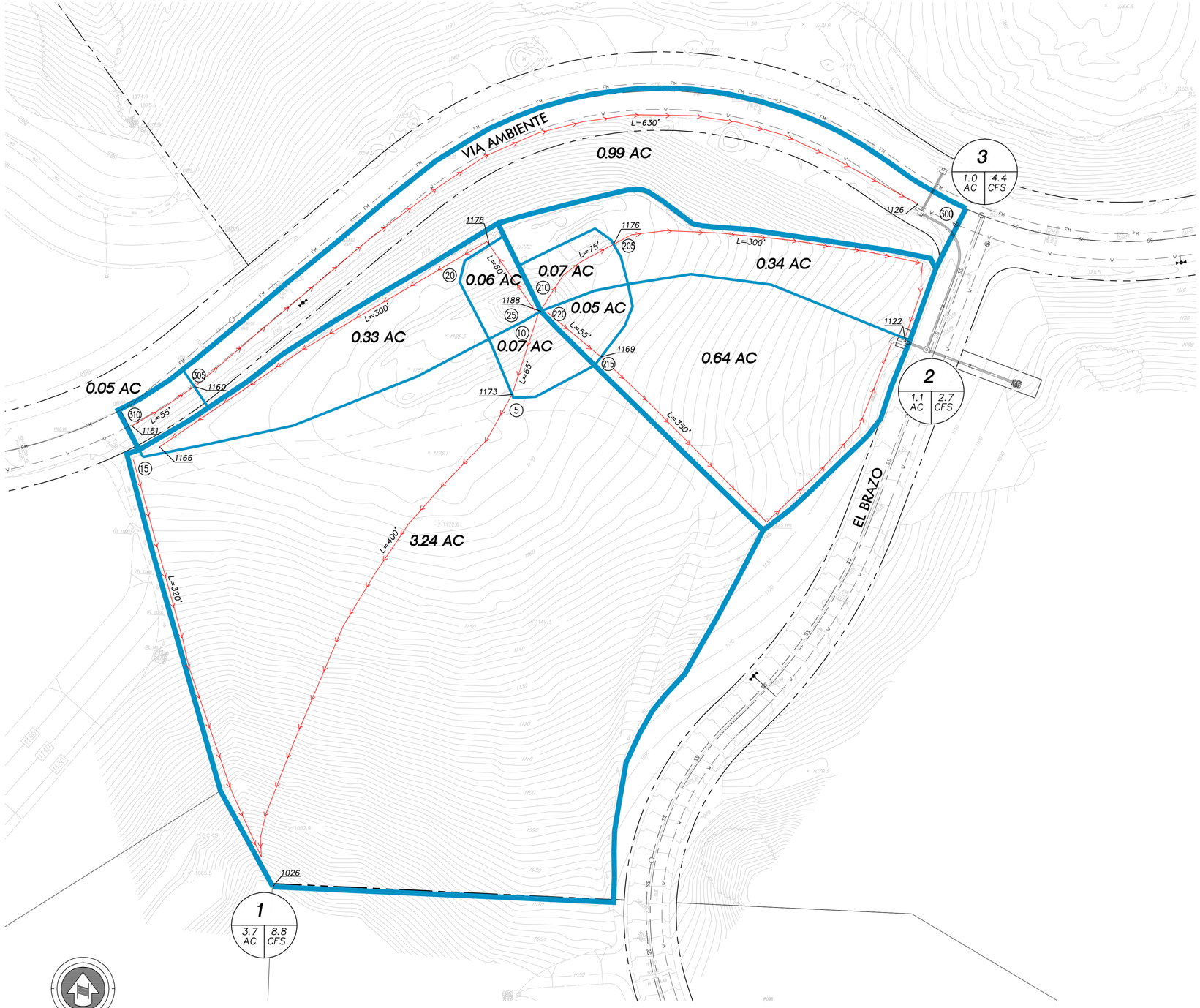
```
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    6.74
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.85
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.01
  STREET FLOW TRAVEL TIME(MIN.) =   0.62   Tc(MIN.) =    9.18
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.518
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .7500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.635
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    1.20
  TOTAL AREA(ACRES) =        0.8        PEAK FLOW RATE(CFS) =       2.73

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   7.52
  FLOW VELOCITY(FEET/SEC.) =  4.00   DEPTH*VELOCITY(FT*FT/SEC.) =   1.11
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     35.00 =     359.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     15.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1158.50  DOWNSTREAM(FEET) =   1157.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =    17.00   CHANNEL SLOPE =  0.0588
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   1.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.73
  FLOW VELOCITY(FEET/SEC.) =   6.96   FLOW DEPTH(FEET) =   0.18
  TRAVEL TIME(MIN.) =   0.04   Tc(MIN.) =    9.22
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     15.00 =     376.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     10.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1157.50  DOWNSTREAM(FEET) =   1157.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    63.00   CHANNEL SLOPE =  0.0079
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.73
  FLOW VELOCITY(FEET/SEC) =   1.64 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.64   Tc(MIN.) =    9.86
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     10.00 =     439.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     10.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.269
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5799
  SUBAREA AREA(ACRES) =    0.36   SUBAREA RUNOFF(CFS) =    0.87
  TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       3.48
  TC(MIN.) =    9.86

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE      5.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1151.50  DOWNSTREAM(FEET) =  1144.00
  FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.012
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.31
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.48
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    9.99
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE      5.00 =     529.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      1.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1144.00  DOWNSTREAM(FEET) =   1026.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   235.00   CHANNEL SLOPE =  0.5021
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.48
  FLOW VELOCITY(FEET/SEC) =   6.14 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.64   Tc(MIN.) =   10.62
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE      1.00 =     764.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      1.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.023
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5033
  SUBAREA AREA(ACRES) =    0.57   SUBAREA RUNOFF(CFS) =    1.00
  TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =       4.32
  TC(MIN.) =   10.62

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.62
  RAINFALL INTENSITY(INCH/HR) =   5.02
  TOTAL STREAM AREA(ACRES) =     1.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.32

****************************************************************************
  FLOW PROCESS FROM NODE     45.00 TO NODE     40.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
  UPSTREAM ELEVATION(FEET) =   1170.00
```

```
  DOWNSTREAM ELEVATION(FEET) =   1168.40
  ELEVATION DIFFERENCE(FEET) =      1.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.412
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    80.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.336
  SUBAREA RUNOFF(CFS) =      0.30
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.30

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     39.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1168.40  DOWNSTREAM(FEET) =   1167.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   135.00   CHANNEL SLOPE =  0.0104
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.30
  FLOW VELOCITY(FEET/SEC) =   1.53 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.47   Tc(MIN.) =    8.88
  LONGEST FLOWPATH FROM NODE     45.00 TO NODE     39.00 =     215.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.00 TO NODE     39.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.637
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5200
  SUBAREA AREA(ACRES) =    0.17   SUBAREA RUNOFF(CFS) =    0.50
  TOTAL AREA(ACRES) =       0.3   TOTAL RUNOFF(CFS) =       0.76
  TC(MIN.) =    8.88

****************************************************************************
  FLOW PROCESS FROM NODE     39.00 TO NODE     38.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1164.00  DOWNSTREAM(FEET) =  1135.00
  FLOW LENGTH(FEET) =    62.00   MANNING'S N =  0.012
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   1.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.65
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.76
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    8.96
  LONGEST FLOWPATH FROM NODE     45.00 TO NODE     38.00 =     277.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     38.00 TO NODE      1.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1135.00  DOWNSTREAM(FEET) =   1072.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   235.00   CHANNEL SLOPE =  0.2681
```

```
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.76
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.83   Tc(MIN.) =    9.78
  LONGEST FLOWPATH FROM NODE     45.00 TO NODE      1.00 =     512.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     38.00 TO NODE      1.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.298
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (4.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .3900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4053
  SUBAREA AREA(ACRES) =    1.95   SUBAREA RUNOFF(CFS) =    4.03
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       4.75
  TC(MIN.) =    9.78

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.78
  RAINFALL INTENSITY(INCH/HR) =   5.30
  TOTAL STREAM AREA(ACRES) =     2.21
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.75

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        4.32    10.62        5.023          1.71
      2        4.75     9.78        5.298          2.21

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        8.84     9.78       5.298
      2        8.82    10.62       5.023

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.84   Tc(MIN.) =    9.78
  TOTAL AREA(ACRES) =        3.9
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE      1.00 =     764.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.9  TC(MIN.) =      9.78
  PEAK FLOW RATE(CFS)   =       8.84
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

♀



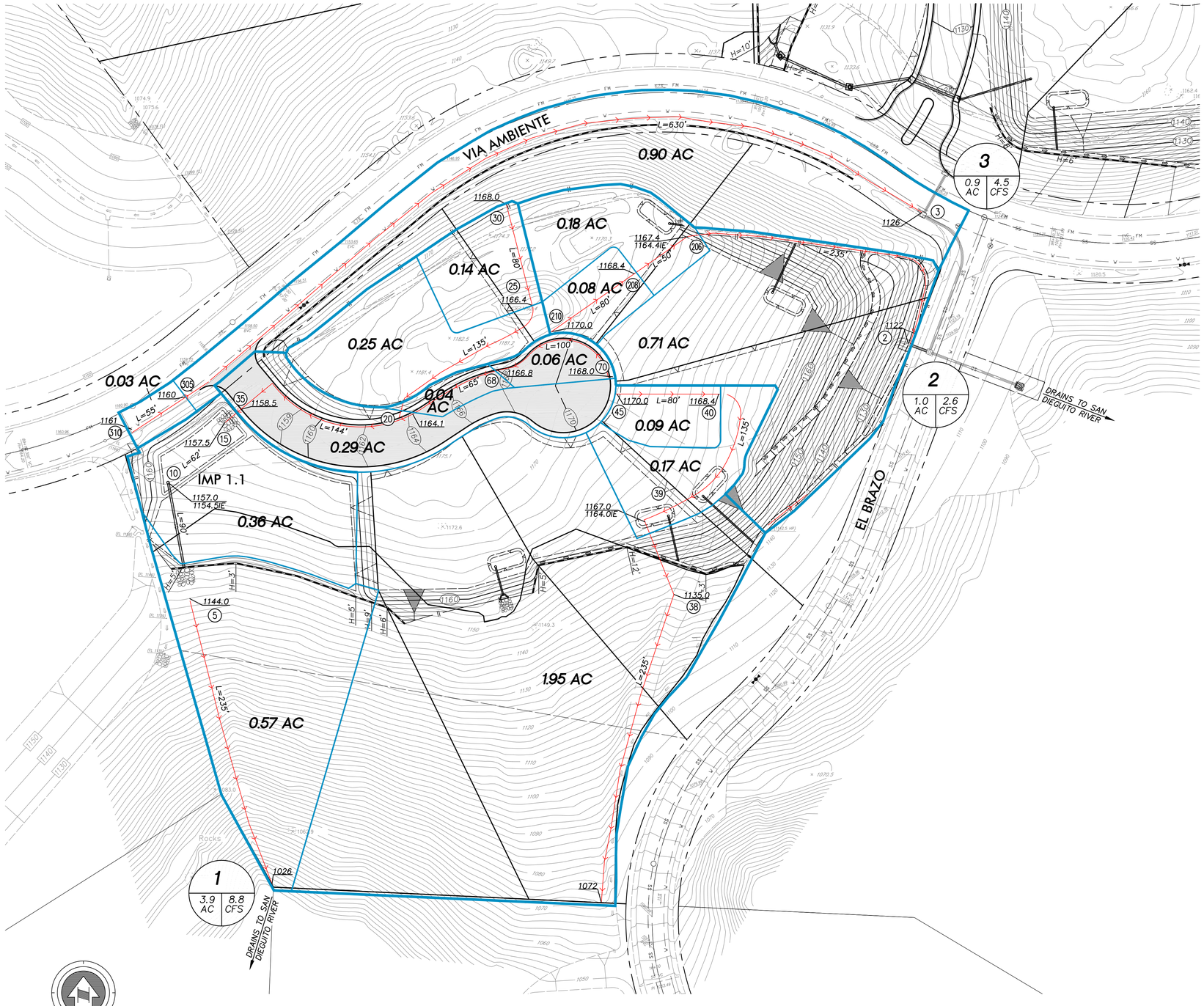
LEGEND

- PROPERTY LINE
- EXISTING LOT LINE
- RIGHT-OF-WAY
- EXISTING CONTOUR
- EXISTING STORM DRAIN
- BASIN BOUNDARY
- FLOW PATH
- HYDROLOGY NODE (XX)
- POINT OF ANALYSIS: X | X AC | X CFS

RANCHO CIELO PARCEL 'VC'
EXISTING 100-YEAR HYDROLOGY
COUNTY OF SAN DIEGO, CA

PROJECT NUMBER: 02711-001-01
DATE: 4/15/13

FUSCOE ENGINEERING
6390 Greenwich Drive, Suite 170
San Diego, California 92122
tel 858.554.1500 ◦ fax 858.597.0335
www.fuscoe.com



LEGEND

- PROPERTY LINE
- EXISTING LOT LINE
- RIGHT–OF–WAY
- EXISTING CONTOUR
- EXISTING STORM DRAIN
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN
- PROPOSED PAVEMENT
- PROPOSED BUILDINGS
- BASIN BOUNDARY
- FLOW PATH
- HYDROLOGY NODE (XX)
- POINT OF ANALYSIS (X; X AC | X CFS)

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DATE6 6/12/2013

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www.fuscoe.com