City of San Marcos CA

PRELIMINARY DRAINAGE STUDY FOR

CUP 20-0006

APN 314-840-09

Prepared for:

Namou Group LLC
450 W El Norte Pkwy
Escondido, CA 92026

Prepared by:

2888 LOKER AVENUE EAST, SUITE 217
CARLSBAD, CA 92010
(760) 929-2288

Preparation Date

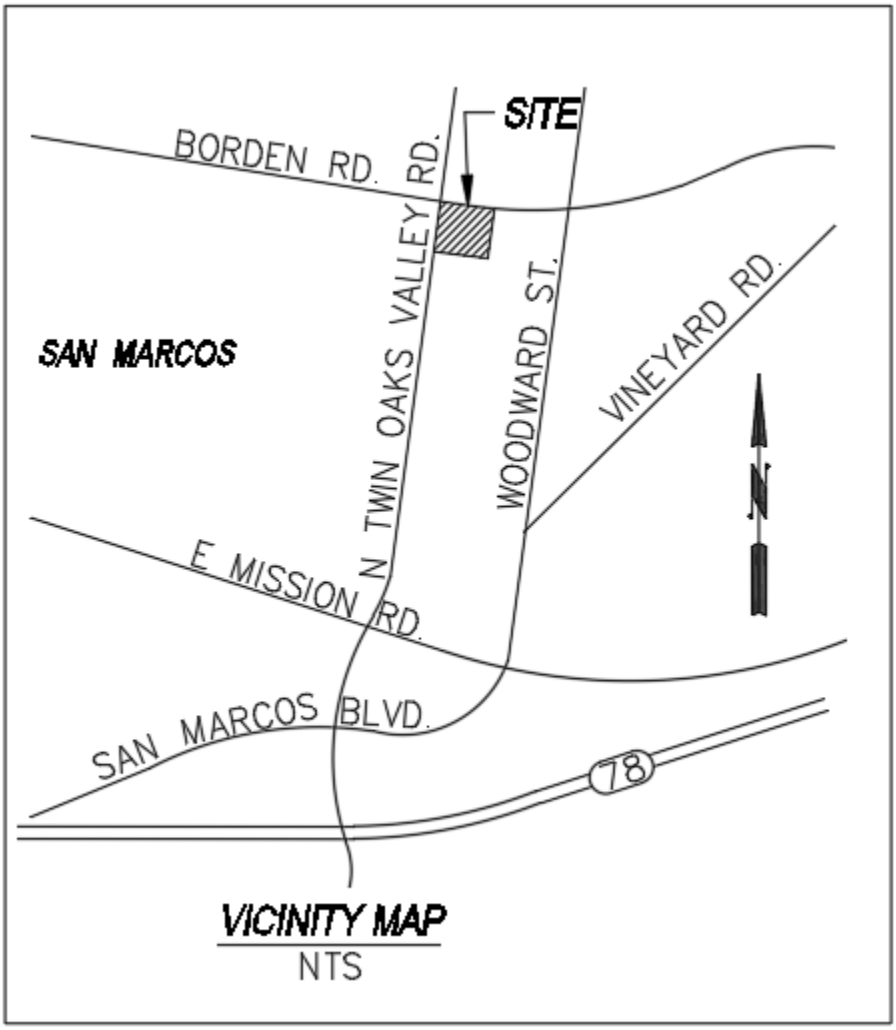
June 4, 2020

Revision Date

August 25, 2020 **December 10, 2020**

TABLE OF CONTENTS

Figure 1 - PROJECT VICINITY MAP



1. Introduction

This Preliminary Drainage Study for the proposed commercial development of property located at the SEC of Twin Oaks Valley Rd. & Borden Rd., San Marcos, CA 92069. This report intends to present both the methodology and the calculations used for determining the runoff from the project site in both the pre-developed (existing) conditions and the post-developed (proposed) conditions produced by the 100-year, 6-hour storm per County of San Diego Hydrology.
Specifically, this report will identify any potential hydrologic impacts and analyze potential mitigation measure alternatives to ensure that no existing public storm drain facilities will be negatively impacted as a result of this development. Refer to the Preliminary Storm Water Quality Management Plan (SWQMP) for a detailed description of how the project will address the water quality and hydromodification requirements consistent with the City of San Marcos Storm Water Standards.

2. Existing Conditions

The rectangular shaped property covers approximately 1.8 acres and is bounded to the west by North Twin Oaks Valley Road, to the north by Borden Road, to the east San Marcos Creek and to the south by 3 existing commercial buildings. Most of the site is currently covered by a light growth of grasses and weeds with the eastern portion covered with dense chaparral and trees adjacent to the existing San Marcos Creek. The site can be accessed from the west by a driveway from North Twin Oaks Valley Road.

Run off travels easterly mostly as sheet flow discharging directly into san Marcos Creek, there is also concentrated offsite run-off and street run-on coming in via an existing 36" RCP and an AC spillway that discharge into an existing on-site vegetated channel, that conveys concentrated flows easterly discharging directly into San marcos Creek. There is no commingle of on onsite and offsite runoff.

3. Proposed Project

Conventional cut and fill grading techniques will be used to develop the site as depicted on the Preliminary Grading Plan. The site will support a one story Convenience Store at the southern end of the property; a carwash proposed at the north end of the property; a fuel pumping area in the center of the site, and the location of the proposed underground fuel storage. It is anticipated that these buildings will be wood-framed structures supported by conventional shallow foundation elements. Associated improvements will include: driveways and parking lots; several retaining walls ranging in height from approximately 1 to 7.5 ; and buried "wet and dry" utilities and appropriate hydro-modification and/or BMP devices to be located at the southern end of the property.

On regards to offsite run-off flows, the project proposes to improve the existing on-site vegetated swale with a combination of a curb inlet and a new concrete channel that will also collect the newly generated and treated onsite flows after discharge out of the bio-filtration facility.

4. Methodology

The watersheds are rather small; therefore, the Rational Method Formula has been selected to calculate runoff.

RATIONAL METHOD

Watersheds Less than 0.5 Square Mile

Method of Computing Runoff

Use the Rational Formula Q = CIA where:

Q: is the peak rate of flow in cubic feet per second.

C: is a runoff coefficient expressed as that percentage of rainfall which

A: is the drainage area in acres tributary to design point.

I: is the average rainfall intensity in inches per hour for storm duration equal to the time of concentration (Tc) of the contributing drainage area.

(1) Runoff Coefficient, C

Table 4-1 lists the estimated coefficients for urban areas.

Table 4-1

		RUNOFF COEFFICIENT			
	(%)	Hydrologic Soil Type			
LAND USE (County Elements)	Imperv.	A	B	C	D
Permanent Open Space		0.20	0.25	0.30	0.35
Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Neighborhood Commercial	80	0.76	0.77	0.78	0.79
General Commercial	85	0.80	0.80	0.81	0.82
Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Limited Industrial	90	0.83	0.84	0.84	0.85
General Industrial	95	0.87	0.87	0.87	0.87

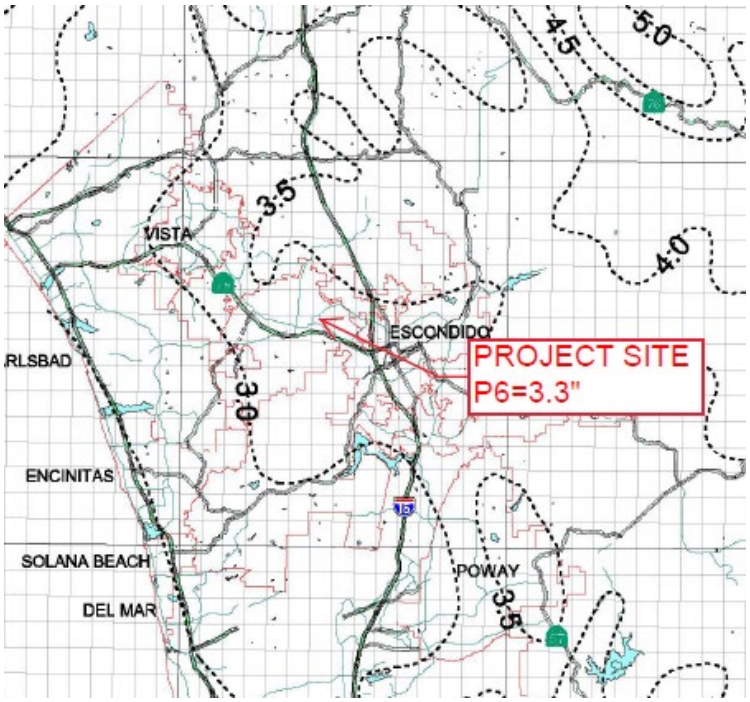
The runoff coefficient C for this site is calculated as follows pursuant to section 3.1.2 of the County Hydrology Manual.

(2) Rainfall Intensity, I

Average rainfall intensity for a duration equal to the Tc for the area, in inches per hour.

The storm frequency for this study has a 100-year recurrence interval. The six-hour anticipated precipitation for the project site subject to the design storm frequency.

P_6 = 3.3 in
P_{24} = 5.7 in
P_6 is in the range of 45% to 65% of P_{24} and therefore does not need to be adjusted.

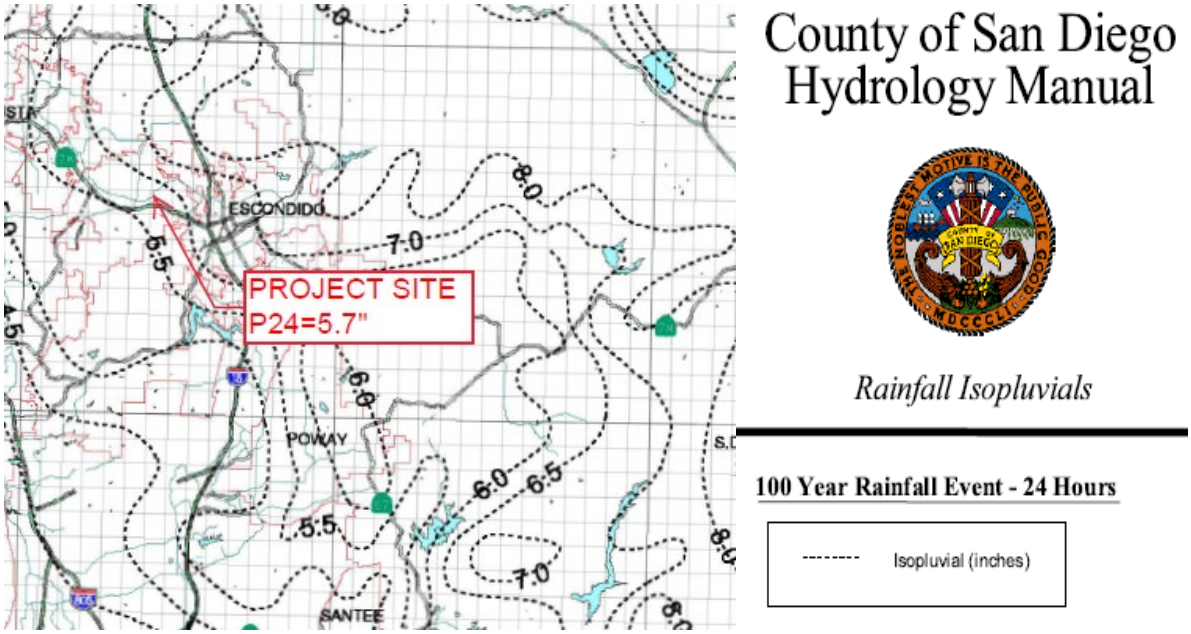


County of San Diego
Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



(3) Time of Concentration, Tc

The time of concentration is the time required for runoff to flow from the most remote part of the watershed to the outlet point under consideration.

The time of concentration for each sub-area on site, *Tc* is determined from the following formula (San Diego County Hydrology Manual, dated June 2003) with the initial lengths and times adjusted per Table 3-2 of the Manual for slope and land use.

$$T_c = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$$ (For overland time of flow)

Where,

T_c = Time of Concentration (hours)

D = Watercourse Distance (ft)

S = Slope (%)

C = Runoff Coefficient

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$ (For natural watersheds)

Where,

T_c = Time of Concentration in hours (hours)

L = Watercourse Distance (miles)

ΔE = Change in elevation along effective slope line (ft)

The average rainfall intensity is calculated from the following equation (San Diego County Hydrology Manual, June 2003).

$$I = 7.44 \times P_6 \times D^{-0.645}$$

Where,

I = Rainfall Intensity (in/hr)

P_6 = Six hour precipitation (inches)

D = Duration (min.)

There is an illustration of this formula in Figure 2, which is per County 2003 Hydrology Manual. Time of concentration (T_C) is composed of two components: The initial time of concentration (T_i), and the travel time (T_t).
The maximum overland flow length (L_M) is used from Table 4 in calculating the initial time
of concentration. The source for this chart is the San Diego County Hydrology Manual (Table 3.2), June 2003.

Table 4 - Maximum Overland Flow Length (L_M) & Initial Time of Concentration (T_i)

Element	DU/ Acre	0.50%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		*50*	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	*85*	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	103.0	70	10.0	*85*	8.8	*95*	8.1	100	7.0	100	*5.6*
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	*6.5*	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	*5.3*	*65*	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com.		50	*5.3*	60	*4.5*	*75*	4.0	85	3.8	95	3.4	100	2.7
G. Com.		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com.		50	41.0	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

In addition to the above Ration Method assumptions, the conservative assumption that all runoff coefficients utilized for this report are based on **Types "C" & "D"**

The County of San Diego Rational Method program within CivilDesign was utilized in calculating runoff for all basins smaller than 0.5 square miles in size.

5. Summary

Upon performing hydrologic and hydraulic analysis of the project site, the following results were produced:

Pre-Development

Discharge Location	Drainage Area (AC)	Runoff Coefficient (C)	100-Year Peak Flow (cfs)
Node 15	1.77	0.30	3.42

Post Development

Discharge Location	Drainage Area (AC)	Runoff Coefficient (C)	100-Year Peak Flow (cfs)	100-Year Peak Flow - Mitigated (cfs)
Node 40	1.25	0.72	5.78	3.02
Node 55	0.37	0.30	0.79	0.79
TOTAL	1.62		6.24(confluence)	3.81

Peak flow attenuation

The approach is as follows: the proposed Bio-filtration will store and manage the Q_{100} peak flows for flow attenuation to pre-development levels. The basin has a 24"x24" riser box with a sharp crest weir having dimensions of 1.25' in length and 0.86' in height which will act as a spillway such that peak flows can be safely discharged to the receiving storm drain system. The development condition Peak flows are calculated using modified rational. The corresponding 6-hr hydrographs are generated using the CivilDesign extension. These hydrographs are then routed through the proposed-on site detention facility in the CivilDesign Flood Hydrograph Routing Program, input values are based on Depth vs Storage and Depth vs Discharge data. To have a more accurate model the elevation inputs are every 0.10 feet to allow for an increase in the precision of the results, see Appendix 1 – Modified Puls - Retention Routing

It should be noted that as a conservative design approach, it will be assumed that the design capture volume has stored in the detention facility prior to the routing of the 100-year storm event. The volumes are a conservative hydraulic design methodology only – for water quality discussion and BMP sizing analysis, refer to site specific SWQMP prepared by Howes Weiler & Associates.

Bypass Offsite run-off and pipe design.

Concentrated offsite run-off flows conveyed by the existing 36" RCP were taken from the City of San Marcos Drainage Master Plan, dated March 2019, prepared by Rick Engineering.

The analysis generated a total of 179.5 cfs Q_{100} for the outfall listed as OTLT10290 (Reference Table and Maps in Appendix 2). The onsite development will generate a total of 3.80 cfs Q_{100} (Mitigated), the total discharge for the new proposed concrete channel is 183.3 cfs $Q_{100.}$

6. Conclusions

The calculations were in accordance with the guidelines set by the County of San Diego Hydrology Manual (2003)

A summary of the facts and findings associated with this project and the measures addressed by this report is as follows:

- The Project will not significantly alter drainage patterns on the site.
- The ultimate discharge points will not be changed. (Natural Canyons to the west)
- Graded areas and slopes will be landscaped to reduce or eliminate sediment discharge.
- The project does not propose to place housing within a 100-year flood hazard zone.

APPENDIX 1
CivilD Calculations

EXISTING CONDITIONS

EX. 7'X3' RCB
EX. 18" RCP
EX. 18" RCP
EX. 18" RCP
BORDEN ROAD
EX. BRIDGE
5 596.3EG
EX. CLEAN OUT
EX. CURB INLET
L = 75
BASIN A.1
0.14 ACRES
Q_{100}=0.28 CFS
593.4EG 10
EX. 18" RCP
EX. OUTLET
SOIL TYPE D
SOIL TYPE C
EX. LOW FLOW CHANNEL
EX. CURB INLET
EX. CLEAN OUT
TWIN OAKS VALLEY RD.
BASIN A.2
1.63 ACRES
Q_{100}=3.14 CFS
SAN MARCOS CREEK
EX. 36" RCP PER CITY DWG NO. IP 4803
EX. 3' WIDE SPILLWAY
EXISTING Q100=179.5 CFS (PER CITY MASTER DRAINAGE STUDY)
EX. CHANNEL (BY-PASS OFFSITE FLOW)
15 588.1 EG Q100=3.42 CFS
AC
EX. DWY
592
594
596
598
600
602
604
588
590

LEGEND

ITEM	SYMBOL
SUBBASIN BOUNDARY	
DRAINAGE DIRECTION	
DRAINAGE DESCRIPTION	BASIN B.1 — 0.04 ACRES — Q_{100}=0.21 CFS
NODE	5

SCALE: 1" = 20'
20 10 0 20 40 60

HOWES | WEILER | LANDY
PLANNING & ENGINEERING
Tel. 760.929.2288 Fax. 760.929.2287
2888 LOKER AVENUE EAST SUITE 217
CARLSBAD, CA 92010

NTI FUEL STATION & CARWASH

SEC TWIN OAKS VALLEY RD. & BORDEN RD.
SAN MARCOS, CA 92069

PRE DEVELOPMENT

DATE: 06/04/2020
DRAWING:
SHEET 1 OF 1

SAVE DATE: 10/19/2020 ~ PLOT DATE: 10/19/2020 ~ FILE NAME: C:\Users\plesp\Dropbox\AP PROJECTS\100.41 TwinOaks San Marcos HWL\Civil3d\Hydro\Pre_Conditions_final.dwg

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2018 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 06/04/20
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 6446

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.300
24 hour precipitation(inches) =  5.700
P6/P24 =    57.9%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       10.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.400
Decimal fraction soil group D = 0.600
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.330
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  596.300(Ft.)
Lowest elevation =  593.400(Ft.)
Elevation difference =    2.900(Ft.) Slope =  3.867 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   3.87 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   8.83 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3300)*( 100.000^.5)/(   3.867^(1/3)]=   8.83
Rainfall intensity (I) =      6.025(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.330
Subarea runoff =      0.278(CFS)
Total initial stream area =        0.140(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       15.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      6.025(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.320 given for subarea
Time of concentration =     8.83 min.
Rainfall intensity =      6.025(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.321  CA =      0.568
Subarea runoff =      3.142(CFS) for      1.630(Ac.)
Total runoff =      3.421(CFS)    Total area =       1.770(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       15.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.770(Ac.)
Runoff from this stream =      3.421(CFS)
Time of concentration =    8.83 min.
Rainfall intensity =     6.025(In/Hr)
Summary of stream data:

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


1        3.421      8.83             6.025
Qmax(1) =
         1.000 *    1.000 *     3.421) + =       3.421

Total of 1 streams to confluence:
Flow rates before confluence point:
       3.421
Maximum flow rates at confluence using above data:
        3.421
Area of streams before confluence:
        1.770
Results of confluence:
Total flow rate =      3.421(CFS)
Time of concentration =     8.830 min.
Effective stream area after confluence =      1.770(Ac.)
End of computations, total study area =           1.770 (Ac.)
```

PROPOSED CONDITIONS

BORDEN ROAD

EX. 7' X3' RCB
EX. 18" RCP
EX. 18" RCP
EX. 18" RCP
EX. 18" RCP
EX. BRIDGE
EX. CLEAN OUT
EX. CURB INLET
EX. CURB INLET
EX. CLEAN OUT
EX. 36" RCP

20 600.0FS
5 600.5FS
10 599.5FS
45 594.5FS
25 599.0EG
50 592.6EG
30 598.0TG 596.0IE
17
19 597.3FL
15
37
39
40 590.05 FL Q100=5.78 CFS V100=7.95 FT/S UNMITIGATED
35 595.6FL
55 588.1 EG Q100=0.79 CFS
587.15 FL Q100=183.3 CFS V100=10.8 FT/S

LANDSCAPE
PROPOSED 2,134 SF CAR WASH
PROPOSED 5,462 SF 8 - MPD CANOPY
PROPOSED 1,000 SF STORAGE
PROPOSED 3,790 SF C-STORE FF=599.25

BASIN A.1 — 0.14 ACRES — Q_{100}=0.95 CFS
BASIN B.1 — 0.22 ACRES — Q_{100}=0.86 CFS
BASIN B.2 — 0.34 ACRES — Q_{100}=1.52 CFS
BASIN A.2 — 0.47 ACRES — Q_{100}=3.56 CFS
BASIN A.3 — 0.016 ACRES — Q_{100}=0.12 CFS
BASIN C.1 — 0.053 ACRES — Q_{100}=0.10 CFS
BASIN D.1 — 0.06 ACRES — Q_{100}=0.10 CFS
BASIN D.2 — 0.32 ACRES — Q_{100}=0.67 CFS

SOIL TYPE D
SOIL TYPE C
TWIN OAKS VALLEY RD.
SAN MARCOS CREEK
NEW TRENCH DRAIN
GRADE BREAK
18" PVC - 121LF
PROPOSED CURB INLET
PROPOSED BIO-FILTRATION FACILITY
PROPOSED CONCRETE CHANNEL @ 0.70 % SLOPE (BY-PASS OFFSITE FLOW)
NEW 18" RCP ~ 5 LF
PROPOSED OUTLET AND RIPRAP
EX. LOW FLOW CHANNEL
EX. OUTLET
EX. DWY
AC

LEGEND

ITEM	SYMBOL
SUBBASIN BOUNDARY	———
DRAINAGE DIRECTION	←
DRAINAGE DESCRIPTION	BASIN B.1 — 0.04 ACRES — Q_{100}=0.21 CFS
NODE	(5)

SCALE: 1" = 20'
20 10 0 20 40 60

HOWES | WEILER | LANDY
PLANNING & ENGINEERING
Tel. 760.929.2288 Fax. 760.929.2287
2888 LOKER AVENUE EAST SUITE 217
CARLSBAD, CA 92010

NTI FUEL STATION & CARWASH

SEC TWIN OAKS VALLEY RD. & BORDEN RD.
SAN MARCOS, CA 92069

POST DEVELOPMENT

DATE: 08/24/2020
DRAWING:
SHEET 1 OF 1

```
            San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2018 Version 9.0

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study        Date: 08/24/20
--------------------------------------------------------------------------




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

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


Program License Serial Number 6446

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

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.300
24 hour precipitation(inches) =  5.700
P6/P24 =    57.9%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       10.000
**** INITIAL AREA EVALUATION ****
__________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.600
Decimal fraction soil group D = 0.400
[HIGH DENSITY RESIDENTIAL                    ]
(43.0 DU/A or Less      )
Impervious value, Ai = 0.800
Sub-Area C Value = 0.784
Initial subarea total flow distance  =   70.000(Ft.)
Highest elevation =  600.500(Ft.)
Lowest elevation =  599.500(Ft.)
Elevation difference =    1.000(Ft.) Slope =  1.429 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of   1.43 %, in a development type of
 43.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.07 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7840)*(  65.000^.5)/(   1.429^(1/3)]=   4.07
Calculated TC of    4.071 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
```

```
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.784
Subarea runoff =      0.954(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       15.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Calculated TC of    4.071 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.650
Decimal fraction soil group D = 0.350
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Time of concentration =     4.07 min.
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.850  CA =      0.519
Subarea runoff =      3.555(CFS) for      0.470(Ac.)
Total runoff =      4.510(CFS)    Total area =       0.610(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       19.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Calculated TC of    4.071 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(Limited Industrial       )
Impervious value, Ai = 0.900
Sub-Area C Value = 0.850
Time of concentration =     4.07 min.
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.850  CA =      0.532
Subarea runoff =      0.118(CFS) for      0.016(Ac.)
Total runoff =      4.628(CFS)    Total area =       0.626(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       37.000 to Point/Station       37.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
```

```
Stream flow area =      0.626(Ac.)
Runoff from this stream =      4.628(CFS)
Time of concentration =    4.07 min.
Rainfall intensity =     8.695(In/Hr)
Summary of stream data:

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


1        4.628      4.07             8.695
Qmax(1) =
         1.000 *    1.000 *     4.628) + =       4.628

Total of 1 streams to confluence:
Flow rates before confluence point:
       4.628
Maximum flow rates at confluence using above data:
        4.628
Area of streams before confluence:
        0.626
Results of confluence:
Total flow rate =      4.628(CFS)
Time of concentration =     4.071 min.
Effective stream area after confluence =      0.626(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       25.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.600
Initial subarea total flow distance  =  125.000(Ft.)
Highest elevation =  600.000(Ft.)
Lowest elevation =  599.000(Ft.)
Elevation difference =    1.000(Ft.) Slope =  0.800 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 65.00 (Ft)
for the top area slope value of   0.80 %, in a development type of
 14.5 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   7.82 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6000)*(  65.000^.5)/(   0.800^(1/3)]=   7.82
Rainfall intensity (I) =      6.518(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.600
Subarea runoff =      0.860(CFS)
Total initial stream area =        0.220(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       30.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      6.518(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[HIGH DENSITY RESIDENTIAL                    ]
(24.0 DU/A or Less      )
Impervious value, Ai = 0.650
Sub-Area C Value = 0.690
Time of concentration =     7.82 min.
Rainfall intensity =      6.518(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.655  CA =      0.367
Subarea runoff =      1.529(CFS) for      0.340(Ac.)
Total runoff =      2.389(CFS)    Total area =       0.560(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       35.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   596.000(Ft.)
Downstream point/station elevation =   595.600(Ft.)
Pipe length  =   120.00(Ft.) Slope =   0.0033  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.389(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     2.389(CFS)
Normal flow depth in pipe =    7.85(In.)
Flow top width inside pipe =   17.85(In.)
Critical Depth =    7.02(In.)
Pipe flow velocity =      3.23(Ft/s)
Travel time through pipe =    0.62 min.
Time of concentration (TC) =     8.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       37.000 to Point/Station       39.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      6.205(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.900
Decimal fraction soil group D = 0.100
[UNDISTURBED NATURAL TERRAIN                 ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.305
The area added to the existing stream causes a
a lower flow rate of Q =      2.375(CFS)
therefore the upstream flow rate of Q =      2.389(CFS) is being used
Time of concentration =     8.44 min.
Rainfall intensity =      6.205(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.624  CA =      0.383
Subarea runoff =      0.000(CFS) for      0.053(Ac.)
Total runoff =      2.389(CFS)    Total area =       0.613(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       35.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.613(Ac.)
Runoff from this stream =      2.389(CFS)
Time of concentration =    8.44 min.
Rainfall intensity =     6.205(In/Hr)
Summary of stream data:

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


1        4.628      4.07             8.695
2        2.389      8.44             6.205
Qmax(1) =
         1.000 *    1.000 *     4.628) +
         1.000 *    0.483 *     2.389) + =       5.781
Qmax(2) =
         0.714 *    1.000 *     4.628) +
         1.000 *    1.000 *     2.389) + =       5.692

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.628       2.389
Maximum flow rates at confluence using above data:
        5.781        5.692
Area of streams before confluence:
        0.626        0.613
Results of confluence:
Total flow rate =      5.781(CFS)
Time of concentration =     4.071 min.
Effective stream area after confluence =      1.239(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       39.000 to Point/Station       40.000
**** 6 HOUR HYDROGRAPH ****
________________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June
2003


Time of Concentration =   4.07
Basin Area =     1.24 Acres
6 Hour Rainfall =  3.300 Inches
Runoff Coefficient =  0.739
Peak Discharge =     5.78 CFS
```

Time (Min)	Discharge (CFS)
0	0.000
4	0.180
8	0.181
12	0.184
16	0.185
20	0.188
24	0.189
28	0.192
32	0.194
36	0.197
40	0.199
44	0.202
48	0.204
52	0.208
56	0.210
60	0.214
64	0.216
68	0.220
72	0.222
76	0.227
80	0.229
84	0.234
88	0.236
92	0.242
96	0.245
100	0.250
104	0.253
108	0.260
112	0.263
116	0.270
120	0.274
124	0.282
128	0.286
132	0.295
136	0.300
140	0.310
144	0.315
148	0.326
152	0.332
156	0.345
160	0.352
164	0.368
168	0.376
172	0.394
176	0.404
180	0.426
184	0.438
188	0.465
192	0.480
196	0.515
200	0.535
204	0.581
208	0.609
212	0.675
216	0.716
220	0.821

224	0.890
228	1.088
232	1.239
236	1.819
240	2.563
244	5.781
248	1.459
252	0.976
256	0.764
260	0.640
264	0.557
268	0.497
272	0.451
276	0.414
280	0.385
284	0.360
288	0.339
292	0.320
296	0.305
300	0.290
304	0.278
308	0.267
312	0.257
316	0.247
320	0.239
324	0.231
328	0.224
332	0.218
336	0.212
340	0.206
344	0.201
348	0.196
352	0.191
356	0.186
360	0.182
364	0.178

++

6 - H O U R S T O R M

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

Hydrograph in 1 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	1.4	2.9	4.3	5.8
0+ 0	0.0000	0.00	Q	|	|	|	|
0+ 1	0.0001	0.04	Q	|	|	|	|
0+ 2	0.0002	0.09	Q	|	|	|	|
0+ 3	0.0004	0.13	Q	|	|	|	|
0+ 4	0.0006	0.18	VQ	|	|	|	|
0+ 5	0.0009	0.18	VQ	|	|	|	|
0+ 6	0.0011	0.18	VQ	|	|	|	|
0+ 7	0.0014	0.18	VQ	|	|	|	|
0+ 8	0.0016	0.18	VQ	|	|	|	|
0+ 9	0.0019	0.18	VQ	|	|	|	|
0+10	0.0021	0.18	VQ	|	|	|	|
0+11	0.0024	0.18	VQ	|	|	|	|

0+12	0.0026	0.18	VQ	|	|	|	|
0+13	0.0029	0.18	VQ	|	|	|	|
0+14	0.0031	0.18	VQ	|	|	|	|
0+15	0.0034	0.18	VQ	|	|	|	|
0+16	0.0036	0.19	VQ	|	|	|	|
0+17	0.0039	0.19	VQ	|	|	|	|
0+18	0.0041	0.19	VQ	|	|	|	|
0+19	0.0044	0.19	VQ	|	|	|	|
0+20	0.0047	0.19	VQ	|	|	|	|
0+21	0.0049	0.19	VQ	|	|	|	|
0+22	0.0052	0.19	VQ	|	|	|	|
0+23	0.0054	0.19	VQ	|	|	|	|
0+24	0.0057	0.19	VQ	|	|	|	|
0+25	0.0060	0.19	|Q	|	|	|	|
0+26	0.0062	0.19	|Q	|	|	|	|
0+27	0.0065	0.19	|Q	|	|	|	|
0+28	0.0068	0.19	|Q	|	|	|	|
0+29	0.0070	0.19	|Q	|	|	|	|
0+30	0.0073	0.19	|Q	|	|	|	|
0+31	0.0076	0.19	|Q	|	|	|	|
0+32	0.0078	0.19	|Q	|	|	|	|
0+33	0.0081	0.19	|Q	|	|	|	|
0+34	0.0084	0.20	|Q	|	|	|	|
0+35	0.0086	0.20	|Q	|	|	|	|
0+36	0.0089	0.20	|Q	|	|	|	|
0+37	0.0092	0.20	|Q	|	|	|	|
0+38	0.0094	0.20	|Q	|	|	|	|
0+39	0.0097	0.20	|Q	|	|	|	|
0+40	0.0100	0.20	|Q	|	|	|	|
0+41	0.0103	0.20	|Q	|	|	|	|
0+42	0.0105	0.20	|Q	|	|	|	|
0+43	0.0108	0.20	|Q	|	|	|	|
0+44	0.0111	0.20	|Q	|	|	|	|
0+45	0.0114	0.20	|Q	|	|	|	|
0+46	0.0117	0.20	|QV	|	|	|	|
0+47	0.0119	0.20	|QV	|	|	|	|
0+48	0.0122	0.20	|QV	|	|	|	|
0+49	0.0125	0.20	|QV	|	|	|	|
0+50	0.0128	0.21	|QV	|	|	|	|
0+51	0.0131	0.21	|QV	|	|	|	|
0+52	0.0134	0.21	|QV	|	|	|	|
0+53	0.0136	0.21	|QV	|	|	|	|
0+54	0.0139	0.21	|QV	|	|	|	|
0+55	0.0142	0.21	|QV	|	|	|	|
0+56	0.0145	0.21	|QV	|	|	|	|
0+57	0.0148	0.21	|QV	|	|	|	|
0+58	0.0151	0.21	|QV	|	|	|	|
0+59	0.0154	0.21	|QV	|	|	|	|
1+ 0	0.0157	0.21	|QV	|	|	|	|
1+ 1	0.0160	0.21	|QV	|	|	|	|
1+ 2	0.0163	0.21	|QV	|	|	|	|
1+ 3	0.0166	0.22	|QV	|	|	|	|
1+ 4	0.0169	0.22	|QV	|	|	|	|
1+ 5	0.0172	0.22	|QV	|	|	|	|
1+ 6	0.0175	0.22	|Q V	|	|	|	|
1+ 7	0.0178	0.22	|Q V	|	|	|	|
1+ 8	0.0181	0.22	|Q V	|	|	|	|

1+ 9	0.0184	0.22	Q V	|	|	|
1+10	0.0187	0.22	Q V	|	|	|
1+11	0.0190	0.22	Q V	|	|	|
1+12	0.0193	0.22	Q V	|	|	|
1+13	0.0196	0.22	Q V	|	|	|
1+14	0.0199	0.22	Q V	|	|	|
1+15	0.0202	0.23	Q V	|	|	|
1+16	0.0205	0.23	Q V	|	|	|
1+17	0.0208	0.23	Q V	|	|	|
1+18	0.0211	0.23	Q V	|	|	|
1+19	0.0215	0.23	Q V	|	|	|
1+20	0.0218	0.23	Q V	|	|	|
1+21	0.0221	0.23	Q V	|	|	|
1+22	0.0224	0.23	Q V	|	|	|
1+23	0.0227	0.23	Q V	|	|	|
1+24	0.0231	0.23	Q V	|	|	|
1+25	0.0234	0.23	Q V	|	|	|
1+26	0.0237	0.24	Q V	|	|	|
1+27	0.0240	0.24	Q V	|	|	|
1+28	0.0244	0.24	Q V	|	|	|
1+29	0.0247	0.24	Q V	|	|	|
1+30	0.0250	0.24	Q V	|	|	|
1+31	0.0253	0.24	Q V	|	|	|
1+32	0.0257	0.24	Q V	|	|	|
1+33	0.0260	0.24	Q V	|	|	|
1+34	0.0263	0.24	Q V	|	|	|
1+35	0.0267	0.24	Q V	|	|	|
1+36	0.0270	0.24	Q V	|	|	|
1+37	0.0274	0.25	Q V	|	|	|
1+38	0.0277	0.25	Q V	|	|	|
1+39	0.0280	0.25	Q V	|	|	|
1+40	0.0284	0.25	Q V	|	|	|
1+41	0.0287	0.25	Q V	|	|	|
1+42	0.0291	0.25	Q V	|	|	|
1+43	0.0294	0.25	Q V	|	|	|
1+44	0.0298	0.25	Q V	|	|	|
1+45	0.0301	0.26	Q V	|	|	|
1+46	0.0305	0.26	Q V	|	|	|
1+47	0.0308	0.26	Q V	|	|	|
1+48	0.0312	0.26	Q V	|	|	|
1+49	0.0316	0.26	Q V	|	|	|
1+50	0.0319	0.26	Q V	|	|	|
1+51	0.0323	0.26	Q V	|	|	|
1+52	0.0326	0.26	Q V	|	|	|
1+53	0.0330	0.27	Q V	|	|	|
1+54	0.0334	0.27	Q V	|	|	|
1+55	0.0337	0.27	Q V	|	|	|
1+56	0.0341	0.27	Q V	|	|	|
1+57	0.0345	0.27	Q V	|	|	|
1+58	0.0349	0.27	Q V	|	|	|
1+59	0.0352	0.27	Q V	|	|	|
2+ 0	0.0356	0.27	Q V	|	|	|
2+ 1	0.0360	0.28	Q V	|	|	|
2+ 2	0.0364	0.28	Q V	|	|	|
2+ 3	0.0368	0.28	Q V	|	|	|
2+ 4	0.0372	0.28	Q V	|	|	|
2+ 5	0.0375	0.28	Q V	|	|	|

2+ 6	0.0379	0.28	|Q V |	|	|	|
2+ 7	0.0383	0.29	|Q V |	|	|	|
2+ 8	0.0387	0.29	|Q V |	|	|	|
2+ 9	0.0391	0.29	|Q V |	|	|	|
2+10	0.0395	0.29	| Q V |	|	|	|
2+11	0.0399	0.29	| Q V |	|	|	|
2+12	0.0403	0.29	| Q V |	|	|	|
2+13	0.0407	0.30	| Q V |	|	|	|
2+14	0.0411	0.30	| Q V |	|	|	|
2+15	0.0416	0.30	| Q V |	|	|	|
2+16	0.0420	0.30	| Q V |	|	|	|
2+17	0.0424	0.30	| Q V |	|	|	|
2+18	0.0428	0.30	| Q V |	|	|	|
2+19	0.0432	0.31	| Q V |	|	|	|
2+20	0.0437	0.31	| Q V |	|	|	|
2+21	0.0441	0.31	| Q V |	|	|	|
2+22	0.0445	0.31	| Q V |	|	|	|
2+23	0.0449	0.31	| Q V |	|	|	|
2+24	0.0454	0.31	| Q V |	|	|	|
2+25	0.0458	0.32	| Q V |	|	|	|
2+26	0.0463	0.32	| Q V |	|	|	|
2+27	0.0467	0.32	| Q V |	|	|	|
2+28	0.0472	0.33	| Q V |	|	|	|
2+29	0.0476	0.33	| Q V |	|	|	|
2+30	0.0481	0.33	| Q V |	|	|	|
2+31	0.0485	0.33	| Q V |	|	|	|
2+32	0.0490	0.33	| Q V |	|	|	|
2+33	0.0494	0.34	| Q V |	|	|	|
2+34	0.0499	0.34	| Q V |	|	|	|
2+35	0.0504	0.34	| Q V |	|	|	|
2+36	0.0508	0.35	| Q V |	|	|	|
2+37	0.0513	0.35	| Q V |	|	|	|
2+38	0.0518	0.35	| Q V |	|	|	|
2+39	0.0523	0.35	| Q V|	|	|	|
2+40	0.0528	0.35	| Q V|	|	|	|
2+41	0.0533	0.36	| Q V|	|	|	|
2+42	0.0538	0.36	| Q V|	|	|	|
2+43	0.0543	0.36	| Q V|	|	|	|
2+44	0.0548	0.37	| Q V|	|	|	|
2+45	0.0553	0.37	| Q V|	|	|	|
2+46	0.0558	0.37	| Q V|	|	|	|
2+47	0.0563	0.37	| Q V|	|	|	|
2+48	0.0568	0.38	| Q V|	|	|	|
2+49	0.0573	0.38	| Q V|	|	|	|
2+50	0.0579	0.38	| Q V|	|	|	|
2+51	0.0584	0.39	| Q V	|	|	|
2+52	0.0590	0.39	| Q V	|	|	|
2+53	0.0595	0.40	| Q V	|	|	|
2+54	0.0600	0.40	| Q V	|	|	|
2+55	0.0606	0.40	| Q V	|	|	|
2+56	0.0612	0.40	| Q V	|	|	|
2+57	0.0617	0.41	| Q V	|	|	|
2+58	0.0623	0.41	| Q V	|	|	|
2+59	0.0629	0.42	| Q V	|	|	|
3+ 0	0.0635	0.43	| Q V	|	|	|
3+ 1	0.0640	0.43	| Q |V	|	|	|
3+ 2	0.0646	0.43	| Q |V	|	|	|

3+ 3	0.0652	0.43	Q	V			
3+ 4	0.0658	0.44	Q	V			
3+ 5	0.0665	0.44	Q	V			
3+ 6	0.0671	0.45	Q	V			
3+ 7	0.0677	0.46	Q	V			
3+ 8	0.0684	0.46	Q	V			
3+ 9	0.0690	0.47	Q	V			
3+10	0.0696	0.47	Q	V			
3+11	0.0703	0.48	Q	V			
3+12	0.0710	0.48	Q	V			
3+13	0.0716	0.49	Q	V			
3+14	0.0723	0.50	Q	V			
3+15	0.0730	0.51	Q	V			
3+16	0.0737	0.51	Q	V			
3+17	0.0744	0.52	Q	V			
3+18	0.0752	0.52	Q	V			
3+19	0.0759	0.53	Q	V			
3+20	0.0766	0.53	Q	V			
3+21	0.0774	0.55	Q	V			
3+22	0.0782	0.56	Q	V			
3+23	0.0789	0.57	Q	V			
3+24	0.0797	0.58	Q	V			
3+25	0.0806	0.59	Q	V			
3+26	0.0814	0.60	Q	V			
3+27	0.0822	0.60	Q	V			
3+28	0.0830	0.61	Q	V			
3+29	0.0839	0.63	Q	V			
3+30	0.0848	0.64	Q	V			
3+31	0.0857	0.66	Q	V			
3+32	0.0866	0.68	Q	V			
3+33	0.0876	0.69	Q	V			
3+34	0.0885	0.70	Q	V			
3+35	0.0895	0.71	Q	V			
3+36	0.0905	0.72	Q	V			
3+37	0.0915	0.74	Q	V			
3+38	0.0926	0.77	Q	V			
3+39	0.0937	0.79	Q	V			
3+40	0.0948	0.82	Q	V			
3+41	0.0959	0.84	Q	V			
3+42	0.0971	0.86	Q	V			
3+43	0.0983	0.87	Q	V			
3+44	0.0995	0.89	Q	V			
3+45	0.1008	0.94	Q	V			
3+46	0.1022	0.99	Q	V			
3+47	0.1036	1.04	Q	V			
3+48	0.1051	1.09	Q	V			
3+49	0.1067	1.13	Q	V			
3+50	0.1083	1.16	Q	V			
3+51	0.1099	1.20	Q	V			
3+52	0.1116	1.24	Q	V			
3+53	0.1136	1.38	Q	V			
3+54	0.1157	1.53	Q	V			
3+55	0.1180	1.67	Q	V			
3+56	0.1205	1.82	Q	V			
3+57	0.1232	2.01	Q	V			
3+58	0.1263	2.19	Q	V			
3+59	0.1295	2.38	Q	V			

```
4+ 0       0.1331      2.56  |         |      Q  | V       |         |
4+ 1       0.1377      3.37  |         |         |  Q      |         |
4+ 2       0.1434      4.17  |         |         |   V   Q |         |
4+ 3       0.1503      4.98  |         |         |    V    |   Q     |
4+ 4       0.1583      5.78  |         |         |      V  |         Q
4+ 5       0.1647      4.70  |         |         |       V | Q       |
4+ 6       0.1697      3.62  |         |         |    Q   V|         |
4+ 7       0.1732      2.54  |         |      Q  |        V|         |
4+ 8       0.1752      1.46  |         Q         |         V         |
4+ 9       0.1771      1.34  |        Q|         |         V         |
4+10       0.1787      1.22  |       Q |         |         V         |
4+11       0.1803      1.10  |      Q  |         |         |V        |
4+12       0.1816      0.98  |     Q   |         |         |V        |
4+13       0.1829      0.92  |     Q   |         |         |V        |
4+14       0.1841      0.87  |     Q   |         |         |V        |
4+15       0.1852      0.82  |    Q    |         |         |V        |
4+16       0.1863      0.76  |    Q    |         |         | V       |
4+17       0.1873      0.73  |    Q    |         |         | V       |
4+18       0.1882      0.70  |   Q     |         |         | V       |
4+19       0.1892      0.67  |   Q     |         |         | V       |
4+20       0.1900      0.64  |   Q     |         |         | V       |
4+21       0.1909      0.62  |   Q     |         |         | V       |
4+22       0.1917      0.60  |   Q     |         |         |  V      |
4+23       0.1925      0.58  |  Q      |         |         |  V      |
4+24       0.1933      0.56  |  Q      |         |         |  V      |
4+25       0.1940      0.54  |  Q      |         |         |  V      |
4+26       0.1947      0.53  |  Q      |         |         |  V      |
4+27       0.1954      0.51  |  Q      |         |         |  V      |
4+28       0.1961      0.50  |  Q      |         |         |  V      |
4+29       0.1968      0.49  |  Q      |         |         |  V      |
4+30       0.1975      0.47  |  Q      |         |         |   V     |
4+31       0.1981      0.46  |  Q      |         |         |   V     |
4+32       0.1987      0.45  |  Q      |         |         |   V     |
4+33       0.1993      0.44  |  Q      |         |         |   V     |
4+34       0.1999      0.43  | Q       |         |         |   V     |
4+35       0.2005      0.42  | Q       |         |         |   V     |
4+36       0.2011      0.41  | Q       |         |         |   V     |
4+37       0.2016      0.41  | Q       |         |         |   V     |
4+38       0.2022      0.40  | Q       |         |         |   V     |
4+39       0.2027      0.39  | Q       |         |         |   V     |
4+40       0.2033      0.38  | Q       |         |         |    V    |
4+41       0.2038      0.38  | Q       |         |         |    V    |
4+42       0.2043      0.37  | Q       |         |         |    V    |
4+43       0.2048      0.37  | Q       |         |         |    V    |
4+44       0.2053      0.36  | Q       |         |         |    V    |
4+45       0.2058      0.35  | Q       |         |         |    V    |
4+46       0.2063      0.35  | Q       |         |         |    V    |
4+47       0.2067      0.34  | Q       |         |         |    V    |
4+48       0.2072      0.34  | Q       |         |         |    V    |
4+49       0.2077      0.33  | Q       |         |         |    V    |
4+50       0.2081      0.33  | Q       |         |         |    V    |
4+51       0.2086      0.33  | Q       |         |         |    V    |
4+52       0.2090      0.32  | Q       |         |         |     V   |
4+53       0.2094      0.32  | Q       |         |         |     V   |
4+54       0.2099      0.31  | Q       |         |         |     V   |
4+55       0.2103      0.31  | Q       |         |         |     V   |
4+56       0.2107      0.30  | Q       |         |         |     V   |
```

4+57	0.2111	0.30	| Q	|	|	|	V |
4+58	0.2115	0.30	| Q	|	|	|	V |
4+59	0.2119	0.29	| Q	|	|	|	V |
5+ 0	0.2123	0.29	| Q	|	|	|	V |
5+ 1	0.2127	0.29	|Q	|	|	|	V |
5+ 2	0.2131	0.28	|Q	|	|	|	V |
5+ 3	0.2135	0.28	|Q	|	|	|	V |
5+ 4	0.2139	0.28	|Q	|	|	|	V |
5+ 5	0.2143	0.28	|Q	|	|	|	V |
5+ 6	0.2146	0.27	|Q	|	|	|	V |
5+ 7	0.2150	0.27	|Q	|	|	|	V |
5+ 8	0.2154	0.27	|Q	|	|	|	V |
5+ 9	0.2158	0.26	|Q	|	|	|	V |
5+10	0.2161	0.26	|Q	|	|	|	V |
5+11	0.2165	0.26	|Q	|	|	|	V |
5+12	0.2168	0.26	|Q	|	|	|	V |
5+13	0.2172	0.25	|Q	|	|	|	V |
5+14	0.2175	0.25	|Q	|	|	|	V |
5+15	0.2179	0.25	|Q	|	|	|	V |
5+16	0.2182	0.25	|Q	|	|	|	V |
5+17	0.2185	0.25	|Q	|	|	|	V |
5+18	0.2189	0.24	|Q	|	|	|	V |
5+19	0.2192	0.24	|Q	|	|	|	V |
5+20	0.2195	0.24	|Q	|	|	|	V |
5+21	0.2199	0.24	|Q	|	|	|	V |
5+22	0.2202	0.24	|Q	|	|	|	V |
5+23	0.2205	0.23	|Q	|	|	|	V |
5+24	0.2208	0.23	|Q	|	|	|	V |
5+25	0.2211	0.23	|Q	|	|	|	V |
5+26	0.2215	0.23	|Q	|	|	|	V |
5+27	0.2218	0.23	|Q	|	|	|	V |
5+28	0.2221	0.22	|Q	|	|	|	V |
5+29	0.2224	0.22	|Q	|	|	|	V |
5+30	0.2227	0.22	|Q	|	|	|	V |
5+31	0.2230	0.22	|Q	|	|	|	V |
5+32	0.2233	0.22	|Q	|	|	|	V |
5+33	0.2236	0.22	|Q	|	|	|	V |
5+34	0.2239	0.21	|Q	|	|	|	V |
5+35	0.2242	0.21	|Q	|	|	|	V |
5+36	0.2245	0.21	|Q	|	|	|	V |
5+37	0.2248	0.21	|Q	|	|	|	V |
5+38	0.2250	0.21	|Q	|	|	|	V |
5+39	0.2253	0.21	|Q	|	|	|	V |
5+40	0.2256	0.21	|Q	|	|	|	V |
5+41	0.2259	0.20	|Q	|	|	|	V |
5+42	0.2262	0.20	|Q	|	|	|	V|
5+43	0.2265	0.20	|Q	|	|	|	V|
5+44	0.2267	0.20	|Q	|	|	|	V|
5+45	0.2270	0.20	|Q	|	|	|	V|
5+46	0.2273	0.20	|Q	|	|	|	V|
5+47	0.2276	0.20	|Q	|	|	|	V|
5+48	0.2278	0.20	|Q	|	|	|	V|
5+49	0.2281	0.19	|Q	|	|	|	V|
5+50	0.2284	0.19	|Q	|	|	|	V|
5+51	0.2286	0.19	|Q	|	|	|	V|
5+52	0.2289	0.19	|Q	|	|	|	V|
5+53	0.2291	0.19	|Q	|	|	|	V|

```
    5+54       0.2294      0.19  |Q        |         |         |        V|
    5+55       0.2297      0.19  |Q        |         |         |        V|
    5+56       0.2299      0.19  |Q        |         |         |        V|
    5+57       0.2302      0.19  |Q        |         |         |        V|
    5+58       0.2304      0.18  |Q        |         |         |        V|
    5+59       0.2307      0.18  |Q        |         |         |        V|
    6+ 0       0.2309      0.18  |Q        |         |         |        V|
    6+ 1       0.2312      0.18  |Q        |         |         |        V|
    6+ 2       0.2314      0.18  |Q        |         |         |        V|
    6+ 3       0.2317      0.18  |Q        |         |         |        V|
    6+ 4       0.2319      0.18  |Q        |         |         |         V
-------------------------------------------------------------------------
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       39.000 to Point/Station       40.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   590.150(Ft.)
Downstream point/station elevation =   590.050(Ft.)
Pipe length  =     5.00(Ft.) Slope =   0.0200  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.781(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     5.781(CFS)
Normal flow depth in pipe =    7.79(In.)
Flow top width inside pipe =   17.84(In.)
Critical Depth =   11.12(In.)
Pipe flow velocity =      7.88(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     4.08 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       55.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.239(Ac.)
Runoff from this stream =      5.781(CFS)
Time of concentration =    4.08 min.
Rainfall intensity =     8.695(In/Hr)
Summary of stream data:

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


1        5.781      4.08              8.695
Qmax(1) =
         1.000 *    1.000 *     5.781) + =       5.781

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

```
       5.781
Maximum flow rates at confluence using above data:
        5.781
Area of streams before confluence:
        1.239
Results of confluence:
Total flow rate =      5.781(CFS)
Time of concentration =     4.082 min.
Effective stream area after confluence =      1.239(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       45.000 to Point/Station       50.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  594.500(Ft.)
Lowest elevation =  592.600(Ft.)
Elevation difference =    1.900(Ft.) Slope =  2.533 %
Top of Initial Area Slope adjusted by User to  8.533 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   8.53 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   7.05 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(   8.533^(1/3)]=   7.05
Rainfall intensity (I) =      6.968(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      0.125(CFS)
Total initial stream area =        0.060(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       55.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Rainfall intensity (I) =      6.968(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Time of concentration =     7.05 min.
Rainfall intensity =      6.968(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      0.114
Subarea runoff =      0.669(CFS) for      0.320(Ac.)
Total runoff =      0.794(CFS)    Total area =       0.380(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       55.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.380(Ac.)
Runoff from this stream =      0.794(CFS)
Time of concentration =    7.05 min.
Rainfall intensity =     6.968(In/Hr)
Summary of stream data:

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


1         5.781      4.08             8.695
2         0.794      7.05             6.968
Qmax(1) =
         1.000 *    1.000 *     5.781) +
         1.000 *    0.579 *     0.794) + =       6.241
Qmax(2) =
         0.801 *    1.000 *     5.781) +
         1.000 *    1.000 *     0.794) + =       5.428

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.781       0.794
Maximum flow rates at confluence using above data:
        6.241        5.428
Area of streams before confluence:
        1.239        0.380
Results of confluence:
Total flow rate =      6.241(CFS)
Time of concentration =     4.082 min.
Effective stream area after confluence =      1.619(Ac.)
End of computations, total study area =          1.619 (Ac.)
```

Modified-Puls Detention Routing

```
                FLOOD HYDROGRAPH ROUTING PROGRAM
          Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018
                     Study date: 08/25/20


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

Program License Serial Number 6446

------------------------------------------------------------------------
********************* HYDROGRAPH INFORMATION **********************

           From study/file name: twinoakpost.rte
****************************HYDROGRAPH DATA*****************************
           Number of intervals =   364
           Time interval =    1.0 (Min.)
           Maximum/Peak flow rate =        5.781 (CFS)
           Total volume =       0.232 (Ac.Ft)
      Status of hydrographs being held in storage
                 Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
      Peak (CFS)      0.000     0.000     0.000     0.000     0.000
      Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
************************************************************************



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       39.000 to Point/Station       40.000
**** RETARDING BASIN ROUTING ****
________________________________________________________________________

Program computation of outflow v. depth


CALCULATED OUTFLOW DATA AT DEPTH =    0.10(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.10(Ft.)   Flow =      0.12 (CFS)

Total outflow at this depth =      0.12(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.20(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.20(Ft.)   Flow =      0.34 (CFS)

Total outflow at this depth =      0.34(CFS)
```

```
CALCULATED OUTFLOW DATA AT DEPTH =    0.30(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.30(Ft.)   Flow =      0.62 (CFS)

Total outflow at this depth =      0.62(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.40(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.40(Ft.)   Flow =      0.95 (CFS)

Total outflow at this depth =      0.95(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.50(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.50(Ft.)   Flow =      1.33 (CFS)

Total outflow at this depth =      1.33(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.60(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.60(Ft.)   Flow =      1.74 (CFS)

Total outflow at this depth =      1.74(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.70(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.70(Ft.)   Flow =      2.20 (CFS)

Total outflow at this depth =      2.20(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.80(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.80(Ft.)   Flow =      2.68 (CFS)

Total outflow at this depth =      2.68(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    0.90(Ft.))
```

```
Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    0.90(Ft.)   Flow =      3.20 (CFS)

Total outflow at this depth =      3.20(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    1.00(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    1.00(Ft.)   Flow =      3.75 (CFS)

Total outflow at this depth =      3.75(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    1.10(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    1.10(Ft.)   Flow =      4.33 (CFS)

Total outflow at this depth =      4.33(CFS)


CALCULATED OUTFLOW DATA AT DEPTH =    1.20(Ft.))

Weir capacity using equation Q = CLH^Exp(Using Feet as units)
Weir Length =   1.25(Ft.)   C value =   3.00   Exp =   1.50
Weir flow:  Depth = H =    1.20(Ft.)   Flow =      4.93 (CFS)

Total outflow at this depth =      4.93(CFS)

------------------------------------------------------------------------
Total number of inflow hydrograph intervals = 364
Hydrograph time unit =  1.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)
------------------------------------------------------------------------
------------------------------------------------------------------------
Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)
------------------------------------------------------------------------
------------------------------------------------------------------------
Depth vs. Storage and Depth vs. Discharge data:
 Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
     (Ft.)    (Ac.Ft)    (CFS)     (Ac.Ft)    (Ac.Ft)
------------------------------------------------------------------------
    0.000      0.000      0.000      0.000        0.000
    0.100      0.058      0.119      0.058        0.058
    0.200      0.063      0.335      0.063        0.063
    0.300      0.069      0.616      0.069        0.069
    0.400      0.074      0.949      0.073        0.075
    0.500      0.079      1.326      0.078        0.080
    0.600      0.085      1.743      0.084        0.086
    0.700      0.090      2.196      0.088        0.092
    0.800      0.095      2.683      0.093        0.097
```

0.900	0.101	3.202	0.099	0.103
1.000	0.106	3.750	0.103	0.109
1.100	0.111	4.326	0.108	0.114
1.200	0.116	4.930	0.113	0.119

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	1.4	2.89	4.34	5.78	Depth (Ft.)
0.017	0.04	0.00	0.000	O	|	|	|	|	0.00
0.033	0.09	0.00	0.000	O	|	|	|	|	0.00
0.050	0.13	0.00	0.000	O	|	|	|	|	0.00
0.067	0.18	0.00	0.000	O	|	|	|	|	0.00
0.083	0.18	0.00	0.001	O	|	|	|	|	0.00
0.100	0.18	0.00	0.001	O	|	|	|	|	0.00
0.117	0.18	0.00	0.001	OI	|	|	|	|	0.00
0.133	0.18	0.00	0.001	OI	|	|	|	|	0.00
0.150	0.18	0.00	0.002	OI	|	|	|	|	0.00
0.167	0.18	0.00	0.002	OI	|	|	|	|	0.00
0.183	0.18	0.00	0.002	OI	|	|	|	|	0.00
0.200	0.18	0.01	0.002	OI	|	|	|	|	0.00
0.217	0.18	0.01	0.003	OI	|	|	|	|	0.00
0.233	0.18	0.01	0.003	OI	|	|	|	|	0.01
0.250	0.18	0.01	0.003	OI	|	|	|	|	0.01
0.267	0.19	0.01	0.003	OI	|	|	|	|	0.01
0.283	0.19	0.01	0.004	OI	|	|	|	|	0.01
0.300	0.19	0.01	0.004	OI	|	|	|	|	0.01
0.317	0.19	0.01	0.004	OI	|	|	|	|	0.01
0.333	0.19	0.01	0.004	OI	|	|	|	|	0.01
0.350	0.19	0.01	0.005	OI	|	|	|	|	0.01
0.367	0.19	0.01	0.005	OI	|	|	|	|	0.01
0.383	0.19	0.01	0.005	OI	|	|	|	|	0.01
0.400	0.19	0.01	0.005	OI	|	|	|	|	0.01
0.417	0.19	0.01	0.006	OI	|	|	|	|	0.01
0.433	0.19	0.01	0.006	OI	|	|	|	|	0.01
0.450	0.19	0.01	0.006	OI	|	|	|	|	0.01
0.467	0.19	0.01	0.006	OI	|	|	|	|	0.01
0.483	0.19	0.01	0.007	OI	|	|	|	|	0.01
0.500	0.19	0.01	0.007	OI	|	|	|	|	0.01
0.517	0.19	0.01	0.007	OI	|	|	|	|	0.01
0.533	0.19	0.02	0.007	OI	|	|	|	|	0.01
0.550	0.19	0.02	0.008	OI	|	|	|	|	0.01
0.567	0.20	0.02	0.008	OI	|	|	|	|	0.01
0.583	0.20	0.02	0.008	OI	|	|	|	|	0.01
0.600	0.20	0.02	0.008	OI	|	|	|	|	0.01
0.617	0.20	0.02	0.009	OI	|	|	|	|	0.01
0.633	0.20	0.02	0.009	OI	|	|	|	|	0.02
0.650	0.20	0.02	0.009	OI	|	|	|	|	0.02
0.667	0.20	0.02	0.009	OI	|	|	|	|	0.02
0.683	0.20	0.02	0.010	OI	|	|	|	|	0.02
0.700	0.20	0.02	0.010	OI	|	|	|	|	0.02
0.717	0.20	0.02	0.010	OI	|	|	|	|	0.02
0.733	0.20	0.02	0.010	OI	|	|	|	|	0.02
0.750	0.20	0.02	0.011	OI	|	|	|	|	0.02

0.767	0.20	0.02	0.011	OI				0.02
0.783	0.20	0.02	0.011	OI				0.02
0.800	0.20	0.02	0.011	OI				0.02
0.817	0.20	0.02	0.012	OI				0.02
0.833	0.21	0.02	0.012	OI				0.02
0.850	0.21	0.02	0.012	OI				0.02
0.867	0.21	0.03	0.012	OI				0.02
0.883	0.21	0.03	0.013	OI				0.02
0.900	0.21	0.03	0.013	OI				0.02
0.917	0.21	0.03	0.013	OI				0.02
0.933	0.21	0.03	0.013	OI				0.02
0.950	0.21	0.03	0.014	OI				0.02
0.967	0.21	0.03	0.014	OI				0.02
0.983	0.21	0.03	0.014	OI				0.02
1.000	0.21	0.03	0.014	OI				0.02
1.017	0.21	0.03	0.015	OI				0.03
1.033	0.21	0.03	0.015	OI				0.03
1.050	0.22	0.03	0.015	OI				0.03
1.067	0.22	0.03	0.015	OI				0.03
1.083	0.22	0.03	0.016	OI				0.03
1.100	0.22	0.03	0.016	OI				0.03
1.117	0.22	0.03	0.016	OI				0.03
1.133	0.22	0.03	0.016	OI				0.03
1.150	0.22	0.03	0.017	OI				0.03
1.167	0.22	0.03	0.017	OI				0.03
1.183	0.22	0.04	0.017	OI				0.03
1.200	0.22	0.04	0.017	OI				0.03
1.217	0.22	0.04	0.018	OI				0.03
1.233	0.22	0.04	0.018	OI				0.03
1.250	0.23	0.04	0.018	OI				0.03
1.267	0.23	0.04	0.018	OI				0.03
1.283	0.23	0.04	0.019	OI				0.03
1.300	0.23	0.04	0.019	OI				0.03
1.317	0.23	0.04	0.019	OI				0.03
1.333	0.23	0.04	0.019	OI				0.03
1.350	0.23	0.04	0.020	OI				0.03
1.367	0.23	0.04	0.020	OI				0.03
1.383	0.23	0.04	0.020	OI				0.03
1.400	0.23	0.04	0.021	OI				0.04
1.417	0.23	0.04	0.021	OI				0.04
1.433	0.24	0.04	0.021	OI				0.04
1.450	0.24	0.04	0.021	OI				0.04
1.467	0.24	0.04	0.022	OI				0.04
1.483	0.24	0.04	0.022	OI				0.04
1.500	0.24	0.05	0.022	OI				0.04
1.517	0.24	0.05	0.022	OI				0.04
1.533	0.24	0.05	0.023	OI				0.04
1.550	0.24	0.05	0.023	OI				0.04
1.567	0.24	0.05	0.023	OI				0.04
1.583	0.24	0.05	0.023	OI				0.04
1.600	0.24	0.05	0.024	OI				0.04
1.617	0.25	0.05	0.024	OI				0.04
1.633	0.25	0.05	0.024	OI				0.04
1.650	0.25	0.05	0.025	OI				0.04
1.667	0.25	0.05	0.025	OI				0.04
1.683	0.25	0.05	0.025	OI				0.04
1.700	0.25	0.05	0.025	OI				0.04

1.717	0.25	0.05	0.026	OI				0.04
1.733	0.25	0.05	0.026	OI				0.04
1.750	0.26	0.05	0.026	OI				0.05
1.767	0.26	0.05	0.026	OI				0.05
1.783	0.26	0.05	0.027	OI				0.05
1.800	0.26	0.06	0.027	OI				0.05
1.817	0.26	0.06	0.027	OI				0.05
1.833	0.26	0.06	0.028	OI				0.05
1.850	0.26	0.06	0.028	OI				0.05
1.867	0.26	0.06	0.028	OI				0.05
1.883	0.27	0.06	0.028	OI				0.05
1.900	0.27	0.06	0.029	OI				0.05
1.917	0.27	0.06	0.029	OI				0.05
1.933	0.27	0.06	0.029	OI				0.05
1.950	0.27	0.06	0.030	OI				0.05
1.967	0.27	0.06	0.030	OI				0.05
1.983	0.27	0.06	0.030	OI				0.05
2.000	0.27	0.06	0.030	OI				0.05
2.017	0.28	0.06	0.031	OI				0.05
2.033	0.28	0.06	0.031	OI				0.05
2.050	0.28	0.06	0.031	OI				0.05
2.067	0.28	0.06	0.032	OI				0.05
2.083	0.28	0.07	0.032	OI				0.06
2.100	0.28	0.07	0.032	OI				0.06
2.117	0.29	0.07	0.033	OI				0.06
2.133	0.29	0.07	0.033	OI				0.06
2.150	0.29	0.07	0.033	OI				0.06
2.167	0.29	0.07	0.033	OI				0.06
2.183	0.29	0.07	0.034	OI				0.06
2.200	0.29	0.07	0.034	OI				0.06
2.217	0.30	0.07	0.034	OI				0.06
2.233	0.30	0.07	0.035	OI				0.06
2.250	0.30	0.07	0.035	OI				0.06
2.267	0.30	0.07	0.035	OI				0.06
2.283	0.30	0.07	0.036	OI				0.06
2.300	0.30	0.07	0.036	OI				0.06
2.317	0.31	0.07	0.036	OI				0.06
2.333	0.31	0.07	0.037	OI				0.06
2.350	0.31	0.08	0.037	OI				0.06
2.367	0.31	0.08	0.037	OI				0.06
2.383	0.31	0.08	0.038	OI				0.06
2.400	0.31	0.08	0.038	OI				0.07
2.417	0.32	0.08	0.038	OI				0.07
2.433	0.32	0.08	0.039	OI				0.07
2.450	0.32	0.08	0.039	OI				0.07
2.467	0.33	0.08	0.039	OI				0.07
2.483	0.33	0.08	0.040	OI				0.07
2.500	0.33	0.08	0.040	OI				0.07
2.517	0.33	0.08	0.040	OI				0.07
2.533	0.33	0.08	0.041	OI				0.07
2.550	0.34	0.08	0.041	OI				0.07
2.567	0.34	0.08	0.041	OI				0.07
2.583	0.34	0.09	0.042	OI				0.07
2.600	0.35	0.09	0.042	OI				0.07
2.617	0.35	0.09	0.042	OI				0.07
2.633	0.35	0.09	0.043	OI				0.07
2.650	0.35	0.09	0.043	OI				0.07

2.667	0.35	0.09	0.043	OI				0.07
2.683	0.36	0.09	0.044	OI				0.08
2.700	0.36	0.09	0.044	OI				0.08
2.717	0.36	0.09	0.045	O I				0.08
2.733	0.37	0.09	0.045	O I				0.08
2.750	0.37	0.09	0.045	O I				0.08
2.767	0.37	0.09	0.046	O I				0.08
2.783	0.37	0.09	0.046	O I				0.08
2.800	0.38	0.10	0.046	O I				0.08
2.817	0.38	0.10	0.047	O I				0.08
2.833	0.38	0.10	0.047	O I				0.08
2.850	0.39	0.10	0.048	O I				0.08
2.867	0.39	0.10	0.048	O I				0.08
2.883	0.40	0.10	0.048	O I				0.08
2.900	0.40	0.10	0.049	O I				0.08
2.917	0.40	0.10	0.049	O I				0.09
2.933	0.40	0.10	0.050	O I				0.09
2.950	0.41	0.10	0.050	O I				0.09
2.967	0.41	0.10	0.051	O I				0.09
2.983	0.42	0.10	0.051	O I				0.09
3.000	0.43	0.11	0.051	O I				0.09
3.017	0.43	0.11	0.052	O I				0.09
3.033	0.43	0.11	0.052	O I				0.09
3.050	0.43	0.11	0.053	O I				0.09
3.067	0.44	0.11	0.053	O I				0.09
3.083	0.44	0.11	0.054	O I				0.09
3.100	0.45	0.11	0.054	O I				0.09
3.117	0.46	0.11	0.055	O I				0.09
3.133	0.46	0.11	0.055	O I				0.10
3.150	0.47	0.11	0.056	O I				0.10
3.167	0.47	0.11	0.056	O I				0.10
3.183	0.48	0.12	0.057	O I				0.10
3.200	0.48	0.12	0.057	O I				0.10
3.217	0.49	0.12	0.058	O I				0.10
3.233	0.50	0.12	0.058	O I				0.10
3.250	0.51	0.14	0.059	O I				0.11
3.267	0.51	0.17	0.059	O I				0.12
3.283	0.52	0.19	0.060	|OI				0.13
3.300	0.52	0.21	0.060	|OI				0.14
3.317	0.53	0.22	0.060	|OI				0.15
3.333	0.53	0.24	0.061	|OI				0.16
3.350	0.55	0.26	0.061	|O I				0.17
3.367	0.56	0.28	0.062	|O I				0.17
3.383	0.57	0.29	0.062	|O I				0.18
3.400	0.58	0.31	0.062	|O I				0.19
3.417	0.59	0.33	0.063	|O I				0.20
3.433	0.60	0.34	0.063	|O I				0.20
3.450	0.60	0.36	0.063	|O I				0.21
3.467	0.61	0.37	0.064	| OI				0.21
3.483	0.63	0.39	0.064	| OI				0.22
3.500	0.64	0.40	0.064	| OI				0.22
3.517	0.66	0.42	0.065	| OI				0.23
3.533	0.68	0.43	0.065	| OI				0.24
3.550	0.69	0.45	0.065	| OI				0.24
3.567	0.70	0.46	0.066	| OI				0.25
3.583	0.71	0.48	0.066	| OI				0.25
3.600	0.72	0.49	0.066	| OI				0.26

3.617	0.74	0.51	0.067	O I				0.26
3.633	0.77	0.52	0.067	O I				0.27
3.650	0.79	0.54	0.067	O I				0.27
3.667	0.82	0.56	0.068	OI				0.28
3.683	0.84	0.57	0.068	OI				0.28
3.700	0.86	0.59	0.068	OI				0.29
3.717	0.87	0.61	0.069	OI				0.30
3.733	0.89	0.63	0.069	OI				0.30
3.750	0.94	0.65	0.070	O I				0.31
3.767	0.99	0.68	0.070	O I				0.32
3.783	1.04	0.71	0.070	O I				0.33
3.800	1.09	0.74	0.071	O I				0.34
3.817	1.13	0.77	0.071	O I				0.35
3.833	1.16	0.81	0.072	O I				0.36
3.850	1.20	0.84	0.072	O I				0.37
3.867	1.24	0.87	0.073	O I				0.38
3.883	1.38	0.91	0.073	O I				0.39
3.900	1.53	0.96	0.074	O I				0.40
3.917	1.67	1.02	0.075	O I				0.42
3.933	1.82	1.09	0.076	O I				0.44
3.950	2.01	1.18	0.077	O I				0.46
3.967	2.19	1.27	0.078	O I				0.48
3.983	2.38	1.36	0.080	O I				0.51
4.000	2.56	1.46	0.081	O I				0.53
4.017	3.37	1.60	0.083	O	I			0.57
4.033	4.17	1.82	0.086	O		I		0.62
4.050	4.98	2.14	0.089	O		I		0.69
4.067	5.78	2.54	0.094	O			I	0.77
4.083	4.70	2.86	0.097	O		I		0.83
4.100	3.62	3.01	0.099	O	I			0.86
4.117	2.54	3.02	0.099	I O				0.86
4.133	1.46	2.90	0.098	I O				0.84
4.150	1.34	2.73	0.096	I O				0.81
4.167	1.22	2.56	0.094	I O				0.77
4.183	1.10	2.38	0.092	I O				0.74
4.200	0.98	2.21	0.090	I O				0.70
4.217	0.92	2.06	0.089	I O				0.67
4.233	0.87	1.92	0.087	I O				0.64
4.250	0.82	1.80	0.086	I O				0.61
4.267	0.76	1.69	0.084	I O				0.59
4.283	0.73	1.61	0.083	I O				0.57
4.300	0.70	1.53	0.082	I O				0.55
4.317	0.67	1.45	0.081	I O				0.53
4.333	0.64	1.38	0.080	I O				0.51
4.350	0.62	1.31	0.079	I O				0.49
4.367	0.60	1.24	0.078	I O				0.48
4.383	0.58	1.17	0.077	I O				0.46
4.400	0.56	1.11	0.076	I O				0.44
4.417	0.54	1.06	0.075	I O				0.43
4.433	0.53	1.01	0.075	I O				0.42
4.450	0.51	0.96	0.074	I O				0.40
4.467	0.50	0.92	0.074	I O				0.39
4.483	0.49	0.88	0.073	I O				0.38
4.500	0.47	0.84	0.072	I O				0.37
4.517	0.46	0.81	0.072	I O				0.36
4.533	0.45	0.78	0.071	I O				0.35
4.550	0.44	0.75	0.071	I O				0.34

4.567	0.43	0.72	0.071	| I O	|	|	|	0.33
4.583	0.42	0.70	0.070	| IO	|	|	|	0.32
4.600	0.41	0.67	0.070	| IO	|	|	|	0.32
4.617	0.41	0.65	0.070	| IO	|	|	|	0.31
4.633	0.40	0.63	0.069	| IO	|	|	|	0.30
4.650	0.39	0.61	0.069	| IO	|	|	|	0.30
4.667	0.38	0.60	0.069	| IO	|	|	|	0.29
4.683	0.38	0.58	0.068	| IO	|	|	|	0.29
4.700	0.37	0.57	0.068	| IO	|	|	|	0.28
4.717	0.37	0.56	0.068	| IO	|	|	|	0.28
4.733	0.36	0.55	0.067	|I O	|	|	|	0.27
4.750	0.35	0.53	0.067	|IO	|	|	|	0.27
4.767	0.35	0.52	0.067	|IO	|	|	|	0.27
4.783	0.34	0.51	0.067	|IO	|	|	|	0.26
4.800	0.34	0.50	0.067	|IO	|	|	|	0.26
4.817	0.33	0.49	0.066	|IO	|	|	|	0.26
4.833	0.33	0.48	0.066	|IO	|	|	|	0.25
4.850	0.33	0.47	0.066	|IO	|	|	|	0.25
4.867	0.32	0.46	0.066	|IO	|	|	|	0.25
4.883	0.32	0.45	0.066	|IO	|	|	|	0.24
4.900	0.31	0.44	0.065	|IO	|	|	|	0.24
4.917	0.31	0.44	0.065	|IO	|	|	|	0.24
4.933	0.30	0.43	0.065	|IO	|	|	|	0.23
4.950	0.30	0.42	0.065	|IO	|	|	|	0.23
4.967	0.30	0.41	0.065	|IO	|	|	|	0.23
4.983	0.29	0.41	0.064	|IO	|	|	|	0.22
5.000	0.29	0.40	0.064	|IO	|	|	|	0.22
5.017	0.29	0.39	0.064	|IO	|	|	|	0.22
5.033	0.28	0.38	0.064	|IO	|	|	|	0.22
5.050	0.28	0.38	0.064	|IO	|	|	|	0.22
5.067	0.28	0.37	0.064	|IO	|	|	|	0.21
5.083	0.28	0.37	0.064	|IO	|	|	|	0.21
5.100	0.27	0.36	0.064	|O	|	|	|	0.21
5.117	0.27	0.35	0.063	|O	|	|	|	0.21
5.133	0.27	0.35	0.063	|O	|	|	|	0.20
5.150	0.26	0.34	0.063	|O	|	|	|	0.20
5.167	0.26	0.34	0.063	|O	|	|	|	0.20
5.183	0.26	0.33	0.063	|O	|	|	|	0.20
5.200	0.26	0.33	0.063	|O	|	|	|	0.20
5.217	0.25	0.33	0.063	|O	|	|	|	0.20
5.233	0.25	0.32	0.063	|O	|	|	|	0.19
5.250	0.25	0.32	0.063	|O	|	|	|	0.19
5.267	0.25	0.31	0.062	|O	|	|	|	0.19
5.283	0.25	0.31	0.062	|O	|	|	|	0.19
5.300	0.24	0.31	0.062	|O	|	|	|	0.19
5.317	0.24	0.30	0.062	|O	|	|	|	0.18
32.333	0.00	0.00	0.001	O	|	|	|	0.00
32.350	0.00	0.00	0.001	O	|	|	|	0.00
32.367	0.00	0.00	0.001	O	|	|	|	0.00
32.383	0.00	0.00	0.001	O	|	|	|	0.00
32.400	0.00	0.00	0.001	O	|	|	|	0.00
32.417	0.00	0.00	0.001	O	|	|	|	0.00
32.433	0.00	0.00	0.001	O	|	|	|	0.00
32.450	0.00	0.00	0.001	O	|	|	|	0.00
32.467	0.00	0.00	0.001	O	|	|	|	0.00
32.483	0.00	0.00	0.001	O	|	|	|	0.00

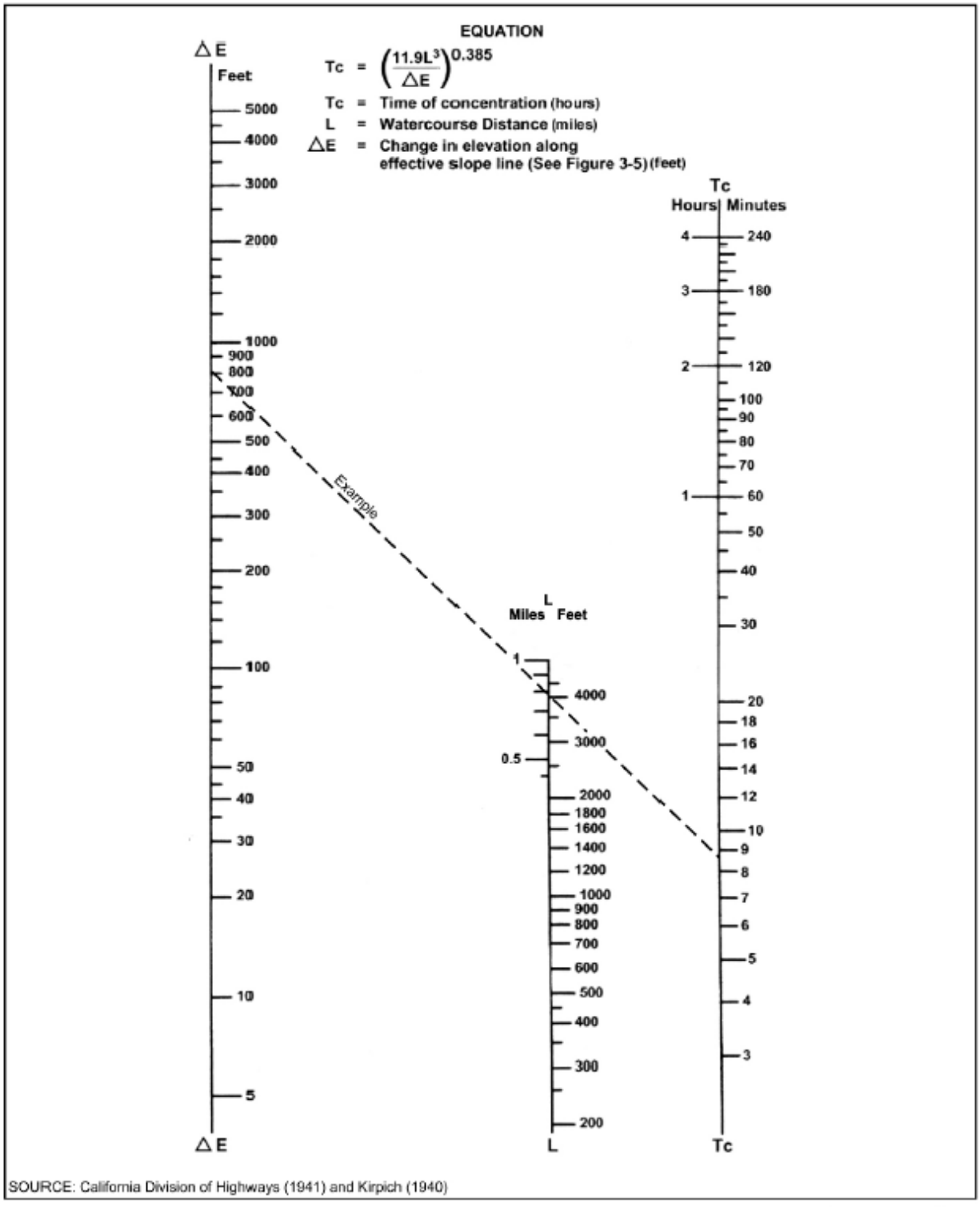
32.500	0.00	0.00	0.001	O	|	|	|	0.00
32.517	0.00	0.00	0.001	O	|	|	|	0.00
32.533	0.00	0.00	0.001	O	|	|	|	0.00
32.550	0.00	0.00	0.001	O	|	|	|	0.00
32.567	0.00	0.00	0.001	O	|	|	|	0.00
32.583	0.00	0.00	0.001	O	|	|	|	0.00
32.600	0.00	0.00	0.001	O	|	|	|	0.00
32.617	0.00	0.00	0.001	O	|	|	|	0.00
32.633	0.00	0.00	0.001	O	|	|	|	0.00
32.650	0.00	0.00	0.001	O	|	|	|	0.00
32.667	0.00	0.00	0.001	O	|	|	|	0.00
32.683	0.00	0.00	0.001	O	|	|	|	0.00
32.700	0.00	0.00	0.001	O	|	|	|	0.00
32.717	0.00	0.00	0.001	O	|	|	|	0.00
32.733	0.00	0.00	0.001	O	|	|	|	0.00
32.750	0.00	0.00	0.001	O	|	|	|	0.00
32.767	0.00	0.00	0.001	O	|	|	|	0.00
32.783	0.00	0.00	0.001	O	|	|	|	0.00
32.800	0.00	0.00	0.001	O	|	|	|	0.00
32.817	0.00	0.00	0.001	O	|	|	|	0.00
32.833	0.00	0.00	0.001	O	|	|	|	0.00
32.850	0.00	0.00	0.001	O	|	|	|	0.00
32.867	0.00	0.00	0.001	O	|	|	|	0.00
32.883	0.00	0.00	0.001	O	|	|	|	0.00
32.900	0.00	0.00	0.001	O	|	|	|	0.00
32.917	0.00	0.00	0.001	O	|	|	|	0.00
32.933	0.00	0.00	0.001	O	|	|	|	0.00
32.950	0.00	0.00	0.001	O	|	|	|	0.00
32.967	0.00	0.00	0.001	O	|	|	|	0.00
32.983	0.00	0.00	0.001	O	|	|	|	0.00
33.000	0.00	0.00	0.001	O	|	|	|	0.00
33.017	0.00	0.00	0.001	O	|	|	|	0.00
33.033	0.00	0.00	0.001	O	|	|	|	0.00
33.050	0.00	0.00	0.001	O	|	|	|	0.00
33.067	0.00	0.00	0.001	O	|	|	|	0.00
33.083	0.00	0.00	0.001	O	|	|	|	0.00
33.100	0.00	0.00	0.001	O	|	|	|	0.00
33.117	0.00	0.00	0.001	O	|	|	|	0.00
33.133	0.00	0.00	0.001	O	|	|	|	0.00
33.150	0.00	0.00	0.001	O	|	|	|	0.00
33.167	0.00	0.00	0.001	O	|	|	|	0.00
33.183	0.00	0.00	0.001	O	|	|	|	0.00
33.200	0.00	0.00	0.001	O	|	|	|	0.00
33.217	0.00	0.00	0.001	O	|	|	|	0.00
33.233	0.00	0.00	0.001	O	|	|	|	0.00
33.250	0.00	0.00	0.001	O	|	|	|	0.00
33.267	0.00	0.00	0.001	O	|	|	|	0.00
33.283	0.00	0.00	0.001	O	|	|	|	0.00
33.300	0.00	0.00	0.001	O	|	|	|	0.00
33.317	0.00	0.00	0.001	O	|	|	|	0.00
33.333	0.00	0.00	0.001	O	|	|	|	0.00
33.350	0.00	0.00	0.001	O	|	|	|	0.00
33.367	0.00	0.00	0.001	O	|	|	|	0.00
33.383	0.00	0.00	0.001	O	|	|	|	0.00
33.400	0.00	0.00	0.001	O	|	|	|	0.00
33.417	0.00	0.00	0.001	O	|	|	|	0.00
33.433	0.00	0.00	0.001	O	|	|	|	0.00

```
33.450    0.00    0.00      0.001  O       |       |       |       |     0.00
33.467    0.00    0.00      0.001  O       |       |       |       |     0.00
33.483    0.00    0.00      0.001  O       |       |       |       |     0.00

    ****************************HYDROGRAPH DATA****************************
              Number of intervals =  2009
              Time interval =    1.0 (Min.)
              Maximum/Peak flow rate =        3.016 (CFS)
              Total volume =       0.231 (Ac.Ft)
        Status of hydrographs being held in storage
                    Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
    ***********************************************************************

    -----------------------------------------------------------------------
```

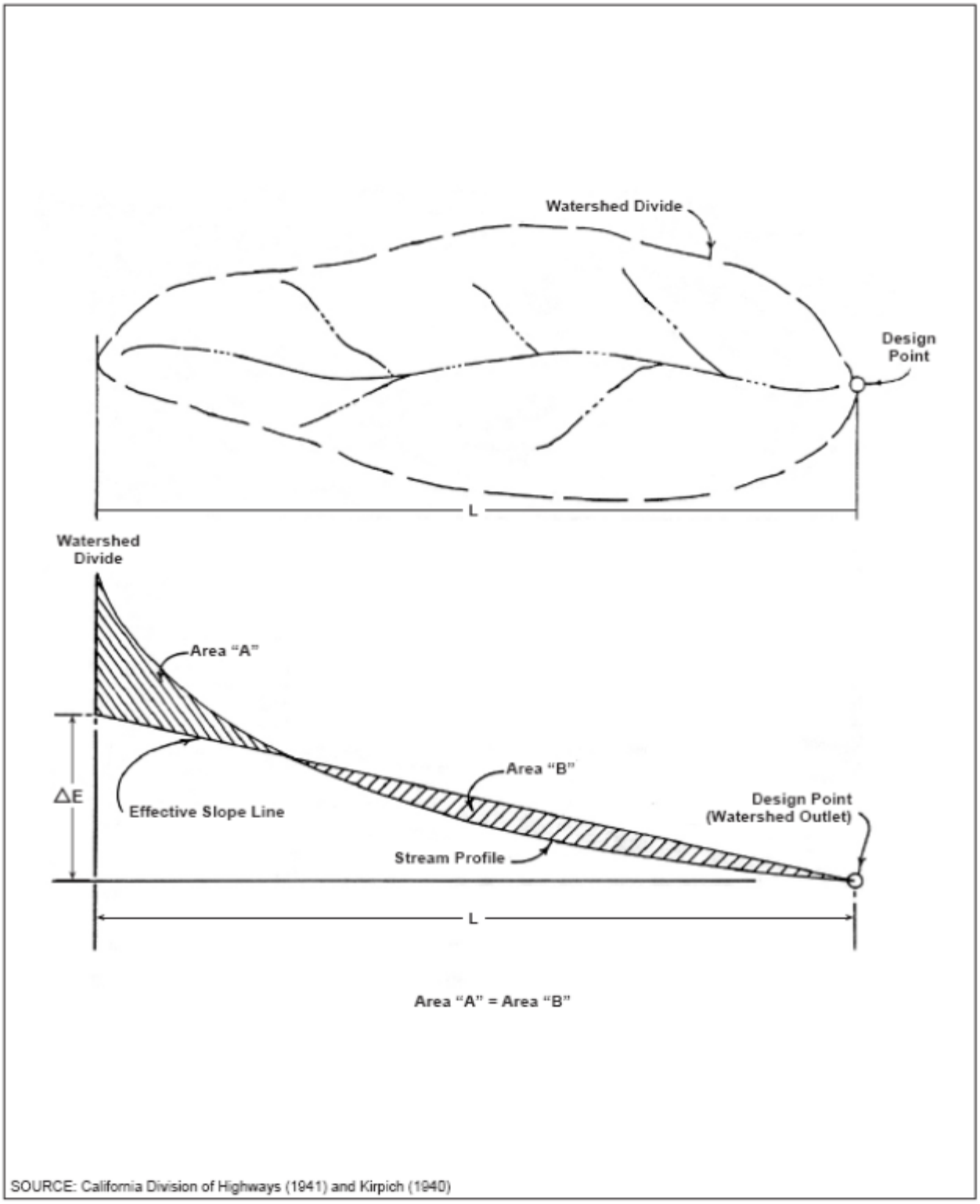
APPENDIX 2
Maps and Charts



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

FIGURE 3-4

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

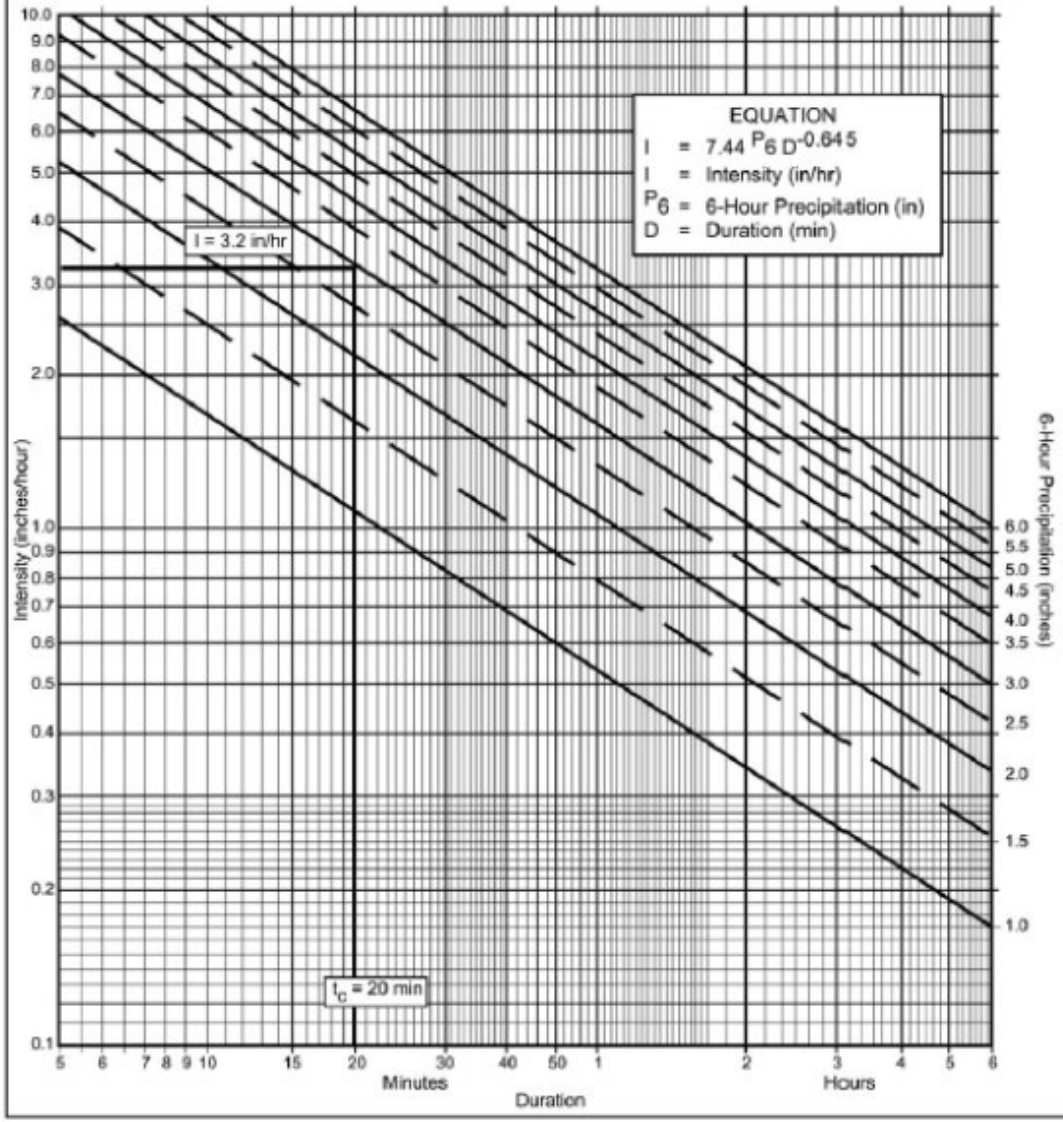


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds

39



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 50 year

(b) P_6 = 3 in., P_{24} = 5.5 , $\frac{P_6}{P_{24}}$ = 54.5 %(2)

(c) Adjusted P_6(2) = 3 in.

(d) t_x = 20 min.

(e) I = 3.2 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 - Example

FIGURE 3-2

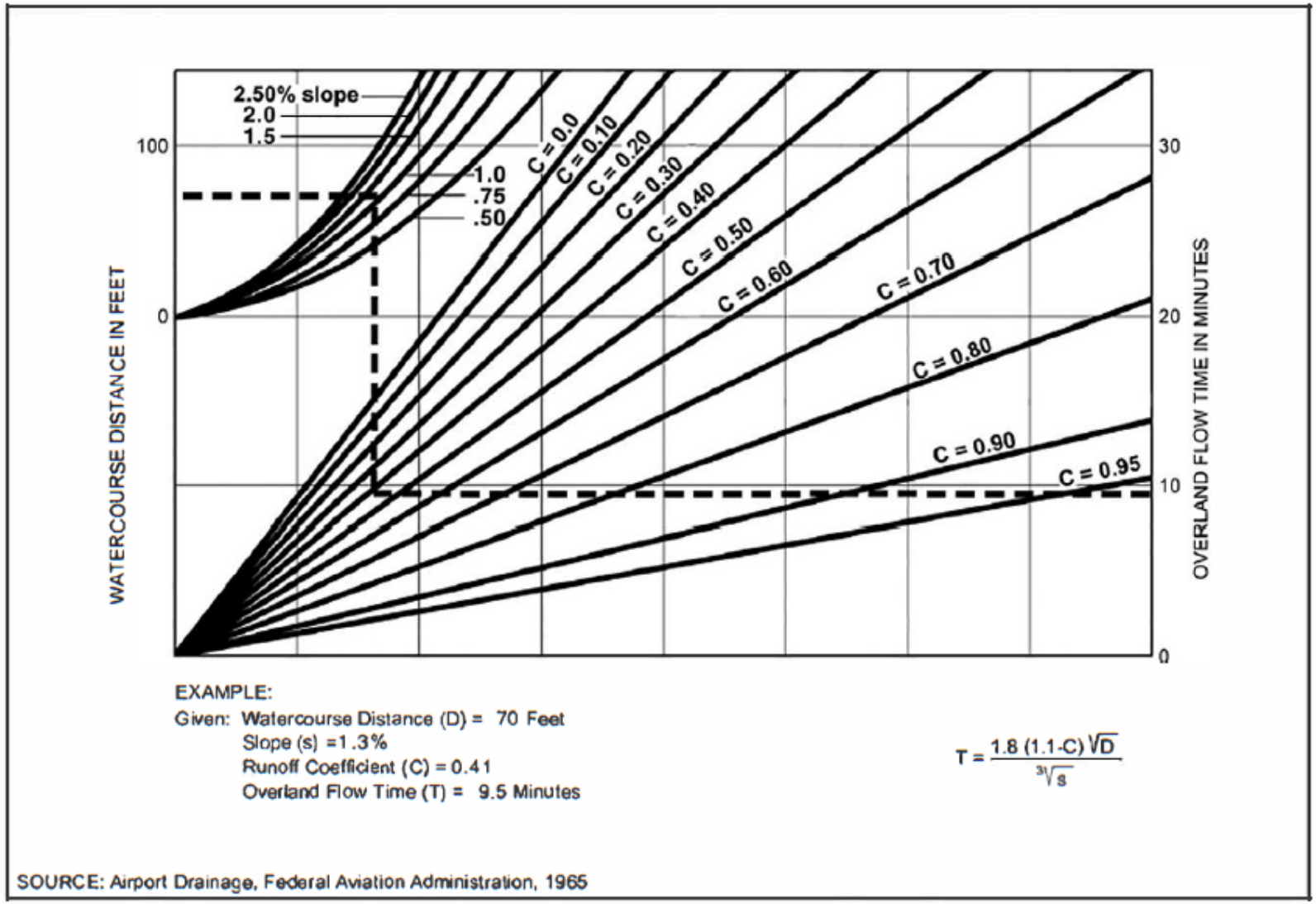
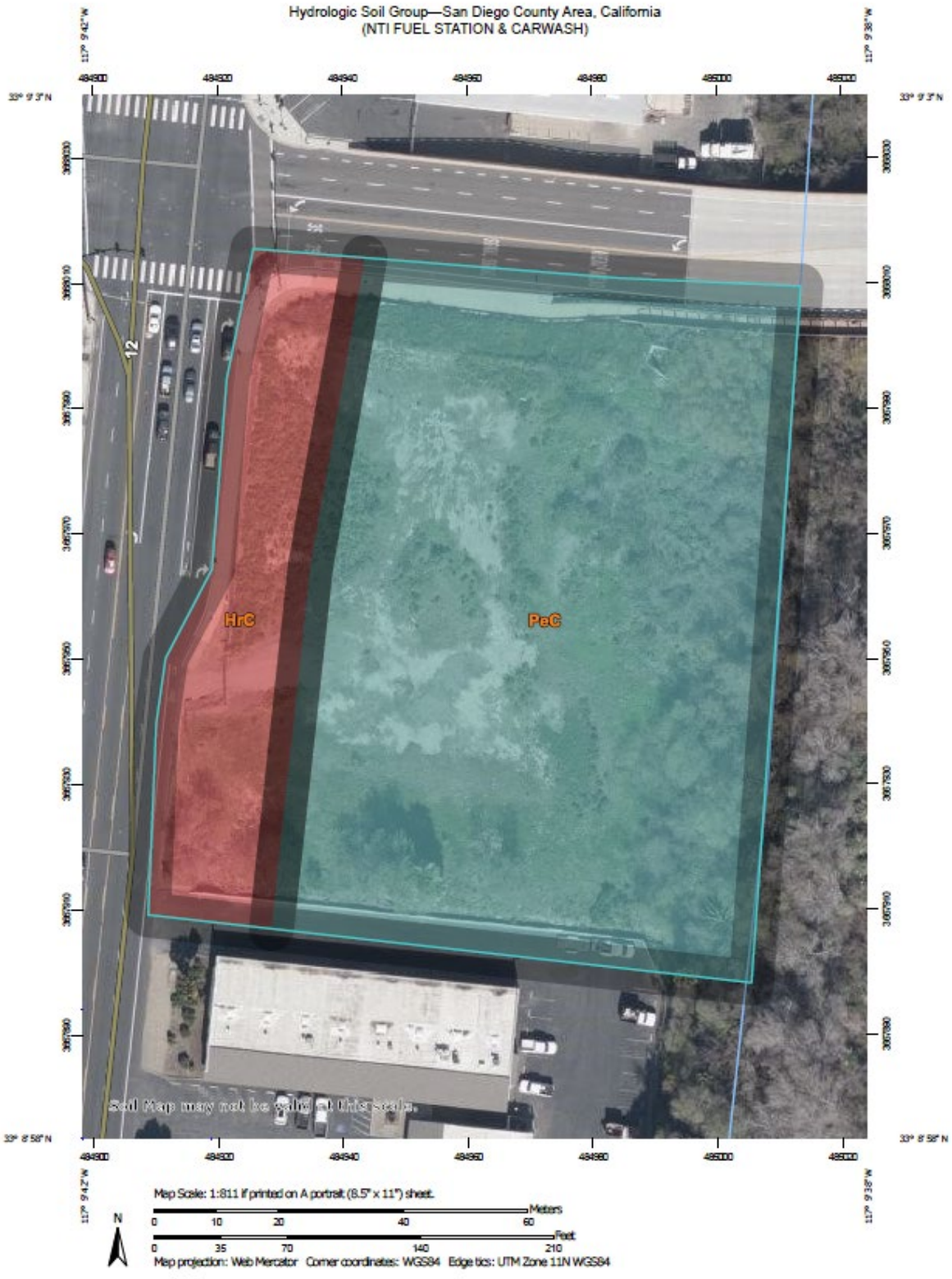


FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph


Hydrologic Soil Group—San Diego County Area, California
(NTI FUEL STATION & CARWASH)
HrC
PeC
12
Soil Map may not be valid at this scale.
Map Scale: 1:811 if printed on A portrait (8.5" x 11") sheet.
Meters
0 10 20 40 60
Feet
0 35 70 140 210
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84
N
USDA
Natural Resources
Conservation Service
Web Soil Survey
National Cooperative Soil Survey
4/30/2020
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

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

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

Date(s) aerial images were photographed: Jan 23, 2020—Feb 13, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HrC	Huerhuero loam, 2 to 9 percent slopes	D	0.5	20.1%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	2.0	79.9%
Totals for Area of Interest			**2.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX 3

OFFSITE RUN-OFF ANALYSIS AND BY-PASS CONCRETE CHANNEL SIZING

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Dec 10 2020

NTI Fuel Station - Bypass channel

Trapezoidal

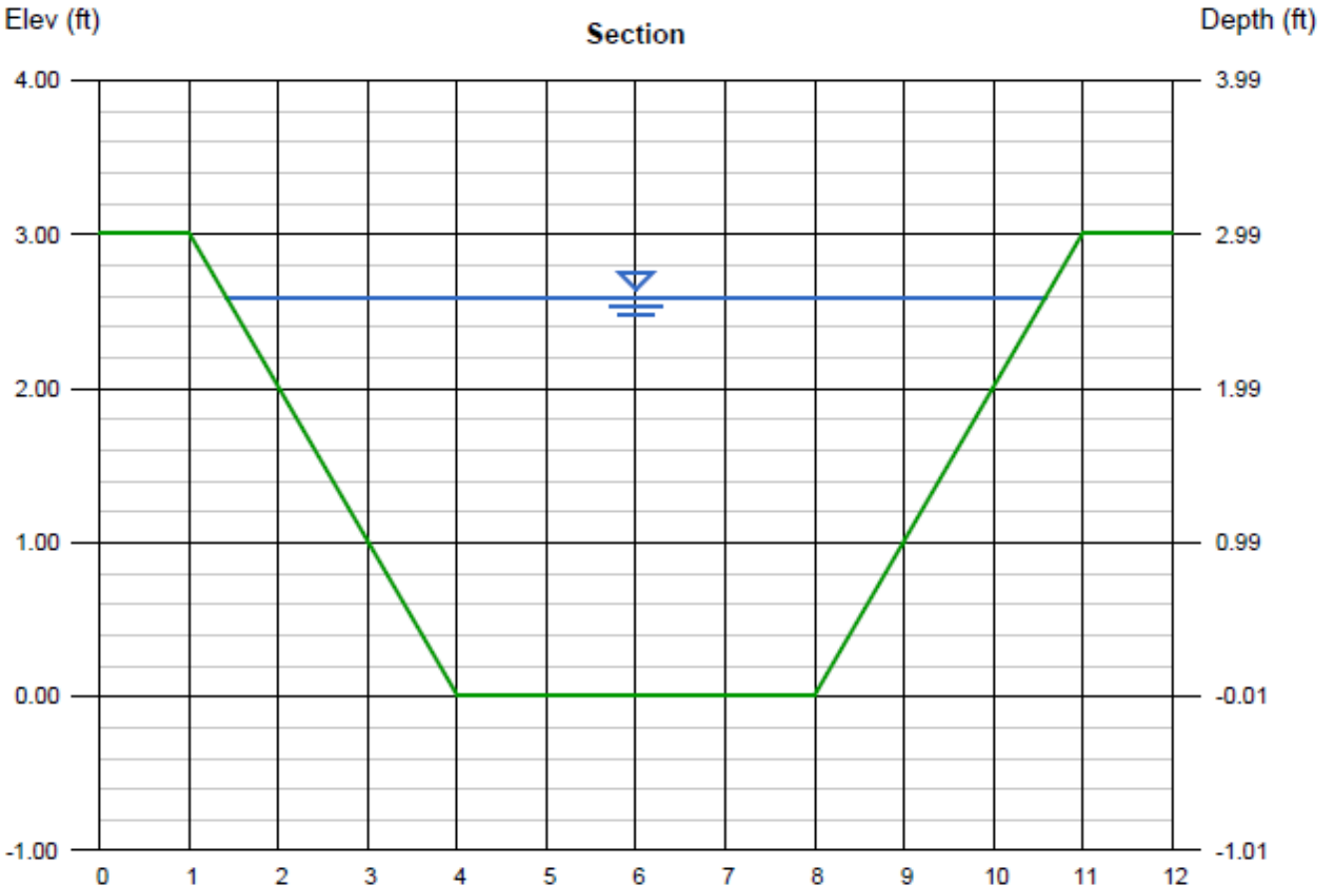
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 1.00, 1.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 0.01
Slope (%)	= 0.70
N-Value	= 0.015

Calculations

Compute by:	Known Q
Known Q (cfs)	= 183.30

Highlighted

Depth (ft)	= 2.58
Q (cfs)	= 183.30
Area (sqft)	= 16.98
Velocity (ft/s)	= 10.80
Wetted Perim (ft)	= 11.30
Crit Depth, Yc (ft)	= 3.00
Top Width (ft)	= 9.16
EGL (ft)	= 4.39

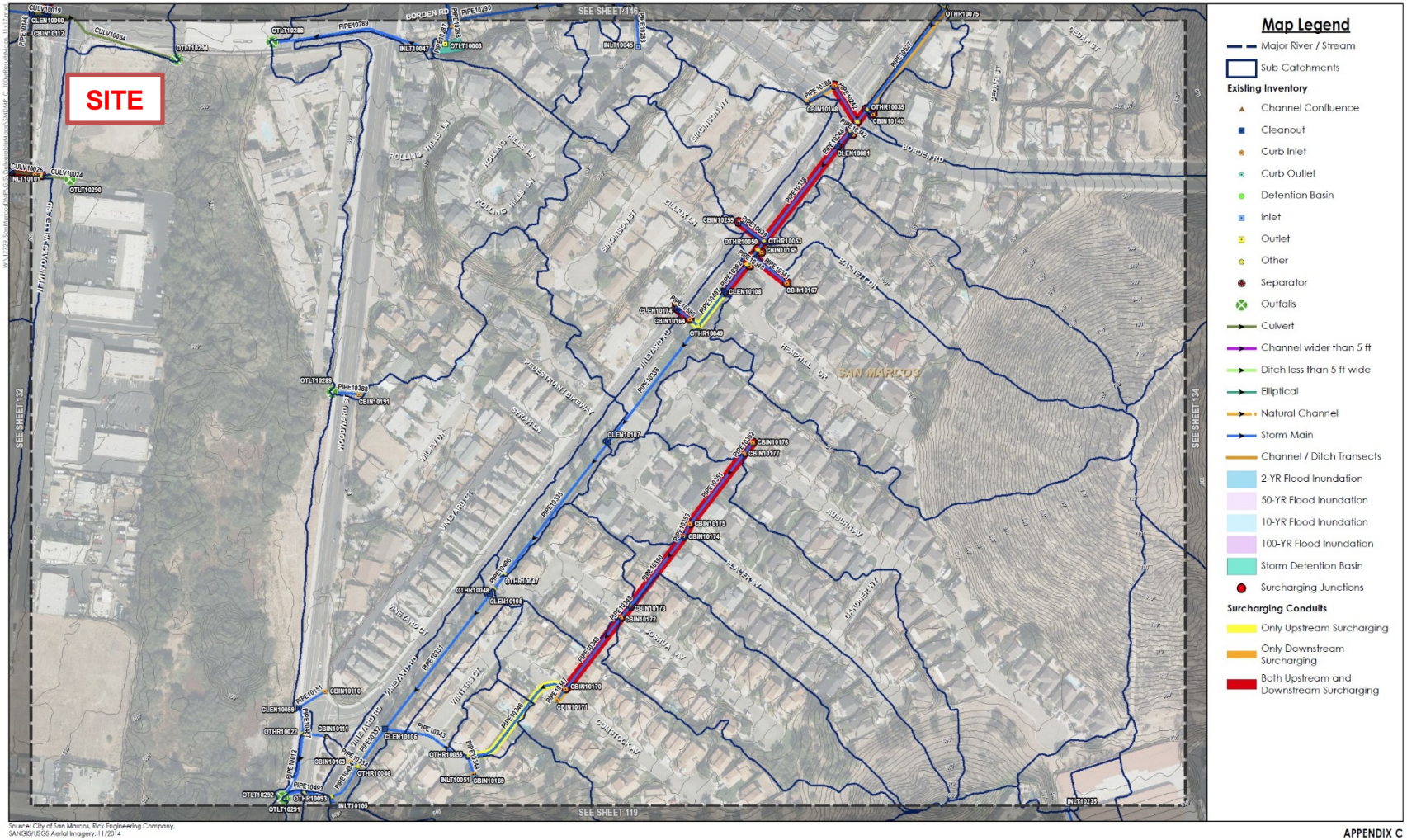


Depth	Q	Area
(ft)	(cfs)	(sqft)
0.30	4.421	1.290
0.60	14.11	2.760
0.90	28.09	4.410
1.20	46.19	6.240
1.50	68.42	8.250
1.80	94.90	10.44
2.10	125.8	12.81
2.40	161.1	15.36
2.70	201.2	18.09
3.00	246.2	21.00

Veloc	Wp	Yc
(ft/s)	(ft)	(ft)
3.43	4.85	0.33
5.11	5.70	0.69
6.37	6.55	1.06
7.40	7.39	1.42
8.29	8.24	1.79
9.09	9.09	2.16
9.82	9.94	2.53
10.49	10.79	2.90
11.12	11.64	3.00
11.72	12.49	3.00

Excerpts from city of San Marcos Master Drainage Study

OUTFALL SUMMARY				
Outfall ID	Discharge (cfs)	Total Contributing Area(ac)	Unit Discharge (cfs/ac)	Total Contributing Impervious Area (ac)
CBIN11889	187.6	70.9	2.6	54.7
CBIN11890	19.5	4.5	4.3	3.6
CBOL10007	34.1	8.4	4.1	4.6
CINT10001	40.1	8.9	4.5	8.0
CINT10002	121.6	36.2	3.4	19.7
CINT10003	260.6	122.6	2.1	77.8
CINT10004	124.3	95.1	1.3	34.7
CINT10005	310.0	103.5	3.0	86.8
CINT10006	404.8	174.6	2.3	80.5
CLEN11555	286.0	97.9	2.9	48.1
CLEN11556	85.2	37.7	2.3	21.7
INLT10952	85.7	44.7	1.9	8.0
INLT10953	77.4	26.7	2.9	24.1
OTHR11733	266.6	187.7	1.4	61.8
OTHR11735	95.1	18.8	5.1	13.1
OTHR11736	0.0	0.0	0.0	0.0
OTHR11737	486.7	399.1	1.2	120.0
OTHR11738	14.4	3.7	3.9	2.8
OTHR11739	13.3	3.6	3.7	1.2
OTHR11740	85.0	35.7	2.4	5.4
OTHR11741	305.0	86.1	3.5	50.5
OTHR11742	655.0	260.0	2.5	67.1
OTHR11743	404.1	146.8	2.8	95.5
OTHR11744	545.8	1351.7	0.4	379.3
OTHR11745	65.7	36.7	1.8	16.2
OTHR11746	9.4	2.2	4.3	1.8
OTHR11747	10.1	2.3	4.4	1.6
OTHR11748	2915.7	498.3	5.9	228.9
OTHR11749	1027.2	857.1	1.2	454.7
OTHR11750	333.0	260.8	1.3	94.5
OTHR11751	149.2	53.3	2.8	14.8
OTLT10287	325.6	141.8	2.3	98.8
OTLT10288	34.3	8.1	4.2	4.8
OTLT10289	25.4	6.5	3.9	3.8
OTLT10290	179.5	64.6	2.8	26.1
OTLT10291	612.8	356.7	1.7	140.5
OTLT10292	31.7	9.6	3.3	5.5
OTLT10293	77.4	39.8	1.9	21.2
OTLT10294	179.7	65.1	2.8	32.6
OTLT10295	177.5	60.5	2.9	31.1
OTLT10296	57.4	19.2	3.0	6.2
OTLT10297	524.5	392.3	1.3	115.1
OTLT10298	211.2	60.2	3.5	30.5
OTLT10299	192.2	58.7	3.3	33.6
OTLT10300	202.5	98.0	2.1	30.8
OTLT10301	227.2	176.3	1.3	36.3
OTLT10302	678.6	619.5	1.1	120.1
OTLT10303	259.5	189.8	1.4	70.8
OTLT10304	46.8	19.9	2.3	5.6
OTLT10305	34.0	9.3	3.7	3.9



Sources: City of San Marcos, Rick Engineering Company.
SANGIS/USGS Aerial Imagery: 11/2014

Scale in Feet
0 200 400
North

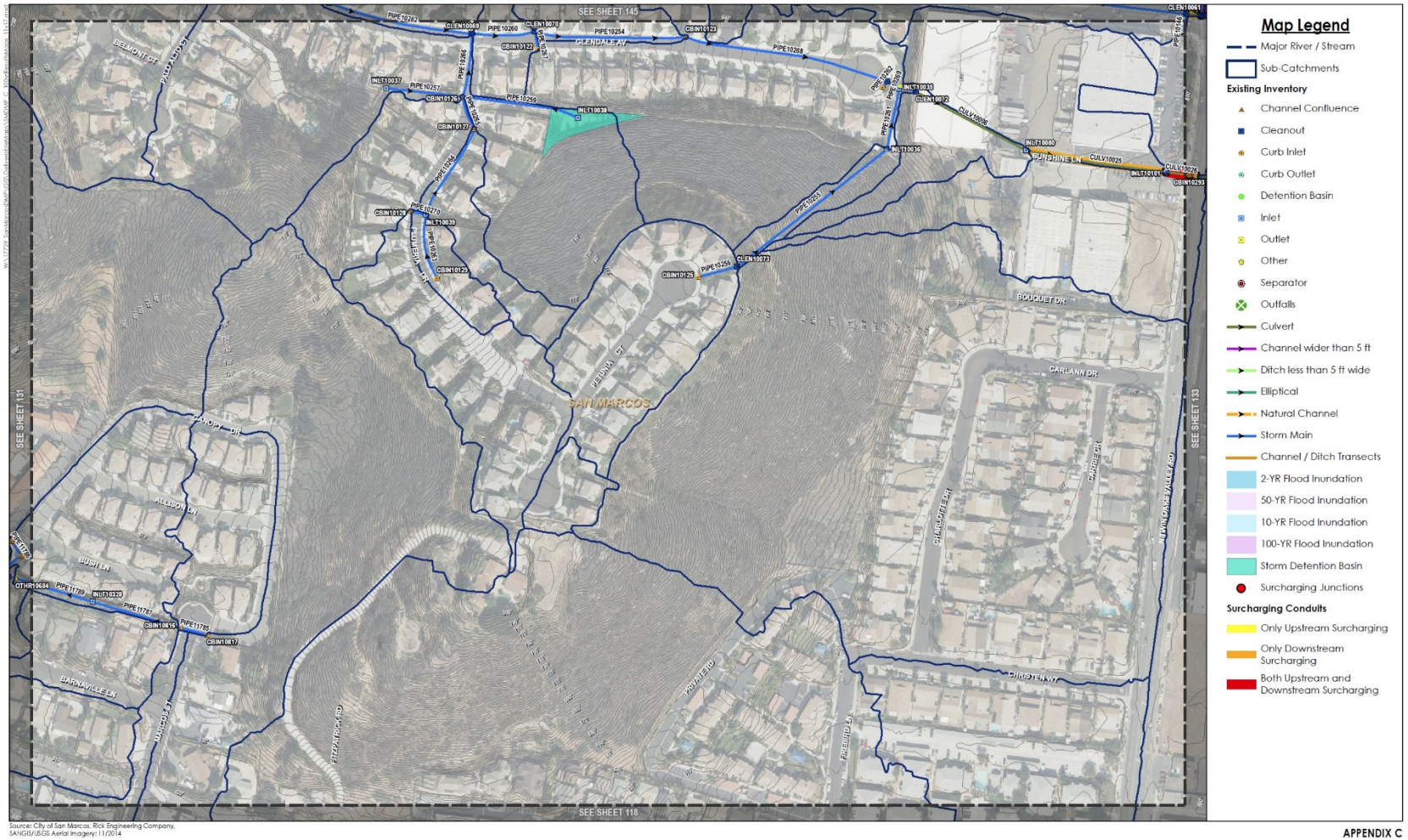
APPENDIX C

City of San Marcos - Drainage Master Plan

Existing Deficient Systems, 100 Year Results - Sheet 133

April, 2019


CULV10019
CLEN10060
PIPE10146
CBIN10112
CULV10034
OTLT10294
SITE
600'
CULV10026
CULV10024
INLT10101
OTLT10290
590'
rcosDMP\GIS\DeliverableMaps\SMDMP_C_100yrResultsMaps_11x17.mxd



Source: City of San Marcos, Rick Engineering Company, SANGIS/USGS Aerial Imagery: 11/2014

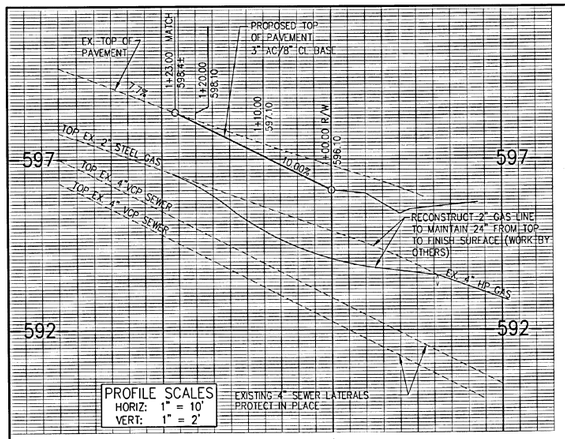
APPENDIX C

City of San Marcos - Drainage Master Plan

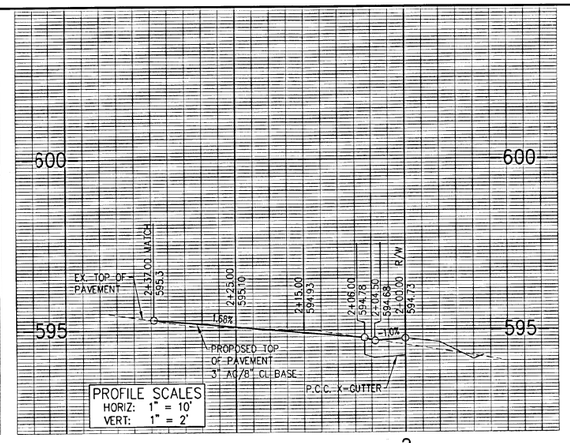
Existing Deficient Systems, 100 Year Results - Sheet 132

April, 2019

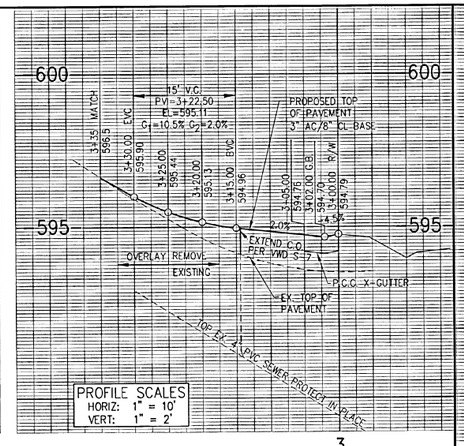
AS-BUILT FOR EXISTING 36" RCP
CITY DRAWING NO. IP 4803



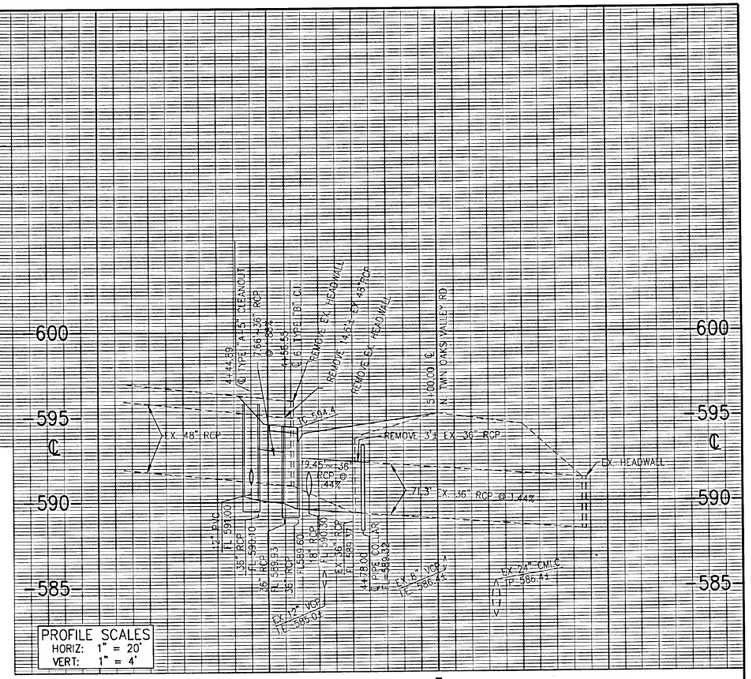
1



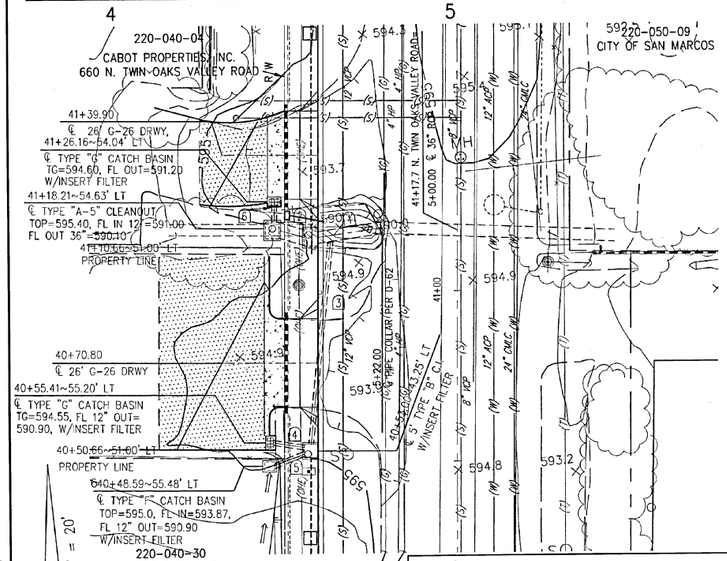
2



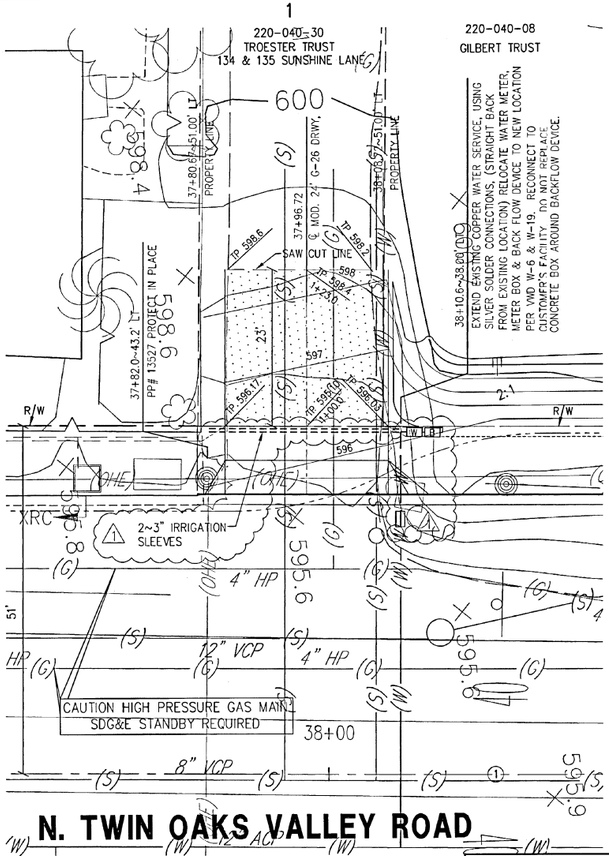
3

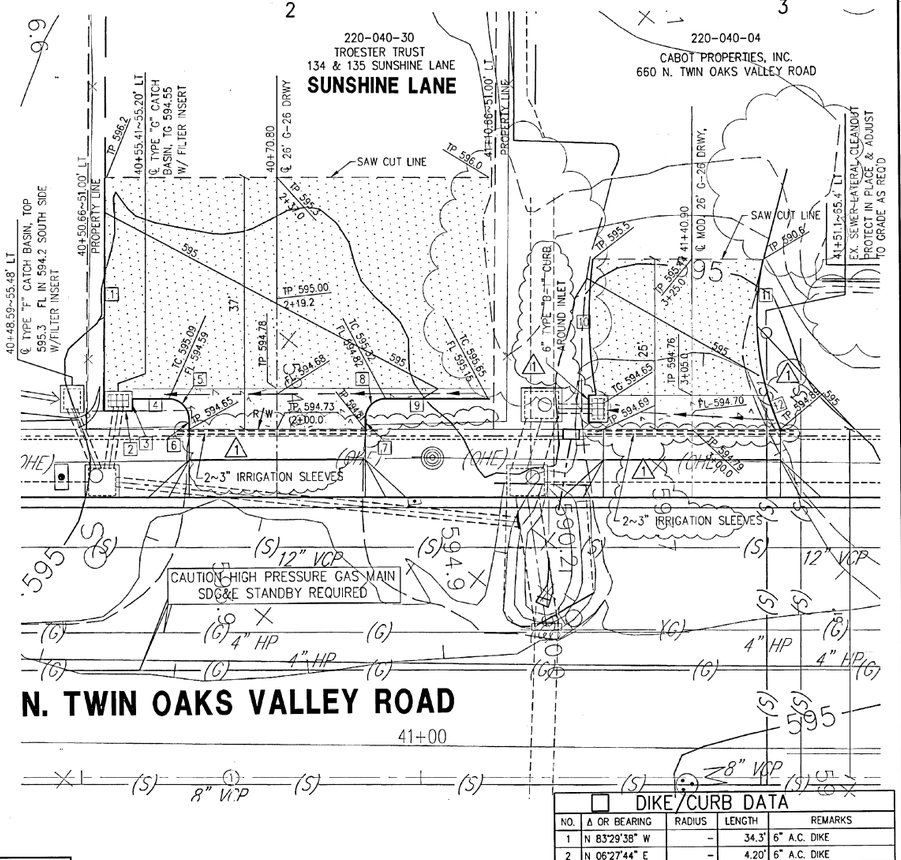


4



5





DIKE/CURB DATA

NO.	Δ OR BEARING	RADIUS	LENGTH	REMARKS
1	N 83°29'38" W	–	34.3'	6" A.C. DIKE
2	N 06°27'44" E	–	4.20'	6" A.C. DIKE
3	N 83°32'16" W	–	1.82'	6" A.C. DIKE
4	N 06°24'11" E	–	5.29'	6" TYPE "G-2" C & G
5	Δ =90°00'00"	3.00'	4.71'	6" TYPE "G-1" CURB
6	N 83°35'49" W	–	1.50'	6" TYPE "G-1" CURB
7	N 83°35'49" W	–	1.50'	6" TYPE "G-1" CURB
8	Δ =90°00'00"	3.00'	4.71'	6" TYPE "G-1" CURB
9	N 06°24'11" E	–	15.3'±	6" TYPE "G-2" C & G
10	Δ =17°24'53"	65.95'	20.1'±	6" A.C. DIKE
11	Δ =28°02'56"	41.29'	20.3'±	6" A.C. DIKE
12	Δ =07°22'52"	41.29'	5.32'	6" TYPE B-1 CURB

STORM DRAIN DATA

NO.	Δ OR BEARING	RADIUS	LENGTH	REMARKS
1	N 87°56'33" E	–	19.45'	36" RCP (1800-D)+
2	N 67°22'35" W	–	7.66'	36" RCP (1800-D)
3	N 12°03'47" E	–	59.75'	18" RCP (1500-D)
4	N 74°46'39" W	–	9.14'	12" PVC (SDR-35)
5	N 74°13'50" E	–	9.42'	12" PVC (SDR-35)
6	N 06°24'11" E	–	5.00'	12" PVC (SDR-35)

+ – 4" GRAVEL UNDER PIPE AND 2 SACK BEDDING TO 1' ABOVE PIPE

CENTERLINE DATA

NO.	Δ OR BEARING	RADIUS	LENGTH	REMARKS
1	N 06°24'11" E	–	–	–
–	–	–	–	–
–	–	–	–	–

"AS-BUILT"
INSPECTED AND RECOMMENDED FOR ACCEPTANCE
Public Works Inspector — Date 9/25/13

SCALE 1" = 10'

STA ENGINEERING, INCORPORATED
P.O. BOX 2636 — 2530 3/4 FOOTHILL DRIVE
VISTA, CA. 92085-2636 — (760) 758-8057 FAX: 758-8059
SURVEYING, CIVIL & TRAFFIC ENGINEERING

REGISTERED PROFESSIONAL ENGINEER — Leonard Schatzman — NO. C32161 — CIVIL — STATE OF CALIFORNIA

VWD DWG NO.

VALLECITOS WATER DISTRICT	ENGINEER OF WORK	CITY APPROVED CHANGES	APP'D	DATE	Recommended for Approval	Approved for Construction	BENCH MARK
BY _____ Date _____	LEONARD SCHATZMAN, R.C.E. 32161 — DATE 8-26-2013 — EXPIRES: 12-31-2014 — DRAWN BY L.F.S.	1 AS-BUILT, ADD IRR SLEEVES, MOVE METER CHANGE DIKE TO CURB, REMOVE CL FENCE			By _____ Elias Gallegos, R.C.E. 66149, exp 6-30-14 Senior Civil Engineer — Date _____	By _____ Michael Edwards, R.C.E. 32977, exp 6-30-14 City Engineer — Date _____	DESCRIPTION: 2" BRASS DISC, IN STREET WELL MONUMENT, STAMPED "RCE 15421". LOCATION: INTERSECTION OF BORDEN RD & VINEYARD RD, IN WESTERLY OF THE TWO WELL MONUMENTS. RECORD FROM: R.O.S. 13928, CITY OF SAN MARCOS SURVEY CONTROL. ELEV: 603.849 DATUM: M.S.L.

CITY OF SAN MARCOS

PLAN FOR THE IMPROVEMENT OF C.I.P. # 294:
NORTH TWIN OAKS VALLEY ROAD
DRIVEWAY RECONSTRUCTIONS & STORM DRAINS

Drawing No. IP-4803
Sheet 5 of 21

V.W.D. W.O. # 105325

17500:\2531 NTOV AB\IMP-FSD.DWG 8/26/2013
ROT: -84°00'00" 0.0000,0.0000

DRAWING NUMBER IP 4803
DRAWING NUMBER As Built