PRELIMINARY DRAINAGE STUDY

CEQA Level

FOR

County of San Diego

Orchard Hill Subdivision
(Tract No. 5570)

Prepared By:

S H A P O U R I & A S S O C I A T E S

P R O J E C T M A N A G E M E N T S E R V I C E S

E N G I N E E R I N G • A R C H I T E C T U R E • P L A N N I N G

18029 Calle Ambiente, Suite 501-502, P.O. Box 676221, Rancho Santa Fe, California 92067
*P H O N E : **(8 5 8) 7 5 6 - 8 3 4 0*** *F A X : (8 5 8) 7 5 6 - 8 3 4 4*

M.H. Shapouri
RCE No. C52794
Expires 12/31/2014

~~March 11, 2013~~

~~November 29, 2013~~

Revised: February 6, 2014

Table of Contents

List of Text

List of Figures

List of Attachments

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

INTRODUCTION & SUMMARY:

This Drainage Study has been prepared pursuant to the San Diego County Grading Ordinance, Grading Plan Manual, Drainage Design Manual and all other applicable County, State and Federal Regulations. This study provides hydrologic and hydraulic analyses in support of a Tentative Map (TM) submittal to the County of San Diego. It will calculate the existing, pre-development hydrologic conditions as well as examine the post-development hydrology as proposed on the Orchard Hill Preliminary Grading Plan (Tract No. 5570).

The proposed Orchard Hill Project is intended to provide a 20 unit single residential subdivision of a 12.5 acre parcel situated on the northeast side of Richland Road and Tide Way. The project minimum lot size is 15,000 square feet. There is an existing Vista Irrigation Flume that serves as the northern boundary for this project. The project density is 1.6 dwelling units per acre.

Figure A, Vicinity Map

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

The project will be accessed via a central roadway on Richland Road which intersects with Tide Way. This internal subdivision street will provide access to all of the lots and will consist of 52-foot right-of-way with a 32-foot wide pavement width and 10-foot wide parkway on each side. In addition, the project would also construct frontage improvements to Richland Road. Currently Richland Road half street width is 12 feet paved; it is proposed to be widened to 20 feet of pavement width and 10 feet wide parkway. An approximately 32 feet wide Bioretention will be provided along part the project frontage on Richland Road and will be used for drainage BMP's.

Earthwork quantities are anticipated to be approximately 30,000 cubic yards of balanced grading. The project will be graded in one-phase. Residential unit construction may be developed in phases. The project is in conformance with the requirements Resource Protection Ordinance as well as the County's storm water discharge requirements.

This Preliminary Drainage Study analyzes the pre and post-development hydrology per the latest project specifications and scope of work. The capacity of the proposed drainage system will be determined in regards to the 100 year storm event.

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Figure B, Aerial Photo

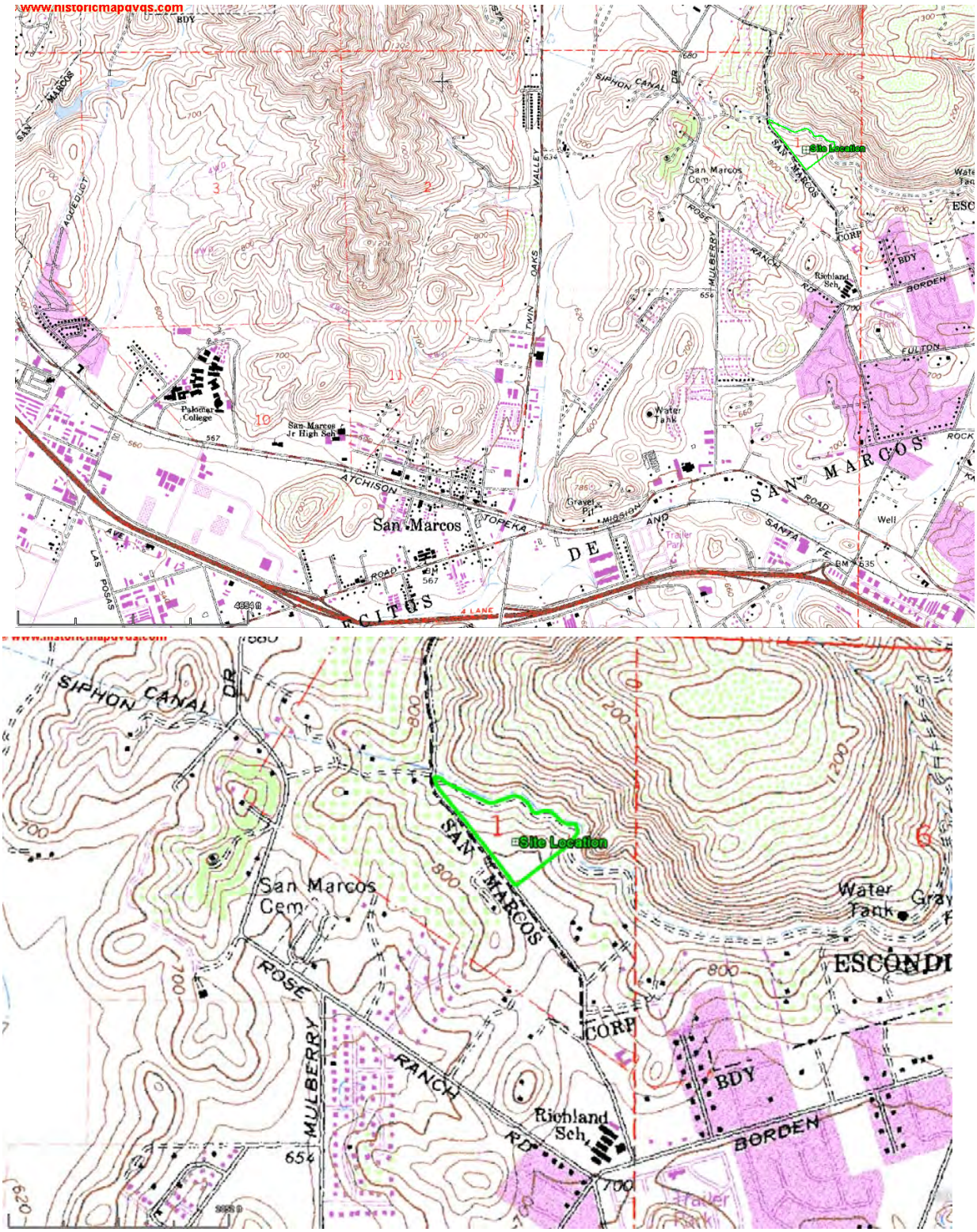


Figure C – Site Location on USGS Map

METHODOLOGY

This study has been prepared consistent with all current County of San Diego's ordinances and procedures. All components of the study are designed to convey storm water based on a 100 year flood event. The anticipated storm runoff has been calculated based on the County of San Diego Rational Method for Computing Water Runoff of Small Watersheds.

The following references have been used in preparation of this report:

- *County of San Diego Hydrology Manual, June 2003.*
- *San Diego County Grading, Clearing and Watercourses Ordinance, dated April 23, 2004*
- *San Diego County Drainage Design Manual, dated July 2005.*
- *San Diego County Rational Hydrology Program – CIVILCADD/CIVILDESIGN Engineering Software, Version 7.5*
- *FHWA HY8 Software, Version 7.2 dated January, 2012.*
- *County of San Diego Hydrology Manual, Soils Hydrologic Group Map, 2007.*

Civil Design Hydrology Program

The Civil Design Hydrology Program is a computer-aided design program in which the user develops a node-link model of the watershed. The program has the capability of estimating culvert sizes and using culverts or open channels to convey designed storm discharges. Developing independent node-link models of each interior watershed and linking these sub models together at confluence points create the node-link model.

Rational Method

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage, where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and small drainage structures.

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (Tc), which is the time required for water to flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed as follows:

Q = C I A

Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, proportion of rainfall running off surface (no units)

I = average rainfall intensity for duration equal to the Tc for the area, in inches per hour

A = drainage area contributing to the design location, in acres

The RM formula is based on the assumption that for constant rainfall intensity, the peak discharge rate at a point will occur when the raindrop that falls at the most upstream point in the tributary drainage basin arrives at the point of interest.

Runoff coefficients (C) based on land use and soil types were obtained from the San Diego County Hydrology Manual, Table 3-1. Soil types were determined from the Hydrology Soils Map provided in Appendix A as well as the US Department of Agriculture (USDA) Soil Survey program. This runoff coefficient was then multiplied by the percentage of total area (A) included in that class.

The rainfall intensity (I) can be determined from the County of San Diego Intensity-Duration Design Chart. The 6-hour storm rainfall amount (P6) and 24-hour storm rainfall amount (P24), were determined from the isopluvial maps provided in Appendix B. Intensity can also be calculated using the following equation:

$$\mathbf{I = 7.44 (P_6) (D^{-.645})}$$

I = Intensity (inches/hour)

P_6 = 6 Hour Precipitation (inches)

D = Duration in minutes (use Tc)

The Time of Concentration (Tc) is the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The Tc is composed of two components: initial time of concentration (Ti) and travel time (Tt). The Ti is the time required for runoff to travel across the surface of the most remote subarea in the study, or "initial subarea." The Tt is the time required for the runoff to flow in a watercourse or series of watercourses from the initial subarea to the point of interest. For the RM, the Tc at any point within the drainage area is given by:

$$Tc = Ti + Tt$$

PRE-DEVELOPMENT CONDITIONS (Existing)

The Project site is located in the southern portion of North County Metro Community Planning Area; in a County island surrounded by the City of Escondido on the north side and City of San Marcos on all other sides. The location is approximately two miles north of Highway 78 and 2.5 miles west of Interstate 15, the northern boundary of the site is defined by the existing Vista Flume, the southern boundary is defined by Richland Road.

Currently existing to the west, south and further east are existing single family subdivisions, similar to the proposed project. The site is currently covered with some eucalyptus trees and has had previous agricultural operations; however the extent and the history are unknown. There are no existing buildings or structures on the project site. Overall, the site has a gentle and well defined topography, there are some isolated slopes greater than 25% located on the north east corner of the site as shown on the attached Slope Analysis Map (Figure "H" Existing Topography Slope Analysis).

Richland Road was previously improved per Curb Grad Improvement Plans CG-4071 in 1999. As a part of this improvement plan a Modified Type "F" Catch basin was installed within the project boundary; at this point an existing storm drain system downstream of the project site was designed as a part of the City of San Marcos Drainage Study for Richland Road in Rose Ranch Unit 2 – TSM 392, prepared by the MAY Group in 1999 (see Figure "D" below). A part of that report shows the first reach of the storm drain as a 30 inch diameter RCP, while the second reach is a 42 inch RCP. Node 28 of the current study is the same as Node 5 of the Rose Ranch Study. The hydrologic results from the Rose Ranch Study are shown in Table 1. The storm drain system in Richland Road was designed to convey a 10-year storm.

Table 1. Summary of Flows from Rose Ranch Study

Node	Area (ac.)	Q_{10} (cfs)	Q_{100} (cfs)
3	28.4	42	61
5	67	104	153

At the Northerly Boundary of the project site, the Vista Canal Aqueduct, owned, operated and maintained by Vista Irrigation District (VID), is a continuous concrete structure with a height of

approximately four feet. Runoff from the offsite areas northeast of the aqueduct is conveyed to the site through three existing 12-inch concrete culverts. Runoff in excess of the capacity of these culverts is conveyed along the northeast side of the aqueduct and is discharged to Richland Road northwest of the project site. The discharge location is north of a highpoint in Richland Road, so runoff that is conveyed along the northeast side of the aqueduct does not reach the project site.

For the current project, it has been assumed that the only offsite flow reaching the project site is the runoff that can be conveyed through the three existing 12 inch diameter culverts. The aqueduct was not discussed in the Rose Ranch Report, but field observations indicated that the aqueduct intercepts larger flows, limiting the runoff that reaches the project site. The capacities of the 12 inch diameter concrete culverts were determined using the FHWA HY8 Software. The slopes of the culverts were estimated from the project topography conditions, and the available headwater depth was determined as the elevation difference between the culvert invert and approximately one foot above the ground elevation behind the concrete aqueduct. As previously stated, it has been observed that excess runoff flows along the aqueduct in the northwesterly direction to a point of discharge at Richland Road northwest of the project site.

The flows entering the site from the upstream of the aqueduct are shown in Table 2. Pre-hydrology results for the 100-year storm and the HY8 culvert calculations are attached.

Table 2. Summary of Flows Entering Site

Nodes	Area (ac.)*	Q (cfs)
1	2.47	6.7
2 & 3	3	8.1

(*) Note: Not an actual area, but that which will produce the peak Q for a 5 minute time concentration

The capacity of the 12 inch diameter culvert at Node 1, is approximately 6.7 cfs, and the capacities of the 12 inch diameter culverts at Nodes 2 & 3 are approximately 8.1 cfs. This assumes no blockage at the pipes at the upstream entrance, but the flows will likely be less based on a field investigation, which revealed accumulation of debris and a poor condition of the projecting pipe entrances.

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Drainage facilities at the site will be designed with the assumption that VID's Vista Canal Aqueduct intercepts much of the flow from the offsite area and limits the runoff reaching the site to the culverts capacities of the three existing concrete culverts under the aqueduct.

Figure "D", Existing Type "F" Inlet ate the Southeast corner of the project on Richland Road

Figure E, Photo Key Map

Figure F, Picture 1, showing existing Richland Road and Concrete Ditch

Figure F, Picture 2, Looking Easterly towards existing Vista Irrigation Flume

Figure F, Picture 3, Looking Uphill at Existing Open Space and Homes

Figure F, Picture 4, Looking West

Figure F, Picture 5, Looking North West on Richland Road

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Figure F, Picture 6, Looking South West

Figure F, Picture 7, Looking South

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Figure F, Picture 8, Looking North on Richland Road

Hydrologically the project site is within the Richland subarea as delineated on the Regional Water Quality Control Board Map for San Diego Hydrologic Basin Planning Area, Region 9 and as shown on Figure "G" below;

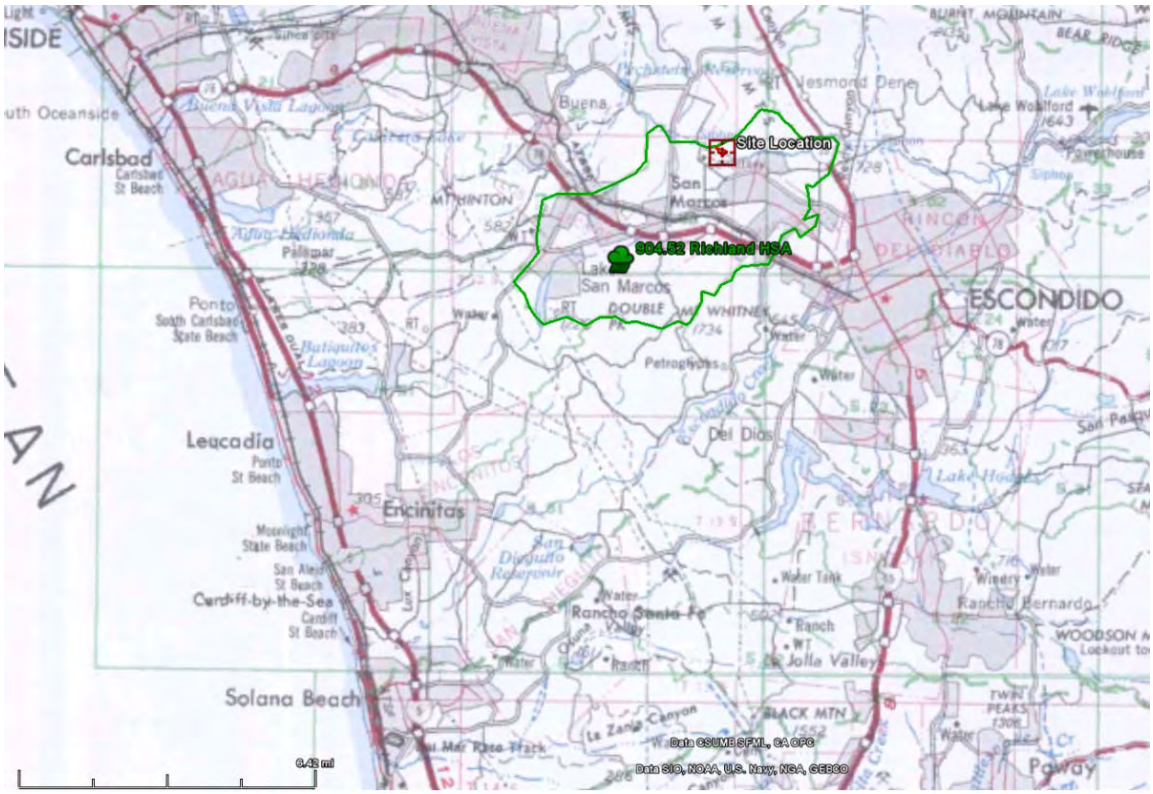


Figure G, Hydrologic Basin Map, 904.52 Richland Sub Area

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Topography;

Topographically the Site is characterized by gentle and uniform topography with elevations ranging from approximately 785 feet to 900 feet above mean sea level. The project site is relatively flat with approximately 80% of the project area having natural slopes of 0%-25% and northwestern portion of the site is generally depicted as moderate to steep slopes, 2.4% of the site has slopes over 50% as shown on Figure "H", Existing Ground Slope Analysis Map.

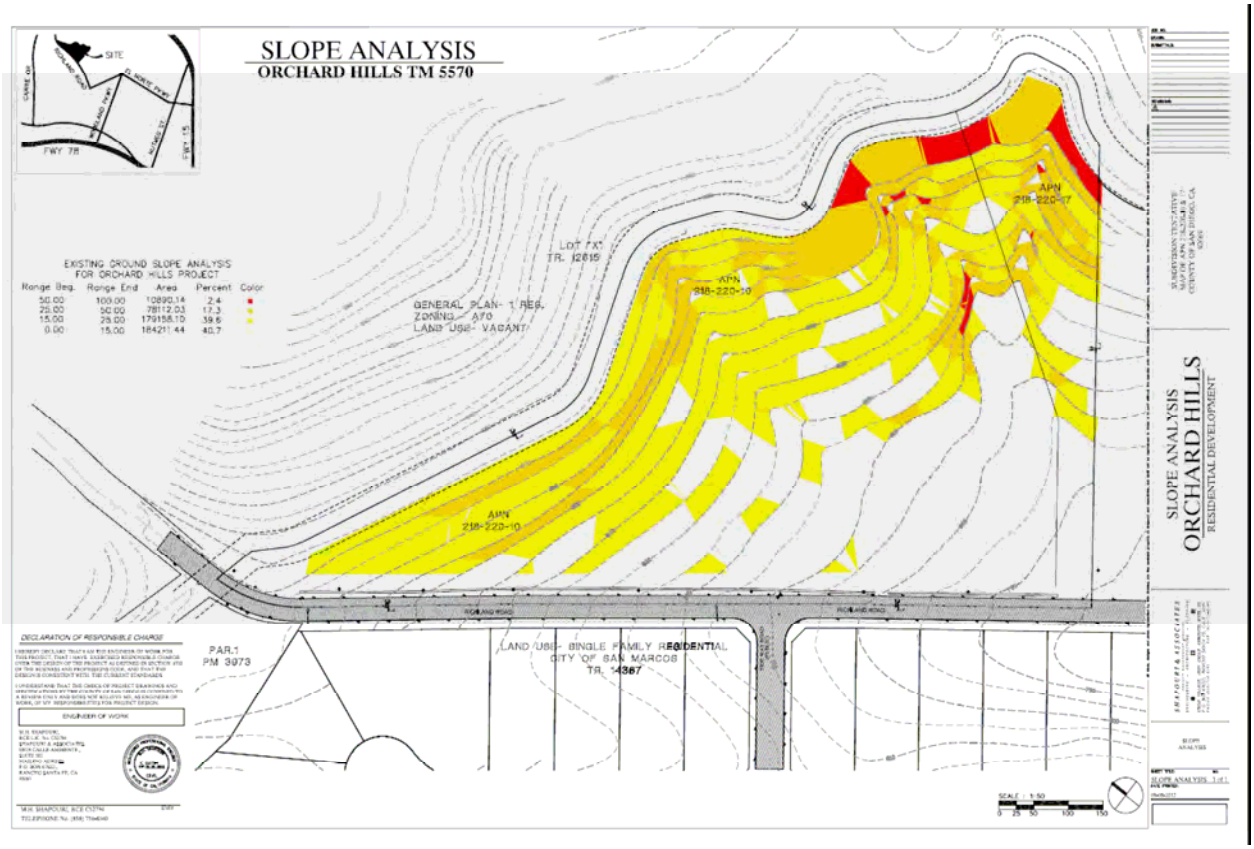


Figure H, Existing Topography Slope Analysis

Soils;

Project Site soils are mostly classified as fine sandy loams the County Soils Map shows that this site is covered by 2 types of soils, “C” and “D” as shown in Figure “I” below;

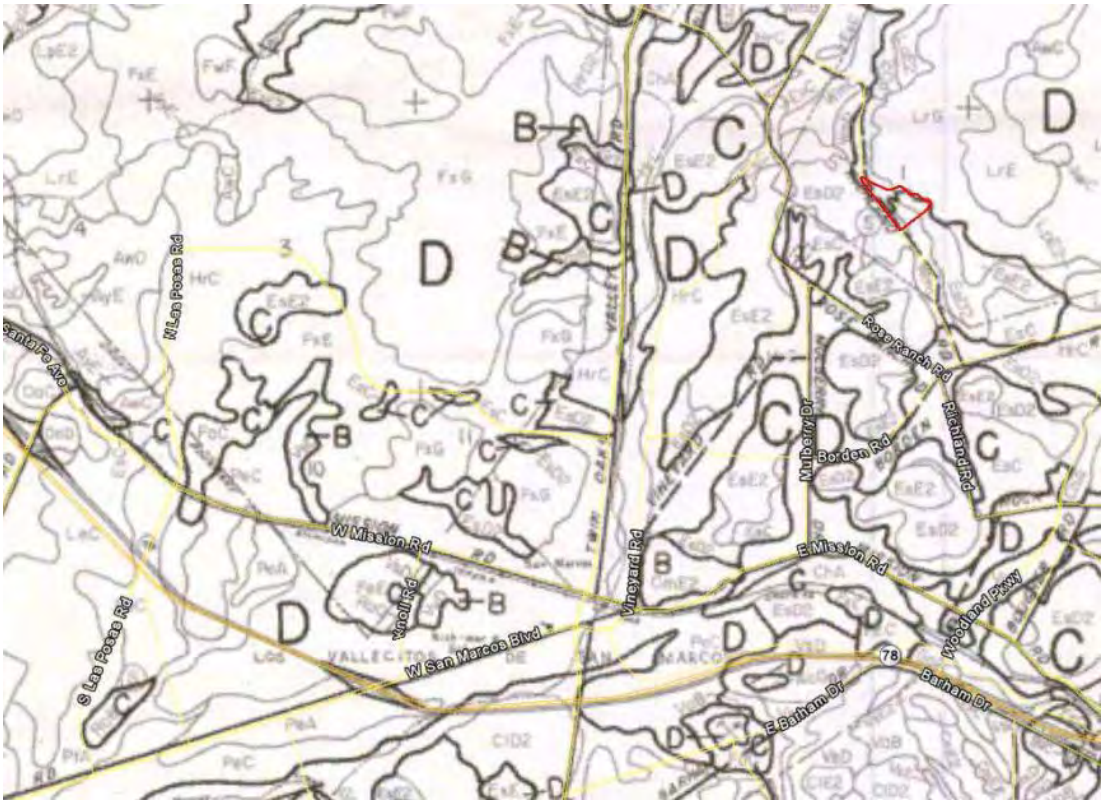
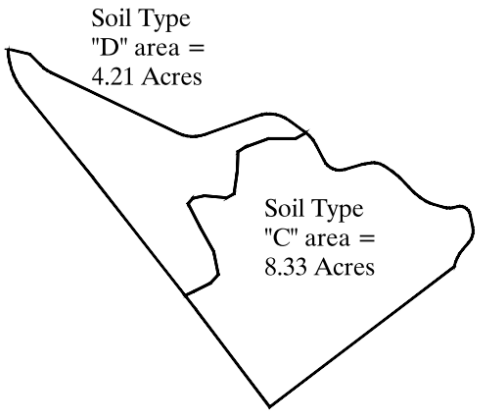


Figure I, Project Site Soils Classification

The areas of these 2 soil types were calculated as follows;



Runoff Coefficient;

The Pre-Development Runoff Coefficient (C) value for the existing condition is based on the Undisturbed Natural Terrain (Natural) category of the mostly Permanent Open Space area that is shown on the Table 3-1, San Diego County Hydrology Manual for various soil types.

The drainage basin is entirely within soils group "C" and "D", this data is extracted from the "Soils Group Map" prepared by the County of San Diego, dated 2007. The peak runoff rates will be presented at the point of discharge shown on the attached hydrology maps as Design Point 1.

Vegetation;

The Project Site is mostly covered with row crops from previous agricultural activity; a portion of the site is also classified as "Urban/Developed" due to existence of eucalyptus trees. The area is characterized by rolling grassy hills and shrubs.. See Figure "J", Existing vegetation Types.

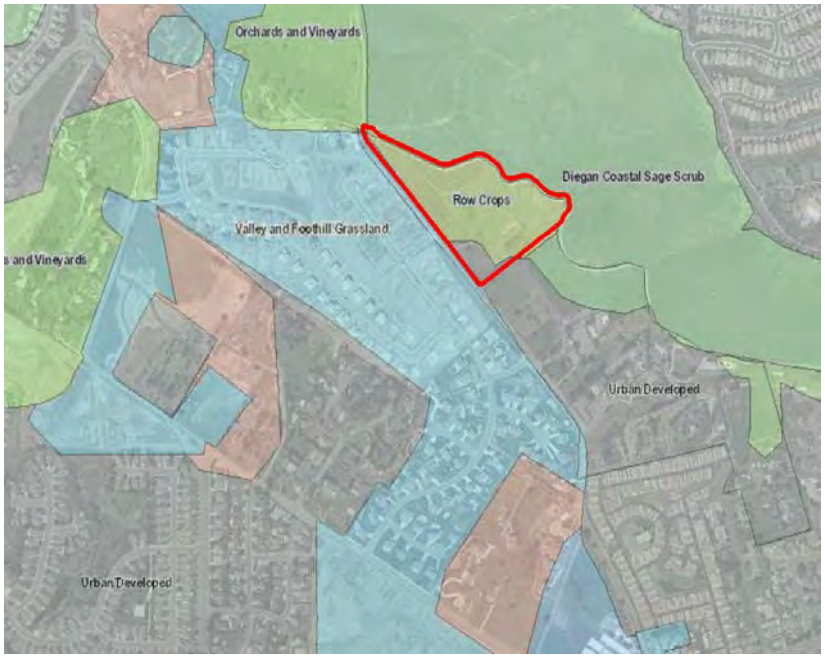


Figure J, Existing Vegetation Types

POST-DEVELOPMENT CONDITIONS

As mentioned before, it has been assumed that the only offsite flow reaching the project site is the runoff that can be conveyed in the three existing 12 inch diameter culverts. The proposed grading plan is following the current flow patterns of the project site to Design Point 1.

On top of the proposed cut slopes a 36" wide Type "B" concrete brow ditch (SDRSD D-75) is proposed to convey the existing offsite flows from 12 inch culverts at Nodes 2 & 3 (approximately 8.1 cfs each), this flow is directed to a proposed type "F" catch basin (SDRSD D-7) on the corner of the southeast side of the property. Additional offsite flow from the existing 12 inch diameter culvert on the North West at Node 1 (approximately 6.7 cfs), conveys to a proposed 24" wide Type "B" concrete ditch (SDRSD D-75), that flows along the projects frontage. Additional flows from Richland Rd. converge with flows from the 24" concrete ditch, that inflows via an under sidewalks curb cut. At this point flows enter a proposed 24" RCP, that runs under Street "A" and into Bioretention 1 (BMP 1) and eventually to the existing storm drain system.

The proposed home site pads will capture flows from roof tops and patio areas and routed to Street "B" and into proposed curb inlets (SDRSD D-2). Proposed RCP culverts will carry the majority of Post-development runoff, which is routed to Bioretention 1 (BMP 1) along the frontage, running parallel to Richland Rd. and into south east corner of the site. At this point additional water runoff from Richland Rd. converge through an under sidewalk curb cut, and eventually to the San Marcos Creek further south.

As described, all onsite and the majority offsite flows merge at the existing 30" diameter RCP along Richland Road (Node 18), and then travel underground to the existing Type "F" inlet that captures flows from Basin 8 (approximately 4.37 cfs).

The total Post-Development 100-year storm runoff at Design Point 1 is 50.39 cfs (Node 28). Additionally, the post-development 100-year peak flow rate at Design Point 1 (Node 28) of 46.44 cfs is approximately 46% of the 10-year peak flow rate of 104 cfs at Node 5 of the Rose Ranch Study (See attachments). This decrease in the peak flow rates is attributed to the aqueduct that passes through the project vicinity and intercepts much of the flows from the upper portion of the watershed previously analyzed for the Rose Ranch Study to the northwest.

CONCLUSION

As designed, the development will not alter the natural drainage path or divert any water from the existing natural conditions or drainage boundaries. This CEQA Drainage Study has analyzed the hydrological flow and calculations for the proposed improvements and Preliminary Grading Plans. All drainage facilities at the site will be designed with the assumption that VID's Vista Canal Aqueduct intercepts much of the flow from the offsite area and limits the runoff reaching the site to the culvert capacities of the three existing concrete culverts under the aqueduct.

Since the results from our analysis are less than the flows from the Rose Ranch Study, which was designed to carry higher flows, the post-development 100-year flow rate of 46.44 cfs indicates that that downstream storm drain system will have the capacity to convey the peak flow rate from the site.

In conclusion our study demonstrates that post-development runoff of 46.4 cfs is slightly less, than the pre-development conditions of 51.5 cfs.

Table 3. Summary of Discharges

Node	Pre-Development Conditions					Post-Development Conditions				
	C*	Tc (min)	I (in/hr)	A (ac.)**	Q_{100} (cfs)	C*	Tc (min)	I (in/hr)	A (ac.)**	Q_{100} (cfs)
28	0.32	6.99	6.64	23.43	51.56	0.49	12.23	8.96	23.43	46.44

Note: (*) C value is a composite for the onsite area of 12.5 acres

(**) Not an actual area. Effective area 14.96 ac., the other 8.47 ac. where determine to produce the peak Q for a 5 minute time concentration and maximum capacity of the three 12-inch offsite culverts (See Table 2 & Offsite Culvert Calculations below)

Offsite Culvert Calculations

Performance Curve for Existing 12-inch Culvert at Node 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	874.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.67	0.67	874.44	0.44	1-S2n	0.16	0.34	0.17	0.19	7.57	1.78
1.35	1.35	874.66	0.66	1-S2n	0.23	0.49	0.24	0.30	9.48	2.27
2.02	2.02	874.84	0.84	1-S2n	0.29	0.61	0.29	0.39	10.51	2.60
2.69	2.69	875.02	1.02	5-S2n	0.34	0.70	0.34	0.47	11.39	2.84
3.37	3.37	875.23	1.23	5-S2n	0.38	0.78	0.42	0.55	10.80	3.05
4.04	4.04	875.48	1.48	5-S2n	0.42	0.84	0.47	0.63	11.18	3.21
4.71	4.71	875.78	1.78	5-S2n	0.46	0.90	0.52	0.70	11.52	3.36
5.38	5.38	876.14	2.14	5-S2n	0.50	0.96	0.56	0.77	12.00	3.49
6.06	6.06	876.54	2.54	6-FFc	0.54	1.00	1.00	0.84	7.71	3.60
6.73	6.73	876.98	2.98	6-FFc	0.57	1.00	1.00	0.91	8.57	3.70

Performance Curve for Existing 12-inch Culvert at Node 2 & 3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	872.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
0.81	0.81	872.48	0.48	1-S2n	0.18	0.37	0.18	0.21	8.12	1.90
1.62	1.62	872.73	0.73	1-S2n	0.26	0.54	0.26	0.34	9.76	2.42
2.43	2.43	872.95	0.95	1-S2n	0.32	0.67	0.32	0.44	11.08	2.76
3.24	3.24	873.18	1.18	5-S2n	0.37	0.77	0.38	0.54	11.82	3.01
4.05	4.05	873.48	1.48	5-S2n	0.42	0.85	0.47	0.63	11.18	3.22
4.86	4.86	873.86	1.86	5-S2n	0.47	0.91	0.53	0.72	11.59	3.39
5.67	5.67	874.30	2.30	5-S2n	0.52	0.98	0.52	0.80	13.89	3.54
6.48	6.48	874.81	2.81	6-FFc	0.56	1.00	1.00	0.88	8.25	3.66
7.29	7.29	875.42	3.42	6-FFc	0.60	1.00	1.00	0.97	9.28	3.78
8.10	8.00	876.01	4.01	4-FFf	0.64	1.00	0.72	1.04	13.13	3.88

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with the current standards.

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

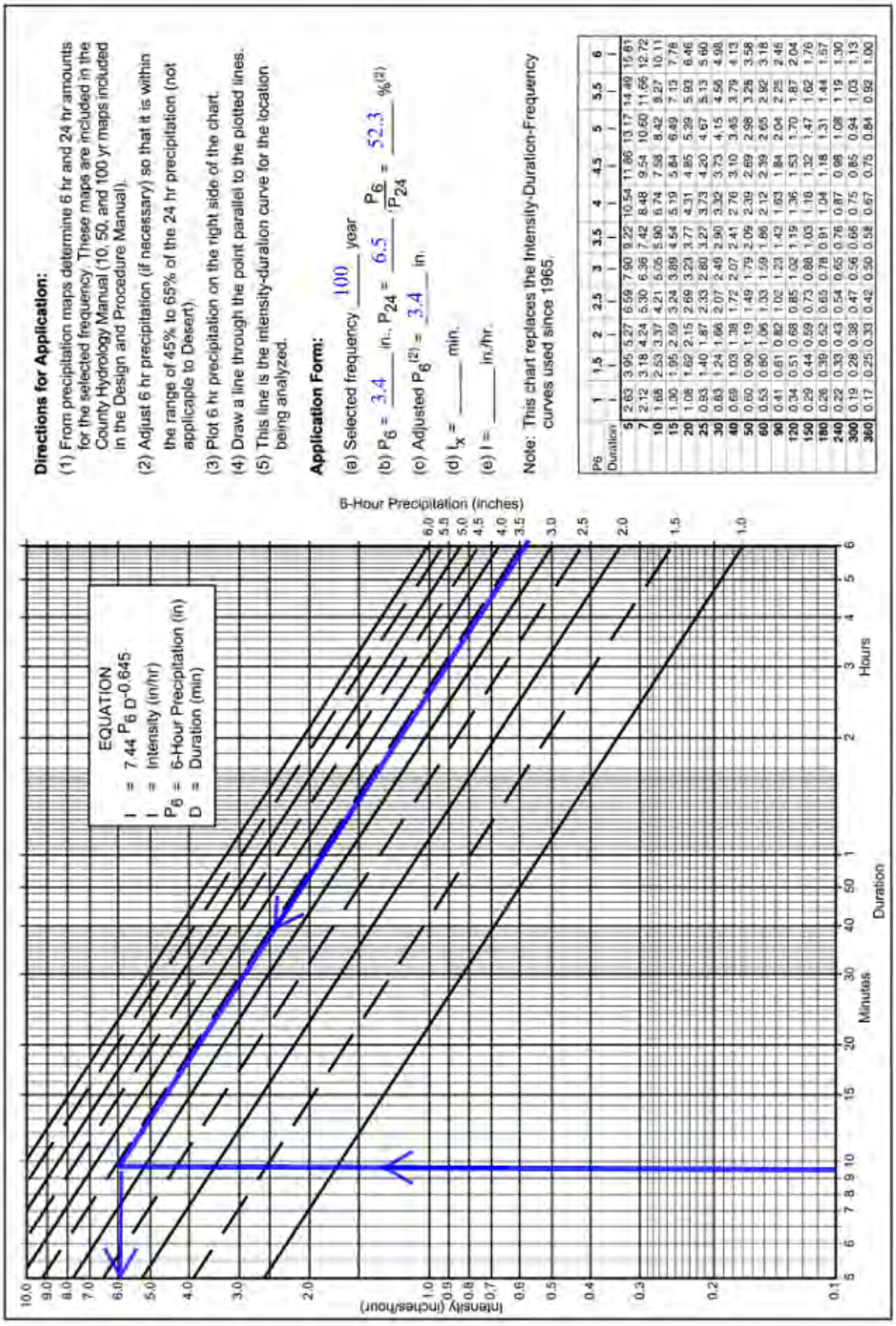
Name: M.H. Shapouri

Address: 18029 Calle Ambiente Suite 502, Rancho Santa Fe, CA 92067

Telephone No: (858) 756-8340

By: _____ Date: 02-06-2014
M.H. Shapouri

R.C.E. No: C52794 Expires: 12/31/2014



P6 Duration	1 I	1.5 I	2 I	2.5 I	3 I	3.5 I	4 I	4.5 I	5 I	5.5 I	6 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	1.00	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	2.46
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

FIGURE 3-1

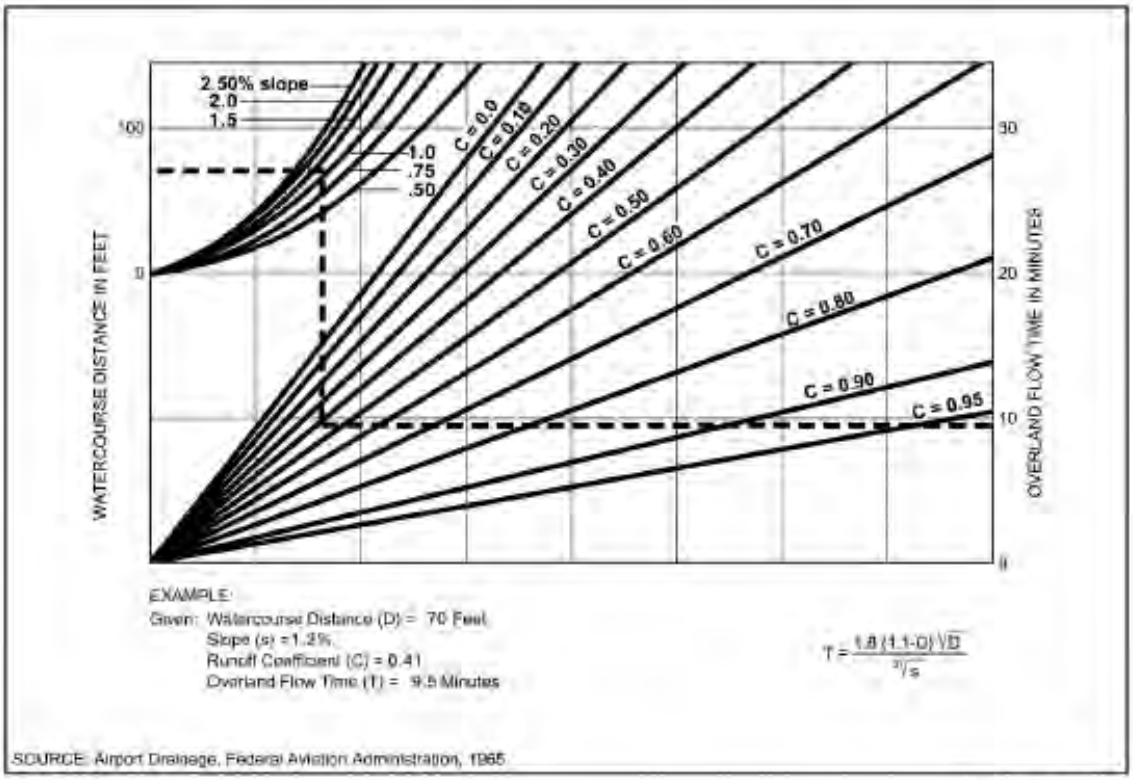


FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

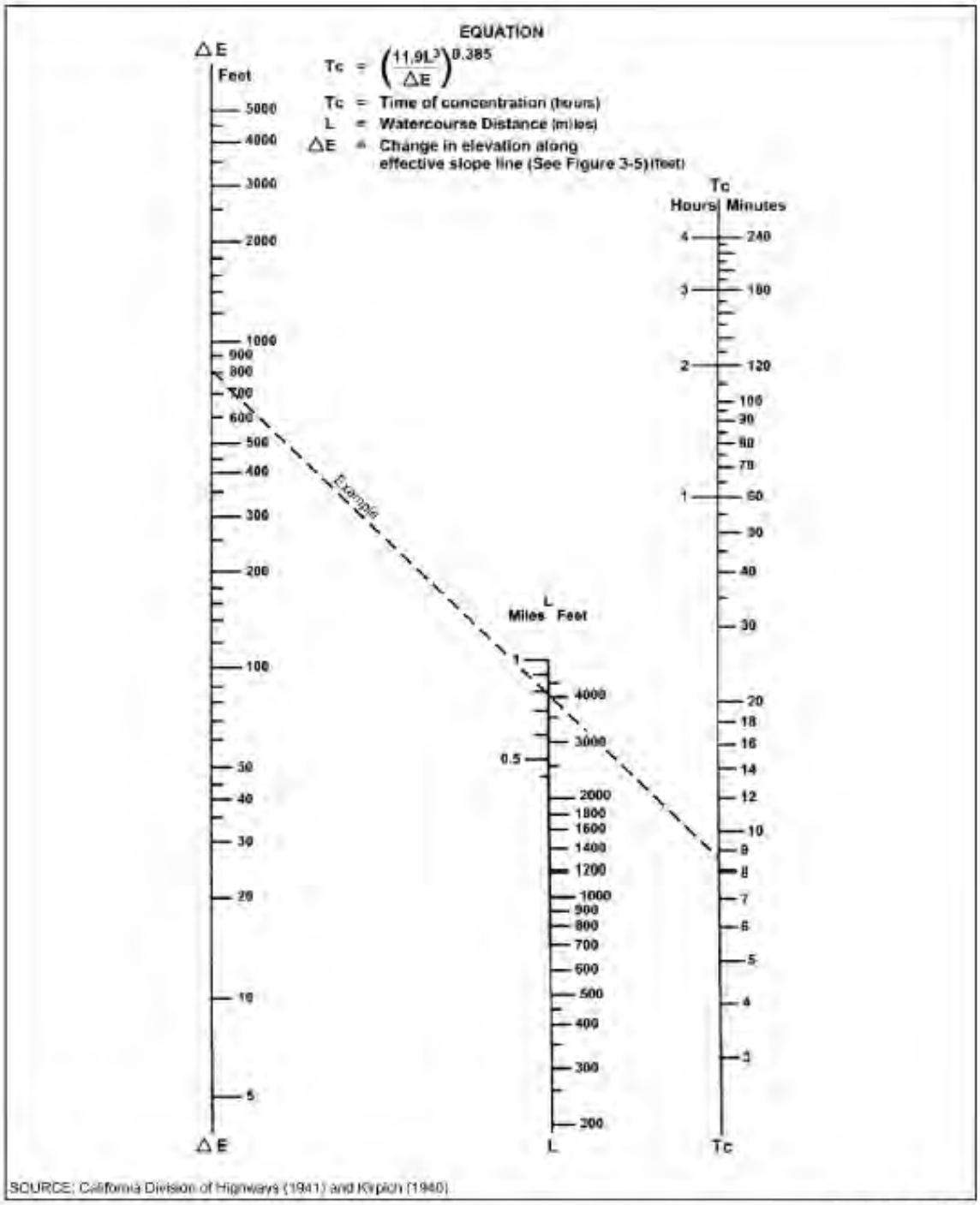
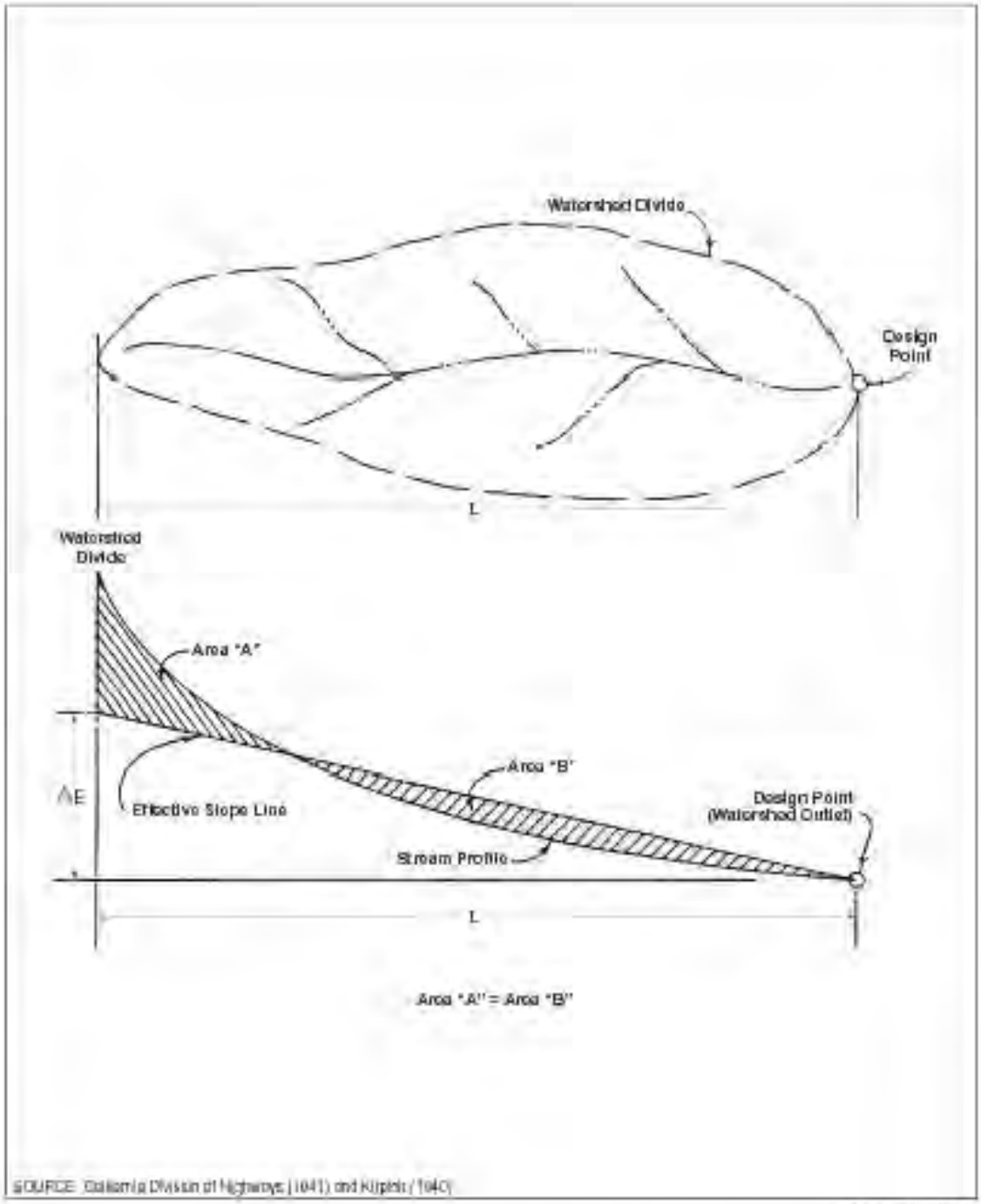


FIGURE 3-4

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



FIGURE

Computation of Effective Slope for Natural Watersheds

3-5

Shapouri & Associates
18029 Calle Ambiente, Suite 501-502
Rancho Santa Fe, California 92067

Appendix, Calculations

ORCHARD HILLS
PRE-DEVELOPMENT HYDROLOGY MAP

LEGEND

- EXISTING CONTOURS
- PROJECT BOUNDARY
- BASIN AREAS (DMA)
- EXISTING ROADS
- NODE 22 / 873' — NODE ELEVATION
- SURFACE FLOW
- EXISTING DITCH
- EXISTING STORM DRAIN SYSTEM
- EXISTING SWALE

NODE 3
880'

EXISTING
12-INCH CULVERT
OFFSITE Q_{100}= 8.1 CFS

CENTERLINE OF 50' VISTA IRRIGATION DISTRICT FLUME EASEMENT. PER RECORDER'S OFFICE BOOK OF DEEDS DATED OCT. 2, 1925, IN BOOK 1127, PAGE 155-158.

NODE 2
872'

EXISTING
12-INCH CULVERT
OFFSITE Q_{100}= 8.1 CFS

LOT "X"
TR. 12615

BASIN 3
1.80 ac.

APN
218-220-17

NODE 16
875'

EXISTING
12-INCH CULVERT
OFFSITE Q_{100}= 6.7 CFS

NODE 1
874'

BASIN 2
1.83 ac.

GENERAL PLAN- 1 RES.
ZONING - A70
LAND USE- VACANT

BASIN 1
4.44 ac.

NODE 4
873'

CENTERLINE OF 50' VISTA IRRIGATION DISTRICT FLUME EASEMENT. PER RECORDER'S OFFICE BOOK OF DEEDS DATED OCT. 2, 1925, IN BOOK 1127, PAGE 155-158.

BASIN 6
1.72 ac.

NODE 6
795'

BASIN 5
1.21 ac.

BASIN 4
3.36 ac.

APN
218-220-10

EX. 24" TYPE "B" DITCH
PER CG 4196

EX. 36" TYPE "B" DITCH
PER CG 4196

EX. 42" TYPE "B" DITCH
PER CG 4196

NODE 18
783'

EX. 30" RCP
PER CG 4071

EX. 12± WIDE
GRASS SWALE

EX. TYPE "F" INLET
PER CG 4071

EX. 42" RCP PER
CG 4071

NODE 5
870'

PAR.1
PM 3973

RICHLAND ROAD
(PUBLIC)

RICHLAND ROAD
(PUBLIC)

RICHLAND ROAD
(PUBLIC)

NODE 28
773.9'

DESIGN POINT 1
Q_{100}=51.56 cfs

EX. TYPE "F" INLET
PER CG 4071
Q_{100}=21.96 cfs

BASIN 7
0.61 ac.

TIDEWAY ROAD
(PUBLIC)

LAND USE- SINGLE FAMILY RESIDENTIAL
CITY OF SAN MARCOS
TR. 14397

REGISTERED PROFESSIONAL ENGINEER
M.H. SHAPOURI
C 52794
EXP. 12-31-2014
CIVIL
STATE OF CALIFORNIA

SCALE : 1:50
0 25 50 100 150

JOB NO.
DRAWN:
SUBMITTALS:
REVISIONS:
1

SUBDIVISION TENTATIVE
MAP OF APN 218-220-10 & 17
COUNTY OF SAN DIEGO, CA.
92069

PRE-DEVELOPMENT HYDROLOGY MAP
ORCHARD HILLS
RESIDENTIAL DEVELOPMENT

SHAPOURI & ASSOCIATES
ENGINEERING PROJECT MANAGEMENT SERVICES
ARCHITECTURE PLANNING
CIELO VILLAGE, 1929 CALLE AMBIENTE, SUITE 502
P.O. BOX 878221, RANCHO SANTA FE, CALIF. 92067
PHONE (858) 756-8118 FAX (858) 756-8414

PRE-DEVELOPMENT HYDROLOGY MAP

SHEET TITLE: TM 5570
NO. 1 of 1
DATE PRINTED: 11-29-2013

ORCHARD HILLS
POST-DEVELOPMENT HYDROLOGY MAP

LEGEND

- EXISTING CONTOURS
- FINISHED CONTOURS
- PROJECT BOUNDARY
- BASIN AREAS
- EXISTING ROADS
- NODE ELEVATION (NODE 22 / 873')
- PROPOSED BIORETENTION
- PROPOSED ROADS
- SURFACE FLOW
- EXISTING DITCH
- EXISTING STORM DRAIN SYSTEM
- EXISTING SWALE
- PROPOSED ROOFTOP
- PROPOSED CONCRETE DITCH
- PROPOSED CURB INLET
- PROPOSED CLEANOUT
- PROPOSED STORM DRAIN PIPE
- PROPOSED CATCH BASIN
- PROPOSED UNDER SIDEWALK CURB CUT
- PROPOSED KEYSTONE RETAINING WALL
- PROPOSED EASEMENT LINE

NODE 1 874' | NODE 2 872' | NODE 3 880' | NODE 7 838' | NODE 8 INV. 805.07' | NODE 9 INV. 806.14' | NODE 10 817' | NODE 11 866' | NODE 12 817' | NODE 13 872' | NODE 14 821' | NODE 15 821' | NODE 17 786.0' | NODE 18 771.7' | NODE 19 785' | NODE 20 810' | NODE 21 803.5' | NODE 21.1 813' | NODE 21.2 788' | NODE 22 873' | NODE 23 845' | NODE 24 825' | NODE 25 845' | NODE 26 870' | NODE 27 785.5' | NODE 28 773.9' | NODE 29 875' | NODE 4 813' INV. 806.0' | NODE 5 813' | NODE 6 813' INV. 807.95' | NODE 26.1 814'

BASIN 1 2.31 ac. | BASIN 2 2.16 ac. | BASIN 3 3.55 ac. | BASIN 4 1.07 ac. | BASIN 5 0.64 ac. | BASIN 5 0.11 ac. | BASIN 6 0.08 ac. | BASIN 6 0.64 ac. | BASIN 7 0.51 ac. | BASIN 8 2.19 ac. | BASIN 9 0.26 ac. | BASIN 10 0.16 ac. | BASIN 11 0.20 ac. | BASIN 12 0.34 ac. | BASIN 13 0.27 ac. | BASIN 14 0.09 ac. | BASIN 15 0.38 ac.

EXISTING 12-INCH CULVERT OFFSITE Q_{100}= 6.7 CFS

EXISTING 12-INCH CULVERT OFFSITE Q_{100}= 8.1 CFS

EXISTING 12-INCH CULVERT OFFSITE Q_{100}= 8.1 CFS

36" CONCRETE DITCH TYPE "B" PER SDRSD D-75 Q_{100}=11.22 cfs

24" CONCRETE DITCH TYPE "B" PER SDRSD D-75 Q_{100}=10.29 cfs

24" CONCRETE DITCH TYPE "B" PER SDRSD D-75

24" CONCRETE DITCH TYPE "B" PER SDRSD D-75 Q_{100}=7.19 cfs

36" CONCRETE DITCH TYPE "B" PER SDRSD D-75

36" CONCRETE DITCH TYPE "B" PER SDRSD D-75 Q_{100}=21.22 cfs

CENTERLINE OF 50' VISTA IRRIGATION DISTRICT FLUME EASEMENT, PER RECORDER'S OFFICE BOOK OF DEEDS DATED OCT. 2, 1925, IN BOOK 1127, PAGE 155-158.

CURB INLET TYPE "B" PER SDRSD D-2 W/ CURB INLET INSERTS (TRASH RACKS)

30" RCP Q_{100}=26.35 cfs L=95.59'

24" RCP Q_{100}=9.07 cfs

STORM DRAIN CLEANOUT TYPE "A" PER SDRSD D-9

STORM DRAIN CLEANOUT TYPE "A" PER SDRSD D-9

STREET "A"

STREET "B"

18" RCP Q_{100}=9.86 cfs

30" RCP Q_{100}=25.85 cfs L=126.46'

24" RCP Q_{100}=10.92 cfs

30" RCP Q_{100}=26.99 cfs

24" RCP Q_{100}=6.63 cfs

24" RCP Q_{100}=11.87 cfs L=188.34'

CURB INLET TYPE "B" PER SDRSD D-2 W/ CURB INLET INSERTS (TRASH RACKS)

10' WIDE PRIVATE DRAINAGE EASEMENT FOR OVER FLOW PROTECTION

±32' WIDE BIORETENTION Q_{100}= 37.17 cfs

No. 2 BACKING ROCK RIP RAP CHANNEL

BIORETENTION Q_{100}=39.17 cfs Q_{1000}=29.01 cfs Area= 15,400 sq.ft.

MOD. TYPE "F" CATCH BASIN PER SDRSD D-7, WITH 3 OPENINGS

30" RCP Q_{100}=42.74 cfs

EX. 30" RCP TO REMAIN Q_{100}=42.74 cfs

EX. 12'± WIDE GRASS SWALE

EX. TYPE "F" INLET PER CG 4071 TO REMAIN

EX. 42" RCP PER CG 4071 TO REMAIN Q_{100}=46.44 cfs

30" RCP Q_{100}=42.74 cfs

STORM DRAIN CLEANOUT TYPE "A" PER SDRSD D-9 TO BE CONECTED TO EX. 30" RCP

WING TYPE HEADWALL PER SDRSD D-34 No. 2 BACKING ROCK RIP RAP ENERGY DISSIPATOR PER SDRSD D-40 Q_{100}=26.99 cfs

EX. 42" DITCH TO BE REMOVED

EX. 42" DITCH TO BE REMOVED

EX. 24" DITCH TO BE REMOVED

UNDER SIDEWALK CURB CUT Q_{100}=3.94 cfs

UNDER SIDEWALK CURB CUT Q_{100}=2.96 cfs

PROPOSED PRIVATE DRAINAGE EASEMENT

EX. TYPE "F" INLET TO BE REMOVED

REMOVE PORTION OF 30" RCP

DESIGN POINT 1 Q_{100}=46.44 cfs

RUNOFF DRAINS TO THE NORTH

WING TYPE HEADWALL PER SDRSD D-34

TIDE WAY ROAD (PUBLIC)

RICHLAND ROAD (PUBLIC)

RICHLAND ROAD (PUBLIC)

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

EX. DITCH

2:1 SLOPE

3:1 SLOPE

APN 218-220-17

APN 218-220-10

LOT "X" TR. 12815

GENERAL PLAN- 1 RES. ZONING - A70 LAND USE- VACANT

PAR.1 PM 3973

LAND USE- SINGLE FAMILY RESIDENTIAL CITY OF SAN MARCOS TR. 14397

950 940 930 920 910 900 890 880 870 860 850 840 830 820

REGISTERED PROFESSIONAL ENGINEER MATT SHAPOURI C 52794 EXP.12-31-2014 CIVIL STATE OF CALIFORNIA

SCALE : 1:50

0 25 50 100 150

JOB NO.
DRAWN:
SUBMITTALS:

REVISIONS:
1

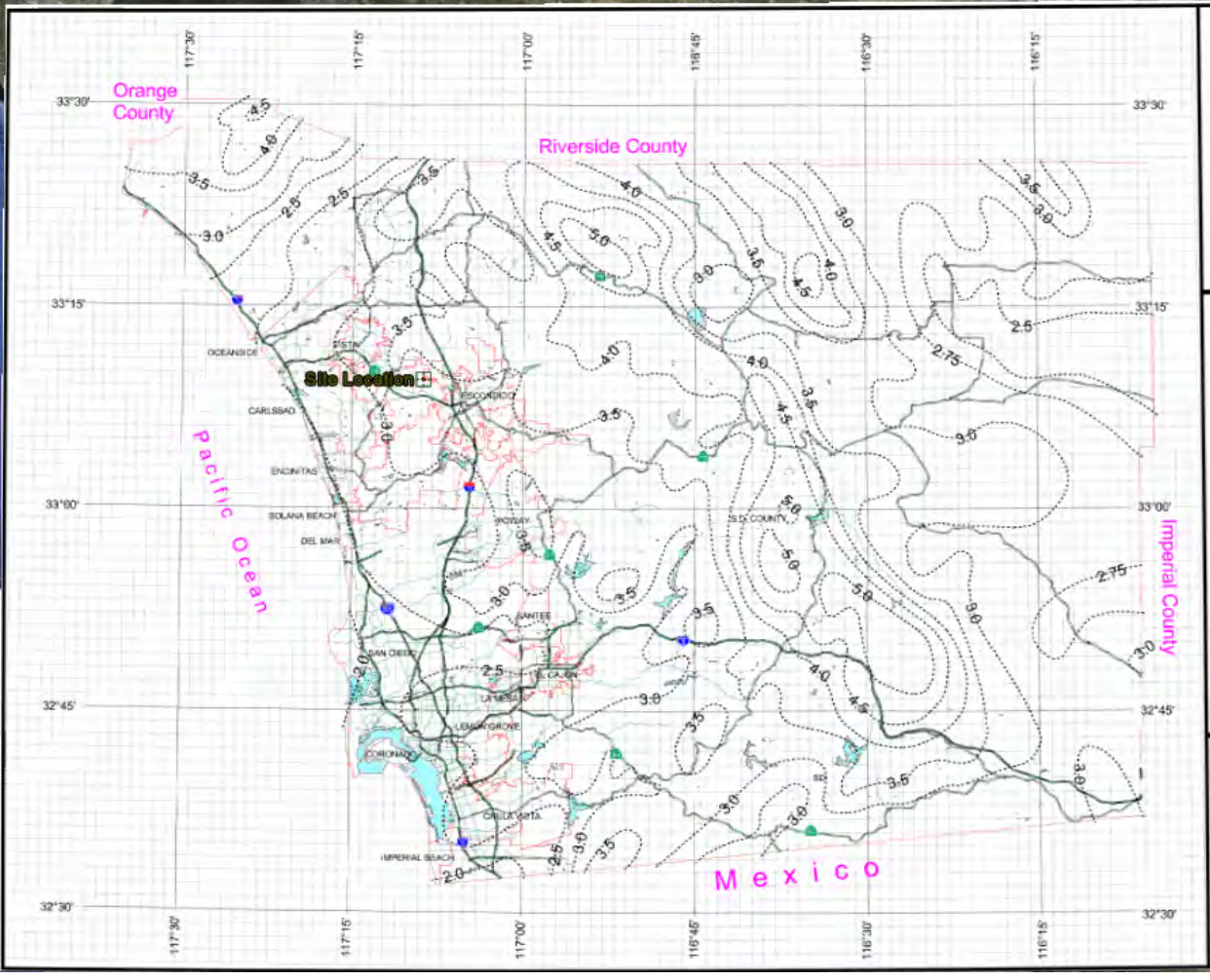
SUBDIVISION TENTATIVE
MAP OF APN 218-220-10 & 17
COUNTY OF SAN DIEGO, CA.
92069

POST-DEVELOPMENT HYDROLOGY MAP
ORCHARD HILLS
RESIDENTIAL DEVELOPMENT

SHAPOURI & ASSOCIATES
CIVIL ENGINEERING · PROJECT MANAGEMENT SERVICES · PLANNING
ARCHITECTURE
2121 PALOMAR AIRPORT RD. SUITE 302
CARLSBAD, CALIFORNIA 92011
PHONE: (858)756-8340 FAX: (858)756-8344

POST-DEVELOPMENT HYDROLOGY MAP

SHEET TITLE: TM 5570 NO. 1 of 1
DATE PRINTED: 02-04-2014



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Lat. = 33Deg. 9' 46.5"N
Lon. = 117Deg. 8' 36.5"W

P6 = 3.4 in./hr.

DPW GIS

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

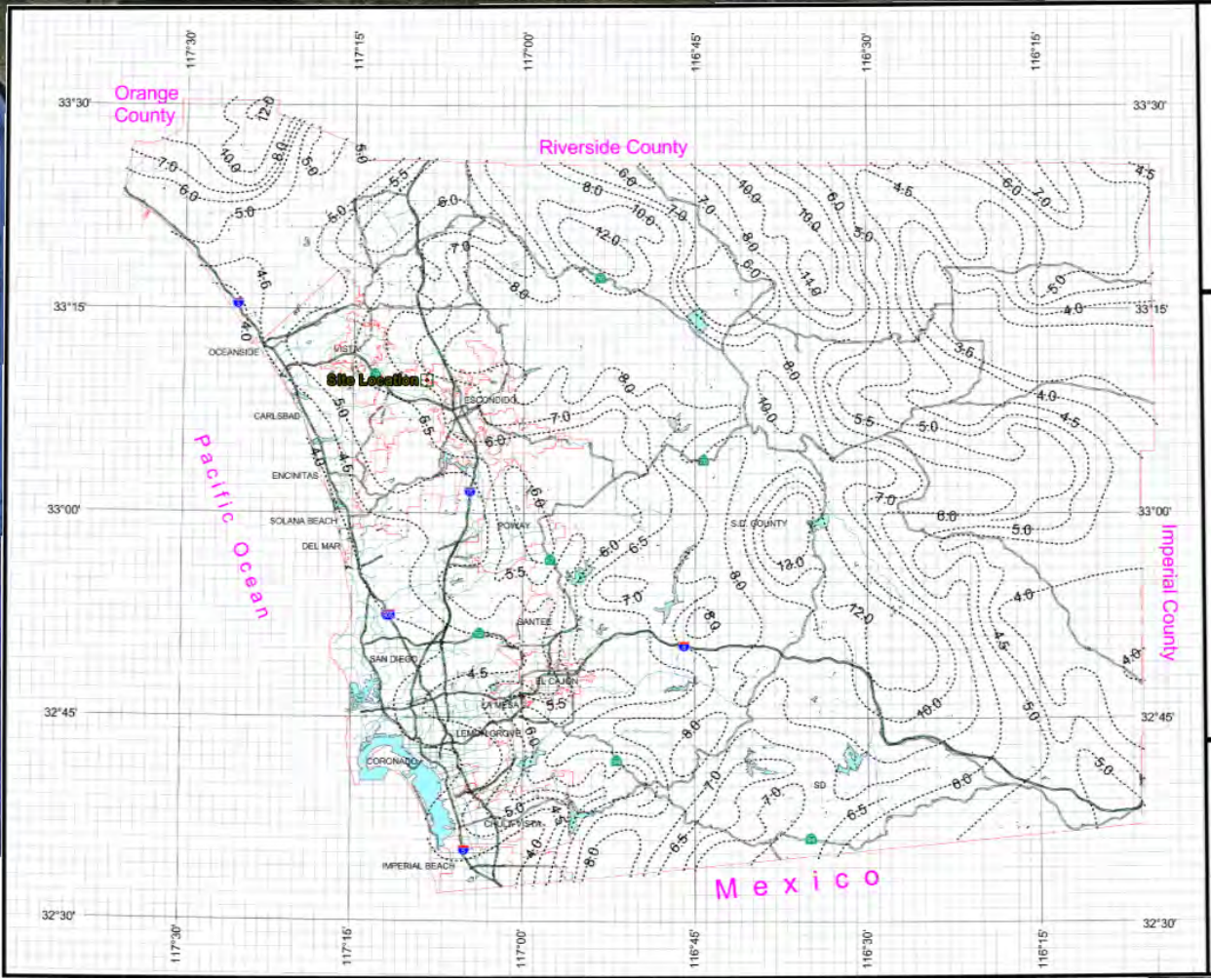
Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Lat. = 33Deg. 9' 46.5"N
Lon. = 117Deg. 8' 36.5"W

P24 = 6.5 in./hr.



DPW GIS — Department of Public Works

SanGIS — We Have San Diego Covered!

N W E S

3 0 3 Miles

PRE-DEVELOPMENT HYDROLOGY REPORT (100-YEAR STORM EVENT)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 03/12/13

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

Program License Serial Number 6052

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.400
24 hour precipitation(inches) = 6.500
P6/P24 = 52.3%
San Diego hydrology manual 'C' values used

ORCHARD HILLS PRE-DEVELOPMENT 100-YEAR STORM EVENT

++
Process from Point/Station 4.000 to Point/Station 18.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.200
Decimal fraction soil group D = 0.800
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.340
Initial subarea total flow distance = 800.000(Ft.)
Highest elevation = 873.000(Ft.)
Lowest elevation = 783.000(Ft.)
Elevation difference = 90.000(Ft.) Slope = 11.250 %
Top of Initial Area Slope adjusted by User to 11.125 %
Bottom of Initial Area Slope adjusted by User to 11.125 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 11.13 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 6.13 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3400)*(100.000^.5)/(11.125^(1/3)]= 6.13

The initial area total distance of 800.00 (Ft.) entered leaves a
remaining distance of 700.00 (Ft.)
Using Figure 3-4, the travel time for this distance is 2.82 minutes
for a distance of 700.00 (Ft.) and a slope of 11.13 %
with an elevation difference of 77.88(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
= 2.822 Minutes
Tt=[(11.9*0.1326^3)/(77.88)]^.385= 2.82
Total initial area Ti = 6.13 minutes from Figure 3-3 formula plus
2.82 minutes from the Figure 3-4 formula = 8.95 minutes
Rainfall intensity (I) = 6.154(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.340
Subarea runoff = 7.030(CFS)
Total initial stream area = 3.360(Ac.)

++
Process from Point/Station 4.000 to Point/Station 18.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 3.360(Ac.)
Runoff from this stream = 7.030(CFS)
Time of concentration = 8.95 min.
Rainfall intensity = 6.154(In/Hr)

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

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 8.96(In/Hr)
Total area = 2.470(Ac.) Total runoff = 6.700(CFS)

++
Process from Point/Station 1.000 to Point/Station 18.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 874.000(Ft.)
Downstream point elevation = 783.000(Ft.)
Channel length thru subarea = 820.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 11.730(CFS)
Manning's 'N' = 0.030

```
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     11.730(CFS)
Depth of flow =   0.702(Ft.), Average velocity =   7.929(Ft/s)
Channel flow top width =    4.213(Ft.)
Flow Velocity =    7.93(Ft/s)
Travel time  =    1.72 min.
Time of concentration =    6.72 min.
Critical depth =      0.992(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.180
Decimal fraction soil group D = 0.820
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.341
Rainfall intensity =      7.400(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.326  CA =      2.255
Subarea runoff =      9.988(CFS) for      4.440(Ac.)
Total runoff =     16.688(CFS)    Total area =       6.910(Ac.)
Depth of flow =   0.801(Ft.), Average velocity =   8.660(Ft/s)
Critical depth =      1.141(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station       18.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      6.910(Ac.)
Runoff from this stream =     16.688(CFS)
Time of concentration =    6.72 min.
Rainfall intensity =     7.400(In/Hr)
Summary of stream data:

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


1        7.030      8.95           6.154
2       16.688      6.72           7.400
Qmax(1) =
           1.000 *    1.000 *     7.030) +
           0.832 *    1.000 *    16.688) + =      20.907
Qmax(2) =
           1.000 *    0.751 *     7.030) +
           1.000 *    1.000 *    16.688) + =      21.969

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.030      16.688
Maximum flow rates at confluence using above data:
       20.907       21.969
Area of streams before confluence:
        3.360        6.910
Results of confluence:
Total flow rate =     21.969(CFS)
Time of concentration =     6.724 min.
Effective stream area after confluence =     10.270(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       28.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   772.710(Ft.)
Downstream point/station elevation =   765.160(Ft.)
Pipe length  =   215.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.969(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    21.969(CFS)
Normal flow depth in pipe =   10.98(In.)
Flow top width inside pipe =   28.90(In.)
Critical Depth =   19.13(In.)
Pipe flow velocity =     13.49(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =     6.99 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       28.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     10.270(Ac.)
Runoff from this stream =     21.969(CFS)
Time of concentration =    6.99 min.
Rainfall intensity =     7.217(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       8.96(In/Hr)
Total area =        3.000(Ac.)  Total runoff =     8.100(CFS)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   872.000(Ft.)
Downstream point elevation =   795.000(Ft.)
Channel length thru subarea  =   535.000(Ft.)
Channel base width        =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      9.805(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      9.805(CFS)
Depth of flow =   0.625(Ft.), Average velocity =   8.358(Ft/s)
Channel flow top width =    3.752(Ft.)
Flow Velocity =    8.36(Ft/s)
Travel time  =    1.07 min.
Time of concentration =    6.07 min.
Critical depth =      0.922(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity =      7.908(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      1.449
Subarea runoff =      3.358(CFS) for      1.830(Ac.)
Total runoff =     11.458(CFS)    Total area =       4.830(Ac.)
Depth of flow =   0.663(Ft.), Average velocity =   8.690(Ft/s)
Critical depth =      0.984(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      4.830(Ac.)
Runoff from this stream =     11.458(CFS)
Time of concentration =    6.07 min.
Rainfall intensity =     7.908(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       8.96(In/Hr)
Total area =        3.000(Ac.)  Total runoff =     8.100(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        6.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   872.000(Ft.)
Downstream point elevation =   795.000(Ft.)
Channel length thru subarea  =   540.000(Ft.)
Channel base width        =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      9.761(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      9.761(CFS)
Depth of flow =   0.625(Ft.), Average velocity =   8.319(Ft/s)
Channel flow top width =    3.752(Ft.)
Flow Velocity =    8.32(Ft/s)
Travel time  =    1.08 min.
Time of concentration =    6.08 min.
Critical depth =      0.922(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity =      7.895(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      1.440
Subarea runoff =      3.269(CFS) for      1.800(Ac.)
Total runoff =     11.369(CFS)    Total area =       4.800(Ac.)
Depth of flow =   0.662(Ft.), Average velocity =   8.643(Ft/s)
Critical depth =      0.977(Ft.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        6.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      4.800(Ac.)
Runoff from this stream =     11.369(CFS)
Time of concentration =    6.08 min.
Rainfall intensity =     7.895(In/Hr)
Summary of stream data:

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


1       11.458      6.07           7.908
2       11.369      6.08           7.895
Qmax(1) =
           1.000 *    1.000 *    11.458) +
           1.000 *    0.998 *    11.369) + =      22.799
Qmax(2) =
           0.998 *    1.000 *    11.458) +
           1.000 *    1.000 *    11.369) + =      22.809

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.458      11.369
Maximum flow rates at confluence using above data:
       22.799       22.809
Area of streams before confluence:
        4.830        4.800
Results of confluence:
Total flow rate =     22.809(CFS)
Time of concentration =     6.082 min.
Effective stream area after confluence =      9.630(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station       28.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =   795.000(Ft.)
Downstream point elevation =   773.900(Ft.)
Channel length thru subarea  =   370.000(Ft.)
Channel base width        =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     23.246(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     23.246(CFS)
Depth of flow =   1.028(Ft.), Average velocity =   7.329(Ft/s)
Channel flow top width =    6.169(Ft.)
Flow Velocity =    7.33(Ft/s)
Travel time  =    0.84 min.
Time of concentration =    6.92 min.
Critical depth =      1.297(Ft.)

 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity =      7.262(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.300  CA =      3.252
Subarea runoff =      0.807(CFS) for      1.210(Ac.)
Total runoff =     23.616(CFS)    Total area =      10.840(Ac.)
Depth of flow =   1.034(Ft.), Average velocity =   7.358(Ft/s)
Critical depth =      1.313(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station       28.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =     10.840(Ac.)
Runoff from this stream =     23.616(CFS)
Time of concentration =    6.92 min.
Rainfall intensity =     7.262(In/Hr)
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       28.000
**** 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  =  650.000(Ft.)
Highest elevation =  875.000(Ft.)
Lowest elevation =  773.900(Ft.)
Elevation difference =  101.100(Ft.) Slope = 15.554 %
Top of Initial Area Slope adjusted by User to 15.000 %
Bottom of Initial Area Slope adjusted by User to 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  15.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.84 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  15.000^(1/3)]=   5.84
```

```
The initial area total distance of  650.00 (Ft.) entered leaves a
remaining distance of  550.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.09 minutes
for a distance of 550.00 (Ft.) and a slope of 15.00 %
with an elevation difference of  82.50(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.089 Minutes
Tt=[(11.9*0.1042^3)/( 82.50)]^.385=  2.09
Total initial area Ti =   5.84 minutes from Figure 3-3 formula plus
  2.09 minutes from the Figure 3-4 formula =   7.93 minutes
Rainfall intensity (I) =      6.654(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      3.434(CFS)
Total initial stream area =        1.720(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       28.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.720(Ac.)
Runoff from this stream =      3.434(CFS)
Time of concentration =    7.93 min.
Rainfall intensity =     6.654(In/Hr)
Program is now starting with Main Stream No. 4


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       28.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.200
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  = 1470.000(Ft.)
Highest elevation =  870.000(Ft.)
Lowest elevation =  773.900(Ft.)
Elevation difference =   96.100(Ft.) Slope =  6.537 %
Top of Initial Area Slope adjusted by User to  6.500 %
Bottom of Initial Area Slope adjusted by User to  6.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   6.50 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.10 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   6.500^(1/3)]=   2.10
The initial area total distance of 1470.00 (Ft.) entered leaves a
remaining distance of 1380.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   5.85 minutes
for a distance of 1380.00 (Ft.) and a slope of  6.50 %
with an elevation difference of  89.70(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    5.852 Minutes
Tt=[(11.9*0.2614^3)/( 89.70)]^.385=  5.85
Total initial area Ti =   2.10 minutes from Figure 3-3 formula plus
  5.85 minutes from the Figure 3-4 formula =   7.96 minutes
Rainfall intensity (I) =      6.639(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      3.523(CFS)
Total initial stream area =        0.610(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       28.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 4
Stream flow area =      0.610(Ac.)
Runoff from this stream =      3.523(CFS)
Time of concentration =    7.96 min.
Rainfall intensity =     6.639(In/Hr)
Summary of stream data:

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


1       21.969      6.99           7.217
2       23.616      6.92           7.262
3        3.434      7.93           6.654
4        3.523      7.96           6.639
Qmax(1) =
           1.000 *    1.000 *    21.969) +
           0.994 *    1.000 *    23.616) +
           1.000 *    0.882 *     3.434) +
           1.000 *    0.878 *     3.523) + =      51.562
Qmax(2) =
           1.000 *    0.990 *    21.969) +
           1.000 *    1.000 *    23.616) +
           1.000 *    0.873 *     3.434) +
           1.000 *    0.870 *     3.523) + =      51.440
Qmax(3) =
           0.922 *    1.000 *    21.969) +
           0.916 *    1.000 *    23.616) +
           1.000 *    1.000 *     3.434) +
           1.000 *    0.996 *     3.523) + =      48.840
Qmax(4) =
           0.920 *    1.000 *    21.969) +
           0.914 *    1.000 *    23.616) +
           0.998 *    1.000 *     3.434) +
           1.000 *    1.000 *     3.523) + =      48.745

Total of 4 main streams to confluence:
Flow rates before confluence point:
```

```
      21.969      23.616       3.434       3.523
Maximum flow rates at confluence using above data:
       51.562       51.440       48.840       48.745
Area of streams before confluence:
       10.270       10.840        1.720        0.610


Results of confluence:
Total flow rate =     51.562(CFS)
Time of concentration =     6.990 min.
Effective stream area after confluence  =     23.440(Ac.)
End of computations, total study area =         23.440 (Ac.)
```

POST-DEVELOPMENT HYDROLOGY REPORT

(100-YEAR STORM EVENT)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
        Rational Hydrology Study   Date: 02/04/14

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

 Program License Serial Number 6052

ORCHARD HILLS POST-DEVELOPMENT 100-YEAR STORM EVENT – TO BIORETENTION 1 (BMP 1)

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.400
24 hour precipitation(inches) = 6.500
P6/P24 =   52.3%
San Diego hydrology manual 'C' values used

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

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN   ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity (I) =   8.958(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min. Rain intensity =   8.96(In/Hr)
Total area =   2.470(Ac.) Total runoff =   6.700(CFS)

++
Process from Point/Station   1.000 to Point/Station   20.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel =   7.186(CFS)
Depth of flow =   0.518(Ft.), Average velocity = 11.659(Ft/s)
        ******* Irregular Channel Data ***********

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	1.00
2	0.08	0.62
3	0.29	0.29
4	0.62	0.08
5	1.00	0.00
6	1.38	0.08
7	1.71	0.29
8	1.92	0.62
9	2.00	1.00

Manning's 'N' friction factor =   0.013

Sub-Channel flow =   7.186(CFS)
  '   '   flow top width =   1.710(Ft.)
  '   '   velocity=   11.659(Ft/s)
  '   '   area =   0.616(Sq.Ft)
  '   '   Froude number =   3.423

Upstream point elevation =   874.000(Ft.)
Downstream point elevation =   810.000(Ft.)
Flow length = 1200.000(Ft.)
Travel time =   1.72 min.
Time of concentration =   6.72 min.
Depth of flow =   0.518(Ft.)
Average velocity = 11.659(Ft/s)
Total irregular channel flow =   7.186(CFS)
Irregular channel normal depth above invert elev. =   0.518(Ft.)
Average velocity of channel(s) = 11.659(Ft/s)
 Adding area flow to channel
User specified 'C' value of 0.290 given for subarea
Rainfall intensity =   7.406(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.290 CA =   1.027
Subarea runoff =   0.903(CFS) for   1.070(Ac.)
Total runoff =   7.603(CFS)   Total area =   3.540(Ac.)
Depth of flow =   0.533(Ft.), Average velocity = 11.847(Ft/s)

++
Process from Point/Station   1.000 to Point/Station   20.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =   3.540(Ac.)
Runoff from this stream =   7.603(CFS)
Time of concentration =   6.72 min.
Rainfall intensity =   7.406(In/Hr)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       26.000 to Point/Station       26.100
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  720.000(Ft.)
Highest elevation =  870.000(Ft.)
Lowest elevation =  814.000(Ft.)
Elevation difference =   56.000(Ft.) Slope =  7.778 %
Top of Initial Area Slope adjusted by User to  7.700 %
Bottom of Initial Area Slope adjusted by User to  7.700 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   7.70 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.10 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*( 100.000^.5)/(   7.700^(1/3)]=   2.10
The initial area total distance of  720.00 (Ft.) entered leaves a
remaining distance of  620.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.96 minutes
for a distance of 620.00 (Ft.) and a slope of  7.70 %
with an elevation difference of  47.74(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.961 Minutes
Tt=[(11.9*0.1174^3)/( 47.74)]^.385=  2.96
Total initial area Ti =   2.10 minutes from Figure 3-3 formula plus
  2.96 minutes from the Figure 3-4 formula =   5.06 minutes
Rainfall intensity (I) =      8.892(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      3.945(CFS)
Total initial stream area =        0.510(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       26.100 to Point/Station       20.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   814.000(Ft.)
Downstream point elevation =   810.000(Ft.)
Channel length thru subarea  =    30.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.025
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =      3.945(CFS)
Depth of flow =   0.421(Ft.), Average velocity =   7.417(Ft/s)
Channel flow top width =    2.527(Ft.)
Flow Velocity =    7.42(Ft/s)
Travel time  =    0.07 min.
Time of concentration =    5.12 min.
Critical depth =      0.641(Ft.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       26.100 to Point/Station       20.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.510(Ac.)
Runoff from this stream =      3.945(CFS)
Time of concentration =    5.12 min.
Rainfall intensity =     8.817(In/Hr)
Summary of stream data:

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


1        7.603      6.72           7.406
2        3.945      5.12           8.817
Qmax(1) =
           1.000 *    1.000 *     7.603) +
           0.840 *    1.000 *     3.945) + =      10.917
Qmax(2) =
           1.000 *    0.763 *     7.603) +
           1.000 *    1.000 *     3.945) + =       9.748

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.603       3.945
Maximum flow rates at confluence using above data:
       10.917        9.748
Area of streams before confluence:
        3.540        0.510
Results of confluence:
Total flow rate =     10.917(CFS)
Time of concentration =     6.715 min.
Effective stream area after confluence =      4.050(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   810.000(Ft.)
Downstream point/station elevation =   803.500(Ft.)
Pipe length  =    69.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.917(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =    10.917(CFS)
Normal flow depth in pipe =    7.23(In.)
Flow top width inside pipe =   17.65(In.)
Critical Depth =   15.20(In.)
Pipe flow velocity =     16.43(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     6.79 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.050(Ac.)
Runoff from this stream =     10.917(CFS)
Time of concentration =    6.79 min.
Rainfall intensity =     7.356(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        6.000
**** 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
[LOW DENSITY RESIDENTIAL                    ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.450
Initial subarea total flow distance  =  480.000(Ft.)
Highest elevation =  838.000(Ft.)
Lowest elevation =  813.000(Ft.)
Elevation difference =   25.000(Ft.) Slope =  5.208 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to  3.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  30.00 %, in a development type of
 2.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.77 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*( 100.000^.5)/(  30.000^(1/3)]=   3.77
The initial area total distance of  480.00 (Ft.) entered leaves a
remaining distance of  380.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.92 minutes
for a distance of 380.00 (Ft.) and a slope of  3.00 %
with an elevation difference of  11.40(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.920 Minutes
Tt=[(11.9*0.0720^3)/( 11.40)]^.385=  2.92
Total initial area Ti =   3.77 minutes from Figure 3-3 formula plus
  2.92 minutes from the Figure 3-4 formula =   6.69 minutes
Rainfall intensity (I) =      7.428(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff =     11.866(CFS)
Total initial stream area =        3.550(Ac.)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   807.950(Ft.)
Downstream point/station elevation =   806.140(Ft.)
Pipe length  =   188.31(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.866(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    11.866(CFS)
Normal flow depth in pipe =   12.49(In.)
Flow top width inside pipe =   23.98(In.)
Critical Depth =   14.83(In.)
Pipe flow velocity =      7.18(Ft/s)
Travel time through pipe =    0.44 min.
Time of concentration (TC) =     7.12 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.550(Ac.)
Runoff from this stream =     11.866(CFS)
Time of concentration =    7.12 min.
Rainfall intensity =     7.130(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.220
Decimal fraction soil group D = 0.780
[LOW DENSITY RESIDENTIAL                    ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.481
Initial subarea total flow distance  =  470.000(Ft.)
Highest elevation =  872.000(Ft.)
Lowest elevation =  817.000(Ft.)
Elevation difference =   55.000(Ft.) Slope = 11.702 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to  6.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  30.00 %, in a development type of
 2.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.58 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4812)*( 100.000^.5)/(  30.000^(1/3)]=   3.58
The initial area total distance of  470.00 (Ft.) entered leaves a
remaining distance of  370.00 (Ft.)
```

```
Using Figure 3-4, the travel time for this distance is   2.19 minutes
for a distance of 370.00 (Ft.) and a slope of  6.00 %
with an elevation difference of  22.20(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.190 Minutes
Tt=[(11.9*0.0701^3)/( 22.20)]^.385=  2.19
Total initial area Ti =   3.58 minutes from Figure 3-3 formula plus
  2.19 minutes from the Figure 3-4 formula =   5.78 minutes
Rainfall intensity (I) =      8.163(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.481
Subarea runoff =      9.074(CFS)
Total initial stream area =        2.310(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station        9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   809.620(Ft.)
Downstream point/station elevation =   806.140(Ft.)
Pipe length  =    26.33(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.074(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =     9.074(CFS)
Normal flow depth in pipe =    5.38(In.)
Flow top width inside pipe =   20.02(In.)
Critical Depth =   12.91(In.)
Pipe flow velocity =     17.23(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     5.80 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.310(Ac.)
Runoff from this stream =      9.074(CFS)
Time of concentration =    5.80 min.
Rainfall intensity =     8.140(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 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 = 0.820
Decimal fraction soil group D = 0.180
[LOW DENSITY RESIDENTIAL                    ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.457
Initial subarea total flow distance  =  780.000(Ft.)
Highest elevation =  866.000(Ft.)
Lowest elevation =  817.000(Ft.)
Elevation difference =   49.000(Ft.) Slope =  6.282 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to  4.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  30.00 %, in a development type of
 2.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.72 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4572)*( 100.000^.5)/(  30.000^(1/3)]=   3.72
The initial area total distance of  780.00 (Ft.) entered leaves a
remaining distance of  680.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   4.09 minutes
for a distance of 680.00 (Ft.) and a slope of  4.00 %
with an elevation difference of  27.20(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    4.091 Minutes
Tt=[(11.9*0.1288^3)/( 27.20)]^.385=  4.09
Total initial area Ti =   3.72 minutes from Figure 3-3 formula plus
  4.09 minutes from the Figure 3-4 formula =   7.81 minutes
Rainfall intensity (I) =      6.716(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.457
Subarea runoff =      6.633(CFS)
Total initial stream area =        2.160(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station        9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   808.000(Ft.)
Downstream point/station elevation =   806.140(Ft.)
Pipe length  =     7.66(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.633(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =     6.633(CFS)
Normal flow depth in pipe =    3.97(In.)
Flow top width inside pipe =   17.84(In.)
Critical Depth =   10.95(In.)
Pipe flow velocity =     19.48(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     7.82 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station        9.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 3
Stream flow area =      2.160(Ac.)
Runoff from this stream =      6.633(CFS)
Time of concentration =    7.82 min.
Rainfall intensity =     6.713(In/Hr)
Summary of stream data:
```

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


1       11.866      7.12           7.130
2        9.074      5.80           8.140
3        6.633      7.82           6.713
Qmax(1) =
           1.000 *    1.000 *    11.866) +
           0.876 *    1.000 *     9.074) +
           1.000 *    0.911 *     6.633) + =      25.854
Qmax(2) =
           1.000 *    0.814 *    11.866) +
           1.000 *    1.000 *     9.074) +
           1.000 *    0.742 *     6.633) + =      23.656
Qmax(3) =
           0.941 *    1.000 *    11.866) +
           0.825 *    1.000 *     9.074) +
           1.000 *    1.000 *     6.633) + =      25.286

Total of 3 streams to confluence:
Flow rates before confluence point:
      11.866       9.074       6.633
Maximum flow rates at confluence using above data:
       25.854       23.656       25.286
Area of streams before confluence:
        3.550        2.310        2.160
Results of confluence:
Total flow rate =     25.854(CFS)
Time of concentration =     7.122 min.
Effective stream area after confluence =      8.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station        8.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   806.140(Ft.)
Downstream point/station elevation =   805.070(Ft.)
Pipe length  =    95.59(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.854(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    25.854(CFS)
Normal flow depth in pipe =   16.68(In.)
Flow top width inside pipe =   29.81(In.)
Critical Depth =   20.79(In.)
Pipe flow velocity =      9.23(Ft/s)
Travel time through pipe =    0.17 min.
Time of concentration (TC) =     7.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   805.070(Ft.)
Downstream point/station elevation =   803.760(Ft.)
Pipe length  =   125.78(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.854(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    25.854(CFS)
Normal flow depth in pipe =   17.06(In.)
Flow top width inside pipe =   29.72(In.)
Critical Depth =   20.79(In.)
Pipe flow velocity =      8.97(Ft/s)
Travel time through pipe =    0.23 min.
Time of concentration (TC) =     7.53 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      8.020(Ac.)
Runoff from this stream =     25.854(CFS)
Time of concentration =    7.53 min.
Rainfall intensity =     6.880(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station        4.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.200
Decimal fraction soil group D = 0.800
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  110.000(Ft.)
Highest elevation =  821.000(Ft.)
Lowest elevation =  813.000(Ft.)
Elevation difference =    8.000(Ft.) Slope =  7.273 %
Top of Initial Area Slope adjusted by User to  7.300 %
Bottom of Initial Area Slope adjusted by User to  7.300 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   7.30 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.02 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   7.300^(1/3)]=   2.02
The initial area total distance of  110.00 (Ft.) entered leaves a
remaining distance of   20.00 (Ft.)
```

```
Using Figure 3-4, the travel time for this distance is   0.21 minutes
for a distance of  20.00 (Ft.) and a slope of  7.30 %
with an elevation difference of   1.46(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.215 Minutes
Tt=[(11.9*0.0038^3)/(  1.46)]^.385=  0.21
Total initial area Ti =   2.02 minutes from Figure 3-3 formula plus
  0.21 minutes from the Figure 3-4 formula =   2.24 minutes
Calculated TC of    2.239 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.857(CFS)
Total initial stream area =        0.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   806.000(Ft.)
Downstream point/station elevation =   803.760(Ft.)
Pipe length  =    26.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.857(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     0.857(CFS)
Normal flow depth in pipe =    2.06(In.)
Flow top width inside pipe =   11.47(In.)
Critical Depth =    4.13(In.)
Pipe flow velocity =      7.63(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     2.30 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.110(Ac.)
Runoff from this stream =      0.857(CFS)
Time of concentration =    2.30 min.
Rainfall intensity =     8.958(In/Hr)
Summary of stream data:

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


1       25.854      7.53           6.880
2        0.857      2.30           8.958
Qmax(1) =
           1.000 *    1.000 *    25.854) +
           0.768 *    1.000 *     0.857) + =      26.512
Qmax(2) =
           1.000 *    0.305 *    25.854) +
           1.000 *    1.000 *     0.857) + =       8.743

Total of 2 streams to confluence:
Flow rates before confluence point:
      25.854       0.857
Maximum flow rates at confluence using above data:
       26.512        8.743
Area of streams before confluence:
        8.020        0.110
Results of confluence:
Total flow rate =     26.512(CFS)
Time of concentration =     7.529 min.
Effective stream area after confluence =      8.130(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station        5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
________________________________________________________________________
Upstream point/station elevation =   803.760(Ft.)
Downstream point/station elevation =   803.460(Ft.)
Pipe length  =    19.67(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.512(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    26.512(CFS)
Normal flow depth in pipe =   15.41(In.)
Flow top width inside pipe =   29.99(In.)
Critical Depth =   21.07(In.)
Pipe flow velocity =     10.44(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     7.56 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station        5.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      8.130(Ac.)
Runoff from this stream =     26.512(CFS)
Time of concentration =    7.56 min.
Rainfall intensity =     6.861(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station        5.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.200
Decimal fraction soil group D = 0.800
[INDUSTRIAL area type                         ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  110.000(Ft.)
Highest elevation =  821.000(Ft.)
```

```
Lowest elevation =  813.000(Ft.)
Elevation difference =    8.000(Ft.) Slope =  7.273 %
Top of Initial Area Slope adjusted by User to  7.300 %
Bottom of Initial Area Slope adjusted by User to  7.300 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   7.30 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.02 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   7.300^(1/3)]=   2.02
The initial area total distance of  110.00 (Ft.) entered leaves a
remaining distance of   20.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.21 minutes
for a distance of  20.00 (Ft.) and a slope of  7.30 %
with an elevation difference of   1.46(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.215 Minutes
Tt=[(11.9*0.0038^3)/(  1.46)]^.385=  0.21
Total initial area Ti =   2.02 minutes from Figure 3-3 formula plus
  0.21 minutes from the Figure 3-4 formula =   2.24 minutes
Calculated TC of    2.239 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.623(CFS)
Total initial stream area =        0.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station        5.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.080(Ac.)
Runoff from this stream =      0.623(CFS)
Time of concentration =    2.24 min.
Rainfall intensity =     8.958(In/Hr)
Summary of stream data:

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


1       26.512      7.56           6.861
2        0.623      2.24           8.958
Qmax(1) =
           1.000 *    1.000 *    26.512) +
           0.766 *    1.000 *     0.623) + =      26.990
Qmax(2) =
           1.000 *    0.296 *    26.512) +
           1.000 *    1.000 *     0.623) + =       8.477

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.512       0.623
Maximum flow rates at confluence using above data:
       26.990        8.477
Area of streams before confluence:
        8.130        0.080
Results of confluence:
Total flow rate =     26.990(CFS)
Time of concentration =     7.560 min.
Effective stream area after confluence =      8.210(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   803.600(Ft.)
Downstream point/station elevation =   803.400(Ft.)
Pipe length  =     6.60(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.990(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    26.990(CFS)
Normal flow depth in pipe =   12.79(In.)
Flow top width inside pipe =   29.67(In.)
Critical Depth =   21.26(In.)
Pipe flow velocity =     13.53(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =     7.57 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station       21.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      8.210(Ac.)
Runoff from this stream =     26.990(CFS)
Time of concentration =    7.57 min.
Rainfall intensity =     6.857(In/Hr)
Summary of stream data:

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


1       10.917      6.79           7.356
2       26.990      7.57           6.857
Qmax(1) =
           1.000 *    1.000 *    10.917) +
           1.000 *    0.897 *    26.990) + =      35.118
Qmax(2) =
           0.932 *    1.000 *    10.917) +
           1.000 *    1.000 *    26.990) + =      37.166

Total of 2 main streams to confluence:
Flow rates before confluence point:
      10.917      26.990
Maximum flow rates at confluence using above data:
```

```
       35.118       37.166
Area of streams before confluence:
        4.050        8.210


Results of confluence:
Total flow rate =     37.166(CFS)
Time of concentration =     7.568 min.
Effective stream area after confluence  =     12.260(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       17.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     37.196(CFS)
Depth of flow =   0.367(Ft.), Average velocity =   4.807(Ft/s)
        ******* Irregular Channel Data ***********
----------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2              6.00              0.00
        3             26.00              0.00
        4             32.00              2.00
Manning's 'N' friction factor =   0.030
----------------------------------------------------------------------
Sub-Channel flow  =     37.196(CFS)
  '     '         flow top width =     22.200(Ft.)
  '     '    velocity=    4.807(Ft/s)
  '     '         area =      7.738(Sq.Ft)
  '     '         Froude number =     1.435

Upstream point elevation =   803.400(Ft.)
Downstream point elevation =   786.000(Ft.)
Flow length =   450.000(Ft.)
Travel time  =    1.56 min.
Time of concentration =    9.13 min.
Depth of flow =   0.367(Ft.)
Average velocity =   4.807(Ft/s)
Total irregular channel flow =    37.196(CFS)
Irregular channel normal depth above invert elev. =   0.367(Ft.)
Average velocity of channel(s) =   4.807(Ft/s)
 Adding area flow to channel
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
The area added to the existing stream causes a
a lower flow rate of Q =     33.564(CFS)
therefore the upstream flow rate of Q =     37.166(CFS) is being used
Rainfall intensity =      6.076(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.428  CA =      5.524
Subarea runoff =      0.000(CFS) for      0.640(Ac.)
Total runoff =     37.166(CFS)    Total area =      12.900(Ac.)
Depth of flow =   0.367(Ft.), Average velocity =   4.805(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       17.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     12.900(Ac.)
Runoff from this stream =     37.166(CFS)
Time of concentration =    9.13 min.
Rainfall intensity =     6.076(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.100 to Point/Station       21.200
**** 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
[INDUSTRIAL area type                       ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  460.000(Ft.)
Highest elevation =  813.000(Ft.)
Lowest elevation =  788.000(Ft.)
Elevation difference =   25.000(Ft.) Slope =  5.435 %
Top of Initial Area Slope adjusted by User to  5.400 %
Bottom of Initial Area Slope adjusted by User to  5.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   5.40 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.24 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   5.400^(1/3)]=   2.24
The initial area total distance of  460.00 (Ft.) entered leaves a
remaining distance of  370.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.28 minutes
for a distance of 370.00 (Ft.) and a slope of  5.40 %
with an elevation difference of  19.98(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.281 Minutes
Tt=[(11.9*0.0701^3)/( 19.98)]^.385=  2.28
Total initial area Ti =   2.24 minutes from Figure 3-3 formula plus
  2.28 minutes from the Figure 3-4 formula =   4.52 minutes
Calculated TC of    4.520 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
```

```
Subarea runoff =      2.962(CFS)
Total initial stream area =        0.380(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.200 to Point/Station       17.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   788.000(Ft.)
Downstream point elevation =   786.000(Ft.)
Channel length thru subarea  =    10.000(Ft.)
Channel base width        =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Manning's 'N'    = 0.025
Maximum depth of channel  =    1.500(Ft.)
Flow(q) thru subarea =      2.962(CFS)
Depth of flow =   0.350(Ft.), Average velocity =   8.037(Ft/s)
Channel flow top width =    2.103(Ft.)
Flow Velocity =    8.04(Ft/s)
Travel time  =    0.02 min.
Time of concentration =    4.54 min.
Critical depth =      0.570(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.200 to Point/Station       17.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.380(Ac.)
Runoff from this stream =      2.962(CFS)
Time of concentration =    4.54 min.
Rainfall intensity =     8.958(In/Hr)
Summary of stream data:

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


1       37.166      9.13           6.076
2        2.962      4.54           8.958
Qmax(1) =
           1.000 *    1.000 *    37.166) +
           0.678 *    1.000 *     2.962) + =      39.174
Qmax(2) =
           1.000 *    0.497 *    37.166) +
           1.000 *    1.000 *     2.962) + =      21.448

Total of 2 streams to confluence:
Flow rates before confluence point:
      37.166       2.962
Maximum flow rates at confluence using above data:
       39.174       21.448
Area of streams before confluence:
       12.900        0.380
Results of confluence:
Total flow rate =     39.174(CFS)
Time of concentration =     9.128 min.
Effective stream area after confluence =     13.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       17.000
**** 6 HOUR HYDROGRAPH ****
______________________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June
2003


Time of Concentration =   9.13
Basin Area =    13.28 Acres
6 Hour Rainfall =  3.400 Inches
Runoff Coefficient =  0.441
Peak Discharge =    39.17 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
       9               1.171
       18              1.210
       27              1.230
       36              1.275
       45              1.298
       54              1.349
       63              1.377
       72              1.436
       81              1.469
       90              1.539
       99              1.578
       108             1.663
       117             1.711
       126             1.817
       135             1.876
       144             2.012
       153             2.090
       162             2.272
       171             2.379
       180             2.638
       189             2.798
       198             3.207
       207             3.477
       216             4.250
       225             4.841
       234             7.108
       243            10.015
       252            39.174
       261             5.701
       270             3.814
       279             2.985
       288             2.500
       297             2.176
       306             1.941
       315             1.762
       324             1.619
```

333	1.503
342	1.406
351	1.323
360	1.252
369	1.190

End of computations, total study area = 13.280 (Ac.)

Effective Area = 10.82 (Ac.)

Job File: C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1
-.PPW
Rain Dir: C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\

==========
JOB TITLE
==========

Project Date: ***02/04/2014***
Project Engineer: ***Shapouri & Associates***
Project Title: ***Orchard Hills***
Project Comments:
Post Hydrology - 100 Yr. Storm Event
Bioretention 1 (BMP1)
Node 17

S/N:
PondPack Ver: Compute Time: Date:

Table of Contents

Table of Contents (continued)

S/N:
PondPack Ver: Compute Time: Date:

MASTER DESIGN STORM SUMMARY

Hydrograph Queue Only Network

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 1 node(s)

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol cu.ft	Trun	Qpeak min	Qpeak cfs	Max WSEL ft	Max Pond Storage cu.ft
BIOR 1 (BMP1)IN	POND	100	74211		252.00	39.17		
BIOR 1 (BMP1)OUT	POND	100	50696		255.00	29.01	788.43	37945
N-17	HYG	100	74211		252.00	39.17		
*OUT 1 - N-17	JCT	100	50696		255.00	29.01		

S/N:
PondPack Ver: Compute Time: Date:

NETWORK SUMMARY -- NODES
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

	Node ID	Type	HYG Vol cu.ft	Trun.	Qpeak min	Qpeak cfs	Max WSEL ft
	BIOR 1 (BMP1)IN	POND	74211		252.00	39.17	
	BIOR 1 (BMP1)OUT	POND	50696		255.00	29.01	788.43
	N-17	HYG	74211		252.00	39.17	
Outfall	OUT 1 - N-17	JCT	50696		255.00	29.01	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol cu.ft	Trun.	Peak Time min	Peak Q cfs	End Points
30" DRAIN PIPE	PONDrt	UN	74211		252.00	39.17	BIOR 1 (BMP1)IN
30" DRAIN PIPE			50696		255.00	29.01	BIOR 1 (BMP1)OUT
		DL	50696		255.00	29.01	
		DN	50696		255.00	29.01	OUT 1 - N-17
ADDLINK 10	ADD	UN	74211		252.00	39.17	N-17
		DL	74211		252.00	39.17	
		DN	74211		252.00	39.17	BIOR 1 (BMP1)IN

NETWORK RUNOFF NODE SEQUENCE

Runoff Data	Apply to Node	Receiving Link
Read HYGN-17	HYG Qin N-17	Add Hyd N-17

S/N:
PondPack Ver: Compute Time: Date:

NETWORK ROUTING SEQUENCE

Link Operation	UPstream Node	DNstream Node
Add Hyd ADDLINK 10	HYG Qin N-17	Pond BIOR 1 (BMP1)IN
POND ROUTE TOTAL OUTFLOW...		
Total Pond Outflow	Pond BIOR 1 (BMP1)IN	Outflow BIOR 1 (BMP1)OUT
SET POND ROUTING LINK TO TOTAL POND OUTFLOW...		
Outlet 30" DRAIN PIPE	Outflow BIOR 1 (BMP1)OUT	Jct OUT 1 - N-17

S/N:
PondPack Ver: Compute Time: Date:

HYG file =
HYG ID = BIORET 1 (BMP1)
HYG Tag = N-17

Peak Discharge =	39.17 cfs
Time to Peak =	252.00 min
HYG Volume =	74211 cu.ft

HYDROGRAPH ORDINATES (cfs)
Output Time increment = 9.00 min
Time on left represents time for first value in each row.

Time min					
.00	.00	1.17	1.21	1.23	1.28
45.00	1.30	1.35	1.38	1.44	1.47
90.00	1.54	1.58	1.66	1.71	1.82
135.00	1.88	2.01	2.09	2.27	2.38
180.00	2.64	2.80	3.21	3.48	4.25
225.00	4.84	7.11	10.02	39.17	5.70
270.00	3.81	2.99	2.50	2.18	1.94
315.00	1.76	1.62	1.50	1.41	1.32
360.00	1.25	1.19	.00		

S/N:
PondPack Ver: Compute Time: Date:

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
780.50	-----	9000	0	0	0
781.50	-----	9000	27000	9000	9000
782.00	-----	9000	27000	4500	13500
783.00	-----	9000	27000	9000	22500
784.00	-----	9000	27000	9000	31500
785.00	-----	9000	27000	9000	40500
786.00	-----	9000	27000	9000	49500
787.00	-----	11850	31177	10392	59892
788.00	-----	14800	39893	13298	73190
788.50	-----	16300	46632	7772	80962

S/N:
PondPack Ver: Compute Time: Date:

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

VOLUME COMPLETELY FILLED WITH MATERIAL
(Adjust Volumes for Voids)

Void Spaces = 47.50000 %

HW Elv, ft	Total, cu.ft	Adjusted,cu.ft
780.50	0	0
781.50	9000	4275
782.00	13500	6413
783.00	22500	10688
784.00	31500	14963
785.00	40500	19238
786.00	49500	23513
787.00	59892	28449
788.00	73190	34765
788.50	80962	38457

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 780.50 ft
Increment = .25 ft
Max. Elev.= 788.50 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Stand Pipe	RP	--->	CV	787.600	788.500
Orifice-Circular	O1	--->	CV	786.000	788.500
Culvert-Circular	CV	--->	TW	775.000	788.500
Orifice-Circular	O0	--->	TW	786.666	788.500

TW SETUP, DS Channel

S/N:
PondPack Ver: Compute Time: Date:

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

OUTLET STRUCTURE INPUT DATA

Structure ID = RP
Structure Type = Stand Pipe

# of Openings = 1
Invert Elev. = 787.60 ft
Diameter = 2.5000 ft
Orifice Area = 4.9087 sq.ft
Orifice Coeff. = .600
Weir Length = 7.85 ft
Weir Coeff. = 3.100
K, Reverse = 1.000
Mannings n = .0000
Kev,Charged Riser = .000
Weir Submergence = No

Structure ID = O1
Structure Type = Orifice-Circular

# of Openings = 60
Invert Elev. = 786.00 ft
Diameter = .1100 ft
Orifice Coeff. = .600

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

OUTLET STRUCTURE INPUT DATA

Structure ID = CV
Structure Type = Culvert-Circular

No. Barrels	=	1
Barrel Diameter	=	2.5000 ft
Upstream Invert	=	775.00 ft
Dnstream Invert	=	771.70 ft
Horiz. Length	=	11.51 ft
Barrel Length	=	11.97 ft
Barrel Slope	=	.28671 ft/ft

OUTLET CONTROL DATA...

Mannings n	=	.0130	
Ke	=	.5000	(forward entrance loss)
Kb	=	.009217	(per ft of full flow)
Kr	=	.5000	(reverse entrance loss)
HW Convergence	=	.001	+/- ft

INLET CONTROL DATA...

Equation form	=	1
Inlet Control K	=	.0078
Inlet Control M	=	2.0000
Inlet Control c	=	.03790
Inlet Control Y	=	.6900
T1 ratio (HW/D)	=	.992
T2 ratio (HW/D)	=	1.153
Slope Factor	=	-.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...
At T1 Elev = 777.48 ft ---> Flow = 27.16 cfs
At T2 Elev = 777.88 ft ---> Flow = 31.05 cfs

S/N:
PondPack Ver: Compute Time: Date:

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

OUTLET STRUCTURE INPUT DATA

Structure ID = O0
Structure Type = Orifice-Circular

# of Openings = 45
Invert Elev. = 786.67 ft
Diameter = .1666 ft
Orifice Coeff. = .600

Structure ID = TW
Structure Type = TW SETUP, DS Channel

USE DOWNSTREAM CHANNEL NORMAL DEPTH FOR TW...
Channel Type: Chn-Circular
Channel ID: Chn-Cir - 1

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

File.... C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\TM 5570 - BMP 1 - .PPW

USE DOWNSTREAM CHANNEL NORMAL DEPTH FOR TW...
Channel Type: Chn-Circular
Channel ID: Chn-Cir - 1

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

CIRCULAR CROSS SECTION

Slope = .025000 ft/ft
Mannings n = 0.01300
Invert Elev. = 768.20 ft
Top of Channel = 770.70 ft
Diameter = 2.5000 ft

LEVEL POOL ROUTING DATA

HYG Dir = C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\
Inflow HYG file = NONE STORED - BIOR 1 (BMP1)IN 100
Outflow HYG file = NONE STORED - BIOR 1 (BMP1)OUT 100

Pond Node Data = BIOR 1 (BMP1)
Pond Volume Data = BIOR 1 (BMP1)
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	780.50 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
780.50	.00	0	9000	.00	.00	.00
780.75	.00	1069	9000	.00	.00	35.62
781.00	.00	2138	9000	.00	.00	71.25
781.25	.00	3206	9000	.00	.00	106.87
781.50	.00	4275	9000	.00	.00	142.50
781.75	.00	5344	9000	.00	.00	178.12
782.00	.00	6413	9000	.00	.00	213.75
782.25	.00	7481	9000	.00	.00	249.37
782.50	.00	8550	9000	.00	.00	285.00
782.75	.00	9619	9000	.00	.00	320.62
783.00	.00	10688	9000	.00	.00	356.25
783.25	.00	11756	9000	.00	.00	391.87
783.50	.00	12825	9000	.00	.00	427.50
783.75	.00	13894	9000	.00	.00	463.12
784.00	.00	14963	9000	.00	.00	498.75
784.25	.00	16031	9000	.00	.00	534.37
784.50	.00	17100	9000	.00	.00	570.00
784.75	.00	18169	9000	.00	.00	605.62
785.00	.00	19238	9000	.00	.00	641.25
785.25	.00	20306	9000	.00	.00	676.87

S/N:
PondPack Ver: Compute Time: Date:

LEVEL POOL ROUTING DATA

HYG Dir = C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\
Inflow HYG file = NONE STORED - BIOR 1 (BMP1)IN 100
Outflow HYG file = NONE STORED - BIOR 1 (BMP1)OUT 100

Pond Node Data = BIOR 1 (BMP1)
Pond Volume Data = BIOR 1 (BMP1)
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	780.50 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

Elevation ft	Outflow cfs	Storage cu.ft	Area sq.ft	Infilt. cfs	Q Total cfs	2S/t + O cfs
785.50	.00	21375	9000	.00	.00	712.50
785.75	.00	22444	9000	.00	.00	748.12
786.00	.00	23513	9000	.00	.00	783.75
786.25	1.21	24621	9676	.00	1.21	821.91
786.50	1.83	25811	10376	.00	1.83	862.21
786.67	2.15	26649	10855	.00	2.15	890.43
786.75	2.71	27086	11101	.00	2.71	905.59
787.00	5.03	28449	11850	.00	5.03	953.33
787.25	6.34	29898	12557	.00	6.34	1002.93
787.50	7.39	31432	13284	.00	7.39	1055.12
787.60	7.79	32070	13581	.00	7.79	1076.78
787.75	9.71	33054	14032	.00	9.71	1111.49
788.00	15.27	34765	14800	.00	15.27	1174.11
788.25	22.61	36567	15541	.00	22.61	1241.50
788.50	31.33	38457	16300	.00	31.33	1313.23

LEVEL POOL ROUTING SUMMARY

HYG Dir = C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\
Inflow HYG file = NONE STORED - BIOR 1 (BMP1)IN 100
Outflow HYG file = NONE STORED - BIOR 1 (BMP1)OUT 100

Pond Node Data = BIOR 1 (BMP1)
Pond Volume Data = BIOR 1 (BMP1)
Pond Outlet Data = Outlet 1

No Infiltration

INITIAL CONDITIONS

Starting WS Elev	=	780.50 ft
Starting Volume	=	0 cu.ft
Starting Outflow	=	.00 cfs
Starting Infiltr.	=	.00 cfs
Starting Total Qout	=	.00 cfs
Time Increment	=	1.00 min

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

Peak Inflow	=	39.17 cfs	at	252.00 min
Peak Outflow	=	29.01 cfs	at	255.00 min
Peak Elevation	=	788.43 ft		
Peak Storage	=	37945 cu.ft		

MASS BALANCE (cu.ft)

+ Initial Vol	=	0
+ HYG Vol IN	=	74211
- Infiltration	=	0
- HYG Vol OUT	=	50696
- Retained Vol	=	23515
Unrouted Vol	=	- cu.ft (.000% of Inflow Volume)

S/N:
PondPack Ver: Compute Time: Date:

DETENTION TIMES SUMMARY

HYG Dir = C:\Shap_Ass\Active Projects\Orchard Hills\7th Submital\POND PACK\
Inflow HYG file = NONE STORED - BIOR 1 (BMP1)IN 100
Outflow HYG file = NONE STORED - BIOR 1 (BMP1)OUT 100

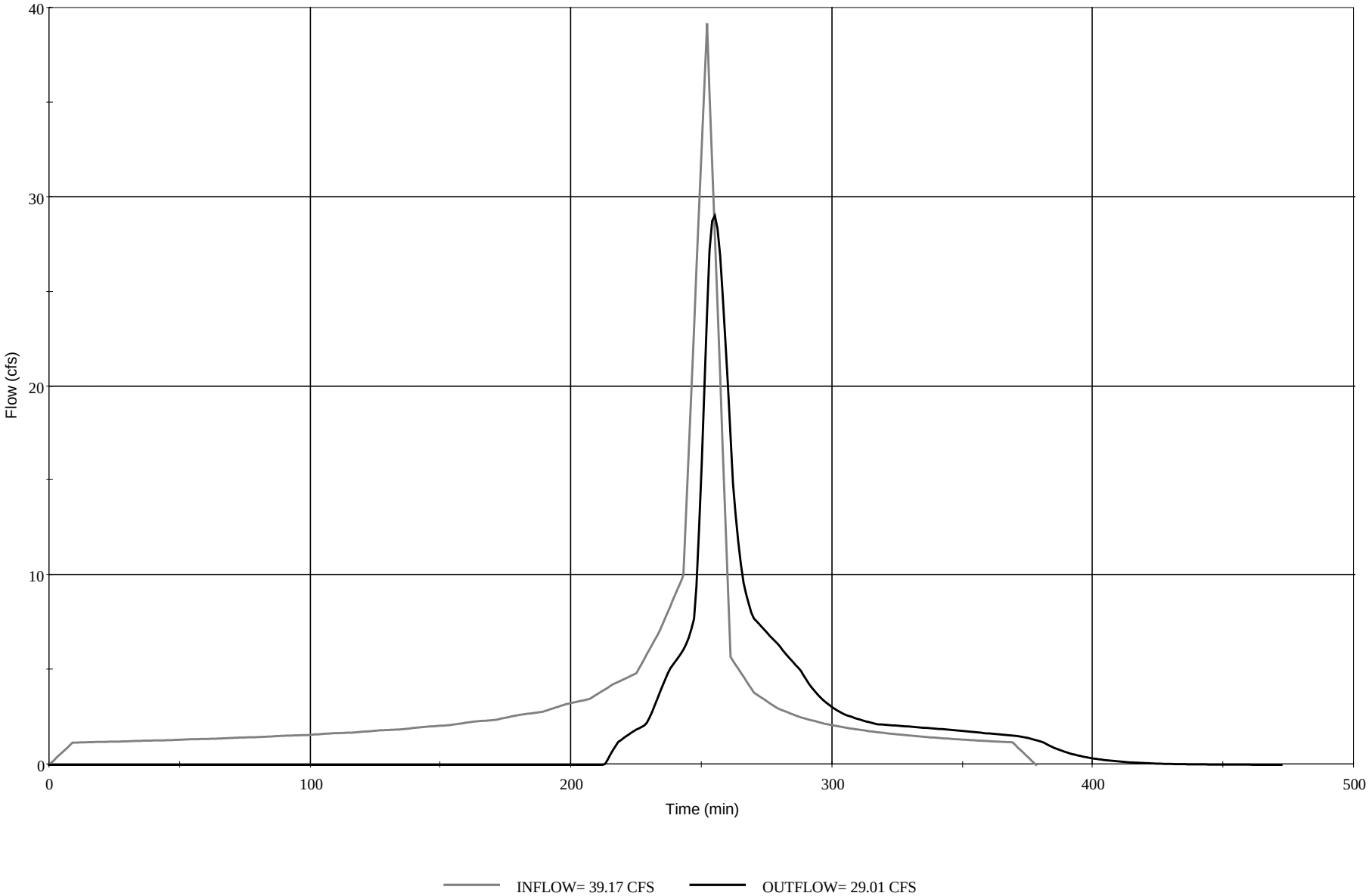
Pond Node Data = BIOR 1 (BMP1)
Pond Volume Data = BIOR 1 (BMP1)
Pond Outlet Data = Outlet 1

No Infiltration

APPROXIMATE DETENTION TIME

Tp, Outflow + Infilt.	=	255.00 min
Tp, Total Inflow	=	252.00 min
Peak to Peak	=	3.00 min
Qout+Infilt. Centroid	=	276.81 min
Inflow Centroid	=	219.40 min
Centroid to Centroid	=	57.40 min
Weighted Avg. Plug Time	=	120.89 min
Max.Plug Vol. Plug Time	=	109.28 min
Max.Inflow Plug Volume	=	2253 cu.ft (From 251.00 to 252.00 min)

NODE 17 - BIORETENTION - (BMP 1)
INFLOW/OUTFLOW HYDROGRAPH
100-YEAR STORM EVENT



San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 7.5

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 02/04/14

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

ORCHARD HILLS POST-DEVELOPMENT 100-YEAR STORM EVENT

Program License Serial Number 6052

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.400
24 hour precipitation(inches) = 6.500
P6/P24 = 52.3%
San Diego hydrology manual 'C' values used

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

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity (I) = 8.958(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 8.96(In/Hr)
Total area = 3.000(Ac.) Total runoff = 8.100(CFS)

++
Process from Point/Station 2.000 to Point/Station 23.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 872.000(Ft.)
Downstream point elevation = 845.000(Ft.)
Channel length thru subarea = 115.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 8.814(CFS)
Manning's 'N' = 0.030
Maximum depth of channel = 2.000(Ft.)
Flow(q) thru subarea = 8.814(CFS)
Depth of flow = 0.548(Ft.), Average velocity = 9.778(Ft/s)
Channel flow top width = 3.289(Ft.)
Flow Velocity = 9.78(Ft/s)
Travel time = 0.20 min.
Time of concentration = 5.20 min.
Critical depth = 0.883(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 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
Rainfall intensity = 8.739(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.347 CA = 1.098
Subarea runoff = 1.495(CFS) for 0.160(Ac.)
Total runoff = 9.595(CFS) Total area = 3.160(Ac.)
Depth of flow = 0.566(Ft.), Average velocity = 9.987(Ft/s)
Critical depth = 0.914(Ft.)

++
Process from Point/Station 2.000 to Point/Station 23.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 3.160(Ac.)
Runoff from this stream = 9.595(CFS)
Time of concentration = 5.20 min.
Rainfall intensity = 8.739(In/Hr)

++
Process from Point/Station 22.000 to Point/Station 23.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.800
Decimal fraction soil group D = 0.200
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.310
Initial subarea total flow distance = 340.000(Ft.)
Highest elevation = 873.000(Ft.)
Lowest elevation = 845.000(Ft.)
Elevation difference = 28.000(Ft.) Slope = 8.235 %
Top of Initial Area Slope adjusted by User to 2.000 %
Bottom of Initial Area Slope adjusted by User to 2.000 %

```
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 85.00 (Ft)
for the top area slope value of   2.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =  10.41 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3100)*(  85.000^.5)/(   2.000^(1/3)]=  10.41
The initial area total distance of  340.00 (Ft.) entered leaves a
remaining distance of  255.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.51 minutes
for a distance of 255.00 (Ft.) and a slope of  2.00 %
with an elevation difference of   5.10(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.510 Minutes
Tt=[(11.9*0.0483^3)/(  5.10)]^.385=  2.51
Total initial area Ti =  10.41 minutes from Figure 3-3 formula plus
  2.51 minutes from the Figure 3-4 formula =  12.92 minutes
Rainfall intensity (I) =      4.857(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.310
Subarea runoff =      0.391(CFS)
Total initial stream area =        0.260(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       23.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.260(Ac.)
Runoff from this stream =      0.391(CFS)
Time of concentration =   12.92 min.
Rainfall intensity =     4.857(In/Hr)
Summary of stream data:

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


1        9.595      5.20          8.739
2        0.391     12.92          4.857
Qmax(1) =
            1.000 *    1.000 *     9.595) +
            1.000 *    0.402 *     0.391) + =       9.753
Qmax(2) =
            0.556 *    1.000 *     9.595) +
            1.000 *    1.000 *     0.391) + =       5.725

Total of 2 streams to confluence:
Flow rates before confluence point:
       9.595       0.391
Maximum flow rates at confluence using above data:
        9.753        5.725
Area of streams before confluence:
        3.160        0.260
Results of confluence:
Total flow rate =      9.753(CFS)
Time of concentration =     5.196 min.
Effective stream area after confluence =      3.420(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     10.530(CFS)
Depth of flow =   0.562(Ft.), Average velocity =  12.120(Ft/s)
        ******* Irregular Channel Data ***********
----------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.50
        2              0.11              0.93
        3              0.44              0.44
        4              0.93              0.11
        5              1.50              0.00
        6              2.07              0.11
        7              2.56              0.44
        8              2.89              0.93
        9              3.00              1.50
Manning's 'N' friction factor =   0.013
----------------------------------------------------------------------
Sub-Channel flow  =     10.530(CFS)
  '     '         flow top width =      2.284(Ft.)
  '     '    velocity=   12.120(Ft/s)
  '     '         area =      0.869(Sq.Ft)
  '     '         Froude number =     3.463

Upstream point elevation =   845.000(Ft.)
Downstream point elevation =   825.000(Ft.)
Flow length =   405.000(Ft.)
Travel time  =    0.56 min.
Time of concentration =    5.75 min.
Depth of flow =   0.562(Ft.)
Average velocity =  12.120(Ft/s)
Total irregular channel flow =    10.530(CFS)
Irregular channel normal depth above invert elev. =   0.562(Ft.)
Average velocity of channel(s) =  12.120(Ft/s)
 Adding area flow to channel
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
Rainfall intensity =      8.183(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.338  CA =      1.371
Subarea runoff =      1.463(CFS) for      0.640(Ac.)
Total runoff =     11.216(CFS)    Total area =       4.060(Ac.)
Depth of flow =   0.579(Ft.), Average velocity =  12.353(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.060(Ac.)
Runoff from this stream =     11.216(CFS)
Time of concentration =    5.75 min.
Rainfall intensity =     8.183(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
----------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       8.96(In/Hr)
Total area =        3.000(Ac.)  Total runoff =     8.100(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station       25.000
**** IMPROVED CHANNEL TRAVEL TIME ****
----------------------------------------------------------------------------
Upstream point elevation =   872.000(Ft.)
Downstream point elevation =   845.000(Ft.)
Channel length thru subarea  =   135.000(Ft.)
Channel base width        =    0.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      8.880(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      8.880(CFS)
Depth of flow =   0.566(Ft.), Average velocity =   9.224(Ft/s)
Channel flow top width =    3.399(Ft.)
Flow Velocity =    9.22(Ft/s)
Travel time  =    0.24 min.
Time of concentration =    5.24 min.
Critical depth =      0.883(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      8.687(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.350  CA =      1.120
Subarea runoff =      1.630(CFS) for      0.200(Ac.)
Total runoff =      9.730(CFS)    Total area =       3.200(Ac.)
Depth of flow =   0.586(Ft.), Average velocity =   9.437(Ft/s)
Critical depth =      0.922(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       24.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
----------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =     10.037(CFS)
Depth of flow =   0.482(Ft.), Average velocity =  14.522(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.50
        2              0.11              0.93
        3              0.44              0.44
        4              0.93              0.11
        5              1.50              0.00
        6              2.07              0.11
        7              2.56              0.44
        8              2.89              0.93
        9              3.00              1.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =     10.037(CFS)
  '     '         flow top width =      2.177(Ft.)
  '     '    velocity=   14.522(Ft/s)
  '     '         area =      0.691(Sq.Ft)
  '     '         Froude number =     4.542

Upstream point elevation =   845.000(Ft.)
Downstream point elevation =   825.000(Ft.)
Flow length =   230.000(Ft.)
Travel time  =    0.26 min.
Time of concentration =    5.51 min.
Depth of flow =   0.482(Ft.)
Average velocity =  14.522(Ft/s)
Total irregular channel flow =    10.037(CFS)
Irregular channel normal depth above invert elev. =   0.482(Ft.)
Average velocity of channel(s) =  14.522(Ft/s)
 Adding area flow to channel
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
```

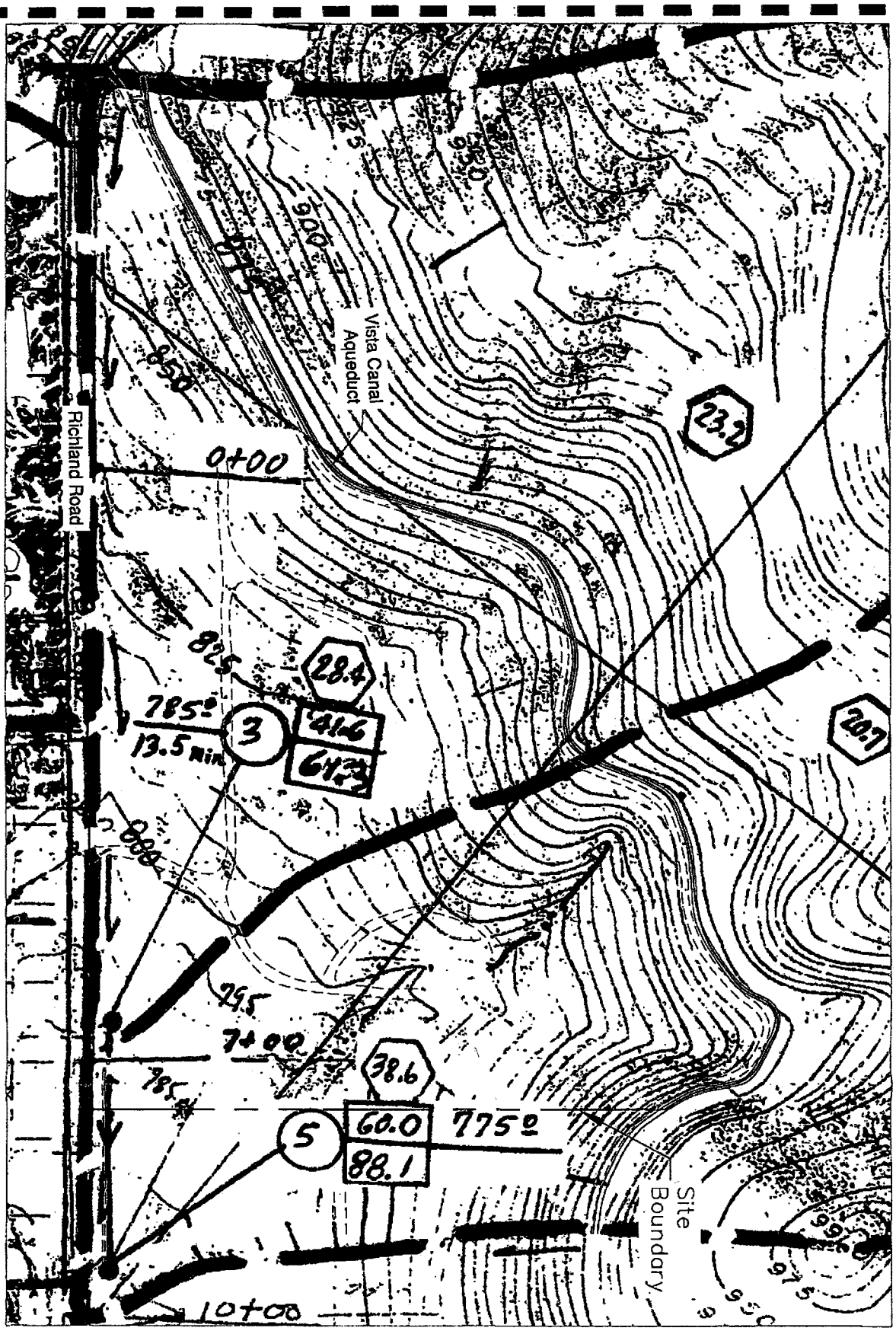
```
Rainfall intensity =      8.416(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.345  CA =      1.222
Subarea runoff =      0.555(CFS) for      0.340(Ac.)
Total runoff =     10.285(CFS)    Total area =       3.540(Ac.)
Depth of flow =   0.488(Ft.), Average velocity =  14.633(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       24.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.540(Ac.)
Runoff from this stream =     10.285(CFS)
Time of concentration =    5.51 min.
Rainfall intensity =     8.416(In/Hr)
Summary of stream data:

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


1       11.216      5.75           8.183
2       10.285      5.51           8.416
Qmax(1) =
           1.000 *    1.000 *    11.216) +
           0.972 *    1.000 *    10.285) + =      21.216
Qmax(2) =
           1.000 *    0.957 *    11.216) +
           1.000 *    1.000 *    10.285) + =      21.023

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.216      10.285
Maximum flow rates at confluence using above data:
       21.216       21.023
Area of streams before confluence:
        4.060        3.540
Results of confluence:
Total flow rate =     21.216(CFS)
Time of concentration =     5.753 min.
Effective stream area after confluence =      7.600(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       19.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =     21.263(CFS)
Depth of flow =   0.669(Ft.), Average velocity =  18.970(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.50
        2              0.11              0.93
        3              0.44              0.44
        4              0.93              0.11
        5              1.50              0.00
        6              2.07              0.11
        7              2.56              0.44
        8              2.89              0.93
        9              3.00              1.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =     21.263(CFS)
  '     '         flow top width =      2.428(Ft.)
  '     '    velocity=   18.970(Ft/s)
  '     '         area =      1.121(Sq.Ft)
  '     '         Froude number =     4.920

Upstream point elevation =   825.000(Ft.)
Downstream point elevation =   785.000(Ft.)
Flow length =   410.000(Ft.)
Travel time  =    0.36 min.
Time of concentration =    6.11 min.
Depth of flow =   0.669(Ft.)
Average velocity =  18.970(Ft/s)
Total irregular channel flow =    21.263(CFS)
Irregular channel normal depth above invert elev. =   0.669(Ft.)
Average velocity of channel(s) =  18.970(Ft/s)
 Adding area flow to channel
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
The area added to the existing stream causes a
a lower flow rate of Q =     21.038(CFS)
therefore the upstream flow rate of Q =     21.216(CFS) is being used
Rainfall intensity =      7.869(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.340  CA =      2.674
Subarea runoff =      0.000(CFS) for      0.270(Ac.)
Total runoff =     21.216(CFS)    Total area =       7.870(Ac.)
Depth of flow =   0.668(Ft.), Average velocity =  18.958(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       19.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.870(Ac.)
Runoff from this stream =     21.216(CFS)
Time of concentration =    6.11 min.
Rainfall intensity =     7.869(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       19.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
----------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.200
Decimal fraction soil group D = 0.800
[LOW DENSITY RESIDENTIAL                    ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.482
Rainfall intensity (I) =      5.093(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  12.00 min.  Rain intensity =       5.09(In/Hr)
Total area =       13.280(Ac.)  Total runoff =    29.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       19.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     13.280(Ac.)
Runoff from this stream =     29.010(CFS)
Time of concentration =   12.00 min.
Rainfall intensity =     5.093(In/Hr)
Summary of stream data:

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


1       21.216      6.11           7.869
2       29.010     12.00           5.093
Qmax(1) =
           1.000 *    1.000 *    21.216) +
           1.000 *    0.509 *    29.010) + =      35.994
Qmax(2) =
           0.647 *    1.000 *    21.216) +
           1.000 *    1.000 *    29.010) + =      42.742

Total of 2 streams to confluence:
Flow rates before confluence point:
      21.216      29.010
Maximum flow rates at confluence using above data:
       35.994       42.742
Area of streams before confluence:
        7.870       13.280
Results of confluence:
Total flow rate =     42.742(CFS)
Time of concentration =    12.000 min.
Effective stream area after confluence =     21.150(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       19.000 to Point/Station       18.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   775.000(Ft.)
Downstream point/station elevation =   771.700(Ft.)
Pipe length  =    11.51(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.742(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    42.742(CFS)
Normal flow depth in pipe =    8.97(In.)
Flow top width inside pipe =   27.47(In.)
Critical Depth =   26.23(In.)
Pipe flow velocity =     34.66(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =    12.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       28.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
----------------------------------------------------------------------
Upstream point/station elevation =   771.700(Ft.)
Downstream point/station elevation =   765.160(Ft.)
Pipe length  =   210.25(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.742(CFS)
Given pipe size =     30.00(In.)
Calculated individual pipe flow  =    42.742(CFS)
Normal flow depth in pipe =   16.59(In.)
Flow top width inside pipe =   29.83(In.)
Critical Depth =   26.23(In.)
Pipe flow velocity =     15.35(Ft/s)
Travel time through pipe =    0.23 min.
Time of concentration (TC) =    12.23 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       28.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     21.150(Ac.)
Runoff from this stream =     42.742(CFS)
Time of concentration =   12.23 min.
Rainfall intensity =     5.030(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       29.000 to Point/Station       28.000
**** 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   )
```

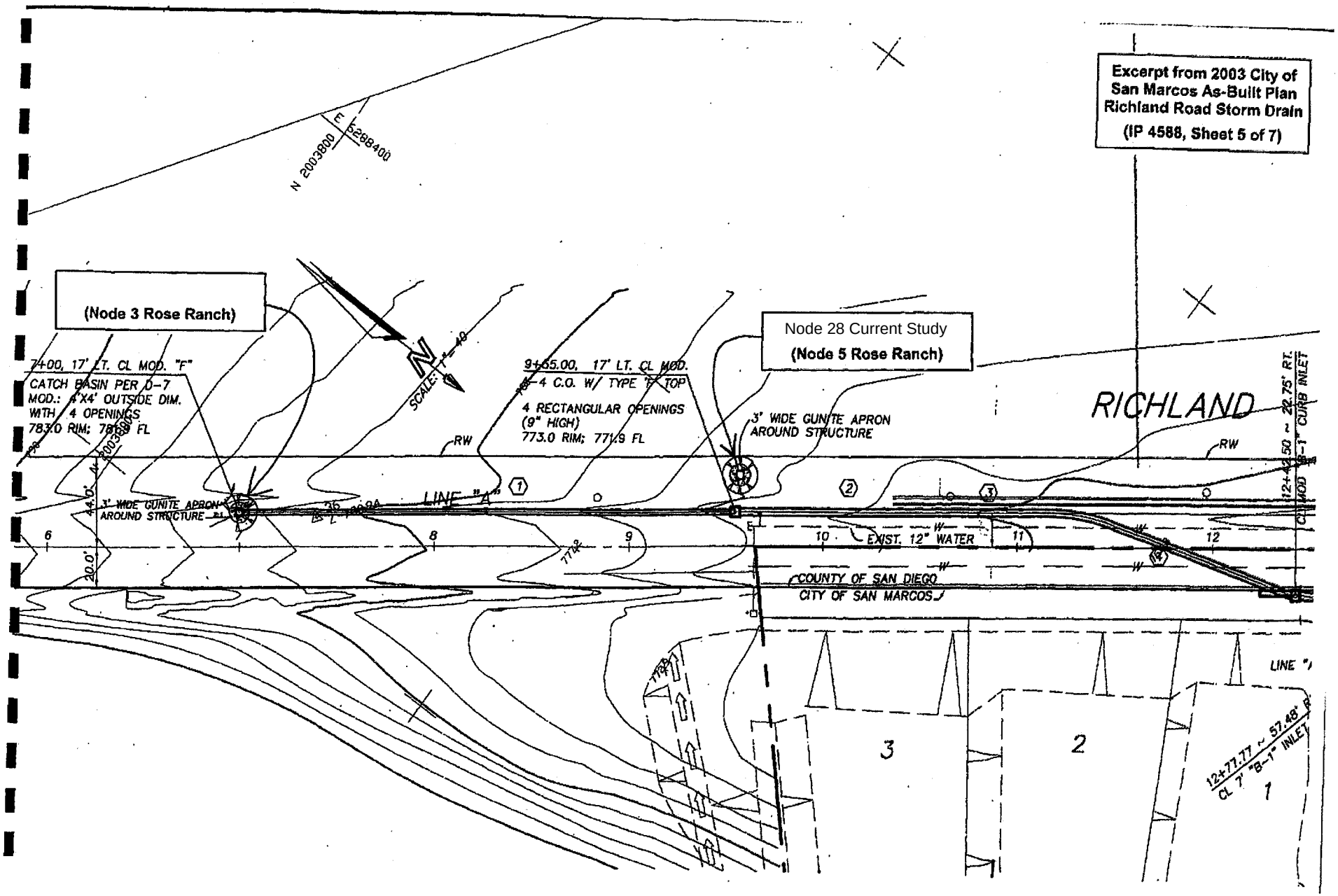
```
Impervious value, Ai = 0.000
Sub-Area C Value = 0.300
Initial subarea total flow distance  =  650.000(Ft.)
Highest elevation =  875.000(Ft.)
Lowest elevation =  773.900(Ft.)
Elevation difference =  101.100(Ft.) Slope = 15.554 %
Top of Initial Area Slope adjusted by User to 15.000 %
Bottom of Initial Area Slope adjusted by User to 15.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  15.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.84 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3000)*( 100.000^.5)/(  15.000^(1/3)]=   5.84
The initial area total distance of  650.00 (Ft.) entered leaves a
remaining distance of  550.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   2.09 minutes
for a distance of 550.00 (Ft.) and a slope of 15.00 %
with an elevation difference of  82.50(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    2.089 Minutes
Tt=[(11.9*0.1042^3)/( 82.50)]^.385=  2.09
Total initial area Ti =   5.84 minutes from Figure 3-3 formula plus
  2.09 minutes from the Figure 3-4 formula =   7.93 minutes
Rainfall intensity (I) =      6.654(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.300
Subarea runoff =      4.372(CFS)
Total initial stream area =        2.190(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       29.000 to Point/Station       28.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.190(Ac.)
Runoff from this stream =      4.372(CFS)
Time of concentration =    7.93 min.
Rainfall intensity =     6.654(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       27.000 to Point/Station       28.000
**** 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
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =  245.000(Ft.)
Highest elevation =  785.500(Ft.)
Lowest elevation =  773.900(Ft.)
Elevation difference =   11.600(Ft.) Slope =  4.735 %
Top of Initial Area Slope adjusted by User to  4.400 %
Bottom of Initial Area Slope adjusted by User to  4.400 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   4.40 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  90.000^.5)/(   4.400^(1/3)]=   2.40
The initial area total distance of  245.00 (Ft.) entered leaves a
remaining distance of  155.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.26 minutes
for a distance of 155.00 (Ft.) and a slope of  4.40 %
with an elevation difference of   6.82(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.263 Minutes
Tt=[(11.9*0.0294^3)/(  6.82)]^.385=  1.26
Total initial area Ti =   2.40 minutes from Figure 3-3 formula plus
  1.26 minutes from the Figure 3-4 formula =   3.66 minutes
Calculated TC of    3.660 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.958(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.701(CFS)
Total initial stream area =        0.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       27.000 to Point/Station       28.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.090(Ac.)
Runoff from this stream =      0.701(CFS)
Time of concentration =    3.66 min.
Rainfall intensity =     8.958(In/Hr)
Summary of stream data:

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


1       42.742     12.23           5.030
2        4.372      7.93           6.654
3        0.701      3.66           8.958
Qmax(1) =
           1.000 *    1.000 *    42.742) +
           0.756 *    1.000 *     4.372) +
           0.562 *    1.000 *     0.701) + =      46.440
Qmax(2) =
           1.000 *    0.648 *    42.742) +
           1.000 *    1.000 *     4.372) +
           0.743 *    1.000 *     0.701) + =      32.590
Qmax(3) =
```

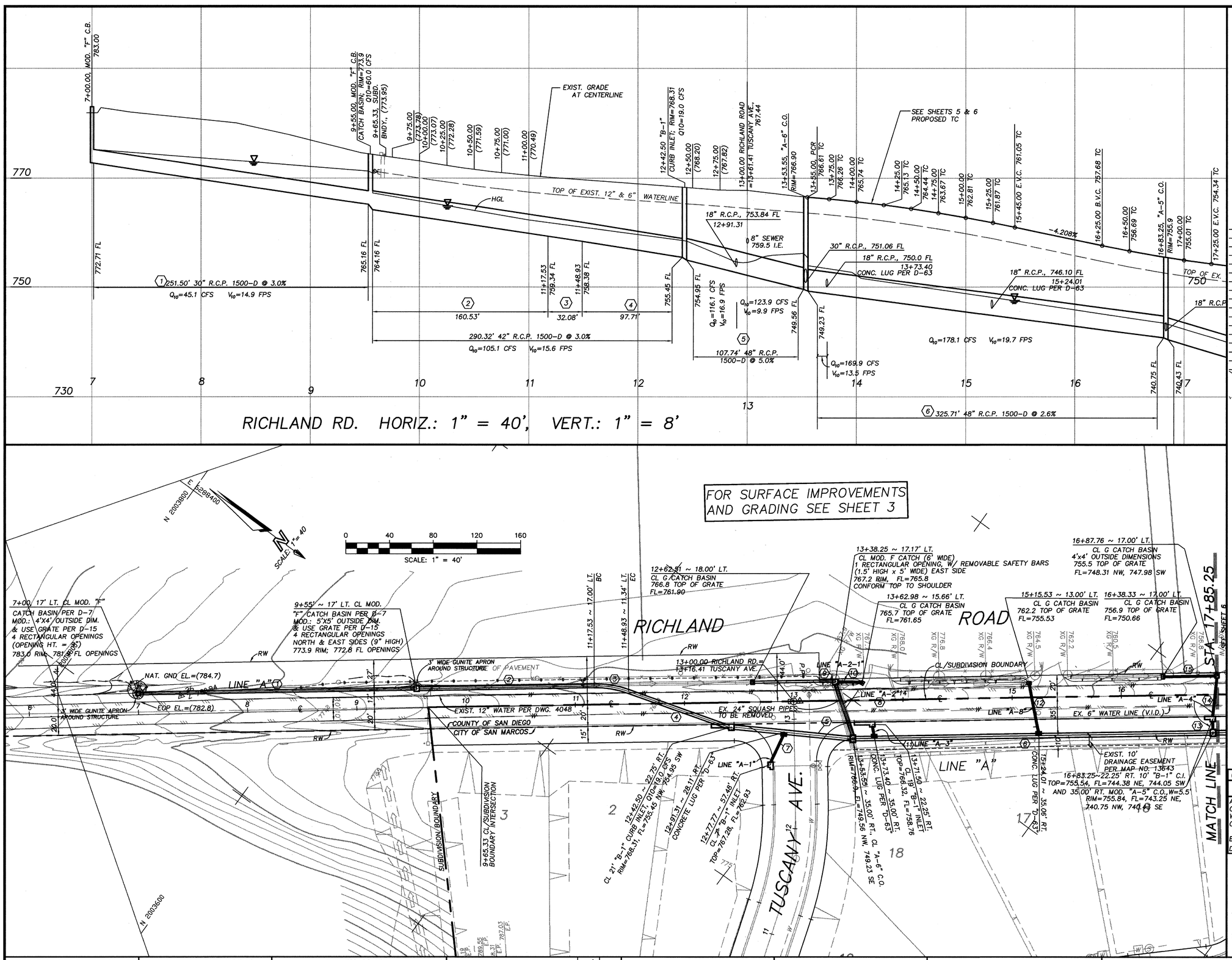
```
           1.000 *    0.299 *    42.742) +
           1.000 *    0.462 *     4.372) +
           1.000 *    1.000 *     0.701) + =      15.506

Total of 3 streams to confluence:
Flow rates before confluence point:
      42.742       4.372       0.701
Maximum flow rates at confluence using above data:
       46.440       32.590       15.506
Area of streams before confluence:
       21.150        2.190        0.090
Results of confluence:
Total flow rate =     46.440(CFS)
Time of concentration =    12.234 min.
Effective stream area after confluence =     23.430(Ac.)
End of computations, total study area =          23.430 (Ac.)
```

REFERENCE PLANS



Sheet 1 of 1 Scale 1"=100'		Excerpt from Rose Ranch Hydrology Map Richland Road Subdivision - San Diego County


Excerpt from 2003 City of San Marcos As-Built Plan Richland Road Storm Drain (IP 4588, Sheet 5 of 7)
(Node 3 Rose Ranch)
Node 28 Current Study
(Node 5 Rose Ranch)
7+00, 17' LT. CL MOD. "F"
CATCH BASIN PER D-7
MOD.: 4'X4' OUTSIDE DIM.
WITH 4 OPENINGS
783.0 RIM; 780.9 FL
9+65.00, 17' LT. CL MOD.
4 C.O. W/ TYPE 'F' TOP
4 RECTANGULAR OPENINGS
(9" HIGH)
773.0 RIM; 771.9 FL
3' WIDE GUNITE APRON
AROUND STRUCTURE
RICHLAND
RW
LINE "A"
EXIST. 12" WATER
COUNTY OF SAN DIEGO
CITY OF SAN MARCOS
SCALE: 1"=40'
N 2003800
E 6288400
12+42.50 ~ 22.75' RT.
CL MOD "B-1" CURB INLET
12+77.77 ~ 57.48' R.
CL 7' "B-1" INLET
LINE "
3
2
1



STORM DRAIN DATA

NO.	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	N36°56'50"W	---	251.50'	30" R.C.P. 1350-D
2	N36°56'50"W	---	160.53'	42" R.C.P. 1350-D
3	D=20°25'20"	90.00'	32.08'	42" R.C.P. 1350-D
4	N16°31'30"W	---	97.71'	42" R.C.P. 1350-D
5	N30°25'12"W	---	107.74'	48" R.C.P. 1350-D
6	N36°56'50"W	---	325.71'	48" R.C.P. 1350-D
7	N79°23'28"E	---	30.56'	18" R.C.P. 1350-D
8	N35°05'09"E	---	49.59'	30" R.C.P. 1350-D
9	N36°56'50"W	---	1.50'	18" R.C.P. 1350-D
10	N36°56'51"W	---	19.25'	"
11	N43°03'10"E	---	10.92'	"
12	N43°03'11"E	---	52.38'	"
13	N53°08'06"E	---	7.99'	"
14	N60°12'20"E	---	36.03'	"
15	N36°56'51"W	---	46.97'	18" R.C.P. 1350-D

* 8' LENGTHS, 5' BEVEL ONE END

FOR SURFACE IMPROVEMENTS AND GRADING SEE SHEET 3

CG 4071	VISTA IRRIGATION DISTRICT
COUNTY OF SAN DIEGO DEPARTMENT OF PUBLIC WORKS	By: SEE COVER SHEET
APPROVED: DOUGLAS M. ISBELL COUNTY ENGINEER. FOR WORK WITHIN COUNTY RIGHT-OF-WAY ONLY.	John Amodeo, R.C.E. 31161 District Engineer Date:
BY: Douglas M. Isbell DATE: 9-21-99	

MAY GROUP
PLANNING • ENGINEERING • SURVEYING
6540 Lusk Boulevard • Suite C-225 • San Diego, CA 92121
619/550-9901, FAX 619/550-9469

REGISTERED PROFESSIONAL ENGINEER MARWAN A. YOUNIS NO. 43217 EXP. 3/31/00 CIVIL STATE OF CALIFORNIA

SAN MARCOS FIRE PROTECTION DIST.	VALLECITOS WATER DISTRICT	ENGINEER OF WORK	CITY APPOVED CHANGES	APP'D	DATE
By: Fire Marshall Date:	By: PRESTON H. LEWIS, P.E. R.C.E. 45927 EXP. 12/[illegible]02	Drawn By By: Name: MARWAN YOUNIS R.C.E. 43217 exp. 3-31-00 Date: 9/1799			

Recommended for Approval	Approved for Construction	BENCH MARK
By: Principal Civil Engineer R.C.E. 38149 exp: 3/31/01 Date:	By: City Engineer R.C.E.30928 exp: Date:	DESCRIPTION "3" BRASS DISK IN CONCRETE MONUMENT STAMPED "CITY OF S.M. VERTICAL CONTROL V20781980" LOCATION ON RICHLAND RD. 0.2 MI N'LY OF BORDEN RD AT N'LY CURB PCR OF "FOOTHILLS OF S.M." MOBIL HOME PARKS RECORD FROM ROS #13928 ELEV. 808.22 DATUM: U.S.C. & G.S.

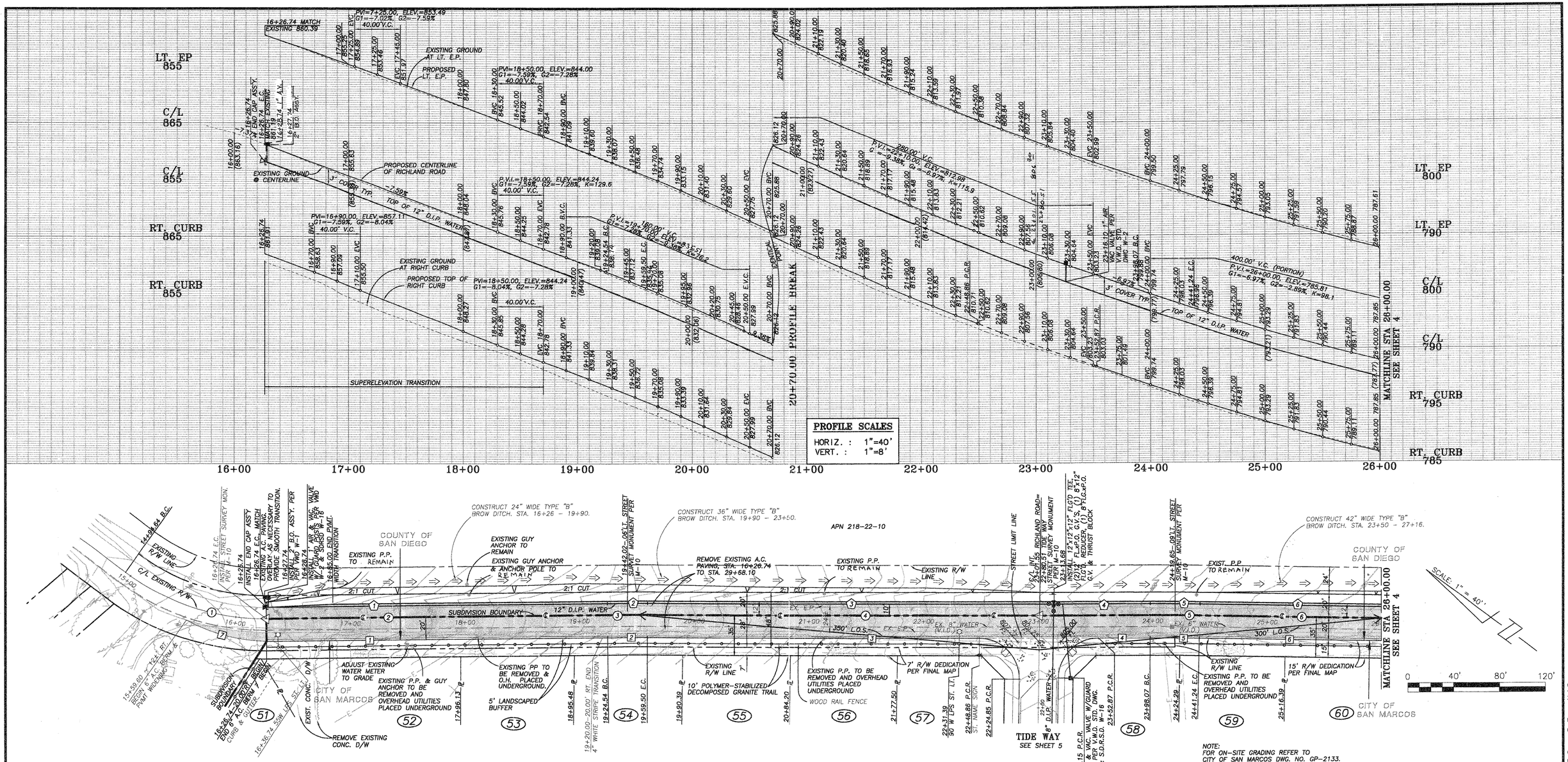
CITY OF SAN MARCOS

IMPROVEMENT PLANS FOR:
STORM DRAIN IN RICHLAND ROAD
STATION 6+94.79 thru 17+85.25

Drawing No. **CG-4071**
Sheet 5 of 9

V.W.D. 97-022

J.N. 0050-04X X:\CADD\PRJ\PRJ\UNIT_2\RICHLAND\RCH-12-03.DWG <XREF> RR & RR2-BNT 09-17-99



RICHLAND ROAD

CENTERLINE DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	37°50'40"	200.00'	132.10'	CROWN LINE
2	S38°43'58"E		297.80'	CROWN LINE
3	0°48'04"	2500.00'	34.96'	CROWN LINE
4	S37°55'54"E		438.57'	CROWN LINE
5	0°59'22"	2500.00'	43.17'	CROWN LINE
6	S36°56'32"E		158.76'	CROWN LINE

CURB DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	S38°43'58"E		297.80'	6" TYPE 'G' C&G
2	0°48'04"	2480.00'	34.68'	6" TYPE 'G' C&G
3	S37°55'54"E		289.36'	6" TYPE 'G' C&G
4	S37°55'54"E		45.20'	6" TYPE 'G' C&G
5	0°59'22"	2480.00'	42.83'	6" TYPE 'G' C&G
6	S36°56'32"E		158.76'	6" TYPE 'G' C&G
7	28°00'41"	150.00'	73.33'	6" A.C. BERM

WATER DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	S38°43'58"E		297.80'	12" D.I.P. CL. 350"
2	0°48'04"	2510.00'	35.10'	12" D.I.P. CL. 350"
3	S37°55'54"E		354.18'	12" D.I.P. CL. 350"
4	S37°55'54"E		84.39'	12" D.I.P. CL. 350"
5	0°59'22"	2510.00'	43.17'	12" D.I.P. CL. 350"
6	S 36°56'32"E		158.76'	12" D.I.P. CL. 350"

*WITH POLYETHYLENE WRAP (SEE DETAIL, SHT. 2)

CITY "AS-BUILT"

DATE

(SIGNATURE)
TOMAS E. ROMERO P.E. NO.: 29648

MY REGISTRATION EXPIRES: 3-31-03 DISCIPLINE R.C.E.

VWD "AS-BUILT"

DATE

(SIGNATURE)
TOMAS E. ROMERO P.E. NO.: 29648

MY REGISTRATION EXPIRES: 3-31-03 DISCIPLINE R.C.E.

REGISTERED PROFESSIONAL ENGINEER TOMAS E ROMERO NO. 29648 Exp. 3/31/03 CIVIL STATE OF CALIFORNIA

VWD Drawing No.

HUNSAKER & ASSOCIATES SAN DIEGO, INC.
PLANNING 10179 Huennekens St. Suite 200
ENGINEERING San Diego, Ca 92121
SURVEYING PH(619)558-4500 · FX(619)558-1414

County Drawing No. CG 4196

COUNTY OF SAN DIEGO
Approved
COUNTY ENGINEER
FOR WORK WITHIN COUNTY JURISDICTION ONLY
By: Date 12/21/01

SAN MARCOS FIRE DEPARTMENT	VALLECITOS WATER DISTRICT	ENGINEER OF WORK	CITY APPROVED CHANGES	RECOMMENDED FOR APPROVAL	APPROVED FOR CONSTRUCTION	BENCH MARK
By: Fire Marshal	By: PRESTON H. LEWIS, P.E., R.C.E. 45927 EXP. 12-31-02	By: Date: 12-3-01	No. Description App'd By Date	By: SASSAN HAGHGOO, PRINCIPLE CIVIL ENGINEER	By: Alan F. Schuler, City Engineer	Description: 4" BRASS DISK IN CONCRETE BASE STAMPED "CITY OF SAN MARCOS VERTICAL CONTROL VC 074 1990"
Date: 3/4/02	Date: 3/7/02	Name: TOMAS E. ROMERO		R.C.E.: 42201 exp.: 3-31-04	R.C.E.: 33530 exp.: 06/30/2002	Location: ON EAST SIDE OF MULBERRY DRIVE APPROX. 700' SOUTH OF INT. WITH WOODWARD DRIVE
		Drawn By R.C.E.: 29648 exp: 3-31-03		Date: 3/11/02	Date: 3/11/02	Record From: Record of Survey 13928 Elev.: 748.337 Datum: M.S.L.

CITY OF SAN MARCOS ENGINEERING DIVISION

IMPROVEMENT PLANS FOR: TSM 401

RICHLAND ROAD
STA. 16+26.74 TO STA. 26+00.00 PRESSURE ZONE 920

City Drawing No. IP-4444
Sheet 3 of 14

VWD 98-061

3 of 5

W.O. NO. 2388-1 ENGINEER: HUNSAKER & ASSOC., S.D., INC. PHONE: (858) 558-4500

COUNTY GENERAL NOTES (RICHLAND ROAD ONLY):

1. A PERMIT SHALL BE OBTAINED FROM THE COUNTY DEPARTMENT OF PUBLIC WORKS FOR ANY WORK WITHIN THE STREET RIGHT-OF-WAY.

2. THE STRUCTURAL SECTION SHALL BE IN ACCORDANCE WITH SAN DIEGO COUNTY STANDARDS AND AS APPROVED BY THE MATERIALS LABORATORY.

3. APPROVAL OF THESE IMPROVEMENT PLANS AS SHOWN DOES NOT CONSTITUTE APPROVAL OF ANY CONSTRUCTION OUTSIDE THE PROJECT BOUNDARY.

4. ALL UNDERGROUND UTILITIES WITHIN THE STREET RIGHT-OF-WAY SHALL BE CONSTRUCTED, CONNECTED AND TESTED PRIOR TO CONSTRUCTION OF BERM, CURB, CROSS GUTTER AND PAVING.

5. THE EXISTENCE AND LOCATION OF EXISTING UNDERGROUND FACILITIES SHOWN ON THESE PLANS WERE OBTAINED BY A SEARCH OF THE AVAILABLE RECORDS. TO THE BEST OF OUR KNOWLEDGE, THERE ARE NO OTHER EXISTING FACILITIES EXCEPT AS SHOWN ON THESE PLANS. HOWEVER, THE CONTRACTOR IS REQUIRED TO TAKE PRECAUTIONARY MEASURES TO PROTECT ANY EXISTING FACILITY SHOWN HEREON AND ANY OTHER WHICH IS NOT OF RECORD OR NOT SHOWN ON THESE PLANS.

6. LOCATION AND ELEVATION OF IMPROVEMENTS TO BE MET BY WORK TO BE DONE SHALL BE CONFIRMED BY FIELD MEASUREMENTS PRIOR TO CONSTRUCTION OF NEW WORK. CONTRACTOR WILL MAKE EXPLORATORY EXCAVATIONS AND LOCATE EXISTING UNDERGROUND FACILITIES SUFFICIENTLY AHEAD OF CONSTRUCTION TO PERMIT REVISIONS TO PLANS IF REVISIONS ARE NECESSARY BECAUSE OF ACTUAL LOCATION OF EXISTING FACILITIES.

7. THE CONTRACTOR SHALL NOTIFY THE SAN DIEGO GAS & ELECTRIC COMPANY PRIOR TO STARTING WORK NEAR COMPANY FACILITIES AND SHALL COORDINATE HIS WORK WITH COMPANY REPRESENTATIVES.
NOTICE: ALL ELECTRICAL AND GAS SERVICES WITHIN THIS PROJECT ARE "UNDERGROUND INSTALLATIONS". FOR LOCATION OF ELECTRICAL CABLES AND GAS PIPING AND APPURTENANCES CONTACT THE SAN DIEGO GAS AND ELECTRIC COMPANY.
TELEPHONE: 1-800-422-4133

8. THE CONTRACTOR SHALL NOTIFY THE PACIFIC BELL TELEPHONE COMPANY PRIOR TO STARTING WORK NEAR COMPANY FACILITIES AND SHALL COORDINATE HIS WORK WITH COMPANY REPRESENTATIVES:
NOTICE: ALL TELEPHONE SERVICES WITHIN THIS PROJECT ARE "UNDERGROUND INSTALLATIONS". FOR LOCATION OF CABLES AND APPURTENANCES CONTACT THE PACIFIC BELL TELEPHONE COMPANY.
TELEPHONE: 1-800-422-4133

9. IT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER TO CONTACT THE UTILITY AGENCIES, ADVISE THEM OF THE PROPOSED IMPROVEMENTS, AND BEAR THE COST OF RELOCATIONS, IF NEEDED.

10. ALL TELEVISION SERVICES WITHIN THIS PROJECT ARE "UNDERGROUND INSTALLATIONS". FOR LOCATION OF CABLES AND APPURTENANCES CONTACT THE APPROPRIATE COMPANY.

11. POWER SOURCES AND RUNS SERVING STREET LIGHTS SHALL BE SHOWN ON THE "AS-BUILT" IMPROVEMENT DRAWINGS. ALL SOURCES SHALL BE LOCATED WITHIN THE DEDICATED RIGHT-OF-WAY, OR WITHIN EASEMENTS DEDICATED TO THE COUNTY OF SAN DIEGO.

12. ALL EXISTING DRIVEWAYS SHALL BE RECONSTRUCTED TO PROVIDE SMOOTH TRANSITION.

13. NO PAVING SHALL BE DONE UNTIL EXISTING POWER POLES ARE RELOCATED OUTSIDE THE AREAS TO BE PAVED.

14. THE SUBDIVIDER SHALL CONSTRUCT ON WOOD OR ORNAMENTAL POLES, TO THE SATISFACTION OF THE DIRECTOR OF PUBLIC WORKS, A PUBLIC STREET LIGHTING SYSTEM THAT COMPLIES WITH THE FOLLOWING CONDITIONS:
[DPW-DEVELOPMENT REVIEW SECTION]
A. ALL FIXTURES SHALL USE A LOW PRESSURE SODIUM VAPOR LIGHT SOURCE AND NO MERCURY VAPOR, QUARTZ, METAL HALIDE OR HIGH PRESSURE SODIUM LAMPS SHALL BE USED.
B. DEPOSIT WITH THE COUNTY OF SAN DIEGO, THROUGH THE DEPARTMENT OF PUBLIC WORKS, A CASH DEPOSIT SUFFICIENT TO:
ENERGIZE, MAINTAIN AND OPERATE THE STREET LIGHTING SYSTEM UNTIL TAX REVENUES BEGIN ACCRUING FROM THE SUBDIVISION FOR THOSE PURPOSES.

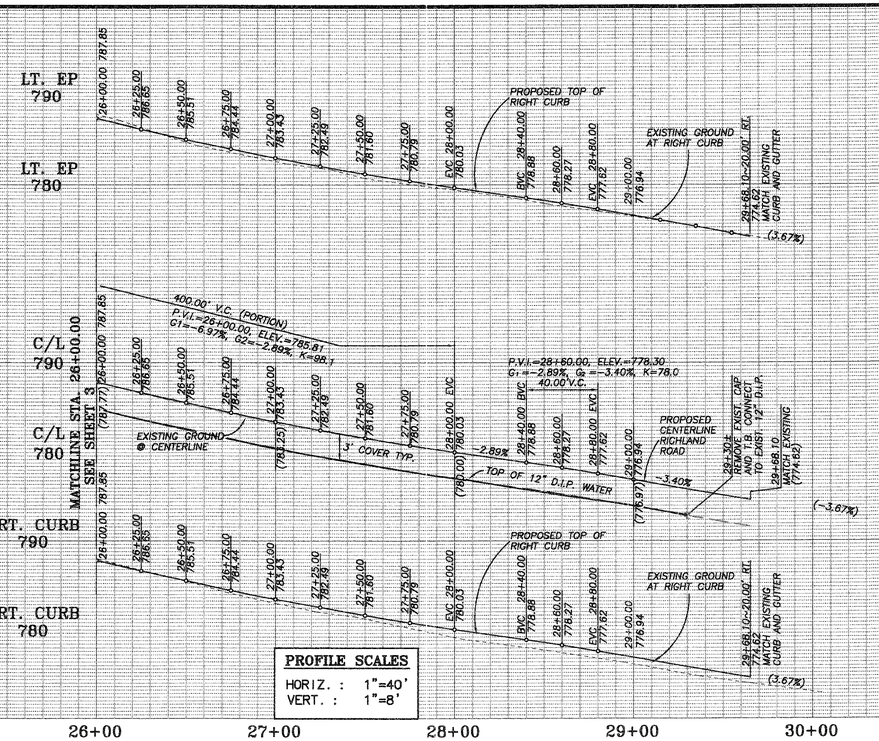
15. CONTRACTOR WILL BE RESPONSIBLE FOR THE REPLACEMENT OF ANY STRIPING OR PAVEMENT MARKERS OR LEGENDS OBLITERATED BY NEW PAVEMENT.

16. ALL NEW STRIPING AND SANDBLASTING OR REDUNDANT STRIPING SHOULD BE DONE BY CONTRACTOR.

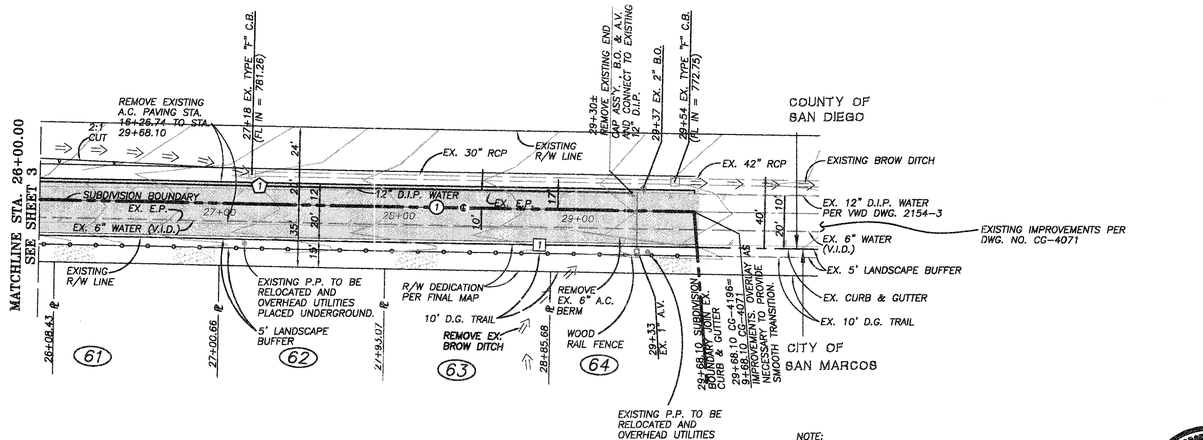
17. ALL SIGNS TO BE ALUMINUM WITH 3M HIGH INTENSITY TYPE REFLECTIVE FACE OR EQUIVALENT.

18. ALL TREES WITHIN THE COUNTY RIGHT-OF-WAY SHALL BE REMOVED.

19. GRADES OF 10-11.99%, 2-1/2" A.C. OVER COUNTY APPROVED BASE.
GRADES OF 12-13.99%, 3" A.C. OVER COUNTY APPROVED BASE.
GRADES OF 14-15.99%, 3-1/2" A.C. OVER COUNTY APPROVED BASE.
GRADES OF 16-17.99%, 4" A.C. OVER COUNTY APPROVED BASE.



PROFILE SCALES
HORIZ. : 1"=40'
VERT. : 1"=8'



NOTE:
FOR ON-SITE GRADING SEE CITY OF SAN MARCOS DWG. NO. GP-2133.

SCALE: 1" = 40'

0 40' 80' 120'

RICHLAND ROAD

REGISTERED PROFESSIONAL ENGINEER TOMAS E ROMERO NO. 29648 Exp. 3/31/03 CIVIL STATE OF CALIFORNIA

HUNSAKER & ASSOCIATES SAN DIEGO, INC
PLANNING 10179 Huennekens St. Suite 200
ENGINEERING San Diego, Ca 92121
SURVEYING PH(619)558-4500 · FX(619)558-1414

ENGINEER: HUNSAKER & ASSOC., S.D., INC.
PHONE: (858) 558-4500

W.O. NO. 2388-1

CENTERLINE DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	S36°56'32"E		365.33'	CROWN LINE

CURB DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	S36°56'32"E		368.10'	6" TYPE 'G' C&G

WATER DATA

	BEARING/DELTA	RADIUS	LENGTH	REMARKS
1	S36°56'32"E		330.43'	12" D.I.P. CL. 350*

*WITH POLYETHYLENE WRAP (SEE DETAIL, SHT. 2)

CITY "AS-BUILT"
(SIGNATURE) TOMAS E. ROMERO DATE
P.E. NO.: 29648
MY REGISTRATION EXPIRES: 3-31-03 DISCIPLINE R.C.E.

VWD "AS-BUILT"
(SIGNATURE) TOMAS E. ROMERO DATE
P.E. NO.: 29648
MY REGISTRATION EXPIRES: 3-31-03 DISCIPLINE R.C.E.

VWD Drawing No.

County Drawing No. CG 4196
COUNTY OF SAN DIEGO
Approved: Douglas M. Isbell
COUNTY ENGINEER
FOR WORK WITHIN COUNTY JURISDICTION ONLY
By: Date 12/21/01

SAN MARCOS FIRE DEPARTMENT	VALLECITOS WATER DISTRICT	ENGINEER OF WORK	CITY APPROVED CHANGES	RECOMMENDED FOR APPROVAL	APPROVED FOR CONSTRUCTION	BENCH MARK
By: Fire Marshal	By: PRESTON H. LEWIS, P.E., R.C.E. 45927 EXP. 12-31-02	By: Date: 12-3-01	No. Description App'd By Date	By: SASSAN HAGHGOO, PRINCIPLE CIVIL ENGINEER	By: Alan F. Schuler, City Engineer	Description: 3" BRASS DISK IN CONCRETE BASE, STAMPED "CITY OF SAN MARCOS VERTICAL CONTROL VC 074 1980"
Date: 3/4/02	Date: 3/7/02	Name: TOMAS E. ROMERO		R.C.E.: 42201 exp.: 3-31-04	R.C.E.: 33530 exp.: 06/30/2002	Location: ON EAST SIDE OF MULBERRY DRIVE APPROX. 700' SOUTH OF INT. WITH WOODWARD DRIVE
	Drawn By	R.C.E.: 29648 exp: 3-31-03		Date: 3/11/02	Date: 3/11/02	Record From: Record of Survey 13978 Elev.: 748.337 Datum: M.S.L.

CITY OF SAN MARCOS ENGINEERING DIVISION

IMPROVEMENT PLANS FOR: TSM 401

RICHLAND ROAD
STA. 26+00.00 TO STA. 29+65.33 PRESSURE ZONE 920

City Drawing No. IP-4444

Sheet 4 of 14

VWD 98-061

4 of 5

RECEIVED 2002 2 8
PRECISION