BONITA ROAD SELF STORAGE
PRELIMINARY DRAINAGE STUDY

Date Prepared:
July 25, 2018

Permit No: PDS2016-MUP-16-010 & PDS2016-ER-16-18-002

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

Patric T. de Boer RCE 83583
Registration Expires 3-31-2019

REGISTERED PROFESSIONAL ENGINEER
PATRIC T. DE BOER
No. C 83583
CIVIL
STATE OF CALIFORNIA

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Appendices

Site & Project Description

This hydrology study has been prepared as part of the development of the vacant lot just northeast of the intersection of Bonita Rd. and Acacia St. in the County of San Diego (Lat: 32.666 Long: -117.022°). The project site is located within the Sweetwater Hydrologic Unit and Hydrologic Sub-Area 909.12. The project proposes the construction of a Self-Storage facility with three buildings and associated hardscape. See Figure No. 1 for Vicinity Map, Figure 2 for the existing drainage limits, and Figure 3 for the proposed drainage limits.

This project is not subject to requiring approval of construction under Regional Water Quality Control Board section 401 or 404. No construction over water bodies or dredging is to occur as part of this project.

Methodology

This drainage report has been prepared in accordance with the current County of San Diego Hydrology Manual. The Modified Rational Method (MRM) was used to compute the anticipated peak runoff flowrates. As the project is proposing onsite stormwater storage for flow attenuation, the MRM was not sufficient to calculate attenuated flows after flood routing is considered. RatHydro, a hydrology program provided by Rick Engineering was used to generate a hydrograph based on the peak flow rates determined in the MRM calculations.

This hydrograph was imported into Autodesk Hydraflow Hydrographs and run through the modeled detention element of the biofiltration basin. The resulting peak flow from this was input back into the MRM calculations and confluenced with the flow from the other basins.

See the attached calculations for particulars. The following references have been used in preparation of this report:

(1) Handbook of Hydraulics, E.F. Brater & H.W. King, 6th Ed., 1976.
(2) Modern Sewer Design, American Iron & Steel Institute, 1st Ed., 1980.
(3) County of San Diego Hydrology Manual, 2003

Culvert Design and Analysis

The storm drain culverts were sized using the K' values from King's Handbook Appendix 7-14, (Appendix 7.0 of this report). The following formula was used:

Q= (K'/n)*d^(8/3)*s^(0.5)
K'= Discharge Factor
d=Diameter of Conduit (ft)
n=Manning's Coefficient
Q=Runoff Discharge (cfs)
s=Pipe Slope (ft/ft)

Rational Method

Q=CIA

Where:

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

C=runoff coefficient, proportion of the rainfall that runs off the surface (no units)

=(0.90*(% impervious)+Cp*(1-% Impervious)) page 5, County Hydrology Manual

I =average rainfall intensity for a duration equal to the Tc for the area, (in/hr)

= 7.44*P6*Tc-0.645

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

Cp= Pervious Coefficient Runoff Value, County of San Diego Hydrology Manual minimum of 0.35

$$Tc = \frac{1.8\,(1.1-C)*(Tc)^{0.5}*}{S^{0.33}}$$

S= Slope of drainage course*

Existing Conditions

The existing site consists of an unoccupied field split near the northern property line by an existing channel. The southern basin slopes at roughly 2% to the northwest and the northern basin that includes the channel slopes at 0.50% west. The project site is approximately 4.25 acres with no existing permanent structures or hardscape. The site is 100% pervious and is Type C soil. Offsite flow from portions of the adjacent lots is conveyed through the project site. The total area of analysis including offsite and onsite area is 5.43 acres

Proposed Conditions

The proposed site will consist of a self-storage facility with 3 separate buildings. The facility will be located on the southerly portion of the site, with no disturbance proposed in the drainage channel that bisects the northern portion of the site.

Runoff produced by the impervious areas of the project will drain to a single biofiltration basin located the northerly boundary of the project. The biofiltration basin will provide stormwater treatment to meet water quality objectives (see SWQMP), as well as stormwater storage and flow attenuation for the flow control that is detailed in this report. Offsite areas and pervious onsite areas drain to a private storm drain system that will convey runoff directly to a discharge point at the existing drainage channel north of the site. All flow that generated by the proposed area of analysis will confluence in the private storm drain system prior to discharge from the site.

Existing Runoff Analysis

The Modified Rational Method was used for calculating existing peak flow rates for the 100 year, 6 hour storm. Analysis of the existing conditions breaks the site into three separate drainage areas. The Soil Hydrologic Groups Map from the San Diego Hydrology Manual indicates group C soil

(soil map in Appendix 1.1). Per table 3-1 of the County Hydrology Manual, Runoff coefficients of 0.30 are to be used for undisturbed natural terrain. For basins with impervious area a weighted runoff coefficient was calculated using a value of 0.90 for impervious areas.

The existing area of analysis was found to have a overall time of concentration of 10.5 minutes. The confluenced peak flow generated by the existing area of analysis for the 100-year storm was found to be 9.85 cfs.

Existing Conditions Data Table

Basin	C	T	I	A	Q_{100}
EX-1	0.30	10.5	4.50	3.98	5.37
EX-2	0.67	5.0	7.25	0.68	3.06
EX-3	0.80	5.7	6.64	0.77	3.80

Confluenced Flow from all basins is 9.85 cfs.
See attached calculations for details.

Proposed Runoff Analysis

The proposed area of analysis was modeled as 5 separate basins, which confluence at various points on the project site before discharging to the earthen channel that runs through the site. Runoff Coefficients in the range of 0.30 to 0.82 were used for the proposed basins.

The proposed area of analysis was found to have a time of concentration of 9.1 minutes. The confluenced peak flow generated by the proposed area of analysis was found to be 19.06 cfs. As this rate higher than existing conditions, 100-year flow control was found to be necessary. Using RatHydro a program that generates hydrographs from Rational Method Data, a hydrograph of basin A-5 was generated. This hydrograph was input into Autodesk Hydraflow Hydrographs and run through a modeled storage element representing the biofiltration basin at the west end of the site. The outlet structure was modeled as a V-notch weir and a 1" low flow orifice.

The ponding of water and controlled outflow from the biofiltration basin attenuates the flow such that when confluenced with flows from the rest of the site, the total peak flowrate generated by the proposed site is less than or equal to the existing conditions. This will prevent negative impacts to downstream conveyances.

The proposed area of analysis was found to have an overall time of concentration of 9.1 minutes. The confluenced peak flow generated by the proposed area of analysis for the 100-year storm was found to be 19.06 cfs. This will be attenuated via onsite storage to 9.75 cfs.

Proposed Conditions Data Table

Basin	C	T	I	A	Q_{100}
A-1	0.30	9.0	4.94	0.40	0.60
A-2	0.74	5.7	6.64	0.77	3.80
A-3	0.62	5.0	7.25	0.68	3.06
A-4	0.30	5.0	7.25	0.23	0.49
A-5	0.82	9.1	4.92	3.35	4.24*

*Flow from basin A-5 to be attenuated from 13.55 cfs to 4.24 cfs through storage in a biofiltration basin and controlled release. All 5 basins confluence at various points onsite for a total mitigated Q_{100} at the discharge point of 9.76 cfs

See the attached calculations for details.

Results and Conclusions

The redevelopment of the site will result in an increase in generated peak flow rates for the 100-year, 6-hour storm event. This will be mitigated by storing the excess runoff in a biofiltration area and releasing it at a reduced rate. The result is a confluenced peak flow rate at the site discharge point that does not exceed the existing conditions.

The project will modify the onsite drainage pattern, but the discharge point will remain the same. Due to the measures taken to mitigate flow impacts, the project site is not anticipated to have a negative effect on the downstream receiving water.

The project is located in a flood hazard area (FEMA zone AE), but the proposed grading will import soil to raise the finish floor elevation of all structures on site above the base flood elevation. It is the opinion of Omega Engineering Consultants that the project will not cause adverse effects to the downstream facilities or receiving waters.

The project site is 1.5 miles downstream of the Sweetwater Dam. Per Figure S-6 of Chapter 7 of the County General Plan, the project is within an identified Dam Inundation Area. The failure of the dam would expose the people and structures onsite to significant risk of loss, injury or death involving flooding.

A separate Storm Water Quality Management Plan (SWQMP) has been prepared to discuss the water quality impacts for the proposed development.

Bonita Self Storage
HYDROLOGY AND HYDRAULICS CALCS (Table No. 1)

7/25/2018

BASIN	AREA (SF)	AREA (AC)	% Imp	"C" Value
EX-1	173,360	3.98	0%	0.30
EX-2	29,798	0.68	53%	0.62
EX-3	33,545	0.77	74%	0.74
EX. TOTAL	**236,703**	**5.43**	17%	
A-1	17,611	0.40	0%	0.30
A-2	33,545	0.77	74%	0.74
A-3	29,798	0.68	53%	0.62
A-4	9,881	0.23	0%	0.30
A-5	145,878	3.35	87%	0.82
PROP TOTAL	**236,713**	**5.43**	71%	

Basin Confluence	Symbol
EXISTING	
(EX-1:EX-2)	ECP#1
(ECP#1:EX-3)	ECP#2
PROPOSED	
(A-1 & A-2)	CP#1
(CP#1 & A-3)	CP#2
(CP#2 & A-4)	CP#3
(CP#3 & A-5)	CP#4

(A) ECP # - Existing Confluence Point

(B) CP # - Proposed Confluence Point

(C) C value for bare ground is 0.30 (Table 3-1 County Hydrology Manual) (Type 'C' soil)

C value for impervious surfaces is 0.9

Basins with mixed surface type use a weighted average of these 2 values. (impervious % x 0.9)+(pervious % x 0.30)

Bonita Self Storage 7/25/2018

HYDROLOGY AND HYDRAULICS CALCS (Table No. 2)

Sub-Basin	AREA Ac.	"C"	CA	Overland flow length	Concentrated Flow Length, (ft)	H (ft) (elev)	S(%) (avg.)	Ti mins	Tt mins	T tot mins	I in/hr	Q cfs	Q tot cfs	NOTES 85TH
EX-1	3.98	0.30	1.19	100.0	560.0	12.00	2.1%	6.9	3.6	10.5	0.20	0.24	0.24	
EX-2	0.68	0.62	0.42	75.0	170.0	4.00	2.4%	4.0	0.9	5.0	0.20	0.08	0.08	
ECP #1										10.5	0.20		0.32	
EX-3	0.77	0.74	0.57	75.0	270.0	6.00	2.2%	4.0	1.7	5.7	0.20	0.11	0.11	
ECP #2										10.5	0.20		0.44	
									Existing Confluenced Runoff				**0.44**	
A-1	0.40	0.30	0.12	100.0	450.0	10.00	2.9%	6.9	2.1	9.0	0.20	0.02	0.02	
A-2	0.77	0.74	0.57	75.0	270.0	6.00	2.2%	4.0	1.7	5.7	0.20	0.11	0.11	
CP #1										5.7	0.20		0.14	
A-3	0.68	0.62	0.42	220.0	240.0	4.00	2.4%	4.0	0.9	5.0	0.20	0.08	0.08	
CP #2										5.0	0.20		0.22	
A-4	0.23	0.30	0.07	220.0	180.0	2.00	0.9%	4.1	0.9	5.0	0.20	0.01	0.01	
CP #3										5.0	0.20		0.24	
A-5	3.35	0.82	2.75	60.0	450.0	3.00	0.5%	4.1	2.1	6.2	0.20	0.55	0.55	
CP #4										5.0	0.20		0.79	
									Proposed Confluenced Runoff				**0.79**	

Bonita Self Storage 7/25/2018

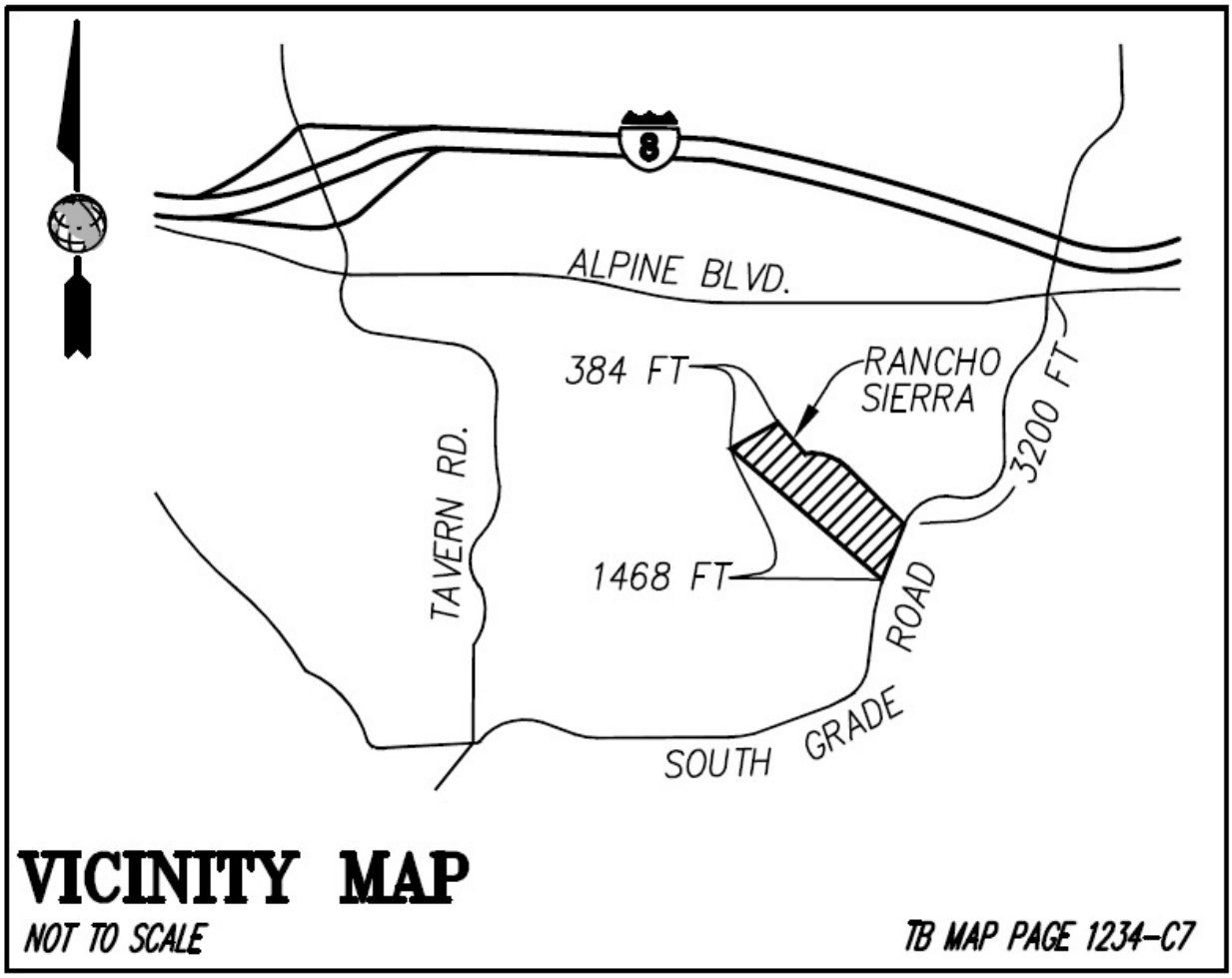
HYDROLOGY AND HYDRAULICS CALCS (Table No. 2)

Sub-Basin	AREA Ac.	"C"	CA	Overland flow length	Total Basin Flow Length, (ft)	H (ft) (elev)	S(%) (avg.)	Ti mins	Tc mins	T tot mins	I in/hr	Q cfs	Q tot cfs	NOTES 100-Year Storm P(6) 2.75
EX-1	3.98	0.30	1.19	100	560	12.00	2.1%	6.9	3.6	10.5	4.50	5.37	5.37	
EX-2	0.68	0.62	0.42	75	170	4.00	2.4%	4.0	0.9	5.0	7.25	3.06	3.06	
ECP #1										10.5	4.50		7.27	
EX-3	0.77	0.74	0.57	75	270	6.00	2.2%	4.0	1.7	5.7	6.64	3.80	3.80	
ECP #2										10.5	0.20		9.85	
									Existing Confluenced Runoff				**9.85**	
A-1	0.40	0.30	0.12	100	450	10.00	2.9%	6.9	2.1	9.0	4.94	0.60	0.60	
A-2	0.77	0.74	0.57	75	270	6.00	2.2%	4.0	1.7	5.7	6.64	3.80	3.80	
CP #1										5.7	6.64		4.18	
A-3	0.68	0.62	0.42	75	170	4.00	2.4%	4.0	0.9	5.0	7.25	3.06	3.06	
CP #2										5.7	6.64		6.99	
A-4	0.23	0.30	0.07	60	180	2.00	0.9%	4.1	0.9	5.0	7.25	0.49	0.49	
CP #3										5.7	6.64		7.44	
A-5	3.35	0.82	2.75	50	800	3.00	0.5%	5.3	3.8	9.1	4.92	13.55	13.55	
CP #4										9.1	4.92		19.06	
									Proposed Confluenced Runoff				**19.06**	

Bonita Self Storage 7/25/2018

HYDROLOGY AND HYDRAULICS CALCS (Table No. 2)

Sub-Basin	AREA Ac.	"C"	CA	Overland flow length	Total Basin Flow Length, (ft)	H (ft) (elev)	S(%) (avg.)	Ti mins	Tc mins	T tot mins	I in/hr	Q cfs	Q tot cfs	NOTES 100-Year Storm P(6) 2.75
EX-1	3.98	0.30	1.19	100	560	12.00	2.1%	6.9	3.6	10.5	4.50	5.37	5.37	
EX-2	0.68	0.62	0.42	75	170	4.00	2.4%	4.0	0.9	5.0	7.25	3.06	3.06	
ECP #1										10.5	4.50		7.27	
EX-3	0.77	0.74	0.57	75	270	6.00	2.2%	4.0	1.7	5.7	6.64	3.80	3.80	
ECP #2										10.5	0.20		9.85	
									Existing Confluenced Runoff				**9.85**	
A-1	0.40	0.30	0.12	100	450	10.00	2.9%	6.9	2.1	9.0	4.94	0.60	0.60	
A-2	0.77	0.74	0.57	75	270	6.00	2.2%	4.0	1.7	5.7	6.64	3.80	3.80	
CP #1										5.7	6.64		4.18	
A-3	0.68	0.62	0.42	75	170	4.00	2.4%	4.0	0.9	5.0	7.25	3.06	3.06	
CP #2										5.7	6.64		6.99	
A-4	0.23	0.30	0.07	60	180	2.00	0.9%	4.1	0.9	5.0	7.25	0.49	0.49	
CP #3										5.7	6.64		7.44	
A-5	3.35	0.82	2.75	50	800	3.00	0.5%	5.3	3.8	9.1	4.92	13.55	4.24	*Mitigated by outlet control see Hydraflow Hydrographs calculation for pond routing
CP #4										9.1	4.92		9.76	
									Proposed Confluenced Runoff				**9.76**	

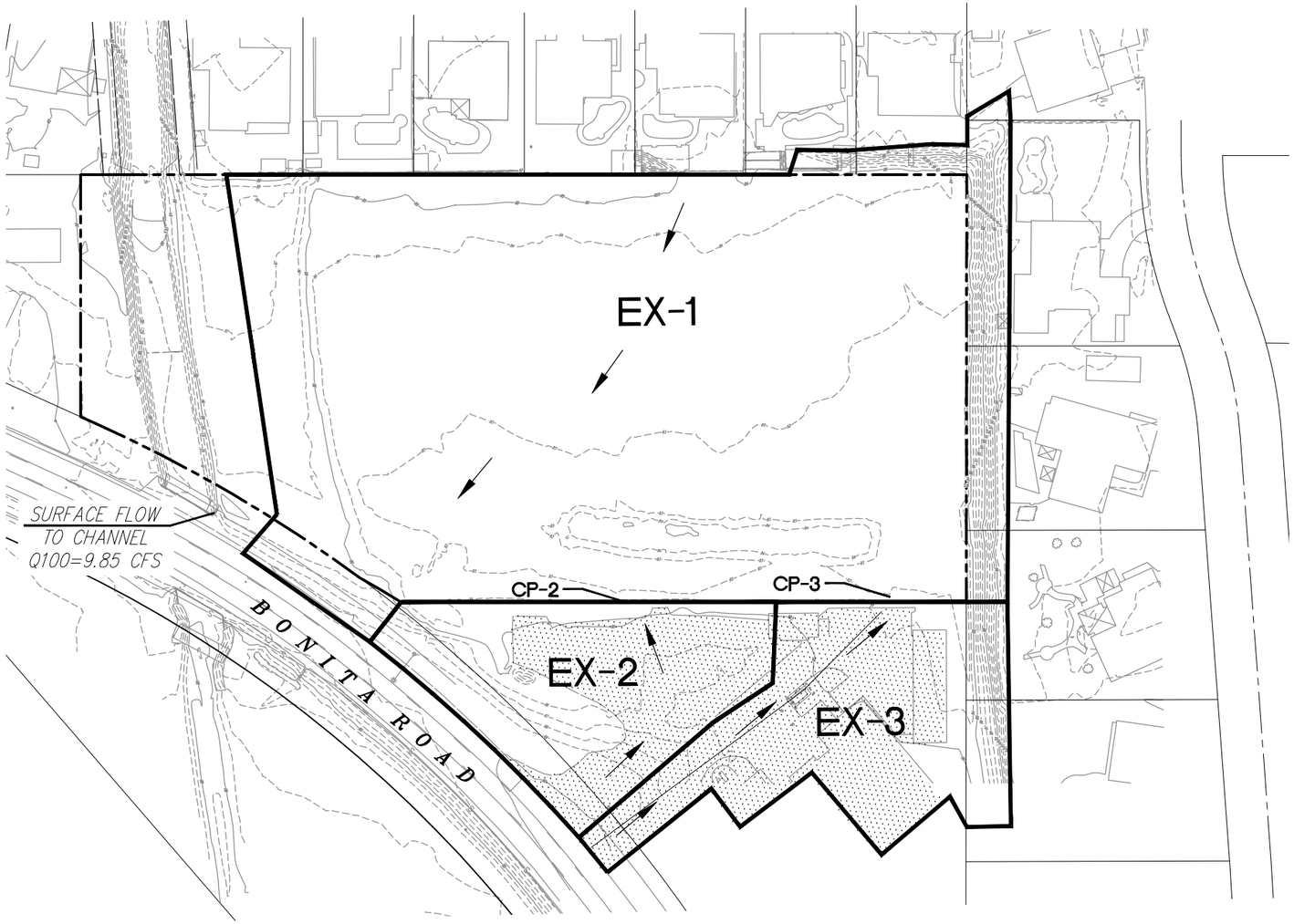


VICINITY MAP

NOT TO SCALE

TB MAP PAGE 1234-C7

BONITA SELF STORAGE
EXISTING HYDROLOGY EXHIBIT



LEGEND:

- PROJECT BOUNDARY
- AREA LIMITS
- DRAINAGE DIRECTION ARROW
- BASIN NUMBER — EX-#
- PAVEMENT AREA
- PERVIOUS AREA

TABLE OF BASIN DATA

BASIN	AREA	IMPERVIOUS %	Q_{100}
EX-1	3.98 AC	0%	5.37 CFS
EX-2	0.68 AC	53%	3.06 CFS
EX-3	0.77 AC	74%	3.80 CFS
TOTAL	5.43 AC	17%	9.85 CFS

GRAPHICAL SCALE: 1" = 100'

0 50 100 200

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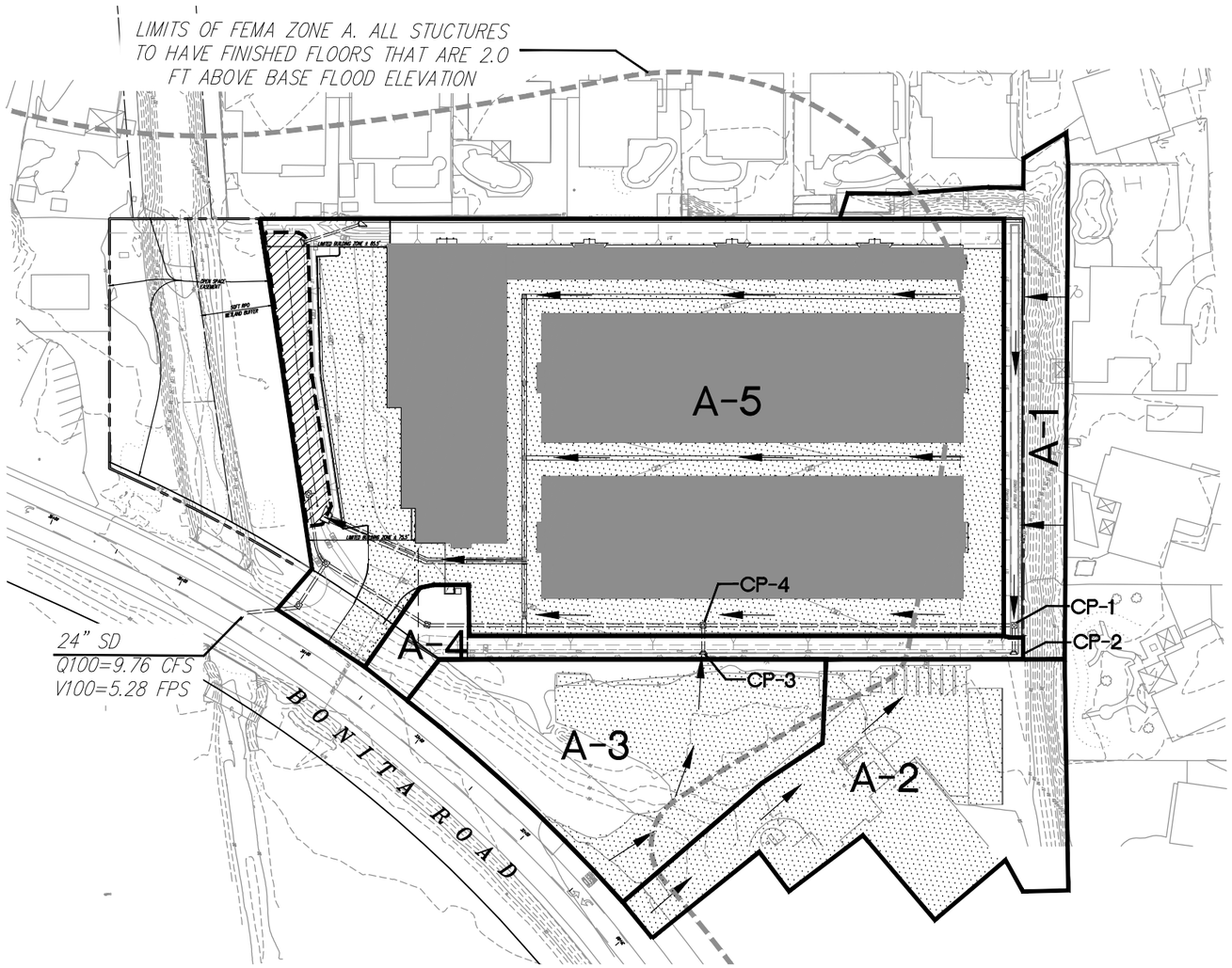
FIGURE 2

BONITA SELF STORAGE
PROPOSED HYDROLOGY EXHIBIT



LEGEND:

- PROJECT BOUNDARY
- AREA LIMITS
- DRAINAGE DIRECTION ARROW
- BASIN NUMBER — EX-#
- PAVEMENT AREA
- ROOFTOP AREA
- PERVIOUS AREA

TABLE OF BASIN DATA			
BASIN	AREA	IMPERVIOUS %	Q_{100}
A-1	0.30 AC	0%	0.60 CFS
A-2	0.74 AC	74%	3.80 CFS
A-3	0.62 AC	53%	3.06 CFS
A-4	0.30 AC	0%	0.49 CFS
A-5	0.82 AC	87%	4.24 CFS*
TOT:	5.43 AC	71%	9.76 CFS

* FLOW FROM BASIN A-4 PRIOR TO MITIGATION IS 13.55 CFS.

GRAPHICAL SCALE: 1" = 100'

0 50 100 200

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FIGURE 3

UNMITIGATED HYDROGRAPH FOR BASIN A-5

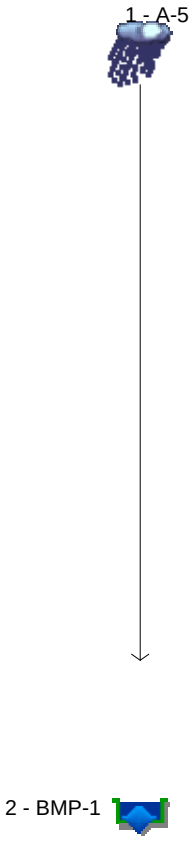
TIME OF CONCENTRATION 9 MIN
6 HR RAINFALL 2.75 INCHES
BASIN AREA 3.35 ACRES
RUNOFF COEFFICIENT 0.82
PEAK DISCHARGE 13.55 CFS

TIME (MIN) =	0	DISCHARGE (CFS) =	0
TIME (MIN) =	9	DISCHARGE (CFS) =	0
TIME (MIN) =	18	DISCHARGE (CFS) =	0.5
TIME (MIN) =	27	DISCHARGE (CFS) =	0.5
TIME (MIN) =	36	DISCHARGE (CFS) =	0.5
TIME (MIN) =	45	DISCHARGE (CFS) =	0.5
TIME (MIN) =	54	DISCHARGE (CFS) =	0.5
TIME (MIN) =	63	DISCHARGE (CFS) =	0.5
TIME (MIN) =	72	DISCHARGE (CFS) =	0.5
TIME (MIN) =	81	DISCHARGE (CFS) =	0.6
TIME (MIN) =	90	DISCHARGE (CFS) =	0.6
TIME (MIN) =	99	DISCHARGE (CFS) =	0.6
TIME (MIN) =	108	DISCHARGE (CFS) =	0.6
TIME (MIN) =	117	DISCHARGE (CFS) =	0.6
TIME (MIN) =	126	DISCHARGE (CFS) =	0.7
TIME (MIN) =	135	DISCHARGE (CFS) =	0.7
TIME (MIN) =	144	DISCHARGE (CFS) =	0.8
TIME (MIN) =	153	DISCHARGE (CFS) =	0.8
TIME (MIN) =	162	DISCHARGE (CFS) =	0.9
TIME (MIN) =	171	DISCHARGE (CFS) =	0.9
TIME (MIN) =	180	DISCHARGE (CFS) =	1
TIME (MIN) =	189	DISCHARGE (CFS) =	1.1
TIME (MIN) =	198	DISCHARGE (CFS) =	1.2
TIME (MIN) =	207	DISCHARGE (CFS) =	1
TIME (MIN) =	216	DISCHARGE (CFS) =	1.6
TIME (MIN) =	225	DISCHARGE (CFS) =	1.8
TIME (MIN) =	234	DISCHARGE (CFS) =	2.7
TIME (MIN) =	243	DISCHARGE (CFS) =	3.9
TIME (MIN) =	252	DISCHARGE (CFS) =	13.55
TIME (MIN) =	261	DISCHARGE (CFS) =	2.2
TIME (MIN) =	270	DISCHARGE (CFS) =	1
TIME (MIN) =	279	DISCHARGE (CFS) =	1.1
TIME (MIN) =	288	DISCHARGE (CFS) =	0.9
TIME (MIN) =	297	DISCHARGE (CFS) =	0.8
TIME (MIN) =	306	DISCHARGE (CFS) =	0.7
TIME (MIN) =	315	DISCHARGE (CFS) =	0.7
TIME (MIN) =	324	DISCHARGE (CFS) =	0.6
TIME (MIN) =	333	DISCHARGE (CFS) =	0.6
TIME (MIN) =	342	DISCHARGE (CFS) =	0.5
TIME (MIN) =	351	DISCHARGE (CFS) =	0.5
TIME (MIN) =	360	DISCHARGE (CFS) =	0.5
TIME (MIN) =	369	DISCHARGE (CFS) =	0

Note:
This hydrograph was generated using RatHydro, using input data that was determined via the preceding Rational Method Calculations. The hydrograph was input into Autodesk Hydraflow Hydrographs and was run through a modeled storage element with a raised overflow structure. See the following pages for the Hydraflow Hydrograph calculations for details on the storage and orifice flow analysis.

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

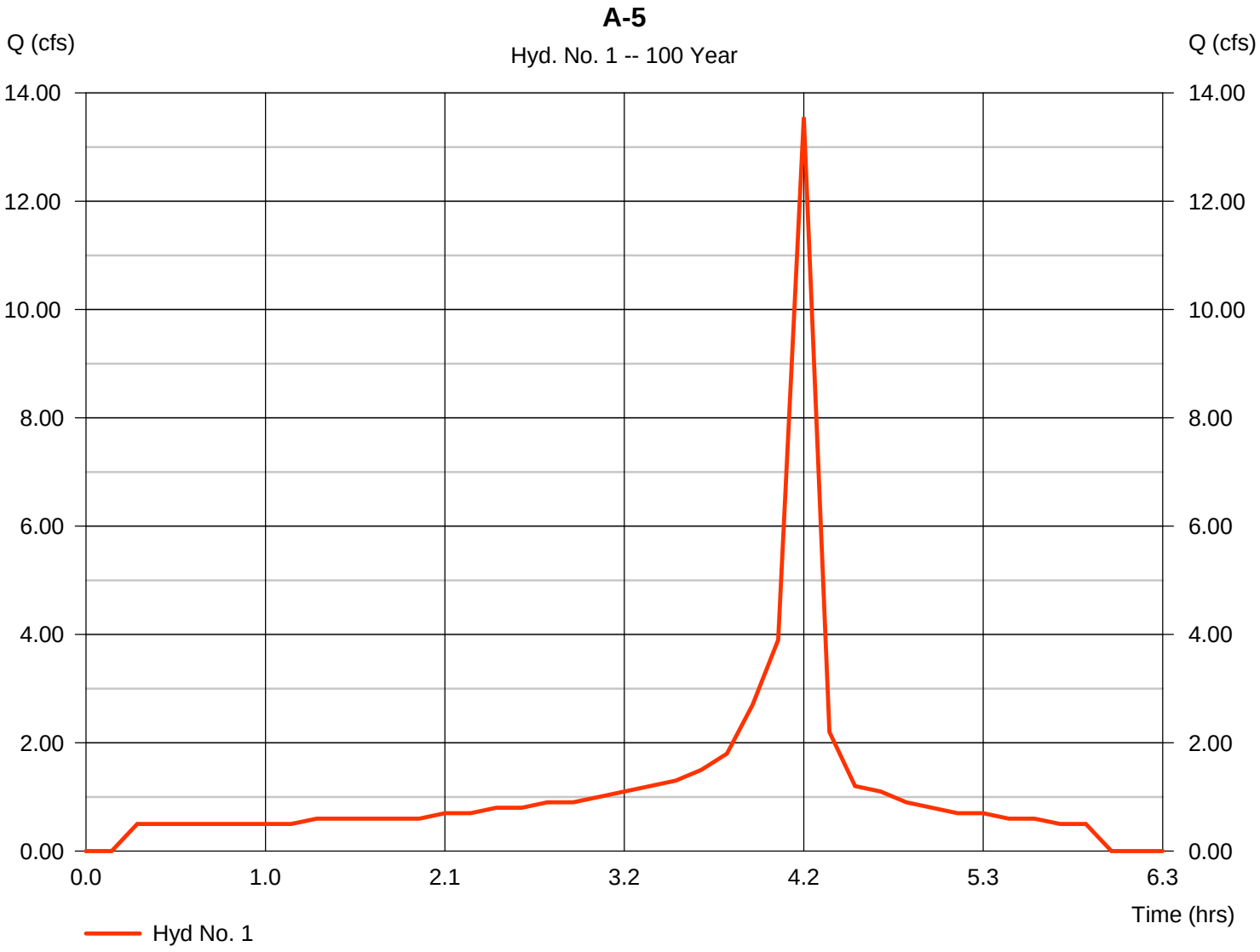


Hydrograph Report

Hyd. No. 1

A-5

Hydrograph type	= Manual	Peak discharge	= 13.55 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.20 hrs
Time interval	= 9 min	Hyd. volume	= 26,541 cuft



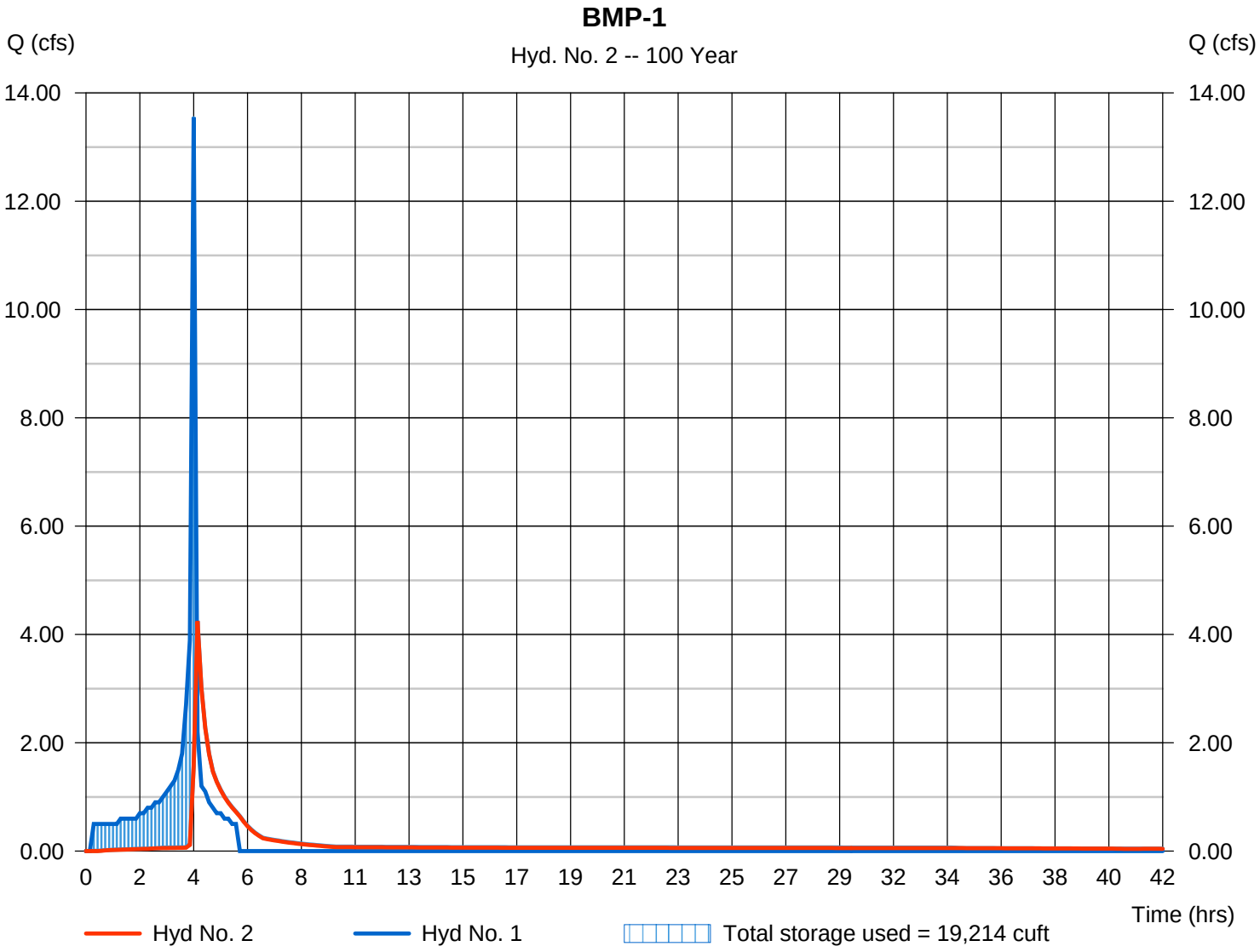
Hydrograph Report

Hyd. No. 2

BMP-1

Hydrograph type	=	Reservoir	Peak discharge	=	4.243 cfs
Storm frequency	=	100 yrs	Time to peak	=	4.35 hrs
Time interval	=	9 min	Hyd. volume	=	24,202 cuft
Inflow hyd. No.	=	1 - A-5	Max. Elevation	=	107.19 ft
Reservoir name	=	BMP-1	Max. Storage	=	19,214 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - BMP-1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 100.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	4,400	0	0
0.01	100.01	1,760	30	30
2.50	102.50	1,760	4,382	4,412
2.51	102.51	880	13	4,425
4.00	104.00	880	1,311	5,736
4.01	104.01	4,400	24	5,760
7.50	107.50	4,400	15,354	21,114

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 1.00	0.00	0.00	0.00
Span (in)	= 1.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.25	0.00	0.00	0.00
Length (ft)	= 0.50	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.65	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

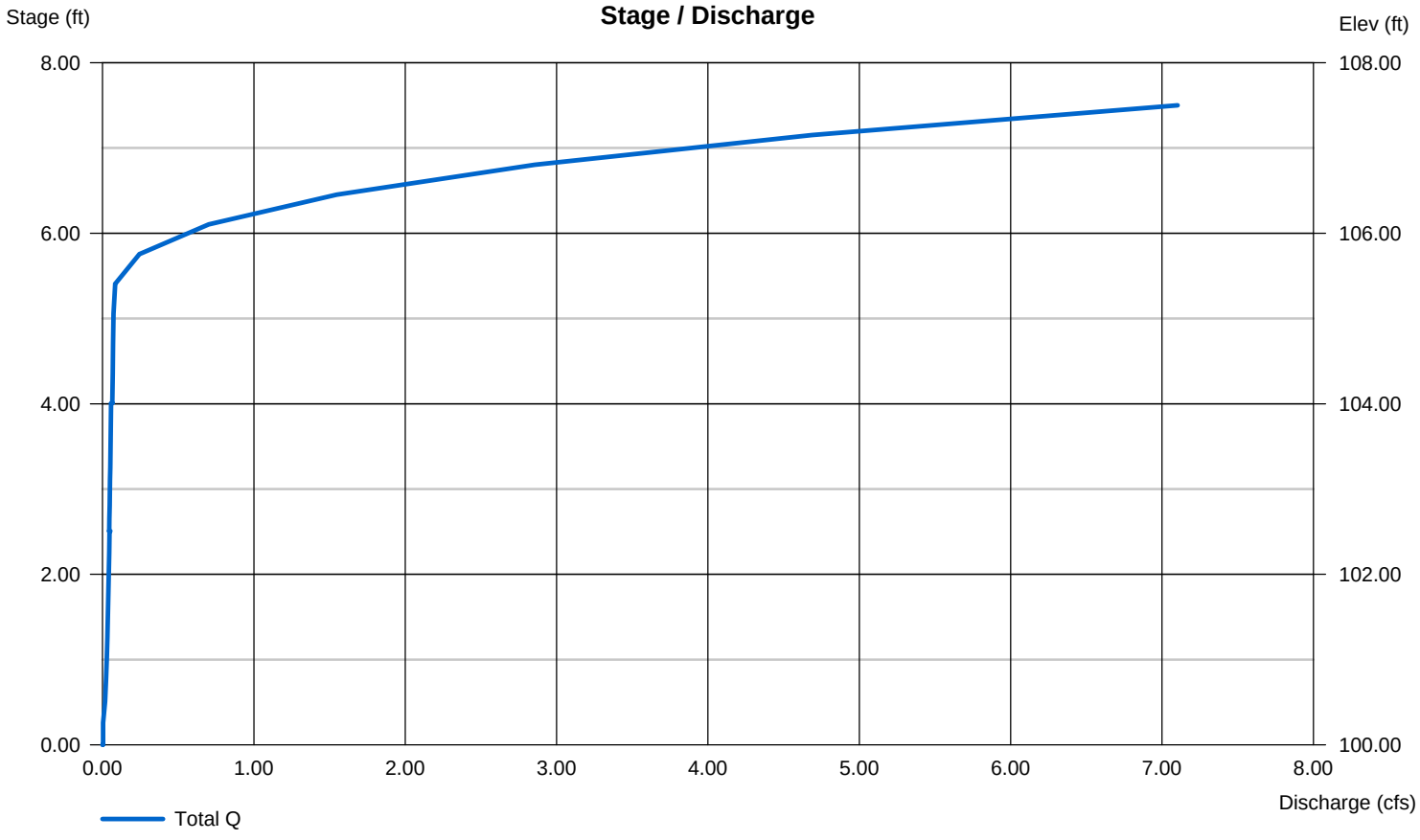
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 105.25	0.00	0.00	0.00
Weir Coeff.	= 0.92	3.33	3.33	3.33
Weir Type	= 40 degV	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.100 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

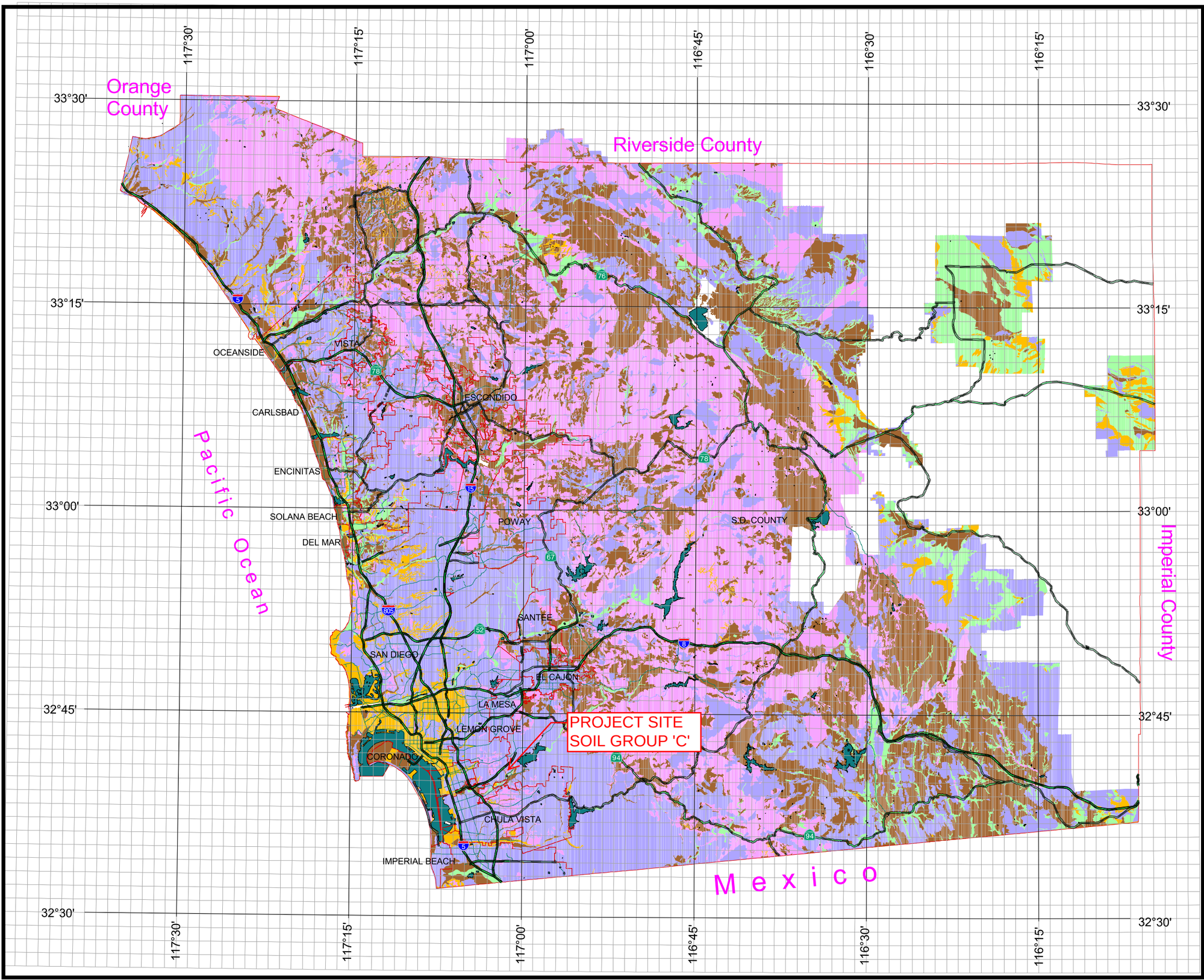


Appendices

Appendix 1

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

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

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APPENDIX 1.0

Appendix 2

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

PROJECT SITE

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

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

33°30' 33°15' 33°00' 32°45' 32°30'

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APPENDIX 2.0

Appendix 3

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

PROJECT SITE

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

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

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APPENDIX 3.0

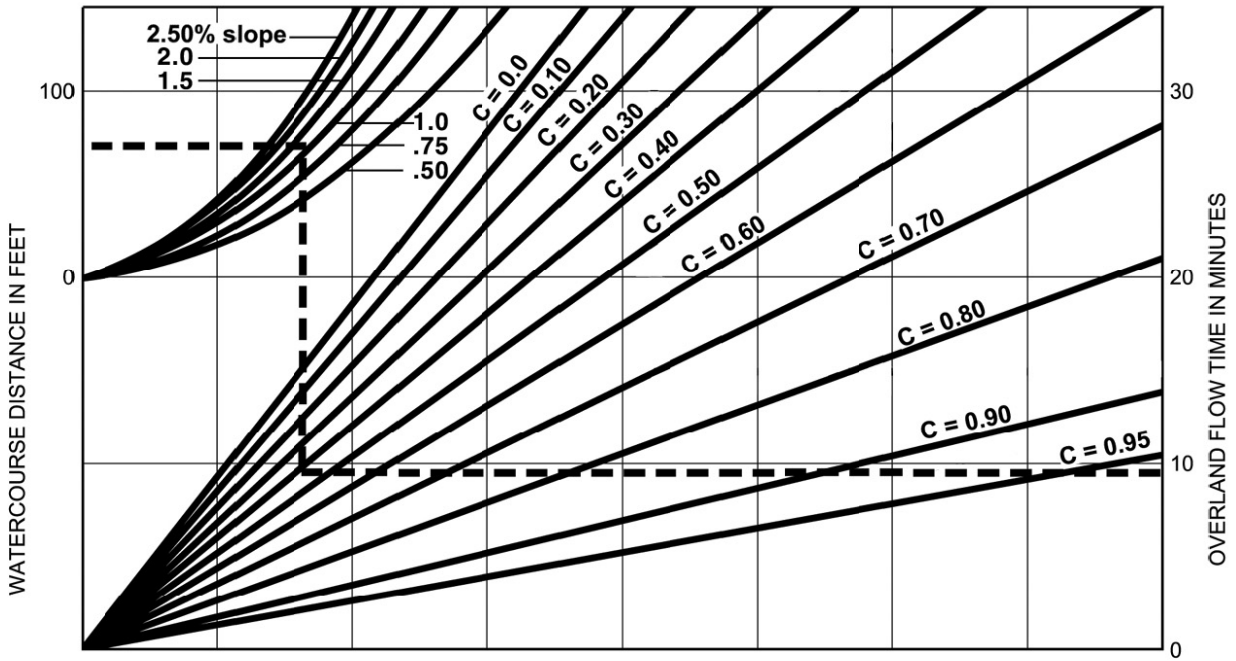
Appendix 4

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

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

Appendix 5



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE 3-3

Appendix 6

Appendix 7

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

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

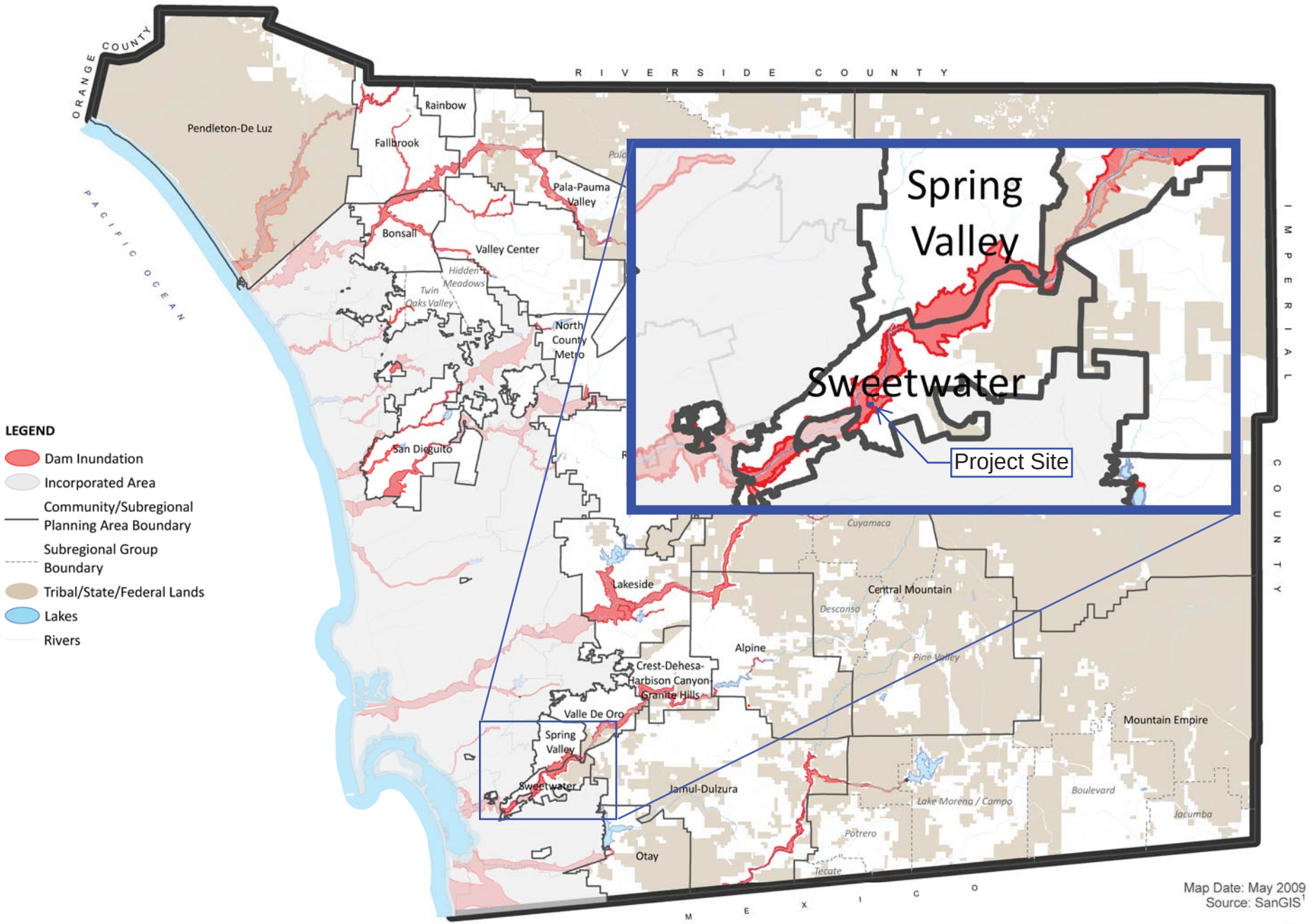
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Appendix 8



DAM INUNDATION AREAS

San Diego County General Plan

Figure S-6