Woodside Self-Storage
Drainage Study

12407-12413 Woodside Avenue
Lakeside, CA 92040
Permit #: PDS2022-MUP-22-006

Date Prepared:
November 22, 2023

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	3-31-2025

REGISTERED PROFESSIONAL ENGINEER
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Appendices

Site & Project Description

This drainage study has been prepared for the proposed commercial development at 12407-12413 Woodside Avenue, Lakeside, CA 92040. The proposed improvements include a three-story self-storage building with a one-story subterranean level, a driveway, and two tree wells. The total area of analysis is 7.57 acres, which includes portions of the offsite flow. The offsite areas include the existing development next to the project and portion of Cactus Street and Woodside Avenue. The site is located approximately 0.5 miles south of State Route 67. See figure No. 1 for a Vicinity Map.

The proposed project will construct a lined biofiltration basin in the frontage of the property for stormwater treatment purposes. The treatment properties of the facility are detailed in a separate Stormwater Quality Report (SWQMP).

Methodology

This drainage report has been prepared in accordance with current County of San Diego regulations and procedures. The Modified Rational Method was used to determine the peak flowrates generated by the existing and proposed site conditions.

The proposed storm drain pipes and channels were sized using Manning's Equation as specified for conduits in the San Diego County Hydraulic Design Manual.

The initial time of concentration (Ti) and maximum overland flow length (Lm) were determined using Table 3-2 of the Hydrology Manual included as Appendix 6 on this report. Ti values were selected based off the slope and associated imperviousness of each basin.

The 100-yr, 6-hr storm depth (P_6) was determined using the isopluvial map included as Appendix 2 on this report.

The effective slope has been determined using Figure 3-5 of the Hydrology Manual included as Appendix 8 on this report.

The overland time of flow was determined using the equation shown on Appendix 7.

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

The travel time (Tt) for natural watersheds was determined using the equation shown on Appendix 8.

$$\mathbf{Tt} = \left(\frac{11.9L^3}{E}\right)^{0.385}$$

The total time of concentration was determined by adding the Ti value to the travel time (Tt).

$$\mathbf{Tc = Ti+Tt}$$

The Tc and the P_6 values were entered into the peak intensity formula from page 3-7 of the hydrology manual to determine the intensity of the rainfall during the peak of the 100-year, 6-hr storm.

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

The peak discharge rate was determined using the Rational Method Formula.

$$Q = C \times I \times A$$

In cases where the stormwater of a subarea continues directly the flow path of the downstream subarea, the following equation is used to determine the peak discharge rate:

$$Q = \Sigma (CA) I$$

Where, the summation the area and the runoff coefficient of the upstream and downstream subareas are added prior to multiplying by the intensity.

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

(1) San Diego County Hydraulic Design Manual, 2014
(2) County of San Diego Hydrology Manual, 2003
(3) Modern Sewer Design, American Iron & Steel Institute, 1st Ed., 1980

Existing Conditions

The site is currently a vacant lot located at the southeasterly corner of a commercial development plaza. The site is relatively flat with an average slope of 1.0%. The site includes paved drive aisles on the south and north sides of the site. The analysis includes the existing commercial development around the site and a portion of Cactus Street and Woodside Avenue.

The northerly portion of the site drains via sheet flow to the northwest direction and comingles with the offsite flow of the existing developed plaza until it ultimately reaches the storm drain inlet on Woodside Avenue. The offsite flow generated by Woodside Avenue and Cactus Street confluences with the flow of the entire plaza at the existing curb inlet on Woodside Avenue. This point is referred to as Discharge Point # 1 in this report.

The southerly drive aisle drains via sheet flow to the west until it reaches a grated inlet at the low point of the existing development. This point is referred to as Discharge Point # 2 in this report.

Proposed Conditions

The proposed improvements include the construction of a three-story self-storage building, drive aisles and private storm drain system. The project proposes to grade the entire site but will keep the same discharge points.

The northerly portion of the site will drain via gutter flow to the west, thence via sheet flow to the northwesterly direction where it comingles with the offsite flow of the existing developed plaza until it reaches the storm drain curb inlet on Woodside Avenue. The entire proposed building will drain to a proposed lined biofiltration basin that will drain to a curb outlet on Cactus Street, thence confluence with the flow generated by Woodside Avenue and Cactus Street, and ultimately drain at the storm drain curb inlet on Woodside Avenue.
The southerly drive aisle will drain via gutter and sheet flow to the west until it reaches a grated inlet at the low point of the existing development.

The proposed site proposes a diversion of flow by draining to the gutter on Cactus Street, whereas in the existing conditions the site drains to the northwest direction towards the existing development and ultimately drains to the public storm drain system on Woodside Avenue. Hydraulic calculations for the street gutter capacity on Cactus Street and Woodside Avenue have been provided in Appendix 12. The calculations demonstrate that the additional flow discharged on Cactus and Woodside Avenue will not over-capacitate the street gutter.

Existing Rational Analysis

The existing site is modeled as five basins. The existing basins are referred to as E-1.1, E-2.1, O-1, O-2 and O-3 in this report. The slope of the basins varies between 0.3% and 1.2%.

Below is a summary of the input data and the resulting flowrates for the 100-year, 6- hour storm.

Existing Rational Calculation Summary

Basin	Area (ac)	Impervious %	C	CA	Tc (mins)	I_{100} (in/hr)	Q_{100} (cfs)	DP-#
E-1.1	5.10	82%	0.80	4.07	6.47	6.24	25.43	DP-1
O-1	0.29	82%	0.80	0.23	8.13	5.39	1.26	
O-2	0.18	78%	0.78	0.14	10.53	4.56	1.71	
O-3	1.11	80%	0.79	0.87	16.46	3.42	4.28	
E-2.1	0.89	82%	0.80	0.71	7.43	5.71	4.08	DP-2

Below is a summary of the existing confluence flow calculations.

Existing Flow Junction Calculation Summary Confluence Pt. 1

Confluence Pt.	Tributary Flows	Tc (mins)	I_{100} (in/hr)	Q_{100} (cfs)	Confluence Flow (cfs)
DP-1	O-3	16.46	3.42	4.28	27.11
	E-1.1	6.47	3.24	25.43	

The peak flowrate for DP-1 and DP-2 are 27.11 cfs and 4.08 cfs, respectively.

Proposed Rational Analysis

The proposed site was modeled as five basins. The proposed basins are referred to as P-1.1, P-1.2, P-2.1, O-1, O-2 and O-3 in this report. The slope of the basins varies between 0.3% and 1.2%.

Proposed Rational Calculation Summary

Basin	Area (ac)	Impervious %	C	CA	Tc (mins)	I_{100} (in/hr)	Q_{100} (cfs)	DP-#
P-1.1	4.45	93%	0.86	3.82	7.05	5.91	22.57	DP-1
P-1.2	0.68	91%	0.85	0.58	5.00	7.38	4.27	
O-1	0.29	86%	0.82	0.24	8.13	5.39	1.29	
O-2	0.18	78%	0.78	0.14	7.41	5.73	5.49	
O-3	1.11	80%	0.79	0.87	13.33	3.92	7.19	
P-2.1	0.86	87%	0.83	0.71	7.43	5.71	4.07	DP-2

Below is a summary of the proposed confluence flow calculations.

Proposed Flow Junction Calculation Summary

Confluence Pt.	Tributary Flows	Tc (mins)	I_{100} (in/hr)	Q_{100} (cfs)	Confluence Flow (cfs)
CP-1	P-1.2	5.00	7.38	4.27	5.07
	O-1	8.13	5.39	1.29	
DP-1	O-3	13.33	3.92	7.19	26.37
	P-1.1	7.05	5.91	22.57	

The peak flowrate for DP-1 and DP-2 are 26.37 cfs and 4.07 cfs, respectively.

Results & Conclusions

The proposed improvements result in a decrease of generated runoff during the peak of the 100-year, 6-hr storm. Below is a summary of the existing and proposed peak flowrates and velocities.

	DP-#	Area (ac)	Q_{100} (cfs)
Existing Conditions	DP-1	6.68	27.11
	DP-2	0.89	4.08
Proposed Conditions	DP-1	6.71	26.37
	DP-2	0.86	4.07

	Discharge Location	V_{100} (fps)	Q_{100} (cfs)
Existing Conditions	Cactus Street	1.76	1.71
	Woodside Avenue*	2.22	4.28
	DP-1	11.55**	27.11
	DP-2	1.79	4.08
Proposed Conditions	Cactus Street	2.27	5.49
	Woodside Avenue*	2.49	7.19
	DP-1	11.41**	26.37
	DP-2	1.78	4.07

The existing curb inlet on Woodside Ave that accepts flow from Woodside Ave. and Cactus St has an opening width of 9.5 ft. and the existing flow captured by the curb inlet is 4.28 CFS; the proposed flow to the existing curb inlet is 7.19 CFS. The max capacity of the curb inlet (sag) is 10.08 CFS.

* The Q100 tributary to Woodside Avenue includes the flow from Cactus Street and (in the proposed conditions) the flow generated from Basin P-2.1.

** As reference drawings for the storm drain system within Woodside Ave. and Cactus St. are unavailable or do not exist, several assumptions have been made. Based on site walks, it appears that stormwater from Basins E-1.1 and P-1.1 will enter the public MS4 system first via a private inlet in the parking lot of the existing development. This flow will then confluence with stormwater generated by Woodside Ave and Cactus St. This confluence point is assumed to take place within the public MS4 below Woodside Ave.

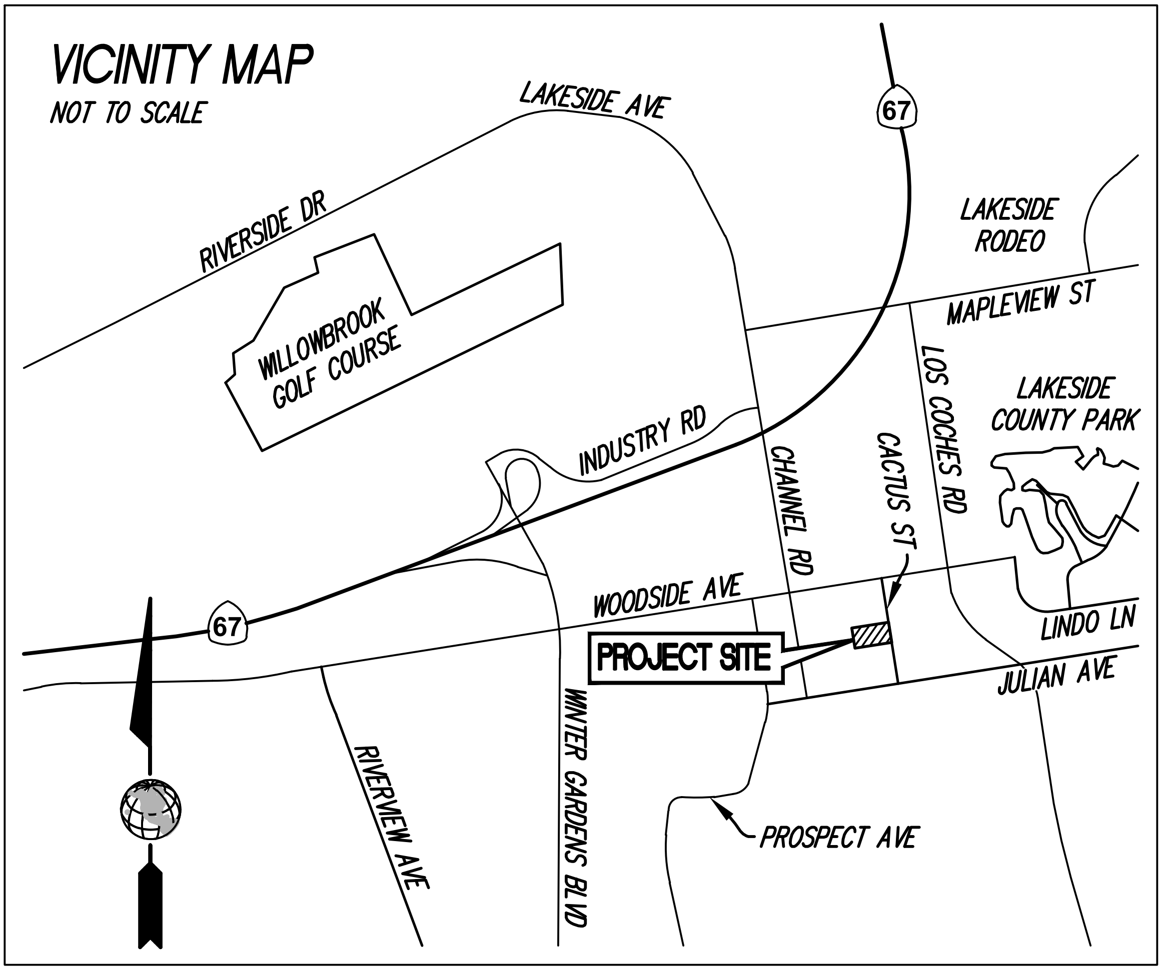
The project will modify the onsite drainage patterns, but the discharge points will remain the same. The project is not anticipated to contribute runoff that will exceed the capacity of the existing or planned storm drain system conveyances. The street gutter capacity analysis on the "Proposed Conditions" section demonstrates that the diversion of flow to Cactus Street and Woodside Avenue will not over-capacitate the gutter, curb inlet, and the existing storm drain system (See Appendix 12).

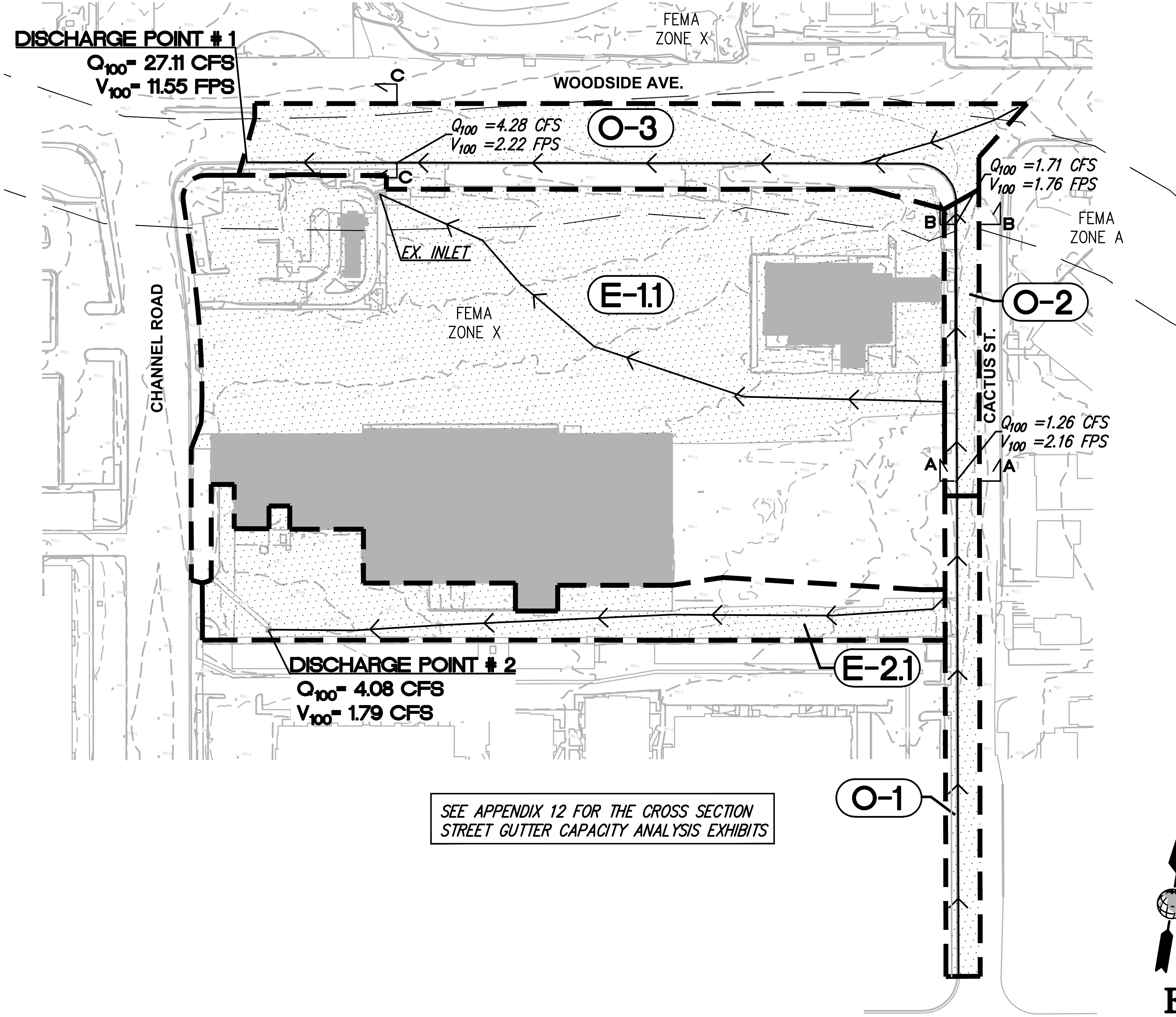
The proposed project will not alter the existing drainage pattern substantially, through the alteration of the course of a stream or river, or in a manner that would result in substantial erosion or siltation on- or off-site.

The proposed project will not place any structures in the 100-year flood hazard areas or flood plain as mapped on the FEMA National Flood Hazard Layer FIRMette (See Appendix 14). The proposed project will not place any structures within a 100-year flood hazard area which will impede or redirect flood flows.

The project site is located 1.8 miles downstream of Chet Harritt Dam. Per Sunny Day Failure Analysis Flood Inundation Map, Sheet 2, the project is within an identified Inundation Area (See Appendix 15). The failure of the dam would expose the people and structures on-site to significant loss, injury or death involving flooding.

It is the opinion of Omega Engineering Consultants that the project will not cause adverse effects to the downstream facilities or receiving waters. A separate Storm Water Quality Management Plan has been prepared to discuss the water quality impacts for the proposed development.


VICINITY MAP
NOT TO SCALE
LAKESIDE AVE
67
RIVERSIDE DR
WILLOWBROOK GOLF COURSE
LAKESIDE RODEO
MAPLEVIEW ST
LOS COCHES RD
LAKESIDE COUNTY PARK
INDUSTRY RD
CHANNEL RD
CACTUS ST
WOODSIDE AVE
LINDO LN
PROJECT SITE
JULIAN AVE
67
RIVERVIEW AVE
WINTER GARDENS BLVD
PROSPECT AVE



LEGEND

BASIN NUMBER	E-#.#
AREA LIMITS	
DRAINAGE FLOW PATH	
BUILDING AREA	
PAVEMENT AREA	
PERVIOUS AREA	

DRAINAGE BASIN DATA

BASIN #	AREA (AC)	C	CA	T_c (MINS)	I_{100} (IN/HR)	Q_{100} (CFS)
E-1.1	5.10	0.80	4.07	6.47	6.24	25.43
E-2.1	0.89	0.80	0.71	7.43	5.71	4.08
O-1	0.29	0.80	0.23	8.13	5.39	1.26
O-2	0.18	0.78	014	10.53	4.56	1.71
O-3	1.11	0.79	0.87	16.46	3.42	4.28

PIPE DATA

PIPE #	DIAMETER (INCHES)	SLOPE (%)	DEPTH /DIA	V_{100} (FPS)	Q_{100} (CFS)
– *	24	2.0	0.70	11.55	27.11

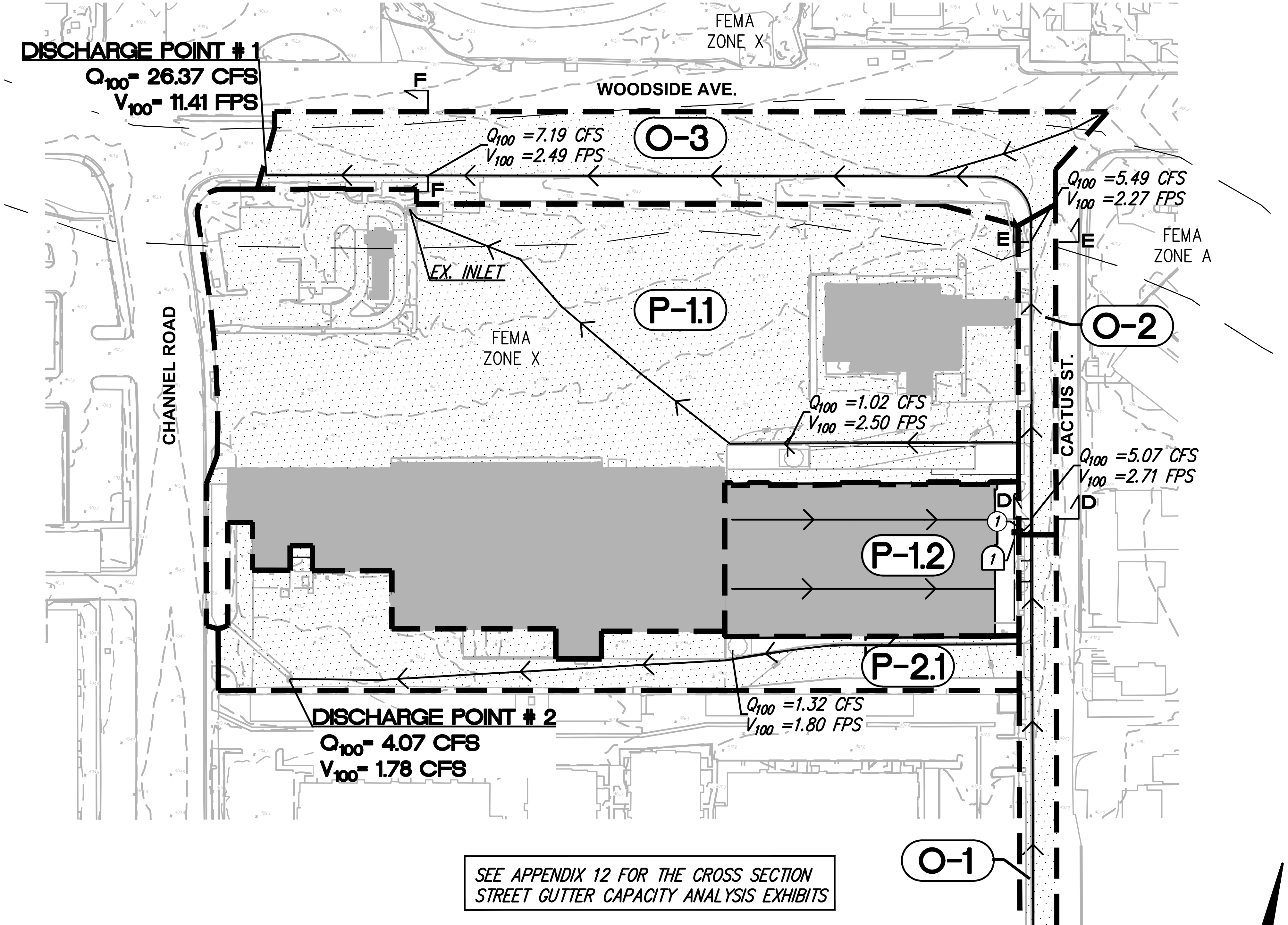
* ASSUMPTIONS WERE MADE ON THE EXISTING STORM DRAIN SYSTEM ON WOODSIDE AVENUE.

WOODSIDE SELF-STORAGE
EXISTING HYDROLOGY EXHIBIT

GRAPHICAL SCALE: 1" = 100'
0 50 100 200

ΩMEGA

EX. HYDROLOGY EXHIBIT



SEE APPENDIX 12 FOR THE CROSS SECTION STREET GUTTER CAPACITY ANALYSIS EXHIBITS

LEGEND

- BASIN NUMBER .... (P-#.#)
- AREA LIMITS
- DRAINAGE FLOW PATH
- BUILDING AREA
- PAVEMENT AREA
- PERVIOUS AREA

DRAINAGE BASIN DATA

BASIN #	AREA (AC)	C	CA	T_c (MINS)	I_{100} (IN/HR)	Q_{100} (CFS)
P-1.1	4.45	0.86	3.82	7.05	5.91	22.57
P-1.2	0.68	0.85	0.58	5.00	7.38	4.27
P-2.1	0.86	0.83	0.71	7.43	7.43	4.07
O-1	0.29	0.82	0.24	8.13	5.39	1.29
O-2	0.18	0.78	0.14	7.41	5.73	5.49
O-3	1.11	0.79	0.87	13.33	3.92	7.19

(X) PIPE DATA

PIPE #	DIAMETER (INCHES)	SLOPE (%)	DEPTH /DIA	V_{100} (FPS)	Q_{100} (CFS)
1	10	9.4	0.57	13.31	4.27
– *	24	2.0	0.69	11.41	2.37

* ASSUMPTIONS WERE MADE ON THE EXISTING STORM DRAIN SYSTEM ON WOODSIDE AVENUE.

CHANNEL DATA

(X)	WIDTH (INCHES)	DEPTH (INCHES)	SLOPE (%)	V_{100} (FPS)	Q_{100} (CFS)
1**	36	3	2.0	5.79	4.34

** CHANNEL # 1 IS A PROPOSED CURB OUTLET TYPE A (PER SAN DIEGO REGIONAL STANDARD DRAWING D-25) STRUCTURE DISCHARGING TO CACTUS ST. THE CURB OUTLET HAS A MAXIMUM CAPACITY OF 4.34 CFS WHICH IS GREATER THAN THE ANTICIPATED RUNOFF OF 4.27 CFS.

WOODSIDE SELF-STORAGE PROPOSED HYDROLOGY EXHIBIT

GRAPHICAL SCALE: 1" = 100'
0 50 100 200

OMEGA

PROP. HYDROLOGY EXHIBIT

BASIN	AREA (SF)	AREA (AC)	% Imp	"C" Value
E-1.1	221,977	5.10	82%	0.80
E-2.1	38,791	0.89	82%	0.80
O-1	12,695	0.29	82%	0.80
O-2	7,899	0.18	78%	0.78
O-3	48,339	1.11	80%	0.79
EX. TOTAL	**329,701**	**7.57**		
P-1.1	193,696	4.45	93%	0.86
P-1.2	29,585	0.68	91%	0.85
P-2.1	37,487	0.86	87%	0.83
O-1	12,695	0.29	86%	0.82
O-2	7,899	0.18	78%	0.78
O-3	48,339	1.11	80%	0.79
PROP TOTAL	**329,701**	**7.57**		

Basin Confluence	Symbol
Existing	
(O-3 & E-1.1)	**DP-1**
Proposed	
(P-1.2 & O-1)	**CP-1**
(O-3 & P-1.1)	**DP-1**

(A) CP # - Confluence Point

(B) DP # - Discharge Point

(C) C value for bare ground is 0.35 (Table 3-1 County Hydrology Manual)
(Type 'D' 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 0.35)

Sub-Basin	AREA Ac.	"C"	CA	ΣCA	Overland flow length	Concentrated Flow Length,	S(%) (avg.)	Ti mins	Tt mins	T_c mins	I in/hr	Q cfs	
E-1.1	5.10	0.80	4.07	4.07	60.0	480.0	1.2%	4.1	2.37	6.47	6.24	25.43	
O-1	0.29	0.80	0.23	0.23	50.0	370.0	0.5%	4.7	3.43	8.13	5.39	1.26	
O-2	0.18	0.78	0.14	0.38	0.0	260.0	0.3%	0.0	2.41	10.53	4.56	1.71	
O-3	1.11	0.79	0.87	1.25	0.0	640.0	0.6%	0.0	5.93	16.46	3.42	4.28	
Confluence calcs for O-3 and E-1.1						T1=8.13, I1=5.39, Q1=27.11				**8.13**	**5.39**	**27.11**	**Q(T1)**
						T2=16.46, I2=3.42, Q2=18.21				**16.46**	**3.42**	**18.21**	**Q(T2)**
										8.13	**5.39**	**27.11**	**DP-1**
E-2.1	0.89	0.80	0.71	0.71	60.0	540.0	0.9%	4.1	3.33	7.43	5.71	4.08	
										7.43	**5.71**	**4.08**	**DP-2**
P-1.2	0.68	0.85	0.58	0.58	215.0	155.0	1.0%	4.1	0.00	5.00	7.38	4.27	
O-1	0.29	0.82	0.24	0.24	50.0	370.0	0.5%	4.7	3.43	8.13	5.39	1.29	
Confluence calcs for P-1.2 & O-1						T1=5.00, I1=7.38, Q1=4.27				**5.00**	**7.38**	**5.07**	**Q(T1)**
						T2=8.13, I2=5.39, Q2=1.29				**8.13**	**5.39**	**4.41**	**Q(T2)**
										5.00	**7.38**	**5.07**	**CP-1**
O-2	0.18	0.78	0.14	0.96	0.0	260.0	0.3%	0.0	2.41	7.41	5.73	5.49	
O-3	1.11	0.79	0.87	1.83	0.0	640.0	0.6%	0.0	5.93	13.33	3.92	7.19	
P-1.1	4.45	0.86	3.82	3.82	60.0	480.0	1.2%	4.1	2.95	7.05	5.91	22.57	
Confluence calcs for O-3 & P-1.1						T1=7.05, I1=5.91, Q1=26.37				**7.05**	**5.91**	**26.37**	**Q(T1)**
						T2=13.33, I2=3.92, Q2=22.16				**13.33**	**3.92**	**22.16**	**Q(T2)**
										7.05	**5.91**	**26.37**	**DP-1**
P-2.1	0.86	0.83	0.71	0.71	60.0	540.0	0.8%	4.1	3.33	7.43	5.71	4.07	
										7.43	**5.71**	**4.07**	**DP-2**

NOTES
100-year, 6 hr storm

P(6)= 2.8

Basins O-1 & O-2 flow through basin O-3. No Ti is accounted for Basins O-2 & O-3. Flow at downstream end of Basin O-3 = ΣCA* I

Let Q_1, T_1, and I_1 correspond to the tributary area with the shortest T_c. Likewise, let Q_2, T_2, and I_2 correspond to the tributary area with the next longer T_c; Q_3, T_3, and I_3 correspond to the tributary area with the next longer T_c; and so on. When only two independent drainage systems are combined, leave Q_3, T_3, and I_3 out of the equation. Combine the independent drainage systems using the junction equation below:

Junction Equation: $T_1 < T_2 < T_3$

$$Q_{T1} = Q_1 + \frac{T_1}{T_2} Q_2 + \frac{T_1}{T_3} Q_3$$

$$Q_{T2} = Q_2 + \frac{I_2}{I_1} Q_1 + \frac{T_2}{T_3} Q_3$$

$$Q_{T3} = Q_3 + \frac{I_3}{I_1} Q_1 + \frac{I_3}{I_2} Q_2$$

Calculate Q_{T1}, Q_{T2}, and Q_{T3}. Select the largest Q and use the T_c associated with that Q for further calculations (see the three Notes for options). If the largest calculated Q's are equal (e.g., $Q_{T1} = Q_{T2} > Q_{T3}$), use the shorter of the T_c's associated with that Q.

Basins P-1.2, O-1 & O-2 flow through basin O-3. No Ti is accounted for Basins P-1.2, O-2 & O-3. Flow at downstream end of Basin O-3 = ΣCA* I

CONDUIT SIZING CALCULATIONS

The following chart details the sizing parameters and for conduits that convey runoff on the site.
Flow parameters from *Handbook of Hydraulics, King & Brater* were used, see following page.

K'= Discharge factor	=	$(Q*n)/(d^{8/3}*s^{1/2})$
n= Mannings coefficient	=	0.013 for PVC & HDPE
d=diameter of conduit (ft)	=	per chart
Q= Discharge	=	based off portions of basins tributary to outlet
s=Minimum Pipe Slope (ft/ft)	=	per chart
D=depth of flow	=	From table 7-4 of the *Handbook of Hydraulics, King & Brater* See right
C_a= Flow factor	=	From table 7-14 of the *Handbook of Hydraulics, King & Brater* See right
A=Cross sectional area of flow	=	C_a*d^2
V=Velocity	=	Q/A

Pipe Flow

Pipe	Tributary Areas	Q (cfs)	S (%)	d (in)	K'	D/d	C_a	A (sf)	V (fps)
1	**Entire Building Roof**	4.27	9.4	10	0.2944	0.57	0.462	0.321	13.31
*	**DP-1, Existing Conditions**	27.11	2	24	0.3925	0.70	0.587	2.348	11.55
*	**DP-1, Proposed Conditions**	26.37	2	24	0.3818	0.69	0.578	2.312	11.41

* Note: Due to not being able to obtain the reference drawings for the storm drain network on Woodside Avenue and Cactus Street, assumptions were made on the existing storm drain system on DP-1.

Table 7-4. For Determining the Area a of the Cross Section of a Circular Conduit Flowing Part Full

Let $\frac{\text{depth of water}}{\text{diameter of channel}} = \frac{D}{d}$ and C_a = the tabulated value. Then $a = C_a d^2$.

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0013	.0037	.0069	.0105	.0147	.0192	.0242	.0294	.0350
.1	.0409	.0470	.0534	.0600	.0668	.0739	.0811	.0885	.0961	.1039
.2	.1118	.1199	.1281	.1365	.1449	.1535	.1623	.1711	.1800	.1890
.3	.1982	.2074	.2167	.2260	.2355	.2450	.2546	.2642	.2739	.2836
.4	.2934	.3032	.3130	.3229	.3328	.3428	.3527	.3627	.3727	.3827
.5	.393	.403	.413	.423	.433	.443	.453	.462	.472	.482
.6	.492	.502	.512	.521	.531	.540	.550	.559	.569	.578
.7	.587	.596	.605	.614	.623	.632	.640	.649	.657	.666
.8	.674	.681	.689	.697	.704	.712	.719	.725	.732	.738
.9	.745	.750	.756	.761	.766	.771	.775	.779	.782	.784

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

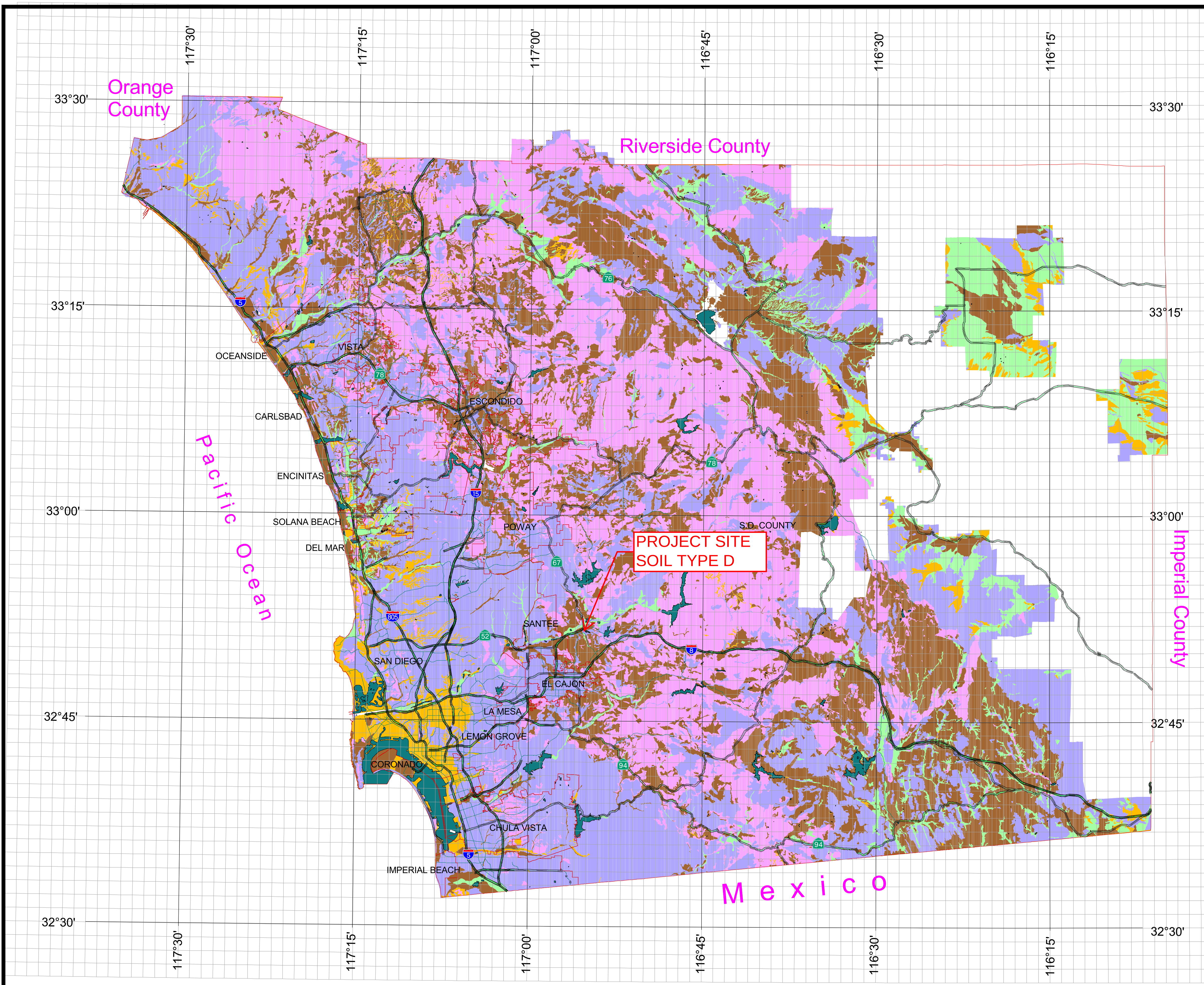
D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

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

Department of Public Works Geographic Information Services

We Have San Diego Covered!

N S W E

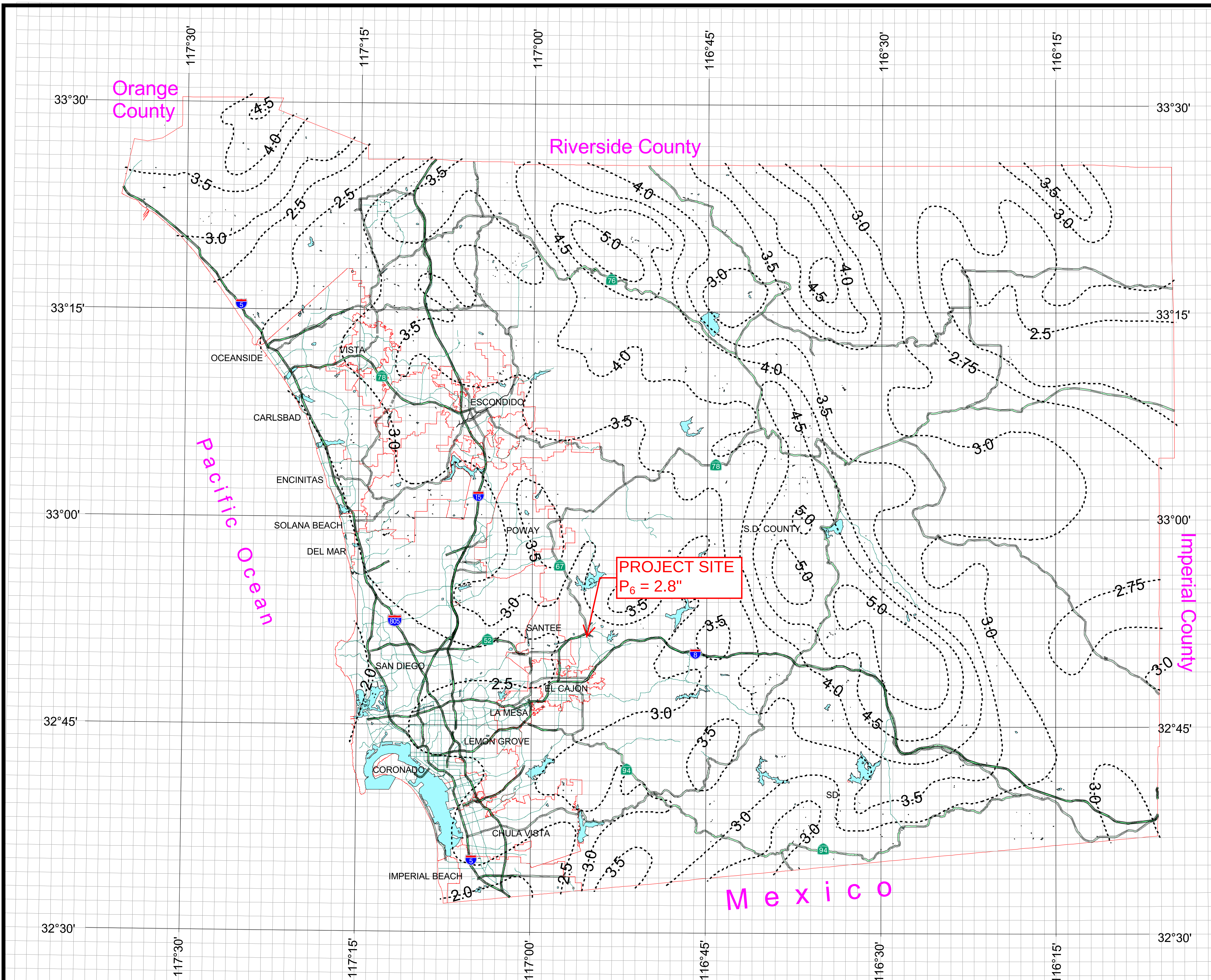
3 0 3 Miles

APPENDIX 1.0

Appendix 2

County of San Diego Hydrology Manual

Rainfall Isopluviials



100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Department of Public Works
Geographic Information Services

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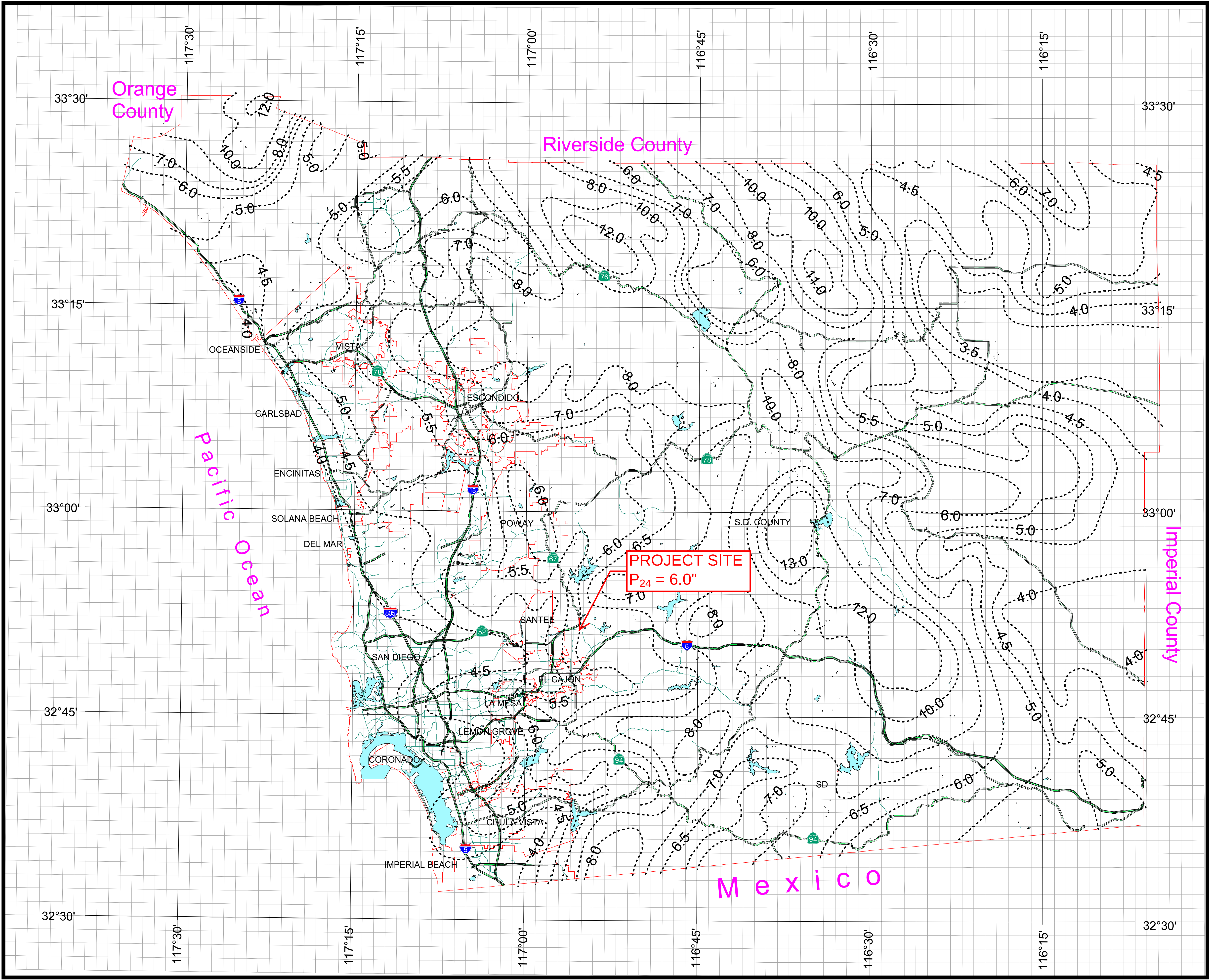
3 0 3 Miles

APPENDIX 2.0

Appendix 3



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

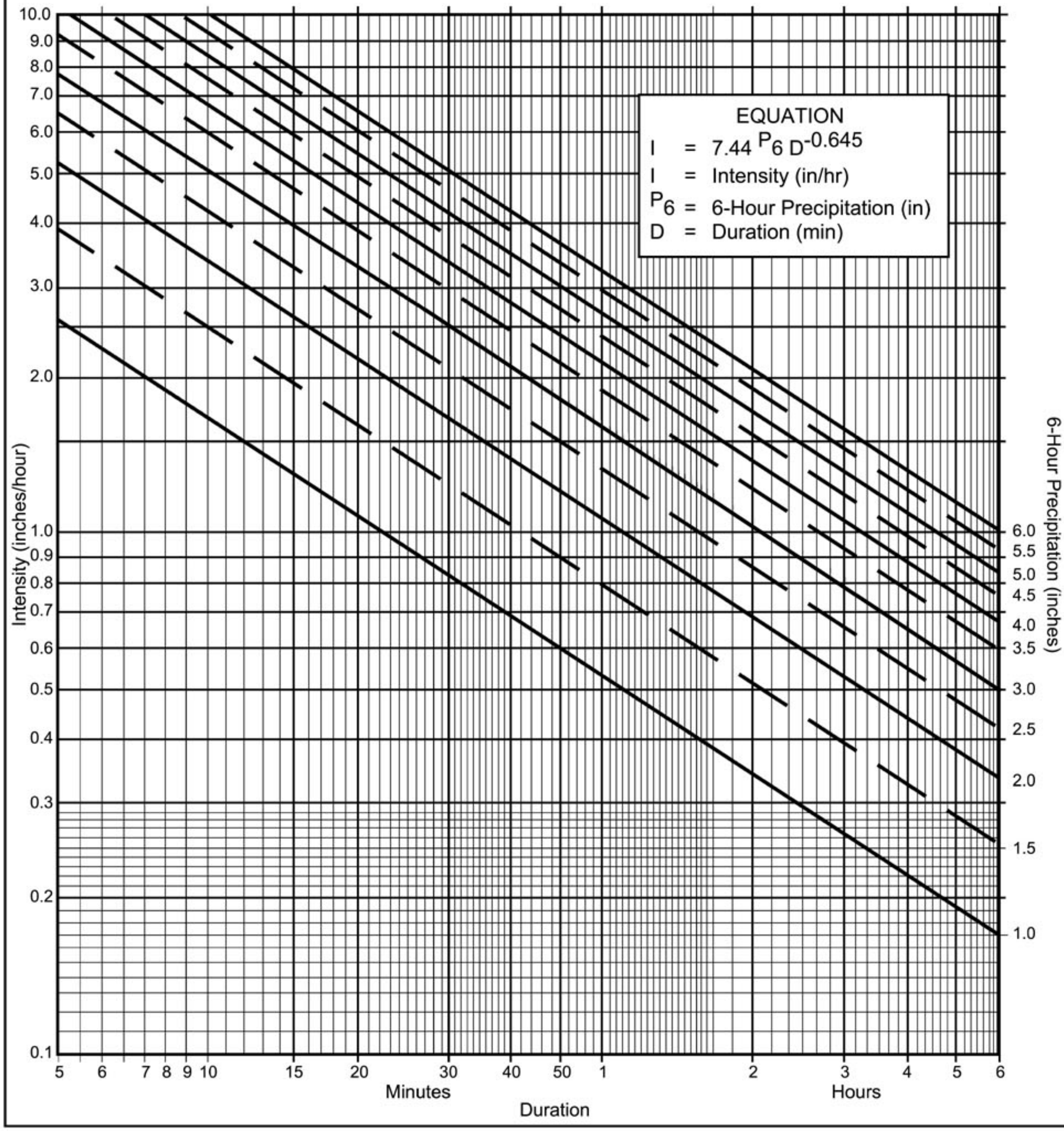
- - - - Isopluvial (inches)

N
W E
S

3 0 3 Miles

APPENDIX 3.0

Appendix 4



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.8 in., P_{24} = 6.0 , $\frac{P_6}{P_{24}}$ = 46.7 %(2)

(c) Adjusted $P_6^{(2)}$ = ______ in.

(d) t_x = ______ min. see calculations for values of each basin

(e) I = ______ in./hr. See methodology to see the equations used for Intensity and time of concentration

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

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

Intensity-Duration Design Chart - Template

FIGURE

3-1

Appendix 5

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 6

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.

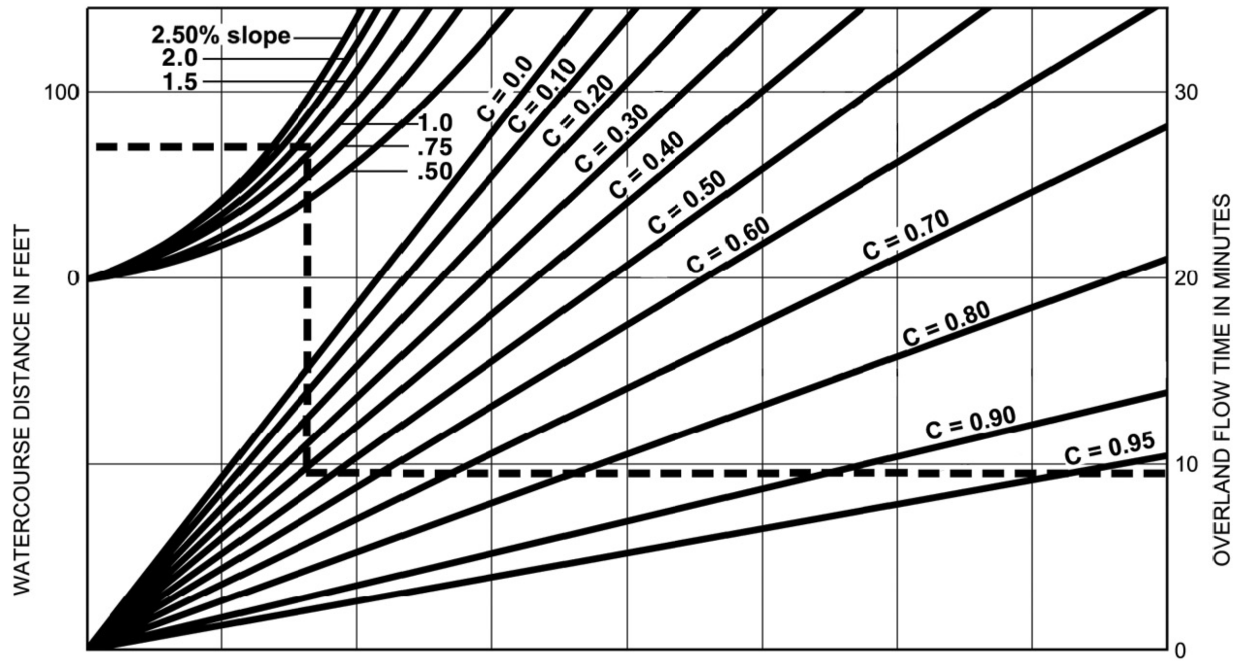
Table 3-2

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	[illegible]	[illegible]	[illegible]	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	[illegible]	[illegible]	[illegible]	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 7



EXAMPLE:

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

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

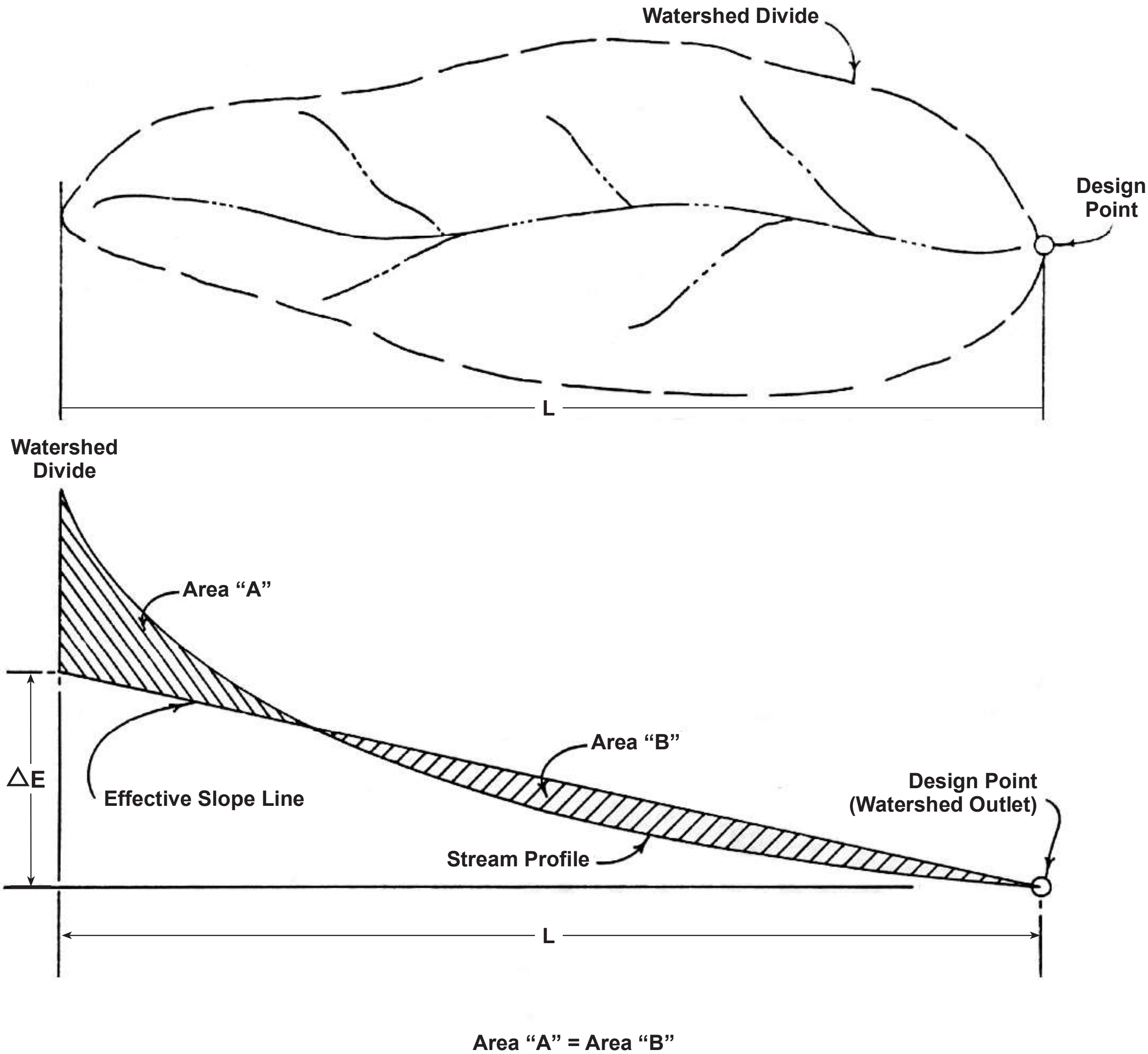
SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE

3-3

Appendix 8



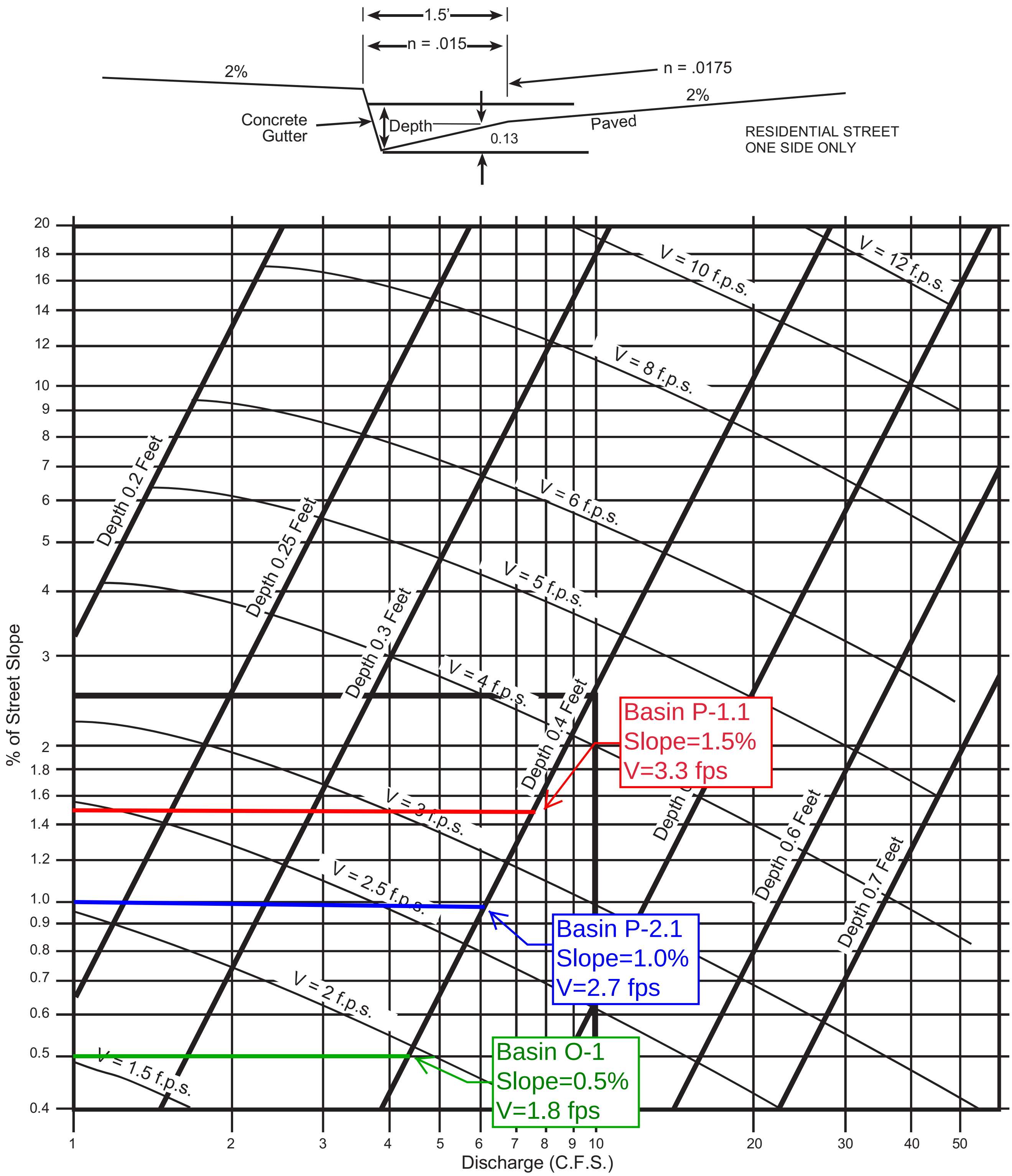
SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-5

Computation of Effective Slope for Natural Watersheds

Appendix 9



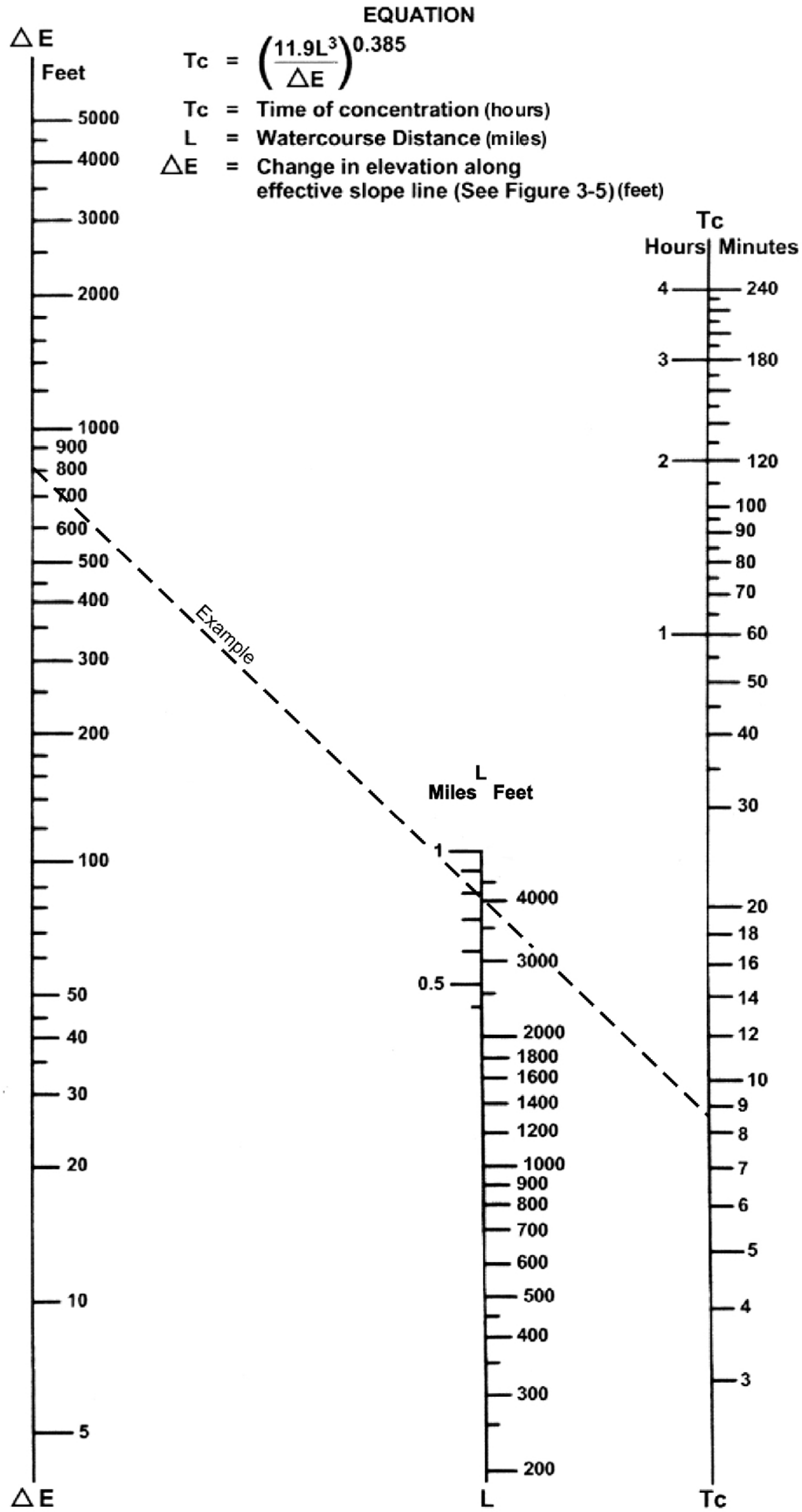
EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE **3-6**

Gutter and Roadway Discharge - Velocity Chart

Appendix 10



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

FIGURE

3-4

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

Appendix 11

Figure 2-7

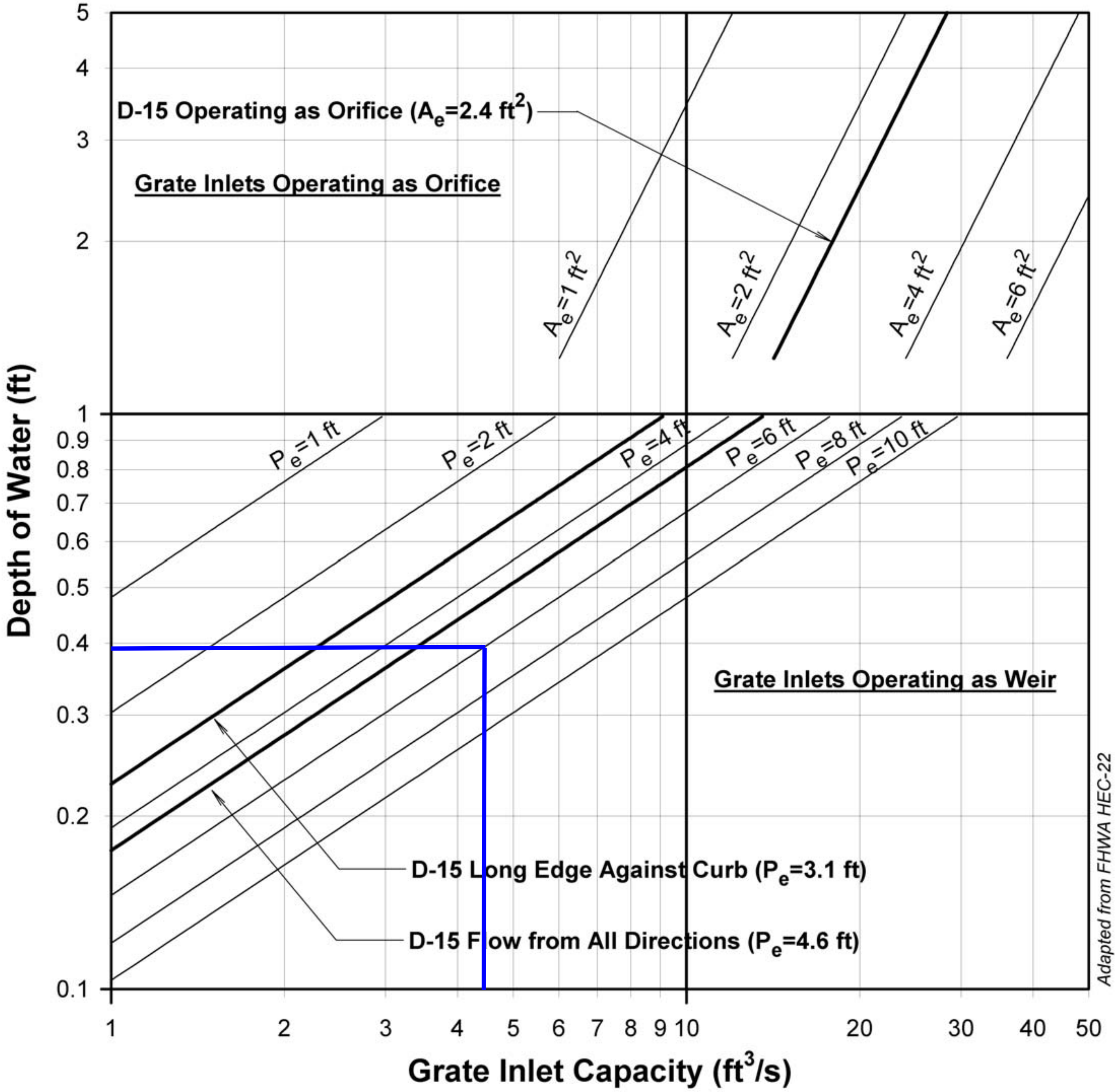


Figure 2-7 Capacity of Grate Inlets in Sump Locations

Appendix 12

Channel Report

A-A - Existing - Cactus St. Curb & Gutter Capacity

Gutter

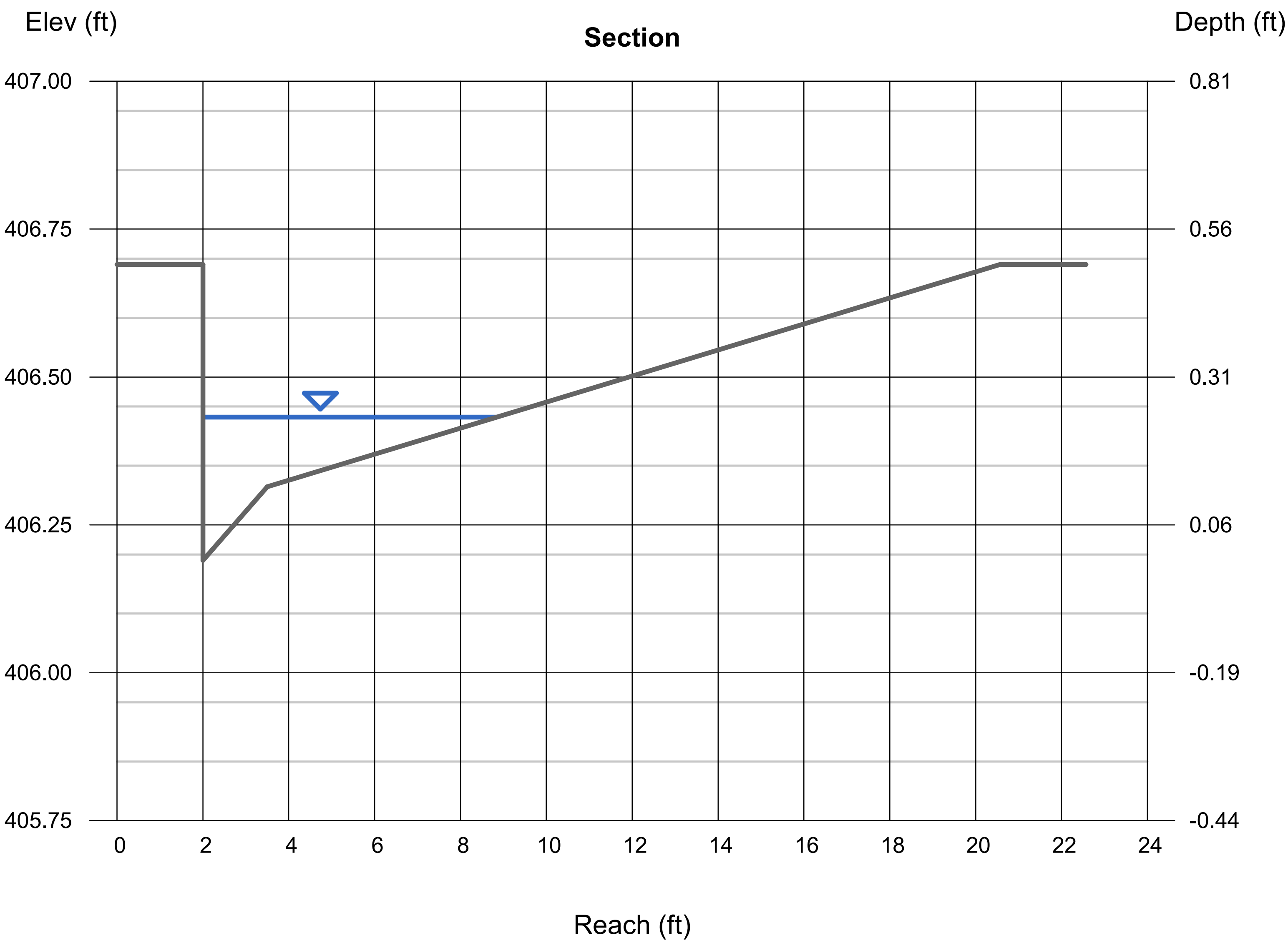
Cross Sl, Sx (ft/ft)	= 0.022
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 1.50
Invert Elev (ft)	= 406.19
Slope (%)	= 0.60
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.26

Highlighted

Depth (ft)	= 0.24
Q (cfs)	= 1.260
Area (sqft)	= 0.58
Velocity (ft/s)	= 2.16
Wetted Perim (ft)	= 7.09
Crit Depth, Yc (ft)	= 0.27
Spread Width (ft)	= 6.84
EGL (ft)	= 0.31



Channel Report

B-B - Existing - Cactus St. Curb & Gutter Capacity

Gutter

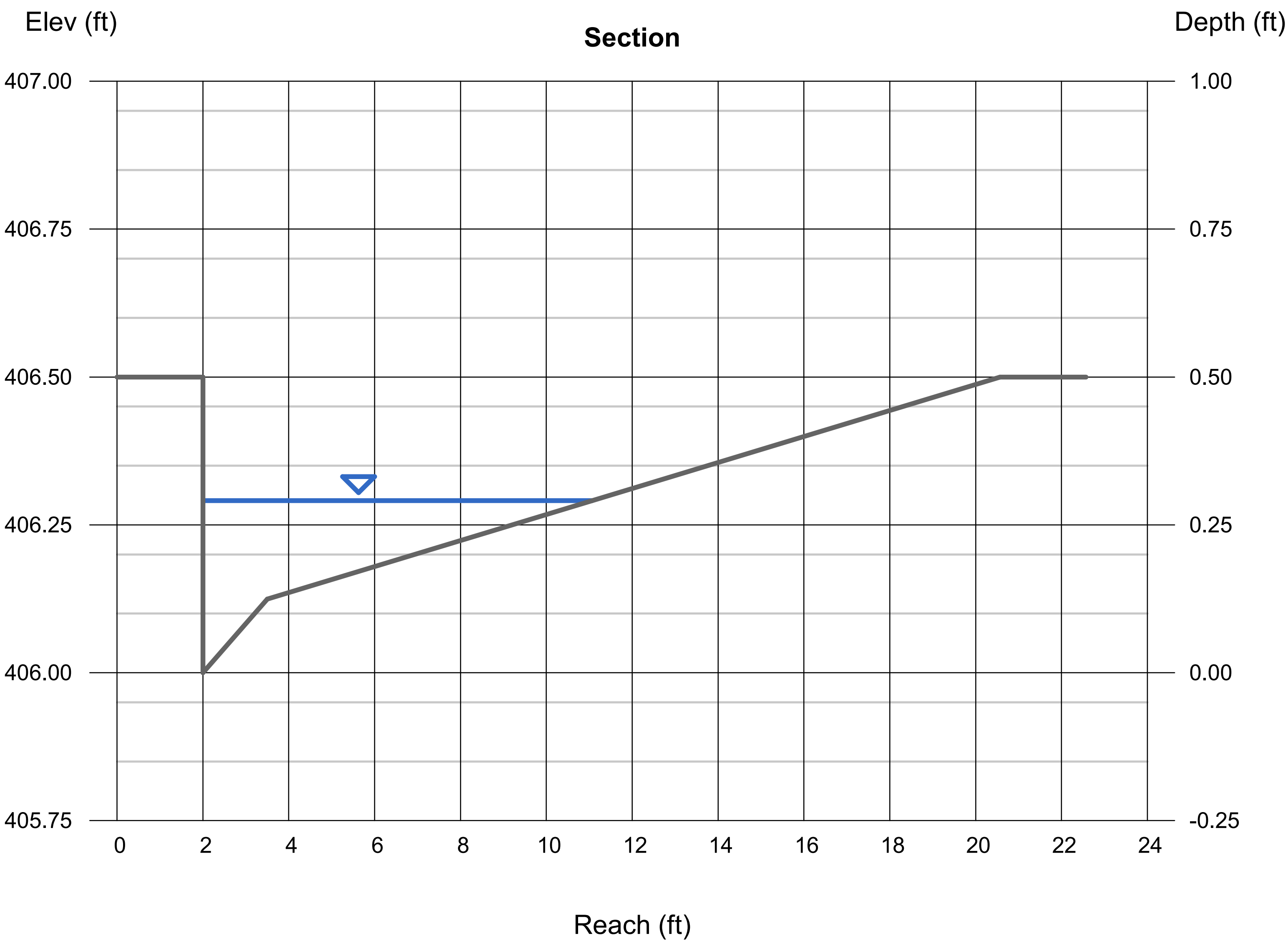
Cross Sl, Sx (ft/ft)	= 0.022
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 1.50
Invert Elev (ft)	= 406.00
Slope (%)	= 0.30
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.71

Highlighted

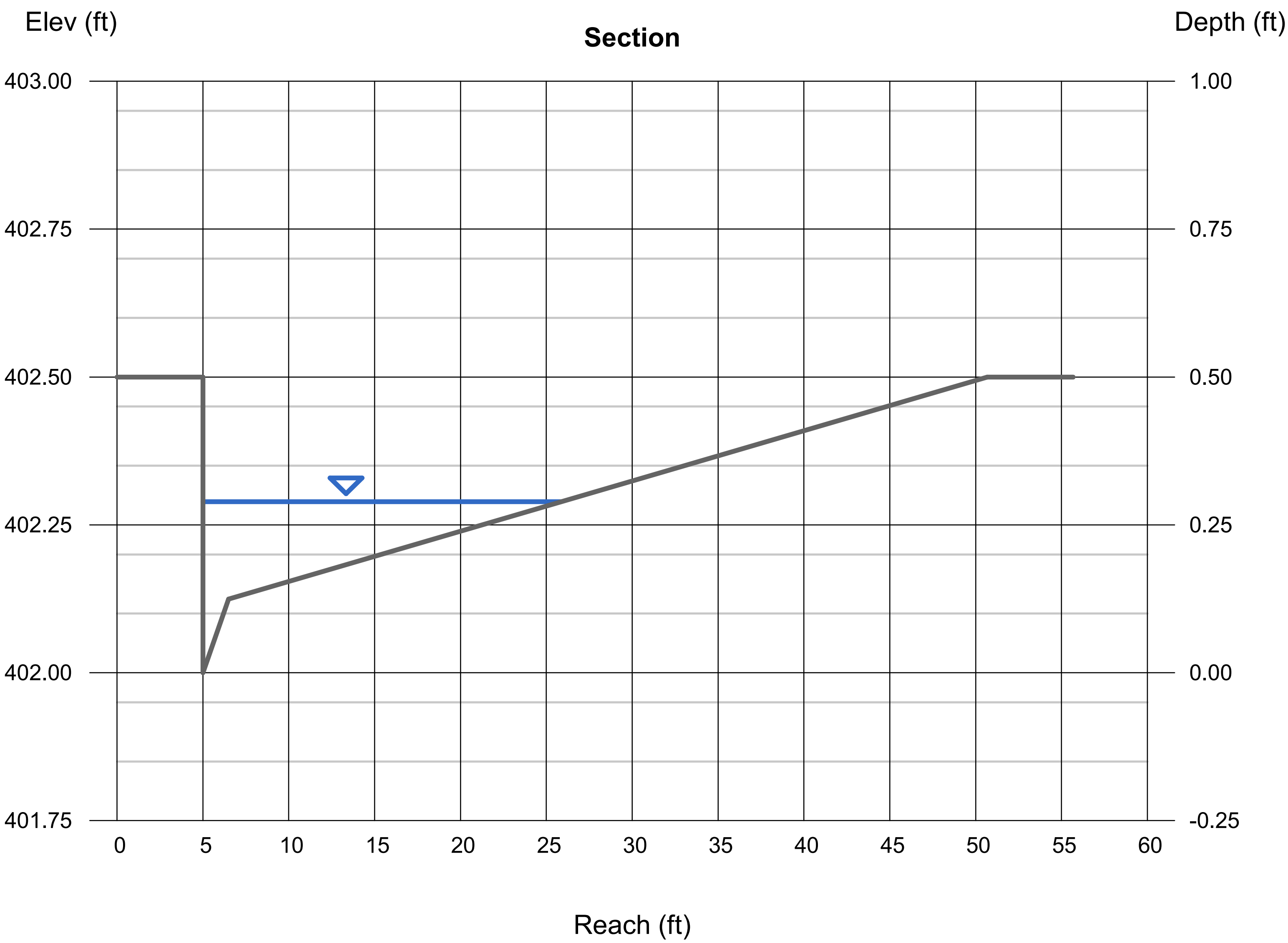
Depth (ft)	= 0.29
Q (cfs)	= 1.710
Area (sqft)	= 0.97
Velocity (ft/s)	= 1.76
Wetted Perim (ft)	= 9.37
Crit Depth, Yc (ft)	= 0.29
Spread Width (ft)	= 9.07
EGL (ft)	= 0.34



Channel Report

C-C - Existing - Woodside Ave. Curb & Gutter Capacity

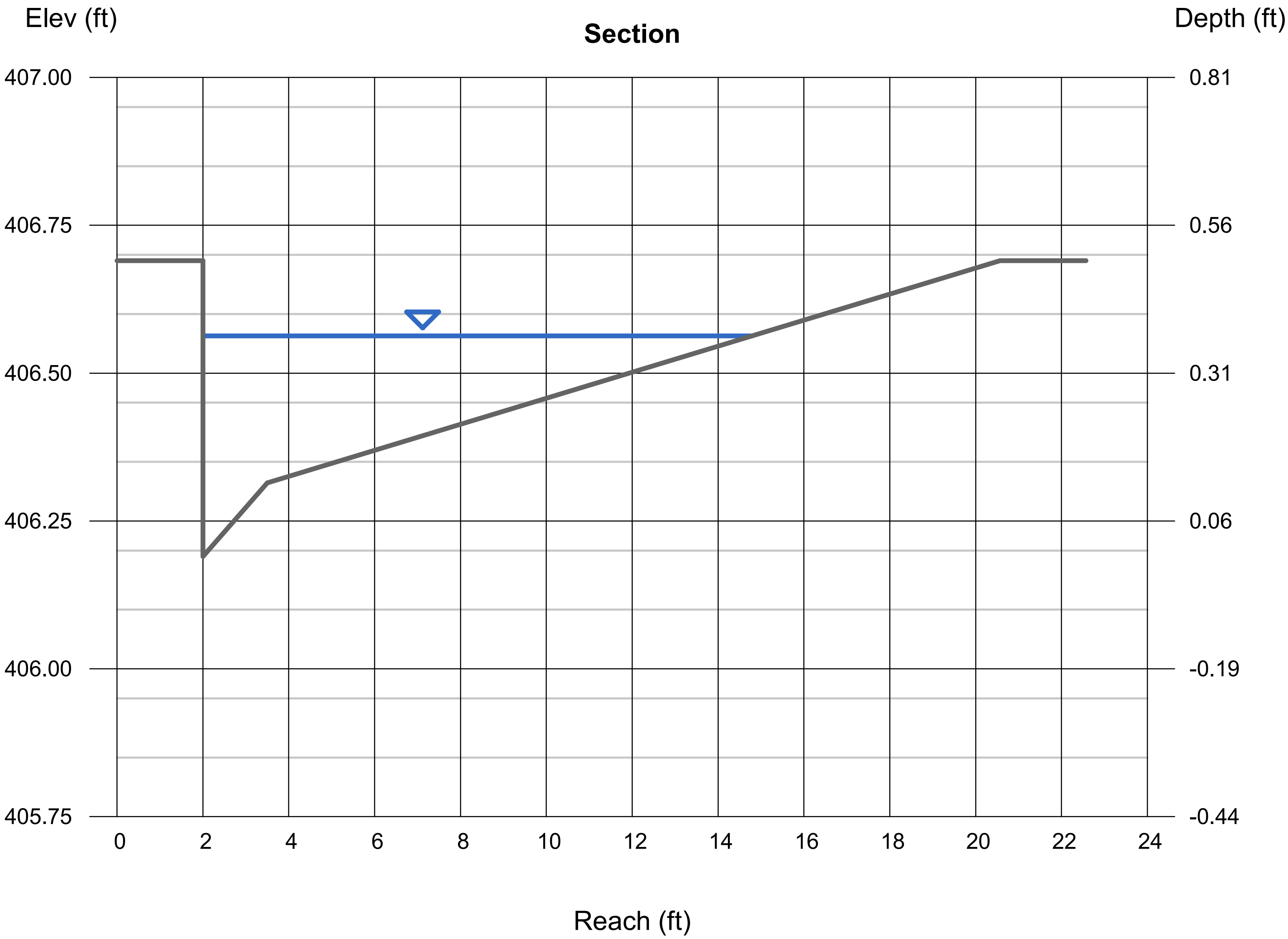
Gutter		**Highlighted**	
Cross Sl, Sx (ft/ft)	= 0.009	Depth (ft)	= 0.29
Cross Sl, Sw (ft/ft)	= 0.083	Q (cfs)	= 4.280
Gutter Width (ft)	= 1.50	Area (sqft)	= 1.93
Invert Elev (ft)	= 402.00	Velocity (ft/s)	= 2.22
Slope (%)	= 0.60	Wetted Perim (ft)	= 21.15
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.31
		Spread Width (ft)	= 20.85
Calculations		EGL (ft)	= 0.37
Compute by:	Known Q		
Known Q (cfs)	= 4.28		



Channel Report

D-D - Proposed - Cactus St. Curb & Gutter Capacity

Gutter		**Highlighted**	
Cross Sl, Sx (ft/ft)	= 0.022	Depth (ft)	= 0.37
Cross Sl, Sw (ft/ft)	= 0.083	Q (cfs)	= 5.070
Gutter Width (ft)	= 1.50	Area (sqft)	= 1.87
Invert Elev (ft)	= 406.19	Velocity (ft/s)	= 2.71
Slope (%)	= 0.50	Wetted Perim (ft)	= 13.18
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.41
		Spread Width (ft)	= 12.80
Calculations		EGL (ft)	= 0.49
Compute by:	Known Q		
Known Q (cfs)	= 5.07		



Channel Report

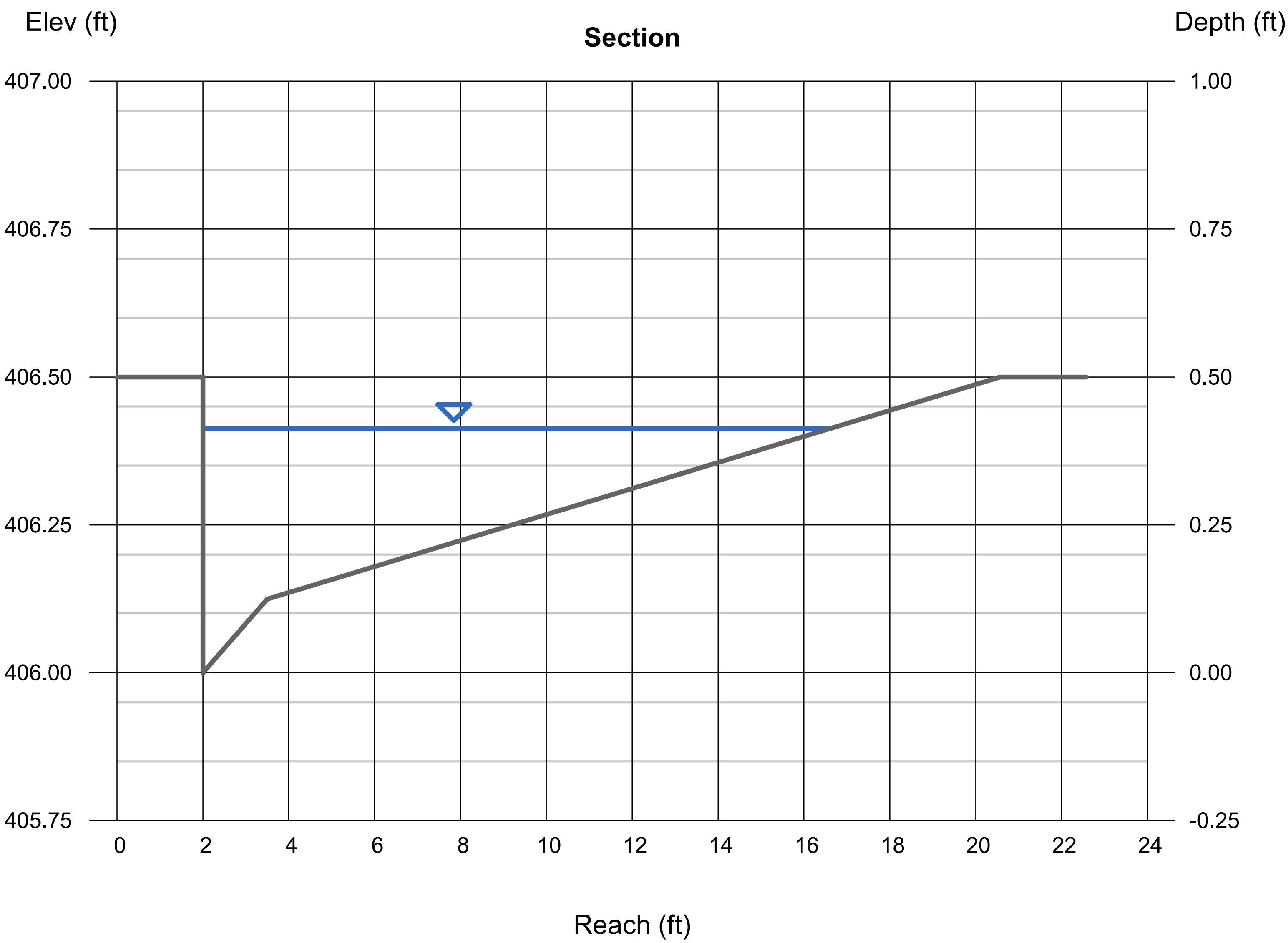
E-E - Existing - Cactus St. Curb & Gutter Capacity

Gutter		**Highlighted**	
Cross Sl, Sx (ft/ft)	= 0.022	Depth (ft)	= 0.41
Cross Sl, Sw (ft/ft)	= 0.083	Q (cfs)	= 5.490
Gutter Width (ft)	= 1.50	Area (sqft)	= 2.42
Invert Elev (ft)	= 406.00	Velocity (ft/s)	= 2.27
Slope (%)	= 0.30	Wetted Perim (ft)	= 15.03
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.42
		Spread Width (ft)	= 14.61
		EGL (ft)	= 0.49

Calculations

Compute by: Known Q

Known Q (cfs) = 5.49



Channel Report

F-F - Proposed - Woodside Ave. Curb & Gutter Capacity

Gutter

Cross Sl, Sx (ft/ft)	= 0.009
Cross Sl, Sw (ft/ft)	= 0.083
Gutter Width (ft)	= 1.50
Invert Elev (ft)	= 402.00
Slope (%)	= 0.60
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.19

Highlighted

Depth (ft)	= 0.33
Q (cfs)	= 7.190
Area (sqft)	= 2.89
Velocity (ft/s)	= 2.49
Wetted Perim (ft)	= 26.01
Crit Depth, Yc (ft)	= 0.36
Spread Width (ft)	= 25.68
EGL (ft)	= 0.43

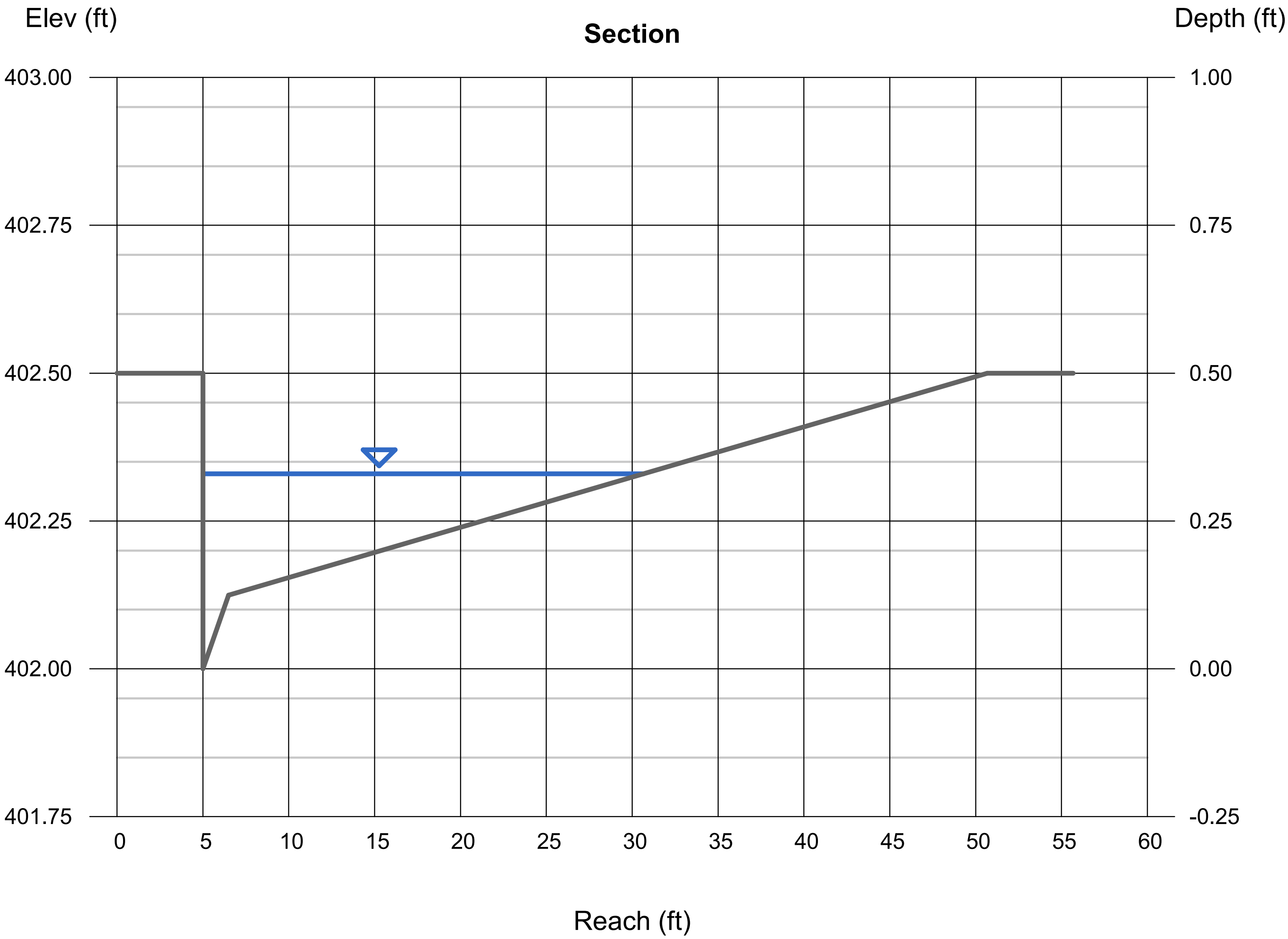


Table No. 7 Type B Curb Inlet In Sag	Length of opening required for proposed flow				
Tributary Basin #	Q cfs	Cw ft	d ft	Lw ft	L(actual) ft
O-3	7.19	3.00	0.50	6.78	9.50

- Existing Curb Inlet openeing L(actual) = 9.5 ft
- Length required to accept the entire 100-yr storm flow = 6.78 ft
- The added flow will not over-capacitate the existing curb inlet

Table No. 8 Type B Curb Inlet In Sag	Capacity of Ex. Inlet			
	Q cfs	Cw ft	d ft	Lw ft
	10.08	3.00	0.50	9.50

- Exiting curb inlet with opening length of 9.5 ft has a max capacity of 10.08 CFS

Curb Inlets in Sag

Curb inlets in sags or sump locations operate as weirs at shallow depths, and operate as orifices as water depth increases. The designer shall estimate the capacity of the inlet under each condition and adopt a design capacity equal to the smaller of the two results. When designing the size of a facility, the designer shall use the larger of the sizes obtained by solving for the two conditions.

Inlets in sumps act as weirs for shallow depths, which can be described using Equation 2-8:

$$Q = C_W L_W d^{3/2} \qquad (2\text{-}8)$$

where ...

Q = inlet capacity (ft^3/s);
C_W = weir discharge coefficient (see Table 2-1)
L_W = weir length (ft); and
d = flow depth (ft).

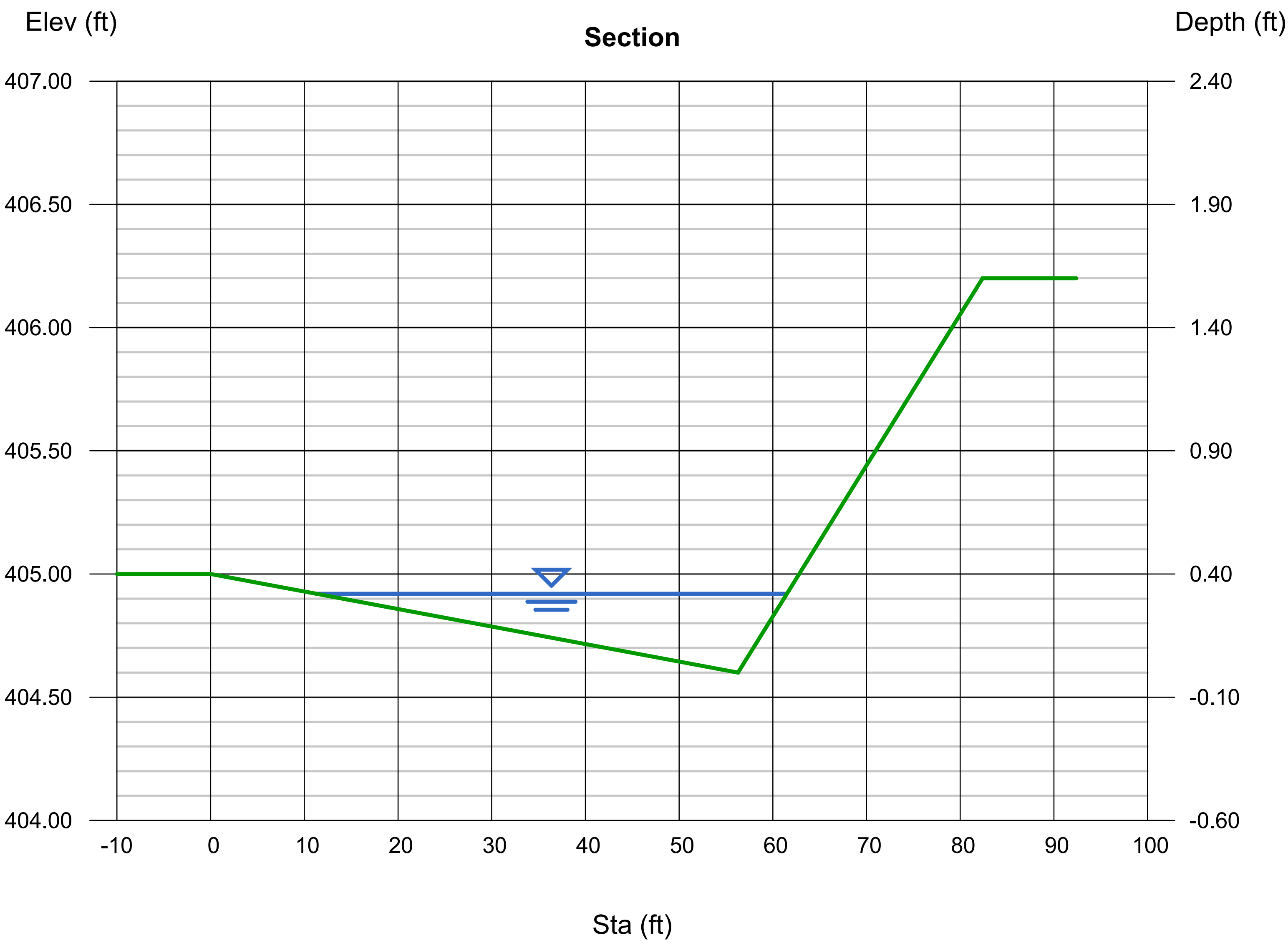
Appendix 13

Channel Report

Asphalt Swale-Basin E-1.1 & P-1.1

User-defined		**Highlighted**	
Invert Elev (ft)	= 404.60	Depth (ft)	= 0.32
Slope (%)	= 1.00	Q (cfs)	= 27.12
N-Value	= Composite	Area (sqft)	= 8.04
		Velocity (ft/s)	= 3.37
Calculations		Wetted Perim (ft)	= 50.26
Compute by:	Q vs Depth	Crit Depth, Yc (ft)	= 0.38
No. Increments	= 10	Top Width (ft)	= 50.25
		EGL (ft)	= 0.50

(Sta, El, n)-(Sta, El, n)...
(0.00, 405.00)-(56.28, 404.60, 0.013)-(82.39, 406.20, 0.013)



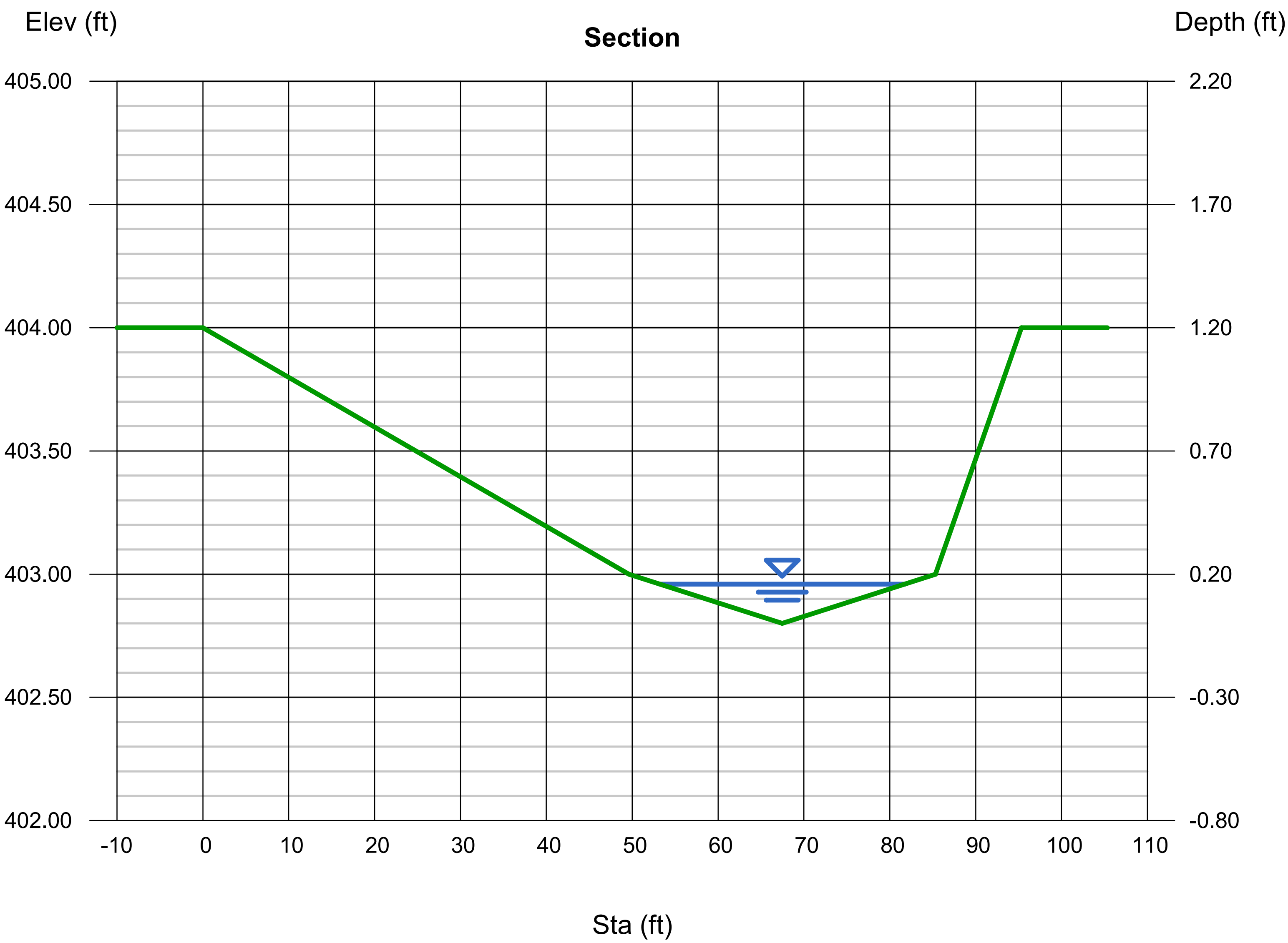
Channel Report

Existing Conditions Basin E-2.1

User-defined		**Highlighted**	
Invert Elev (ft)	= 402.80	Depth (ft)	= 0.16
Slope (%)	= 0.90	Q (cfs)	= 4.080
N-Value	= 0.013	Area (sqft)	= 2.28
		Velocity (ft/s)	= 1.79
Calculations		Wetted Perim (ft)	= 28.56
Compute by:	Known Q	Crit Depth, Yc (ft)	= 0.17
Known Q (cfs)	= 4.08	Top Width (ft)	= 28.56
		EGL (ft)	= 0.21

(Sta, El, n)-(Sta, El, n)...

(0.00, 404.00)-(49.63, 403.00, 0.013)-(67.48, 402.80, 0.013)-(85.33, 403.00, 0.013)-(95.33, 404.00, 0.013)



Channel Report

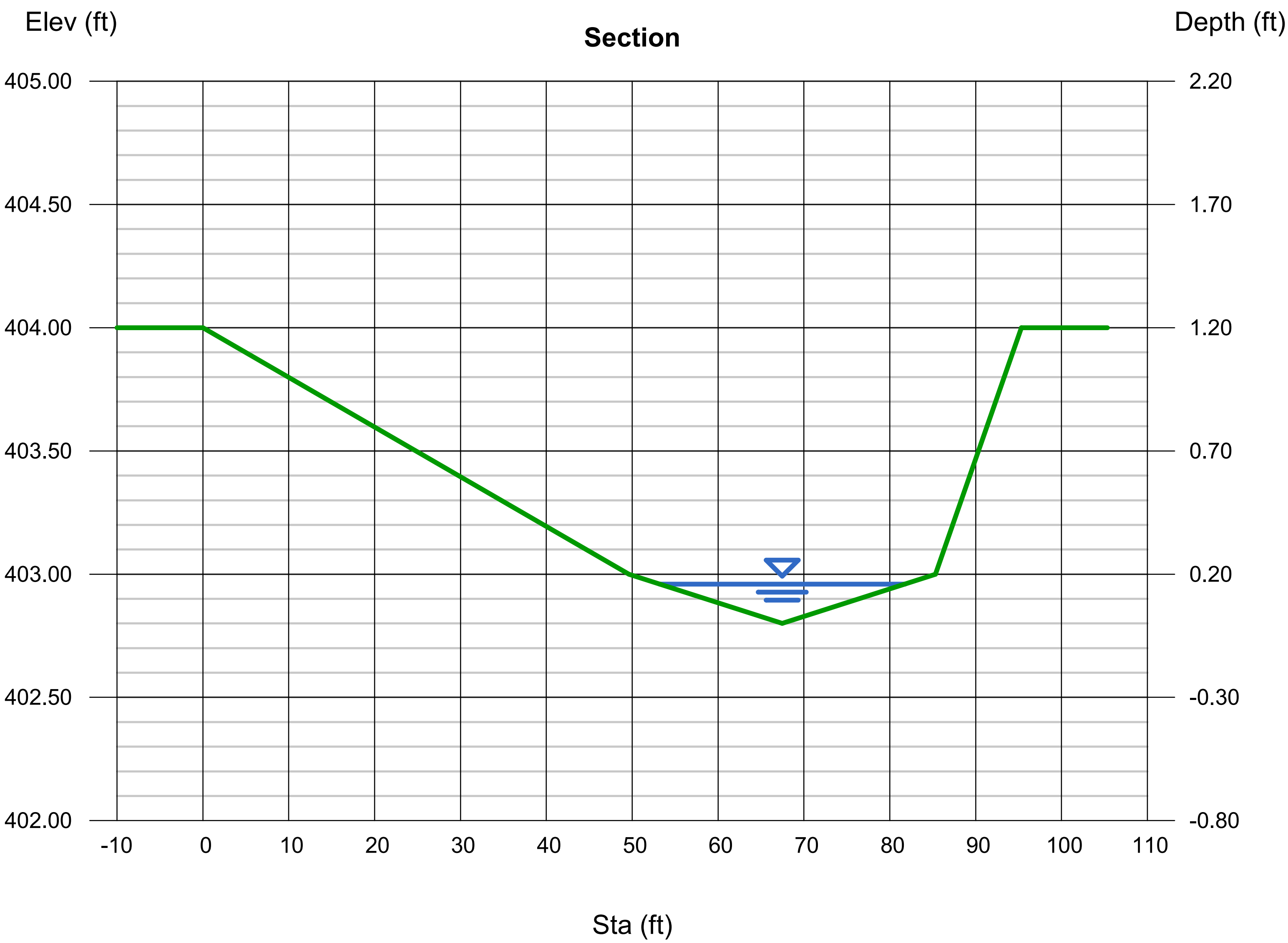
Proposed Conditions Basin P-2.1

User-defined
Invert Elev (ft) = 402.80
Slope (%) = 0.90
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 4.07

Highlighted
Depth (ft) = 0.16
Q (cfs) = 4.070
Area (sqft) = 2.28
Velocity (ft/s) = 1.78
Wetted Perim (ft) = 28.56
Crit Depth, Yc (ft) = 0.17
Top Width (ft) = 28.56
EGL (ft) = 0.21

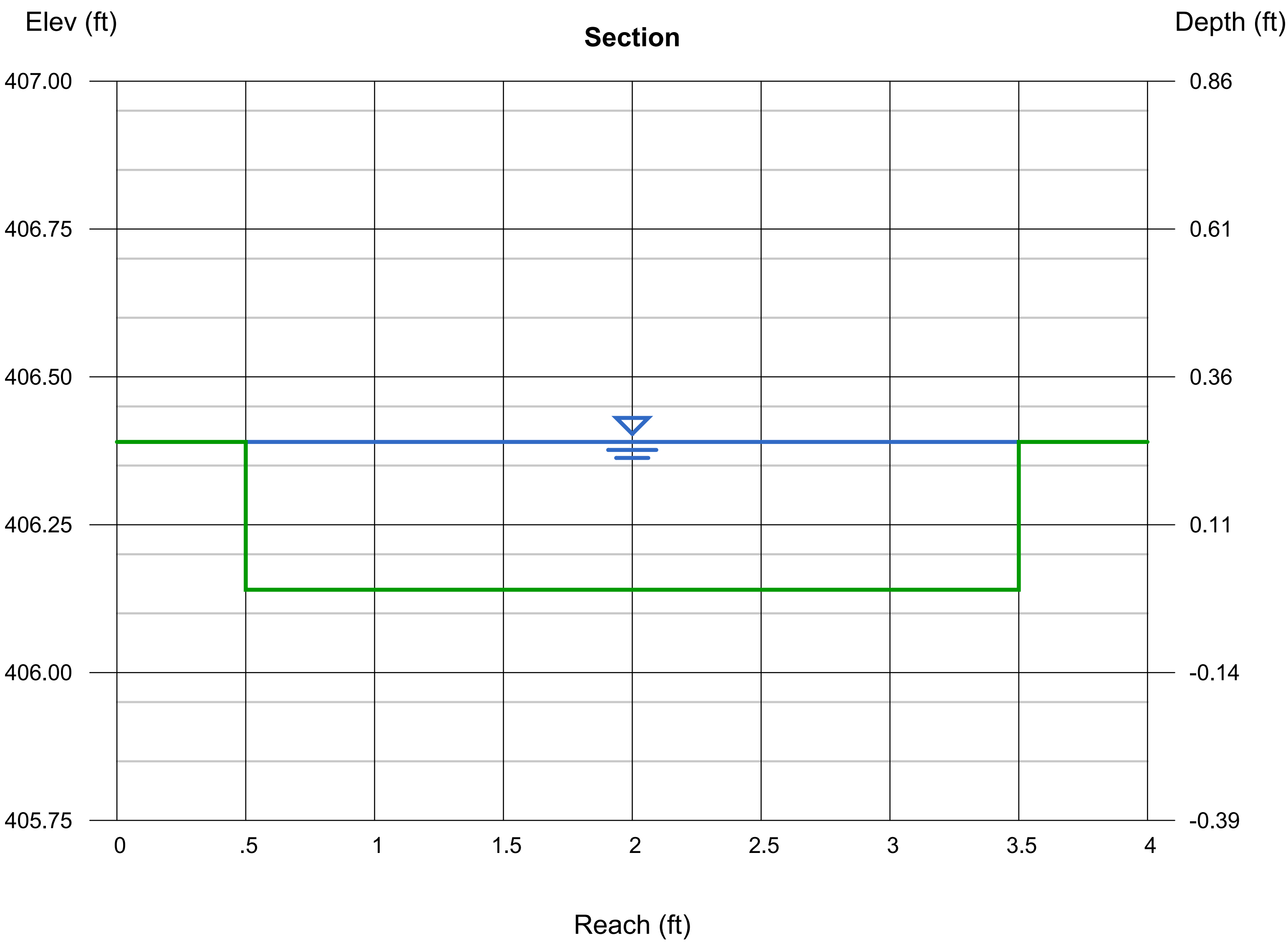
(Sta, El, n)-(Sta, El, n)...
(0.00, 404.00)-(49.63, 403.00, 0.013)-(67.48, 402.80, 0.013)-(85.33, 403.00, 0.013)-(95.33, 404.00, 0.013)



Channel Report

Curb Outlet Capacity

Rectangular		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.25
Total Depth (ft)	= 0.25	Q (cfs)	= 4.339
		Area (sqft)	= 0.75
Invert Elev (ft)	= 406.14	Velocity (ft/s)	= 5.79
Slope (%)	= 2.00	Wetted Perim (ft)	= 3.50
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.25
		Top Width (ft)	= 3.00
Calculations		EGL (ft)	= 0.77
Compute by:	Q vs Depth		
No. Increments	= 10		



Appendix 14

National Flood Hazard Layer FIRMette

FEMA

116°56'21"W 32°51'43"N

116°55'44"W 32°51'13"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

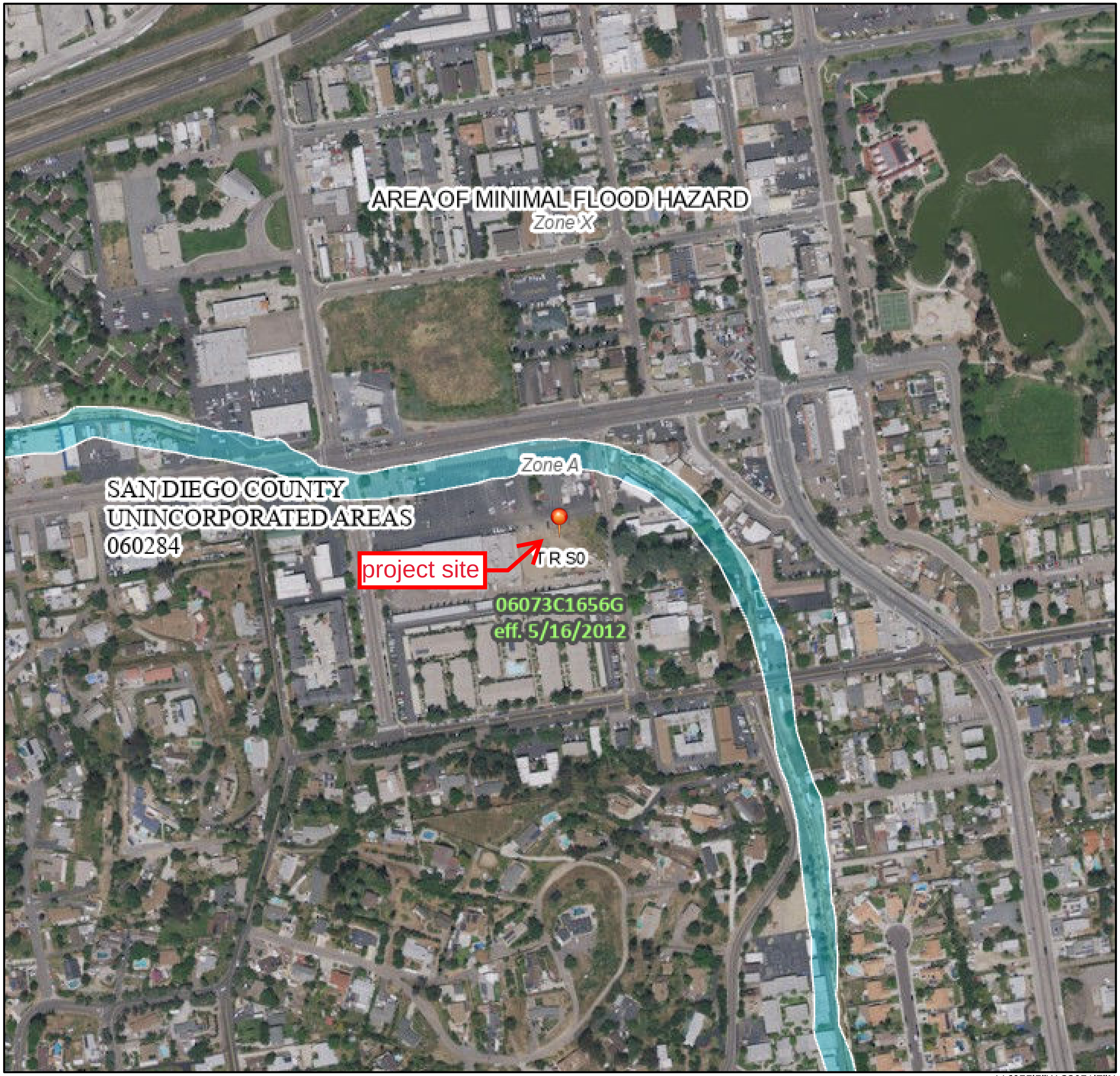
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/29/2022 at 2:08 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

116°55'43"W 32°51'37"N



116°55'5"W 32°51'7"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/21/2023 at 6:20 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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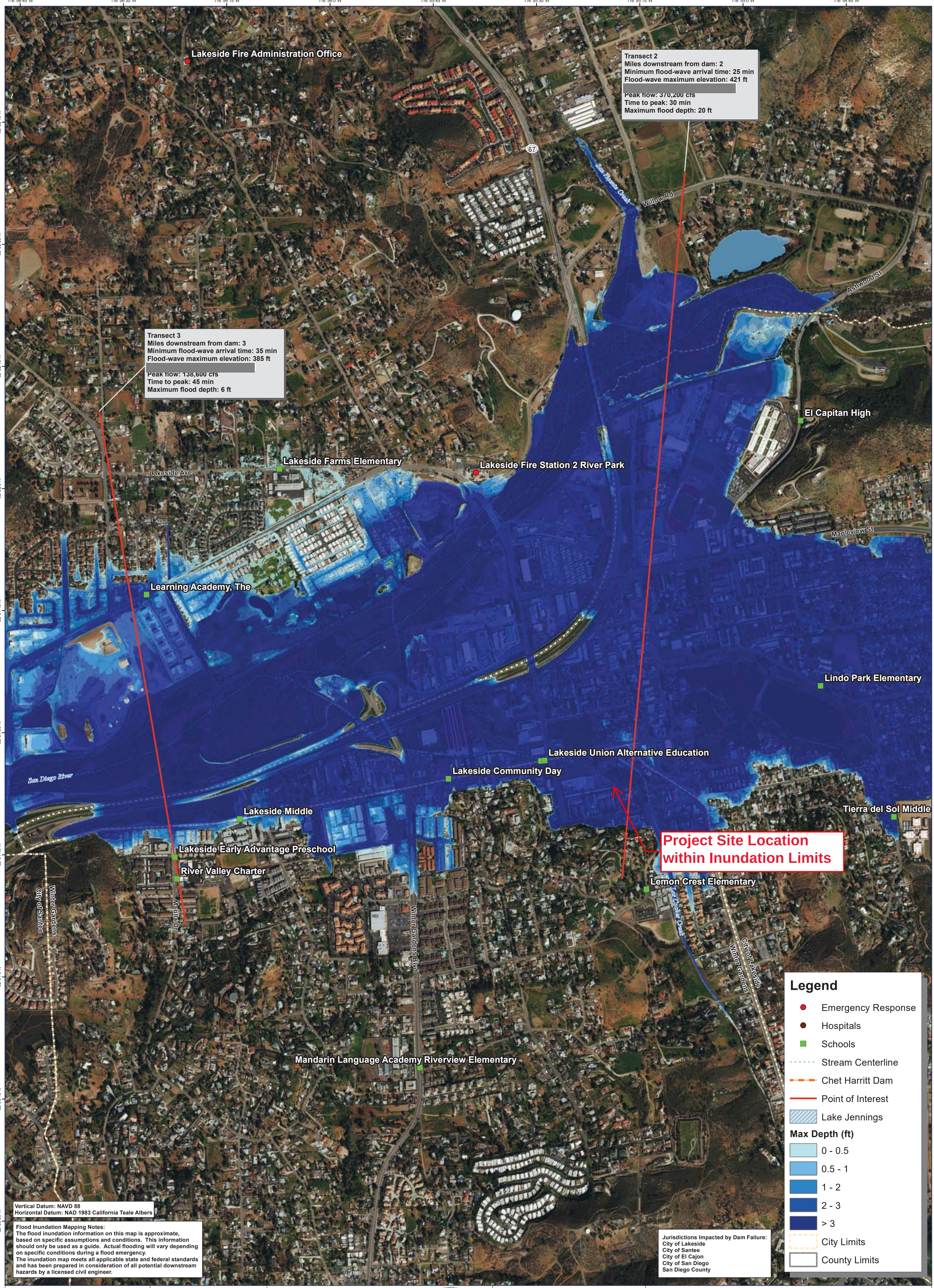
Appendix 15



REVISIONS:

Revised by:
Revision date:

Accepted by:
Acceptance date:

Helix Water District

Helix WATER DISTRICT

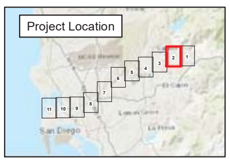
WEST Consultants, Inc.

Civil Engineer: David S. Smith, P.E.
Engineering Firm: WEST Consultants, Inc.
Address: 11440 W. Bernardo Court, Suite 360
San Diego, CA 92127-1671
Phone number (858) 487-9378

REGISTERED PROFESSIONAL ENGINEER DAVID S. SMITH No. C056132 Exp. 12/31/18 CIVIL STATE OF CALIFORNIA

Name of Dam: Chet Harritt
DWR Jurisdictional Dam Number: 56-009
National Dam ID: CA00236
County: San Diego

Dam Owner: Helix Water Disctrict
Address: 1233 Vernon Way, El Cajon,CA 92020
Phone: (619) 596-1349



Chet Harritt Dam
Sunny Day Failure Analysis
Flood Inundation Map
Sheet 2 of 11

January 2018

0 250 500 1,000 1,500 Feet