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Preliminary Drainage Report

CITY OF SAN DIEGO

3030 MAINSTREET SAN DIEGO CA 92133

OCTOBER 2021 | VERSION 1

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This Drainage Study has been prepared by Kimley-Horn and Associates, Inc. under the direct supervision of the following Registered Civil Engineer. The undersigned attests to the technical data contained in this study, and to the qualifications of technical specialists providing engineering computations upon which the recommendations and conclusions are based.

10/22/2021

Bryan C. Nord R.C.E. 87326 Date

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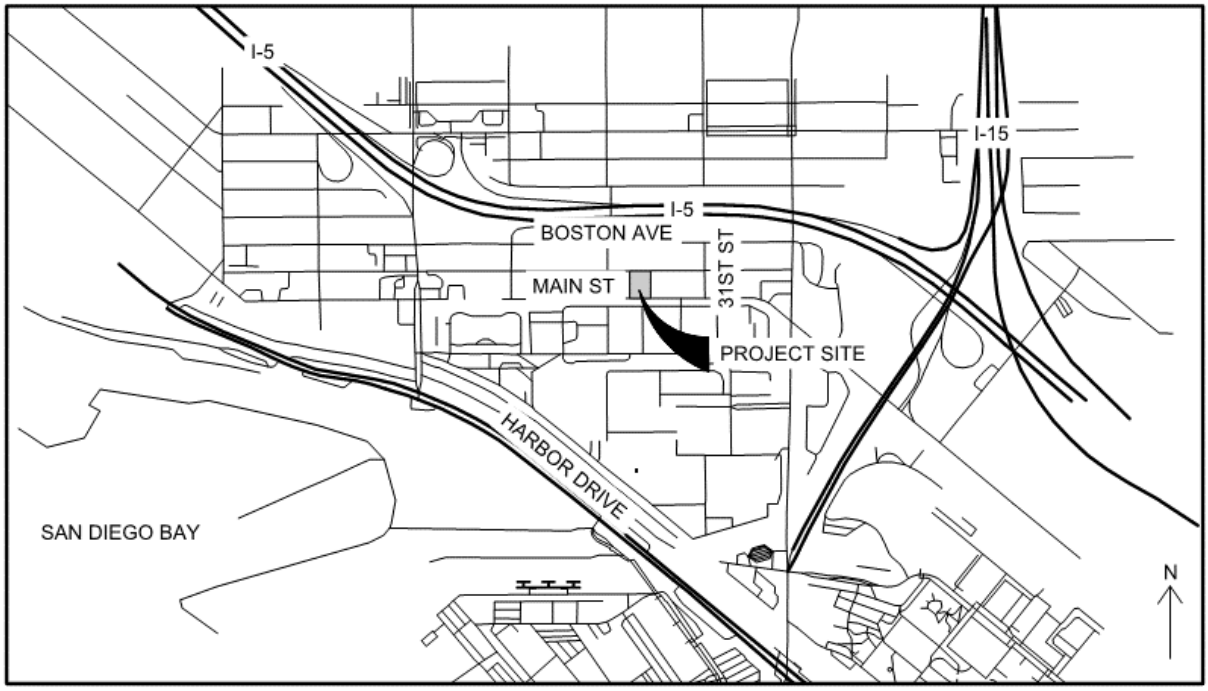
Figure 1 Vicinity Map



VICINITY MAP

1 PROJECT DESCRIPTION

PURPOSE OF STUDY

The purpose of this study is to support the redevelopment of the site. The study will provide sizing of proposed preliminary drainage structures, confirm that post developed runoff will not exceed pre-developed peak flows, and ensure there will be no negative impacts to surrounding and downstream properties

PROJECT DESCRIPTION

The proposed project lies within the limits of the City of San Diego and is located generally south of I-5, West of I-15, and between 30th Street and 31st Street on Main Street. The parcel in which the project is located is approximately 0.32 acres, of which approximately 0.32 acres will be improved. Existing project site contains an existing building, and paved walkways. Proposed improvements include the construction of an educational building, parking spaces, sidewalks, minor drainage infrastructure, and stormwater treatment facilities.

2 DESCRIPTION OF WATERSHED

PRE-DEVELOPMENT DRAINAGE PATTERN

The project is located on a developed parcel, zoned Light Industry within the City of San Diego. The site is bound by a public alley to the North, existing buildings to the East, Main Street to the south, and existing buildings to the west.

The existing topography within the project parcel slopes from north to south between 2% and 5% and discharges to the gutter in Main Street at the point of compliance labeled POC-A. The gutter carries drainage west to the intersection of 30th Street. There are two possible conveyance routes that depend on the existing downstream topography. Drainage either sheet flows to the grate inlet on the southern gutter of Main Street at the intersection of 30th, or it crosses 30th and 29th in the gutter and is collected in the curb inlet on the north east corner of Main and 28th. From these collection points, storm water is carried in the public storm drain system and discharges directly to the San Diego Bay, and then the Pacific Ocean. The Project will determine the exact route in Final Design.

POST-DEVELOPMENT DRAINAGE PATTERN

The project proposes to grade the entire 0.32 acre parcel. The proposed drainage pattern follows historic and existing conditions and has been designed to convey runoff to the existing point of discharge, labeled as POC-A. The site has been designed and analyzed as two drainage basins due to the routing of runoff to storm water BMPs. Stormwater detention was not analyzed for this project because the project proposes a net decrease in impervious area and existing drainage patterns are followed causing the post-development peak runoff to decrease from the existing condition. The proposed site is designed to bypass the 100-year peak flow.

3 METHODOLOGY

DESIGN STANDARDS

The 2003 San Diego County Hydrology Manual and the City of San Diego Drainage Design Manual are used as guidance to design of drainage facilities within this project.

HYDROLOGY

Surface topography and material are analyzed to determine the runoff produced by the proposed development. Peak flow runoff rates were calculated in accordance with the San Diego County Hydrology Manual. 100-year peak flow runoff for Pre- & Post-development are calculated in accordance with the Hydrology Manual.

DETENTION

Stormwater detention was not analyzed for this project because the project proposes a net decrease in impervious area and existing drainage patterns are followed causing the post-development peak runoff to decrease from the existing condition.

HYDRAULICS

Resulting runoff calculations are utilized to analyze the hydraulic systems within this study. The proposed system was sized using the 2020 Hydraflow Storm Sewers extension.

4 CALCULATIONS

DETERMINATION OF WATERSHEDS WITHIN PROJECT LIMITS

To determine if the proposed design will have a negative impact to downstream facilities, the analysis ensures the contributing areas to the POC (Point of Compliance) remain approximately identical in pre & post development conditions and the resulting post-development runoff flows remain at or below the pre-development flows.

See Attachment 2 for the topographic maps.

CALCULATE RUNOFF COEFFICIENT

Per Web Soil Survey from the USDA, the project impact footprint lays within Hydraulic Soil Group “D”.

To determine the runoff coefficient “C” for the pre-development conditions, Table 3-1 of the Hydrology Manual was utilized. Per section 3.1.2, second paragraph, “impervious percentage (% Impervious) as given in Table 3-1 for any area, shall govern the selected value for C.” Thus, the C value is determined using the percent of impervious and soil type per equation found in section 3.1.2 to the Hydrology Manual:

$$C = 0.90 * (\%Impervious) + C\_p * (1 - \%Impervious)$$

PRE-DEVELOPMENT CALCS FOR DETERMINING "C"							
Basin	Soil Type	Total (sqft)	Imperv (sqft)	Perv (sqft)	Imp (%)	Perv (%)	C-value
A (total)	D	13896	13896	0.00	1.00	0.00	0.90

The ultimate C-value used for each basin is calculated by the weight average method

$$C = \frac{C_{Soil\,type} * Area_{Soil\,Type}}{Area_{Total}} + \frac{C_{Soil\,Type} * Area_{Soil\,Type}}{Area_{Total}}$$

PRE-DEVELOPMENT C-VALUE	
BASIN	C-VALUE
A (total)	0.90

Post-developed C-values were determined through the same process as the pre-developed:

POST-DEVELOPMENT CALCS FOR DETERMINING "C"							
Basin	Soil Type	Total (sqft)	Imperv (sqft)	Perv (sqft)	Imp (%)	Perv (%)	C-value
1	D	8123	7650	473	94%	6%	0.87
2	D	5275	4897	378	93%	7%	0.86
3	D	498	378	120	76%	24%	0.77

POST-DEVELOPMENT C-VALUE	
BASIN	C-VALUE
A	0.87
B	0.86
C	0.77

Attachment 2 shows impervious calculation for this project.

CALCULATE MANNING ROUGHNESS COEFFICIENT

Per Hydraulic Design Manual Appendix A, the average Manning Roughness Coefficient for asphalt pavement is 0.016 and concrete lined channel is 0.013. These values will be used for this study.

CALCULATE STORM FLOWS USING THE MODIFIED RATIONAL METHOD

One POC is identified to assist in comparison of the pre- & post-development conditions. The pre-project condition was analyzed as a single drainage area, labeled Basin A. The proposed basin was analyzed as three drainage area labeled as DA 1, 2, 3. All drainage areas discharge to POC 1, which is located at the southwest corner of the project.

Pre-developed flows are routed using topography that is a combination of aerial topo, precise survey, and County 2-foot contours provided by SanGIS.

See Attachment 2 for Pre- & Post-Development Basin Delineation.

Comparison of Pre and Post runoff are shown below:

	Area (acres)	Tc (min)	Runoff (cfs)	Discharge Velocity (FPS)
Pre	0.32	5.00	1.72	2.09
Post	0.32	5.00	1.65	4.78
		Reduction	0.07 CFS	

DESIGN / ANALYZE PROPOSED STORM DRAIN FACILITIES

The project is analyzed with direct runoff to the POC to ensure the discharge location has capacity for the 100-year peak flow. Onsite storm conveyance facilities were designed using Hydraflow Express.

Drainage basin A consists of the entire site and conveys runoff via sheet flow and curb and gutter to a proposed modular wetlands system to provide water quality treatment. Treated runoff from the raised planter BMPs are routed south where they discharge to the gutter within Mainstreet via curb outlets. The storm drain pipe network was designed to bypass and convey the 100-year storm event.

Detention was not considered in the analysis because peak runoff was not increased due to this project. The proposed site storm drain facilities were designed to bypass the 100-year peak flow.

See Attachment 4 for analysis and results.

5 CONCLUSIONS

This analysis has determined that POC-A will experience less runoff and no negative impacts will occur to existing facilities from the post-developed conditions. Detention was not considered in the analysis because peak runoff was not increased due to this project.

It is determined that the proposed onsite storm conveyance facilities have been adequately sized to convey the 100-year storm runoff.

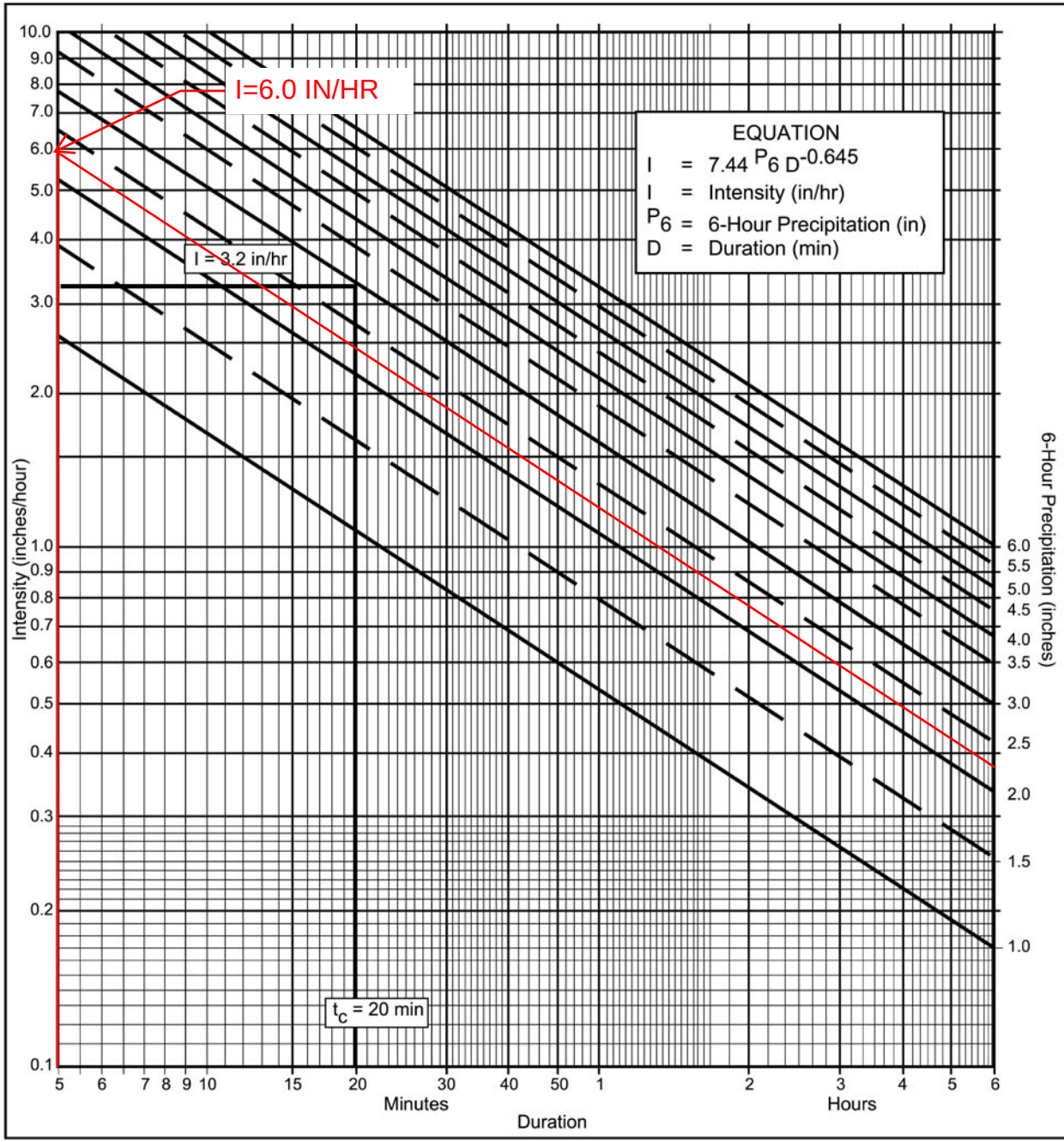
Because the project is not located within navigable waters, water of the United States, or Federal jurisdictional wetlands, as defined by the Clean Water Act, no 401/404 permit is required.

In conclusion, the project has met the City of San Diego and County of San Diego minimum requirements for the peak flow control.

APPENDICIES

APPENDIX A

FIGURES AND TABLES



Directions for Application:

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

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

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

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

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

Application Form:

(a) Selected frequency 50 year

(b) P_6 = 2.3 in., P_{24} = 3.8, $\frac{P_6}{P_{24}}$ = 61 %(2)

(c) Adjusted P_6(2) = 2.3 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

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

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

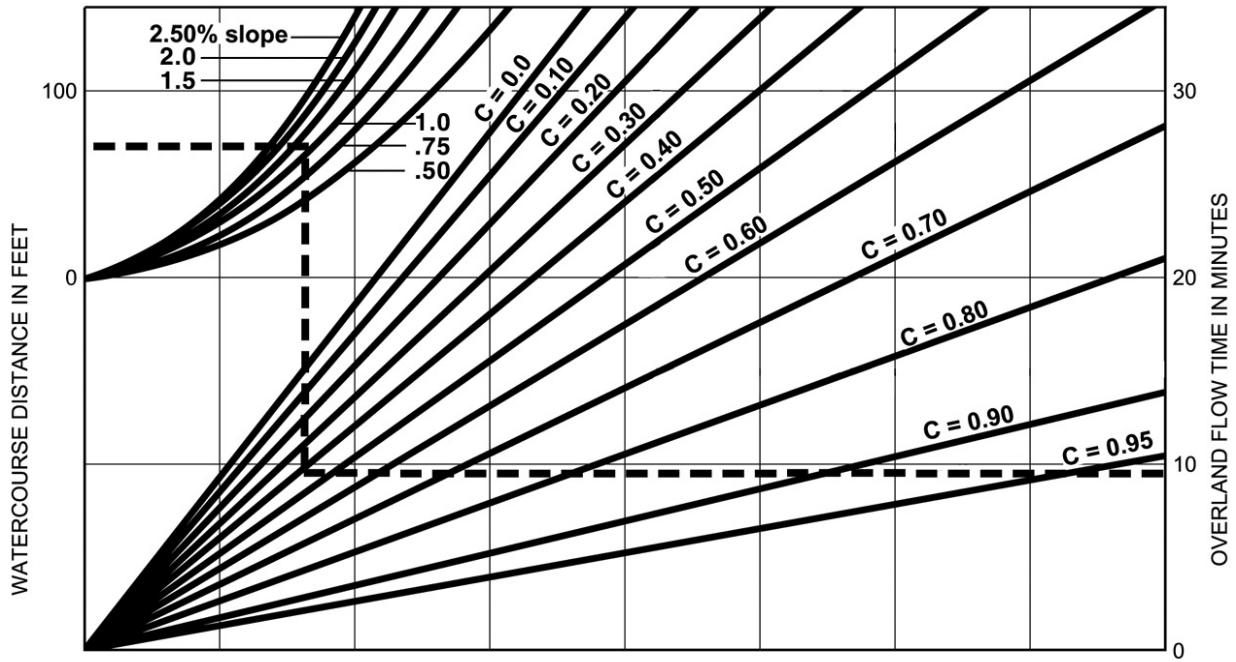
Intensity-Duration Design Chart - Example

FIGURE 3-2

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



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

FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

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.

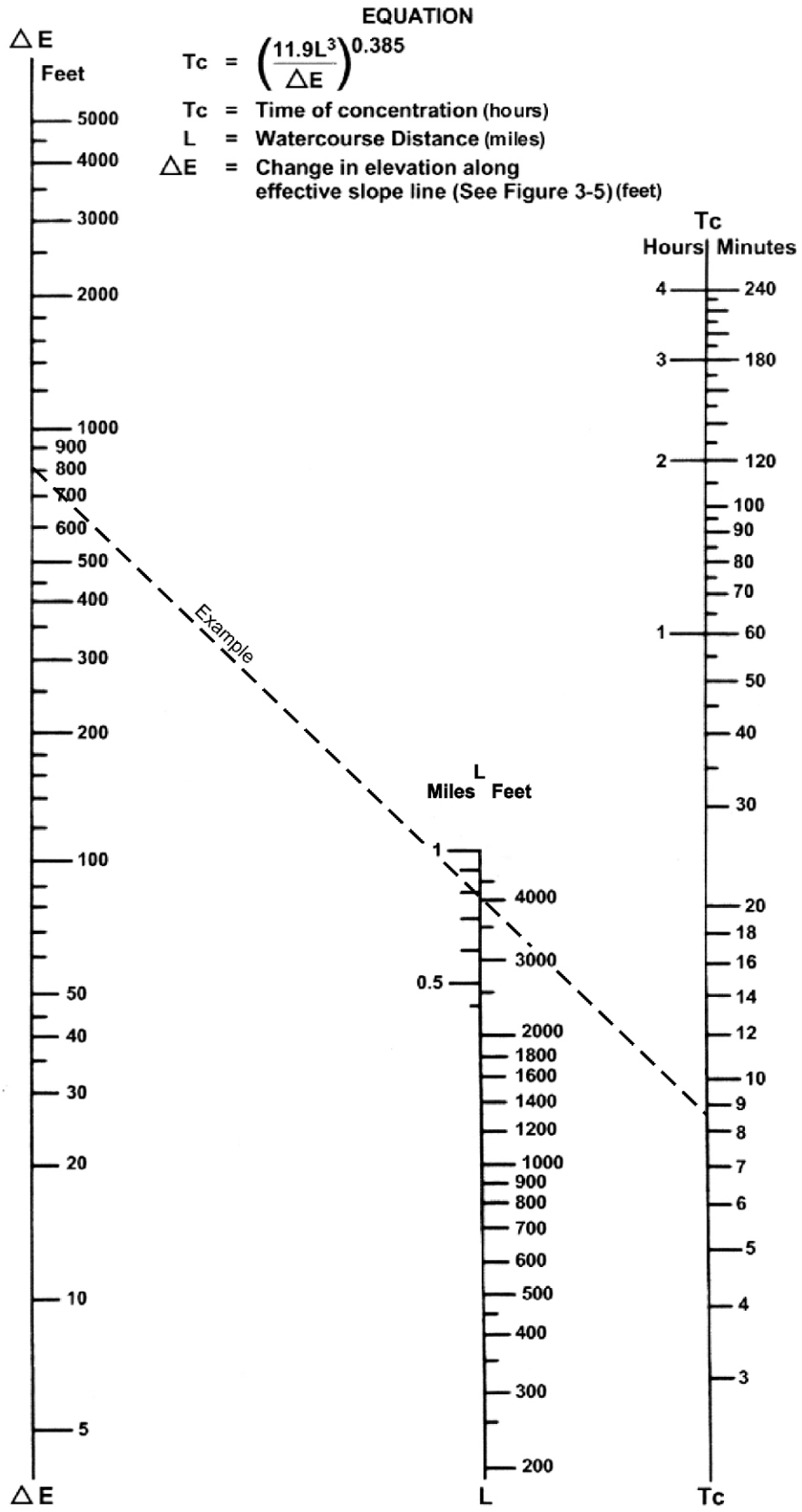
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved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

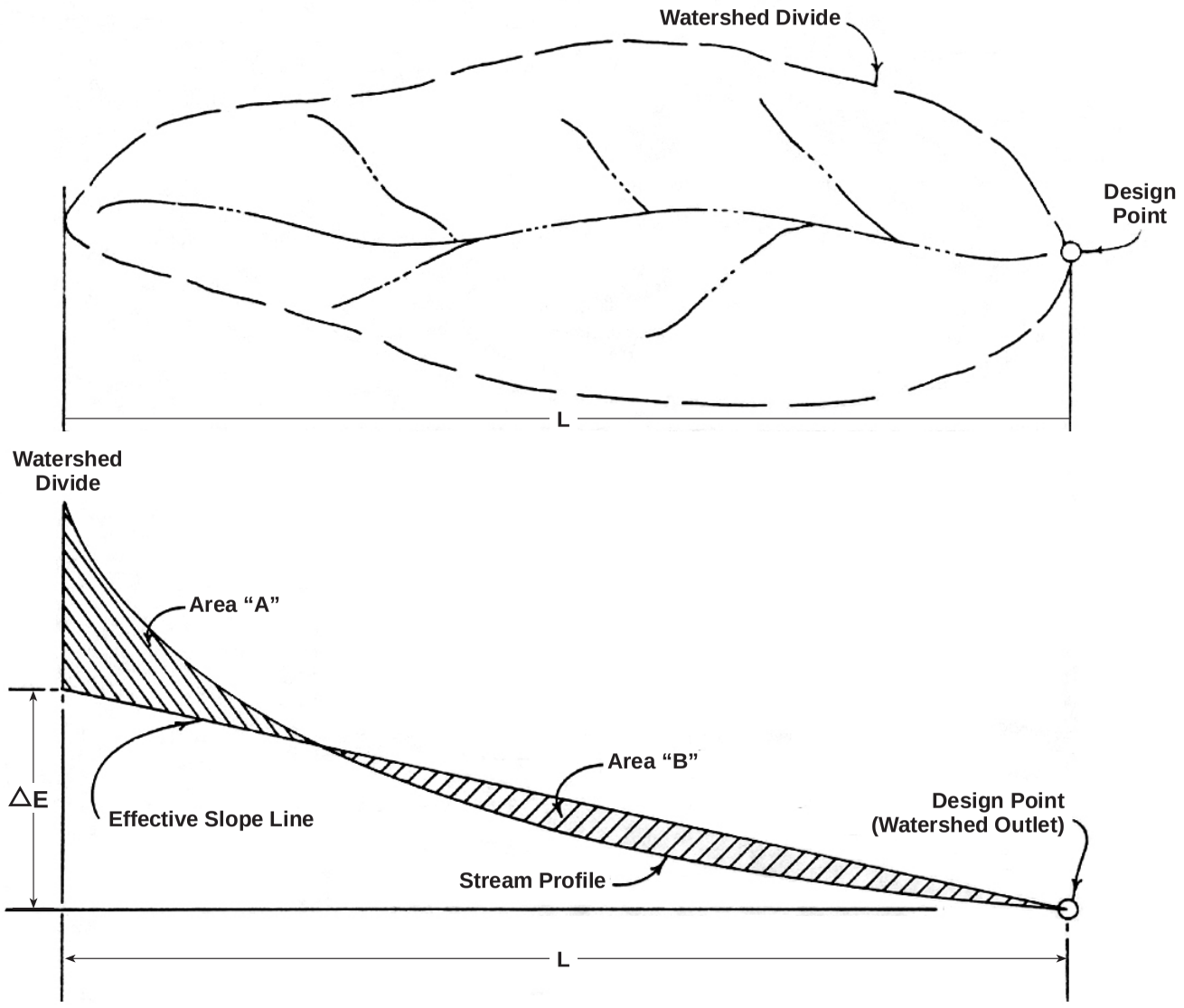
*See Table 3-1 for more detailed description



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

FIGURE 3-4

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



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

FIGURE

Computation of Effective Slope for Natural Watersheds

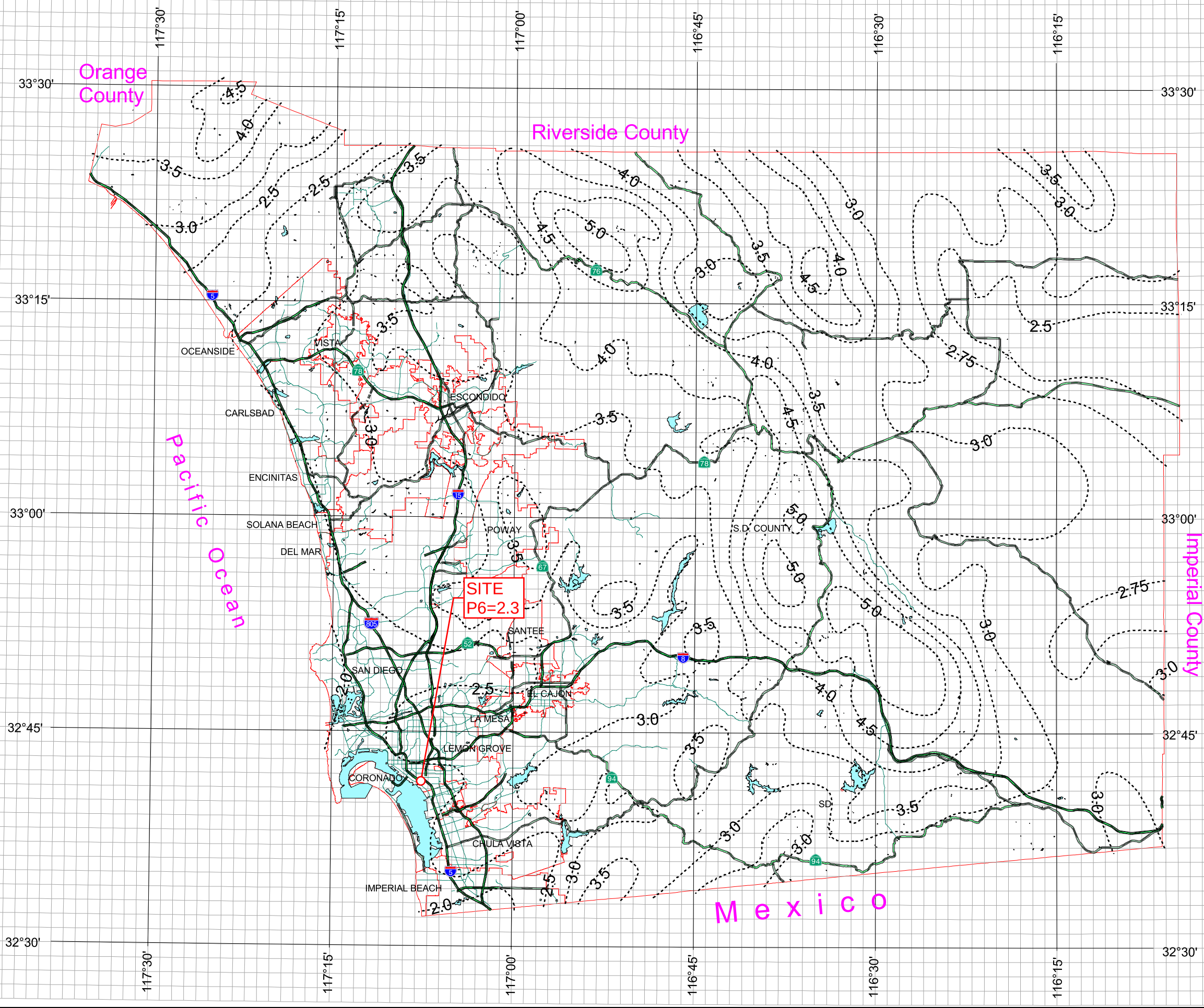
3-5

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



DPW GIS
Department of Public Works
Geographic Information Services

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)

SITE
P24=3.8

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
POWAY
S.D. COUNTY
DEL MAR
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'

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

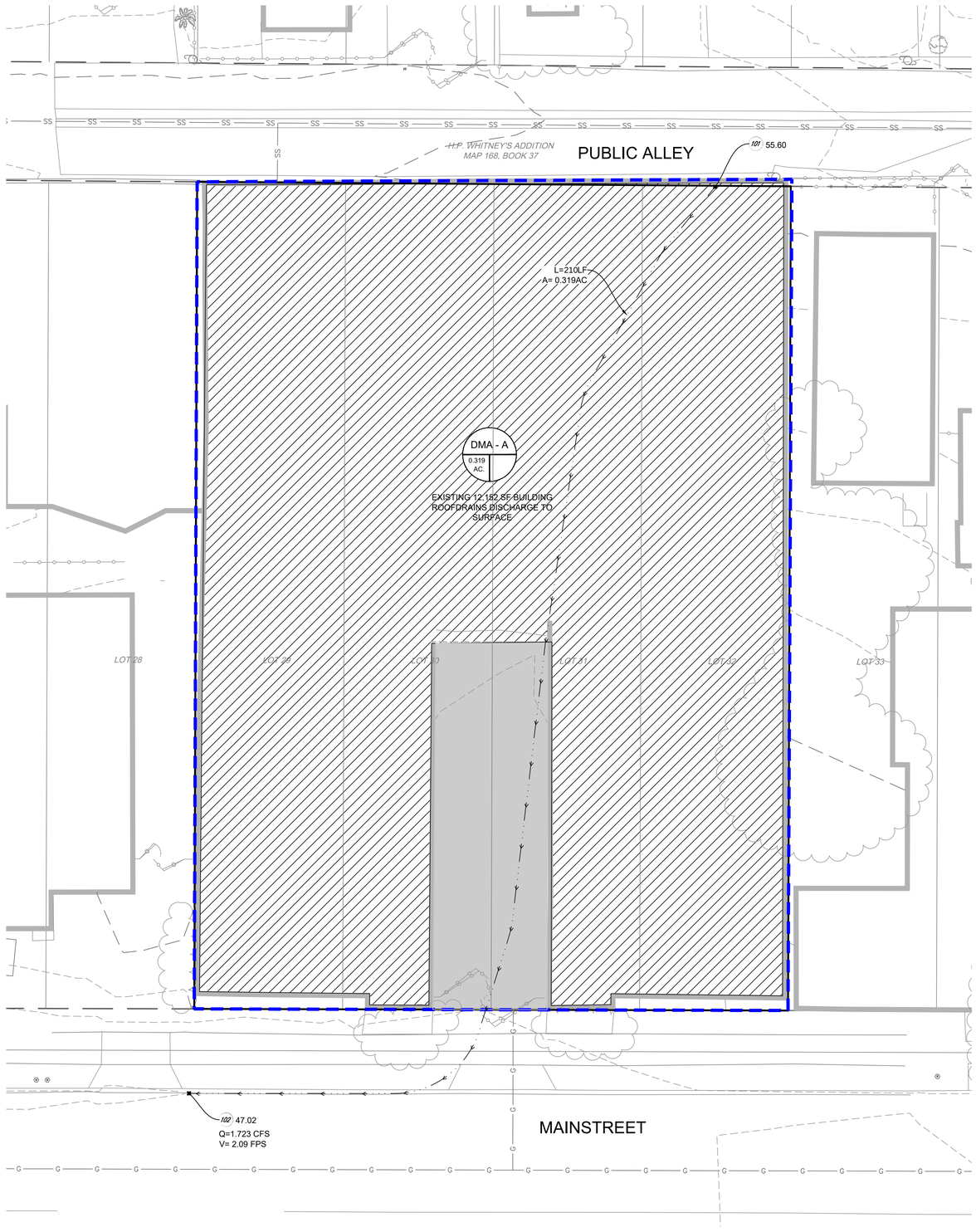
N W E S

3 0 3 Miles

APPENDIX B

WATERSHED INFORMATION

CAUTION: IF THIS SHEET IS NOT 24"x36" IT IS A REDUCED PRINT



LEGEND

PERVIOUS

IMPERVIOUS-ROOFS

IMPERVIOUS

DMA BOUNDARY

FLOW PATH

DMA-TABULAR SUMMARY					
DMA ID	AREA (ACRES)	AREA (SF)	PERVIOUS AREAS (SF)	IMPERVIOUS AREAS (SF)	IMPERVIOUS PERCENTAGE (%)
DMA-A	0.32	13896	0	13896	100%

NORTH

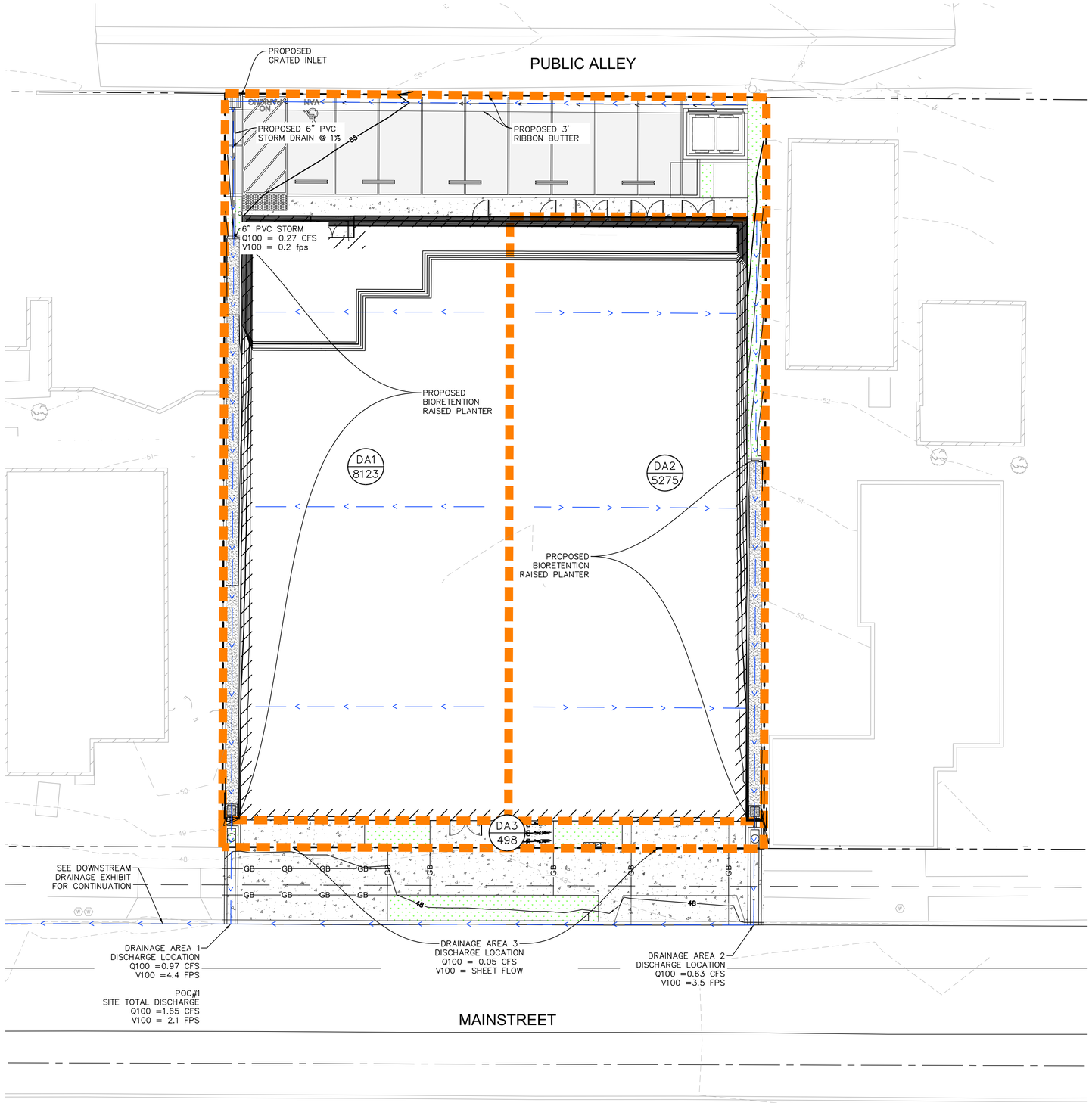
GRAPHIC SCALE IN FEET
0 5 10 20

Kimley»Horn

VETPOWERED
3030 MAIN STREET
SAN DIEGO, CA 92113

EX. DRAINAGE MAP

NO.	DATE	REMARKS
##	##	
##	##	
##	##	
##	##	
##	##	
##	##	
##	##	
##	##	



LEGEND

- DMA ID
- DMA SQUARE FOOTAGE
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPERTY LINE
- ROAD CENTERLINE
- STORM DRAIN PIPE
- LANDSCAPED AREAS
- AC PAVEMENT
- CONCRETE PAVEMENT

NORTH

GRAPHIC SCALE IN FEET
0 5 10 20

Kimley»Horn

PROPOSED DRAINAGE MAP

VETPOWERED - SAN DIEGO

10/20/2021

LEGEND

FLOW DIRECTION

PROPERTY LINE

ROAD CENTERLINE

STORM DRAIN PIPE

PUBLIC STORM DRAIN INLET

NORTH

GRAPHIC SCALE IN FEET
0 30 60 120

Kimley»Horn

DOWNSTREAM DRAINAGE EXHIBIT

VETPOWERED - SAN DIEGO

10/21/2021

APPENDIX C

100-YEAR RATIONAL METHOD CALCULATIONS

100-year Pre-developed Flows

Basin	Soil Type	Total	Imperv	perv	% imp	% perv	C-value	I (in/hr)	Q (CFS)
Pre-Dev A	D	13896.00	13896.00	0.00	1.00	0.00	0.90	6.0	1.723

100-year Post-developed Flows

Basin	Soil Type	Total (SF)	Total (AC)	Imperv	perv	% imp	Impervious Runoff Factor	% perv	Pervious. Runoff Factor	C-Value	I (in/hr)	Q (CFS)
1	D	8123.00	0.19	7650.00	473.00	0.940	0.90	0.06	0.35	0.87	6.0	0.971
2	D	5275.00	0.12	4897.00	378.00	0.930	0.90	0.07	0.35	0.86	6.0	0.625
3	D	498.00	0.01	378.00	120.00	0.760	0.90	0.24	0.35	0.77	6.0	0.053
Total	D	13896.00	0.32	12925.00	971.00	2.63					18.00	1.65

APPENDIX D

HYDRAULIC ANALYSIS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 13 2021

POC 1 PROPOSED

Gutter

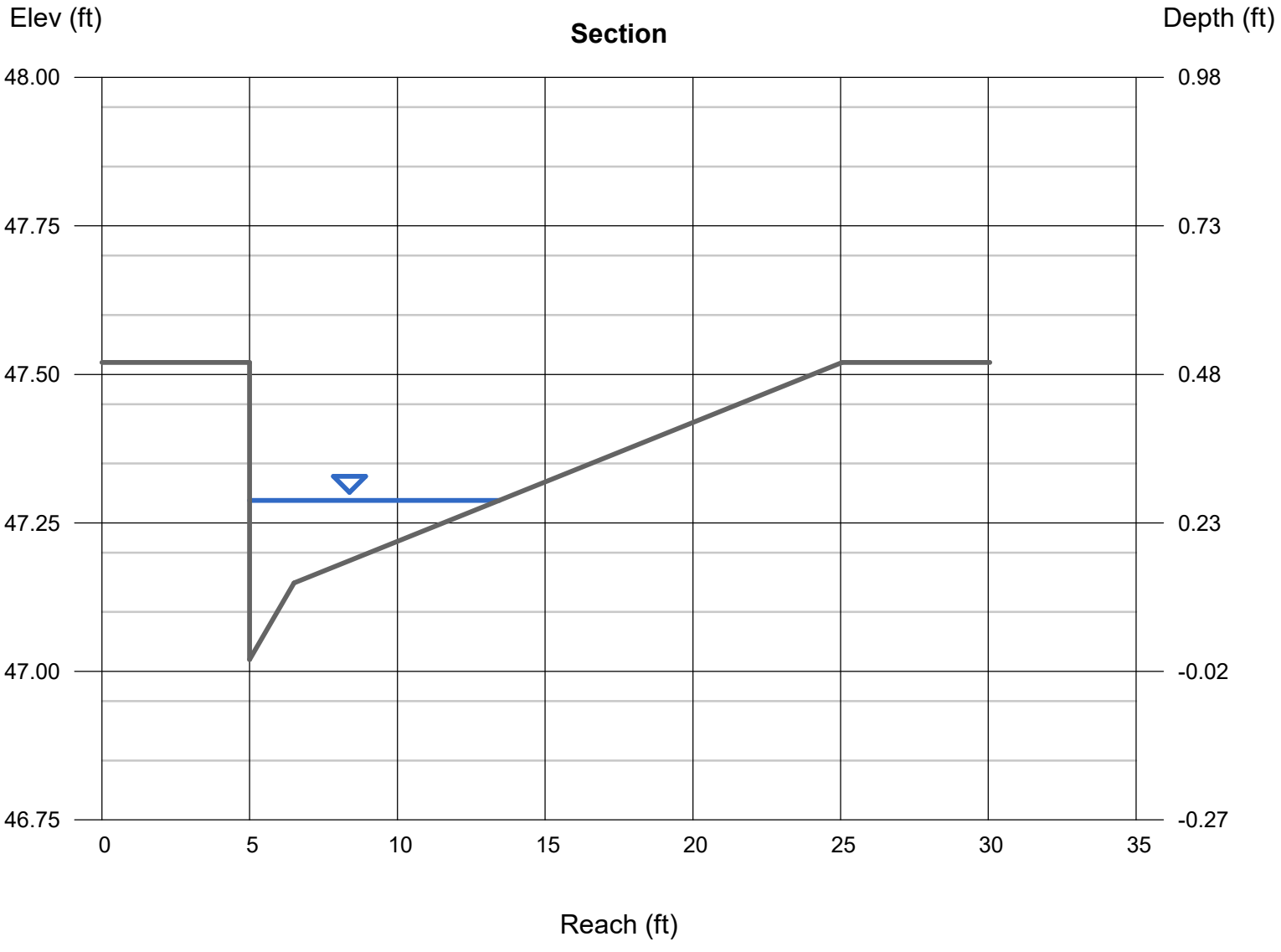
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.086
Gutter Width (ft)	= 1.50
Invert Elev (ft)	= 47.02
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.65

Highlighted

Depth (ft)	= 0.27
Q (cfs)	= 1.650
Area (sqft)	= 0.79
Velocity (ft/s)	= 2.09
Wetted Perim (ft)	= 8.72
Crit Depth, Yc (ft)	= 0.29
Spread Width (ft)	= 8.45
EGL (ft)	= 0.34



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 13 2021

Drainage Area 1 Outlet

Rectangular

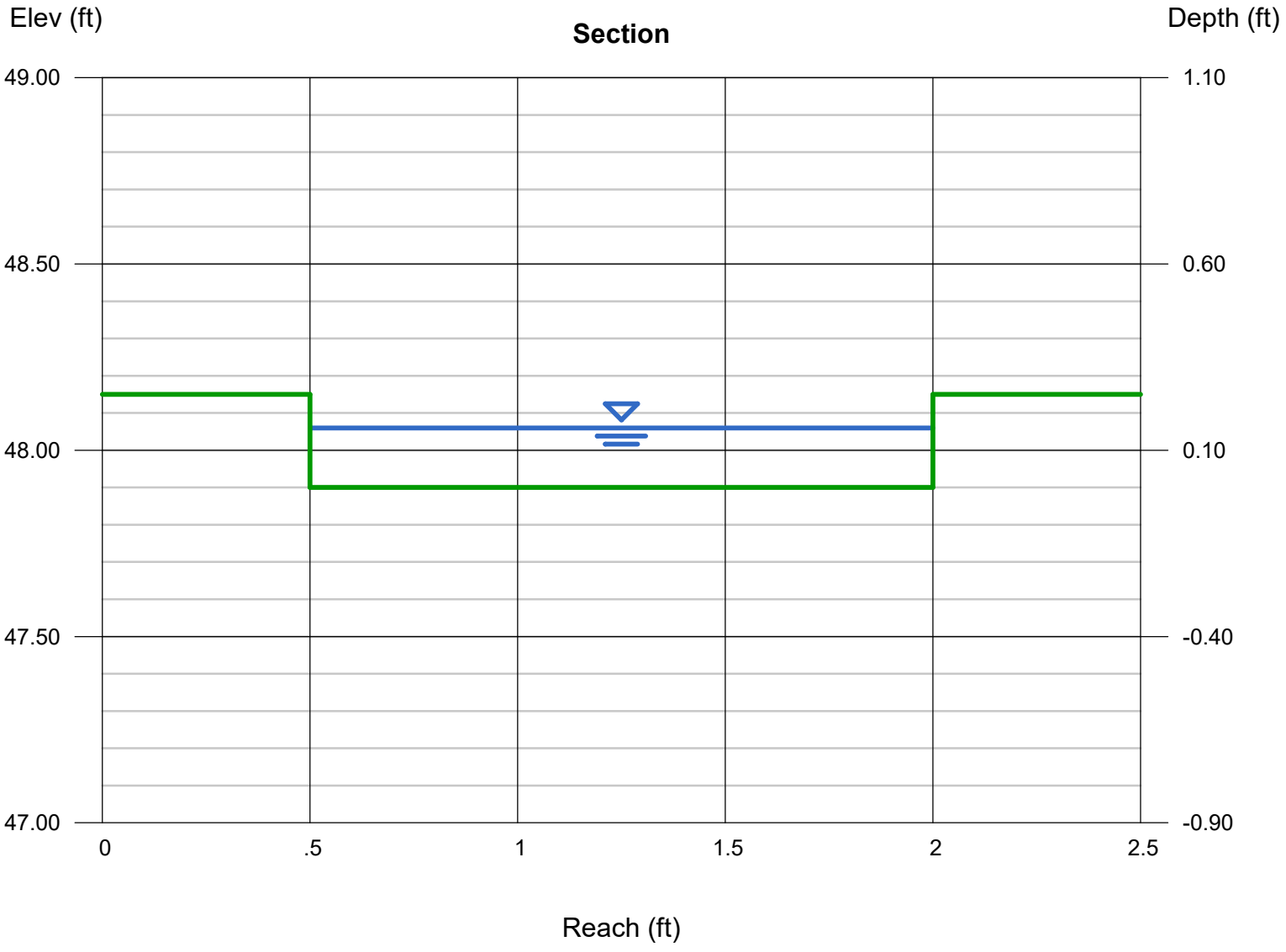
Bottom Width (ft)	= 1.50
Total Depth (ft)	= 0.25
Invert Elev (ft)	= 47.90
Slope (%)	= 2.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.97

Highlighted

Depth (ft)	= 0.16
Q (cfs)	= 0.970
Area (sqft)	= 0.24
Velocity (ft/s)	= 4.04
Wetted Perim (ft)	= 1.82
Crit Depth, Yc (ft)	= 0.24
Top Width (ft)	= 1.50
EGL (ft)	= 0.41



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Aug 13 2021

6 inch Storm Drain to Bioretention

Circular

Diameter (ft)	= 0.50
Invert Elev (ft)	= 50.00
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.27

Highlighted

Depth (ft)	= 0.25
Q (cfs)	= 0.270
Area (sqft)	= 0.10
Velocity (ft/s)	= 2.74
Wetted Perim (ft)	= 0.79
Crit Depth, Yc (ft)	= 0.27
Top Width (ft)	= 0.50
EGL (ft)	= 0.37