JONES
ENGINEERS, INCORPORATED

CEQA HYDROLOGY STUDY
Alpine 21

PDS 2005-3100-5431

Submitted to:
The County of San Diego
Department of Public Works

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For:
Alpine 21, LLC
5295 Beachcomber Court
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DECLARATION OF RESPONSIBLE CHARGE

I, HEREBY DECLARE THAT I AM THE CIVIL 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 THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

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RYAN LONG
RCE 77,844

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PURPOSE AND OBJECTIVES

The purpose of this report is to evaluate stormwater runoff resulting from the proposed development of the Alpine 21 project (TM 5431) during a design flood event according to the requirements of the County of San Diego.

EXISTING CONDITIONS

The project is located directly north of Interstate 8, east of W. Victoria Dr. and west of E. Victoria Drive in Alpine California (Figures 1 and 2). The property, currently undeveloped, has an Existing General plan designation of 1 (Residential), is Zoned A70 (1 acre minimum), with a Regional Category of Country Residential Development Area.

The *USDA's Soil Survey of San Diego Area, California* identifies the soil within the subject property basin as a combination of Hydrologic Groups B and C. The Hydrologic Group B soils consist of Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded (CnG2), and Cienbeba rocky coarse sandy loam, 9 to 30 percent slopes, eroded (CmE2). The Hydrologic Group C soil is designated Fallbrook rocky sandy loam, 5 to 9 percent slopes (FeC) (Appendix I).

Stormwater runoff from the property drains south-westerly. The project is located within the Alpine Creek Hydrologic Subarea (907.33) of the San Diego River Hydrologic Area (907).

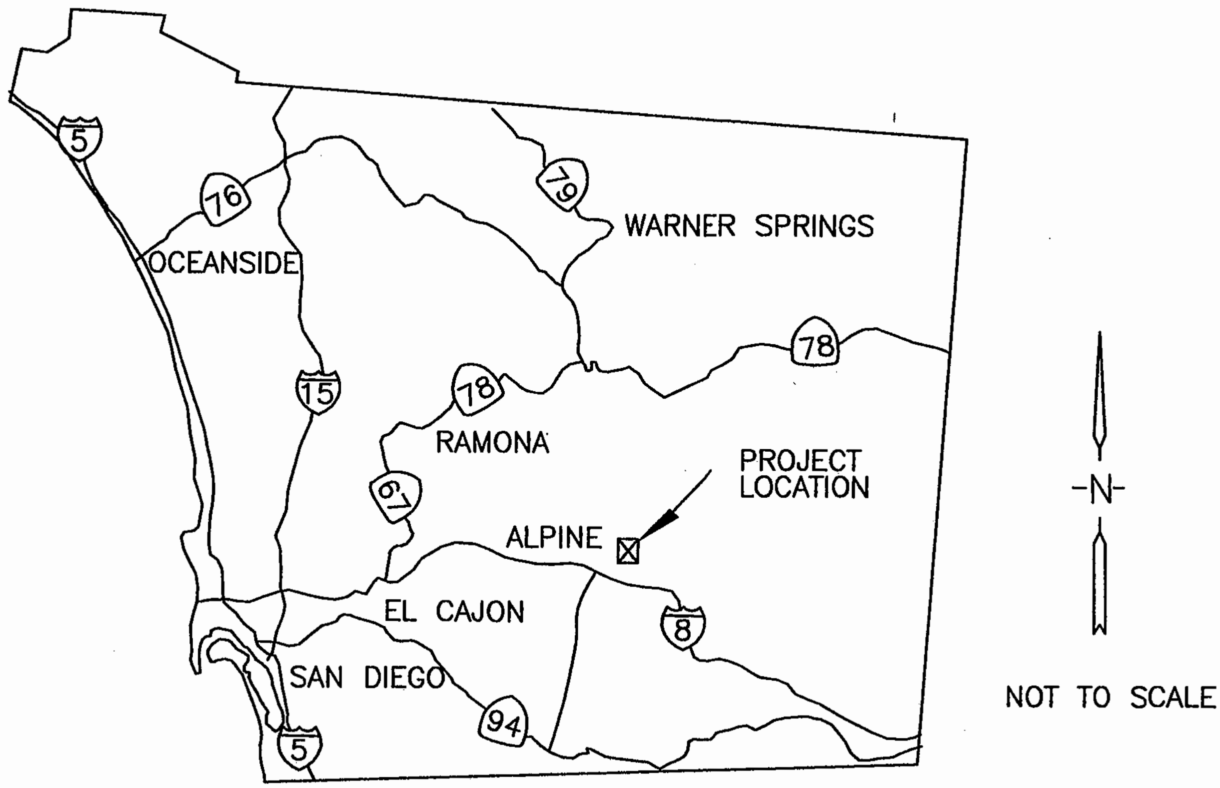
A historical impoundment (dam) exists near the western boundary of the site near POC 2 in Basin 3A. The origins of this feature are not specifically known. A ponding area exists just upstream of the impoundment and an associated rock lined spillway runs southwesterly from the northern end of the ponding area through adjacent property and discharges back into the natural drainage channel downstream of the impoundment. For pre-development peak flow analysis the hydrologic calculations assume conditions prior to construction of the historical dam. The calculations route the 100 year storm runoff accordingly. The existing ponding area does not impact the routing and modeling of the peak discharge for the pre-development conditions at POC 2.

PROPOSED DEVELOPMENT

Proposed development includes 20 single-family residential lots with lot sizes range from 1.1 to 7.6 acres with graded pad areas ranging from 9 to 19 thousand square feet. Each building site will be graded individually to allow stormwater drainage will traverse existing natural routes. Culvert crossings are proposed where drainage courses cross under proposed private roads and driveways. Roadway runoff will be directed into curbs, tree wells, spillways, brow ditches and storm pipes which will discharge into natural drainage courses. Riprap energy dissipators will be placed at all outlets to reduce the potential for erosion.

The project proposes to excavate a wetland bottom channel through the existing ponding area and impoundment (dam) located along the western boundary of the site near POC 2 in Basin 3A. The wetland bottom channel would bypass the rock lined spillway and eliminate the potential for drainage diversion through the spillway. Drainage through this area would be restored to its natural, historic channel course at or below pre-development rates.

Prior to issuance of final grading permits the existing impoundment area (dam) shall be inspected and evaluated by a registered engineer to determine whether the impoundment meets the threshold criteria of the California Division of Safety of Dams, (DSOD). If the impoundment is determined to meet the threshold criteria, removal of the impoundment shall be conducted pursuant to DSOD review requirements.



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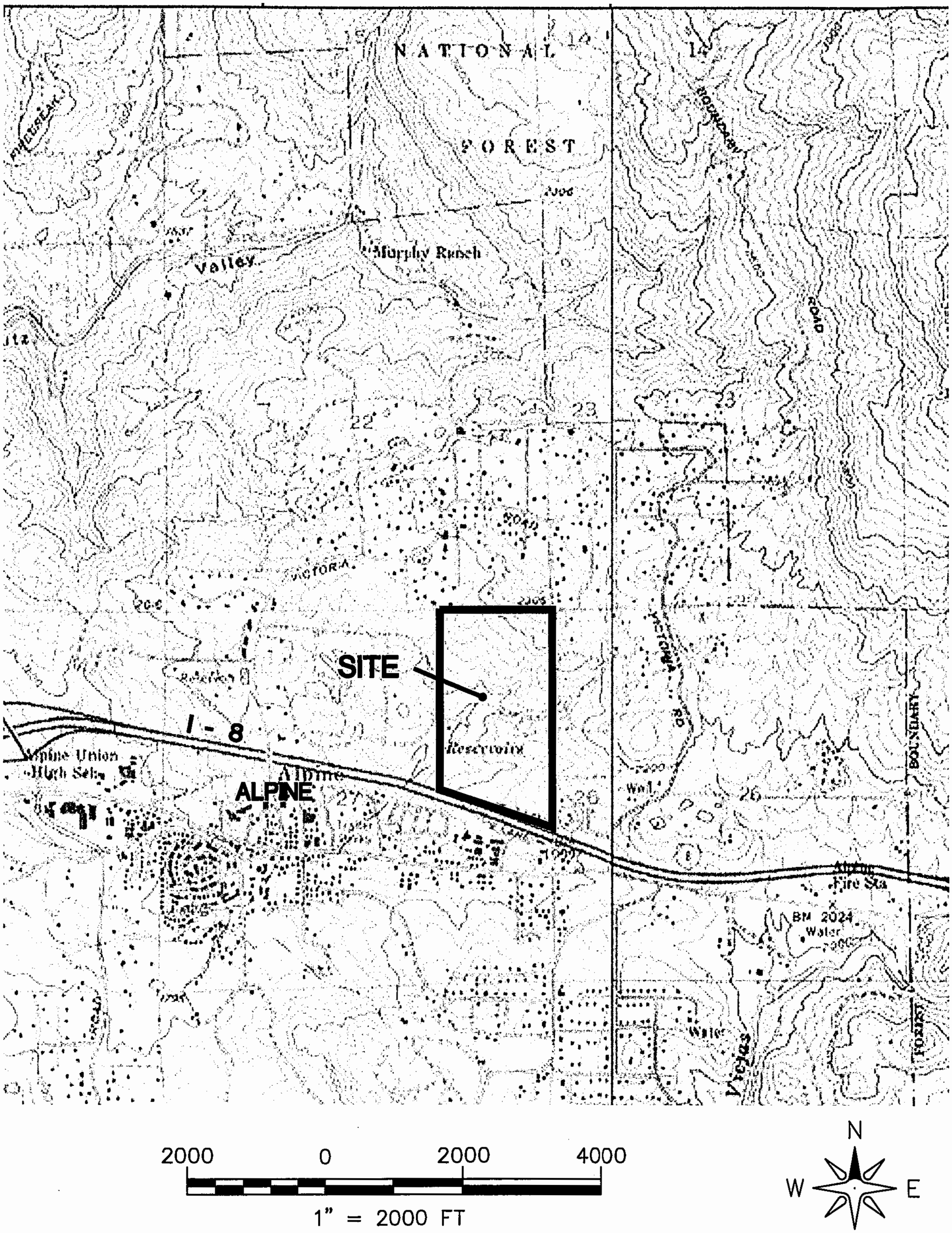
REGIONAL LOCATION MAP

FIGURE 1



SOURCE: USGS 7-1/2' QUADRANGLE MAP – ALPINE

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LOCATION MAP
FIGURE 2

METHOD OF ANALYSIS

The hydrologic analysis for this project is consistent with current engineering standards and the requirements of San Diego County Department of Public Works. The rational method was used to determine the maximum flow rate resulting from the 100-yr, 6-hour design storm event using the current *County of San Diego Drainage Manual's* (*Drainage Manual*) isopluvial map data (Appendix I).

Peak flow rates were computed for existing and post developed conditions. Major drainage basins were identified for the hydrologic analysis and times of concentration were calculated from the hydraulically most distant point of each basin to the point of concentration (POC).

Runoff coefficients (C) for each drainage basin were based on land use and soil type. Where a basin contained multiple soil types, a weighted coefficient was determined by summing the products of the C value and the percentage of total area included in that class. Land use was assumed to be either Natural (undeveloped) or Low Density Residential (LDR), 1.0 dwelling unit/acre (Appendix I).

ANALYSIS

6.1 Pre-Development Hydrologic Analysis

The project site lies within a watershed covering just over 200 acres. Drainage basins were identified in the pre-development analysis. Intensity was calculated using the precipitation maps found in the *Drainage Manual* for each basin using the following equation:

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

Where P_6 = 3.5 inches (Appendix I)
D = varies with basin size and travel path.

The following equation was used to analyze travel times for overland flow:

$$Tc = \left(\frac{11.9L^3}{h} \right)^{0.385}$$

Where L = travel length and h = beginning minus ending elevations (E_1-E_2).

The initial time of concentration (T_i) was based on sheet flow length as limited in the *Drainage Manual's* Table 3-2 (between 50 and 100 ft as determined by slope, Appendix I), travel time (T_f) was calculated through the watershed using the overland flow equation, and channel flow analysis from Haestad Methods Open Channel Flow Module, Version 3.3 © 1991.

6.1.1 Basin A

Basin A is located in the northern portion of the watershed and flows to POC2. The basin is divided into sub-basins A1, A2 and A3. The sub-basins are characterized by a combination of soils and land uses. The following tables display the corresponding weighted C values used in the hydrologic analysis (Tables 1-3, Figure 3).

Table 1: Basin A1 – Pre Development Runoff Coefficient

Basin A1-Drainage Area (acres) = 42.67

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba-Fallbrook rocky sandy loams	CnG2	B	12.44	Undeveloped	0.25	3.11
Cieneba-Fallbrook rocky sandy loams	CnG2	B	5.43	LDR*	0.32	1.74
Cieneba rocky coarse sandy loam	CmE2	B	21.18	Undeveloped	0.25	5.30
Cieneba rocky coarse sandy loam	CmE2	B	3.48	LDR*	0.32	1.11
Fallbrook rocky sandy loam	FeC	C	0.14	LDR*	0.36	0.05
			42.67			11.31
			Mean Runoff Coefficient			0.26

Table 2: Basin A2 – Pre Development Runoff Coefficient

Basin A2-Drainage Area (acres) = 95.02

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba-Fallbrook rocky sandy loams	CnG2	B	6.23	Undeveloped	0.25	1.56
Cieneba-Fallbrook rocky sandy loams	CnG2	B	17.02	LDR*	0.32	5.45
Cieneba rocky coarse sandy loam	CmE2	B	4.27	Undeveloped	0.25	1.07
Cieneba rocky coarse sandy loam	CmE2	B	51.17	LDR*	0.32	16.38
Fallbrook rocky sandy loam	FeC	C	16.33	LDR*	0.36	5.88
			95.02			30.33
			Mean Runoff Coefficient			0.32

Table 3: Basin A3 – Pre Development Runoff Coefficient

Basin A3-Drainage Area (acres) = 10.62

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	7.37	Undeveloped	0.25	1.84
Cieneba rocky coarse sandy loam	CmE2	B	1.92	LDR*	0.32	0.61
Cieneba-Fallbrook rocky sandy loams	CnG2	B	1.30	Undeveloped	0.25	0.32
Cieneba-Fallbrook rocky sandy loams	CnG2	B	0.04	LDR*	0.32	0.01
			10.62			2.79
			Mean Runoff Coefficient			0.26

* Low Density Residential - 1 Dwelling Unit/Acre

Basin A – Time of Concentration and Peak Flow Rate: Pre-Development

Time of concentration and peak flow analysis is located in Table 4. Basins A1 and A2 converge at POC 1. The flows were combined at that point and then routed through Basin A3 to POC 2. The peak flow from Basin A1 was combined with the peak flow from Basin A2 at POC1 using the Modified Rational Method to obtain the maximum flow out of the junction into Basin A3 as follows:

Let Q_A, T_A, and I_A correspond to the tributary area with the shortest T_c (Basin A1). Likewise, let Q_B, T_B, and I_B correspond to the tributary area with the next longer T_c (Basin A2). Combine the independent drainage systems using the junction equation below:

Junction Equation: $T_A < T_B$

$Q_{TA} = Q_A + (T_A/T_B)Q_B$ *or* $\mathbf{Q_{TA} = Q_{BasinA1} + (T_{BasinA1}/T_{BasinA2})Q_{BasinA2}}$

$$Q_{TA} = 54.60 + \left(\frac{13.24}{18.83}\right) 119.21 = 138.05 \text{ cfs}$$

$Q_{TB} = Q_B + (I_B/I_A)Q_A$ *or* $\mathbf{Q_{TB} = Q_{BasinA2} + (I_{BasinA2}/I_{BasinA1})Q_{BasinA1}}$

$$Q_{TB} = 119.21 + \left(\frac{3.92}{4.92}\right) 54.60 = 162.71 \text{ cfs}$$

Select the largest Q (Q_{TB} = 162.71 cfs) and use the T_c ($T_{BasinA2}$ = 18.83 min) associated with that Q for further calculations. Table 4 enumerates the pre-development times of concentration and peak flow rates for each sub-basin.

Table 4: Pre-Development Analysis Basin A

Basin A :																
Run	Sub Basin	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	V (ft/s)	T_f (min)	I_{100} (in/hr)	Q_{100} (cfs)
			0.00			*0.00*										
	A1	42.67		0.26	11.09		initial time	100	2310	2303		0.07		8.00		
L1							overland flow	458	2303	2280	23	0.05		2.76		
L2							nat channel	1645	2280	1980	300	0.18	11.09	2.47		
			42.67			*11.09*						*total =*		*13.24*	4.92	54.60
	A2	95.02		0.32	30.41		initial time	100	2365	2353		0.12		6.20		
L1							overland flow	201	2353	2340	13	0.06		1.33		
L2							ponding area	301	2340	2340	0	0.00		0.00		
L3							overland flow	3088	2340	2070	270	0.09		9.71		
L4							nat channel	1195	2070	1980	90	0.08	12.51	1.59		
			95.02			*30.41*						*total =*		*18.83*	3.92	119.21
Using Modified Rational Method																
Q = 162.71 cfs																
Tc = 18.83 min																
														18.83		
L1	A3	10.62		0.26	2.76		nat channel	506	1980	1968	12	0.02	8.14	1.04		
			148.31			***44.26***						***total =***		***19.87***	**3.79**	**167.64**

6.1.2 Basin B

Basin B is located in the southern portion of the watershed and flows to POC 4. The basin encompasses 51.49 acres. Basin B is characterized by a combination of soils and land uses. The following table displays the corresponding weighted C values used in the hydrologic analysis.

Table 5: Basin B Pre- Development Runoff Coefficient

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
Basin B-Drainage Area (acres) = 51.49						
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	23.30	Undeveloped	0.25	5.83
Cieneba rocky coarse sandy loam	CmE2	B	27.71	LDR	0.32	8.87
Cieneba-Fallbrook rocky sandy loams	CnG2	B	0.48	LDR	0.32	0.15
			51.49			14.85
		Mean Runoff Coefficient				0.29

Basin B – Time of Concentration and Peak Flow Rate

Time of concentration and peak flow analysis for Basin B is located in Table 6. T_i for Basin B is based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis.

Table 6: Pre-Development Analysis Basin B

Run	Sub Basin	Area	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length	E1	E2	h	Slope	V	T_f	I_{100}	Q_{100}
Basin B :																
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(in/hr)	(cfs)
			0.00			*0.00*										
		51.49		0.29	14.85		initial time	100	2275	2267		0.08		7.60		
L1							overland flow	1030	2267	2119	148	0.14		3.44		
L2							channel	2533	2119	1930	189	0.07	10.39	4.06		
			51.49			***14.85***						***total =***		***15.11***	**4.52**	**67.12**

6.1.3 Basin C

Basin C is located in the central portion of the watershed and flows to POC 3. The basin is characterized by a combination of soils and land uses. The following table displays the corresponding weighted C values used in the hydrologic analysis.

Table 7: Basin C – Pre Development Runoff Coefficient

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
Basin B-Drainage Area (acres) = 2.10						
Cieneba rocky coarse sandy loam	CmE2	B	2.10	Undeveloped	0.25	0.25

Basin C – Time of Concentration and Peak Flow Rate

Time of concentration and peak flow analysis for Basin C is located in Table 8. T_i for Basin C is based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis.

Table 8: Pre-Development Analysis Basin C

Basin C :																
Run	**Sub Basin**	**Area**	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length**	**E1**	**E2**	**h**	**Slope**	**V**	**T_f**	**I_{100}**	**Q_{100}**
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(in/hr)	(cfs)
		2.10		0.25	0.53		initial time	100	2058	2048		0.10		6.90		
L1							overland flow	602	2048	1960	88	0.15		2.26		
			2.10			***0.53***						***total =***		***9.16***	**6.24**	**3.28**

6.1.4 Basin D

Basin D is located in the central portion of the watershed and flows to POC 5. The basin is characterized by a combination of soils and land uses. The following table displays the corresponding weighted C values used in the hydrologic analysis.

Table 9: Basin D – Pre Development Runoff Coefficient

Basin D Drainage Area (acres) = 0.60						
Soil Type	**Map Symbol**	**Hyd. Class**	**Area**	**Land Use**	**C**	**A x C**
Cieneba rocky coarse sandy loam	CmE2	B	0.44	Undeveloped	0.25	0.11
Cieneba rocky coarse sandy loam	CmE2	B	0.16	pavement	0.9	0.14
			0.60			0.25
		Mean Runoff Coefficient				0.42

Basin D – Time of Concentration and Peak Flow Rate

Time of concentration and peak flow analysis for Basin D is located in Table 8. T_i for Basin D is based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and gutter flow analysis.

Table 10: Pre-Development Analysis Basin D

Basin D :																	
Run	**Sub Basin**	**Area**	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length**	**E1**	**E2**	**h**	**Slope**	**V**	**T_f**	**T_C**	**I_{100}**	**Q_{100}**
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(min)	(in/hr)	(cfs)
			0.00			*0.00*											
		0.60		0.42	0.25		initial time	100				0.10		6.90			
L1							overland flo	220	2128	2068	60	0.27		0.82			
L2							gutter flow	170	2068	2056	12	0.07	4.70	0.60			
			0.60			***0.25***						***total =***		***8.32***	***8.32***	**6.64**	**1.67**

6.2 Post-Development Hydrologic Analysis

6.2.1 Basin A

The majority of the proposed project site is located within Basin A. T_i for each sub-basin was based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis. The basin areas and runoff coefficients were modified to reflect the proposed development.

Two major culverts are proposed within the drainage routes of Basin A.

BASIN A1: A 36" concrete culvert with concrete headwalls will be installed within the flow path of the Basin A1 for a distance of 195 feet to convey drainage under the proposed roadway, Chelsea Leigh Way. This culvert is designed pursuant to Chapter 4 of the San Diego County Hydraulic Design Manual. Hydraulic calculations for this culvert are presented in Appendix II.

BASIN A2: An 8 foot wide soft bottom channel within a 14 foot wide multi plate arch pipe culvert will be constructed within the flow path of Basin A2 for a distance of approximately 71 feet to convey drainage from Basin A2 under the proposed roadway, Chelsea Leigh Way. This culvert will also serve as a wildlife crossing in conformance with the recommendations in the project Biology Report. This culvert is designed pursuant to Chapter 4 of the San Diego County Hydraulic Design Manual. Plans, details and specifications, including hydraulic calculations for this wildlife crossing culvert are presented in Appendix II.

BASIN A3: The project proposes alterations to a man made ponding area located near the point of concentration of Basin A3. A small earthen berm dam located near POC 2 will be removed and the drainage path for Basin A3 will be restored to it's natural, historic route in conjunction with the wetland restoration plan proposed as a part of this project. The drainage channel is designed pursuant to Chapter 5.6 of the current San Diego County Hydraulic Design Manual. See Appendix II for the constructed wetland channel design details and hydraulic calculations.

Table 11: Basin A1 Post Development Runoff Coefficient

Basin A1-Drainage Area (acres) = 41.60						
Soil Type	**Map Symbol**	**Hyd. Class**	**Area**	**Land Use**	**C**	**A x C**
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	9.76	Undeveloped	0.25	2.44
Cieneba rocky coarse sandy loam	CmE2	B	12.89	LDR	0.32	4.12
Cieneba-Fallbrook rocky sandy loams	CnG2	B	1.30	Undeveloped	0.25	0.33
Cieneba-Fallbrook rocky sandy loams	CnG2	B	17.50	LDR	0.32	5.60
Fallbrook rocky sandy loam	FeC	C	0.15	LDR	0.36	0.05
			41.60			12.54
		Mean Runoff Coefficient				0.30

Table 12: Basin A2 Post-Development Runoff Coefficient

Basin A2-Drainage Area (acres) = 94.70

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	2.83	Undeveloped	0.25	0.71
Cieneba rocky coarse sandy loam	CmE2	B	52.23	LDR	0.32	16.71
Cieneba-Fallbrook rocky sandy loams	CnG2	B	4.10	Undeveloped	0.25	1.03
Cieneba-Fallbrook rocky sandy loams	CnG2	B	19.20	LDR	0.32	6.14
Fallbrook rocky sandy loam	FeC	C	16.33	LDR	0.36	5.88
			94.70			30.47
			Mean Runoff Coefficient			0.32

Table 13: Basin A3 Post-Development Runoff Coefficient

Basin A3-Drainage Area (acres) = 12.67

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	5.11	Undeveloped	0.25	1.28
Cieneba rocky coarse sandy loam	CmE2	B	6.31	LDR	0.32	2.02
Cieneba-Fallbrook rocky sandy loams	CnG2	B	0.61	Undeveloped	0.25	0.15
Cieneba-Fallbrook rocky sandy loams	CnG2	B	0.63	LDR	0.32	0.20
			12.67			3.65
		Mean Runoff Coefficient				0.29

Basin A – Time of Concentration and Peak Flow Rate: Post-Development

Basins A1 and A2 converge at POC 1. The flows were combined at that point and then routed through Basin A3 to POC 2. The peak flow from Basin A1 was combined with the peak flow from Basin A2 at POC1 using the Modified Rational Method to obtain the maximum flow out of the junction into Basin A3 as follows:

Let Q_A, T_A, and I_A correspond to the tributary area with the shortest T_c (Basin A1). Likewise, let Q_B, T_B, and I_B correspond to the tributary area with the next longer T_c (Basin A2). Combine the independent drainage systems using the junction equation below:

Junction Equation: $T_A < T_B$

$Q_{TA} = Q_A + (T_A/T_B)Q_B$ *or* $\mathbf{Q_{TA} = Q_{BasinA1} + (T_{BasinA1}/T_{BasinA2})Q_{BasinA2}}$

$$Q_{TA} = 60.95 + \left(\frac{13.52}{19.63}\right) 116.32 = 141.06 \text{ cfs}$$

$Q_{TB} = Q_B + (I_B/I_A)Q_A$ *or* $\mathbf{Q_{TB} = Q_{BasinA2} + (I_{BasinA2}/I_{BasinA1})Q_{BasinA1}}$

$$Q_{TB} = 116.32 + \left(\frac{3.82}{4.86}\right) 60.95 = 164.23 \text{ cfs}$$

Select the largest Q (Q_{TB} = 164.23 cfs) and use the T_c ($T_{BasinA2}$ = 19.63 min) associated with that Q for further calculations. Table 14 enumerates the pre-development times of concentration and peak flow rates for each sub-basin.

Table 14: Post-Development Analysis Basin A

Basin A :																
Run	**Sub Basin**	**Area**	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length**	**E1**	**E2**	**h**	**Slope**	**V**	**T_f**	**I_{100}**	**Q_{100}**
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(in/hr)	(cfs)
			0.00			*0.00*										
	A1	41.60		0.30	12.55		initial time	70				0.01		11.50		
L1							overland flow	125	2242	2186	56	0.45		0.44		
L2							channel	1175	2186	1992	194	0.17	13.72	1.43		
L3							culvert	195	1992	1980	12	0.06	21.69	0.15		
			41.60			*12.55*						*total =*		*13.52*	4.86	60.95
	A2	94.70		0.32	30.47		initial time	100				0.10		6.90		
L1							overland flow	201	2353	2340	13	0.06		1.33		
L2							ponding area	301	2340	2340	0	0.00		0.00		
L3							overland flow	3088	2340	2070	270	0.09		9.71		
L4							channel flow	1010	2070	2000	70	0.07	12.51	1.35		
L5							culvert	71	2000	1996	4	0.06	10.51	0.11		
L6							channel flow	175	1996	1980	16	0.09	12.51	0.23		
			94.70			*30.47*						*total =*		*19.63*	3.82	116.32
														19.63		
Using Modified Rational Method																
Q = 164.23 cfs																
Tc = 19.63 min																
L1	A3	12.67		0.29	3.67		nat channel	460	1980	1968	12	0.026	8.14	0.94		
L2							const channel	100	1967	1964	3	0.030	2.43	0.69		
			148.97			***46.70***						***total =***		***21.26***	**3.63**	**169.32**

6.2.2 Basin B

Portions of the southerly project site are located within Basin B. T_i for each sub-basin was based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis. The basin areas and runoff coefficients were modified to reflect the proposed development.

Table 15: Basin B Post-Development Runoff Coefficient

Basin B- Drainage Area (acres) = 50.92

Soil Type	Map Symbo	Hyd. Class	Area	Land Use	C	A x C
			(acres)			
Cieneba rocky coarse sandy loam	CmE2	B	16.5	Undeveloped	0.25	4.13
Cieneba rocky coarse sandy loam	CmE2	B	33.96	LDR	0.32	10.87
Cieneba-Fallbrook rocky sandy loam	CnG2	B	0	Undeveloped	0.25	0
Cieneba-Fallbrook rocky sandy loam	CnG2	B	0.46	LDR	0.32	0.15
Fallbrook rocky sandy loam	FeC	C	0	LDR	0.36	0
			50.92			15.14
		Mean Runoff Coefficient				0.30

Basin B – Developed Time of Concentration and Peak Flow Rate

Table 16: Post-Development Analysis Basin B

Basin B :															
Run	Area	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length	E1	E2	h	Slope	V	T_f	I_{100}	Q_{100}
	(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(in/hr)	(cfs)
		0.00			*0.00*										
	50.92		0.30	15.12		initial time	70				0.01		11.50		
L1						overland flow	398	2092	2032	60	0.15		1.63		
L2						channel	1350	2032	1930	102	0.08	10.39	2.17		
		50.92			*15.12*						*total =*		*15.29*	4.48	67.81

6.2.3 Basin C

A small portion of the southerly project site is located within Basin C. T_i for each sub-basin was based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis. The basin areas and runoff coefficients were modified to reflect the proposed development.

Table 17: Basin C Post-Development Runoff Coefficient

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
Cieneba rocky coarse sandy loam	CmE2	B	1.00	Undeveloped	0.25	0.25
Cieneba rocky coarse sandy loam	CmE2	B	0.95	LDR	0.32	0.30
			1.95			0.55
		Mean Runoff Coefficient				0.28

Basin C – Time of Concentration and Peak Flow Rate

Table 18: Post-Development Analysis Basin C

Basin C :

Run	Sub Basin	Area	Sum Area	C	CxA from Tbl 5	Sum CxA	Flowpath Desc.	Flow Length	E1	E2	h	Slope	V	T_f	I_{100}	Q_{100}
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(in/hr)	(cfs)
		1.95		0.29	0.57		initial time	70				0.01		11.50		
L1							overland flow	350	2012	1960	52	0.15		1.48		
			1.95			***0.57***						*total =*		***12.98***	**4.98**	**2.82**

6.2.4 Basin D

A small portion of the northerly project site is located within Basin D. T_i for each sub-basin was based on a maximum overland flow length of 100 feet and T_f was calculated using the overland flow equation and channel flow analysis. The basin areas and runoff coefficients were modified to reflect the proposed development.

Table 19: Basin D Post-Development Runoff Coefficient

Basin D Drainage Area (acres) = 0.91

Soil Type	Map Symbol	Hyd. Class	Area	Land Use	C	A x C
Cieneba rocky coarse sandy loam	CmE2	B	0.54	LDR	0.32	0.17
Cieneba rocky coarse sandy loam	CmE2	B	0.37	pavement	0.9	0.33
			0.91			0.51
		Mean Runoff Coefficient				0.56

Basin D – Time of Concentration and Peak Flow Rate

Table 20: Post-Development Analysis Basin D

Basin D :																	
Run	**Sub Basin**	**Area**	**Sum Area**	**C**	**CxA**	**Sum CxA**	**Flowpath Desc.**	**Flow Length**	**E1**	**E2**	**h**	**Slope**	**V**	**T_f**	**T_C**	**I_{100}**	**Q_{100}**
		(acres)						(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(min)	(min)	(in/hr)	(cfs)
			0.00			*0.00*											
		0.91		0.56	0.51		initial time	100	2096	2080		0.16		6.40			
L1							gutter flow	445	2080	2056	24	0.05	5.70	1.30			
			0.91			***0.51***						***total =***		***7.70***	***7.70***	**6.98**	**3.56**

6.2.5: Pre and Post Development Peak Flow Comparison: Unmitigated

Table 21 shows the comparison of peak flows from the Pre-Development to the Post-Development condition.

Basin Description	**$Area_{pre}$**	**$Area_{post}$**	**Q_{100pre}**	**$Q_{100post}$**
	(acres)	(acres)	(cfs)	(cfs)
Basin A	148.31	148.97	167.64	169.32
Basin B	51.49	50.92	67.12	67.81
Basin C	2.10	1.95	3.28	2.82
Basin D	0.60	0.91	1.67	3.56

6.2.6: Peak Flow Rates and Volumes: Mitigation

As shown in the table above, the development of the Alpine 21 project would marginally increase the peak rate of runoff from Basins A, B and D during the 100 year storm without mitigation measures. The project proposes the installation of conjunctive use tree wells as mitigation to attenuate the peak rate of runoff as well as overall volume of runoff.

The San Diego County Hydraulic Design Manual (Sep 2014) allows for conjunctive use of detention facilities for water quality treatment and flood management. Per Section 6.2.7 of the Hydraulic Design Manual, "When an aboveground detention facility is used for both water quality and flood control, the flood storage volume shall be provided in addition to the storage volume designated for water quality treatment."

Conjunctive use of tree wells as facilities for water quality treatment and flood management is acceptable, and encouraged when it is desirable and feasible. When an aboveground facility is used for both water quality and flood control, the flood storage volume shall be provided in addition to the storage volume designated for water quality treatment.

Stormwater runoff from developed Drainage Management Areas (DMA's) will receive water quality treatment in accordance with the report "Storm Water Quality Management Plan for Alpine 21 -TM 5431" prepared by Jones

Engineers, Inc., February, 2020, (SWQMP). All Points of Compliance (POCs) are compliant as analyzed in the SWQMP. Tree wells are the proposed water quality treatment measures for the project as established in the SWQMP.

Each development area within the project is represented by a Drainage Management Area (DMA). Refer to the DMA plan sheet in the SWQMP and in Appendix IV of this report. Appendix V demonstrates that the installation of conjunctive use tree wells BMP's as proposed will attenuate the peak rate and volume of runoff to levels below the pre development rates for a typical residential DMA. The 100 year runoff from the typical DMA is routed into a typical conjunctive use tree well BMP which includes an outlet control (weir) configuration. Based on this analysis it is expected that the runoff from each residential DMA throughout Basins A, B and C will be mitigated to a level at or below pre development conditions.

Basin D is analyzed in Appendix VI. Basin D can also be expected to represent a typical DMA which serves primarily roadways throughout the project. Appendix Vi demonstrates that the installation of conjunctive use tree wells BMP's as proposed will attenuate the peak rate and volume of runoff to levels below the pre development rates. The 100 year runoff from Basin D is routed into the proposed conjunctive use tree well BMP's which include an outlet control (weir) configuration. Based on this analysis it is expected that the runoff from Basin D will be mitigated to a level at or below pre development conditions.

Rational method hydrographs were generated using RickRat Hydro software from Rick Engineering (copyright 1992, 2001). The parameters of each drainage area were entered into RickRat Hydro software to generate an inflow hydrograph for each area. The data from these hydrographs were then entered into HEC-HMS software to model the release rates from the detention basins.

HEC-HMS allows for hydrology input time steps of 1, 2, 3, 4, 5, 10, 15 & 20 minutes. Rick Rat Hydro requires a minimum time of concentration (Tc) of 5 minutes. Therefore, the time of concentration (Tc) used for the concentration of these hydrographs was rounded to a 10 minute time interval that RickRat Hydro and HEC-HMS could accept. The peak flow remains as per the modified Rational Method analysis and is not reduced (or increased) from these hydrograph developments accordingly.

Typical DMA exhibits, DMA volume calculations, conjunctive use tree well details, rational method calculations, hydrographs, stage-storage-discharge relationships and HEC-HMS model output are provided in Appendices V and VI of this report.

6.3 Summary and Conclusion

The proposed project will not substantially increase the rate or volume of surface runoff which would result in flooding on or off- site. the installation of conjunctive tree wells as proposed will provide attenuation of the peak flow rates and volumes based on the 100 year, 6 hour storm.

The calculations and analysis presented herein demonstrate that the project will not substantially increase the peak rate or volume of runoff from Basins A, B, C or D during the 100 year storm.

In the Post Development condition, the runoff from Basin D will discharge directly into the existing street drainage system within Country Meadows Road and Victoria Circle. The runoff from Basin D will combine with the runoff from the surrounding residential subdivision lands and will run within the existing street gutter from the intersection of Country Meadows Road southerly along east side of Victoria Circle, a distance of approximately 880 feet where it will discharge into an existing curb inlet which drains directly into the natural drainage channel downstream of the project site, which ultimately carries the majority of the overall project runoff. The mitigation proposed herein will ensure the runoff from Basin D will not significantly affect the carrying capacity of the existing street or the intake capacity of the existing curb inlet along Victoria Circle.

For CEQA review, following information is provided in this study for project review and approval of the tentative map.

Q: Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?

A: No. The proposed project would not substantially alter the natural drainage patterns of the site or surrounding areas. The project does not propose to alter the course of existing streams from their natural drainage route.

The project proposes alterations to a man made ponding area located near the point of concentration of Basin A. The drainage path will be restored to it's natural, historic route in conjunction with the wetland restoration plan proposed as a part of this project. The drainage channel is designed pursuant to Chapter 5.6 of the current San Diego County Hydraulic Design Manual.

No increase in off-site erosion or siltation will be caused by this project. The proposed mitigation measures will ensure that project discharge is released at or below pre development rates.

Q: Will the project substantially alter the existing drainage pattern of the site or area including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

A: No. The proposed project would not substantially alter the natural drainage patterns of the site or surrounding areas. The project does not propose to alter the course of existing streams from their natural drainage route.

The project proposes alterations to a man made ponding area located near the point of concentration of Basin A. The drainage path will be restored to it's natural, historic route in conjunction with the wetland restoration plan proposed as a part of this project. The drainage channel is designed pursuant to Chapter 5.6 of the current San Diego County Hydraulic Design Manual.

No. The project will not increase the rate or amount of surface runoff in a manner which would result in flooding on or off site. The proposed mitigation measures will ensure that project discharge is released at or below pre development rates and volumes.

Q: Will the project create or contribute runoff water which will exceed the capacity of existing or planned storm water drainage systems?

A: No. The project will not create or contribute runoff water which will exceed the capacity of existing or planned storm water drainage systems. The proposed mitigation measures will ensure that project discharge is released at or below pre development rates and volumes.

Q: Will the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps?

A: No. The project does not propose to place housing within a 100-year flood hazard area.

Q: Will the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?

A: No. The project will not place structures within a 100-year flood hazard area.

Q: Will the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off-site?

A: No. The project will not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of failure of Dam(s) or levee(s). .

Appendix I: Hydrology

Soil Survey, San Diego Area, CA

Isopluvial Maps

Intensity-Duration Design Chart

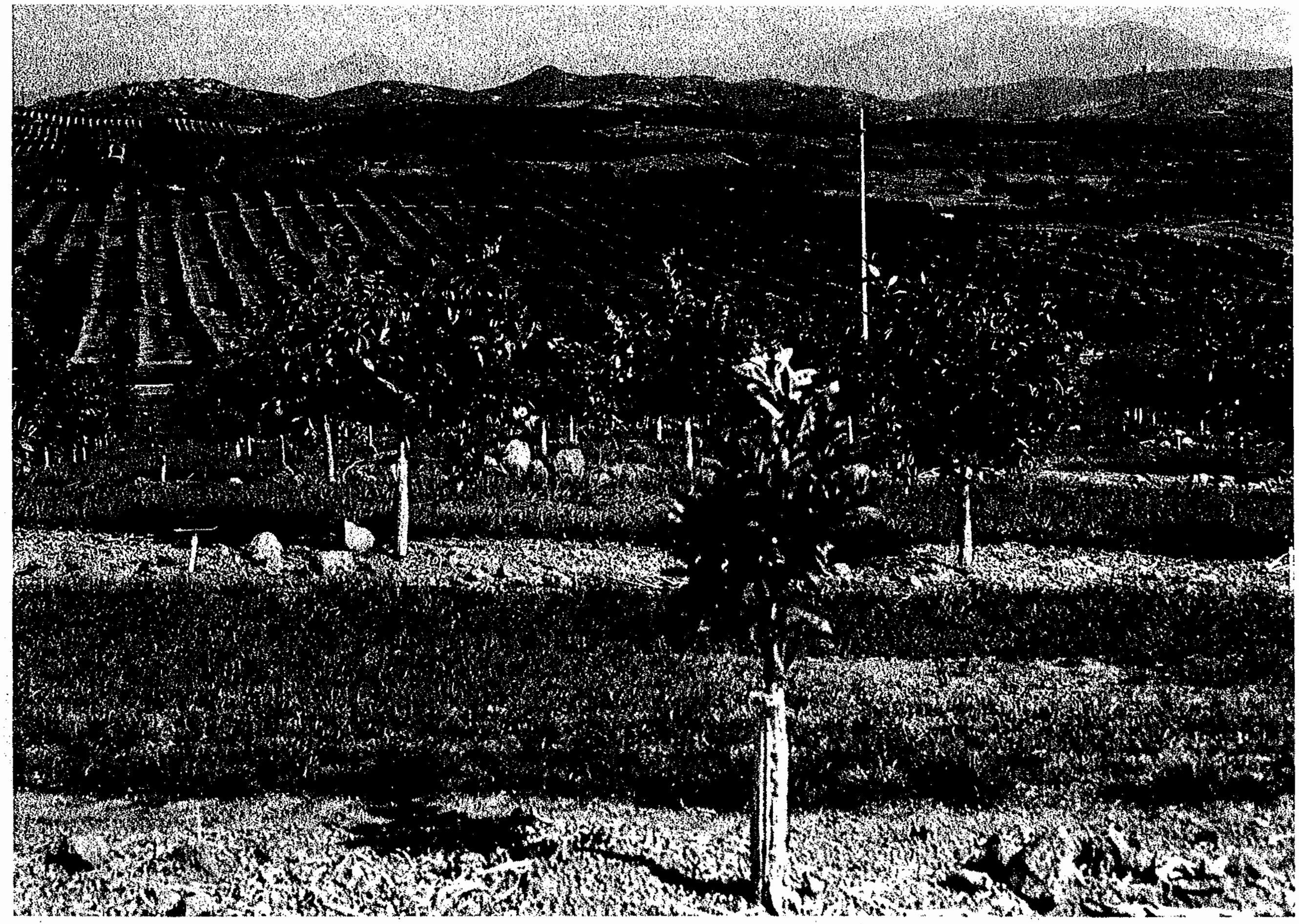
Runoff Coefficients

Maximum Overland Flow Length & Initial Time of Concentration

PART II

SOIL SURVEY

San Diego Area, California



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service and Forest Service
in cooperation with
UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION
UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Indian Affairs
DEPARTMENT OF THE NAVY
United States Marine Corps

Issued December 1973

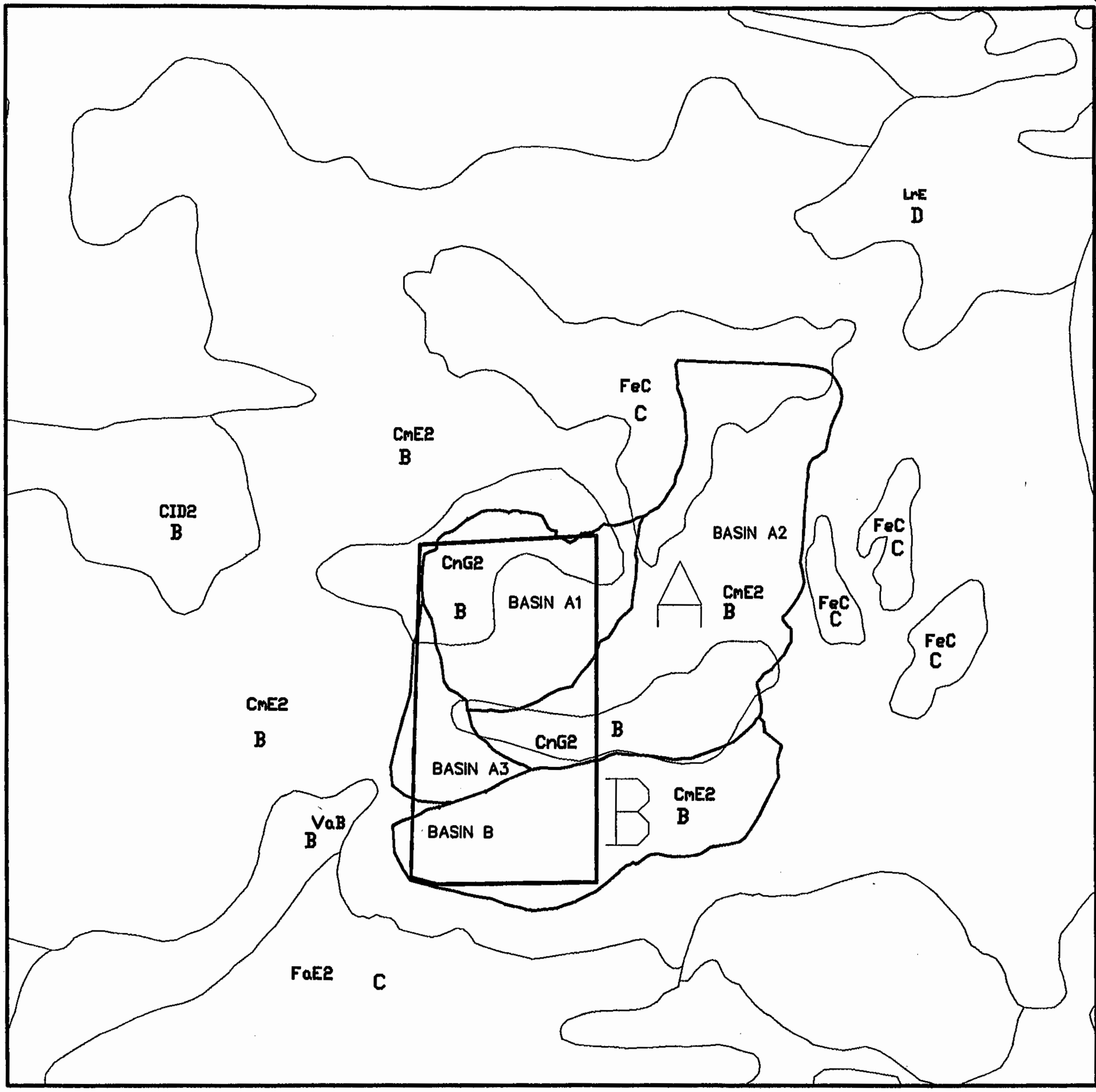
Map symbol	Soil	Hydro-logic group	Erodibility	Limitations for conversion from brush to grass
CaD2	Calpine coarse sandy loam, 9 to 15 percent slopes, eroded.	B	Moderate 2---	Slight. 4/
CbB	Carlsbad gravelly loamy sand, 2 to 5 percent slopes------	C	Severe 2-----	Slight.
CbC	Carlsbad gravelly loamy sand, 5 to 9 percent slopes------	C	Severe 2-----	Slight.
CbD	Carlsbad gravelly loamy sand, 9 to 15 percent slopes-----	C	Severe 2-----	Slight.
CbE	Carlsbad gravelly loamy sand, 15 to 30 percent slopes----	C	Severe 2-----	Slight.
CcC	Carlsbad-Urban land complex, 2 to 9 percent slopes-------	D		
CcE	Carlsbad-Urban land complex, 9 to 30 percent slopes------	D		
CeC	Carrizo very gravelly sand, 0 to 9 percent slopes--------	A	Severe 2	
CfB	Chesterton fine sandy loam, 2 to 5 percent slopes--------	D	Severe 9-----	Slight.
CfC	Chesterton fine sandy loam, 5 to 9 percent slopes--------	D	Severe 9-----	Slight.
CfD2	Chesterton fine sandy loam, 9 to 15 percent slopes, eroded.	D	Severe 9-----	Moderate.
CgC	Chesterton-Urban land complex, 2 to 9 percent slopes:			
	Chesterton---	D		
	Urban land---	D		
ChA	Chino fine sandy loam, 0 to 2 percent slopes------------	C	Severe 16----	Slight.
ChB	Chino fine sandy loam, 2 to 5 percent slopes------------	C	Severe 16----	Slight.
CkA	Chino silt loam, saline, 0 to 2 percent slopes-----------	C	Moderate 2---	Moderate.
ClD2	Cieneba coarse sandy loam, 5 to 15 percent slopes, eroded.	B	Severe 16----	Severe.
ClE2	Cieneba coarse sandy loam, 15 to 30 percent slopes, eroded.	B	Severe 16----	Severe.
ClG2	Cieneba coarse sandy loam, 30 to 65 percent slopes, eroded.	B	Severe 1-----	Severe.
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded.	B	Severe 16----	Severe.
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes.	B	Severe 1-----	Severe.
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded:			
	Cieneba--	B	Severe 16----	Severe.
	Fallbrook--	C	Severe 16----	Severe.
CnG2	Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded:			
	Cieneba--	B	Severe 1-----	Severe.
	Fallbrook--	C	Severe 1-----	Severe.
Co	Clayey alluvial land-------------------------------------	D	Moderate 2---	Slight.
Cr	Coastal beaches--	A	Severe 2	
CsB	Corralitos loamy sand, 0 to 5 percent slopes------------	A	Severe 2-----	Slight.
CsC	Corralitos loamy sand, 5 to 9 percent slopes------------	A	Severe 2-----	Slight.
CsD	Corralitos loamy sand, 9 to 15 percent slopes-----------	A	Severe 2-----	Slight.
CtE	Crouch coarse sandy loam, 5 to 30 percent slopes---------	B	Severe 16----	Slight.
CtF	Crouch coarse sandy loam, 30 to 50 percent slopes--------	B	Severe 1-----	Moderate.
CuE	Crouch rocky coarse sandy loam, 5 to 30 percent slopes.	B	Severe 16----	Moderate.
CuG	Crouch rocky coarse sandy loam, 30 to 70 percent slopes.	B	Severe 1-----	Moderate.
CvG	Crouch stony fine sandy loam, 30 to 75 percent slopes.	B	Severe 1-----	Moderate.
DaC	Diablo clay, 2 to 9 percent slopes-----------------------	D	Slight--------	Slight. 1/
DaD	Diablo clay, 9 to 15 percent slopes----------------------	D	Slight--------	Slight. 1/
DaE	Diablo clay, 15 to 30 percent slopes---------------------	D	Moderate------	Slight. 1/
DaE2	Diablo clay, 15 to 30 percent slopes, eroded-------------	D	Moderate 1---	Slight. 1/
DaF	Diablo clay, 30 to 50 percent slopes---------------------	D	Severe 1-----	Moderate. 1/

See footnotes at end of table.

TABLE 11.--INTERPRETATIONS FOR LAND MANAGEMENT--Continued

Map symbol	Soil	Hydro-logic group	Erodibility	Limitations for conversion from brush to grass
DcD	Diablo-Urban land complex, 5 to 15 percent slopes:			
	Diablo--	D		
	Urban land--	D		
DcF	Diablo-Urban land complex, 15 to 50 percent slopes:			
	Diablo--	D		
	Urban land--	D		
DoE	Diablo-Olivenhain complex, 9 to 30 percent slopes:			
	Diablo--	D	Moderate 1---	Slight.
	Olivenhain--	D	Moderate 1---	Severe.
EdC	Elder shaly fine sandy loam, 2 to 9 percent slopes------	B	Moderate 2---	Slight.
EsC	Escondido very fine sandy loam, 5 to 9 percent slopes.	C	Severe 16----	Slight.
EsD2	Escondido very fine sandy loam, 9 to 15 percent slopes, eroded.	C	Severe 16----	Slight.
EsE2	Escondido very fine sandy loam, 15 to 30 percent slopes, eroded.	C	Severe 16----	Slight.
EvC	Escondido very fine sandy loam, deep, 5 to 9 percent slopes.	C	Severe 16----	Slight.
ExE	Exchequer rocky silt loam, 9 to 30 percent slopes-------	D	Severe 9-----	Severe.
ExG	Exchequer rocky silt loam, 30 to 70 percent slopes------	D	Severe 1-----	Severe.
FaB	Fallbrook sandy loam, 2 to 5 percent slopes------------	C	Severe 16----	Slight.
FaC	Fallbrook sandy loam, 5 to 9 percent slopes------------	C	Severe 16----	Slight.
FaC2	Fallbrook sandy loam, 5 to 9 percent slopes, eroded-----	C	Severe 16----	Slight.
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded----	C	Severe 16----	Slight.
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded---	C	Severe 16----	Slight.
FaE3	Fallbrook sandy loam, 9 to 30 percent slopes, severely eroded.	C	Severe 16----	Severe.
FeC	Fallbrook rocky sandy loam, 5 to 9 percent slopes-------	C	Severe 16----	Slight.
FeE	Fallbrook rocky sandy loam, 9 to 30 percent slopes------	C	Severe 16----	Moderate.
FeE2	Fallbrook rocky sandy loam, 9 to 30 percent slopes, eroded.	C	Severe 16----	Moderate.
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes:			
	Fallbrook---	C	Severe 16----	Slight.
	Vista---	B	Severe 16----	Moderate.
FvE	Fallbrook-Vista sandy loams, 15 to 30 percent slopes:			
	Fallbrook---	C	Severe 16----	Slight.
	Vista---	B	Severe 16----	Moderate.
FwF	Friant fine sandy loam, 30 to 50 percent slopes---------	D	Severe 9-----	Severe.
FxE	Friant rocky fine sandy loam, 9 to 30 percent slopes.	D	Severe 9-----	Severe.
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes.	D	Severe 1-----	Severe.
GaE	Gaviota fine sandy loam, 9 to 30 percent slopes---------	D	Severe 9-----	Severe.
GaF	Gaviota fine sandy loam, 30 to 50 percent slopes--------	D	Severe 1-----	Severe.
GoA	Grangeville fine sandy loam, 0 to 2 percent slopes------	B	Severe 16----	Slight.
GrA	Greenfield sandy loam, 0 to 2 percent slopes-----------	B	Severe 16----	Slight.
GrB	Greenfield sandy loam, 2 to 5 percent slopes-----------	B	Severe 16----	Slight.
GrC	Greenfield sandy loam, 5 to 9 percent slopes-----------	B	Severe 16----	Slight.
GrD	Greenfield sandy loam, 9 to 15 percent slopes----------	B	Severe 16----	Slight.
HaG	Hambright gravelly clay loam, 30 to 75 percent slopes.	D	Severe 1-----	Moderate.
HmD	Holland fine sandy loam, 5 to 15 percent slopes---------	C	Severe 16----	Slight.
HmE	Holland fine sandy loam, 15 to 30 percent slopes--------	C	Severe 16----	Slight.
HnE	Holland stony fine sandy loam, 5 to 30 percent slopes.	C	Severe 16----	Moderate.

See footnotes at end of table.



LEGEND

DRAINAGE BASIN

SCS SOIL TYPE DELINEATION

CmrG SCS SOIL TYPE DESIGNATION

C HYDRAULIC GROUP

PROJECT SITE

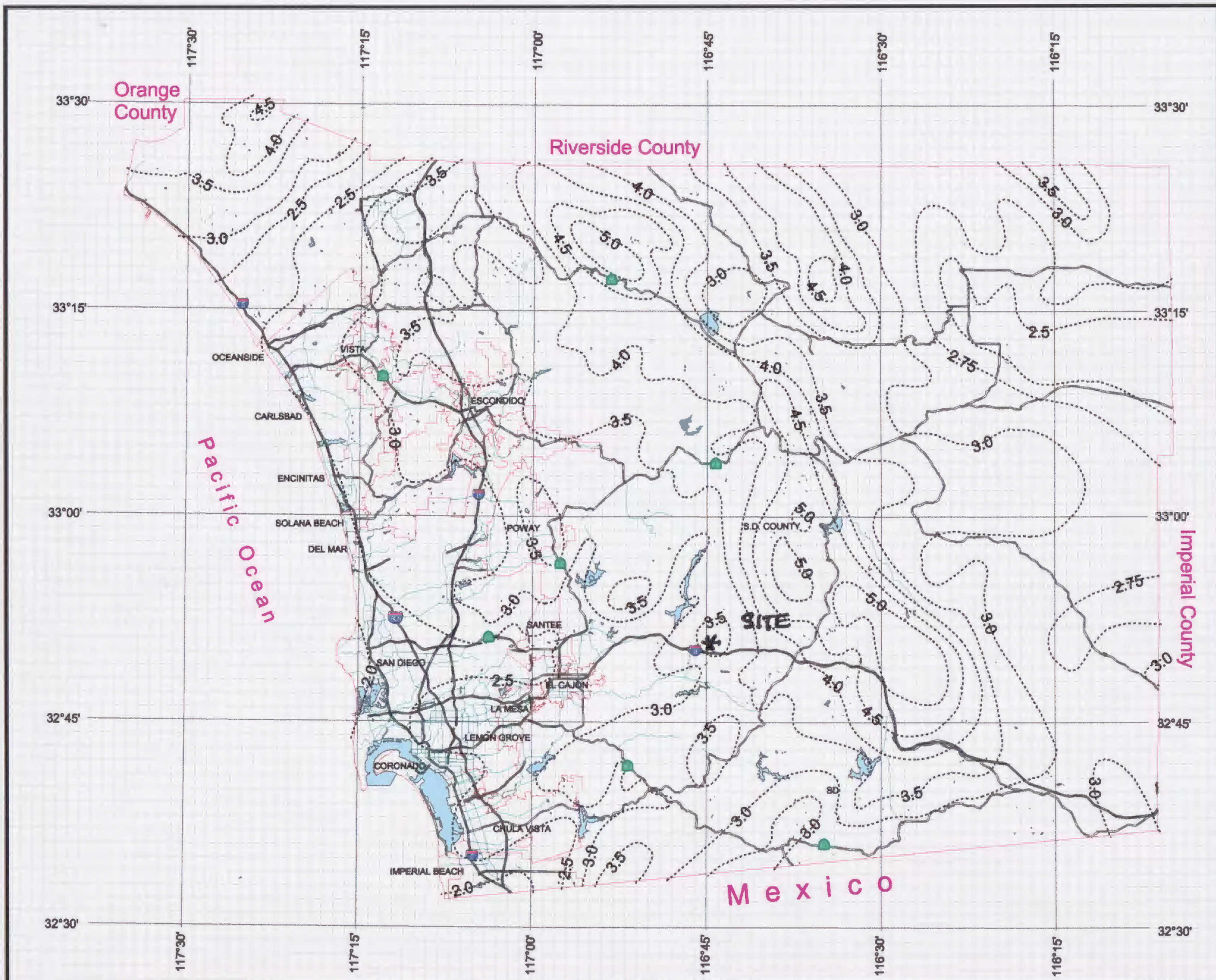
JONES ENGINEERS

phone 360 733 8888 fax 360 671 6666 web jeiwa.com

4164 Meridian Street • Suite 200 • Bellingham, Washington 98226

SOILS MAP

NOT TO SCALE



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

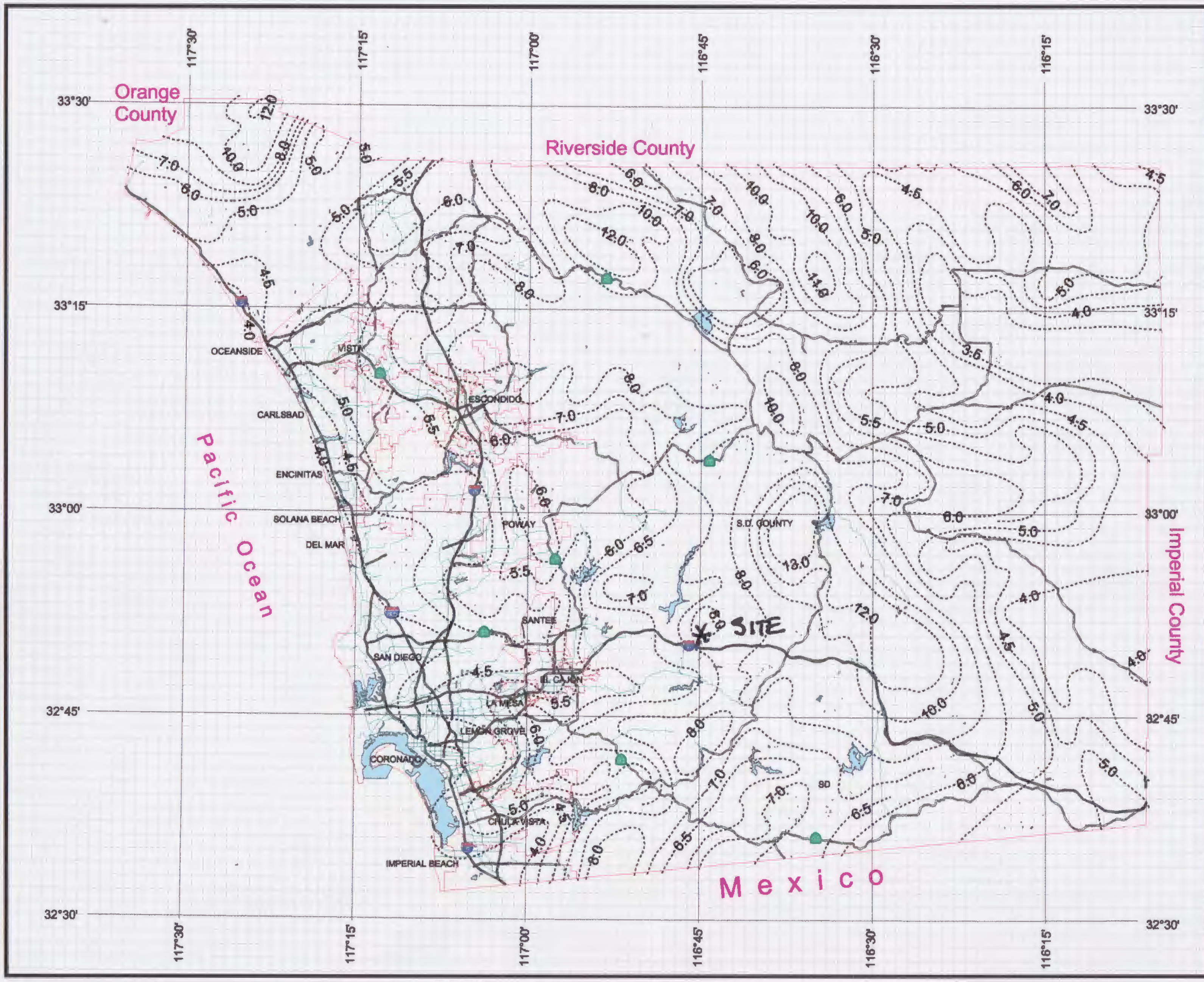
Isopluvial (inches)

$P_6 = 3.5"$

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

------- Isopluvial (inches)

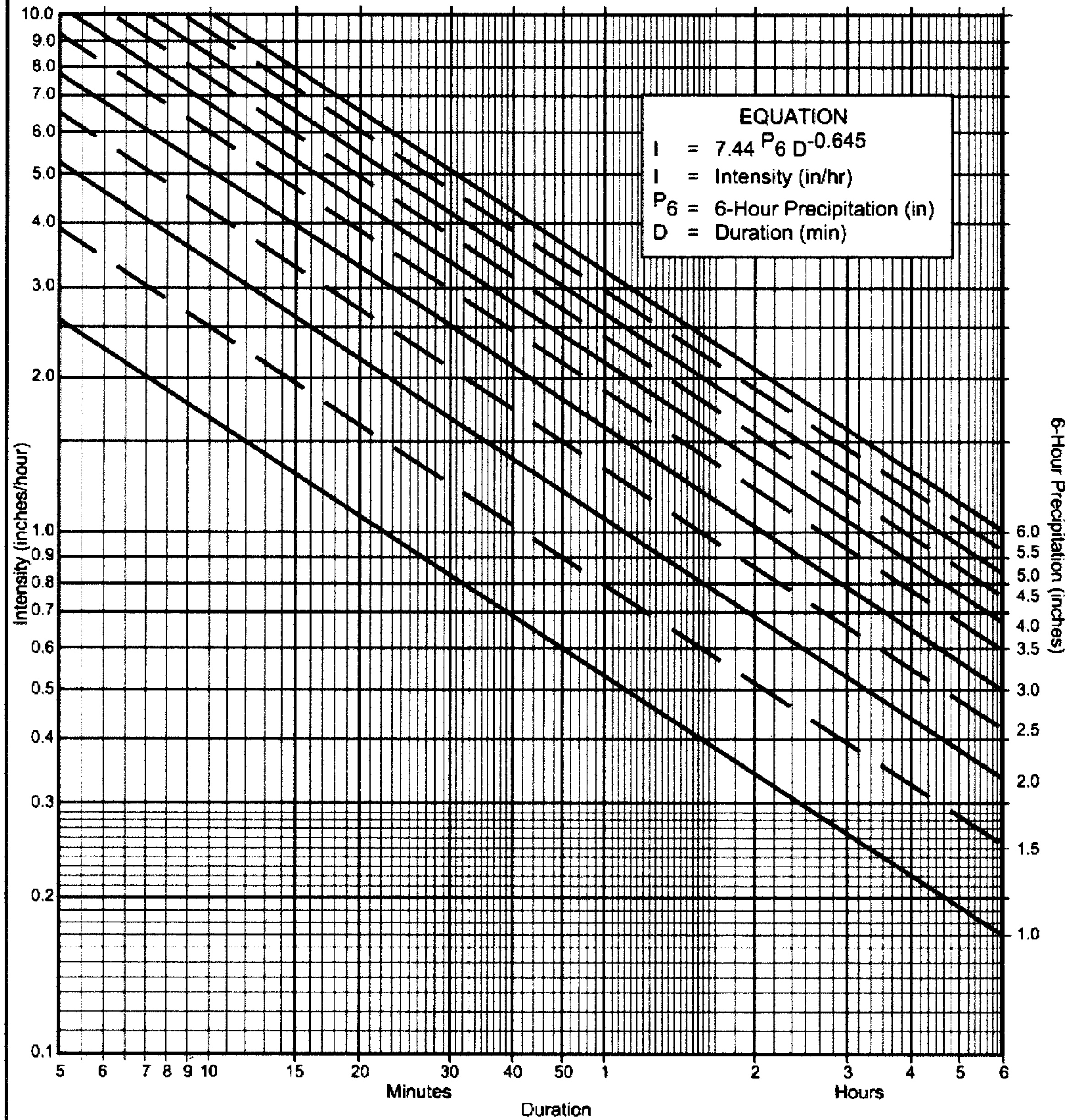
P_{24} = 7.5"

DPW GIS

SanGIS We Have San Diego Covered!

N W E S

3 0 3 Miles



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 100 year

(b) P_6 = 3.5 in., P_{24} = 7.5, $\frac{P_6}{P_{24}}$ = 47 %(2)

(c) Adjusted P_6(2) = 3.5 in.

(d) t_x = ______ min. VARIES - SEE REPORT

(e) I = ______ in./hr. VARIES - SEE REPORT

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

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
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

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

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)**

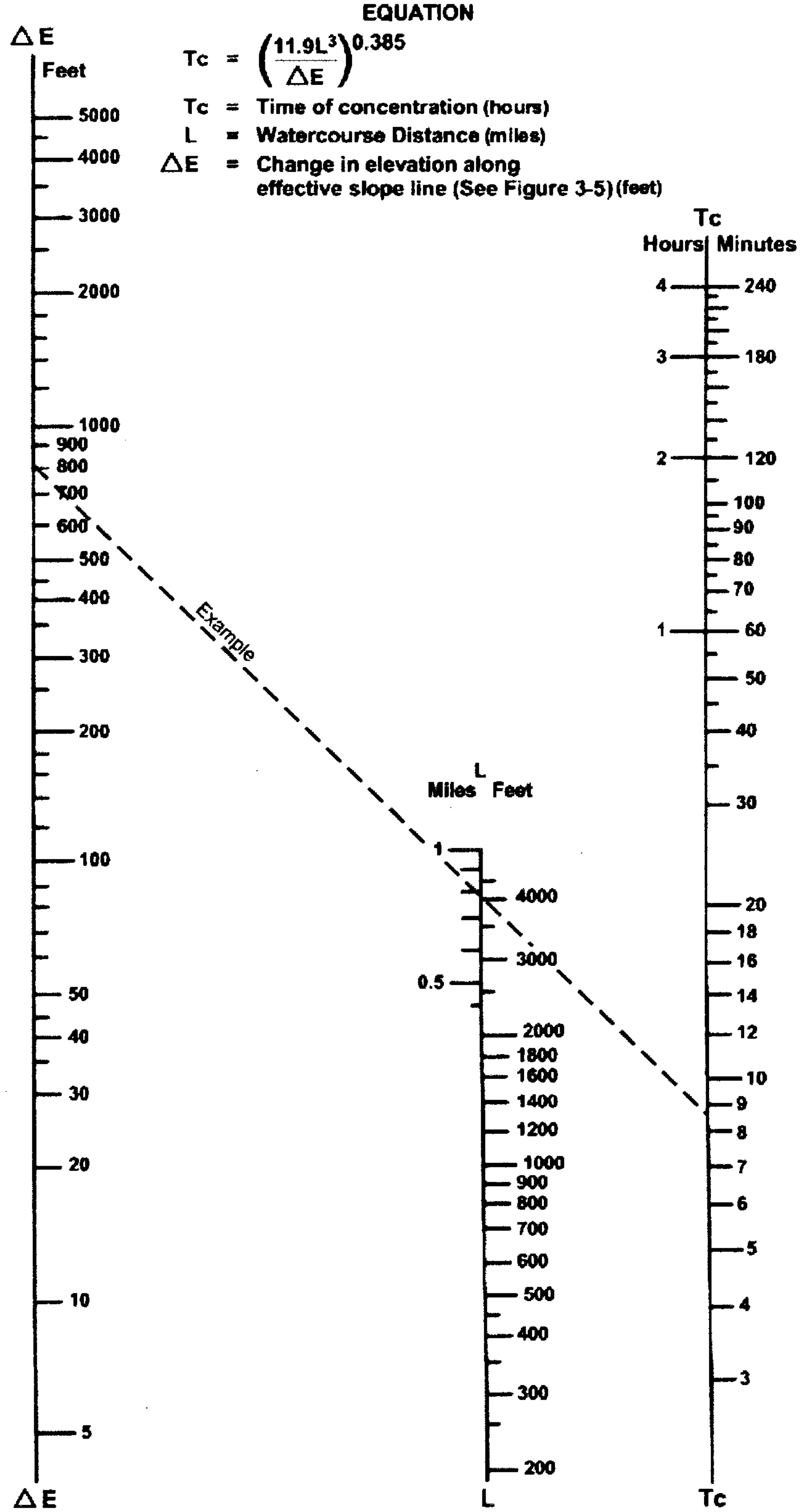
Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	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

EQUATION

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

Tc = Time of concentration (hours)
L = Watercourse Distance (miles)
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)



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 II: Hydraulic Calculations

- NATURAL CHANNEL HYDRAULIC FLOW CALCULATIONS: BASINS A1, A2, A3
- CULVERT FLOW HYDRAULIC CALCULATIONS: BASINS A1, A2
- WILDLIFE CROSSING CULVERT PLAN, SPECS, DETAILS
- CONSTRUCTED WETLAND CHANNEL HYDRAULIC CALCULATIONS, PLANS, DETAILS
- MANNINGS ROUGHNESS COEFFICIENT BACKGROUND DATA
- GUTTER AND ROADWAY DISCHARGE NOMOGRAPH

Trapezoidal Channel Analysis & Design

Open Channel - Uniform flow

Worksheet Name: A1 CHANNEL

Description: A1 CHANNEL

Solve For Depth - Given Constant Data;

Bottom Width....... 2.00

Z-Left............. 3.00

Z-Right............ 3.00

Mannings 'n'....... 0.030

Channel Slope...... 0.1700

Channel Discharge.. 58.25

COMPUTED

Variable Input Data	Minimum	Maximum	Increment By

Bottom Width ft	Z-Left (H:V)	Z-Right (H:V)	Mannings 'n'	Channel Slope ft/ft	Channel Depth ft	Channel Discharge cfs	Velocity fps
2.00	3.00	3.00	0.030	0.1700	0.90	58.25	13.72

Open Channel Flow Module, Version 3.3 (c)

Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design

Open Channel - Uniform flow

Worksheet Name: A2CHANNEL

Description: A2CHANNEL

Solve For Depth - Given Constant Data;

Bottom Width....... 2.00

Z-Left............. 3.00

Z-Right............ 3.00

Mannings 'n'....... 0.030

Channel Slope...... 0.0800

Channel Discharge.. 120.40

COMPUTED

Bottom Width ft	Z-Left (H:V)	Z-Right (H:V)	Mannings 'n'	Channel Slope ft/ft	Channel Depth ft	Channel Discharge cfs	Velocity fps
2.00	3.00	3.00	0.030	0.0800	1.49	120.40	12.51

Open Channel Flow Module, Version 3.3 (c)

Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design

Open Channel - Uniform flow

Worksheet Name: A3CHANNEL

Description: A3 CHANNEL

Solve For Depth - Given Constant Data

Bottom Width....... 2.00

Z-Left............. 3.00

Z-Right............ 3.00

Mannings 'n'....... 0.030

Channel Slope...... 0.0200

Channel Discharge.. 170.71

COMPUTED

Bottom Width ft	Z-Left (H:V)	Z-Right (H:V)	Mannings 'n'	Channel Slope ft/ft	Channel Depth ft	Channel Discharge cfs	Velocity fps
2.00	3.00	3.00	0.030	0.0200	2.33	170.71	8.14

Trapezoidal Channel Analysis & Design

Open Channel - Uniform flow

Worksheet Name: B CHANNEL

Description: B CHANNEL

Solve For Depth - Given Constant Data;

Bottom Width....... 2.00

Z-Left............. 3.00

Z-Right............ 3.00

Mannings 'n'....... 0.030

Channel Slope...... 0.0700

Channel Discharge.. 70.93

COMPUTED

Bottom Width ft	Z-Left (H:V)	Z-Right (H:V)	Mannings 'n'	Channel Slope ft/ft	Channel Depth ft	Channel Discharge cfs	Velocity fps
2.00	3.00	3.00	0.030	0.0700	1.21	70.93	10.39

Open Channel Flow Module, Version 3.3 (c)

Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Circular Channel Analysis & Design

Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: A1 CULVERT

Description: A1 CULVERT

Solve For Actual Depth - Given Constant Data;

Diameter........... 3.00

Slope.............. 0.0600

Mannings n......... 0.013

Discharge.......... 63.78

COMPUTED

Diameter ft	Channel Slope ft/ft	Mannings 'n'	Discharge cfs	Depth ft	Velocity fps	Capacity Full cfs
3.00	0.0600	0.013	63.78	1.30	21.69	163.38

Open Channel Flow Module, Version 3.3 (c)

Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design

Open Channel - Uniform flow

Worksheet Name: A2 Culvert

Description: A2 Culvert / CHANNEL FLOW

Solve For Depth

Given Constant Data;

Bottom Width....... 8.00

Z-Left............. 2.00

Z-Right............ 2.00

Mannings 'n'....... 0.030

Channel Slope...... 0.0550

Channel Discharge.. 116.54

Bottom Width ft	Z-Left (H:V)	Z-Right (H:V)	Mannings 'n'	Channel Slope ft/ft	Channel Depth ft	Channel Discharge cfs	Velocity fps
8.00	2.00	2.00	0.030	0.0550	1.09	116.54	10.51

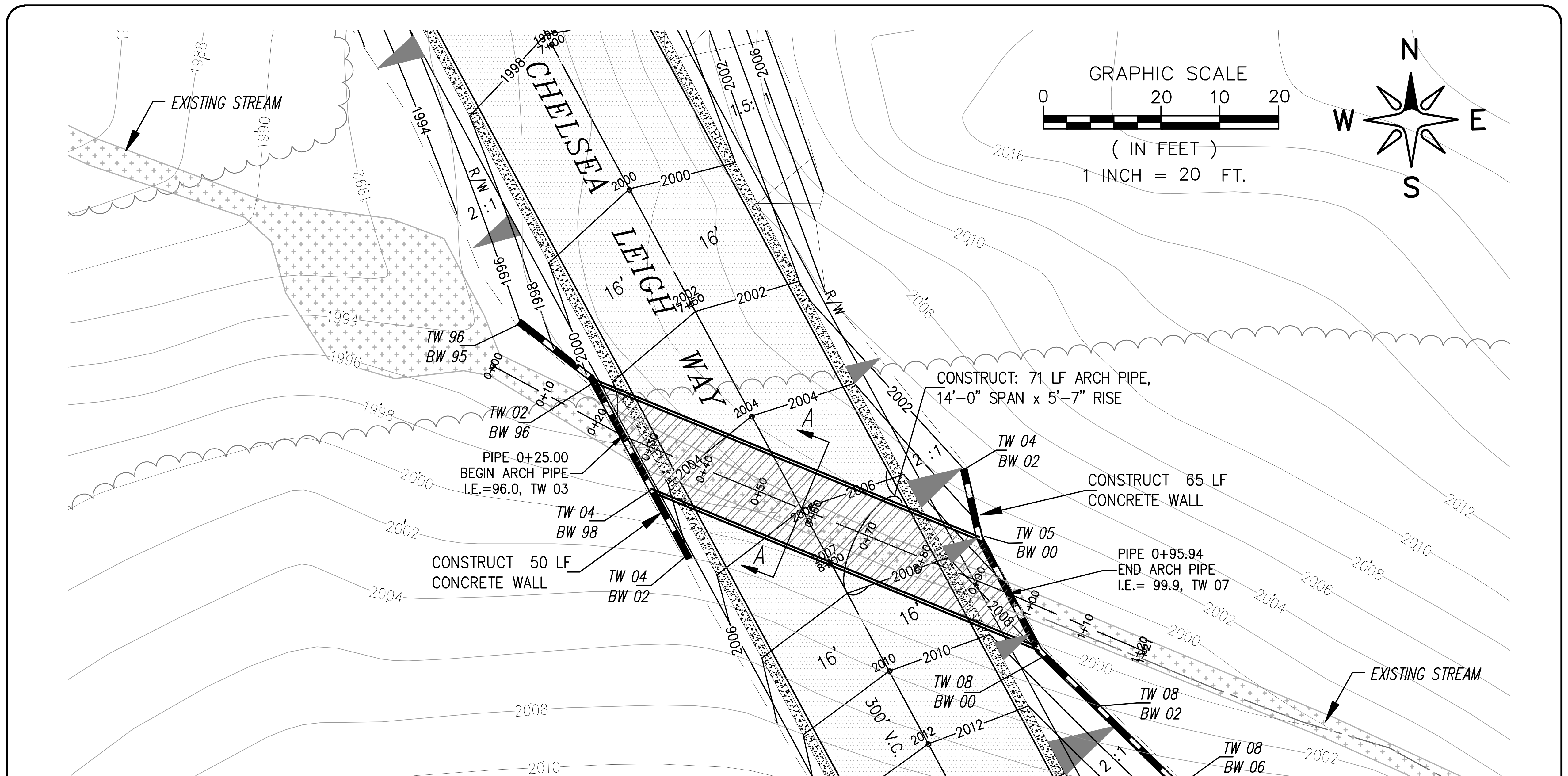
Open Channel Flow Module, Version 3.3 (c)

Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

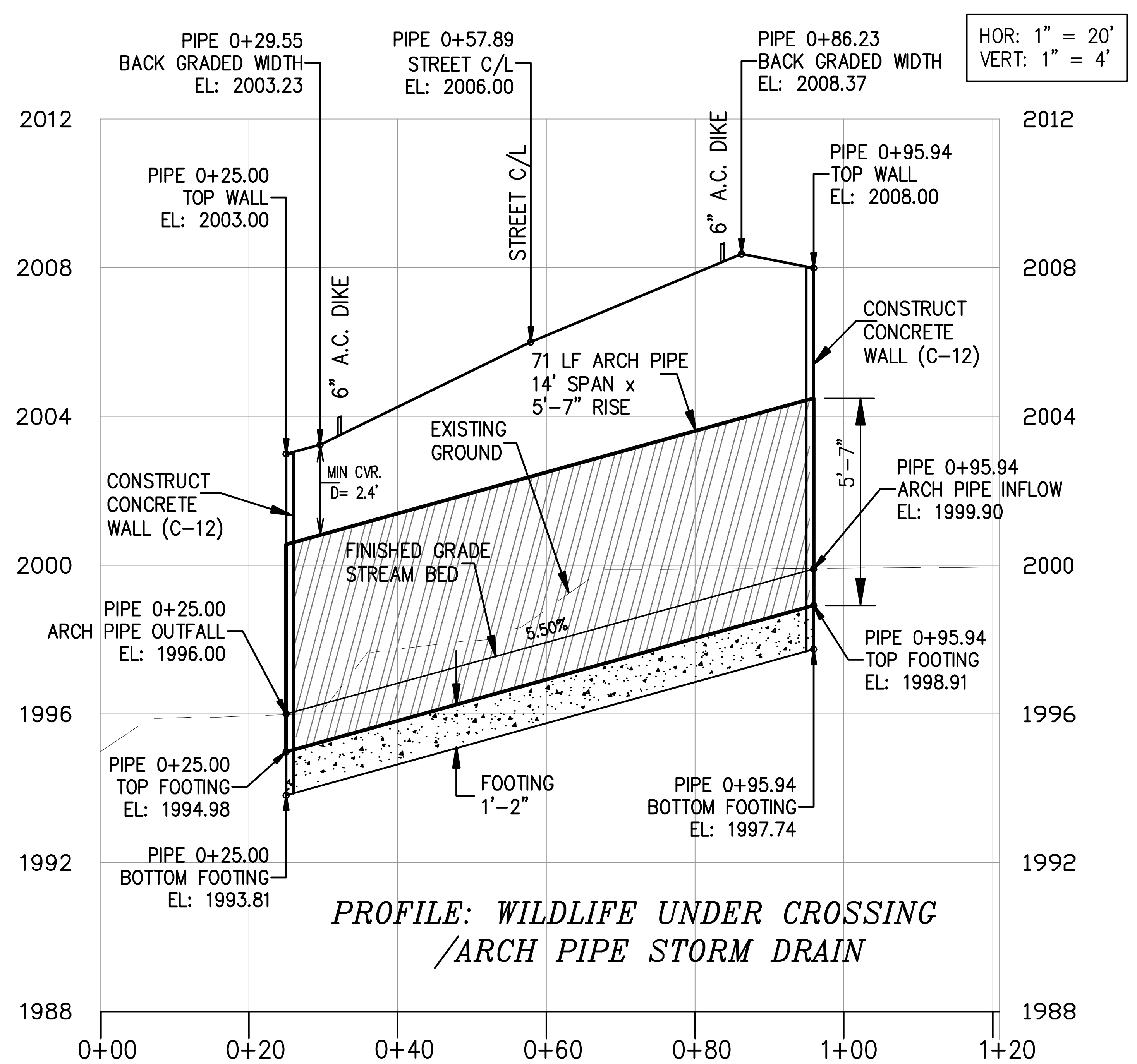
ALPINE-21

PRELIMINARY WILDLIFE UNDER CROSSING /ARCH PIPE STORM DRAIN PLAN & PROFILE

COUNTY OF SAN DIEGO TRACT NO. 5431



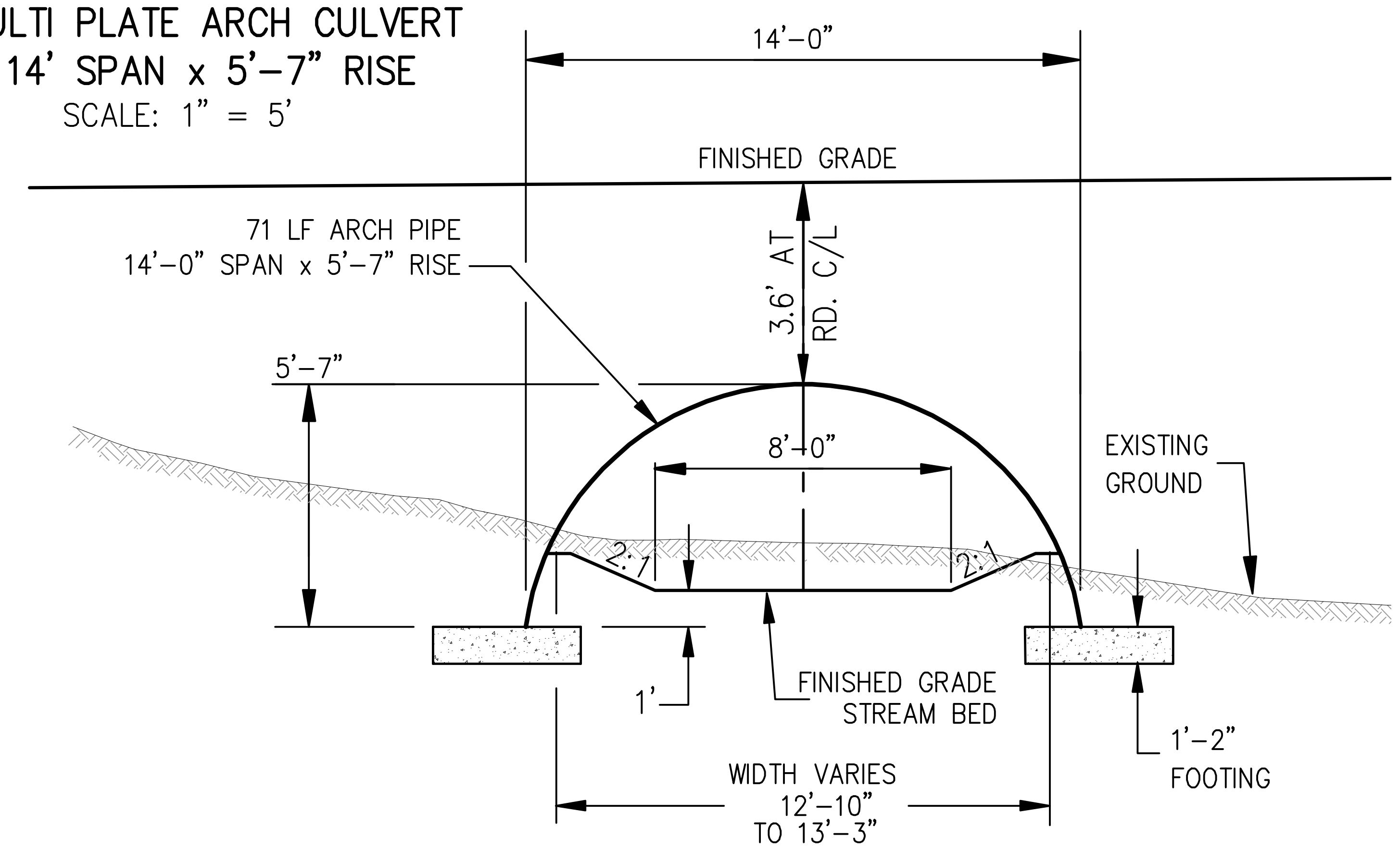
PLAN: WILDLIFE UNDER CROSSING /ARCH PIPE STORM DRAIN



PROFILE: WILDLIFE UNDER CROSSING /ARCH PIPE STORM DRAIN

SECTION A-A

MULTI PLATE ARCH CULVERT
14' SPAN x 5'-7" RISE
SCALE: 1" = 5'



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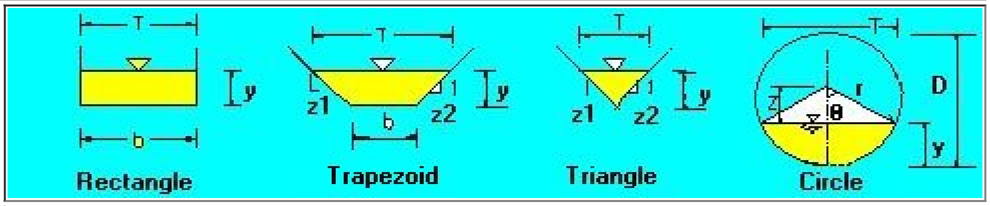
SUITE "A"
SOLANA BEACH, CA. 92075
(858) 847-0011
DATE: JANUARY 2018

SHEET 1 OF 1 SHEETS

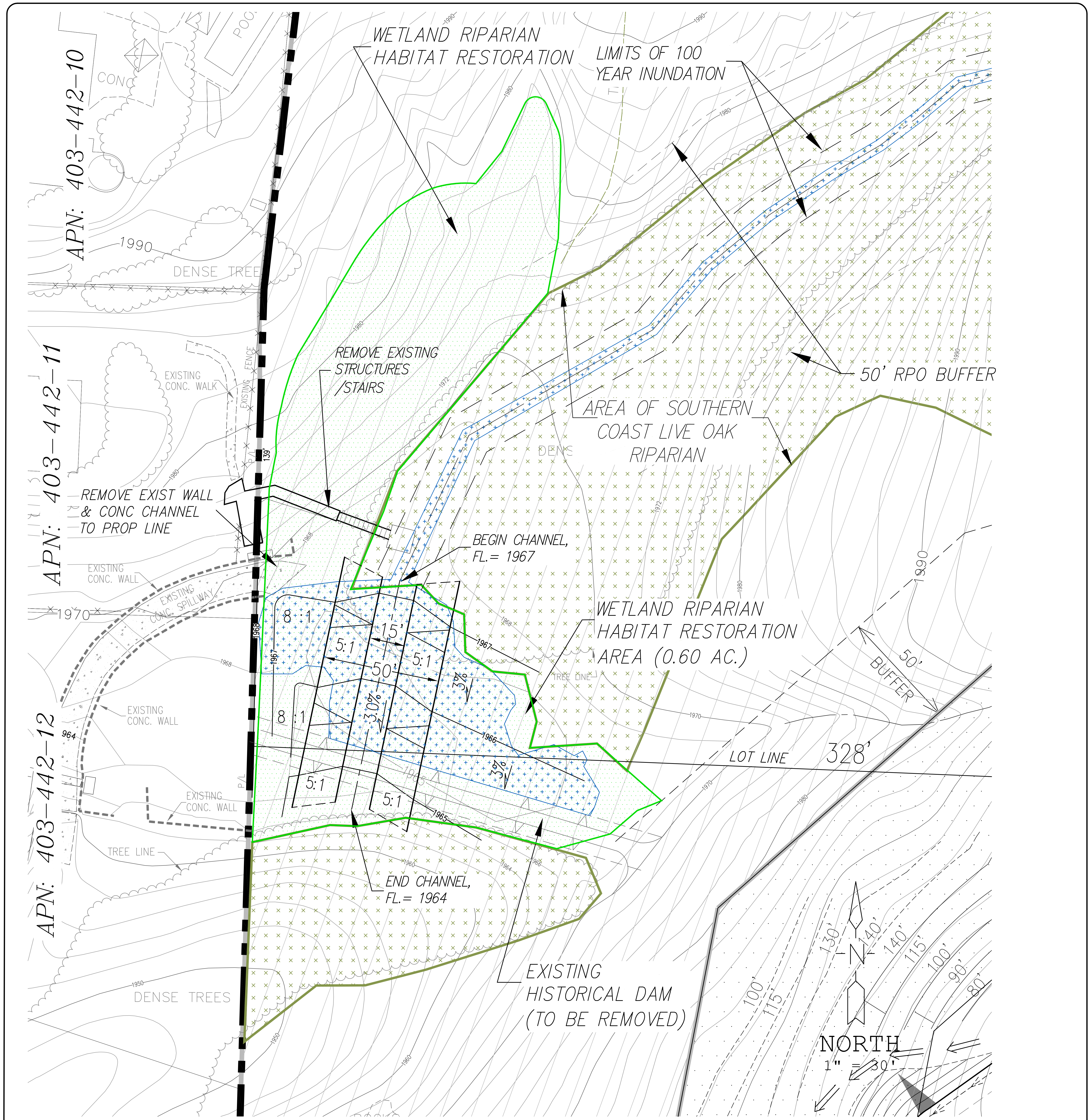
The open channel flow calculator

Select Channel Type: Trapezoid ▼	
Depth from Q ▼	Select unit system: Feet(ft) ▼

Channel slope: .03 ft/ft	Water depth(y): 2.49 ft	Bottom width(b) 15 ft
Flow velocity 2.43 ft/s	LeftSlope (Z1): 5 to 1 (H:V)	RightSlope (Z2): 5 to 1 (H:V)
Flow discharge 166 ft^3/s	Input n value .15 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 40.38 ft	Flow area 68.32 ft^2	Top width(T) 39.89 ft
Specific energy 2.58 ft	Froude number 0.33	Flow status Subcritical flow
Critical depth 1.34 ft	Critical slope 0.3279 ft/ft	Velocity head 0.09 ft

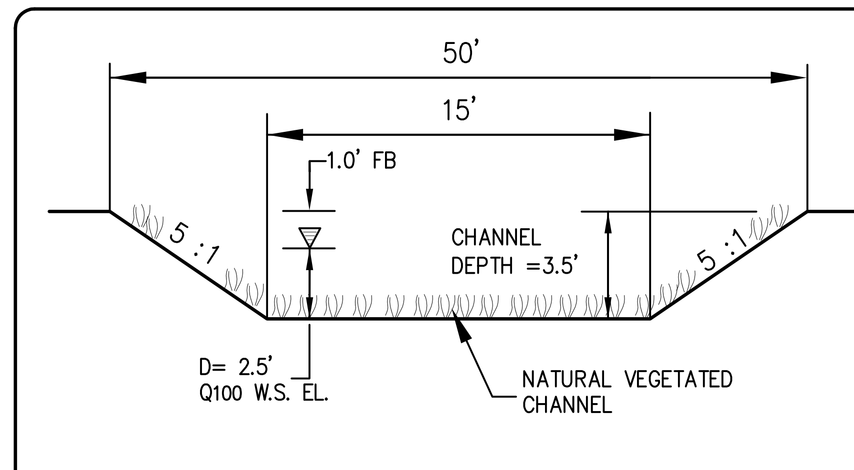
ALPINE-21

WETLAND RESTORATION / CREATION PLAN
COUNTY OF SAN DIEGO TRACT NO. 5431



LEGEND

AREA OF WETLAND RIPARIAN HABITAT RESTORATION (0.60 AC.)	(green outline)
AREA OF EXISTING SOUTHERN COAST LIVE OAK RIPARIAN	(tan stipple)
EXISTING POND (H.W.L)	(blue stipple)



WETLAND CHANNEL

N.T.S.

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(858) 847-0011

DATE: FEBRUARY 2020

SHEET 1 OF 1 SHEETS

Table A-2 Average Manning Roughness Coefficients for Closed Conduits[3]

Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x 1/2 inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D>=0.60	0.016
d/D<0.60	0.013
Fully Lined	0.013
3 x 1 inch Corrugations	0.027
6 x 2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

[3] Based on materials and workmanship required by standard specifications.

Table A-5 Average Manning Roughness Coefficients for Natural Channels

Minor Streams (Surface Width at Flood Stage < 100 ft)	
Fairly Regular Section	
(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater Than Weed Height	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase All Above Values By	0.015
Irregular Section, with Pools, Slight Channel Meander	
Channels (A) to (E) Above, Increase All Values By	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	
(A) Bottom, Gravel, Cobbles and Few Boulders	0.050
(B) Bottom, Cobbles with Large Boulders	0.060
Flood Plains (Adjacent To Natural Streams)	
Pasture, No Brush	
(A) Short Grass	0.030
(B) High Grass	0.040
Cultivated Areas	
(A) No Crop	0.040
(B) Mature Row Crops	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees	0.060
Medium To Dense Brush	0.090
Dense Willows	0.170
Cleared Land with Tree Stumps, 100-150 Per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches	0.140

5.6 DESIGN CRITERIA – WETLAND BOTTOM CHANNEL

This Section presents minimum design criteria for wetland-bottom channels. The design engineer is responsible for confirming that a channel design meets these criteria, the general open-channel criteria outlined in Section 5.3, and any special considerations for a particular design situation.

When designing a wetland-bottom channel, the design engineer must consider both the interim ("new channel") condition and ultimate ("mature channel") condition. For the interim condition, the channel shall maintain non-erosive velocities under the design flow (Section 5.6.1). The design engineer shall evaluate the channel conveyance capacity under ultimate conditions (Section 5.6.2).

5.6.1 Longitudinal Channel Slope

The design engineer shall establish a longitudinal channel slope that maintains non-erosive velocities during the interim condition (a.k.a. the "new channel" condition), assuming minimal or immature wetland vegetation in the channel bottom. Table 5-1 provides guidelines for maximum permissible velocity. Wetland-bottom channels shall maintain a minimum longitudinal slope of 0.5 percent whenever practicable (see Section 5.3.4).

The design engineer may increase the maximum permissible velocity when temporary erosion control measures are properly installed and maintained during the interim condition. The design engineer may also employ temporary grade control structures to reduce the effective slope of the channel during the interim condition. The Froude Number for wetland-bottom portions of a channel during the interim condition shall not exceed $F_R = 0.7$. Where topography is steeper than desirable, permanent drop structures may be used to maintain design velocities.

5.6.2 Roughness Coefficients

Appendix A (Table A-5) provides recommended values for the Manning roughness coefficient for various channel types and overbank conditions. As discussed in Section 5.6.1, a Manning roughness coefficient assuming new channel condition may be used to determine the longitudinal channel slope. A Manning roughness coefficient representing full vegetated growth on the channel bottom (a.k.a. the "mature channel" condition) may be used to determine channel capacity and evaluate freeboard requirements. Unless other information justifies a different roughness value, the design engineer may assume a mature channel roughness of n=0.150 (typical of dense riparian vegetation).

5.6.3 Low-Flow and Trickle Channels

Concrete trickle channels are not permitted in wetland bottom channels. Low-flow channels may be used when the 100-year flow exceeds 1,000 cfs in wetland bottom channels. Low-flow channel design shall be as discussed in Section 5.5.3.2.

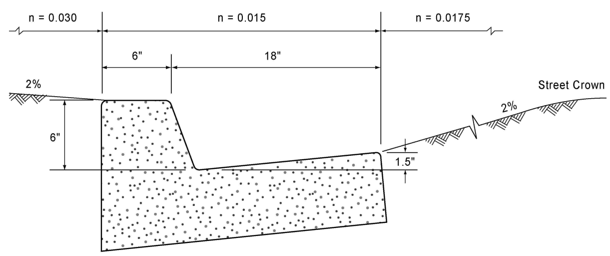
5.6.4 Bottom Width

The selection of the over-all channel bottom width shall consider factors such as ultimate conveyance requirements, constructability, channel stability, and maintenance.

5.6.5 Freeboard and Flow Depth

Wetland-bottom channels shall meet the minimum freeboard requirements outlined in Section 5.3.7. Whenever practicable, excessive depths and velocities shall be avoided for public safety considerations (see Section 5.3.9).

Figure 2-2



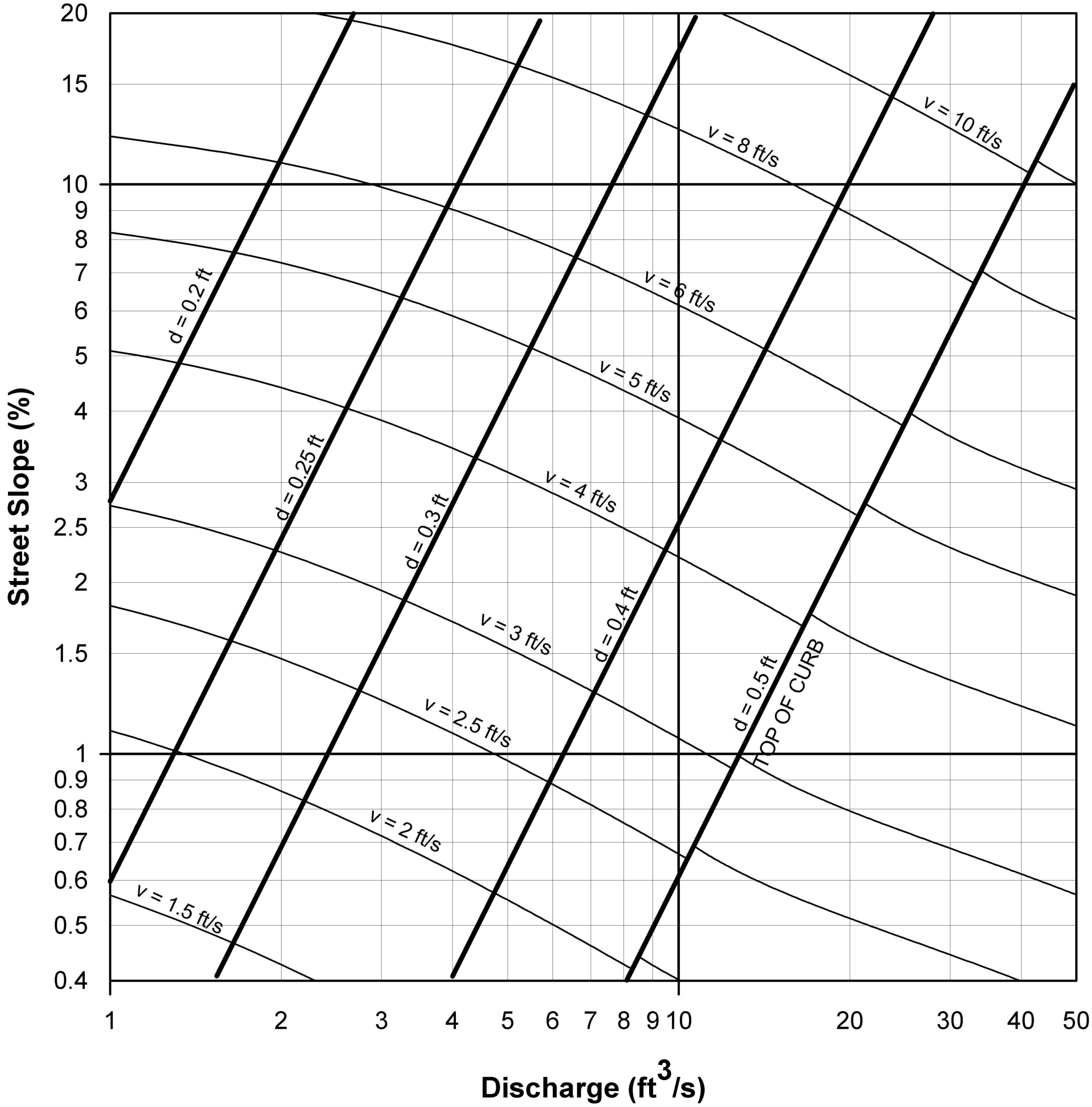


Figure 2-2 6-inch Gutter and Roadway Discharge-Velocity Chart

Appendix III: Hydrology Maps

PRE DEVELOPMENT

POST DEVELOPMENT


HYDROLOGY MAP FOR:
SAN DIEGO COUNTY-
TRACT 5431
PRE - DEVELOPMENT HYDROLOGY
BASIN A
BASIN A1
AREA = 42.67 AC.
BASIN A2
AREA = 95.02 AC.
BASIN A3
AREA = 10.62 AC.
BASIN B
AREA = 51.49 AC.
BASIN C
AREA = 2.10 AC.
BASIN D
AREA = .60 AC.
Q100 = 1.67 CFS
BASIN A
AREA = 148.31 AC.
Q100 = 167.64 CFS
BASIN C
AREA = 2.10 AC.
Q100 = 3.28 CFS
BASIN B
AREA = 51.49 AC.
Q100 = 67.12 CFS
POC 1
EL.= 1,980
POC 2
EL.= 1,968
POC 3
EL. = 1,960
POC 4
EL. = 1,930
POC 5
EL.= 2,056
EL. = 2,365
EL. = 2,353
L1 = 201'
EL. = 2,340
EL. = 2,340
L2 =301'
EL.= 2,310
EL.= 2,303
L1 = 458'
EL.= 2,280
L3= 3,088'
L2 = 1,645'
EL.= 2,146
EL.= 2,128
L1= 220'
EL.= 2,068
L2= 170'
L1=506 LF
EL. = 2,070
L4= 1,195'
EL.= 2,275
EL.= 2,267
L1= 1,030'
EL. = 2,076
EL. = 2,076
EL. = 2,058
EL. = 2,048
L1=100'
L1=602'
L2= 2,533'
EL= 2,119
FeC
C
CmE2
B
CnG2
B
CmE2
B
CnG2
B
CmE2
B
CmE2
B
FeC
C
VaB
B
FaE2
C
VICTORIA HEIGHTS PL.
N
1"= 200'
LEGEND
BASIN TRAVEL PATH
DRAINAGE BASINS
SOIL TYPE BOUNDARY
CmE2 B
PROPERTY BOUNDARY
2' CONTOURS
10' CONTOURS
LIMITS FIELD SURVEY
EX. FENCE LINE
TREES/SHRUBS
EX. STRUCTURES
POINT OF CONCENTRATION
L = LENGTH
S = SLOPE
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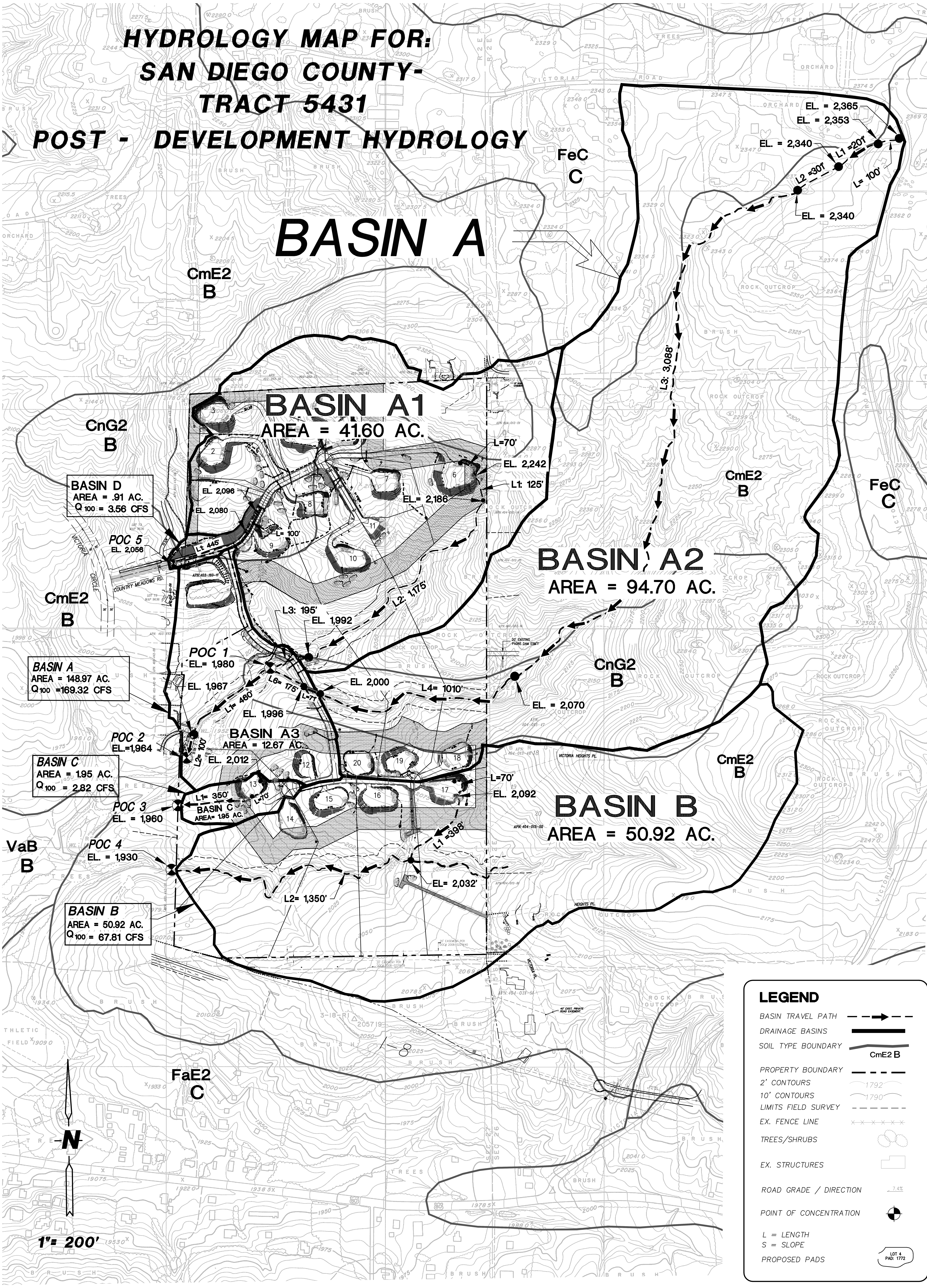
FEBRUARY, 2020

HYDROLOGY MAP FOR: SAN DIEGO COUNTY- TRACT 5431
POST - DEVELOPMENT HYDROLOGY



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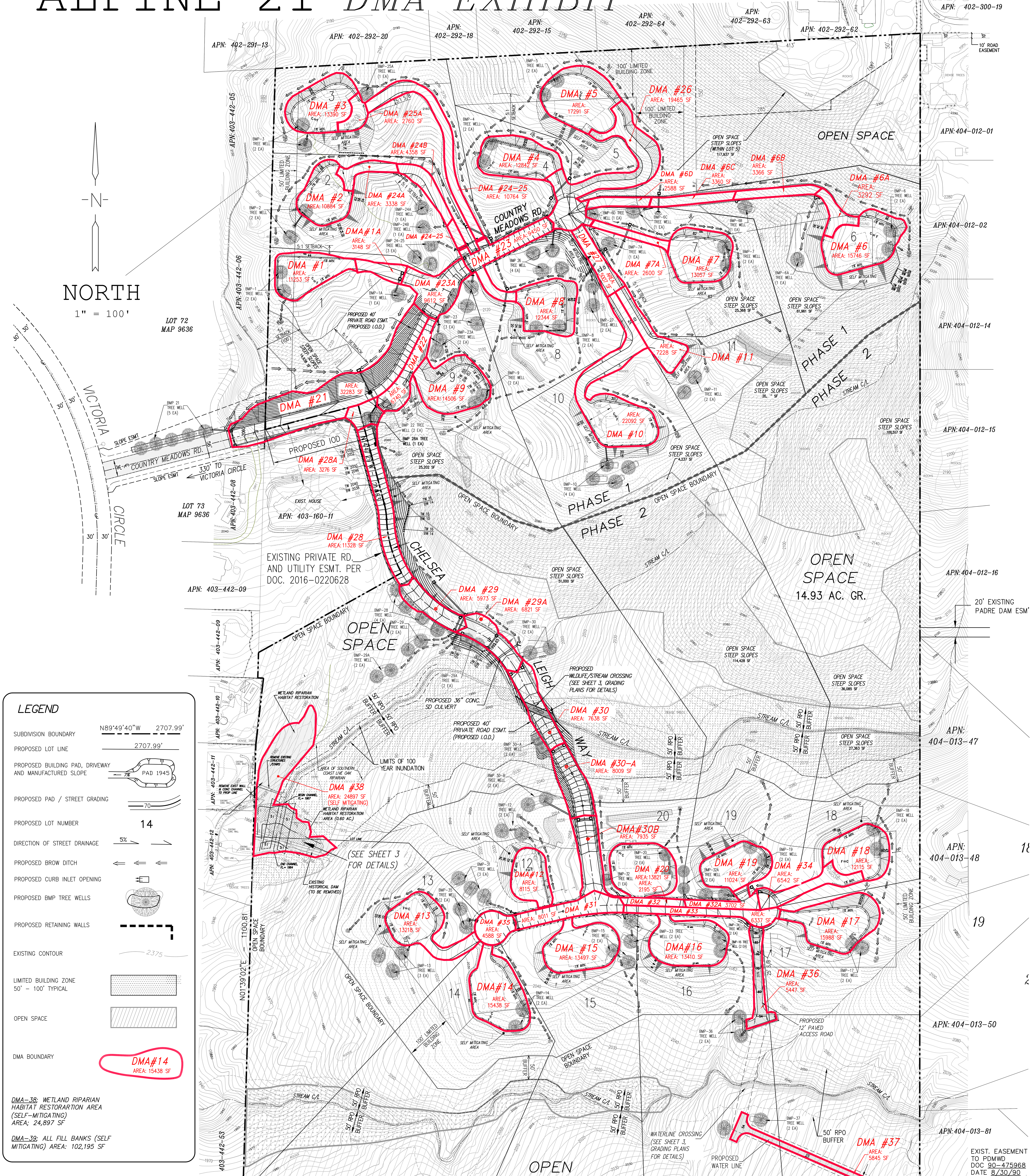
FEBRUARY, 2020

Appendix IV: Drainage Management Area (DMA) Map:

TM 5431 SWQMP – DMA PLAN

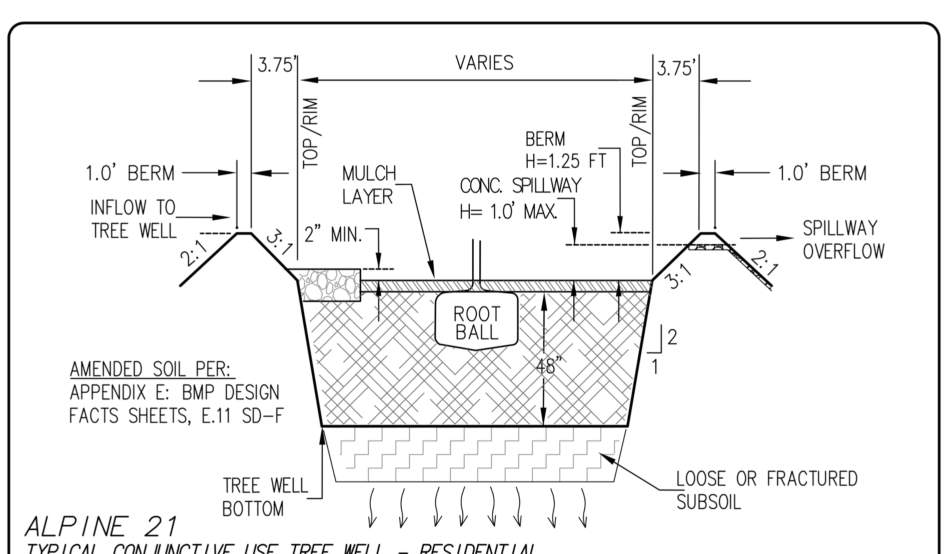
ALPINE-21 *DMA EXHIBIT*



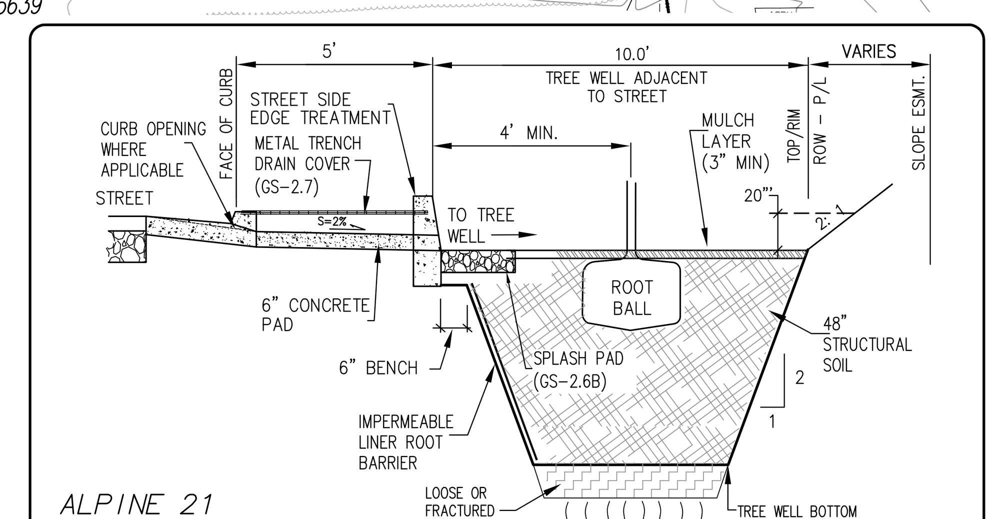
			DMA SUMMARY TABLE				
DMA ID	TOTAL AREA (SF)	IMP. AREA (SF)	YARD / PERV AREA (SF)	BMP TYPE	DCV PROVIDED (CF)	NO OF TREES	DCV PROVIDED PER TREE
DMA-1	11,253	4,000	7,253	TREE WELL	840	2	420
DMA-1A	3,148	2,100	1,048	TREE WELL	420	1	420
DMA-2	10,884	4,000	6,884	TREE WELL	840	2	420
DMA-3	13,390	4,000	9,390	TREE WELL	840	2	420
DMA-4	12,842	4,000	8,842	TREE WELL	840	2	420
DMA-5	17,291	4,000	13,291	TREE WELL	840	2	420
DMA-6	15,746	4,000	11,746	TREE WELL	840	2	420
DMA-6A	3,292	3,292	-	TREE WELL	420	1	420
DMA-6B	3,366	3,366	-	TREE WELL	420	1	420
DMA-6C	3,360	3,360	-	TREE WELL	420	1	420
DMA-6D	2,588	2,588	-	TREE WELL	420	1	420
DMA 7	13,057	4,000	9,057	TREE WELL	840	2	420
DMA 7A	2,600	2,600	-	TREE WELL	420	1	420
DMA 8	12,344	4,000	8,344	TREE WELL	840	2	420
DMA 9	14,506	4,000	10,506	TREE WELL	840	2	420
DMA 10	22,092	10,000	12,092	TREE WELL	1680	4	420
DMA 11	7,228	3,900	3,328	TREE WELL	840	2	420
DMA 12	8,115	3,100	5,015	TREE WELL	840	2	420
DMA 13	13,218	6,585	6,633	TREE WELL	1260	3	420
DMA 14	15,438	4,000	11,438	TREE WELL	840	2	420
DMA 15	13,497	4,000	9,497	TREE WELL	840	2	420
DMA 16	13,410	4,000	9,410	TREE WELL	840	2	420
DMA 17	15,988	4,000	11,988	TREE WELL	840	2	420
DMA 18	12,115	4,000	8,115	TREE WELL	840	2	420
DMA 19	11,024	4,000	7,024	TREE WELL	840	2	420
DMA 20	13,821	4,000	9,821	TREE WELL	840	2	420
DMA 21	32,283	12,519	19,764	TREE WELL	2100	5	420
DMA 22	6,740	4,877	1,863	TREE WELL	840	2	420
DMA 23	9,450	9,450	-	TREE WELL	1260	3	420
DMA 23A	9,612	6,235	3,377	TREE WELL	840	2	420
DMA 24A	3,338	2,951	387	TREE WELL	420	1	420
DMA 24B	4,358	3,227	1,131	TREE WELL	420	1	420
DMA 25A	2,760	2,760	-	TREE WELL	420	1	420
DMA 24-25	10,764	8,450	2,314	TREE WELL	1260	3	420
DMA 26	19,465	12,420	7,045	TREE WELL	1680	4	420
DMA 27	5,007	4,407	600	TREE WELL	840	2	420
DMA 28	11,328	11,328	-	TREE WELL	1680	4	420
DMA 28A	3,276	2,650	626	TREE WELL	420	1	420
DMA 29	5,973	5,411	562	TREE WELL	840	2	420
DMA 29A	6,821	5,392	1,429	TREE WELL	840	2	420
DMA 30	7,638	6,635	1,003	TREE WELL	840	2	420
DMA 30A	8,009	5,750	2,259	TREE WELL	840	2	420
DMA 30B	7,935	6,170	1,765	TREE WELL	840	2	420
DMA 31	8,011	8,011	-	TREE WELL	1260	3	420
DMA 32	2,195	2,195	-	TREE WELL	420	1	420
DMA 32A	3,702	3,702	-	TREE WELL	840	2	420
DMA 33	6,337	6,337	-	TREE WELL	840	2	420
DMA 34	6,542	6,542	-	TREE WELL	840	2	420
DMA 35	4,588	4,588	-	TREE WELL	840	2	420
DMA 36	5,447	5,447	-	TREE WELL	840	2	420
DMA 37	5,845	5,845	-	TREE WELL	840	2	420
						104	

HYDROLOGIC SOILS GROUP
ONSITE AREAS: B
PER CEQA HYDROLOGY STUDY
BY JONES ENGINEERS, INC.
FEBRUARY, 2020

DEPTH OF GROUNDWATER:
> 16' PER PRELIMINARY EVALUATION REPORT FOR INFILTRATION LID IMPROVEMENTS,
ALPINE 21: C.W. LAMONTE, CO.
AUGUST 15, 2016.



ALPINE 21
TYPICAL CONJUNCTIVE USE TREE WELL - RESIDENTIAL
30' DIA. CANOPY - 48" DEPTH



ALPINE 21
BASIN "D" / BMP-21 CONJUNCTIVE USE
TREE WELL ALONG STREET (30' DIA. CANOPY - 48" DEPTH)

JONES ENGINEERS, INCORPORATED
535 NORTH HIGHWAY 101
SUITE "A"
SOLANA BEACH, CA. 92075
(858) 847-0011

DATE: FEBRUARY 2020

SHEET 1 OF 1 SHEETS

Appendix V: Potential Detention Storage Tabulation – Conjunctive Use Tree Wells

Table V presents a tabulation of the potential storage volume provided by the conjunctive use tree wells within each Basin. This table presents a reasonable estimate of the total potential volume provided by the tree wells. This table does not incorporate stage storage discharge analysis, and this table assumes each tree well is identical. In practical application each conjunctive use tree well will provide a potential storage volume based on it's unique configuration. Each individual BMP will be analyzed for compliance in the final engineering stage.

Table V also presents a tabulation of the required volume of detention for each basin based on the following formula $V = P_6 \times A \times \Delta C$ wherein P_6 = 3.5" (,29'), A = Area of Post Development Basin and ΔC = The difference between the pre development and post development runoff coefficients for each basin.

A comparison of the tabulation show that the potentially available detention storage significantly exceeds the calculated required detention storage in each basin.

Appendix VI and VII present analyses of typical DMA's and the stage storage discharge from their associated BMP's using conjunctive use tree wells with controlled outlet structures. These analyses establish that the post development runoff conditions will be mitigated for both peak flow and volume of discharge.

POTENTIAL
BMP DETENTION
TM 5431
FEBRUARY, 2020

DMA ID -	DMA AREA (SF)	IMP. AREA (SF)	YARD / PERV AREA (SF)	NO OF TREE WELLS	DRAINAGE BASIN ID
DMA-1	11,253	4,000	7,253	2	A1
DMA-1A	3,148	2,100	1,048	1	A1
DMA-2	10,884	4,000	6,884	2	A1
DMA-3	13,390	4,000	9,390	2	A1
DMA-4	12,842	4,000	8,842	2	A1
DMA-5	17,291	4,000	13,291	2	A1
DMA-6	15,746	4,000	11,746	2	A1
DMA-6A	3,292	3,292	-	1	A1
DMA-6B	3,366	3,366	-	1	A1
DMA-6C	3,360	3,360	-	1	A1
DMA-6D	2,588	2,588	-	1	A1
DMA 7	13,057	4,000	9,057	2	A1
DMA 7A	2,600	2,600	-	1	A1
DMA 8	12,344	4,000	8,344	2	A1
DMA 9	14,506	4,000	10,506	2	A1
DMA 10	22,092	10,000	12,092	4	A1
DMA 11	7,228	3,900	3,328	2	A1
DMA 12	8,115	3,100	5,015	2	A3
DMA 13	13,218	6,585	6,633	3	C
DMA 14	15,438	4,000	11,438	2	B
DMA 15	13,497	4,000	9,497	2	B
DMA 16	13,410	4,000	9,410	2	B
DMA 17	15,988	4,000	11,988	2	B
DMA 18	12,115	4,000	8,115	2	A2
DMA 19	11,024	4,000	7,024	2	A2
DMA 20	13,821	4,000	9,821	2	A2
DMA 21	32,283	12,519	19,764	5	D
DMA22	6,740	4,877	1,863	2	A1
DMA 23	9,450	9,450	-	3	A1
DMA 23A	9,612	6,235	3,377	2	A1
DMA 24A	3,338	2,951	387	1	A1
DMA 24B	4,358	3,227	1,131	1	A1
DMA 25A	2,760	2,760	-	1	A1
DMA 24-25	10,764	8,450	2,314	3	A1
DMA 26	19,465	12,420	7,045	4	A1
DMA 27	5,007	4,407	600	2	A1
DMA 28	11,328	11,328	-	4	A3
DMA 28A	3,276	2,650	626	1	A3
DMA 29	5,973	5,411	562	2	A3
DMA 29A	6,821	5,392	1,429	2	A3
DMA 30	7,638	6,635	1,003	2	A3
DMA 30A	8,009	5,750	2,259	2	A3
DMA 30B	7,935	6,170	1,765	2	A3
DMA 31	8,011	8,011	-	3	A3
DMA 32	2,195	2,195	-	1	A2
DMA 32A	3,702	3,702	-	2	A2
DMA 33	6,337	6,337	-	2	B
DMA 34	6,542	6,542	-	2	A2
DMA 35	4,588	4,588	-	2	C
DMA 36	5,447	5,447	-	2	B
DMA 37	5,845	5,845	-	2	B
		258,190	224,847		
TOTAL	483,037			104	

DRAINAGE BASIN	DMA AREAS (SF) PER SWQMP	NATURAL AREAS (SF)	DRAINAGE BASIN TOTAL (SF)	NO. TREE WELL PER BASIN PER SWQMP	SD-F TREE WELLS PER BASIN PER SWQMP	STRUCTURAL TREE WELLS PER BASIN PER SWQMP	STORAGE VOL SD-F TREE WELL (CF) PER APPX VI (NO ROUTING)	STORAGE VOL STRUCTURAL TREE WELL (CF) PER APPX VII (NO ROUTING)	STORAGE VOL PER BASIN* (CF) POTENTIAL	STORAGE VOL. REQUIRED PER BASIN (CF) $V = P_6*A*\Delta c$ ** USE POST DEV BASIN AREA
BASIN A1	240,481	1,571,615	1,812,096	49	47	2	2214	4548	113,154	21,020
BASIN A2	49,399	4,075,733	4,125,132	11	11	0	2214	4548	24,354	-
BASIN A3	67,106	484,799	551,905	20	12	8	2214	4548	62,952	4,802
BASIN B	75,962	2,142,113	2,218,075	14	14	0	2214	4548	30,996	6,432
BASIN C	17,806	67,136	84,942	5	5	0	2214	4548	11,070	739
BASIN D	32,283	7,357	39,640	5	-	5	2214	4548	22,740	1,609
TOTAL	483,037	8,348,753	8,831,790	104	89	15			265,266	34,603

* BASINS A,B & C PROVIDE 12" ABOVE GROUND STORAGE DEPTH PER TREE WELL AREA FOR STORAGE. BASIN D PROVIDES 20" ABOVE GROUND STORAGE DEPTH PER TREE WELL. ABOVE GROUND STORAGE DEPTH IS IN ADDITION TO TREE WELL MEDIA DEPTH. SEE TREE WELL DETAILS

**** See tables 1,2,3,5,7,9 for Pre-Dev. runoff coefficient calculation.**
and tables 11,12,13,15,17,19 for Post-Dev runoff coefficient calculation

Appendix VI: Typical Residential DMA Detention Analysis

TYPICAL RESIDENTIAL DMA SITE PLAN

TYPICAL CONJUNCTIVE USE TREE WELL PLAN AND PROFILE

RATIONAL METHOD Q_{100} ANALYSIS

RATIONAL METHOD HYDROGRAPH TABULATION (RICK RATIONAL)

STAGE STORAGE ELEVATIONS AND WEIR CONFIGURATION INPUT DATA FOR HEC HMS

HEC HMS RESULTS: SUMMARY AND HYDROGRAPH

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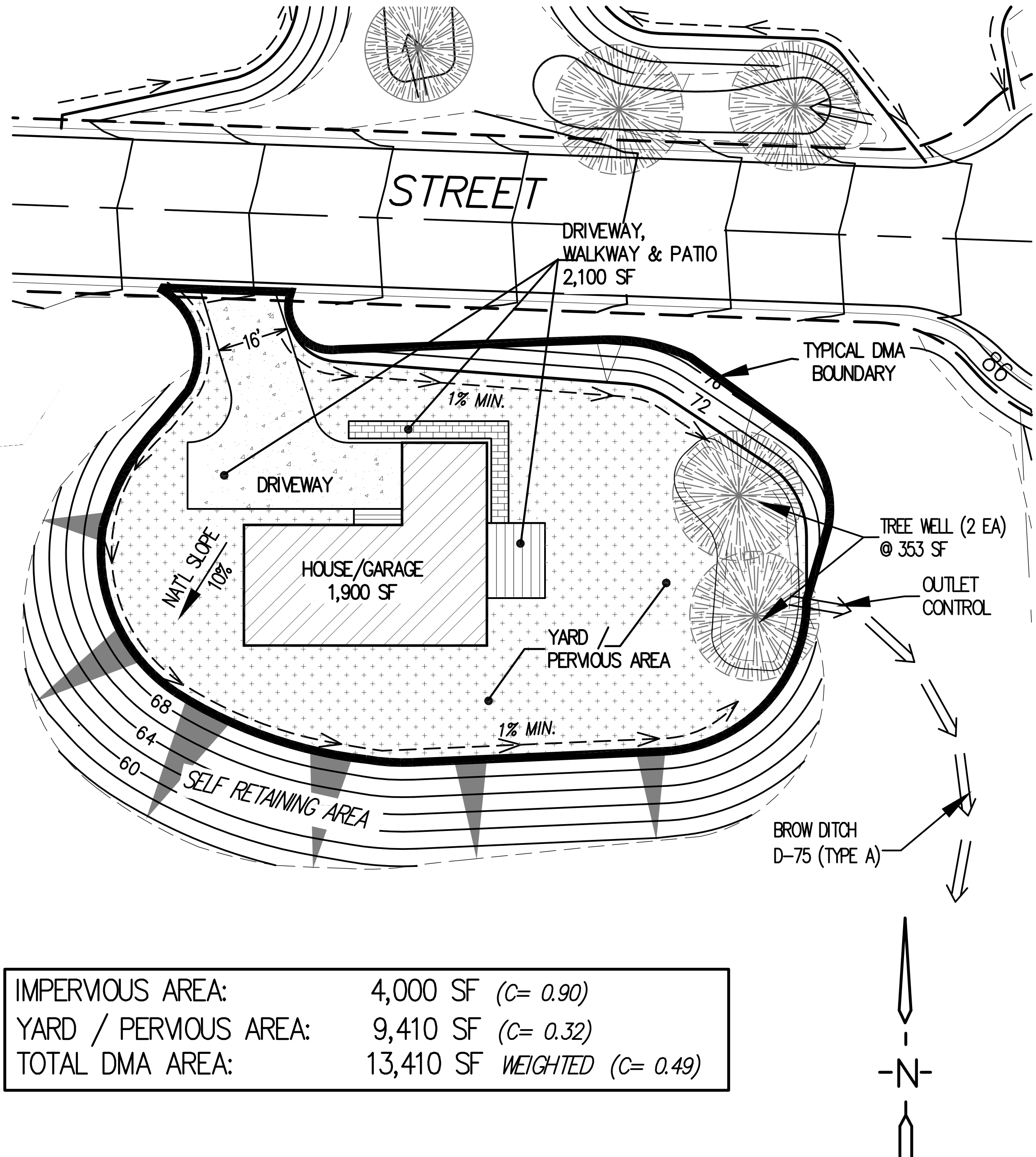
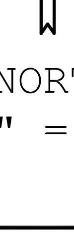


IMPERVIOUS AREA:	4,000 SF	*(C= 0.90)*
YARD / PERVIOUS AREA:	9,410 SF	*(C= 0.32)*
TOTAL DMA AREA:	13,410 SF	*WEIGHTED (C= 0.49)*

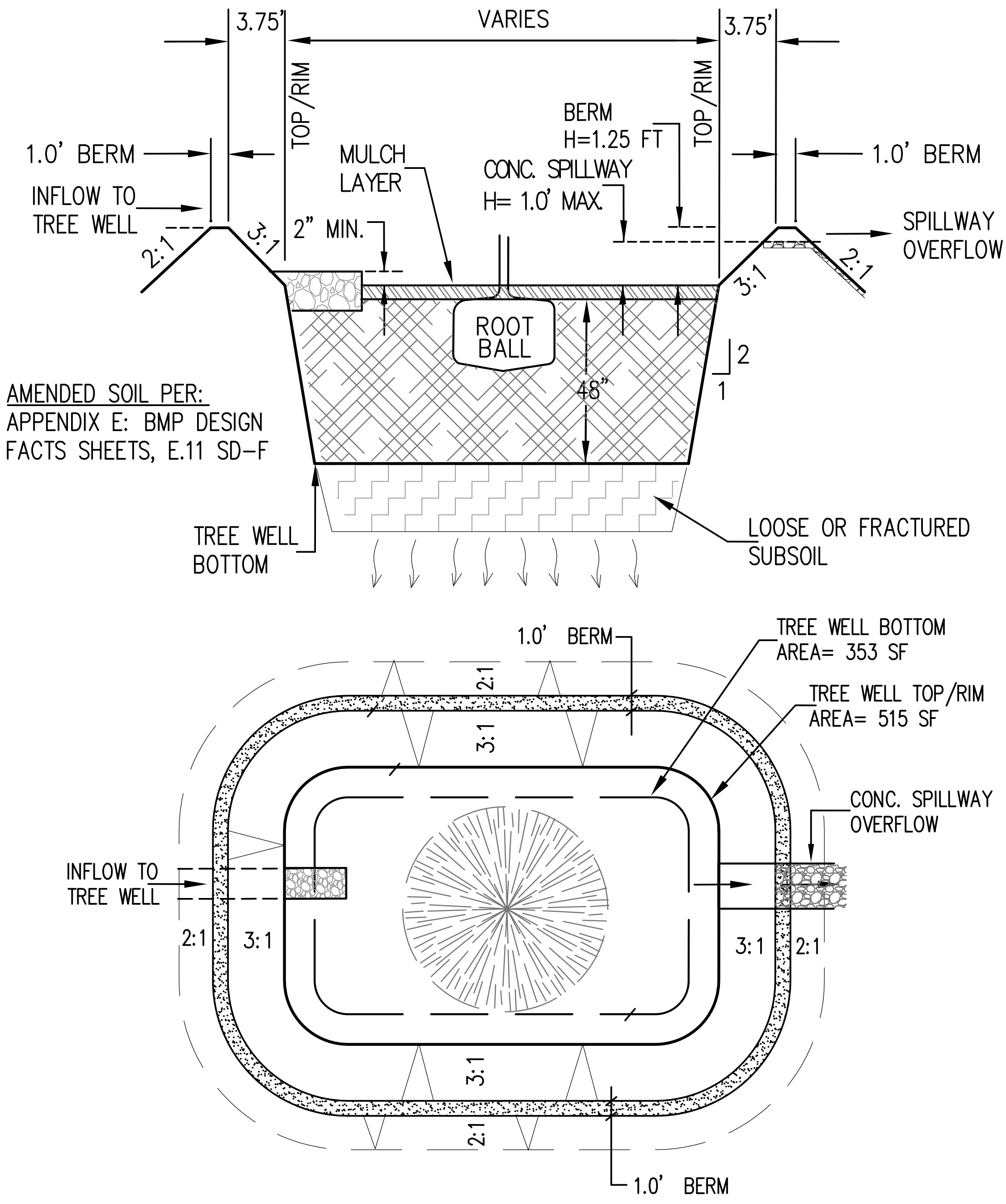


NORTH
1" = 40'

ALPINE 21

TYPICAL DMA- RESIDENTIAL

N.T.S.



ALPINE 21

TYPICAL CONJUNCTIVE USE TREE WELL- RESIDENTIAL

30' DIA. CANOPY - 48" DEPTH

DMA X : WEIGHTED "C" VALUES

DMA X : PRE-DEVELOPMENT WEIGHTED "C" VALUE							
	Map Symbol	Hyd. Class	Area	Area	Land Use	C	A x C
				(acres)			
	CmE2	B	13,410	0.31	Natural	0.25	0.08
			13,410	0.31			0.08
				Mean Runoff Coefficient			0.25

DMA X : POST-DEVELOPMENT WEIGHTED "C" VALUE							
	Map Symbol	Hyd. Class	Area	Area	Land Use	C	A x C
				(acres)			
	CmE2	B	4,000	0.09	Impervious	0.90	0.08
	CmE2	B	9,410	0.22	Yard	0.32	0.07
			13,410	0.31			0.15
				Mean Runoff Coefficient			0.49

DMA X : PRE & POST Q100 RATIONAL RUNOFF

DMA X : PRE-DEV RATIONAL Q100

Run	Sub Basin	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	V (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.31		0.25	0.08		initial time					0.10		6.90			
L1							overland flow	80	2075	2060	15	0.19		0.43			
			0.31			*0.08*						*total =*		*7.33*	*7.33*	7.20	0.55

DMA X : POST-DEV RATIONAL Q100

Run	Sub Basin	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	V (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.31		0.49	0.15		initial time					0.10		6.40			
L1							gutter flow	70	2070	2068	2	0.03	6.00	0.19			
			0.31			***0.15***						***total =***		***6.59***	***6.59***	**7.71**	**1.16**

RATIONAL METHOD HYDROGRAPH PROGRAM
RUN DATE 2/19/2020

PRE-DEVEVELOPMENT
TIME INTERVAL 10 MIN.
6 HOUR RAINFALL 3.5 INCHES
BASIN AREA 0.31 AC., RUNOFF COEFFICIENT 0.25
PEAK DISCHARGE 0.55 CFS

POST-DEVEVELOPMENT
TIME INTERVAL 10 MIN.
6 HOUR RAINFALL 3.5 INCHES
BASIN AREA 0.31 AC., RUNOFF COEFFICIENT 0.49
PEAK DISCHARGE 1.16 CFS

Time (Min.)	Pre-development Runoff (cfs)	Post development Runoff (cfs)
0	0	0
10	0	0
20	0	0
30	0	0
40	0	0
50	0	0
60	0	0
70	0	0
80	0	0
90	0	0
100	0	0
110	0	0
120	0	0
130	0	0.1
140	0	0.1
150	0	0.1
160	0	0.1
170	0	0.1
180	0	0.1
190	0	0.1
200	0	0.1
210	0.1	0.1
220	0.1	0.1
230	0.1	0.2
240	0.1	0.2
250	0.55	1.16
260	0.1	0.1
270	0	0.1
280	0	0.1
290	0	0.1
300	0	0.1
310	0	0
320	0	0
330	0	0
340	0	0
350	0	0
360	0	0
370	0	0

Stage-Storage & Stage-Discharge Relationship for Detention BMP 1

Discharge vs. Elevation Table

BMP Dimensions

Bottom Area: 1030.00 ft^2 — 2 TREE WELLS @ 515 SF (TOP OF MEDIA SURFACE)

Top Area: 1772.00 ft^2 — 2 TREE WELLS @ 886 SF (ASSUMES 3:1 SIDES)

Weir Discharge Structure

C_W: 2.70

Length: 2.00 ft

Height: 0.75 ft

Note:

1. Weir equation, $Q=C_wL_e(h)^{3/2}$

Basin Elev.	Basin Area (ft^2)	Basin Volume (ft^3)	Basin Depth (ft)	Volume (acre-ft)	Q (cfs)
0.000	1,030	0	0.000	0.0000	0.0000
0.083	1,074	89	0.083	0.0021	0.0000
0.167	1,118	186	0.167	0.0043	0.0000
0.250	1,164	291	0.250	0.0067	0.0000
0.333	1,210	403	0.333	0.0093	0.0000
0.417	1,258	524	0.417	0.0120	0.0000
0.500	1,306	653	0.500	0.0150	0.0000
0.583	1,354	790	0.583	0.0181	0.0000
0.666	1,404	936	0.666	0.0215	0.0000
0.750	1,454	1,090	0.750	0.0250	0.0000
0.833	1,506	1,254	0.833	0.0288	0.1291
0.916	1,558	1,428	0.916	0.0328	0.3662
1.000	1,610	1,609	1.000	0.0369	0.6734
1.083	1,664	1,802	1.083	0.0414	1.0372
1.166	1,718	2,004	1.166	0.0460	1.4499
1.250	1,772	2,214	1.250	0.0508	1.9063

TM 5431
ALPINE 21
BMP X – STAGE STORAGE DISCHARGE
CONJUNCTIVE USE TREE WELLS

Project: TM 5431 DISCHARGE Simulation Run: Q100
Reservoir: BMP 1

Start of Run:	01Jan2000, 00:00	Basin Model:	Post_Dev
End of Run:	01Jan2000, 06:05	Meteorologic Model:	Met 1
Compute Time:	21Feb2020, 12:06:05	Control Specifications:	Control 1

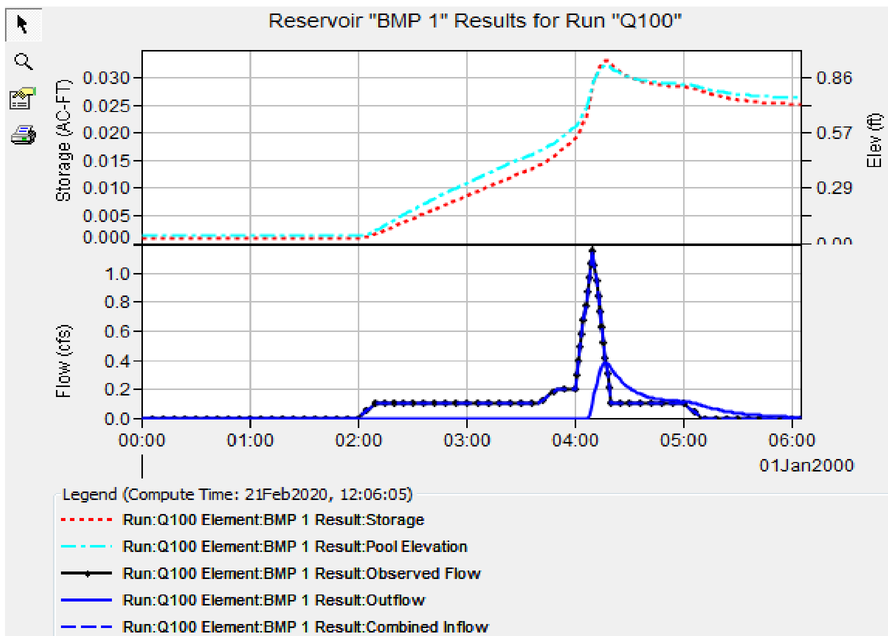
Volume Units: IN AC-FT

Computed Results

Peak Inflow:	1.16 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:09
Peak Discharge:	0.38 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:17
Inflow Volume:	0.04215 (AC-FT)	Peak Storage:	0.03299 (AC-FT)
Discharge Volume:	0.01795 (AC-FT)	Peak Elevation:	0.92 (FT)

Observed Flow Gage POC-1

Peak Discharge:	1.16 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:10
Volume:	0.04215 (AC-FT)		
RMSE Std Dev:	1.00	Nash-Sutcliffe:	0.005
Percent Bias:	-57.41 %		



Appendix VII: Basin D Detention Analysis

BASIN D DMA SITE PLAN (TYPICAL ROADWAY DMA)

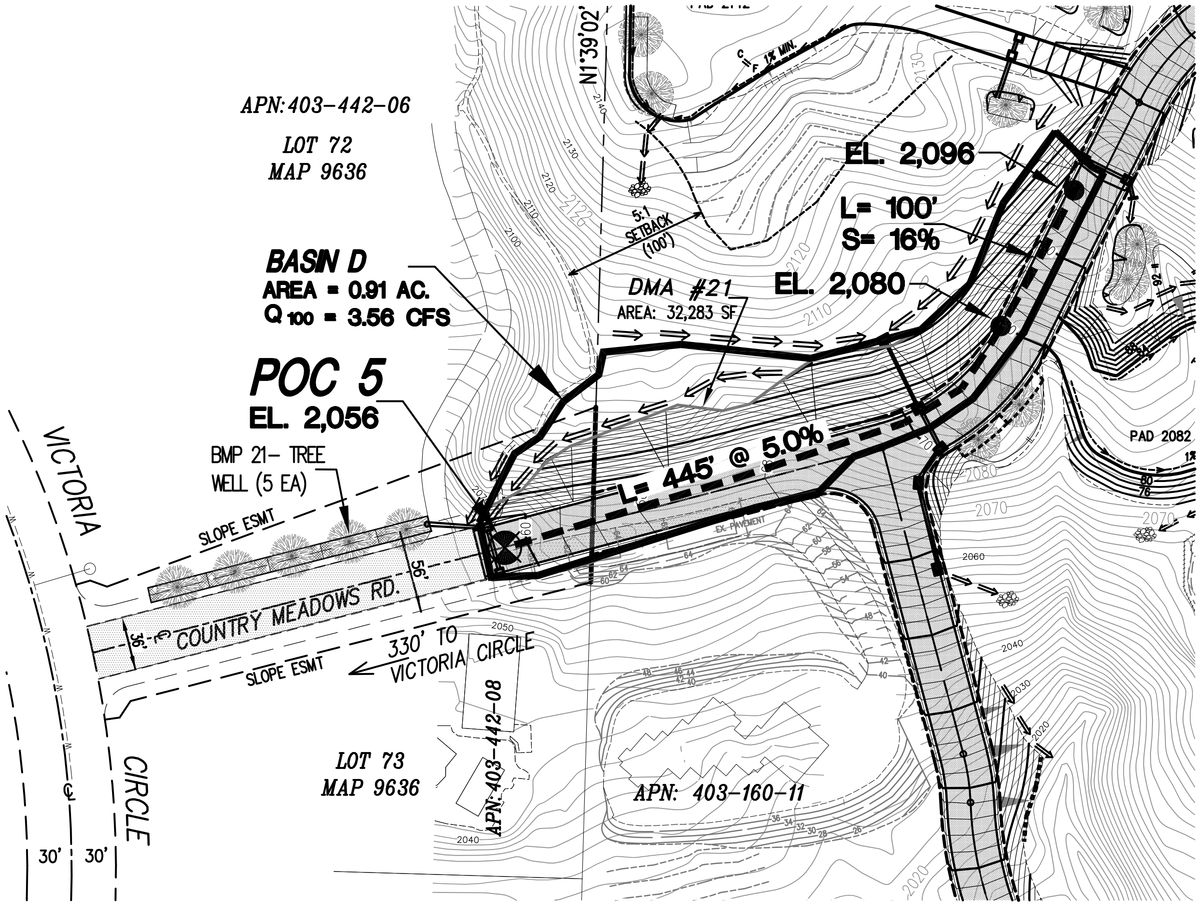
TYPICAL CONJUNCTIVE USE TREE WELL PLAN AND PROFILE

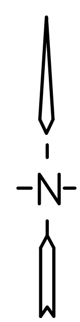
RATIONAL METHOD Q_{100} ANALYSIS: BASIN D

RATIONAL METHOD HYDROGRAPH TABULATION (RICK RATIONAL): BASIN D

STAGE STORAGE ELEVATIONS AND WEIR CONFIGURATION INPUT DATA FOR HEC HMS: BMP 21

HEC HMS RESULTS: SUMMARY AND HYDROGRAPH: BMP 21



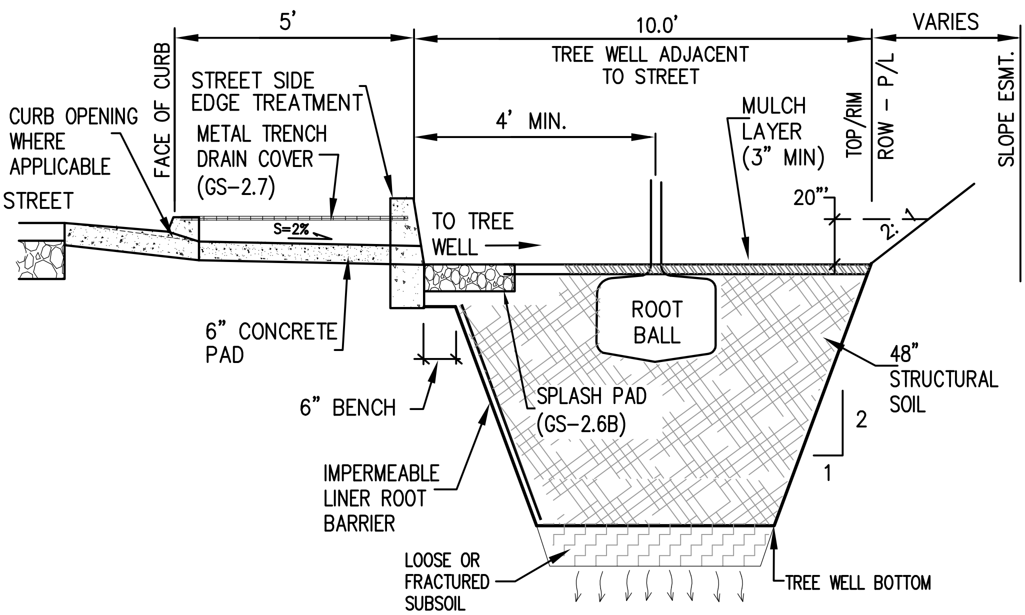


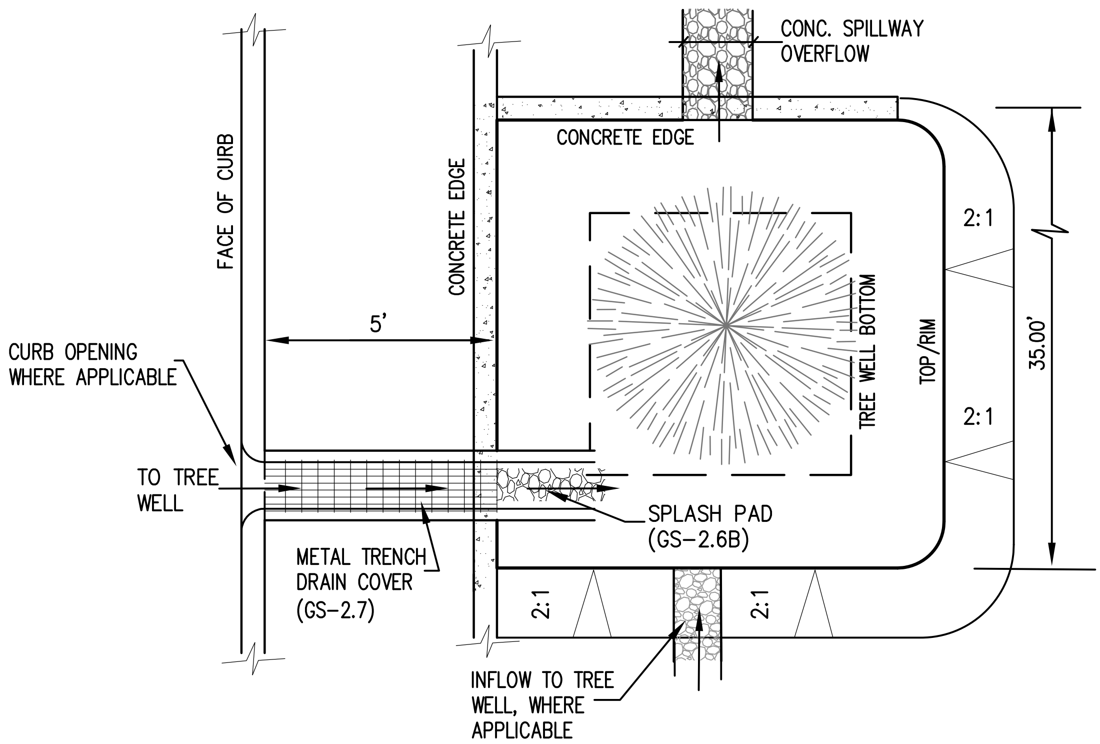
ALPINE 21

BASIN D POST-DEVLOPMENT

(TYPICAL STREET DMA)

N.T.S.





ALPINE 21

BASIN "D" / BMP-21 CONJUNCTIVE USE

TREE WELL ALONG STREET (30' DIA. CANOPY - 48" DEPTH)

BASIN D: PRE-DEV WEIGHTED "C" VALUE

	Map Symbol	Hyd. Class	Area	Area	Land Use	C	A x C
				(acres)			
	CmE2	B	19,166	0.44	natural	0.25	0.11
	CmE2	B	6,970	0.16	pvm't	0.9	0.14
			26,136	0.60			0.25
		Mean Runoff Coefficient					0.42

BASIN D: PRE-DEV RATIONAL Q100

Run	Sub Basin	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	V (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.60		0.42	0.25		initial time	100				0.10		6.90			
L1							overland flow	220	2128	2068	60	0.27		0.82			
L2							gutter flow	170	2068	2056	12	0.07	4.80	0.59			
			0.60			*0.25*						***total =***		***8.31***	***8.31***	**6.65**	**1.67**

BASIN D: POST-DEV WEIGHTED "C" VALUE

	Map Symbol	Hyd. Class	Area	Area	Land Use	C	A x C
				(acres)			
	CmE2	B	16,553	0.38	pvm't	0.90	0.34
	CmE2	B	23,087	0.53	slope	0.32	0.17
				0.91			0.51
		Mean Runoff Coefficient					0.56

BASIN D: POST-DEV RATIONAL Q100

Run	Sub Basin	Area (acres)	Sum Area	C	CxA	Sum CxA	Flowpath Desc.	Flow Length (ft)	E1 (ft)	E2 (ft)	h (ft)	Slope (ft/ft)	V (ft/s)	T_f (min)	T_C (min)	I_{100} (in/hr)	Q_{100} (cfs)
		0.91		0.56	0.51		initial time	100	2096	2080		0.16		6.40			
L1							gutter flow	445	2080	2056	24	0.05	5.70	1.30			
			0.91			***0.51***						***total =***		***7.70***	***7.70***	**6.98**	**3.56**

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY
RUN DATE 2/20/2020

PRE-DEVEVELOPMENT
TIME INTERVAL 10 MIN.
6 HOUR RAINFALL 3.5 INCHES
BASIN AREA 0.60 AC., RUNOFF COEFFICIENT 0.42
PEAK DISCHARGE 1.67 CFS

POST-DEVEVELOPMENT
TIME INTERVAL 10 MIN.
6 HOUR RAINFALL 3.5 INCHES
BASIN AREA 0.91 AC., RUNOFF COEFFICIENT 0.56
PEAK DISCHARGE 3.56 CFS

Time (Min.)	Pre-development Runoff (cfs)	Post development Runoff (cfs)
0	0	0
10	0.1	0.1
20	0.1	0.1
30	0.1	0.1
40	0.1	0.1
50	0.1	0.1
60	0.1	0.1
70	0.1	0.1
80	0.1	0.1
90	0.1	0.1
100	0.1	0.1
110	0.1	0.2
120	0.1	0.2
130	0.1	0.2
140	0.1	0.2
150	0.1	0.2
160	0.1	0.2
170	0.1	0.2
180	0.1	0.2
190	0.1	0.3
200	0.1	0.3
210	0.2	0.4
220	0.2	0.4
230	0.3	0.6
240	0.2	0.6
250	1.67	3.56
260	0.2	0.5
270	0.2	0.3
280	0.1	0.2
290	0.1	0.2
300	0.1	0.2
310	0.1	0.2
320	0.1	0.1
330	0.1	0.1
340	0.1	0.1
350	0.1	0.1
360	0.1	0.1
370	0	0

Stage-Storage & Stage-Discharge Relationship for Detention BMP 1

Discharge vs. Elevation Table

BMP Dimensions

Bottom Area: 2730.00 ft^2 — 5 TREE WELLS @ 546 SF (TOP OF MEDIA SURFACE)

Top Area: 3695.00 ft^2 — 5 TREE WELLS @ 739 SF (TOP OF BERM / WALL)

Weir Discharge Structure

C_W: 2.70

Length: 1.75 ft

Height: 1.00 ft

Note:

1. Weir equation, $Q=C_wL_e(h)^{3/2}$

Basin Elev.	Basin Area (ft^2)	Basin Volume (ft^3)	Basin Depth (ft)	Volume (acre-ft)	Q (cfs)
0.000	2,695	0	0.000	0.0000	0.0000
0.083	2,735	228	0.083	0.0052	0.0000
0.167	2,820	470	0.167	0.0108	0.0000
0.250	2,910	727	0.250	0.0167	0.0000
0.333	3,005	1,001	0.333	0.0230	0.0000
0.417	3,095	1,289	0.417	0.0296	0.0000
0.500	3,185	1,592	0.500	0.0365	0.0000
0.583	3,280	1,913	0.583	0.0439	0.0000
0.666	3,375	2,249	0.666	0.0516	0.0000
0.750	3,470	2,601	0.750	0.0597	0.0000
0.833	3,570	2,974	0.833	0.0683	0.0000
0.916	3,665	3,358	0.916	0.0771	0.0000
1.000	3,765	3,763	1.000	0.0864	0.0000
1.083	3,865	4,185	1.083	0.0961	0.1128
1.166	3,965	4,624	1.166	0.1062	0.3201
1.250	4,070	5,085	1.250	0.1167	0.5889
1.333	4,175	5,564	1.333	0.1277	0.9071
1.416	4,275	6,054	1.416	0.1390	1.2682
1.499	4,380	6,567	1.499	0.1508	1.6675
1.583	4,490	7,106	1.583	0.1631	2.1017
1.666	4,595	7,655	1.666	0.1757	2.5681

Project: TM 5431 DISCHARGE   Simulation Run: Q100
Reservoir: BMP 2

Start of Run:	01Jan2000, 00:00	Basin Model:	Post_Dev
End of Run:	01Jan2000, 06:05	Meteorologic Model:	Met 1
Compute Time:	28Feb2020, 16:32:10	Control Specifications:	Control 1

Volume Units: ◯ IN ◉ AC-FT

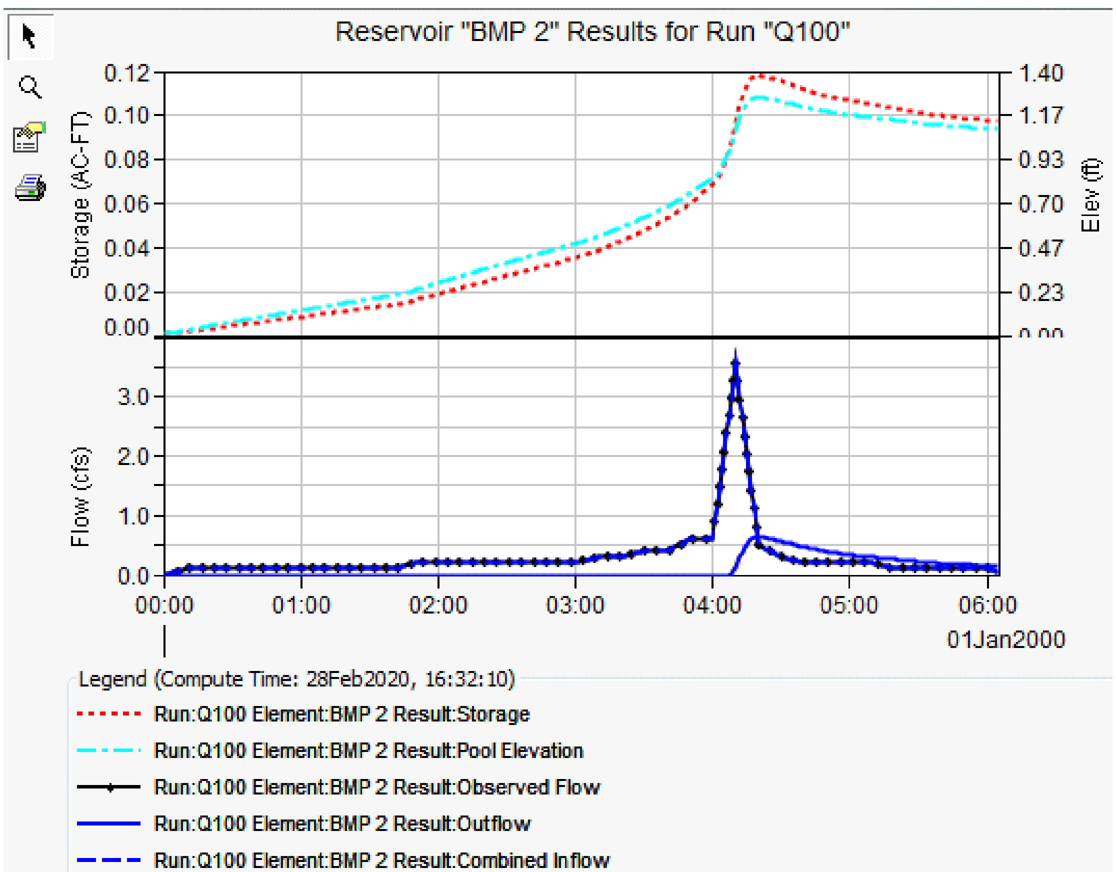
Computed Results

Peak Inflow:	3.56 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 04:09
Peak Discharge:	0.64 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:20
Inflow Volume:	0.14941 (AC-FT)	Peak Storage:	0.11843 (AC-FT)
Discharge Volume:	0.05291 (AC-FT)	Peak Elevation:	1.26 (FT)

Observed Flow Gage POC-2

Peak Discharge:	3.56 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 04:10
Volume:	0.14941 (AC-FT)		
RMSE Std Dev:	1.09	Nash-Sutcliffe:	-0.183
Percent Bias:	-64.53 %		

Screen clipping taken: 2/28/2020 4:35 PM



Screen clipping taken: 2/28/2020 4:36 PM