HYDROLOGY REPORT

Tentative Parcel Map 21208

Ivy Lane (APN 578-050-19-00)

Spring Valley, CA 919

PREPARED BY:

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FOR: Panwebster Investments, Inc.

Jonathan Webster, President

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WO 6543

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PROJECT DISCUSSION

PROJECT PURPOSE

The purpose of this project is to provide a TPM in order to provide building sites for four single family dwellings on a vacant lot on the south side of Ivy Lane, just west of Atlantis Street. See the following vicinity map and aerial photograph. The area surrounding the project site is developing with urban residential uses such as the one proposed for this project. This report evaluates the hydrologic impact of this development.

VICINITY MAP

AERIAL PHOTOGRAPH

DESCRIPTION OF WATERSHED

As can be seen from the above photos and the Drainage Basins map on page 8, the project sets along the crest of a hill. Therefore, the drainage basins of this project consist almost entirely of the project property only. As a consequence, the basins and the flows are very small. The project site sets near the top of a small hill and consists of barren ground flowing to the west and north. This flow pattern will be maintained.

METHODOLOGY

The hydrology analysis for this project was conducted in accordance with the San Diego County Hydrology Manual dated June 2003. Because of the size of the drainage basins involved, the Rational Method was used as specified on page 3-1 of the Hydrology Manual. There are no junctions of independent basins as described in Section 3.4 of the Hydrology Manual. Therefore, it was not necessary to use the Modified Rational Method to combine flows.

All hydraulic analysis was conducted in accordance with standard engineering practice. The references used for these analyses include King's Handbook of Hydraulics, nomographs from the San Diego County Drainage Design Manual, the Bureau of Public Roads, the City of San Diego and other commonly accepted sources.

RAINFALL

The rainfall amounts for this analysis are presented on page 11. They were taken from the isopluvial maps in the San Diego County Hydrology Manual.

SUMMARY

The following table summarizes the results of this analysis. See the Hydrology Calculations section of this report for the detailed calculations of each event. It should be noted that the flows shown for the project are very small flows. This is a result of the project property being at the top of a small hill.

Summary Table

Conc. Pt.	Description	Existing Flow c.f.s. (100-yr)	Existing Area acres	Existing C value	Proposed Flow c.f.s. (100-yr)	Proposed Area acres	Proposed C value	Mitigation
1	Basin A	3.22	1.55	0.35	4.68	1.55	0.46	Flow-Through Planter
2	Basin B	1.69	0.85	0.35	2.41	0.85	0.46	Flow-Through Planter

CONCLUSIONS

This project will **not** have an impact on the drainage flows of this property. The project is designed to maintain surface discharge quantities from the project onto adjacent properties.

The RWQCB and the County of San Diego have adopted regulations requiring projects which substantially increase flood flows to adopt Hydromodification mitigating measures. The project's Hydro Modification Plan is shown in the project Storm Water Management Plan as appendix D. That essentially consists of the construction of flow-through planters to provide water quality control and volume control. These are shown on the project grading plans. Because of this, the flows after are the same as the flows before.

Because of the project design, there will not be any changes that will result in substantial erosion or siltation on- or off-site. For the same reasons discussed above, the project will be not substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. For the same reasons discussed in the above, the proposed project will not create or contribute additional runoff water which will exceed the capacity of existing or planned storm water drainage systems.

The housing pads for this project set above and clear of any drainage flows. The areas within the project is not mapped on a federal Flood Hazard Boundary or Flood Insurance Flood Map or other flood hazard delineation map including County Floodplain Maps are shown on the project plans.

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Mr. Jonathan Webster | Ivy Lane | Spring Valley, CA

HYDROLOGY REPORT

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Jonathan Webster, President
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DECLARATION OF RESPONSIBLE CHARGE

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

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

Jim Magee
2718 Powhatan Avenue
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REGISTERED PROFESSIONAL ENGINEER
JAMES W. MAGEE
No21058
Exp. 9/30/15
STATE OF CALIFORNIA

Jim Magee

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Date: 2014.06.05 15:50:05 -07'00'

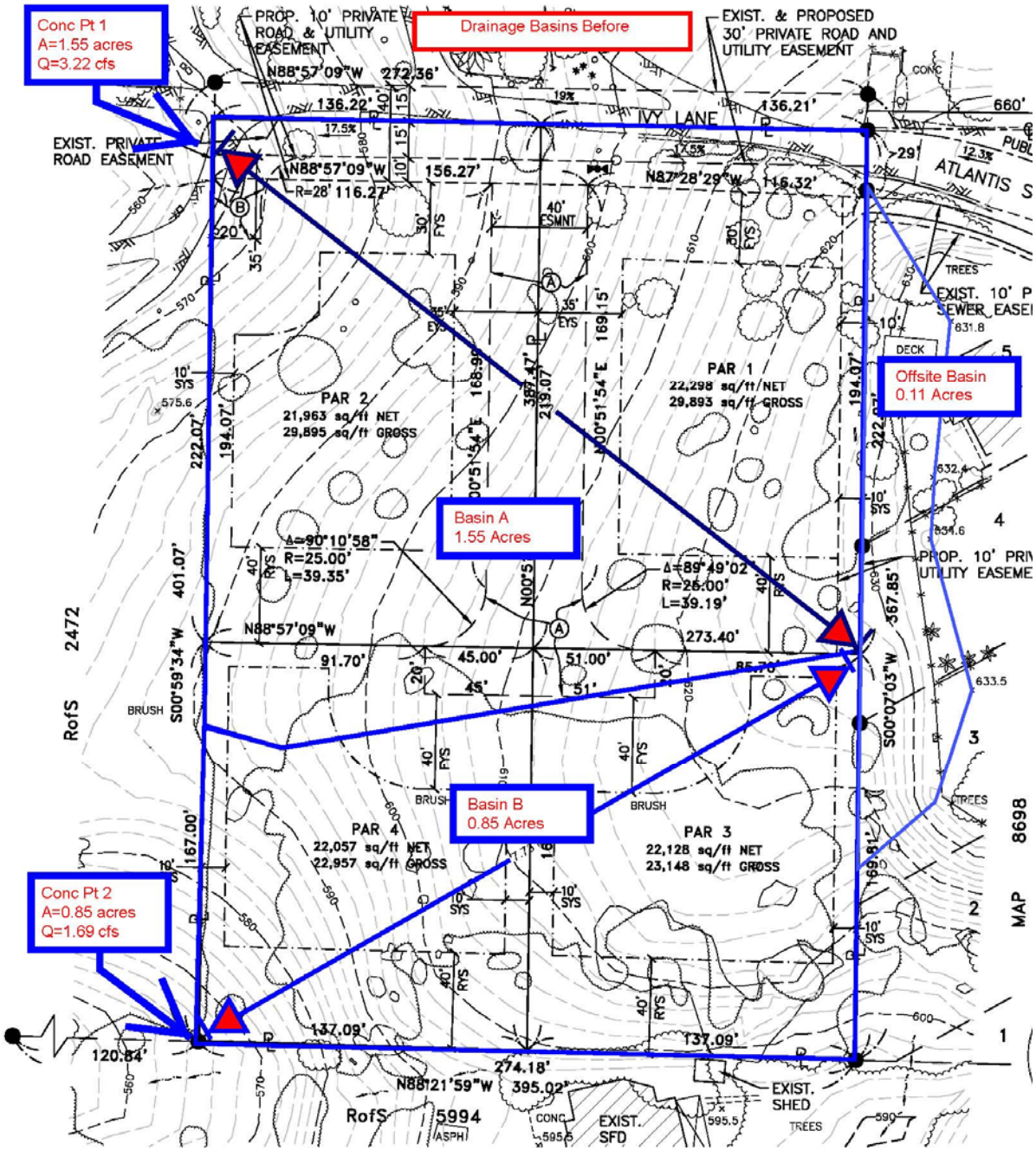
_____ ~~5/20/2014~~ 6/5/2014 .

Jim Magee R.C.E. 21058 Date

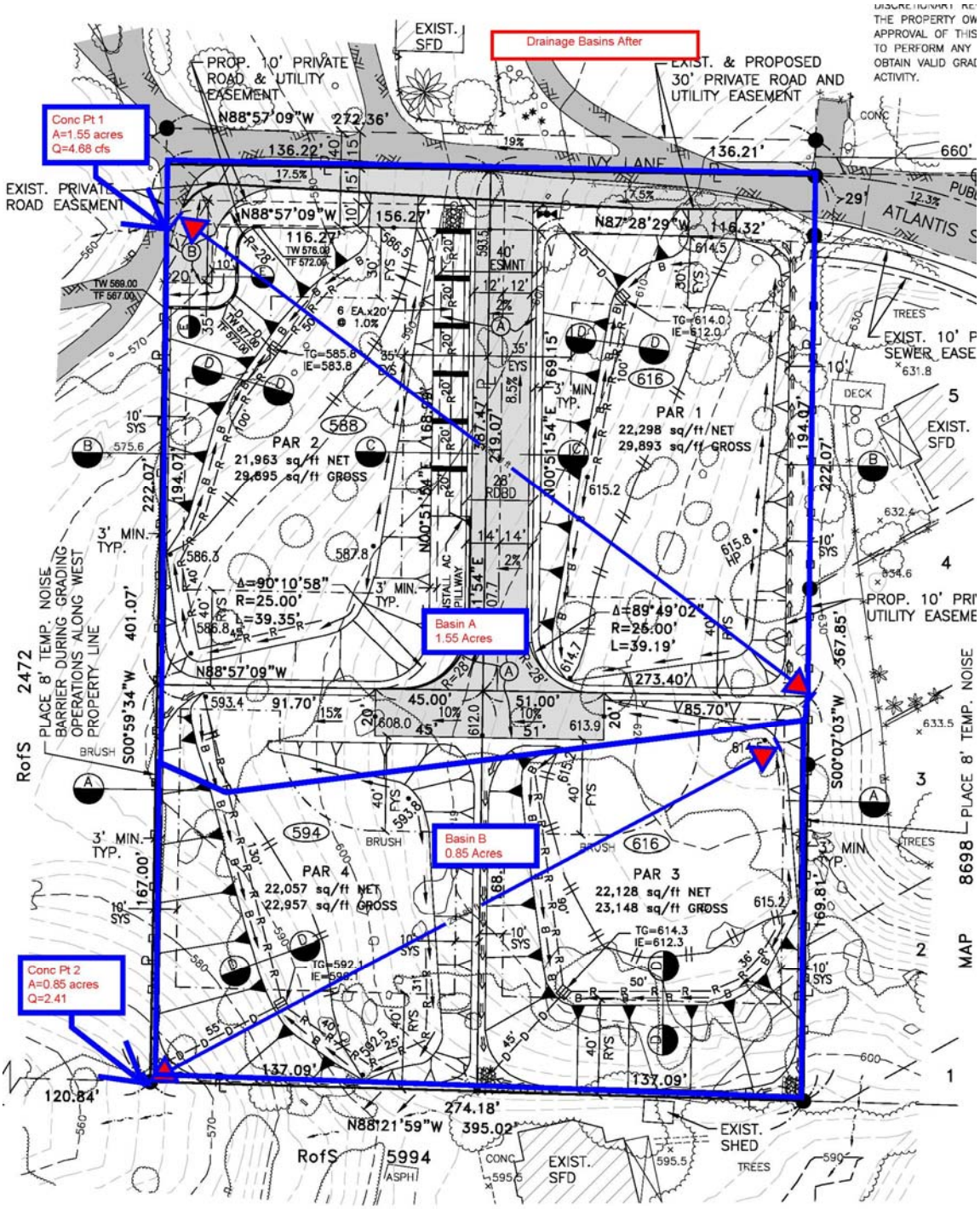
My registration expires 9-30-2015

HYDROLOGIC PARAMETERS

WATERSHED BOUNDARY - TOPOGRAPHIC MAP BEFORE



TOPOGRAPHIC MAP AFTER



The above maps are from the project plans and are at the scale shown. They show the watershed boundaries and the concentration points used in this analysis. They are NOT shown at a particular scale so that it would fit within this report. The following table summarizes the hydrologic factors of the basins.

Drainage Basin A flows toward the northwest corner of the property. After project construction it will discharge at the same location.

Drainage Basin B currently flows toward the southwest corner of the property. This will be the same drainage pattern after the project.

BASIN PROPERTIES

Basin Properties								
Concentration Point #	Basin #	Area (acres)	Hi pt	Low pt	Ti elev	Elev change	Basin Length	Basin slope (%)
1	A	1.55	626.0	556.0	616.0	70.0	334	21.0%
2	B	0.85	626.0	560.0	618.0	66.0	300	22.0%

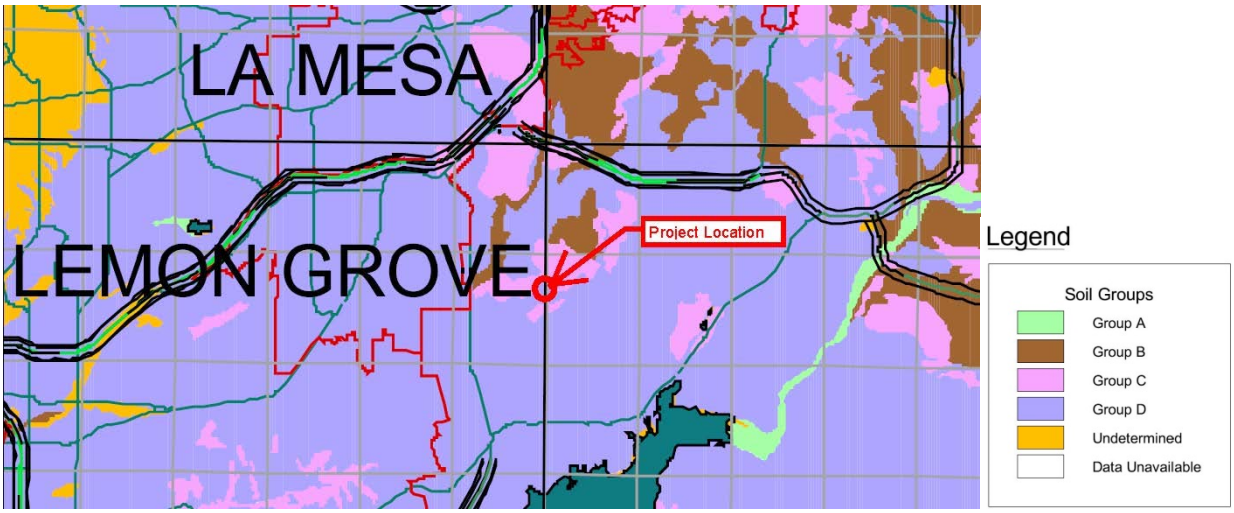
RUNOFF FACTORS

The following table is from the County of San Diego Hydrology Manual and provides runoff factors "C" based on soil type and land use.

	Table 3-1		Soil Type		
Index	Land Use	A	B	C	D
1	Natural	0.20	0.25	0.30	0.35
2	LDR 1.0 DU/A or less	0.27	0.32	0.36	0.41
3	LDR 2.0 DU/A or less	0.34	0.38	0.42	0.46
4	LDR 2.9 DU/A or less	0.38	0.41	0.45	0.49
5	MDR 4.3 DU/A or less	0.41	0.45	0.48	0.52
6	MDR 7.3 DU/A or less	0.48	0.51	0.54	0.57
7	MDR 10.9 DU/A or less	0.52	0.54	0.57	0.60
8	MDR 14.5 DU/A or less	0.55	0.58	0.60	0.63
9	HDR 24.0 DU/A or less	0.66	0.67	0.69	0.71
10	HDR 43.0 DU/A or less	0.76	0.77	0.78	0.79
11	Neighborhood Commercial	0.76	0.77	0.78	0.79
12	General Commercial	0.80	0.80	0.81	0.82
13	Office Professional/Commercial	0.83	0.84	0.84	0.85
14	Commercial/Industrial Limited	0.83	0.84	0.84	0.85
15	Commercial/Industrial General	0.87	0.87	0.87	0.87
16	RDR 0.125 DU/A or less	0.22	0.27	0.32	0.37
17	RDR 0.25 DU/A or less	0.25	0.30	0.34	0.39
18	RDR 0.50 DU/A or less	0.26	0.31	0.35	0.40

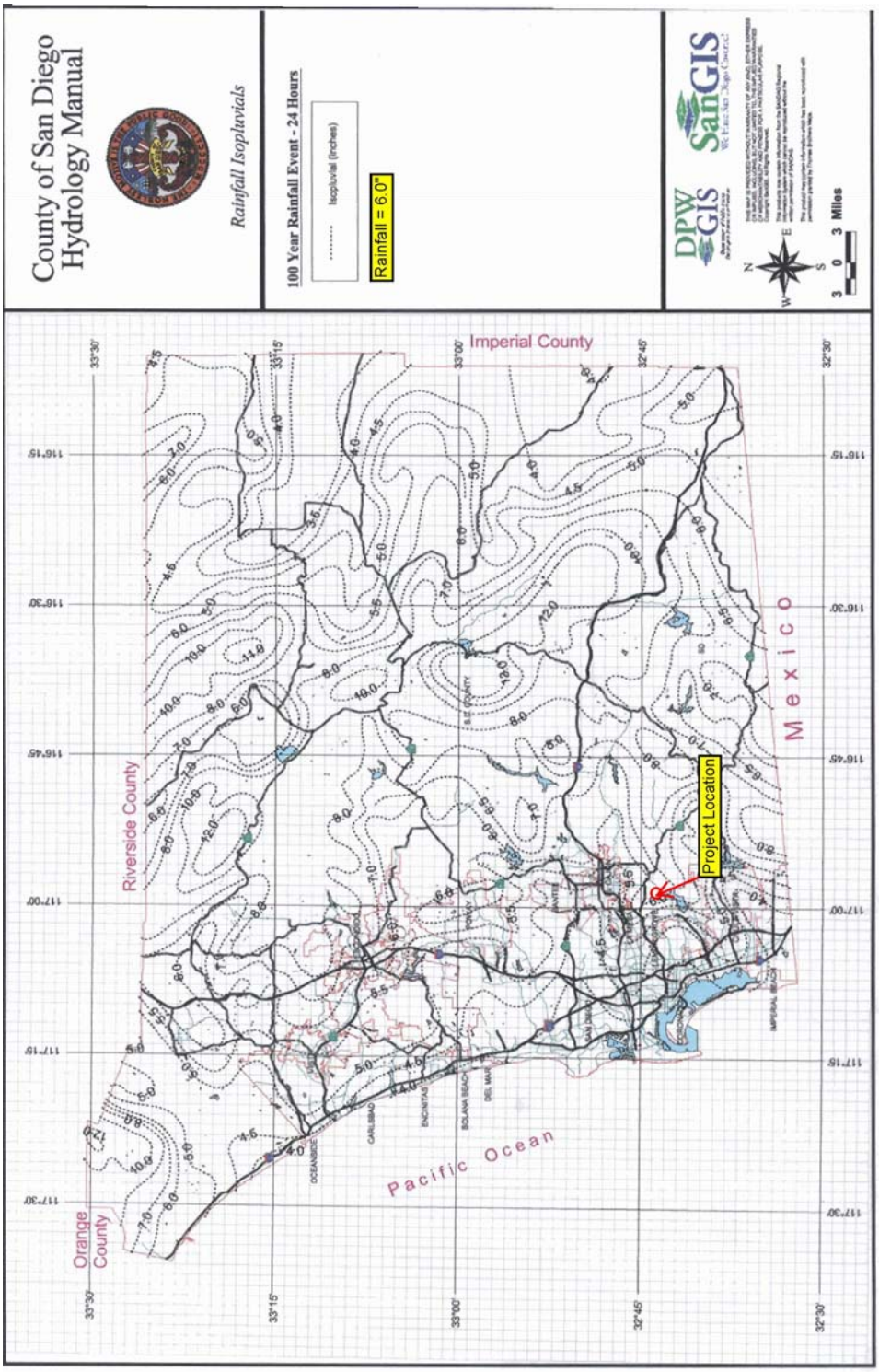
Soil Hydrologic Groups

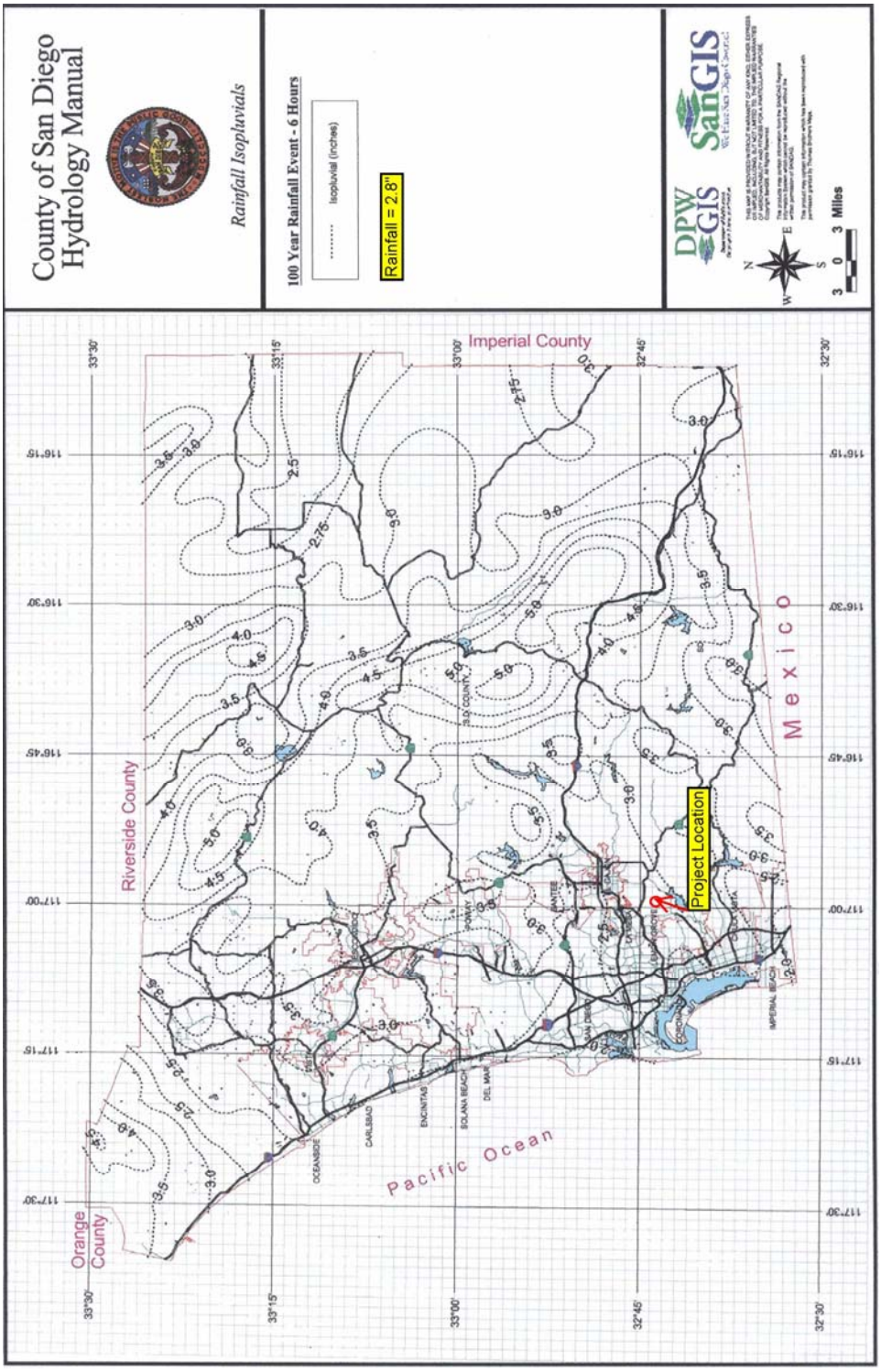
The following map of Soil Groups is from the San Diego County Hydrology Manual. As can be seen, the soil group for the drainage basins of this project is Soil Group "D". This type of soil results in the most runoff during storms because of its inability to absorb the rainwater. This fact is reflected in the above Runoff Factor "C". Those "C" values were used in the analysis of the basins as shown later in this report.



RAINFALL ISOPLUVIALS

The following rainfall amounts are from the isopluvial maps in the San Diego County Hydrology Manual. For the analysis of small basins the Rational Method uses the 100-year 6-hour event as the controlling event and that is used for this analysis. The 6-hour event (**2.8"**) is between 0.45 and 0.65 of the 24-hour event (**6.0"**) for all return intervals and therefore did not need to be adjusted as described in the Hydrology Manual.


County of San Diego
Hydrology Manual
Rainfall Isophlvials
100 Year Rainfall Event - 24 Hours
Isopluvial (inches)
Rainfall = 6.0"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Pacific Ocean
Mexico
Project Location


County of San Diego
Hydrology Manual
Rainfall Isopluvials
100 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Rainfall = 2.8"
DPW GIS
SanGIS
3 0 3 Miles
Imperial County
Riverside County
Orange County
Mexico
Pacific Ocean
Project Location

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HYDROLOGY ANALYSIS

PRE-PROJECT

			Hydrology Calculations (100-year)			
Hydrology Analysis area(s) =		A		Conc Pt =	1	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.55				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	0%	0.00	0.25	0.00		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	100%	1.55	0.35	0.54		
Sum C*A			0.35	0.54		
High Point		626.0				
Low Point		556.0				
Ti elevation		616.0				
Slope after Ti		25.6%				
Calculate Tc						
Approximate slope for the Ti distance of the basin=				10%		
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		6.3	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		1.6	c.f.s.	a=	0.30	sq.ft
BW =		2	feet	p=	2.44	ft.
Z =		5.0	:1	r=	0.12	ft.
s =		25.6%		Q=	1.61	
n =		0.035		diff	0.00	
Depth =		0.04	feet			
Velocity =		5.3	f.p.s.			
Basin Length =		334	feet			
less Ti distance =		100	feet			
Tt distance =		234	feet			
Tt distance/Velocity =		44	seconds			
=		0.7	minutes			
Tc = Ti + Tt =		7.0	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.0	inch			
6 hr/24 hr precip =		0.47	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		5.94	inch/hr			
Q=Sum(C*A) * I		**3.22**	**c.f.s.**			

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			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		B		Conc Pt =	2	
Development Conditions =		Before Project				
Land Use Designation =		Natural		Index=	1	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.85				
Area A soil	0%	0.00	0.20	0.00		
Area B soil	0%	0.00	0.25	0.00		
Area C soil	0%	0.00	0.30	0.00		
Area D soil	100%	0.85	0.35	0.30		
Sum C*A			0.35	0.30		
High Point		626.0				
Low Point		560.0				
100' elevation		618.0				
Slope after 100'		29.00%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				8	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		6.8	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the ground.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		0.8	c.f.s.	a=	0.19	sq.ft
BW =		2	feet	p=	2.28	ft.
Z =		5.0	:1	r=	0.08	ft.
s =		29%		Q=	0.84	
n =		0.035		diff	0.00	
Depth =		0.03	feet			
Velocity =		4.4	f.p.s.			
Basin Length =		300	feet			
less Ti distance =		100	feet			
Tt surface distance =		200	feet			
Tt distance/Velocity =		45	seconds			
=		0.8	minutes			
Tc = Ti + Tt =		7.5	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.0	inch			
6 hr/24 hr precip =		0.47	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		5.67	inch/hr			
Q=Sum(C*A) * I		**1.69**	**c.f.s.**			

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POST-PROJECT (WITHOUT BMPS)

			Hydrology Calculations (100-year)			
Hydrology Analysis area(s) =		A		Conc Pt =	1.2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.0 DU/A or less		Index=	3	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	1.55				
Area A soil	0%	0.00	0.34	0.00		
Area B soil	0%	0.00	0.38	0.00		
Area C soil	0%	0.00	0.42	0.00		
Area D soil	100%	1.55	0.46	0.71		
Sum C*A			0.46	0.71		
High Point		626				
Low Point		556				
100' elevation		616				
Slope after 100'		25.64%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				10	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.4	min.			
Tt = Travel time in natural channel						
Assume a 2' wide bottom with 5:1 side slopes as average shape of the swale.						
Assume an average flow rate of 1/2 expected flow for travel time calculation.						
Q=		2.34	c.f.s.	a=	0.38	sq.ft
BW =		2	feet	p=	2.56	ft.
Z =		5.0	:1	r=	0.15	ft.
s =		26%		Q=	2.34	
n =		0.035		diff	0.00	
Depth =		0.05	feet			
Velocity =		6.1	f.p.s.			
Basin Length =		334	feet			
less Ti distance =		100	feet			
Tt distance =		234	feet			
Tt distance/Velocity =		38	seconds			
=		0.6	minutes			
Tc = Ti + Tt =		6.0	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.0	inch			
6 hr/24 hr precip =		0.47	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.56	inch/hr			
Q=Sum(C*A) * I		**4.68**	**c.f.s.**			

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			Hydrology Calculations (100-yr)			
Hydrology Analysis area(s) =		B		Conc Pt =	2	
Development Conditions =		After Project				
Land Use Designation =		LDR 2.0 DU/A or less		Index=	3	
Calculate C*A		Area	C value	C * A	(C values from Table 3-1)	
Total Area (acres)	100%	0.85				
Area A soil	0%	0.00	0.34	0.00		
Area B soil	0%	0.00	0.38	0.00		
Area C soil	0%	0.00	0.42	0.00		
Area D soil	100%	0.85	0.46	0.39		
Sum C*A			0.46	0.39		
High Point		626.0				
Low Point		560.0				
100' elevation		618.0				
Slope after 100'		29.00%				
Calculate Tc						
Approximate slope for the first 100' of the basin=				8	%	
D = distance over which Ti develops =				100	feet	(Table 3-2)
Ti = 1.8(1.1-C)(d^0.5)/s^0.33			From Figure 3-3)			
Ti =		5.8	min.			
Tt = Travel time in natural channel						
Assume a 3' wide bottom with 20:1 side slopes as average shape of the natural channel.						
Assume an average flow rate of 1/4 expected flow for travel time calculation.						
Q=		0.6	c.f.s.	a=	0.16	sq.ft
BW =		2	feet	p=	2.23	ft.
Z =		5.0	:1	r=	0.07	ft.
s =		29%		Q=	0.60	
n =		0.035		diff	0.00	
Depth =		0.02	feet			
Velocity =		3.9	f.p.s.			
Basin Length =		300	feet			
less Ti distance =		100	feet			
Tt surface distance =		200	feet			
Tt distance/Velocity =		52	seconds			
=		0.9	minutes			
Tc = Ti + Tt =		6.6	minutes			
Selected Frequency =		100	year			
6 hr precipitation =		2.8	inch			
24 hr precipitation =		6.0	inch			
6 hr/24 hr precip =		0.47	(0.45 - .65)	OK		
Adjusted 6 hr =		2.8	inch			
I = (7.44*P6)*(D^-0.645) =		6.15	inch/hr			
Q=Sum(C*A) * I		**2.4**	**c.f.s.**			

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DETENTION BASINS

	Detention Basin #	1						
Input Variable (Urban Conditions)								
	Six hour precipitation amount (inches)					P_6	2.8	
	Time of Concentration (min.)					T_c	6.0	
	Coefficient of runoff					C	0.46	
	Basin Area (acres)					A	1.6	
Computation								
	Time to Peak							
		$T_p=2.0T_cK_D/(1+K_p)=1.1072T_c$				T_p	6.6	
	Time of hydrograph to begin							
		$T_B=20-T_p$				T_B	13.4	
	Time of hydrograph to end							
		$T_E=20+1.5T_B$				T_E	40	40.0
	Peak Flow					Q_p	4.7	cfs
		$Q_p=CIA$						
		$Itc=7.44P_6/T_c^{0.645}=$	6.56	in./hr.				
	Surrounding Flow (Q_s)							
		Depth of precipitation for 2 hours						
		$D_{120}=7.44P_6/120^{0.645}$ (2 hr.)						
		$D_{120}=0.6785P_6=$	1.9	in.				
		Depth of precipitation for hydrograph						
		$D_H=(P_6T_c^{0.355})/5.83=$	0.9	in.				
		Surrounding Intensity						
		$I_s=60(D_{120}-D_H)/(120-2.5T_c)$						
		$I_s=$	0.6	in./hr.				
		$Q_s=CI_sA$				Q_s	0.4	cfs
Plot Hydrograph and Surrounding Flow								
Outflow / Basin Size (Natural Conditions)								
	Outflow							
	C=	0.35	$T_c=$	7.0	min.			
		$I=7.44P_6/T_c^{0.645}=$	5.94	in./hr.				
	$Q_N=CIA=$	3.2	cfs					
	1. Plot on Hydrograph: a. Draw a line from surrounding flow intercept with beginning hydrograph limb to Qn							
	2. Estimate volume needed for reservoir =		1166	Cu.Ft.				
		a. Determine preliminary reservoir dimensions. b. Surrounding flow discharges directly through rese						
	3. Size outlet works: a. Outlet flow, QO less than or equal to QN, a. Outlet flow, QO less than or equal to QN,							
	4. Rout: a. Refine reservoir dimensions and/or outflow facility							
	Hydrograph							
	Project Flows			Natural Flows				
	Time	Flow		Time	Flow			
	13.4	0.4		13.4	0.4			
	20.0	4.7		26.8	3.2			
	40.0	0.4		40.0	0.4			
	Volume Calc			Volume Calc				
	3417	Cu.Ft.		2251	Cu.Ft.			
		Volume Change (Reservoir Volume)						
		1166	**Cu.Ft.**					

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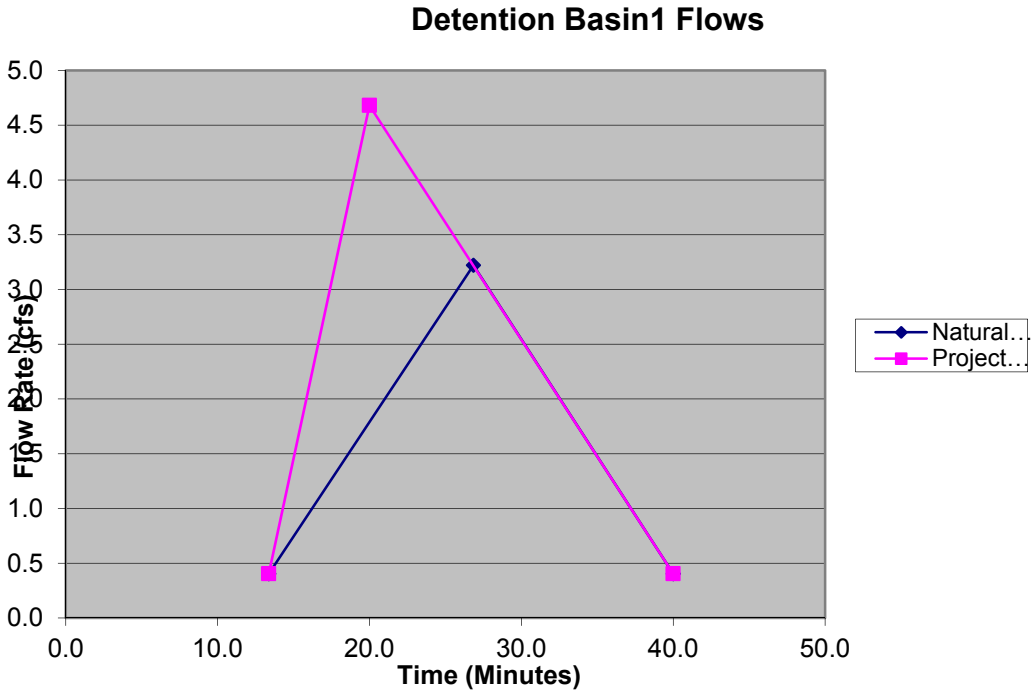
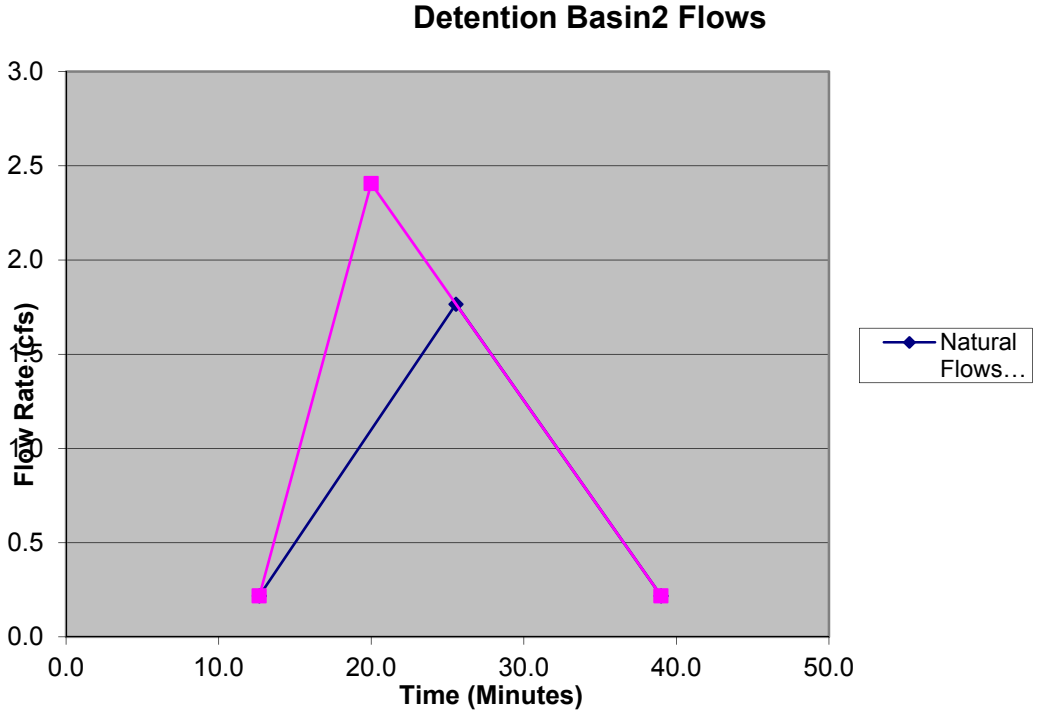
	Detention Basin #	2						
Input Variable (Urban Conditions)								
	Six hour precipitation amount (inches)					P_6	2.80	
	Time of Concentration (min.)					T_c	6.623381	
	Coefficient of runoff					C	0.46	
	Basin Area (acres)					A	0.9	
Computation								
	Time to Peak							
		$T_p=2.0T_cK_D/(1+K_p)=1.1072T_c$				T_p	7.3	
	Time of hydrograph to begin							
		$T_B=20-T_p$				T_B	12.7	
	Time of hydrograph to end							
		$T_E=20+1.5T_B$				T_E	39.0	
	Peak Flow					Q_p	2.4	cfs
		$Q_p=CIA$						
		$Itc=7.44P_6/T_c^{0.645}=$	6.15	in./hr.				
	Surrounding Flow (Q_s)							
		Depth of precipitation for 2 hours						
		$D_{120}=7.44P_6/120^{0.645}$ (2 hr.)						
		$D_{120}=0.6785P_6=$	1.9	in.				
		Depth of precipitation for hydrograph						
		$D_H=(P_6T_c^{0.355})/5.83=$	0.9	in.				
		Surrounding Intensity						
		$I_s=60(D_{120}-D_H)/(120-2.5T_c)$						
		$I_s=$	0.6	in./hr.				
		$Q_s=CI_sA$				Q_s	0	cfs
Plot Hydrograph and Surrounding Flow								
Outflow / Basin Size (Natural Conditions)								
	Outflow							
	C=	0.35	$T_c=$	7.0	min.			
		$I=7.44P_6/T_c^{0.645}=$	5.94	in./hr.				
	$Q_N=CIA=$	1.8	cfs					
	1. Plot on Hydrograph							
		a. Draw line from surrounding flow intercept with beginning hydrograph limb to Q_N						
	2. Estimate volume needed for reservoir =				505	Cu.Ft.		
		a. Determine preliminary reservoir dimensions						
		b. Surrounding flow discharges directly through reservoir without detaining any storage						
	3. Size outlet works							
		a. Outlet flow, Q_O less than or equal to Q_N						
		b. Stay within the limits of the reservoir						
	4. Rout							
		a. Refine reservoir dimensions and/or outflow facility						

	Hydrograph				
	Project Flows		Natural Flows		
	Time	Flow	Time	Flow	
	12.7	0.2	12.7	0.2	
	20.0	2.4	25.6	1.8	
	39.0	0.2	39.0	0.2	
	Volume Calc		Volume Calc		
	1729	Cu.Ft.	1223	Cu.Ft.	

Volume Change (Reservoir Volume)

505 Cu.Ft.


Detention Basin1 Flows
Flow Rate (cfs)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
10.0
20.0
30.0
40.0
50.0
Time (Minutes)
Natural…
Project…


Detention Basin2 Flows
Flow Rate (cfs)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
10.0
20.0
30.0
40.0
50.0
Time (Minutes)
Natural Flows…

The above calculations and charts are based on section 6 of the San Diego County Hydrology Manual. They provide the volume needed so that **the flow after the project is no more than the flow before the project for the 100-year storm**. The following chart compares the volume calculated above the volume provided in the various BMPs that will be built with the project.

Summary of BMP Quantities Provided								
Location	L (ft)	W (ft)	V1 D (ft)	V2 D (ft)	A (sq ft)	V1 (cu ft)	V2 (cu ft)	Detention V
Vegetated Swale	60	10	0.5	0	600	150	0	0
Parcel 1	79	3	1	1	237	237	237	315.21
Private Road	123	10	1	1	1230	1230	1230	1635.9
Parcel 2	240	3	1	1	720	720	720	957.6
****East half Project****					**2787**	**2337**	**2187**	**3058.71**
Parcel 3	189	3	1	1	567	567	567	754.11
Parcel 4	230	3	1	1	690	690	690	917.7
****West half Project****					**1257**	**1257**	**1257**	**1671.81**
Project Totals					**4044**	**3594**	**3444**	**4730.52**

As you can see the East half of the Project (Basin A) will have a volume of 3,058 ft.³ compared with the required 1,166 ft.³. This represents a 260% excess volume. The West half of the Project (Basin B) will have a volume of 1,671 ft.³ compared with the required 505 ft.³. This represents a 330% excess volume.