TECHNICAL MEMORANDUM:

SWMM Modeling for Hydromodification Compliance of:

Valley Center Storage

Prepared For:

Alidade Engineering
December 5, 2024

Prepared by:

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TECHNICAL MEMORANDUM FOR VALLEY CENTER STORAGE

TO: County of San Diego

FROM: Luis Parra, PhD, PE, CFM.

DATE: May 14, 2024. Updated: 12/05/2004.

RE: Summary of SWMM Modeling for Hydromodification Compliance for Valley Center Storage Development, 13630 Old Rd, Valley Center, CA 92082.

INTRODUCTION

This memorandum summarizes the approach used to model the commercial development project site located in the County of San Diego, California, in the City of Valley Center using the Environmental Protection Agency (EPA) Storm Water Management Model 5.0 (SWMM). SWMM models were prepared for the pre and post-developed conditions at the site in order to meet Order R9-2013-001 requirements of the California Regional Water Quality Control Board San Diego Region (SDRWQCB), as explained in the Final Hydromodification Management Plan (HMP), dated March 2011, prepared for the County of San Diego by Brown and Caldwell.

SWMM Model Development

The Valley Center Storage Development project comprises of the development of a commercial storage buildings with permeable gravel roadways and a downstream infiltration basin. Two (2) SWMM models were prepared for this study: the first for the pre-development and the second for the post-developed conditions. The project site drains to one (1) Point of Compliance (POC-1) located at the NW corner of the property, on Old Road, in Valley Center, CA.

The SWMM model was used since we have found it to be more compatible with San Diego area watersheds than the alternative San Diego Hydrology Model (SDHM) and because it is a non-proprietary model approved by the HMP document. For both SWMM models, flow duration curves were prepared to determine if the proposed HMP facilities are sufficient to meet the current HMP requirements.

Per the California Irrigation Management Information System “Reference Evaporation Zones” (CIMIS ETo Zone Map), the project site is located within the Zone 9 Evapotranspiration Area. Thus evapotranspiration values for the site were modeled using Zone 9 average monthly values from Table G.1-1 from the 2020 BMP Design Manual. Per the site specific geotechnical investigation and NRCS Web Soil Survey, the project site is situated upon Class B soil. Soils have been assumed to be uncompacted in the existing condition to represent the natural condition of the site while fully compacted in the post developed conditions. Other SWMM inputs for the subareas are discussed in the appendices to this document, where the selection of parameters is explained in detail.

HMP MODELING

EXISTING CONDITIONS

The current site is partially developed, containing 2 existing buildings and some impervious driveways and parking lots which is the extent of the impervious area (about 50% of the site). The other half of the site is pervious including sparse vegetation, landscape, and some gravel roads/parking areas. The site generally drains in a Western direction towards Old Rd where it then drains North to POC-1. However, in existing conditions, a small portion (0.179 ac) drains to the East towards Valley Center Rd (POC-2). In post developed conditions, POC-2 is not analyzed because the entire area originally draining to POC-2 in existing conditions drains to POC-1 in proposed conditions. The existing impervious areas within the project area (roofs/roads) are not considered because the project exceeds the 50% rule and the entire area must be modeled as pervious for hydromodification compliance. Although the existing impervious area can be modeled as compacted in pre-development conditions, for simplicity of modeling and conservatively all areas were modeled as uncompacted in pre-development conditions.

TABLE 1 – SUMMARY OF PRE-DEVELOPED CONDITIONS

POC	DMA	Tributary Area, A (ac)	Impervious %, Ip(1)
POC-1	DMA-1	4.137	0%
POC-2	DMA-2	0.179	0%

Notes: (1) – Per the 2013 RWQCB permit, existing condition impervious surfaces disturbed by the project are not to be accounted for in existing conditions analysis.

DEVELOPED CONDITIONS

Storm water runoff from the proposed project site is routed to POC-1, the same point than in pre-development conditions. For POC 1, the runoff from the developed project site first arrives at a large portion of the project that is composed of pervious pavement (detaining some of the runoff, to be modeled as a detention basin without infiltration due to the presence of an impervious liner under the gravel) and from there is drained to one (1) infiltration basin. Once flows are routed via the proposed infiltration basin, developed onsite flows are then conveyed to POC 1. The Tributary area draining to POC-1 has increased in developed conditions due to the area previously draining to POC-2 now being routed to POC-1 instead, and also because a small area offsite of the property drains to POC-1 (See post-development map).

It is assumed all storm water quality requirements for the project will be met by the infiltration basin. However, detailed water quality requirements are not discussed within this technical memo. For further information in regards to storm water quality requirements for the project, please refer to the site specific Storm Water Quality Management Plan (SWQMP).

One (1) upstream gravel pavement acting as a detention basin and one (1) downstream infiltration facility are both located within the project site and are responsible for handling hydromodification requirements for the project's runoff to POC 1. In developed conditions, the infiltration basin will have a surface depth and a riser spillway structure (see dimensions in Table 4). Flows will then discharge from the basin via the outlet structure or infiltrate through the base of the facility. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving storm drain systems. Regarding the gravel pavement, runoff will pond at the bottom, and discharge thru one of many 7/16" orifices at the end of all French Drains. Once the volume is full, water will overflow into one of many grated inlets. Characteristics of the gravel layer acting as detention facility are shown in Table 3.

TABLE 2 – SUMMARY OF POST-DEVELOPED CONDITIONS

POC	DMA	Tributary Area, A (ac)	Impervious %, Ip
POC-1	DMA-1A	3.449	78.0%
	DMA-1B	0.194	0%
	DMA-BP-C	0.450	0.44%
	DMA-BP-U	0.277	0%
TOTAL	--	**4.370**	**61.6%**

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMP

One (1) infiltration basin is proposed for water quality treatment and hydromodification conformance for the project site, while the gravel layer will help with hydromodification compliance. Tables 3, 4, & 5 illustrate the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 3 – SUMMARY OF GRAVEL LAYER (AS STORAGE)

BMP	Gravel Pavement			Outlets			
	Area (sq-ft)	Depth (in)	n	Number - orifices	D (in)	Number - weirs	Perimeter (ft)
Up-DET	57210	18	0.40	35	7/16	16	8

TABLE 4 – SUMMARY OF BMP INFILTRATION BASIN DIMENSIONS

BMP	Tributary Area (Ac)	DIMENSIONS			
		BMP Area(1) (ft^2)	Gravel thickness (ft)	Depth (ft) (gravel + surface)	Total Basin Surface Depth(2) (ft)
1	3.643	5,625	3.00	5.50	2.50

Notes: (1) Area at bottom of surface slope (6" of the slope covered by gravel).
(2) Total surface depth of BMP from top crest elevation to the surface of the basin

TABLE 5 – SUMMARY OF OUTLET DETAILS

BMP	Low Flow Orifice		Lower Slot		Emergency Overflow	
	Diameter (in)	Invert (ft)	B x h (ft)	Invert (ft)	$L^{(1)}$ (ft)	Invert (ft)
1	1.00	3.00	10.5 x 0.25	3.50	12	4.50

Notes:

(1): Overflow length is the internal perimeter of the riser structure.

FLOW DURATION CURVE COMPARISON

The Flow Duration Curve (FDC) for the site was compared at the POC by exporting the hourly runoff time series results from SWMM to a spreadsheet.

Q_2 and Q_{10} were determined with a partial duration statistical analysis of the runoff time series in an Excel spreadsheet using the Cunnane plotting position method (which is the preferred plotting methodology in the HMP Permit). As the SWMM Model includes a statistical analysis based on the Weibull Plotting Position Method, the Weibull Method was also used within the spreadsheet to ensure that the results were similar to those obtained by the SWMM Model.

The range between 10% of Q_2 and Q_{10} was divided into 100 equal time intervals; the number of hours that each flow rate was exceeded was counted from the hourly series. Additionally, the intermediate peaks with a return period "i" were obtained (Q_i with i=3 to 9). For the purpose of the plot, the values were presented as percentage of time exceeded for each flow rate. FDC comparison at the POC is illustrated in Figure 1 in both normal and logarithmic scale. Attachment 5 provides a detailed drainage exhibit for the post-developed condition.

As can be seen in Figure 1, the FDC for the proposed condition is within 110% of the curve for the existing condition in both peak flows and durations. The additional runoff volume generated from developing the site will be released to the existing point of discharge at a flow rate below the 10% Q_2 lower threshold for POC-1. Additionally, the project will also not increase peak flow rates between the Q_2 and the Q_{10}, as shown in the peak flow tables in Attachment 1.

Discussion of the Manning's coefficient (Pervious Areas) for Pre and Post-Development Conditions

Typically the Manning's coefficient is selected as n = 0.15 (Appendix G) for pervious areas and n = 0.012 for impervious areas. Due to the complexity of the model carried out in pre and post-development conditions, a more accurate value of the Manning's coefficient for pervious areas has been chosen. Taken into consideration the "Handouts on Supplemental Guidance – Handout #2: Manning's "n" Values for Overland Flow Using EPA SWMM V.5" by the County of San Diego (Reference [6]) a more accurate value of n = 0.05 has been selected (see Table 1 of Reference [6] included in Attachment 7). An average n value between pasture and shrubs and bushes (which is also the value of dense grass) has been selected per the reference cited, for light rain (<0.8 in/hr) as more than 99% of the rainfall has been measured with this intensity. The selected n-value and land cover categories referenced are consistent with the land cover found onsite.

SUMMARY

This study has demonstrated that the proposed HMP BMPs provided for the Valley Center Storage project site are sufficient to meet the current HMP criteria if the areas and volumes recommended within this technical memorandum, and the respective outlet structures are incorporated as specified within the proposed project site.

KEY ASSUMPTIONS

1. Type B Soils are representative of the existing condition site.
2. The infiltration basin will be unlined, with values according to the infiltration calcs.
3. The gravel layer will be lined with an impervious liner. Infiltration there is not considered.

ATTACHMENTS

1. Q_2 to Q_{10} Comparison Tables
2. Flow Duration Curve Analysis
3. List of the "n" largest Peaks: Pre-Development and Post-Development Conditions
4. Area Vs Elevation & Discharge Vs Elevation
5. Pre & Post Development Maps, Project Plan and Section Sketches
6. SWMM Input Data in Input Format (Existing and Proposed Models)
7. EPA SWMM Figures and Explanations
8. Soil Maps & Geotechnical Investigation
9. Summary files from the SWMM Model

REFERENCES

[1] – *"Review and Analysis of San Diego County Hydromodification Management Plan (HMP): Assumptions, Criteria, Methods, & Modeling Tools – Prepared for the Cities of San Marcos, Oceanside & Vista",* May 2012, TRW Engineering.

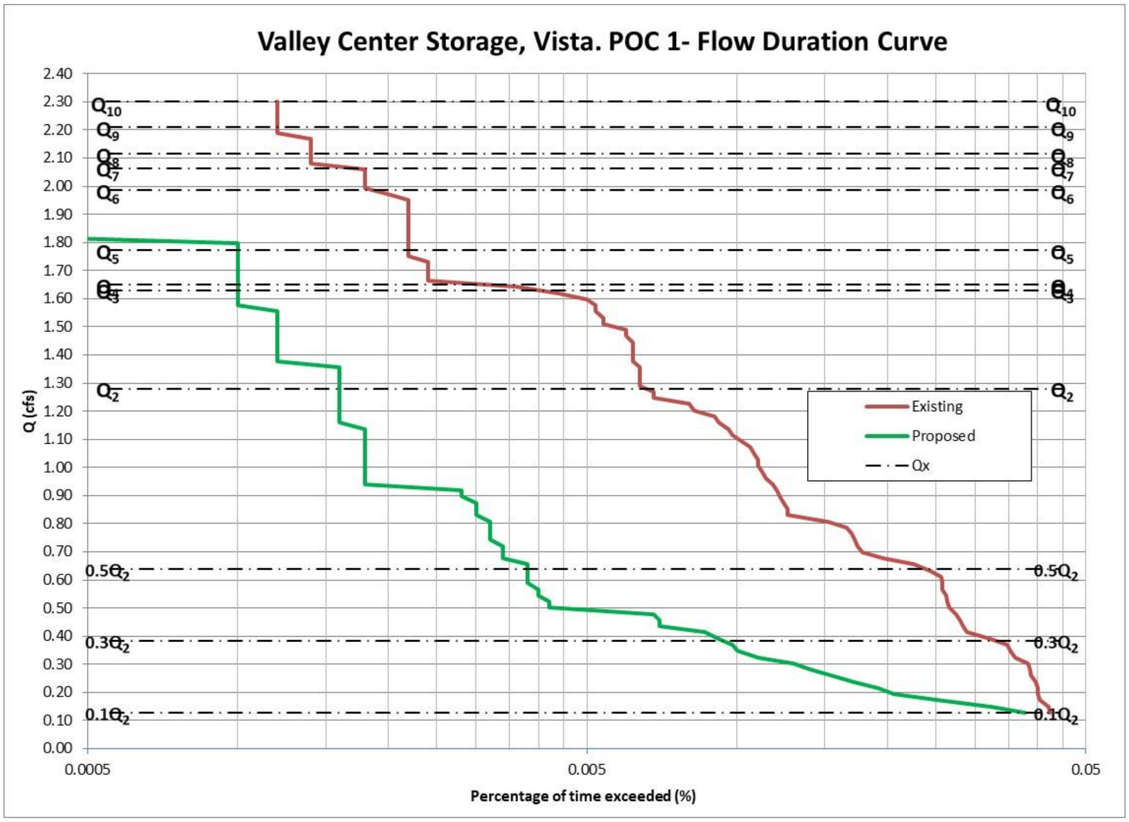
[2] – *"Final Hydromodification Management Plan (HMP) prepared for the County of San Diego",* March 2011, Brown and Caldwell.

[3] - Order R9-20013-001, CA Regional Water Quality Control Board San Diego Region (SDRWQCB).

[4] – "*Handbook of Hydrology*", David R. Maidment, Editor in Chief. 1992, McGraw Hill.

[5] – "County of San Diego *BMP Design Manual*", 2020.

[6] – "*Improving Accuracy in Continuous Hydrologic Modeling: Guidance for Selecting Pervious Overland Flow Manning's n Values in the San Diego Region*", 2016, TRW Engineering.



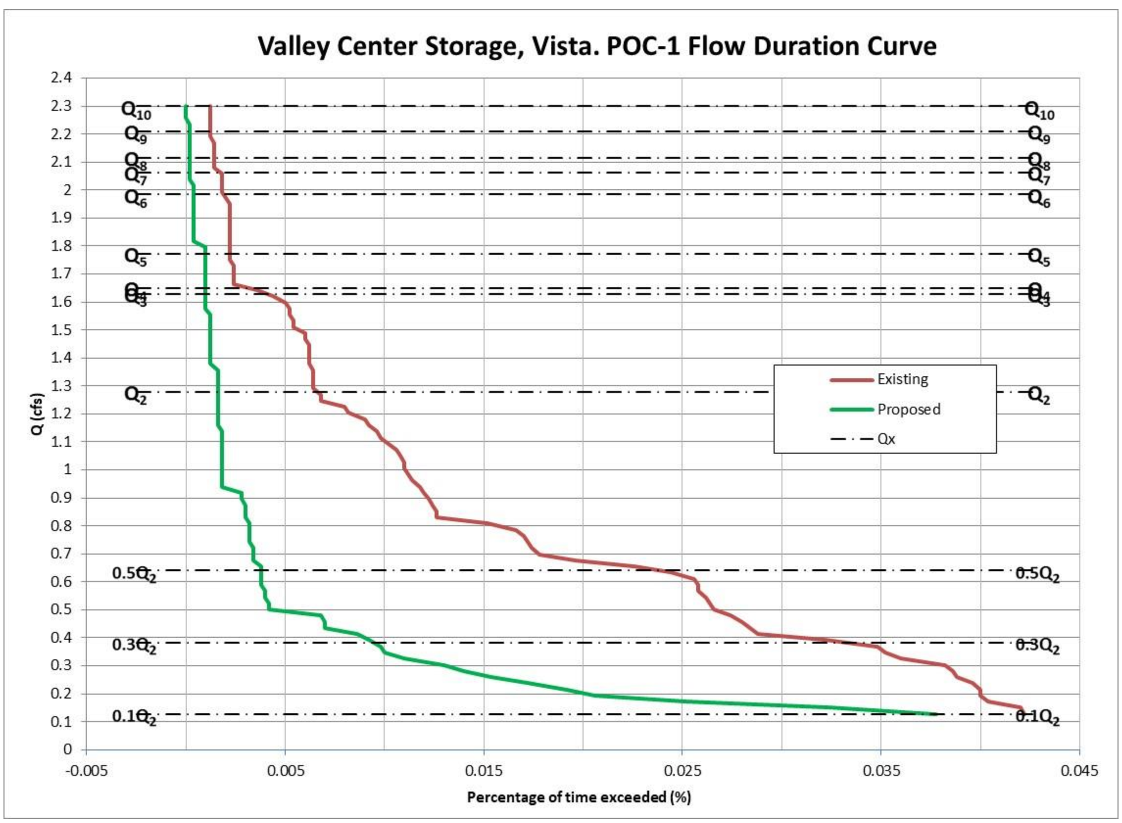


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal “x” scale)

ATTACHMENT 1.

Q_2 to Q_{10} Comparison Table – POC 1

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	1.28	0.31	0.97
3-year	1.63	0.40	1.23
4-year	1.65	0.49	1.16
5-year	1.77	0.71	1.06
6-year	1.98	0.79	1.19
7-year	2.06	0.83	1.24
8-year	2.12	0.88	1.23
9-year	2.21	1.00	1.21
10-year	2.30	1.29	1.01

ATTACHMENT 2

FLOW DURATION CURVE ANALYSIS

1) Flow duration curve shall not exceed the existing conditions by more than 10%, neither in peak flow nor duration.

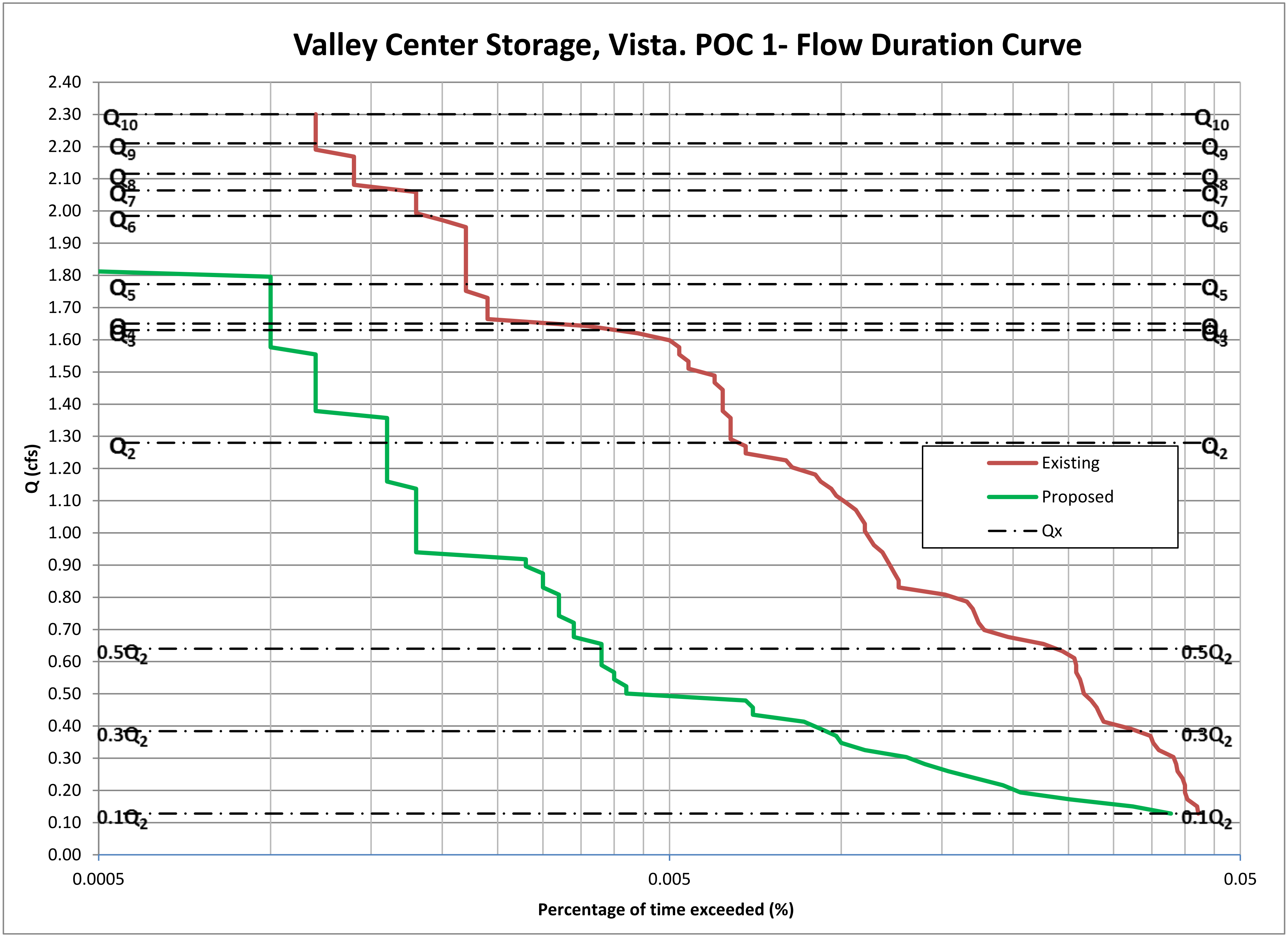
The figures on the following pages illustrate that the flow duration curve in post-development conditions after the proposed BMP is below the existing flow duration curve. The flow duration curve table following the curve shows that if the interval $0.10Q_2 – Q_{10}$ is divided in 100 sub-intervals, then a) the post development divided by pre-development durations are never larger than 110% (the permit allows up to 110%); and b) there are no more than 10 intervals in the range 101%-110% which would imply an excess over 10% of the length of the curve (the permit allows less than 10% of excesses measured as 101-110%).

Consequently, the design passes the hydromodification test.

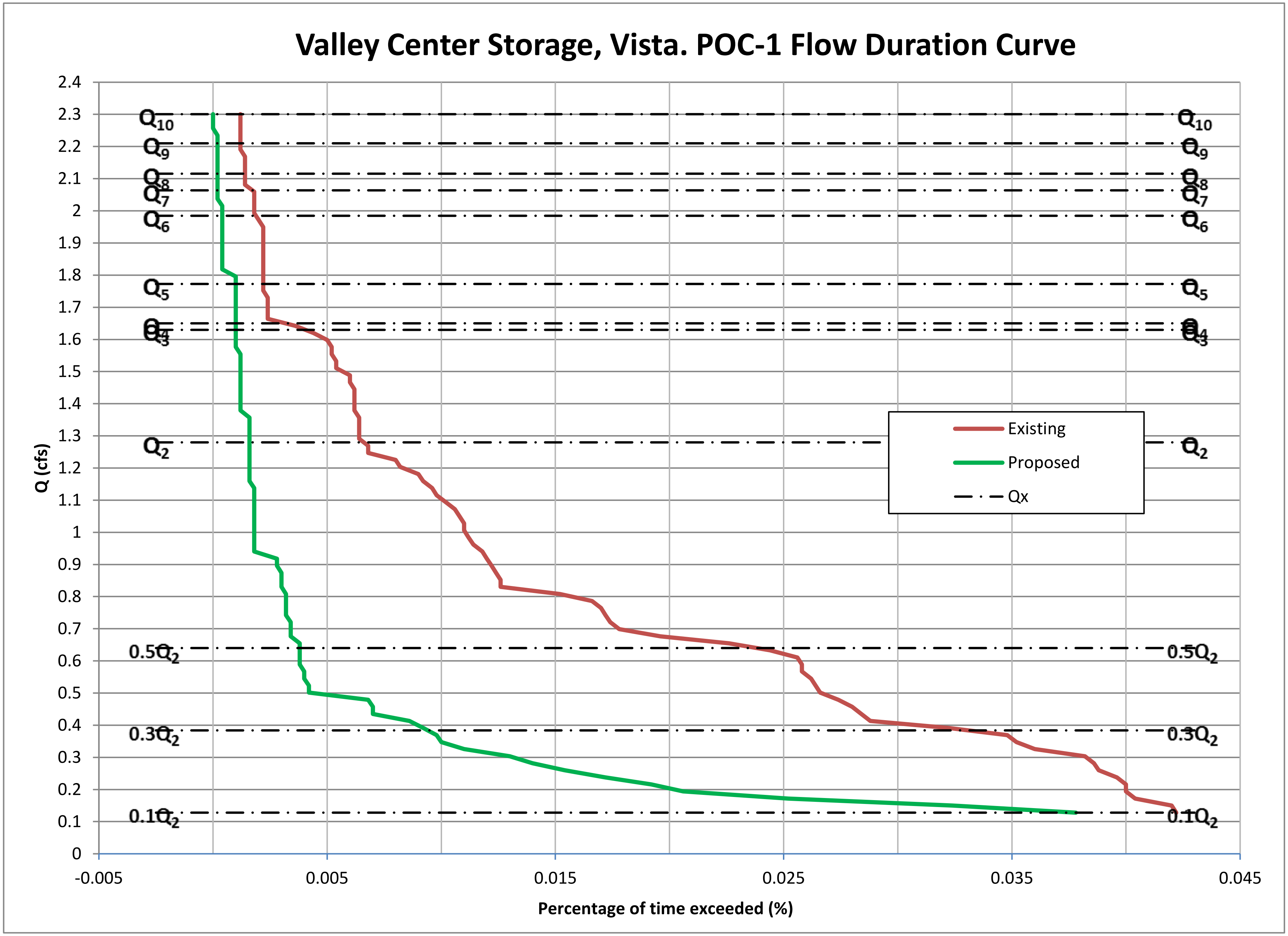
It is important to note that the flow duration curve can be expressed in the “x” axis as percentage of time, hours per year, total number of hours, or any other similar time variable. As those variables only differ by a multiplying constant, their plot in logarithmic scale is going to look exactly the same, and compliance can be observed regardless of the variable selected. However, in order to satisfy the County of San Diego HMP requirements, % of time exceeded is the variable of choice in the flow duration curve. The selection of a logarithmic scale in lieu of the normal scale is preferred, as differences between the pre-development and post-development curves can be seen more clearly in the entire range of analysis. Both graphics are presented just to prove the difference.

In terms of the “y” axis, the peak flow value is the variable of choice. As an additional analysis performed by REC, not only the range of analysis is clearly depicted (10% of Q_2 to Q_{10}) but also all intermediate flows are shown (Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, Q_8 and Q_9) in order to demonstrate compliance at any range $Q_x – Q_{x+1}$. It must be pointed out that one of the limitations of both the SWMM and SDHM models is that the intermediate analysis is not performed (to obtain Q_i from i = 2 to 10). REC performed the analysis using the Cunnane Plotting position Method (the preferred method in the HMP permit) from the “n” largest independent peak flows obtained from the continuous time series.

The largest “n” peak flows are attached in this appendix, as well as the values of Q_i with a return period “i”, from i=2 to 10. The Q_i values are also added into the flow-duration plot.



Valley Center Storage, Vista. POC 1- Flow Duration Curve
Q (cfs)
Percentage of time exceeded (%)
2.40
2.30
2.20
2.10
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0005
0.005
0.05
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx


Valley Center Storage, Vista. POC-1 Flow Duration Curve
Q (cfs)
Percentage of time exceeded (%)
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.005
0.005
0.015
0.025
0.035
0.045
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx

Flow Duration Curve Data for Valley Center Storage - POC-1 , SDC, CA

Q2 =	1.28	cfs		Fraction	10	%	
Q10 =	2.30	cfs					
Step =	0.0219	cfs					
Count =	499995	hours					
	57.04	years					

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.128	211	4.22E-02	189	3.78E-02	90%	Pass
2	0.150	210	4.20E-02	162	3.24E-02	77%	Pass
3	0.172	202	4.04E-02	126	2.52E-02	62%	Pass
4	0.194	200	4.00E-02	103	2.06E-02	52%	Pass
5	0.216	200	4.00E-02	96	1.92E-02	48%	Pass
6	0.238	198	3.96E-02	86	1.72E-02	43%	Pass
7	0.260	194	3.88E-02	77	1.54E-02	40%	Pass
8	0.282	193	3.86E-02	70	1.40E-02	36%	Pass
9	0.304	191	3.82E-02	65	1.30E-02	34%	Pass
10	0.326	180	3.60E-02	55	1.10E-02	31%	Pass
11	0.347	176	3.52E-02	50	1.00E-02	28%	Pass
12	0.369	174	3.48E-02	49	9.80E-03	28%	Pass
13	0.391	161	3.22E-02	46	9.20E-03	29%	Pass
14	0.413	144	2.88E-02	43	8.60E-03	30%	Pass
15	0.435	142	2.84E-02	35	7.00E-03	25%	Pass
16	0.457	140	2.80E-02	35	7.00E-03	25%	Pass
17	0.479	137	2.74E-02	34	6.80E-03	25%	Pass
18	0.501	133	2.66E-02	21	4.20E-03	16%	Pass
19	0.523	132	2.64E-02	21	4.20E-03	16%	Pass
20	0.545	131	2.62E-02	20	4.00E-03	15%	Pass
21	0.567	129	2.58E-02	20	4.00E-03	16%	Pass
22	0.589	129	2.58E-02	19	3.80E-03	15%	Pass
23	0.611	128	2.56E-02	19	3.80E-03	15%	Pass
24	0.633	122	2.44E-02	19	3.80E-03	16%	Pass
25	0.655	113	2.26E-02	19	3.80E-03	17%	Pass
26	0.677	98	1.96E-02	17	3.40E-03	17%	Pass
27	0.699	89	1.78E-02	17	3.40E-03	19%	Pass
28	0.721	87	1.74E-02	17	3.40E-03	20%	Pass
29	0.742	86	1.72E-02	16	3.20E-03	19%	Pass
30	0.764	85	1.70E-02	16	3.20E-03	19%	Pass
31	0.786	83	1.66E-02	16	3.20E-03	19%	Pass
32	0.808	76	1.52E-02	16	3.20E-03	21%	Pass
33	0.830	63	1.26E-02	15	3.00E-03	24%	Pass
34	0.852	63	1.26E-02	15	3.00E-03	24%	Pass
35	0.874	62	1.24E-02	15	3.00E-03	24%	Pass
36	0.896	61	1.22E-02	14	2.80E-03	23%	Pass

Interval	Existing Condition			Detention Optimized			Pass or
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
37	0.918	60	1.20E-02	14	2.80E-03	23%	Pass
38	0.940	59	1.18E-02	9	1.80E-03	15%	Pass
39	0.962	57	1.14E-02	9	1.80E-03	16%	Pass
40	0.984	56	1.12E-02	9	1.80E-03	16%	Pass
41	1.006	55	1.10E-02	9	1.80E-03	16%	Pass
42	1.028	55	1.10E-02	9	1.80E-03	16%	Pass
43	1.050	54	1.08E-02	9	1.80E-03	17%	Pass
44	1.072	53	1.06E-02	9	1.80E-03	17%	Pass
45	1.094	51	1.02E-02	9	1.80E-03	18%	Pass
46	1.116	49	9.80E-03	9	1.80E-03	18%	Pass
47	1.137	48	9.60E-03	9	1.80E-03	19%	Pass
48	1.159	46	9.20E-03	8	1.60E-03	17%	Pass
49	1.181	45	9.00E-03	8	1.60E-03	18%	Pass
50	1.203	41	8.20E-03	8	1.60E-03	20%	Pass
51	1.225	40	8.00E-03	8	1.60E-03	20%	Pass
52	1.247	34	6.80E-03	8	1.60E-03	24%	Pass
53	1.269	34	6.80E-03	8	1.60E-03	24%	Pass
54	1.291	32	6.40E-03	8	1.60E-03	25%	Pass
55	1.313	32	6.40E-03	8	1.60E-03	25%	Pass
56	1.335	32	6.40E-03	8	1.60E-03	25%	Pass
57	1.357	32	6.40E-03	8	1.60E-03	25%	Pass
58	1.379	31	6.20E-03	6	1.20E-03	19%	Pass
59	1.401	31	6.20E-03	6	1.20E-03	19%	Pass
60	1.423	31	6.20E-03	6	1.20E-03	19%	Pass
61	1.445	31	6.20E-03	6	1.20E-03	19%	Pass
62	1.467	30	6.00E-03	6	1.20E-03	20%	Pass
63	1.489	30	6.00E-03	6	1.20E-03	20%	Pass
64	1.511	27	5.40E-03	6	1.20E-03	22%	Pass
65	1.533	27	5.40E-03	6	1.20E-03	22%	Pass
66	1.554	26	5.20E-03	6	1.20E-03	23%	Pass
67	1.576	26	5.20E-03	5	1.00E-03	19%	Pass
68	1.598	25	5.00E-03	5	1.00E-03	20%	Pass
69	1.620	22	4.40E-03	5	1.00E-03	23%	Pass
70	1.642	18	3.60E-03	5	1.00E-03	28%	Pass
71	1.664	12	2.40E-03	5	1.00E-03	42%	Pass
72	1.686	12	2.40E-03	5	1.00E-03	42%	Pass
73	1.708	12	2.40E-03	5	1.00E-03	42%	Pass
74	1.730	12	2.40E-03	5	1.00E-03	42%	Pass
75	1.752	11	2.20E-03	5	1.00E-03	45%	Pass
76	1.774	11	2.20E-03	5	1.00E-03	45%	Pass
77	1.796	11	2.20E-03	5	1.00E-03	45%	Pass
78	1.818	11	2.20E-03	2	4.00E-04	18%	Pass
79	1.840	11	2.20E-03	2	4.00E-04	18%	Pass
80	1.862	11	2.20E-03	2	4.00E-04	18%	Pass
81	1.884	11	2.20E-03	2	4.00E-04	18%	Pass

Interval	Existing Condition			Detention Optimized			Pass or
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
82	1.906	11	2.20E-03	2	4.00E-04	18%	Pass
83	1.928	11	2.20E-03	2	4.00E-04	18%	Pass
84	1.949	11	2.20E-03	2	4.00E-04	18%	Pass
85	1.971	10	2.00E-03	2	4.00E-04	20%	Pass
86	1.993	9	1.80E-03	2	4.00E-04	22%	Pass
87	2.015	9	1.80E-03	2	4.00E-04	22%	Pass
88	2.037	9	1.80E-03	1	2.00E-04	11%	Pass
89	2.059	9	1.80E-03	1	2.00E-04	11%	Pass
90	2.081	7	1.40E-03	1	2.00E-04	14%	Pass
91	2.103	7	1.40E-03	1	2.00E-04	14%	Pass
92	2.125	7	1.40E-03	1	2.00E-04	14%	Pass
93	2.147	7	1.40E-03	1	2.00E-04	14%	Pass
94	2.169	7	1.40E-03	1	2.00E-04	14%	Pass
95	2.191	6	1.20E-03	1	2.00E-04	17%	Pass
96	2.213	6	1.20E-03	1	2.00E-04	17%	Pass
97	2.235	6	1.20E-03	1	2.00E-04	17%	Pass
98	2.257	6	1.20E-03	0	0.00E+00	0%	Pass
99	2.279	6	1.20E-03	0	0.00E+00	0%	Pass
100	2.301	6	1.20E-03	0	0.00E+00	0%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	2.30	1.29	1.01
9	2.21	1.00	1.21
8	2.12	0.88	1.23
7	2.06	0.83	1.24
6	1.98	0.79	1.19
5	1.77	0.71	1.06
4	1.65	0.49	1.16
3	1.63	0.40	1.23
2	1.28	0.31	0.97

ATTACHMENT 3

List of the "n" Largest Peaks: Pre & Post-Developed Conditions

Basic Probabilistic Equation:

R = 1/P R: Return period (years).

P: Probability of a flow to be equaled or exceeded any given year (dimensionless).

Cunnane Equation:

$$P = \frac{i - 0.4}{n + 0.2}$$

Weibull Equation:

$$P = \frac{i}{n + 1}$$

i: Position of the peak whose probability is desired (sorted from large to small)

n: number of years analyzed.

Explanation of Variables for the Tables in this Attachment

Peak: Refers to the peak flow at the date given, taken from the continuous simulation hourly results of the n year analyzed.

Posit: If all peaks are sorted from large to small, the position of the peak in a sorting analysis is included under the variable Posit.

Date: Date of the occurrence of the peak at the outlet from the continuous simulation

Note: all peaks are not annual maxima; instead they are defined as event maxima, with a threshold to separate peaks of at least 12 hours. In other words, any peak P in a time series is defined as a value where dP/dt = 0, and the peak is the largest value in 25 hours (12 hours before, the hour of occurrence and 12 hours after the occurrence, so it is in essence a daily peak).

List of Peak events and Determination of Q2 and Q10 (Pre-Development)
Valley Center Storage - POC-1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**2.30**	**2.35**
9	**2.21**	**2.25**
8	**2.12**	**2.15**
7	**2.06**	**2.07**
6	**1.98**	**2.00**
5	**1.77**	**1.82**
4	**1.65**	**1.65**
3	**1.63**	**1.63**
2	**1.28**	**1.28**

Note:
Cunnane is the preferred method by the HMP permit.

Peaks (cfs)	Date	Posit	Period of Return (Years)	
			Weibull	Cunnane
0.790	11/15/1952	57	1.02	1.01
0.810	3/16/1958	56	1.04	1.03
0.810	3/21/1979	55	1.05	1.05
0.810	2/18/1980	54	1.07	1.07
0.810	2/20/1980	53	1.09	1.09
0.820	4/28/1951	52	1.12	1.11
0.820	12/4/1974	51	1.14	1.13
0.860	1/18/1952	50	1.16	1.15
0.890	10/18/2005	49	1.18	1.18
0.900	1/14/1993	48	1.21	1.20
0.930	4/3/1958	47	1.23	1.23
0.940	11/22/1965	46	1.26	1.25
0.970	3/5/1995	45	1.29	1.28
1.030	4/14/2003	44	1.32	1.31
1.060	11/21/1963	43	1.35	1.34
1.090	11/25/1985	42	1.38	1.38
1.090	3/1/1991	41	1.41	1.41
1.100	1/7/1993	40	1.45	1.44
1.140	3/27/1991	39	1.49	1.48
1.190	1/3/1977	38	1.53	1.52
1.190	12/22/1982	37	1.57	1.56
1.190	1/9/1998	36	1.61	1.61
1.220	3/8/1975	35	1.66	1.65
1.230	2/27/1983	34	1.71	1.70
1.230	3/1/1983	33	1.76	1.75
1.240	1/23/1969	32	1.81	1.81
1.240	1/23/1969	31	1.87	1.87
1.270	10/18/2004	30	1.93	1.93
1.280	12/19/1984	29	2.00	2.00
1.370	2/3/1998	28	2.07	2.07
1.450	2/13/1992	27	2.15	2.15
1.490	1/11/2005	26	2.23	2.23
1.510	2/16/1980	25	2.32	2.33
1.590	11/8/2002	24	2.42	2.42
1.600	12/29/2004	23	2.52	2.53
1.610	9/10/1976	22	2.64	2.65
1.620	3/17/1982	21	2.76	2.78
1.630	2/14/1980	20	2.90	2.92
1.630	11/30/1982	19	3.05	3.08
1.630	2/8/1993	18	3.22	3.25
1.630	11/9/2002	17	3.41	3.45
1.650	12/5/1966	16	3.63	3.67
1.650	12/5/1966	15	3.87	3.92
1.650	1/16/1978	14	4.14	4.21
1.660	12/6/1966	13	4.46	4.54
1.740	2/15/1986	12	4.83	4.93
1.960	12/25/1983	11	5.27	5.40
1.980	1/9/2005	10	5.80	5.96
2.060	1/11/1980	9	6.44	6.65
2.070	1/29/1980	8	7.25	7.53
2.180	2/14/1998	7	8.29	8.67
2.320	1/4/1995	6	9.67	10.21
2.480	3/4/1978	5	11.60	12.43
2.640	10/20/2004	4	14.50	15.89
2.870	2/4/1994	3	19.33	22.00
3.120	2/10/1963	2	29.00	35.75
3.790	2/1/1993	1	58.00	95.33

List of Peak events and Determination of Q2 and Q10 (Post-Development)
Valley Center Storage - POC-1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**1.29**	**1.39**
9	**1.00**	**1.13**
8	**0.88**	**0.89**
7	**0.83**	**0.85**
6	**0.79**	**0.79**
5	**0.71**	**0.71**
4	**0.49**	**0.49**
3	**0.40**	**0.40**
2	**0.31**	**0.31**

Note:
Cunnane is the preferred method by the HMP permit.

Peaks (cfs)	Date	Posit	Period of Return (Years)	
			Weibull	Cunnane
0.182	12/17/1957	57	1.02	1.01
0.182	12/22/1982	56	1.04	1.03
0.183	2/4/1958	55	1.05	1.05
0.184	1/18/1952	54	1.07	1.07
0.199	6/1/1996	53	1.09	1.09
0.201	4/3/1958	52	1.12	1.11
0.205	1/14/1993	51	1.14	1.13
0.206	11/25/1985	50	1.16	1.15
0.21	2/11/1962	49	1.18	1.18
0.211	11/21/1963	48	1.21	1.20
0.216	4/14/2003	47	1.23	1.23
0.223	1/3/1977	46	1.26	1.25
0.225	3/27/1991	45	1.29	1.28
0.235	1/7/1993	44	1.32	1.31
0.239	3/8/1975	43	1.35	1.34
0.241	1/9/1998	42	1.38	1.38
0.249	2/27/1983	41	1.41	1.41
0.254	10/18/2004	40	1.45	1.44
0.258	12/19/1984	39	1.49	1.48
0.262	1/27/1956	38	1.53	1.52
0.269	2/3/1998	37	1.57	1.56
0.275	2/19/1980	36	1.61	1.61
0.279	2/14/1980	35	1.66	1.65
0.283	3/2/1983	34	1.71	1.70
0.289	2/13/1992	33	1.76	1.75
0.306	11/8/2002	32	1.81	1.81
0.31	9/10/1976	31	1.87	1.87
0.313	11/30/1982	30	1.93	1.93
0.313	12/29/2004	29	2.00	2.00
0.315	2/16/1980	28	2.07	2.07
0.319	3/17/1982	27	2.15	2.15
0.33	2/8/1993	26	2.23	2.23
0.331	1/16/1978	25	2.32	2.33
0.331	11/9/2002	24	2.42	2.42
0.336	3/1/1983	23	2.52	2.53
0.378	1/9/2005	22	2.64	2.65
0.385	12/25/1983	21	2.76	2.78
0.395	2/15/1986	20	2.90	2.92
0.408	2/14/1998	19	3.05	3.08
0.445	1/4/1995	18	3.22	3.25
0.446	1/11/2005	17	3.41	3.45
0.465	3/4/1978	16	3.63	3.67
0.488	2/18/1980	15	3.87	3.92
0.502	10/20/2004	14	4.14	4.21
0.531	2/4/1994	13	4.46	4.54
0.708	11/23/1965	12	4.83	4.93
0.724	2/1/1993	11	5.27	5.40
0.792	3/1/1991	10	5.80	5.96
0.793	2/10/1963	9	6.44	6.65
0.874	2/19/1980	8	7.25	7.53
0.9	1/11/1980	7	8.29	8.67
1.353	2/20/1980	6	9.67	10.21
1.563	3/5/1995	5	11.60	12.43
1.762	1/23/1969	4	14.50	15.89
2.249	12/5/1966	3	19.33	22.00
2.251	12/6/1966	2	29.00	35.75
2.672	1/29/1980	1	58.00	95.33

ATTACHMENT 4

Area vs Elevation & Discharge vs Elevation

ELEV - AREA - VOLUME

GRAVEL BASIN

h (ft)	V (acr-ft)	A (sq-ft)
0	0	22884
0.1	0.0525	22884
0.2	0.1051	22884
0.3	0.1576	22884
0.4	0.2101	22884
0.5	0.2627	22884
0.6	0.3152	22884
0.7	0.3677	22884
0.8	0.4203	22884
0.9	0.4728	22884
1	0.5253	22884
1.1	0.5779	22884
1.2	0.6304	22884
1.3	0.6829	22884
1.4	0.7355	22884
1.5	0.7880	22884
1.525	0.7947	314
1.55	0.7951	1257
1.575	0.7963	2827
1.6	0.7985	5027

INFILTRATION BASIN

h (ft)	V (acr-ft)	A (sq-ft)
0.000	0.0000	2250.5
2.500	0.1292	2250.5
2.583	0.1335	2275.4
2.667	0.1379	2300.7
2.750	0.1423	2326.4
2.833	0.1468	2352.4
2.917	0.1513	2378.8
2.999	0.1558	2405.6
3.000	0.1559	6014.0
3.083	0.1675	6081.9
3.167	0.1792	6150.7
3.250	0.1910	6220.4
3.333	0.2030	6291.1
3.417	0.2151	6362.7
3.500	0.2273	6435.2
3.583	0.2397	6508.6
3.667	0.2522	6583.0
3.750	0.2649	6658.3
3.833	0.2777	6734.5
3.917	0.2907	6811.7
4.000	0.3038	6889.8
4.083	0.3170	6968.8
4.167	0.3304	7048.7
4.250	0.3440	7129.6
4.333	0.3577	7211.3
4.417	0.3716	7294.1
4.500	0.3856	7377.7
4.583	0.3998	7462.3
4.667	0.4142	7547.8
4.750	0.4287	7634.2
4.833	0.4434	7721.5
4.917	0.4582	7809.8
5.000	0.4733	7899.0
5.083	0.4885	7989.1
5.167	0.5038	8080.2
5.250	0.5194	8172.2
5.333	0.5351	8265.1
5.417	0.5510	8358.9
5.500	0.5671	8453.7

Outlet structure for Discharge of Gravel Pavement

Discharge vs Elevation Table

Low orifice:	0.4375 "	Lower slot			Emergency Weir		
Number:	35	Invert:	7.00	ft	Invert:	1.500	ft
Cg-low:	0.61	B	0.00	ft	B:	128	ft
		h	0.250	ft			
Middle orifice:	1.25 "	Upper slot					
number of orif:	0	Invert:	0.000	ft			
Cg-middle:	0.61	B:	0.00	ft			
invert elev:	2.833 ft	h	0.000	ft			

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.10	2.743	0.000	0.051	0.062	0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.051
0.20	5.486	0.000	0.076	0.763	0.076	0.000	0.000	0.000	0.000	0.000	0.000	0.076
0.30	8.229	0.000	0.095	0.949	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.095
0.40	10.971	0.000	0.111	1.105	0.111	0.000	0.000	0.000	0.000	0.000	0.000	0.111
0.50	13.714	0.000	0.124	1.241	0.124	0.000	0.000	0.000	0.000	0.000	0.000	0.124
0.60	16.457	0.000	0.136	1.364	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.136
0.70	19.200	0.000	0.148	1.477	0.148	0.000	0.000	0.000	0.000	0.000	0.000	0.148
0.80	21.943	0.000	0.158	1.581	0.158	0.000	0.000	0.000	0.000	0.000	0.000	0.158
0.90	24.686	0.000	0.168	1.680	0.168	0.000	0.000	0.000	0.000	0.000	0.000	0.168
1.00	27.429	0.000	0.177	1.772	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.177
1.10	30.171	0.000	0.186	1.860	0.186	0.000	0.000	0.000	0.000	0.000	0.000	0.186
1.20	32.914	0.000	0.194	1.944	0.194	0.000	0.000	0.000	0.000	0.000	0.000	0.194
1.30	35.657	0.000	0.203	2.025	0.203	0.000	0.000	0.000	0.000	0.000	0.000	0.203
1.40	38.400	0.000	0.210	2.103	0.210	0.000	0.000	0.000	0.000	0.000	0.000	0.210
1.50	41.143	0.000	0.218	2.177	0.218	0.000	0.000	0.000	0.000	0.000	0.000	0.218
1.525	41.829	0.000	0.220	2.196	0.220	0.000	0.000	0.000	0.000	0.000	1.568	1.788
1.550	42.514	0.000	0.221	2.214	0.221	0.000	0.000	0.000	0.000	0.000	4.436	4.658
1.575	43.200	0.000	0.223	2.232	0.223	0.000	0.000	0.000	0.000	0.000	8.150	8.373
1.600	43.886	0.000	0.225	2.250	0.225	0.000	0.000	0.000	0.000	0.000	12.548	12.773
1.625	44.571	0.000	0.227	2.267	0.227	0.000	0.000	0.000	0.000	0.000	17.536	17.763
1.650	45.257	0.000	0.228	2.285	0.228	0.000	0.000	0.000	0.000	0.000	23.052	23.280
1.675	45.943	0.000	0.230	2.302	0.230	0.000	0.000	0.000	0.000	0.000	29.049	29.279

Note: There will be 35 - $^{7}/_{16}$" orifices all over the underground pavement, tied to French Drains

Also, there will be 16 - 8' perimeter grated inlets that will overflow over the pipe system (L = 128 ft)

Outlet structure for Discharge of BMP-1 (INFILTRATION BASIN)

Discharge vs Elevation Table

Low orifice:	1 "	Lower slot		Emergency Weir	
Number:	0	Invert:	3.50 ft	Invert:	4.000 ft
Cg-low:	0.61	B	10.50 ft	B:	12 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	1	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	3.000 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.33	16.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.42	17.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.50	18.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.58	19.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.67	20.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.75	21.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.83	22.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
1.92	23.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.00	24.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.08	25.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.17	26.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.25	27.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.33	28.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.42	29.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.50	30.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.58	31.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.67	32.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.75	33.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.83	34.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.92	35.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
2.999	35.988	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
3.00	36.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.0000
3.08	37.000	1.000	0.000	0.000	0.000	0.005	0.01	0.005	0.000	0.000	0.000	0.0052
3.17	38.000	2.000	0.000	0.000	0.000	0.009	0.01	0.009	0.000	0.000	0.000	0.0094
3.25	39.000	3.000	0.000	0.000	0.000	0.012	0.01	0.012	0.000	0.000	0.000	0.0122
3.33	40.000	4.000	0.000	0.000	0.000	0.014	0.02	0.014	0.000	0.000	0.000	0.0144
3.42	41.000	5.000	0.000	0.000	0.000	0.016	0.10	0.016	0.000	0.000	0.000	0.0163
3.50	42.000	6.000	0.000	0.000	0.000	0.018	0	0.018	0.000	0.000	0.000	0.0181
3.54	42.500	6.500	0.000	0.000	0.000	0.019	1	0.019	0.277	0.000	0.000	0.296
3.58	43.000	7.000	0.000	0.000	0.000	0.020	1	0.020	0.783	0.000	0.000	0.803
3.67	44.000	8.000	0.000	0.000	0.000	0.021	2	0.021	2.215	0.000	0.000	2.236
3.75	45.000	9.000	0.000	0.000	0.000	0.022	5	0.022	4.069	0.000	0.000	4.091
3.83	46.000	10.000	0.000	0.000	0.000	0.024	9	0.024	5.865	0.000	0.000	5.889
3.92	47.000	11.000	0.000	0.000	0.000	0.025	15	0.025	6.940	0.000	0.000	6.965
4.00	48.000	12.000	0.000	0.000	0.000	0.026	24	0.026	7.869	0.000	0.000	7.895
4.08	49.000	13.000	0.000	0.000	0.000	0.027	38	0.027	8.699	0.000	0.895	9.622
4.17	50.000	14.000	0.000	0.000	0.000	0.028	57	0.028	9.457	0.000	2.531	12.017
4.25	51.000	15.000	0.000	0.000	0.000	0.029	84	0.029	10.159	0.000	4.650	14.838
4.33	52.000	16.000	0.000	0.000	0.000	0.030	119	0.030	10.815	0.000	7.159	18.004
4.42	53.000	17.000	0.000	0.000	0.000	0.031	165	0.031	11.433	0.000	10.005	21.470
4.50	54.000	18.000	0.000	0.000	0.000	0.032	225	0.032	12.020	0.000	13.152	25.204
4.58	55.000	19.000	0.000	0.000	0.000	0.033	300	0.033	12.579	0.000	16.574	29.186
4.67	56.000	20.000	0.000	0.000	0.000	0.034	394	0.034	13.115	0.000	20.249	33.398
4.75	57.000	21.000	0.000	0.000	0.000	0.035	511	0.035	13.629	0.000	24.162	37.826
4.83	58.000	22.000	0.000	0.000	0.000	0.036	653	0.036	14.125	0.000	28.299	42.460
4.92	59.000	23.000	0.000	0.000	0.000	0.037	825	0.037	14.604	0.000	32.648	47.289
5.00	60.000	24.000	0.000	0.000	0.000	0.037	1032	0.037	15.068	0.000	37.200	52.305
5.08	61.000	25.000	0.000	0.000	0.000	0.038	1278	0.038	15.518	0.000	41.946	57.502
5.17	62.000	26.000	0.000	0.000	0.000	0.039	1568	0.039	15.955	0.000	46.877	62.871
5.25	63.000	27.000	0.000	0.000	0.000	0.040	1910	0.040	16.381	0.000	51.989	68.409
5.33	64.000	28.000	0.000	0.000	0.000	0.040	2308	0.040	16.795	0.000	57.273	74.109
5.42	65.000	29.000	0.000	0.000	0.000	0.041	2769	0.041	17.200	0.000	62.726	79.967
5.50	66.000	30.000	0.000	0.000	0.000	0.042	3302	0.042	17.596	0.000	68.341	85.978

DISCHARGE EQUATIONS

1) Weir:

   $Q_W = C_W \cdot L \cdot H^{3/2}$ (1)

2) Slot:

   As an orifice: $Q_s = B_s \cdot h_s \cdot c_g \cdot \sqrt{2g\left(H - \frac{h_s}{2}\right)}$ (2.a)

   As a weir: $Q_s = C_W \cdot B_s \cdot H^{3/2}$ (2.b)

   For H > h_s slot works as weir until orifice equation provides a smaller discharge. The elevation such that equation (2.a) = equation (2.b) is the elevation at which the behavior changes from weir to orifice.

3) Vertical Orifices

   As an orifice: $Q_o = 0.25 \cdot \pi D^2 \cdot c_g \cdot \sqrt{2g\left(H - \frac{D}{2}\right)}$ (3.a)

   As a weir: Critical depth and geometric family of circular sector must be solved to determined Q as a function of H:

$$\frac{Q_O^2}{g} = \frac{A_{cr}^3}{T_{cr}}; \quad H = y_{cr} + \frac{A_{cr}}{2 \cdot T_{cr}}; \; T_{cr} = 2\sqrt{y_{cr}(D - y_{cr})}\,; \quad A_{cr} = \frac{D^2}{8}[\alpha_{cr} - sin(\alpha_{cr})]\,;$$

$y_{cr} = \frac{D}{2}[1 - sin(0.5 \cdot \alpha_{cr})]$ (3.b.1, 3.b.2, 3.b.3, 3.b.4 and 3.b.5)

There is a value of H (approximately H = 110% D) from which orifices no longer work as weirs as critical depth is not possible at the entrance of the orifice. This value of H is obtained equaling the discharge using critical equations and equations (3.b).

A mathematical model is prepared with the previous equations depending on the type of discharge.

The following are the variables used above:

Q_W, Q_s, Q_O = Discharge of weir, slot or orifice (cfs)

C_W, c_g : Coefficients of discharge of weir (typically 3.1) and orifice (0.61 to 0.62)

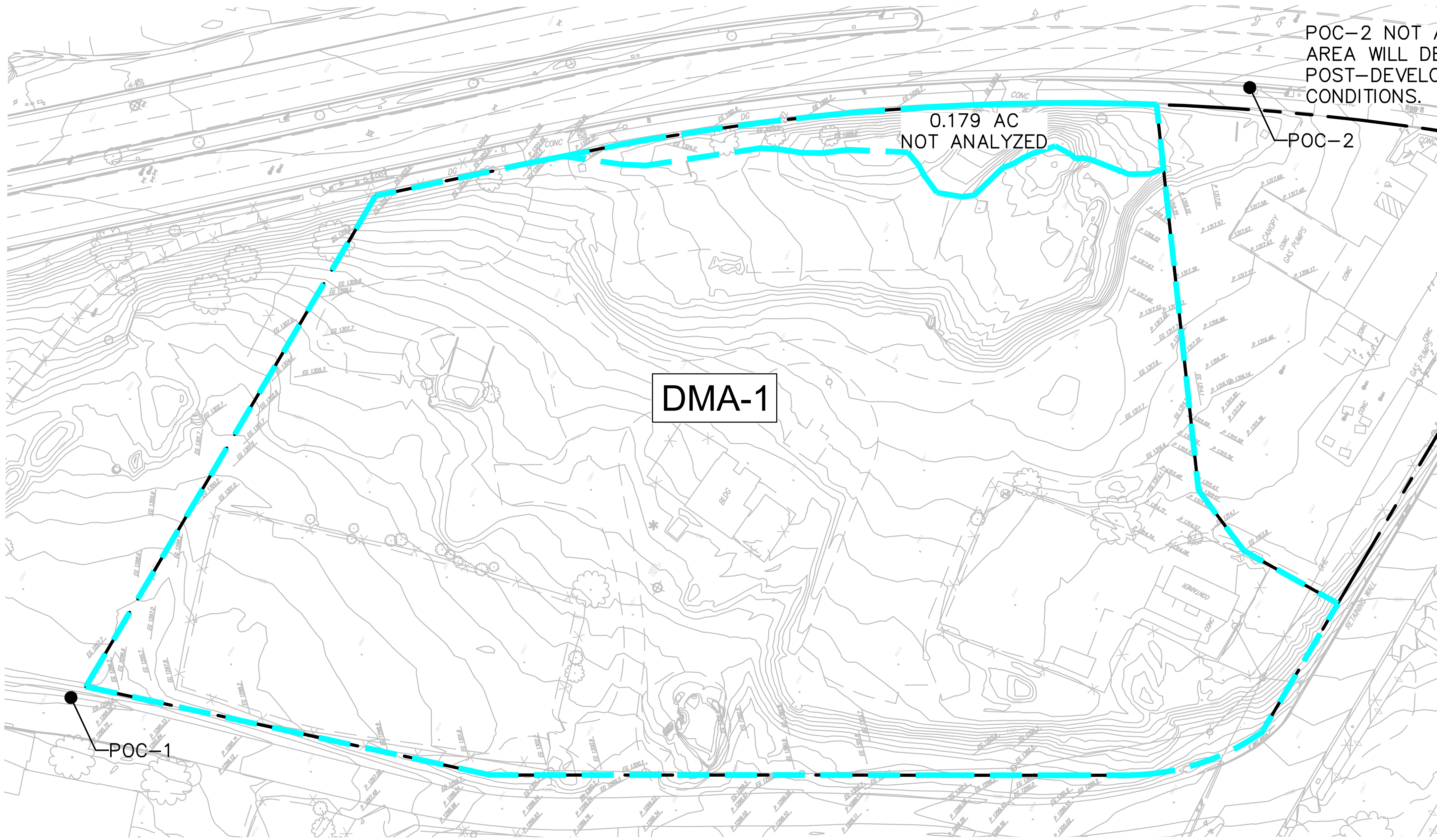
L, B_s, D, h_s : Length of weir, width of slot, diameter of orifice and height of slot, respectively; (ft)

H: Level of water in the pond over the invert of slot, weir or orifice (ft)

A_{cr}, T_{cr}, y_{cr}, α_{cr}: Critical variables for circular sector: area (sq-ft), top width (ft), critical depth (ft), and angle to the center, respectively.

ATTACHMENT 5

Pre & Post-Developed Maps, Project Plan and Detention Section Sketches



LEGEND

BASIN LIMITS

PROJECT BOUNDARY

NOTE: TYPE B SOIL UNDERLYING ENTIRE SITE

70 35 0 70 140 210

SCALE: 1" = 70'

* ASSUME 0% IMPERVIOUS FOR PRE-DEVELOPED CONDITIONS FOR HMP ANALYSIS

BASIN PRE-DEVELOPED AREAS

DMA	PERVIOUS (AC)	*IMPERVIOUS (AC)	TOTAL AREA (AC)	POC
DMA-1	4.072	0.064	4.136	POC-1
TOTAL	4.072	0.064	4.136	

HMP EXHIBIT - PRE

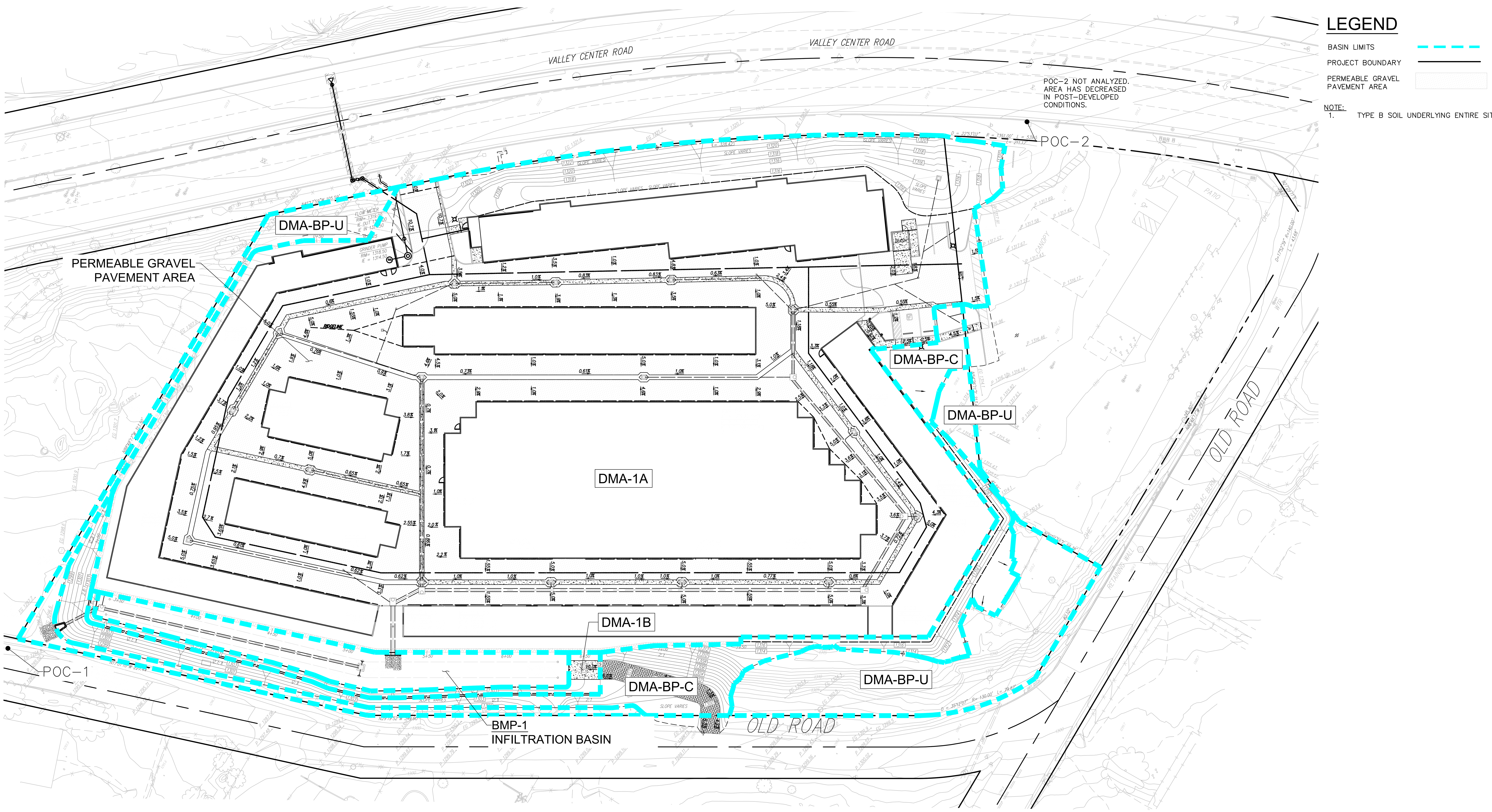
VALLEY CENTER STORAGE
13630 OLD RD
VALLEY CENTER, CA 92082

SHEET
1 OF 1

REC
Consultants, Inc.

Civil Engineering ~ Land Surveying
Water Resources

2970 Fifth Avenue, Unit 340
San Diego, CA 92103
(619)232-9200 (619)232-9210 Fax



SCALE: 1" = 30'

BASIN PRE-DEVELOPED AREAS

DMA	SOIL TYPE	PERVIOUS (AC)	IMPERVIOUS (AC)	TOTAL AREA (AC)	POC
DMA-1A	B	1.966	1.483	3.449	POC-1
DMA-1B	B	0.046	0.000	0.046	
BMP-1	B	0.148	0.000	0.148	
DMA-BP-C	B	0.448	0.002	0.450	
DMA-BP-U	B	0.277	0.000	0.277	
TOTAL		2.885	1.485	4.370	

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

REC Consultants, Inc.
Civil Engineering ~ Land Surveying
Water Resources
2970 Fifth Avenue, Unit 340
San Diego, CA 92103
(619)232-9200 (619)232-9210 Fax

DATE: 11-25-24
SCALE: 1" = 20'
DRAWN: A.S.R.
CHECKED: L.A.P.

SHEET TITLE
HMP EXHIBIT - POST

PROJECT
VALLEY CENTER STORAGE
13630 OLD RD
VALLEY CENTER, CA 92082

SHEET
1
OF 1 SHEETS

ATTACHMENT 6

SWMM Input Data in Input Format (Existing & Proposed Models)

PRE_DEV

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           05/24/1950
START_TIME           00:00:00
REPORT_START_DATE    05/24/1950
REPORT_START_TIME    00:00:00
END_DATE             05/23/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:05:00
DRY_STEP             01:00:00
ROUTING_STEP         0:00:30
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type       Parameters
;;---------- ----------
MONTHLY      0.07   0.10   0.13   0.17   0.19   0.22   0.24   0.22   0.19   0.13   0.09   0.06
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
Lake_Wohlford    INTENSITY 1:00   1.0    TIMESERIES Lake_Wohlford

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb
Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length
Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- -
-------
DMA-1            Lake_Wohlford    POC-1            4.136    0        806      5        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1            0.012      0.05       0.05       0.1        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
DMA-1            3          0.2        0.32

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
POC-1            0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
Lake_Wohlford    FILE "L Wohlford-II.txt"
```

```
[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            5000.000           5000.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1            4478.114           6094.276

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Lake_Wohlford    4713.805           7059.484
```

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           05/24/1950
START_TIME           00:00:00
REPORT_START_DATE    05/24/1950
REPORT_START_TIME    00:00:00
END_DATE             05/23/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:05:00
DRY_STEP             01:00:00
ROUTING_STEP         0:00:30
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type       Parameters
;;---------- ----------
MONTHLY      0.07   0.10   0.13   0.17   0.19   0.22   0.24   0.22   0.19   0.13   0.09   0.06
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
Lake_Wohlford    INTENSITY 1:00   1.0    TIMESERIES Lake_Wohlford

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
DMA-1A           Lake_Wohlford    Up-DET           3.449    78.0     1181     2.44     0
DMA-1B           Lake_Wohlford    BMP-1            0.194    0        300      2        0
DMA-BP-C         Lake_Wohlford    POC-1            0.450    0.44     120      25       0
DMA-BP-U         Lake_Wohlford    POC-1            0.277    0        320      25       0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1A           0.012      0.05       0.05       0.1        25         OUTLET
DMA-1B           0.012      0.05       0.05       0.1        25         OUTLET
DMA-BP-C         0.012      0.05       0.05       0.1        25         OUTLET
DMA-BP-U         0.012      0.05       0.05       0.1        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
DMA-1A           3          0.15       0.32
DMA-1B           3          0.15       0.32
DMA-BP-C         3          0.15       0.32
DMA-BP-U         3          0.2        0.32

[LID_CONTROLS]
;;               Type/Layer Parameters
;;-------------- ---------- ----------
BMP-1            BC
BMP-1            SURFACE    24         0.0        0.1        0          5
```

```
BMP-1            SOIL       24         0.4        0.2        0.1        5          5          1.5
BMP-1            STORAGE    24         0.67       0.08       0
BMP-1            DRAIN      0.0886     0.5        3          6

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSatur  FromImprv  ToPerv     Report File
;;-------------- ---------------- ------- ---------- ---------- ---------- ---------- ---------- -----------

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
POC-1            0          FREE                        NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                      Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                     Area     Frac.    Infiltration
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- -------- ------------
BMP-1            0        5.5      0        TABULAR    Basin-1                    2250     1        3        0.72
Up-DET           0        1.6      0        TABULAR    DET-Up-A                   22884    0

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet          Qcoeff/                     Flap
;;Name           Node             Node             Height     Type            QTable           Qexpon     Gate
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- ----
Out-1            BMP-1            POC-1            0          TABULAR/DEPTH   outlet-1                    NO
Out-DET          Up-DET           BMP-1            0          TABULAR/DEPTH   Det-UP-Q                    NO

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
outlet-1         Rating     0          0
outlet-1                    3          0
outlet-1                    3.08       0.0052
outlet-1                    3.17       0.0094
outlet-1                    3.25       0.0122
outlet-1                    3.33       0.0144
outlet-1                    3.42       0.0163
outlet-1                    3.50       0.0181
outlet-1                    3.58       0.803
outlet-1                    3.67       2.236
outlet-1                    3.75       4.091
outlet-1                    3.83       5.889
outlet-1                    3.92       6.965
outlet-1                    4.00       7.895
outlet-1                    4.08       9.622
outlet-1                    4.17       12.017
outlet-1                    4.25       14.838
outlet-1                    4.33       18.004
outlet-1                    4.42       21.470
outlet-1                    4.50       25.204
outlet-1                    4.58       29.186
outlet-1                    4.67       33.398
outlet-1                    4.75       37.826
outlet-1                    4.83       42.460
outlet-1                    4.92       47.289
outlet-1                    5.00       52.305
outlet-1                    5.08       57.502
outlet-1                    5.17       62.871
outlet-1                    5.25       68.409
outlet-1                    5.33       74.109
outlet-1                    5.42       79.967
outlet-1                    5.50       85.978

Det-UP-Q         Rating     0          0.000
Det-UP-Q                    0.1        0.051
Det-UP-Q                    0.2        0.076
Det-UP-Q                    0.3        0.095
Det-UP-Q                    0.4        0.111
Det-UP-Q                    0.5        0.124
Det-UP-Q                    0.6        0.136
Det-UP-Q                    0.7        0.148
```

```
Det-UP-Q                        0.8         0.158
Det-UP-Q                        0.9         0.168
Det-UP-Q                        1.00        0.177
Det-UP-Q                        1.10        0.186
Det-UP-Q                        1.20        0.194
Det-UP-Q                        1.30        0.203
Det-UP-Q                        1.40        0.210
Det-UP-Q                        1.50        0.218
Det-UP-Q                        1.525       1.788
Det-UP-Q                        1.550       4.658
Det-UP-Q                        1.575       8.373
Det-UP-Q                        1.600       12.773

Basin-1          Storage        0           2250
Basin-1                         1           2250
Basin-1                         2.5         2250
Basin-1                         2.58        2275
Basin-1                         2.67        2301
Basin-1                         2.75        2326
Basin-1                         2.83        2352
Basin-1                         2.92        2379
Basin-1                         2.999       2406
Basin-1                         3           6014
Basin-1                         3.08        6082
Basin-1                         3.17        6151
Basin-1                         3.25        6220
Basin-1                         3.33        6291
Basin-1                         3.42        6363
Basin-1                         3.5         6435
Basin-1                         3.58        6509
Basin-1                         3.67        6583
Basin-1                         3.75        6658
Basin-1                         3.83        6735
Basin-1                         3.92        6812
Basin-1                         4           6890
Basin-1                         4.08        6969
Basin-1                         4.17        7049
Basin-1                         4.25        7130
Basin-1                         4.33        7211
Basin-1                         4.42        7294
Basin-1                         4.5         7378
Basin-1                         4.58        7462
Basin-1                         4.67        7548
Basin-1                         4.75        7634
Basin-1                         4.83        7722
Basin-1                         4.92        7810
Basin-1                         5           7899
Basin-1                         5.08        7989
Basin-1                         5.17        8080
Basin-1                         5.25        8172
Basin-1                         5.33        8265
Basin-1                         5.42        8359
Basin-1                         5.5         8454

DET-Up-A         Storage        0           22884
DET-Up-A                        0.1         22884
DET-Up-A                        0.2         22884
DET-Up-A                        0.3         22884
DET-Up-A                        0.4         22884
DET-Up-A                        0.5         22884
DET-Up-A                        0.6         22884
DET-Up-A                        0.7         22884
DET-Up-A                        0.8         22884
DET-Up-A                        0.9         22884
DET-Up-A                        1.5         22884
DET-Up-A                        1.525       314
DET-Up-A                        1.55        1257
DET-Up-A                        1.575       2827
DET-Up-A                        1.6         5027

[TIMESERIES]
;;Name           Date           Time        Value
```

```
;;-------------- ---------- ---------- ----------
Lake_Wohlford    FILE "P:\Acad\7032 Alidade\026 Valley Center Storage\HMP\SWMM\L Wohlford-II.txt"

[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            5000.000           5000.000
BMP-1            4000.000           5000.000
Up-DET           4000.000           5500.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1A           3500.000           6000.000
DMA-1B           4750.000           6000.000
DMA-BP-C         6000.000           6000.000
DMA-BP-U         6500.000           6000.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Lake_Wohlford    4933.333           6844.444
```

ATTACHMENT 7

EPA SWMM FIGURES AND EXPLANATIONS

Per the attached, the reader can see the screens associated with the EPA-SWMM Model in both pre-development and post-development conditions. Each portion, i.e., sub-catchments, outfalls, storage units, weir as a discharge, and outfalls (point of compliance), are also shown.

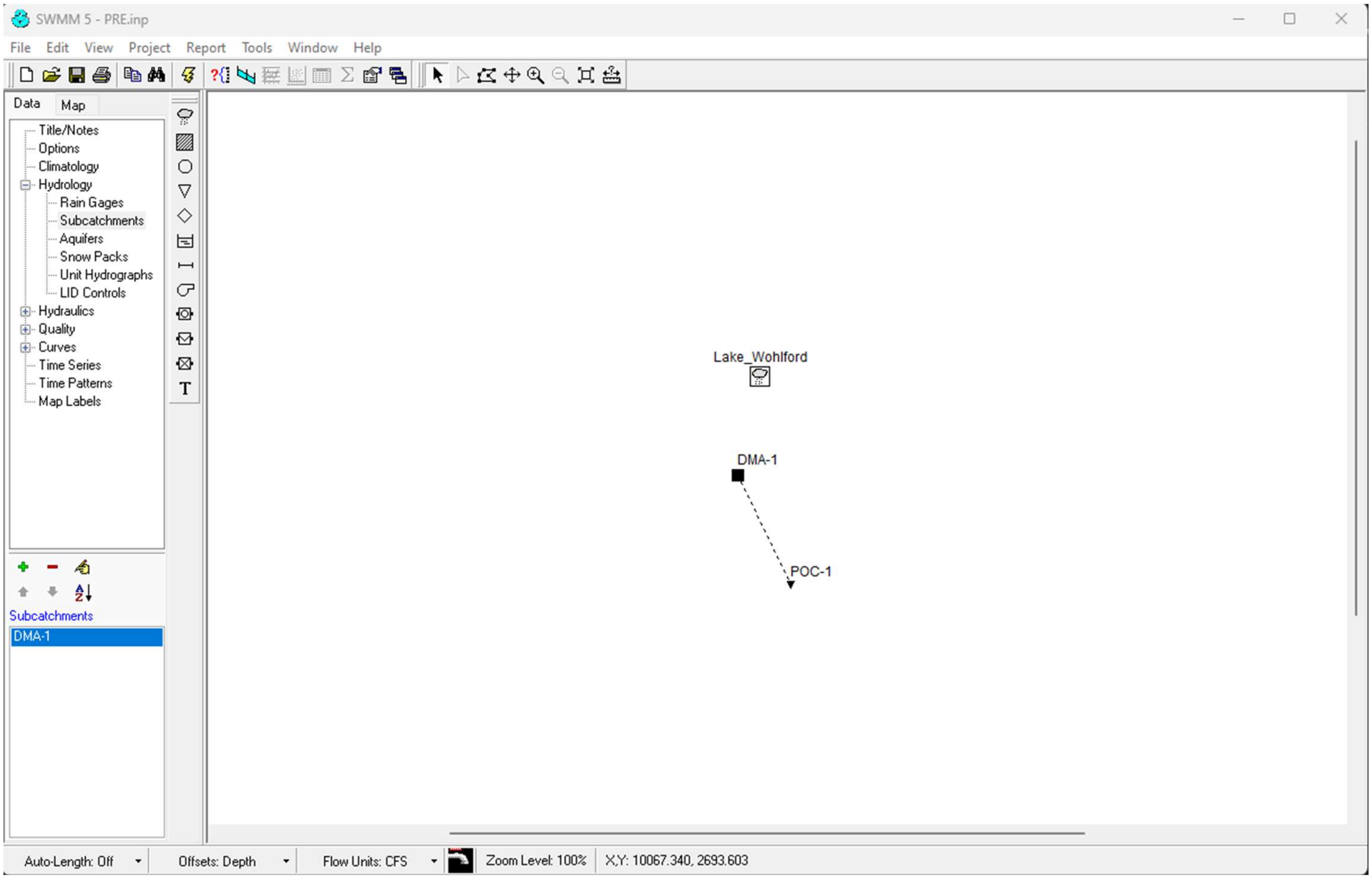
Variables for modeling are associated with typical recommended values by the EPA-SWMM model, typical values found in technical literature (such as Maidment's Handbook of Hydrology). Recommended values for the SWMM model have been attained from Appendix G of the 2020 County of San Diego BMP Design Manual.

Soil characteristics of the existing soils were determined from the USGS WebSoil Survey website, as a conservative estimate, soils have been given a Class B classification (located in Attachment 8 of this report).

A Technical document prepared by Tory R Walker Engineering for the Cities of San Marcos, Oceanside and Vista (Reference [1]) can also be consulted for additional information regarding typical values for SWMM parameters.

Manning's roughness coefficients have been based upon the findings of the "*Improving Accuracy in Continuous Hydrologic Modeling: Guidance for Selecting Pervious Overland Flow Manning's n Values in the San Diego Region*" date 2016 by TRW Engineering (Reference [6]).

PRE-DEVELOPED CONDITIONS



Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	5000.000
Y-Coordinate	5000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

Rain Gage Lake_Wohlford

Property	Value
Name	Lake_Wohlford
X-Coordinate	4713.805
Y-Coordinate	7059.484
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	Lake_Wohlford
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage

Subcatchment DMA-1

Property	Value
Name	DMA-1
X-Coordinate	4478.114
Y-Coordinate	6094.276
Description	
Tag	
Rain Gage	Lake_Wohlford
Outlet	POC-1
Area	4.136
Width	806
% Slope	5
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Infiltration Editor

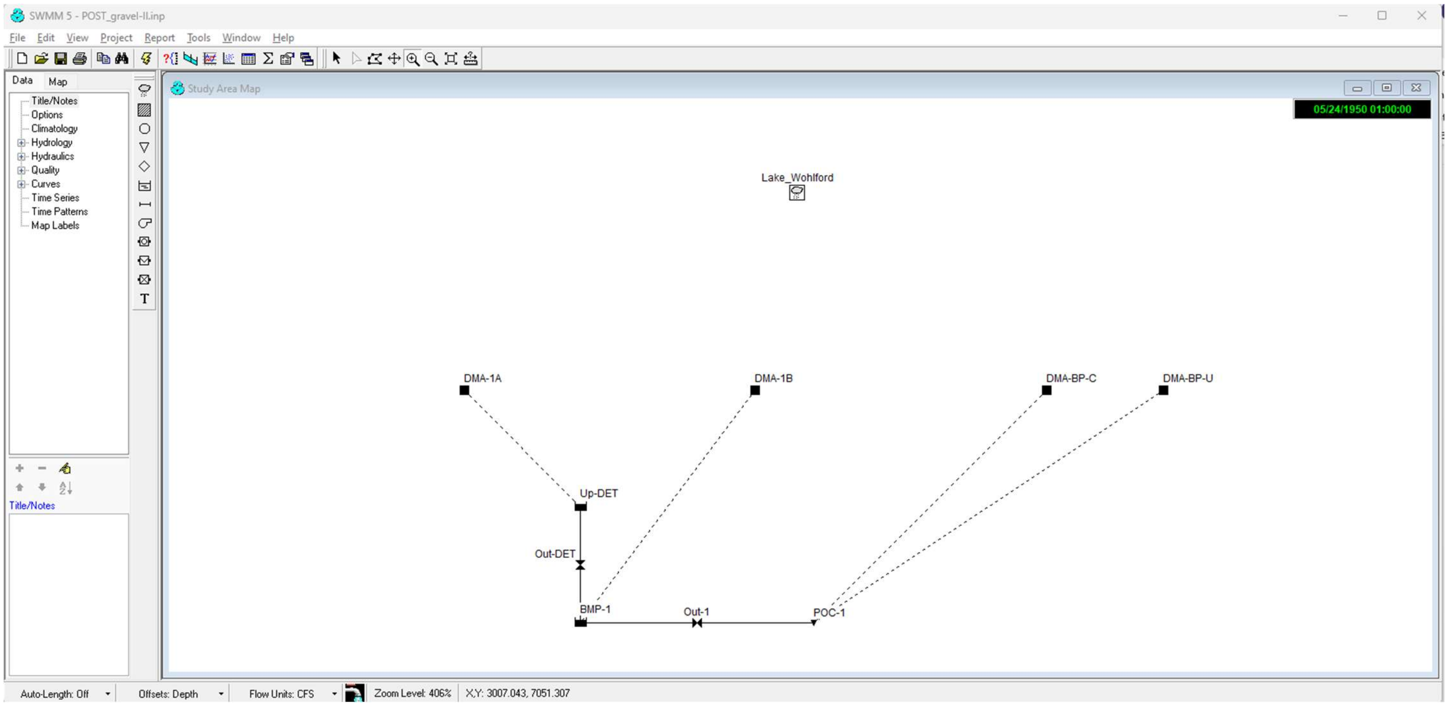
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.2
Initial Deficit	0.32

Soil capillary suction head (inches or mm)

OK Cancel Help

POST-DEVELOPED CONDITIONS



Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	5000.000
Y-Coordinate	5000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

User-assigned name of outfall

Rain Gage Lake_Wohlford

Property	Value
Name	Lake_Wohlford
X-Coordinate	4933.333
Y-Coordinate	6844.444
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	Lake_Wohlford
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage

Subcatchment DMA-1A

Property	Value
Name	DMA-1A
X-Coordinate	3500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	Lake_Wohlford
Outlet	Up-DET
Area	3.449
Width	1181
% Slope	2.44
% Imperv	78.0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

User-assigned name of subcatchment

Subcatchment DMA-1B

Property	Value
Name	DMA-1B
X-Coordinate	4750.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	Lake_Wohlford
Outlet	BMP-1
Area	0.194
Width	300
% Slope	2
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.15
Initial Deficit	0.32

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.15
Initial Deficit	0.32

Subcatchment DMA-BP-C

Property	Value
Name	DMA-BP-C
X-Coordinate	6000.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	Lake_Wohlford
Outlet	POC-1
Area	0.450
Width	120
% Slope	25
% Imperv	0.44
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.15
Initial Deficit	0.32

Subcatchment DMA-BP-U

Property	Value
Name	DMA-BP-U
X-Coordinate	6500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	Lake_Wohlford
Outlet	POC-1
Area	0.277
Width	320
% Slope	25
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.2
Initial Deficit	0.32

Storage Unit Up-DET

Property	Value
Name	Up-DET
X-Coordinate	4000.000
Y-Coordinate	5500.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	1.6
Initial Depth	0
Ponded Area	22884
Evap. Factor	0
Infiltration	NO
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	DET-Up-A

Storage Unit BMP-1

Property	Value
Name	BMP-1
X-Coordinate	4000.000
Y-Coordinate	5000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	5.5
Initial Depth	0
Ponded Area	2250
Evap. Factor	1
Infiltration	YES
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	Basin-1

User-assigned name of storage unit

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	3
Conductivity	0.7225
Initial Deficit	0.32

Outlet Out-DET

Property	Value
Name	Out-DET
Inlet Node	Up-DET
Outlet Node	BMP-1
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/DEPTH
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	Det-UP-Q

Name of rating curve that relates outflow to either depth or head (after specifing a

Outlet Out-1

Property	Value
Name	Out-1
Inlet Node	BMP-1
Outlet Node	POC-1
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/DEPTH
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	outlet-1

Name of rating curve that relates outflow to either depth or head (after specifing a

Rating Curve Editor

Curve Name: Det-UP-Q

Description:

	Head (ft)	Outflow (CFS)
1	0	0.000
2	0.1	0.051
3	0.2	0.076
4	0.3	0.095
5	0.4	0.111
6	0.5	0.124
7	0.6	0.136
8	0.7	0.148
9	0.8	0.158

Rating Curve Editor

Curve Name: outlet-1

Description:

	Head (ft)	Outflow (CFS)
1	0	0
2	3	0
3	3.08	0.0052
4	3.17	0.0094
5	3.25	0.0122
6	3.33	0.0144
7	3.42	0.0163
8	3.50	0.0181
9	3.58	0.803

Overland Flow Manning's Coefficient per TRWE (Reference [6])

appeal of a de facto value, we anticipate that jurisdictions will not be inclined to approve land surfaces other than short prairie grass. Therefore, in order to provide SWMM users with a wider range of land surfaces suitable for local application and to provide Copermittees with confidence in the design parameters, we recommend using the values published by Yen and Chow in Table 3-5 of the EPA SWMM Reference Manual Volume I – Hydrology.

SWMM-Endorsed Values Will Improve Model Quality

In January 2016, the EPA released the SWMM Reference Manual Volume I – Hydrology (SWMM Hydrology Reference Manual). The SWMM Hydrology Reference Manual complements the SWMM 5 User's Manual and SWMM 5 Applications Manual by providing an in-depth description of the program's hydrologic components (EPA 2016). Table 3-5 of the SWMM Hydrology Reference Manual expounds upon SWMM 5 User's Manual Table A.6 by providing Manning's *n* values for additional overland flow surfaces[3]. The values are provided in Table 1:

Table 1: Manning's *n* Values for Overland Flow (EPA, 2016; Yen 2001; Yen and Chow, 1983).

Overland Surface	Light Rain (< 0.8 in/hr)	Moderate Rain (0.8-1.2 in/hr)	Heavy Rain (> 1.2 in/hr)
Smooth asphalt pavement	0.010	0.012	0.015
Smooth impervious surface	0.011	0.013	0.015
Tar and sand pavement	0.012	0.014	0.016
Concrete pavement	0.014	0.017	0.020
Rough impervious surface	0.015	0.019	0.023
Smooth bare packed soil	0.017	0.021	0.025
Moderate bare packed soil	0.025	0.030	0.035
Rough bare packed soil	0.032	0.038	0.045
Gravel soil	0.025	0.032	0.045
Mowed poor grass	0.030	0.038	0.045
Average grass, closely clipped sod	0.040	0.050	0.060
Pasture	0.040	0.055	0.070
Timberland	0.060	0.090	0.120
Dense grass	0.060	0.090	0.120
Shrubs and bushes	0.080	0.120	0.180
Land Use			
Business	0.014	0.022	0.035
Semibusiness	0.022	0.035	0.050
Industrial	0.020	0.035	0.050
Dense residential	0.025	0.040	0.060
Suburban residential	0.030	0.055	0.080
Parks and lawns	0.040	0.075	0.120

For purposes of local hydromodification management BMP design, these Manning's *n* values are an improvement upon the values presented by Engman (1986) in SWMM 5 User's Manual Table A.6. Values from SWMM 5 User's Manual Table A.6, while completely suitable for the intended application to certain agricultural land covers, comes with the disclaimer that the provided Manning's *n* values are valid for shallow-depth overland flow that match the conditions in the experimental plots (Engman,

[3] Further discussion is provided on page 6 under "Discussion of Differences Between Manning's *n* Values"

EXPLANATION OF SELECTED VARIABLES

Sub Catchment Areas:

Please refer to the attached diagrams that indicate the DMA and Bio-Retention BMPs (BMP) sub areas modeled within the project site at both the pre and post developed conditions draining to the POC.

Parameters for the pre- and post-developed models include soil type B as determined from the USGS WebSoil Survey website (attached at the end of this appendix). Suction head, conductivity and initial deficit corresponds to average values expected for these soils types, according to Appendix G of the 2016 City of Oceanside BMP Design Manual.

For surface runoff infiltration values, REC selected infiltration values per Appendix G of the 2016 City of Oceanside BMP Design Manual corresponding to hydrologic soil type.

Selection of a Kinematic Approach: As the continuous model is based on hourly rainfall, and the time of concentration for the pre-development and post-development conditions is significantly smaller than 60 minutes, precise routing of the flows through the impervious surfaces, the underdrain pipe system, and the discharge pipe was considered unnecessary. The truncation error of the precipitation into hourly steps is much more significant than the precise routing in a system where the time of concentration is much smaller than 1 hour.

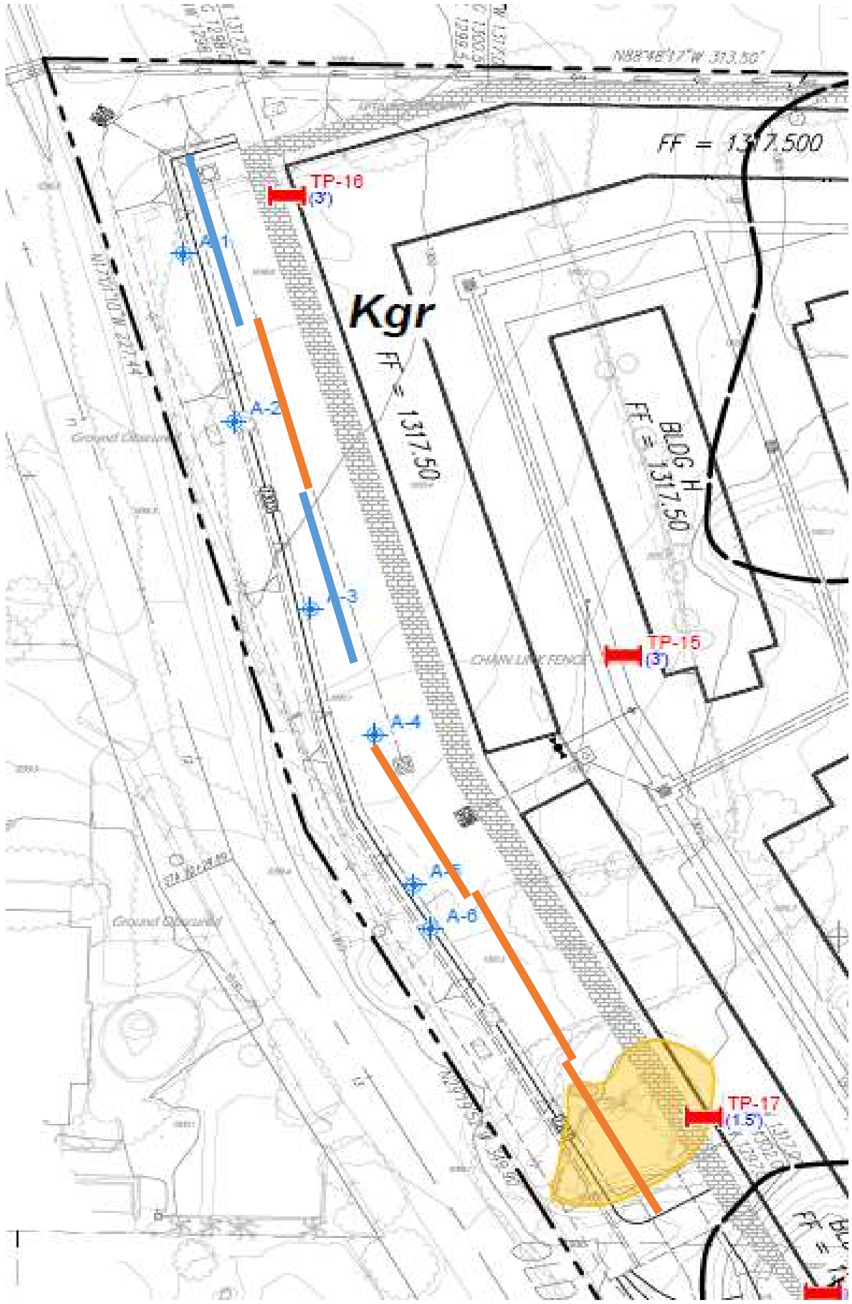
Sub-catchment BMP:

The area of biofiltration must be equal to the area of the development tributary to the biofiltration facility (area that drains into the biofiltration, equal external area plus bio-retention itself). Five (5) decimal places were given regarding the areas of the biofiltration to insure that the area used by the program for the LID subroutine corresponds exactly with this tributary.

ATTACHMENT 8

Geotechnical Documentation

INFILTRATION RATE FOR DESIGN



Point	f (in/hr)	Elev.	% bottom
A-1	0.141	1300	15.0%
A-2	0.337	1301	15.0%
A-3	0.606	1300	25.0%
A-4	*Not performed*		
A-5	1.463	1301	22.5%
A-6	0.353	1301	22.5%

ALL: **0.632**
(NO SAFETY FACTOR)

SF of Design

Inf. Test method: 1
(5 tests performed)
Soil Texture class: 1
(Rocky coarse sandy loam)
Soil variability: 2
(moderately homogeneous)
Depth of GW: 1
(not encountered)

S_A: 1.25

Pretreatment: 2
No runoff from unpaved areas
Resiliency: 1
Protection gravel included
Compaction: 2
Low likelihood

S_B: 1.75

SF: **2.19**

INFILTRATION FOR DESIGN PURPOSES: (0.632 / 2.19) **0.289 in/hr**

Note: As area has been multiplied by 0.4 for voids volume and routing, infiltration in the model must be divided by 0.4, so it will show as 0.7225 in/hr.

Map Scale: 1:1,930 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 19, Aug 30, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 14, 2022—Mar 17, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	3.5	26.0%
VvD	Vista rocky coarse sandy loam, 5 to 15 percent slopes	B	10.1	74.0%
Totals for Area of Interest			**13.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

ATTACHMENT 9

Summary Files from the SWMM Model

POST.rpt

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
 --------------------------------------------------------------


 *********************************************************
 NOTE: The summary statistics displayed in this report are
 based on results found at every computational time step,
 not just on results from each reporting time step.
 *********************************************************

 ****************
 Analysis Options
 ****************
 Flow Units ............... CFS
 Process Models:
   Rainfall/Runoff ........ YES
   Snowmelt ............... NO
   Groundwater ............ NO
   Flow Routing ........... YES
   Ponding Allowed ........ NO
   Water Quality .......... NO
 Infiltration Method ...... GREEN_AMPT
 Flow Routing Method ...... KINWAVE
 Starting Date ............ MAY-24-1950 00:00:00
 Ending Date .............. MAY-23-2008 23:00:00
 Antecedent Dry Days ...... 0.0
 Report Time Step ......... 01:00:00
 Wet Time Step ............ 00:05:00
 Dry Time Step ............ 01:00:00
 Routing Time Step ........ 30.00 sec


 **************************        Volume         Depth
 Runoff Quantity Continuity     acre-feet        inches
 **************************     ---------       -------
 Total Precipitation ......       360.478       989.870
 Evaporation Loss .........        32.472        89.169
 Infiltration Loss ........       130.636       358.726
 Surface Runoff ...........       198.137       544.084
 Final Surface Storage ....         0.007         0.019
 Continuity Error (%) .....        -0.215


 **************************        Volume        Volume
 Flow Routing Continuity        acre-feet      10^6 gal
 **************************     ---------     ---------
 Dry Weather Inflow .......         0.000         0.000
 Wet Weather Inflow .......       198.137        64.566
 Groundwater Inflow .......         0.000         0.000
 RDII Inflow ..............         0.000         0.000
 External Inflow ..........         0.000         0.000
 External Outflow .........        11.661         3.800
 Internal Outflow .........         0.000         0.000
 Storage Losses ...........       186.368        60.731
 Initial Stored Volume ....         0.000         0.000
 Final Stored Volume ......         0.108         0.035
 Continuity Error (%) .....         0.000


 ********************************
 Highest Flow Instability Indexes
 ********************************
 All links are stable.


 *************************
 Routing Time Step Summary
 *************************
 Minimum Time Step           :    30.00 sec
 Average Time Step           :    30.00 sec
 Maximum Time Step           :    30.00 sec
```

POST.rpt

Percent in Steady State   :   0.00
Average Iterations per Step :   1.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA-1A	989.87	0.00	111.61	204.62	676.10	63.32	4.35	0.683
DMA-1B	989.87	0.00	5.76	930.25	54.70	0.29	0.20	0.055
DMA-BP-C	989.87	0.00	6.34	926.95	57.32	0.70	0.47	0.058
DMA-BP-U	989.87	0.00	2.73	954.13	33.83	0.25	0.26	0.034

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min
POC-1	OUTFALL	0.00	0.00	0.00	0 00:00
BMP-1	STORAGE	0.12	3.65	3.65	6040 20:00
Up-DET	STORAGE	0.01	1.54	1.54	6039 07:39

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal
POC-1	OUTFALL	0.72	2.25	6040 20:00	0.955	3.800
BMP-1	STORAGE	0.20	3.12	6039 07:39	0.288	63.582
Up-DET	STORAGE	4.35	4.35	15594 17:00	63.318	63.318

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
BMP-1	STORAGE	508439.01	3.651	1.849
Up-DET	STORAGE	508439.01	1.536	0.064

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary

****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
BMP-1	0.286	1	96	10.884	44	6040 20:00	1.94
Up-DET	0.313	1	0	34.631	100	6039 07:39	3.03

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
POC-1	0.77	0.04	2.25	3.800
System	0.77	0.04	2.25	3.800

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
Out-1	DUMMY	1.94	6040 20:00			
Out-DET	DUMMY	3.03	6039 07:39			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Dec 04 14:21:44 2024
Analysis ended on: Wed Dec 04 14:23:36 2024
Total elapsed time: 00:01:52