TECHNICAL MEMORANDUM:

SWMM Modeling for Hydromodification Compliance of:

Passerelle TM (Parcel 1)

Prepared For:

Passerelle, LLC

Updated: February 2, 2022

Prepared by:

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TECHNICAL MEMORANDUM

TO: Passerelle, LLC.

FROM: Luis Parra, PhD, PE, CPSWQ, ToR, D.WRE, CFM.
David Edwards, MS, PE, CFM.

DATE: March 3, 2021. Updated: February 2, 2022.

RE: Summary of SWMM Modeling for Hydromodification Compliance for Passerelle Parcel 1, County of San Diego, CA.

INTRODUCTION

This memorandum summarizes the approach used to model the proposed residential site in the County of San Diego 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 determine if the proposed LID HMP facilities have sufficient volume 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 Passerelle Parcel 1 project proposes multifamily residential structures on the currently undeveloped site. Two (2) SWMM models were prepared for this study: the first for the predevelopment and the second for the post-developed conditions. The project site drains to a single Point of Compliance (POC-1) located to within the existing storm drain system that the project discharges to.

Per Section G1.2 in Appendix G of the 2020 County of San Diego BMP Design Manual, the EPA SWMM model was used to perform the continuous hydrologic simulation. For both SWMM models, flow duration curves were prepared to determine if the proposed HMP facilities are sufficient to meet the current HMP requirements.

The inputs required to develop SWMM models include rainfall, watershed characteristics, and BMP configurations. The Fallbrook Gage from the Project Clean Water website was used for this study since it is the most representative of the project site precipitation due to elevation and proximity to the project site (see figure included in Attachment 5).

Per the California Irrigation Management Information System "Reference Evaporation Zones" (CIMIS ETo Zone Map), the project site is located within the Zone 6 Evapotranspiration Area (see Attachment 5). Thus, evapotranspiration vales for the site were modeled using Zone 6 average monthly values from Table G.1-1 from the 2020 BMP Design Manual. Per the NRCS web soil survey and site specific geotechnical investigation, the project site is situated upon C soils. Soils have been assumed to be un-compacted in the existing condition to represent the current 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

PRE DEVELOPED CONDITIONS

The current site is an undeveloped lot that drains via overland flow to the south-west corner of the project site to the receiving curb and gutter within the adjacent Friesan Way. Table 1 below illustrates the pre-developed area to be redeveloped and impervious percentage accordingly.

TABLE 1 – SUMMARY OF PRE-DEVELOPED CONDITIONS

POC	DMA	Hydrologic Soil Class	Tributary Area, A (Ac)	Impervious Percentage, Ip(1)
POC-1	DMA-Flat-C	C	2.6641	0%
	DMA-Slope-C	C	0.2803	0%
TOTAL	--	--	**2.9444**	0%

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

DEVELOPED CONDITIONS

Storm water runoff from the proposed project site is routed to the existing discharge location to the south west of the project site at the adjacent Friesen Way. Runoff from the developed project site is drained to one (1) onsite receiving underground HMP detention system. Once flows are routed via the proposed BMP, developed onsite flows are then conveyed to the aforementioned outlet location. It should be noted that a small portion of the project bypasses the HMP detention facility and drains directly to the POC.

TABLE 2 – SUMMARY OF POST-DEVELOPED CONDITIONS

POC	DMA	Hydrologic Soil Class	Tributary Area, A (Ac)	Impervious Percentage, Ip
POC-1	DMA-1-C	C	2.7494	76.5%
	DMA-BYPASS-C	C	0.195	0.0%
TOTAL	--	--	**2.9444**	--

An underground detention system comprising of ninety six (96) StormTech MC-4500 vaults are located within the project site and are responsible for handling hydromodification requirements for the project site. In developed conditions, the total depth of the pipes inclusive of the gravel foundation will have a ponded depth of 6.75 ft and a riser spillway structure (see dimensions in Table 4). It should be noted that the 6.75 feet include the distance from the bottom of the gravel up to the top of the outside diameter of the vaults. Flows will then discharge from the basin via a series of outlets within the riser structure. The riser will act as a spillway such that peak flows can be safely discharged to the receiving storm drain.

Water Quality BMP Sizing

It is assumed all storm water quality requirements for the project will be met by the bio-filtration LID BMPs detailed in the SWQMP and other BMPs included within the site design. 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 (including sizing and drawdown) please refer to the site specific Storm Water Quality Management Plan (SWQMP).

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMPs

One (1) HMP BMP detention vault is proposed for hydromodification conformance for the project site. Table 4 illustrates the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 3 – SUMMARY OF DEVELOPED DUAL PURPOSE BMPs

BMP	Tributary Area (Ac)	DIMENSIONS					
		HMP Area(1), (ft^2)	Depth(5) (ft)	Volume (ft^3)	Depth Riser Invert (ft)(2)	Weir Length(3) (ft)	Total Depth(4) (ft)
BASIN 1	2.7494	1,393	6.75	17,611	5.50-ft	3.5-ft	6.75

Notes: (1): Area where detention pipes or similar system will be placed inclusive of the gravel surrounding it.
(2): Depth of ponding beneath riser structure's surface spillway.
(3): Overflow length of the internal emergency spillway weir.
(4): This total depth includes 9" of gravel foundation.
(5): The depth shown includes 9 inches of gravel foundation below the detention pipes and 12 inches of gravel above the chambers.

TABLE 4 – SUMMARY OF DEVELOPED DUAL PURPOSE UNDERGROUND BMP

BMP	Lower Orifice			Lower Slot		
	Diam. (in)	No.	Elev.(1) (ft)	Width (in)	Height (in)	Elev.(1) (ft)
BASIN 1	1.875	1	0.50	16.5	3.5	2.75

Notes: (1): Elevation 0.0 is equal to the base invert of the underlying gravel layer.

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 with the HMP BMPs 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 the POC. 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 = 0.10 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.

SUMMARY

This study has demonstrated that the proposed HMP BMPs provided for the Passerelle Parcel 1 project site is sufficient to meet the current HMP criteria if the cross-section areas and volumes recommended within this technical memorandum, and the respective orifice and outlet structure are incorporated as specified within the proposed project site.

KEY ASSUMPTIONS

1. Type C Soils is representative of the existing condition site.

ATTACHMENTS

1. Q_2 to Q_{10} Comparison Tables
2. FDC Plots (log and natural "x" scale) and Flow Duration Table.
3. List of the "n" largest Peaks: Pre-Development and Post-Development Conditions
4. Elevations vs. Discharge Curves to be used in SWMM
5. Pre & Post Development Maps, Project plan and section sketches
6. SWMM Input Data in Input Format (Existing and Proposed Models)
7. SWMM Screens and Explanation of Significant Variables
8. Geotechnical Documentation
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.

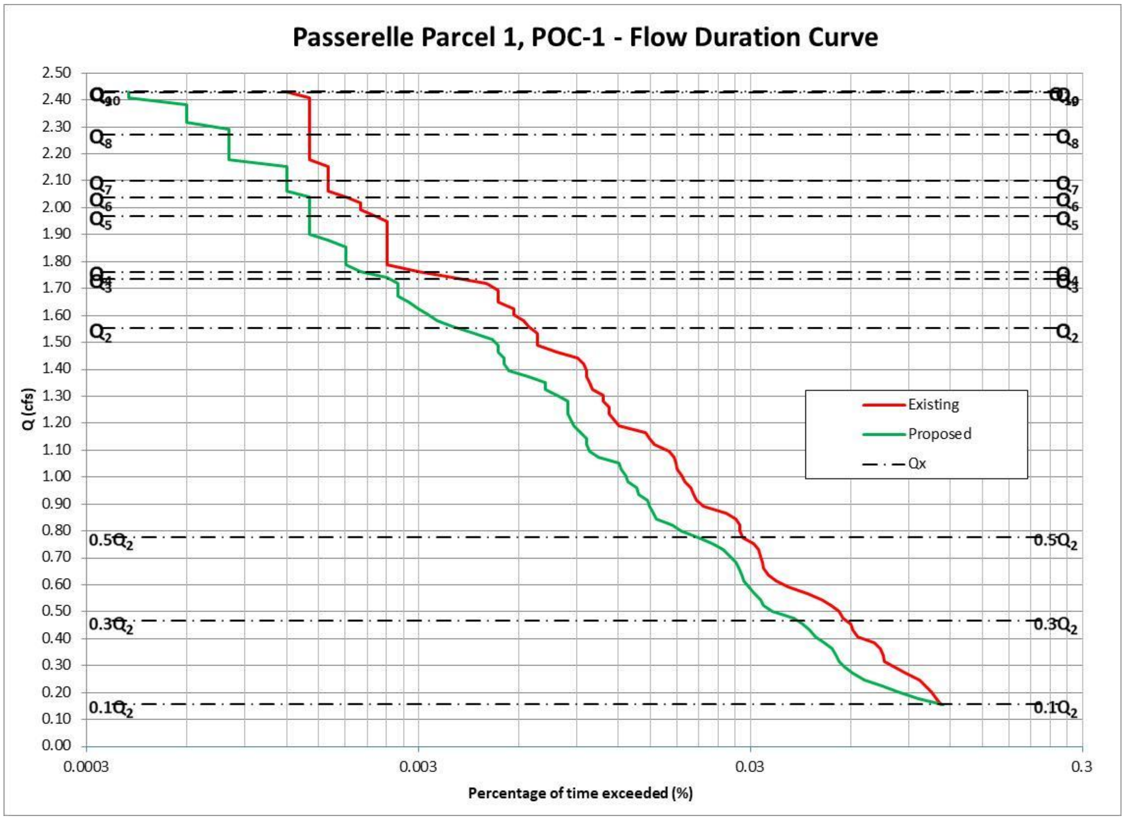
[2] – *"Final Hydromodification Management Plan (HMP) prepared for the County of San Diego",* March 2011, Brown and Caldwell.

[3] - Order R9-20013-001, California 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*", January 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.



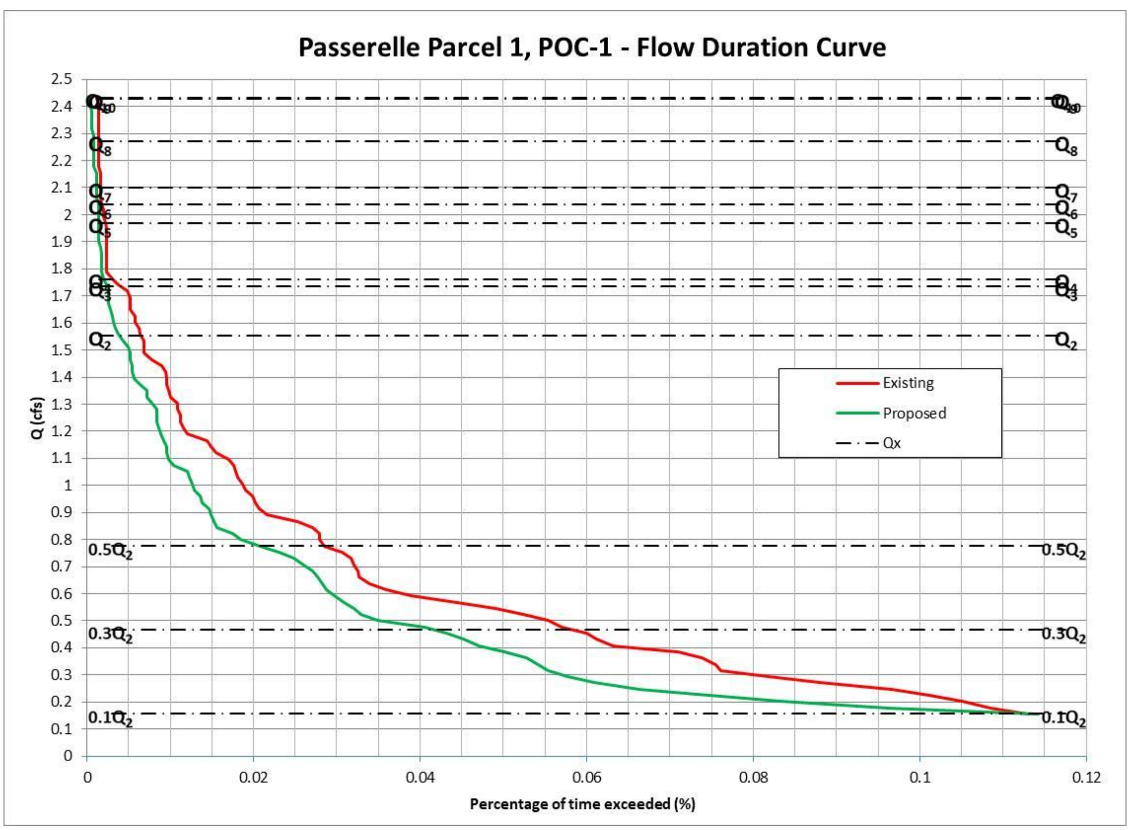


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

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	1.552	1.221	0.331
3-year	1.735	1.521	0.214
4-year	1.763	1.573	0.189
5-year	1.970	1.645	0.325
6-year	2.039	1.733	0.306
7-year	2.100	1.759	0.341
8-year	2.273	1.884	0.388
9-year	2.427	2.073	0.354
10-year	2.430	2.152	0.278

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.

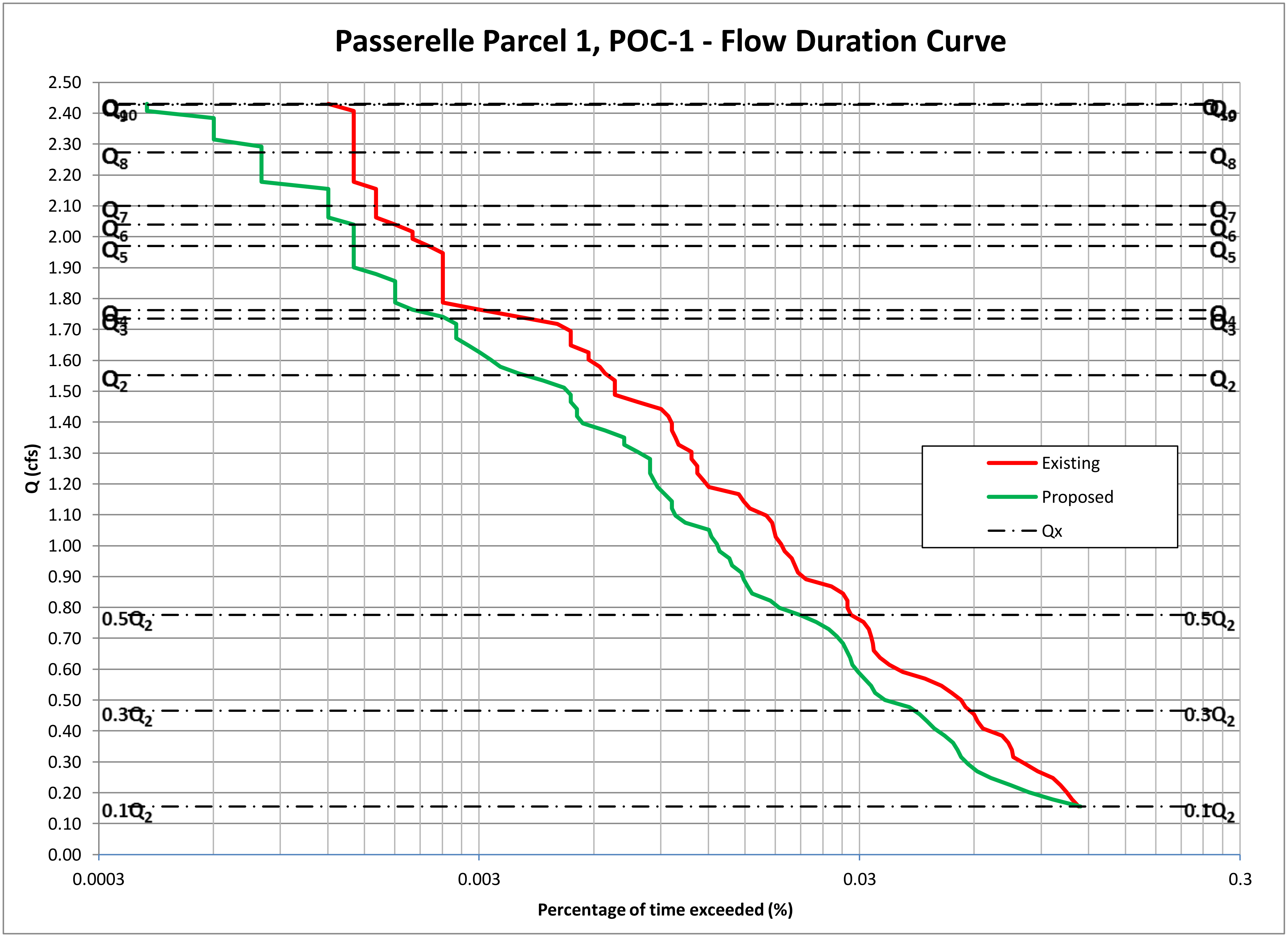
The figures on the following pages illustrate that the flow duration curve in post-development conditions after the proposed BMP is below the existing flow duration curve. The flow duration curve table following the curve shows that if the interval $0.10Q_2 – Q_{10}$ is divided in 100 sub-intervals, 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.

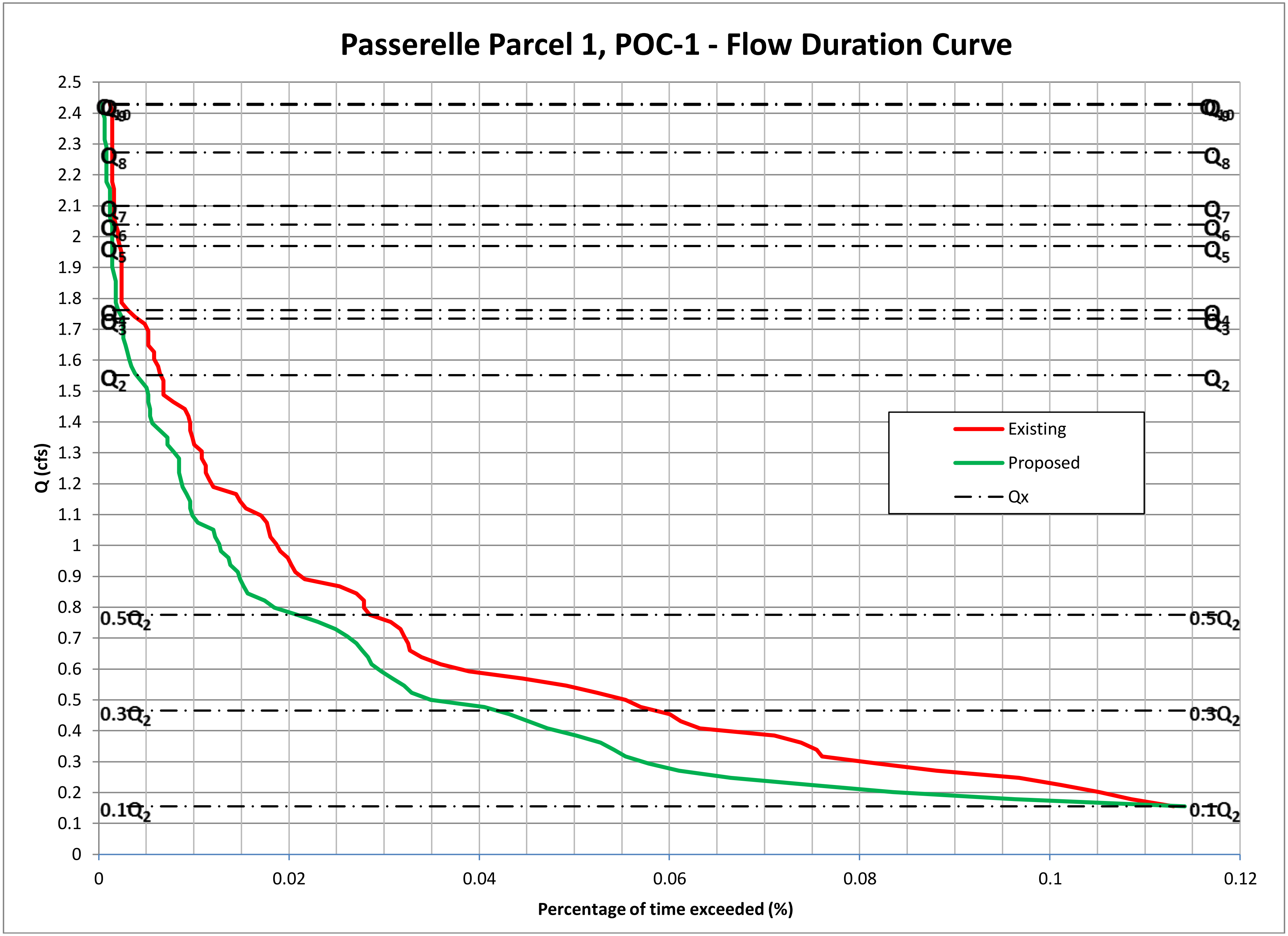
It is important to note that the flow duration curve can be expressed in the "x" axis as percentage of time, hours per year, total number of hours, or any other similar time variable. As those variables only differ by a multiplying constant, their plot in logarithmic scale is going to look exactly the same, and compliance can be observed regardless of the variable selected. However, in order to satisfy the County of San Diego HMP example, % 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.



Passerelle Parcel 1, POC-1 - Flow Duration Curve
Q (cfs)
2.50
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
0.0003
0.003
0.03
0.3
Percentage of time exceeded (%)
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx



Passerelle Parcel 1, POC-1 - Flow Duration Curve
Q (cfs)
Percentage of time exceeded (%)
Existing
Proposed
Qx
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2

Flow Duration Curve Data for Passerelle TM Phase 1, POC-1, County of San Diego

Q2 =	1.55	cfs	Fraction	10 %
Q10 =	2.43	cfs		
Step =	0.0230	cfs		
Count =	498239	hours		
	56.84	years		

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
1	0.155	563	1.13E-01	569	1.14E-01	101%	Pass
2	0.178	541	1.09E-01	480	9.63E-02	89%	Pass
3	0.201	524	1.05E-01	416	8.35E-02	79%	Pass
4	0.224	504	1.01E-01	373	7.49E-02	74%	Pass
5	0.247	482	9.67E-02	331	6.64E-02	69%	Pass
6	0.270	439	8.81E-02	304	6.10E-02	69%	Pass
7	0.293	408	8.19E-02	288	5.78E-02	71%	Pass
8	0.316	379	7.61E-02	276	5.54E-02	73%	Pass
9	0.339	376	7.55E-02	270	5.42E-02	72%	Pass
10	0.362	368	7.39E-02	263	5.28E-02	71%	Pass
11	0.385	354	7.11E-02	250	5.02E-02	71%	Pass
12	0.408	315	6.32E-02	235	4.72E-02	75%	Pass
13	0.431	305	6.12E-02	225	4.52E-02	74%	Pass
14	0.454	299	6.00E-02	215	4.32E-02	72%	Pass
15	0.477	284	5.70E-02	202	4.05E-02	71%	Pass
16	0.500	276	5.54E-02	174	3.49E-02	63%	Pass
17	0.523	261	5.24E-02	164	3.29E-02	63%	Pass
18	0.546	245	4.92E-02	160	3.21E-02	65%	Pass
19	0.569	222	4.46E-02	154	3.09E-02	69%	Pass
20	0.592	194	3.89E-02	148	2.97E-02	76%	Pass
21	0.615	179	3.59E-02	143	2.87E-02	80%	Pass
22	0.638	169	3.39E-02	141	2.83E-02	83%	Pass
23	0.661	163	3.27E-02	138	2.77E-02	85%	Pass
24	0.684	162	3.25E-02	135	2.71E-02	83%	Pass
25	0.707	160	3.21E-02	130	2.61E-02	81%	Pass
26	0.730	158	3.17E-02	124	2.49E-02	78%	Pass
27	0.753	153	3.07E-02	115	2.31E-02	75%	Pass
28	0.776	142	2.85E-02	104	2.09E-02	73%	Pass
29	0.799	139	2.79E-02	92	1.85E-02	66%	Pass
30	0.822	139	2.79E-02	87	1.75E-02	63%	Pass
31	0.845	135	2.71E-02	78	1.57E-02	58%	Pass
32	0.868	126	2.53E-02	76	1.53E-02	60%	Pass
33	0.890	108	2.17E-02	74	1.49E-02	69%	Pass
34	0.913	103	2.07E-02	73	1.47E-02	71%	Pass
35	0.936	101	2.03E-02	69	1.38E-02	68%	Pass
36	0.959	99	1.99E-02	68	1.36E-02	69%	Pass
37	0.982	95	1.91E-02	64	1.28E-02	67%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
38	1.005	93	1.87E-02	63	1.26E-02	68%	Pass
39	1.028	90	1.81E-02	61	1.22E-02	68%	Pass
40	1.051	89	1.79E-02	60	1.20E-02	67%	Pass
41	1.074	88	1.77E-02	52	1.04E-02	59%	Pass
42	1.097	85	1.71E-02	49	9.83E-03	58%	Pass
43	1.120	77	1.55E-02	48	9.63E-03	62%	Pass
44	1.143	74	1.49E-02	48	9.63E-03	65%	Pass
45	1.166	72	1.45E-02	46	9.23E-03	64%	Pass
46	1.189	60	1.20E-02	44	8.83E-03	73%	Pass
47	1.212	58	1.16E-02	43	8.63E-03	74%	Pass
48	1.235	56	1.12E-02	42	8.43E-03	75%	Pass
49	1.258	56	1.12E-02	42	8.43E-03	75%	Pass
50	1.281	54	1.08E-02	42	8.43E-03	78%	Pass
51	1.304	54	1.08E-02	39	7.83E-03	72%	Pass
52	1.327	50	1.00E-02	36	7.23E-03	72%	Pass
53	1.350	49	9.83E-03	36	7.23E-03	73%	Pass
54	1.373	48	9.63E-03	32	6.42E-03	67%	Pass
55	1.396	48	9.63E-03	28	5.62E-03	58%	Pass
56	1.419	47	9.43E-03	27	5.42E-03	57%	Pass
57	1.442	45	9.03E-03	27	5.42E-03	60%	Pass
58	1.465	39	7.83E-03	26	5.22E-03	67%	Pass
59	1.488	34	6.82E-03	26	5.22E-03	76%	Pass
60	1.511	34	6.82E-03	25	5.02E-03	74%	Pass
61	1.534	34	6.82E-03	22	4.42E-03	65%	Pass
62	1.557	32	6.42E-03	19	3.81E-03	59%	Pass
63	1.580	31	6.22E-03	17	3.41E-03	55%	Pass
64	1.603	29	5.82E-03	16	3.21E-03	55%	Pass
65	1.626	29	5.82E-03	15	3.01E-03	52%	Pass
66	1.649	26	5.22E-03	14	2.81E-03	54%	Pass
67	1.672	26	5.22E-03	13	2.61E-03	50%	Pass
68	1.695	26	5.22E-03	13	2.61E-03	50%	Pass
69	1.718	24	4.82E-03	13	2.61E-03	54%	Pass
70	1.741	19	3.81E-03	12	2.41E-03	63%	Pass
71	1.764	15	3.01E-03	10	2.01E-03	67%	Pass
72	1.787	12	2.41E-03	9	1.81E-03	75%	Pass
73	1.810	12	2.41E-03	9	1.81E-03	75%	Pass
74	1.833	12	2.41E-03	9	1.81E-03	75%	Pass
75	1.856	12	2.41E-03	9	1.81E-03	75%	Pass
76	1.879	12	2.41E-03	8	1.61E-03	67%	Pass
77	1.902	12	2.41E-03	7	1.40E-03	58%	Pass
78	1.925	12	2.41E-03	7	1.40E-03	58%	Pass
79	1.948	12	2.41E-03	7	1.40E-03	58%	Pass
80	1.970	11	2.21E-03	7	1.40E-03	64%	Pass
81	1.993	10	2.01E-03	7	1.40E-03	70%	Pass
82	2.016	10	2.01E-03	7	1.40E-03	70%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
83	2.039	9	1.81E-03	7	1.40E-03	78%	Pass
84	2.062	8	1.61E-03	6	1.20E-03	75%	Pass
85	2.085	8	1.61E-03	6	1.20E-03	75%	Pass
86	2.108	8	1.61E-03	6	1.20E-03	75%	Pass
87	2.131	8	1.61E-03	6	1.20E-03	75%	Pass
88	2.154	8	1.61E-03	6	1.20E-03	75%	Pass
89	2.177	7	1.40E-03	4	8.03E-04	57%	Pass
90	2.200	7	1.40E-03	4	8.03E-04	57%	Pass
91	2.223	7	1.40E-03	4	8.03E-04	57%	Pass
92	2.246	7	1.40E-03	4	8.03E-04	57%	Pass
93	2.269	7	1.40E-03	4	8.03E-04	57%	Pass
94	2.292	7	1.40E-03	4	8.03E-04	57%	Pass
95	2.315	7	1.40E-03	3	6.02E-04	43%	Pass
96	2.338	7	1.40E-03	3	6.02E-04	43%	Pass
97	2.361	7	1.40E-03	3	6.02E-04	43%	Pass
98	2.384	7	1.40E-03	3	6.02E-04	43%	Pass
99	2.407	7	1.40E-03	2	4.01E-04	29%	Pass
100	2.430	6	1.20E-03	2	4.01E-04	33%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	2.430	2.152	0.278
9	2.427	2.073	0.354
8	2.273	1.884	0.388
7	2.100	1.759	0.341
6	2.039	1.733	0.306
5	1.970	1.645	0.325
4	1.763	1.573	0.189
3	1.735	1.521	0.214
2	1.552	1.221	0.331

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)

Passerelle TM Phase 1 POC1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**2.430**	**2.43**
9	**2.427**	**2.43**
8	**2.27**	**2.35**
7	**2.10**	**2.13**
6	**2.04**	**2.04**
5	**1.97**	**1.97**
4	**1.76**	**1.76**
3	**1.73**	**1.74**
2	**1.55**	**1.55**

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

Peaks (cfs)	Date	Posit	Period of Return (Years)	
			Weibull	Cunnane
1.1702	3/8/1968	57	1.02	1.01
1.1723	1/18/1973	56	1.04	1.03
1.1723	1/29/1983	55	1.05	1.05
1.1742	2/27/1983	54	1.07	1.07
1.1746	1/16/1973	53	1.09	1.09
1.1777	1/25/1969	52	1.12	1.11
1.2013	1/22/1964	51	1.14	1.13
1.2116	1/29/1981	50	1.16	1.15
1.2296	2/15/1986	49	1.18	1.18
1.2333	1/16/1993	48	1.21	1.20
1.2703	3/11/1995	47	1.23	1.23
1.2713	11/30/2007	46	1.26	1.25
1.3093	2/6/1969	45	1.29	1.28
1.3097	11/14/1972	44	1.32	1.31
1.3098	2/14/1980	43	1.35	1.34
1.3102	2/8/1993	42	1.38	1.38
1.3275	1/11/2001	41	1.41	1.41
1.3726	11/15/1952	40	1.45	1.44
1.4159	6/10/1990	39	1.49	1.48
1.4295	12/29/1965	38	1.53	1.52
1.4429	1/15/1979	37	1.57	1.56
1.4524	3/24/1983	36	1.61	1.61
1.4535	2/15/1992	35	1.66	1.65
1.4641	11/22/1965	34	1.71	1.70
1.4677	2/25/1969	33	1.76	1.75
1.4755	12/6/1966	32	1.81	1.81
1.477	12/5/1966	31	1.87	1.87
1.5513	1/9/1998	30	1.93	1.93
1.5518	2/12/1992	29	2.00	2.00
1.5668	1/14/1993	28	2.07	2.07
1.5903	2/22/2004	27	2.15	2.15
1.5952	2/12/1978	26	2.23	2.23
1.631	1/18/1955	25	2.32	2.33
1.6447	2/19/1980	24	2.42	2.42
1.6462	2/11/1973	23	2.52	2.53
1.72	1/29/1980	22	2.64	2.65
1.7322	3/17/1982	21	2.76	2.78
1.7325	1/11/1980	20	2.90	2.92
1.7372	2/16/1980	19	3.05	3.08
1.7492	2/20/1980	18	3.22	3.25
1.7579	11/24/1983	17	3.41	3.45
1.7592	2/18/1980	16	3.63	3.67
1.7601	9/10/1976	15	3.87	3.92
1.7692	2/23/1998	14	4.14	4.21
1.7707	1/4/1978	13	4.46	4.54
1.9676	2/11/1959	12	4.83	4.93
1.9819	2/10/1963	11	5.27	5.40
2.0378	3/16/1986	10	5.80	5.96
2.057	3/5/1995	9	6.44	6.65
2.1642	2/10/1978	8	7.25	7.53
2.426	1/4/1995	7	8.29	8.67
2.4307	1/20/1982	6	9.67	10.21
2.438	4/5/1967	5	11.60	12.43
2.6629	1/10/1978	4	14.50	15.89
3.2424	10/1/1983	3	19.33	22.00
3.8463	1/16/1978	2	29.00	35.75
3.8505	1/1/1982	1	58.00	95.33

List of Peak events and Determination of Q2 and Q10 (Post-Development)
Passerelle TM Phase 1POC-1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**2.15**	**2.17**
9	**2.07**	**2.11**
8	**1.88**	**1.97**
7	**1.76**	**1.76**
6	**1.73**	**1.74**
5	**1.64**	**1.65**
4	**1.57**	**1.58**
3	**1.52**	**1.52**
2	**1.22**	**1.22**

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

Peaks (cfs)	Date	Posit	Period of Return (Years) Weibull	Period of Return (Years) Cunnane
0.723	2/8/1993	57	1.02	1.01
0.748	3/1/1978	56	1.04	1.03
0.754	2/8/1998	55	1.05	1.05
0.766	2/22/1998	54	1.07	1.07
0.773	3/17/1982	53	1.09	1.09
0.777	2/16/1980	52	1.12	1.11
0.783	1/7/1974	51	1.14	1.13
0.786	1/16/1952	50	1.16	1.15
0.82	10/20/2004	49	1.18	1.18
0.824	3/1/1970	48	1.21	1.20
0.832	3/5/1995	47	1.23	1.23
0.843	2/6/1969	46	1.26	1.25
0.849	2/23/2005	45	1.29	1.28
0.917	1/11/2001	44	1.32	1.31
0.923	1/18/1955	43	1.35	1.34
0.926	12/24/1971	42	1.38	1.38
0.951	1/26/1956	41	1.41	1.41
0.963	1/6/1979	40	1.45	1.44
0.976	3/1/1991	39	1.49	1.48
0.978	12/6/1997	38	1.53	1.52
0.994	11/29/1985	37	1.57	1.56
1.025	3/27/1991	36	1.61	1.61
1.05	11/29/1970	35	1.66	1.65
1.053	9/10/1976	34	1.71	1.70
1.069	1/11/2005	33	1.76	1.75
1.072	1/6/1993	32	1.81	1.81
1.112	1/20/1962	31	1.87	1.87
1.181	2/14/1980	30	1.93	1.93
1.221	1/9/2005	29	2.00	2.00
1.298	3/8/1968	28	2.07	2.07
1.3	2/19/1980	27	2.15	2.15
1.304	1/15/1978	26	2.23	2.23
1.352	1/25/1969	25	2.32	2.33
1.363	2/15/1986	24	2.42	2.42
1.378	1/11/1980	23	2.52	2.53
1.385	1/16/1993	22	2.64	2.65
1.508	3/11/1995	21	2.76	2.78
1.519	1/9/1998	20	2.90	2.92
1.523	11/30/2007	19	3.05	3.08
1.528	3/16/1986	18	3.22	3.25
1.544	3/5/1995	17	3.41	3.45
1.549	11/22/1965	16	3.63	3.67
1.562	2/25/1969	15	3.87	3.92
1.602	2/23/1998	14	4.14	4.21
1.609	12/6/1966	13	4.46	4.54
1.641	12/5/1966	12	4.83	4.93
1.667	2/21/1980	11	5.27	5.40
1.732	2/18/1980	10	5.80	5.96
1.752	1/29/1980	9	6.44	6.65
1.769	1/4/1978	8	7.25	7.53
2.047	2/10/1963	7	8.29	8.67
2.169	10/1/1983	6	9.67	10.21
2.176	1/20/1982	5	11.60	12.43
2.296	1/10/1978	4	14.50	15.89
2.407	1/4/1995	3	19.33	22.00
2.84	1/1/1982	2	29.00	35.75
3.303	1/16/1978	1	58.00	95.33

ATTACHMENT 4

AREA VS ELEVATION

The storage provided by the StormTech detention vault is entered into the Detention Module within SWMM – please refer to Attachment 7 for further information. A stage-storage relationship is provided on the following page for verification.

DISCHARGE VS ELEVATION

The orifices have been selected to maximize their size while still restricting flows to conform with the required 10% of the Q2 event flow as mandated in the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. While REC acknowledges that these orifices are small, to increase the size of these outlets would impact the basin's ability to restrict flows beneath the HMP thresholds, thus preventing the BMP from conformance with HMP requirements.

In order to further reduce the risk of blockage of the orifices, regular maintenance of the riser and orifices must be performed to ensure potential blockages are minimized. A detail of the orifice and riser structure is provided in Attachment 5 of this memorandum.

The LID low flow orifice discharge relationship is addressed within the LID Module within SWMM – please refer to Attachment 7 for further information.

DRAWDOWN CALCULATIONS

Surface drawdown calculations are provided on the following pages for reference and proof of draining within 24 hours. It is assumed the basin is full to the invert of the first surface outlet structure such that the only discharge mechanism available is the LID orifice.

DISCHARGE EQUATIONS

1) Weir:

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

2) Slot:

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

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

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

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

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

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

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 o 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.

Outlet structure for Discharge of Underground System

Discharge vs Elevation Table

Low orifice	1.8750	"	Lower slot			Lower Weir	
Number of orif:	1		# of slots:	1		Number of weirs:	1
Cg-low:	0.61		Invert:	2.25	ft	Invert:	3.75
			B	1.375	ft	B:	0.000
Middle orifice	1.125	"	h_{slot}	0.292	ft		
Number of orif:	0						
Cg-middle:	0.61		Upper slot			Emergency weir	
invert elev:	0.000	ft	# of slots:	0		Invert:	5.500
			Invert:	2.417	ft	W:	3.500 ft
			B:	2.167	ft		
			h_{slot}	0.125	ft		

*Note: h = head above the invert of the lowest surface discharge opening.

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)	Qweir (cfs)	Qemerg (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	0.533	0.889	0.007	0.008	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
0.167	1.067	1.778	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.028
0.250	1.600	2.667	0.039	0.049	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039
0.333	2.133	3.556	0.047	0.063	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047
0.417	2.667	4.444	0.055	0.068	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.055
0.500	3.200	5.333	0.061	0.069	0.061	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061
0.583	3.733	6.222	0.067	0.088	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.067
0.667	4.267	7.111	0.072	0.160	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.072
0.750	4.800	8.000	0.077	0.345	0.077	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.077
0.833	5.333	8.889	0.082	0.726	0.082	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.082
0.917	5.867	9.778	0.086	0.860	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086
1.000	6.400	10.667	0.090	0.901	0.090	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.090
1.083	6.933	11.556	0.094	0.941	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.094
1.167	7.467	12.444	0.098	0.979	0.098	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.098
1.250	8.000	13.333	0.102	1.016	0.102	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.102
1.333	8.533	14.222	0.105	1.052	0.105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105
1.417	9.067	15.111	0.109	1.086	0.109	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.109
1.500	9.600	16.000	0.112	1.119	0.112	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.112
1.583	10.133	16.889	0.115	1.152	0.115	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.115
1.667	10.667	17.778	0.118	1.183	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118
1.750	11.200	18.667	0.121	1.214	0.121	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.121
1.833	11.733	19.556	0.124	1.244	0.124	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.124
1.917	12.267	20.444	0.127	1.273	0.127	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.127
2.000	12.800	21.333	0.130	1.301	0.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.130
2.083	13.333	22.222	0.133	1.329	0.133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.133
2.167	13.867	23.111	0.136	1.357	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136
2.250	14.400	24.000	0.138	1.383	0.138	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.138
2.333	14.933	24.889	0.141	1.410	0.141	0.000	0.000	0.000	0.103	0.000	0.000	0.000	0.243
2.417	15.467	25.778	0.144	1.435	0.144	0.000	0.000	0.000	0.290	0.000	0.000	0.000	0.434
2.500	16.000	26.667	0.146	1.461	0.146	0.000	0.000	0.000	0.533	0.000	0.000	0.000	0.679
2.583	16.533	27.556	0.149	1.486	0.149	0.000	0.000	0.000	0.820	0.000	0.000	0.000	0.969
2.667	17.067	28.444	0.151	1.510	0.151	0.000	0.000	0.000	1.022	0.000	0.000	0.000	1.173
2.750	17.600	29.333	0.153	1.534	0.153	0.000	0.000	0.000	1.168	0.000	0.000	0.000	1.322
2.833	18.133	30.222	0.156	1.558	0.156	0.000	0.000	0.000	1.299	0.000	0.000	0.000	1.454
2.917	18.667	31.111	0.158	1.581	0.158	0.000	0.000	0.000	1.417	0.000	0.000	0.000	1.575
3.000	19.200	32.000	0.160	1.604	0.160	0.000	0.000	0.000	1.526	0.000	0.000	0.000	1.686
3.083	19.733	32.889	0.163	1.627	0.163	0.000	0.000	0.000	1.628	0.000	0.000	0.000	1.790
3.167	20.267	33.778	0.165	1.650	0.165	0.000	0.000	0.000	1.724	0.000	0.000	0.000	1.889
3.250	20.800	34.667	0.167	1.672	0.167	0.000	0.000	0.000	1.814	0.000	0.000	0.000	1.982
3.333	21.333	35.556	0.169	1.694	0.169	0.000	0.000	0.000	1.901	0.000	0.000	0.000	2.070
3.417	21.867	36.444	0.172	1.715	0.172	0.000	0.000	0.000	1.984	0.000	0.000	0.000	2.155
3.500	22.400	37.333	0.174	1.736	0.174	0.000	0.000	0.000	2.063	0.000	0.000	0.000	2.237
3.583	22.933	38.222	0.176	1.757	0.176	0.000	0.000	0.000	2.139	0.000	0.000	0.000	2.315
3.667	23.467	39.111	0.178	1.778	0.178	0.000	0.000	0.000	2.213	0.000	0.000	0.000	2.391
3.750	24.000	40.000	0.180	1.799	0.180	0.000	0.000	0.000	2.285	0.000	0.000	0.000	2.464
3.833	24.533	40.889	0.182	1.819	0.182	0.000	0.000	0.000	2.354	0.000	0.000	0.000	2.536
3.917	25.067	41.778	0.184	1.839	0.184	0.000	0.000	0.000	2.421	0.000	0.000	0.000	2.605
4.000	25.600	42.667	0.186	1.859	0.186	0.000	0.000	0.000	2.486	0.000	0.000	0.000	2.672
4.083	26.133	43.556	0.188	1.879	0.188	0.000	0.000	0.000	2.550	0.000	0.000	0.000	2.738
4.167	26.667	44.444	0.190	1.898	0.190	0.000	0.000	0.000	2.612	0.000	0.000	0.000	2.802
4.250	27.200	45.333	0.192	1.917	0.192	0.000	0.000	0.000	2.673	0.000	0.000	0.000	2.865
4.333	27.733	46.222	0.194	1.936	0.194	0.000	0.000	0.000	2.733	0.000	0.000	0.000	2.926
4.417	28.267	47.111	0.196	1.955	0.196	0.000	0.000	0.000	2.791	0.000	0.000	0.000	2.986
4.500	28.800	48.000	0.197	1.974	0.197	0.000	0.000	0.000	2.848	0.000	0.000	0.000	3.045
4.583	29.333	48.889	0.199	1.992	0.199	0.000	0.000	0.000	2.904	0.000	0.000	0.000	3.103
4.667	29.867	49.778	0.201	2.011	0.201	0.000	0.000	0.000	2.958	0.000	0.000	0.000	3.159
4.750	30.400	50.667	0.203	2.029	0.203	0.000	0.000	0.000	3.012	0.000	0.000	0.000	3.215
4.833	30.933	51.556	0.205	2.047	0.205	0.000	0.000	0.000	3.065	0.000	0.000	0.000	3.270
4.917	31.467	52.444	0.206	2.065	0.206	0.000	0.000	0.000	3.117	0.000	0.000	0.000	3.323
5.000	32.000	53.333	0.208	2.082	0.208	0.000	0.000	0.000	3.168	0.000	0.000	0.000	3.376
5.083	32.533	54.222	0.210	2.100	0.210	0.000	0.000	0.000	3.218	0.000	0.000	0.000	3.428
5.167	33.067	55.111	0.212	2.117	0.212	0.000	0.000	0.000	3.268	0.000	0.000	0.000	3.480
5.250	33.600	56.000	0.213	2.135	0.213	0.000	0.000	0.000	3.317	0.000	0.000	0.000	3.530
5.333	34.133	56.889	0.215	2.152	0.215	0.000	0.000	0.000	3.365	0.000	0.000	0.000	3.580
5.417	34.667	57.778	0.217	2.169	0.217	0.000	0.000	0.000	3.412	0.000	0.000	0.000	3.629
5.500	35.200	58.667	0.219	2.186	0.219	0.000	0.000	0.000	3.459	0.000	0.000	0.000	3.677
5.583	35.733	59.556	0.220	2.202	0.220	0.000	0.000	0.000	3.505	0.000	0.000	0.261	3.986
5.667	36.267	60.444	0.222	2.219	0.222	0.000	0.000	0.000	3.551	0.000	0.000	0.738	4.511
5.750	36.800	61.333	0.224	2.235	0.224	0.000	0.000	0.000	3.595	0.000	0.000	1.356	5.175
5.833	37.333	62.222	0.225	2.252	0.225	0.000	0.000	0.000	3.640	0.000	0.000	2.088	5.953
5.917	37.867	63.111	0.227	2.268	0.227	0.000	0.000	0.000	3.684	0.000	0.000	2.918	6.829
6.000	38.400	64.000	0.228	2.284	0.228	0.000	0.000	0.000	3.727	0.000	0.000	3.836	7.792
6.083	38.933	64.889	0.230	2.300	0.230	0.000	0.000	0.000	3.770	0.000	0.000	4.834	8.834
6.167	39.467	65.778	0.232	2.316	0.232	0.000	0.000	0.000	3.812	0.000	0.000	5.906	9.950
6.250	40.000	66.667	0.233	2.332	0.233	0.000	0.000	0.000	3.854	0.000	0.000	7.047	11.135

Diversion Structure: 2 pipes - PARCEL 1

Discharge vs Elevation Table

Low orifice	3.000 "	Lower slot		Lower Weir	
Number of orif:	1	# of slots:	0	Number of weirs:	0
Cg-low:	0.61	Invert:	2.25 ft	Invert:	3.75
		B	0.000 ft	B:	0.000
Middle orifice	18.000 "	h_{slot}	0.000 ft		
Number of orif:	1				
Cg-middle:	0.61	Upper slot		Emergency weir	
invert elev:	0.750 ft	# of slots:	0	Invert:	5.500
		Invert:	2.500 ft	W:	0.000 ft
*Note: h = head above the invert of the lowest surface discharge opening.		B:	0.000 ft		
		h_{slot}	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)	Qweir (cfs)	Qemerg (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.083	0.333	0.000	0.000	0.011	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.167	0.667	0.000	0.049	0.041	0.041	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.041
0.250	1.000	0.000	0.085	0.081	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.081
0.333	1.333	0.000	0.110	0.125	0.110	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.110
0.417	1.667	0.000	0.130	0.165	0.130	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.130
0.500	2.000	0.000	0.147	0.195	0.147	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.147
0.583	2.333	0.000	0.163	0.213	0.163	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.163
0.667	2.667	0.000	0.177	0.219	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177
0.750	3.000	0.000	0.190	0.221	0.190	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.190
0.833	3.333	0.056	0.202	0.230	0.202	0.000	0.030	0.030	0.000	0.000	0.000	0.000	0.232
0.917	3.667	0.111	0.214	0.270	0.214	0.000	0.116	0.116	0.000	0.000	0.000	0.000	0.330
1.000	4.000	0.167	0.225	0.369	0.225	0.000	0.256	0.256	0.000	0.000	0.000	0.000	0.481
1.083	4.333	0.222	0.235	0.568	0.235	0.000	0.449	0.449	0.000	0.000	0.000	0.000	0.684
1.167	4.667	0.278	0.245	0.919	0.245	0.000	0.691	0.691	0.000	0.000	0.000	0.000	0.937
1.250	5.000	0.333	0.255	1.488	0.255	0.000	0.982	0.982	0.000	0.000	0.000	0.000	1.236
1.333	5.333	0.389	0.264	2.351	0.264	0.000	1.317	1.317	0.000	0.000	0.000	0.000	1.581
1.417	5.667	0.444	0.273	2.731	0.273	0.000	1.695	1.695	0.000	0.000	0.000	0.000	1.968
1.500	6.000	0.500	0.282	2.818	0.282	0.000	2.112	2.112	0.000	0.000	0.000	0.000	2.394
1.583	6.333	0.556	0.290	2.902	0.290	2.497	2.567	2.567	0.000	0.000	0.000	0.000	2.857
1.667	6.667	0.611	0.298	2.984	0.298	3.532	3.055	3.055	0.000	0.000	0.000	0.000	3.353
1.750	7.000	0.667	0.306	3.063	0.306	4.325	3.574	3.574	0.000	0.000	0.000	0.000	3.880
1.833	7.333	0.722	0.314	3.141	0.314	4.994	4.121	4.121	0.000	0.000	0.000	0.000	4.435
1.917	7.667	0.778	0.322	3.216	0.322	5.584	4.692	4.692	0.000	0.000	0.000	0.000	5.014
2.000	8.000	0.833	0.329	3.290	0.329	6.117	5.285	5.285	0.000	0.000	0.000	0.000	5.614
2.083	8.333	0.889	0.336	3.363	0.336	6.607	5.895	5.895	0.000	0.000	0.000	0.000	6.232
2.167	8.667	0.944	0.343	3.433	0.343	7.063	6.521	6.521	0.000	0.000	0.000	0.000	6.864
2.250	9.000	1.000	0.350	3.503	0.350	7.492	7.158	7.158	0.000	0.000	0.000	0.000	7.508
2.333	9.333	1.056	0.357	3.571	0.357	7.897	7.803	7.803	0.000	0.000	0.000	0.000	8.160
2.417	9.667	1.111	0.364	3.638	0.364	8.282	8.453	8.282	0.000	0.000	0.000	0.000	8.646
2.500	10.000	1.167	0.370	3.703	0.370	8.651	9.105	8.651	0.000	0.000	0.000	0.000	9.021
2.583	10.333	1.222	0.377	3.768	0.377	9.004	9.755	9.004	0.000	0.000	0.000	0.000	9.381
2.667	10.667	1.278	0.383	3.831	0.383	9.344	10.401	9.344	0.000	0.000	0.000	0.000	9.727
2.750	11.000	1.333	0.389	3.893	0.389	9.672	11.040	9.672	0.000	0.000	0.000	0.000	10.061
2.833	11.333	1.389	0.395	3.955	0.395	9.989	11.669	9.989	0.000	0.000	0.000	0.000	10.384
2.917	11.667	1.444	0.401	4.015	0.401	10.296	12.285	10.296	0.000	0.000	0.000	0.000	10.698
3.000	12.000	1.500	0.407	4.074	0.407	10.595	12.885	10.595	0.000	0.000	0.000	0.000	11.002
3.083	12.333	1.556	0.413	4.133	0.413	10.885	13.467	10.885	0.000	0.000	0.000	0.000	11.298
3.167	12.667	1.611	0.419	4.191	0.419	11.168	14.029	11.168	0.000	0.000	0.000	0.000	11.587
3.250	13.000	1.667	0.425	4.248	0.425	11.444	14.568	11.444	0.000	0.000	0.000	0.000	11.868
3.333	13.333	1.722	0.430	4.304	0.430	11.713	15.083	11.713	0.000	0.000	0.000	0.000	12.143
3.417	13.667	1.778	0.436	4.360	0.436	11.976	15.571	11.976	0.000	0.000	0.000	0.000	12.412
3.500	14.000	1.833	0.441	4.414	0.441	12.234	16.032	12.234	0.000	0.000	0.000	0.000	12.675

Project: CAMPUS PARK, PARCEL 1

Chamber Model -	MC-4500	
Units -	Imperial	Click Here for Metric
Number of Chambers -	96	
Number of End Caps -	8	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	0.00	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in
Area of system -	4180	sf Min. Area - 3781 sf min. area

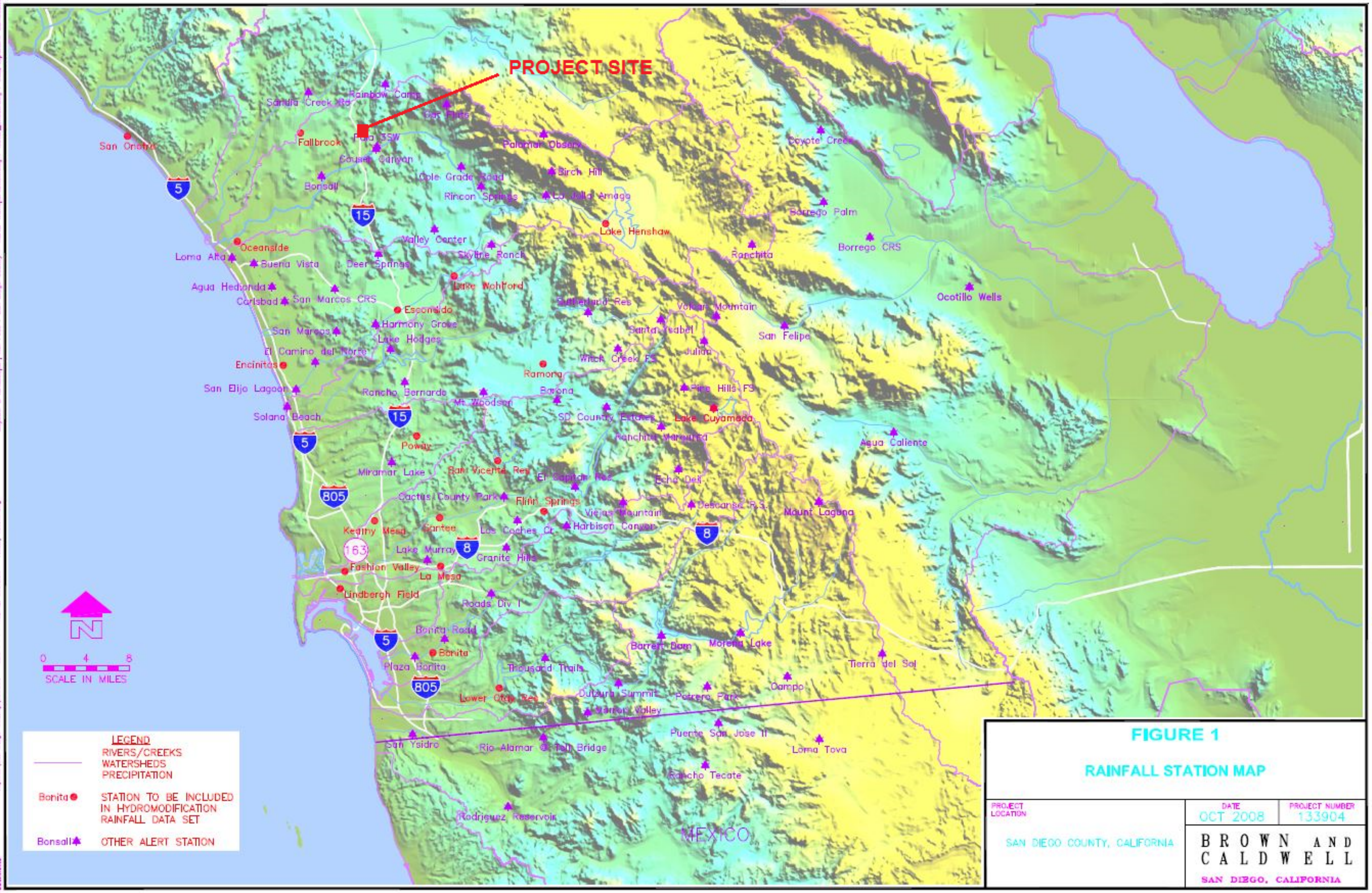
☑ Include Perimeter Stone in Calculations

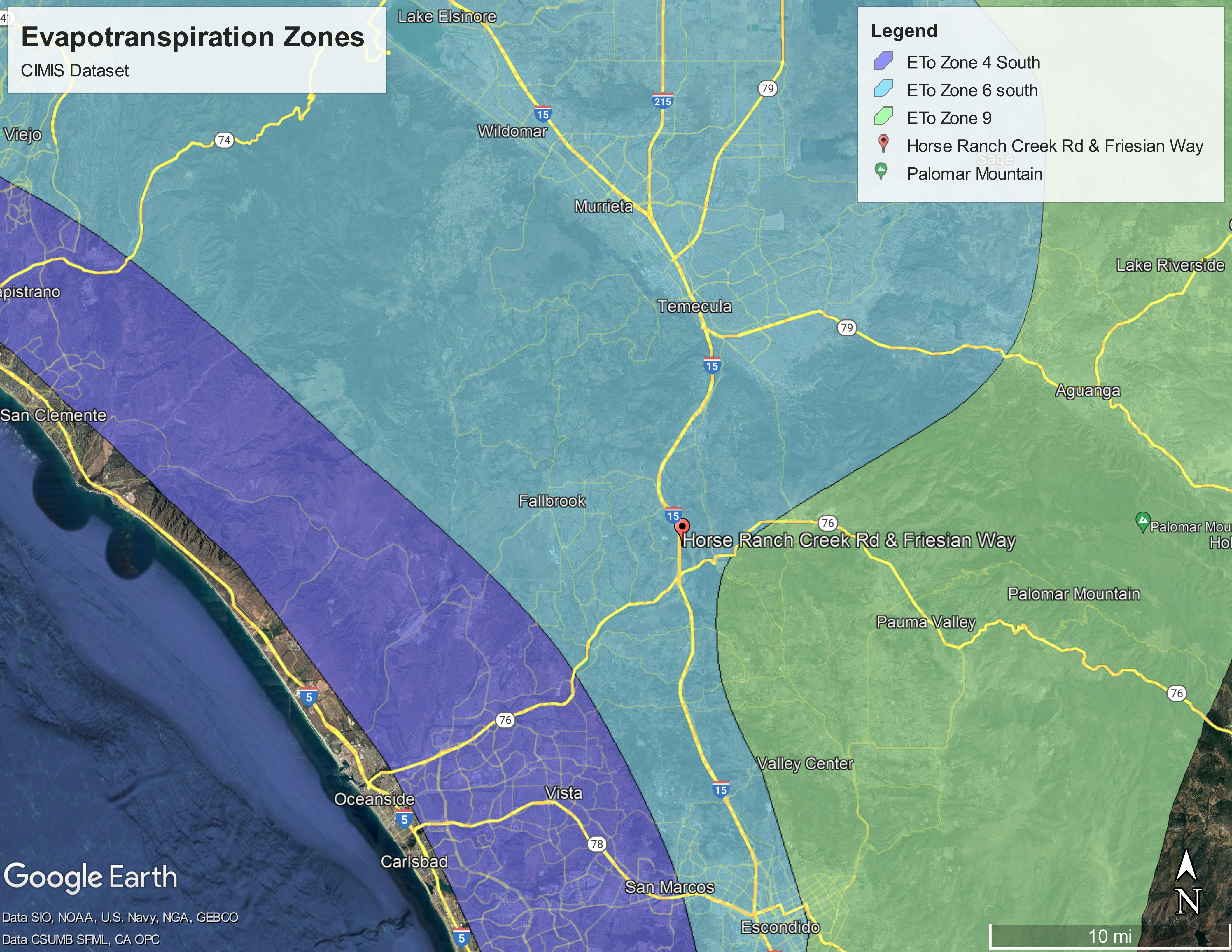
StormTech MC-4500 Cumulative Storage Volumes

Height of System *(inches)*	Incremental Single Chamber *(cubic feet)*	Incremental Single End Cap *(cubic feet)*	Incremental Chambers *(cubic feet)*	Incremental End Cap *(cubic feet)*	Incremental Stone *(cubic feet)*	Incremental Ch, EC and Stone *(cubic feet)*	Cumulative System (cubic feet)	Elevation (feet)
81	0.00	0.00	0.00	0.00	139.33	139.33	17610.59	6.75
80	0.00	0.00	0.00	0.00	139.33	139.33	17471.26	6.67
79	0.00	0.00	0.00	0.00	139.33	139.33	17331.93	6.58
78	0.00	0.00	0.00	0.00	139.33	139.33	17192.59	6.50
77	0.00	0.00	0.00	0.00	139.33	139.33	17053.26	6.42
76	0.00	0.00	0.00	0.00	139.33	139.33	16913.93	6.33
75	0.00	0.00	0.00	0.00	139.33	139.33	16774.59	6.25
74	0.00	0.00	0.00	0.00	139.33	139.33	16635.26	6.17
73	0.00	0.00	0.00	0.00	139.33	139.33	16495.93	6.08
72	0.00	0.00	0.00	0.00	139.33	139.33	16356.59	6.00
71	0.00	0.00	0.00	0.00	139.33	139.33	16217.26	5.92
70	0.00	0.00	0.00	0.00	139.33	139.33	16077.93	5.83
69	0.04	0.01	3.93	0.10	137.72	141.76	15938.59	5.75
68	0.12	0.03	11.15	0.27	134.77	146.18	15796.84	5.67
67	0.16	0.05	15.81	0.41	132.84	149.07	15650.65	5.58
66	0.21	0.07	20.04	0.53	131.11	151.67	15501.58	5.50
65	0.27	0.08	25.76	0.66	128.76	155.19	15349.91	5.42
64	0.45	0.11	43.47	0.84	121.61	165.92	15194.72	5.33
63	0.67	0.13	63.87	1.06	113.36	178.29	15028.80	5.25
62	0.80	0.16	76.71	1.29	108.14	186.13	14850.51	5.17
61	0.91	0.19	87.18	1.51	103.86	192.55	14664.39	5.08
60	1.00	0.22	96.28	1.75	100.12	198.15	14471.84	5.00
59	1.09	0.25	104.38	1.98	96.79	203.15	14273.69	4.92
58	1.16	0.28	111.69	2.20	93.77	207.67	14070.54	4.83
57	1.23	0.30	118.46	2.41	90.98	211.86	13862.87	4.75
56	1.30	0.33	124.77	2.62	88.38	215.77	13651.01	4.67
55	1.36	0.35	130.66	2.84	85.94	219.43	13435.24	4.58
54	1.42	0.38	136.20	3.07	83.63	222.89	13215.81	4.50
53	1.47	0.41	141.44	3.27	81.45	226.16	12992.92	4.42
52	1.53	0.44	146.41	3.53	79.36	229.30	12766.76	4.33
51	1.57	0.47	151.15	3.75	77.37	232.27	12537.46	4.25
50	1.62	0.50	155.65	3.96	75.49	235.10	12305.18	4.17
49	1.67	0.52	159.96	4.17	73.68	237.81	12070.08	4.08
48	1.71	0.54	164.07	4.36	71.96	240.39	11832.27	4.00
47	1.75	0.57	168.01	4.53	70.32	242.86	11591.88	3.92
46	1.79	0.59	171.77	4.71	68.74	245.22	11349.02	3.83
45	1.83	0.61	175.41	4.88	67.22	247.51	11103.80	3.75
44	1.86	0.63	178.89	5.06	65.75	249.70	10856.29	3.67
43	1.90	0.64	182.24	5.14	64.38	251.76	10606.59	3.58
42	1.93	0.68	185.46	5.42	62.98	253.86	10354.83	3.50
41	1.96	0.70	188.55	5.60	61.67	255.82	10100.97	3.42
40	2.00	0.72	191.53	5.78	60.41	257.72	9845.15	3.33
39	2.03	0.74	194.40	5.95	59.19	259.54	9587.43	3.25
38	2.05	0.76	197.16	6.12	58.02	261.30	9327.88	3.17
37	2.08	0.79	199.82	6.28	56.89	263.00	9066.58	3.08
36	2.11	0.80	202.38	6.42	55.81	264.61	8803.58	3.00
35	2.13	0.82	204.85	6.56	54.77	266.18	8538.97	2.92
34	2.16	0.84	207.23	6.71	53.76	267.70	8272.79	2.83
33	2.18	0.85	209.52	6.81	52.80	269.13	8005.10	2.75
32	2.21	0.86	211.73	6.88	51.89	270.50	7735.96	2.67
31	2.23	0.89	213.85	7.12	50.95	271.92	7465.47	2.58
30	2.25	0.90	215.89	7.23	50.08	273.21	7193.55	2.50
29	2.27	0.92	217.86	7.34	49.26	274.45	6920.34	2.42
28	2.29	0.92	219.74	7.36	48.49	275.59	6645.89	2.33
27	2.31	0.94	221.55	7.55	47.69	276.79	6370.30	2.25
26	2.33	0.96	223.29	7.65	46.96	277.90	6093.50	2.17
25	2.34	0.97	224.96	7.75	46.25	278.96	5815.60	2.08
24	2.36	0.98	226.55	7.85	45.57	279.97	5536.65	2.00
23	2.38	0.97	228.08	7.77	45.00	280.84	5256.67	1.92
22	2.39	1.00	229.53	8.03	44.31	281.87	4975.83	1.83
21	2.41	1.01	230.92	8.09	43.73	282.74	4693.96	1.75
20	2.42	1.02	232.25	8.16	43.17	283.58	4411.22	1.67
19	2.43	1.03	233.51	8.24	42.63	284.38	4127.64	1.58
18	2.44	1.04	234.70	8.31	42.13	285.14	3843.26	1.50
17	2.46	1.05	235.84	8.37	41.65	285.86	3558.12	1.42
16	2.47	1.05	236.91	8.43	41.20	286.54	3272.26	1.33
15	2.48	1.05	237.92	8.40	40.81	287.12	2985.72	1.25
14	2.49	1.06	238.87	8.45	40.40	287.73	2698.60	1.17
13	2.50	1.08	239.78	8.60	39.98	288.36	2410.87	1.08
12	2.51	1.08	240.62	8.66	39.62	288.91	2122.50	1.00
11	2.51	1.09	241.41	8.70	39.29	289.40	1833.60	0.92
10	2.53	1.11	242.59	8.85	38.76	290.20	1544.20	0.83
9	0.00	0.00	0.00	0.00	139.33	139.33	1254.00	0.75
8	0.00	0.00	0.00	0.00	139.33	139.33	1114.67	0.67
7	0.00	0.00	0.00	0.00	139.33	139.33	975.33	0.58
6	0.00	0.00	0.00	0.00	139.33	139.33	836.00	0.50
5	0.00	0.00	0.00	0.00	139.33	139.33	696.67	0.42
4	0.00	0.00	0.00	0.00	139.33	139.33	557.33	0.33
3	0.00	0.00	0.00	0.00	139.33	139.33	418.00	0.25
2	0.00	0.00	0.00	0.00	139.33	139.33	278.67	0.17
1	0.00	0.00	0.00	0.00	139.33	139.33	139.33	0.08

ATTACHMENT 5

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


PROJECT SITE
Pala 3SW
Rainbow Camp
Sandia Creek Rd
Fallbrook
San Onofre
Couser Canyon
Bonsall
Cole Grade Road
Rincon Springs
Palomar Observ.
Birch Hill
La Jolla Amago
Lake Henshaw
Coyote Creek
Borrego Palm
Borrego CRS
Ranchita
Ocotillo Wells
Oceanside
Loma Alta
Buena Vista
Valley Center
Deer Springs
Skyline Ranch
Lake Wohlford
Agua Hedionda
Carlsbad
San Marcos CRS
Escondido
Harmony Grove
San Marcos
Lake Hodges
El Camino del Norte
Encinitas
Sutherland Res
Volcan Mountain
Santa Ysabel
Julian
San Felipe
Witch Creek FS
Ramona
Barona
San Elijo Lagoon
Solana Beach
Rancho Bernardo
Mt Woodson
SD County Estates
Pine Hills FS
Lake Cuyamaca
Agua Caliente
Poway
Miramar Lake
San Vicente Res
El Capitan Res
Echo Dell
Cactus County Park
Flinn Springs
Viejas Mountain
Descanso R.S.
Mount Laguna
Kearny Mesa
Santee
Los Coches Cr
Harbison Canyon
Lake Murray
Granite Hills
Fashion Valley
La Mesa
Lindbergh Field
Roads Div I
Bonita Road
Bonita
Plaza Bonita
Thousand Trails
Barrett Dam
Morena Lake
Tierra del Sol
Campo
Lower Otay Res
Dulzura Summit
Potrero Park
Puente San Jose II
San Ysidro
Rio Alamar Toll Bridge
Loma Tova
Rancho Tecate
Rodriguez Reservoir
MEXICO
5
15
805
163
8
N
0 4 8
SCALE IN MILES
LEGEND
RIVERS/CREEKS
WATERSHEDS
PRECIPITATION
Bonita
STATION TO BE INCLUDED IN HYDROMODIFICATION RAINFALL DATA SET
Bonsall
OTHER ALERT STATION
FIGURE 1
RAINFALL STATION MAP
PROJECT LOCATION
SAN DIEGO COUNTY, CALIFORNIA
DATE
OCT 2008
PROJECT NUMBER
133904
BROWN AND CALDWELL
SAN DIEGO, CALIFORNIA



Evapotranspiration Zones
CIMIS Dataset
Legend
ETo Zone 4 South
ETo Zone 6 south
ETo Zone 9
Horse Ranch Creek Rd & Friesian Way
Palomar Mountain
Lake Elsinore
Wildomar
Murrieta
Temecula
Viejo
apistrano
San Clemente
Fallbrook
Aguanga
Lake Riverside
Sage
Pauma Valley
Palomar Mountain
Valley Center
Oceanside
Vista
Carlsbad
San Marcos
Escondido
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data CSUMB SFML, CA OPC
10 mi
N

LEGEND

- EX. STORM DRAIN
- PROP. STORM DRAIN
- EX. INLET/CATCHBASIN/CLEANOUT
- DRAINAGE MANAGEMENT AREA BOUNDARY
- DRAINAGE DIRECTION

NOTES

1. CCSYA: NONE. SEE EXHIBIT IN ATTACHMENT 9
2. HYDROLOGIC SOIL GROUP: TYPE C PER COUNTY SOIL MAP
3. APPROXIMATE DEPTH TO GROUNDWATER: >10' (PREGRADED LOT)
4. EXISTING HYDRAULIC FEATURES: NONE

30 15 0 30 60 90

SCALE: 1" = 30'

PRE-DEVELOPED SUMMARY						
DMA	Total Area (sf)	Total Area (ac)	Impervious Area (sf)	Impervious Area (ac)	Pervious Area (sf)	Pervious Area (ac)
A	128,261	2.944	0	0.000	128,261	2.944

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

REC Consultants, Inc.

Civil Engineering • Environmental Land Surveying

2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

SHEET TITLE
PRE-DEVELOPED HMP EXHIBIT

PROJECT
CAMPUS PARK CONDOS
Horse Ranch Creek Rd
Fallbrook, CA 92028

DATE: 2/11/21
SCALE: 1" = 30'
DRAWN: WOG
CHECKED: WOG

SHEET 1 OF 1 SHEETS

LEGEND

- EX. STORM DRAIN
- PROP. STORM DRAIN
- EX. INLET/CATCHBASIN/CLEANOUT
- DRAINAGE MANAGEMENT AREA BOUNDARY
- DRAINAGE DIRECTION
- PROP. INLET/CATCHBASIN/CLEANOUT

SITE DESIGN BMPS

- SC-1 PREVENTION OF ILLICIT DISCHARGES INTO THE MS4
- SC-5 PROTECT TRASH STORAGE AREAS FROM RAINFALL, RUN-ON, RUNOFF, AND WIND DISPERSAL
- SC-6D1 NEED FOR FUTURE INDOOR & STRUCTURAL PEST CONTROL
- SC-6D2 LANDSCAPE/OUTDOOR PESTICIDE USE
- SC-6G REFUSE AREAS
- SC-6N FIRE SPRINKLER TEST WATER
- SC-6O MISCELLANEOUS DRAIN OR WASH WATER
- SC-6Q PLAZAS, SIDEWALKS, AND PARKING LOTS

SOURCE CONTROL BMPS

- SD-3 MINIMIZE IMPERVIOUS AREA
- SD-4 MINIMIZE SOIL COMPACTION
- SD-5 IMPERVIOUS AREA DISPERSION
- SD-6 RUNOFF COLLECTION
- SD-7 LANDSCAPING WITH NATIVE OR DROUGHT TOLERANT SPECIES

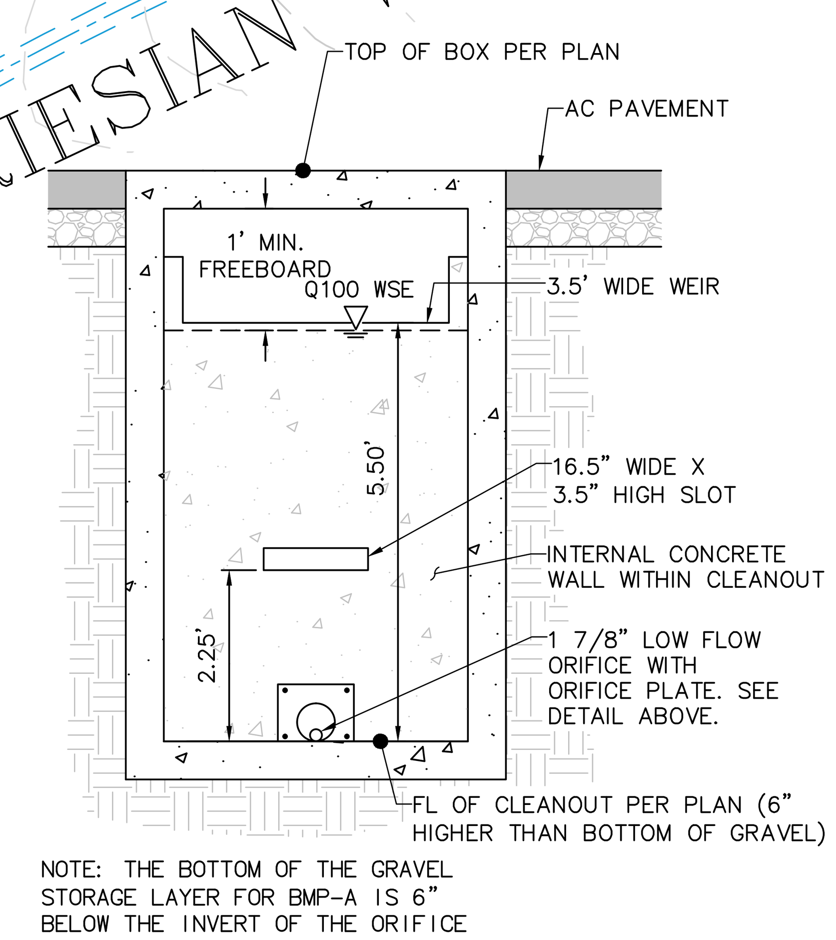
POST-CONSTRUCTION BMPS

- MODULAR WETLAND SYSTEM (BF-3)
- UNDERGROUND STORAGE TANK

NOTES

1. CCSYA: NONE. SEE EXHIBIT IN ATTACHMENT 9
2. HYDROLOGIC SOIL GROUP: TYPE C PER COUNTY SOIL MAP
3. APPROXIMATE DEPTH TO GROUNDWATER: >10' (PREGRADED LOT)
4. EXISTING HYDRAULIC FEATURES: NONE
5. EACH UNIT ASSUMED TO HAVE A 32'X10' MINIMUM IMPERVIOUS PATIO (NOT SHOWN)

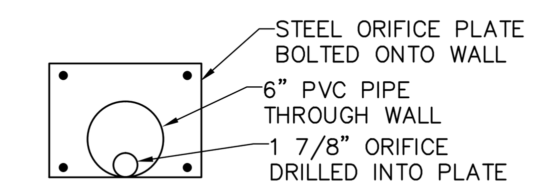
DMA & BMP SUMMARY TABLE								
DMA	DMA TYPE	BMP	TOTAL AREA (SF)	TOTAL AREA (AC)	IMPERVIOUS AREA (SF)	IMPERVIOUS AREA (AC)	PERVIOUS AREA (SF)	PERVIOUS AREA (AC)
A	DRAINS TO BMP	BMP-A: MODULAR WETLAND SYSTEM (BF-2) & BMP-B: UNDERGROUND STORAGE TANK	119,764	2.749	91,623	2.103	28,141	0.646
B	SELF-MITIGATING	N/A	8,497	0.195	0	0.000	8,497	0.195
TOTAL			128,261	2.944	91,623	2.103	36,638	0.841



NOTE: THE BOTTOM OF THE GRAVEL STORAGE LAYER FOR BMP-A IS 6" BELOW THE INVERT OF THE ORIFICE

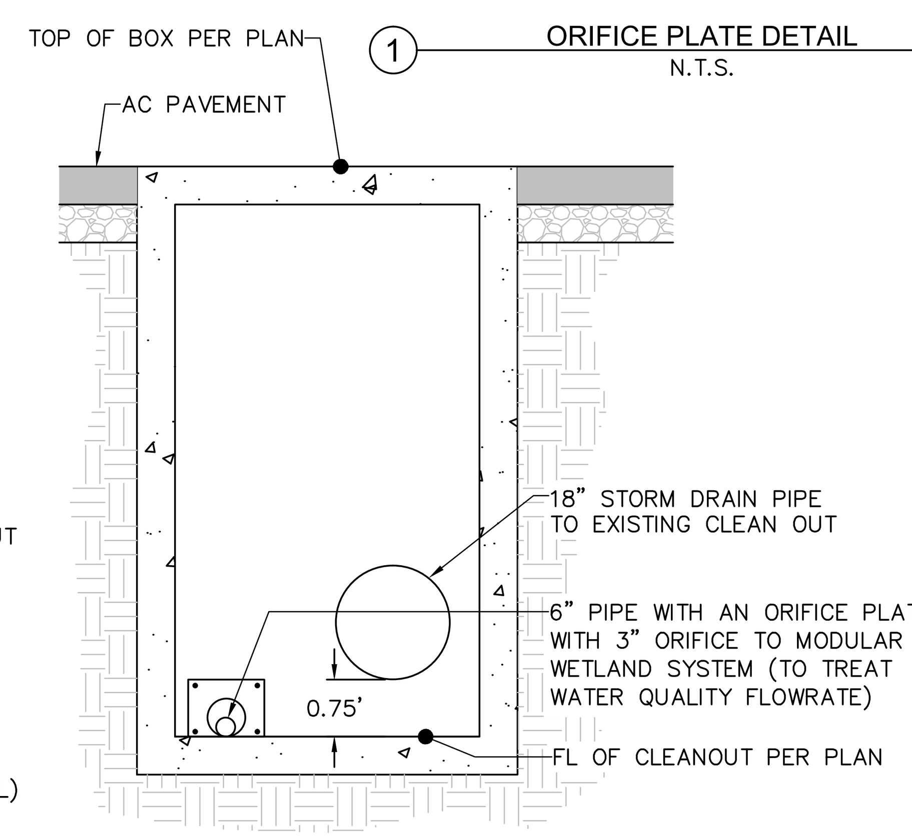
A OUTLET STRUCTURE

SCALE: 1"=2'



1 ORIFICE PLATE DETAIL

N.T.S.



B WQ DIVERSION STRUCTURE

SCALE: 1"=2'

R·E·C Consultants, Inc.
Civil Engineering Environmental
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

REVISIONS		
BY	DATE	DESCRIPTION

JOB NO. 1581

POST DEVELOPED DMA & HMP EXHIBIT
PASSERELLE (PARCEL 1)

COUNTY OF SAN DIEGO TRACT NO. ____

County of San Diego, California

SHEET NO.

10 OF 11

ATTACHMENT 6

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

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           07/24/1951
START_TIME           00:00:00
REPORT_START_DATE    07/24/1951
REPORT_START_TIME    00:00:00
END_DATE             05/24/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00
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      0.06   0.08   0.11   0.16   0.18   0.21   0.21   0.20   0.16   0.12   0.08   0.06
DRY_ONLY     NO

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

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
Flat-C           FALLBROOK        POC-1            2.6641   0        516      1.5      0
Slope-C          FALLBROOK        POC-1            0.2803   0        305      33       0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
Flat-C           0.012      0.05       0.05       0.10       25         OUTLET
Slope-C          0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
Flat-C           6          0.10       0.31
Slope-C          6          0.10       0.31

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

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
FALLBROOK        FILE "Fallbrook.txt"
```

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

[TAGS]

[MAP]
DIMENSIONS 2362.500 4900.000 2637.500 7100.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            2500.000           5000.000

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

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Flat-C           2500.000           6000.000
Slope-C          2950.000           6000.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
FALLBROOK        2500.000           6500.000
```

POST_DEV_1

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           07/24/1951
START_TIME           00:00:00
REPORT_START_DATE    07/24/1951
REPORT_START_TIME    00:00:00
END_DATE             05/24/2008
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00
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      0.06   0.08   0.11   0.16   0.18   0.21   0.21   0.20   0.16   0.12   0.08   0.06
DRY_ONLY     NO

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

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
DMA-1-C          FALLBROOK        UND-Campus       2.7494   76.50    614      2.0      0
BYPASS-C         FALLBROOK        POC-1            0.195    0        305      33       0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1-C          0.012      0.05       0.05       0.10       25         OUTLET
BYPASS-C         0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
DMA-1-C          6          0.075      0.31
BYPASS-C         6          0.10       0.31

[LID_CONTROLS]
;;               Type/Layer Parameters
;;-------------- ---------- ----------
LID-1            BC
LID-1            SURFACE    10.2       0.05       0          0          5
LID-1            SOIL       18         0.4        0.2        0.1        5          5          1.5
LID-1            STORAGE    21         0.67       0          0
LID-1            DRAIN      0.3642     0.5        3          6

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

POST_DEV_1

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

[DIVIDERS]
;;               Invert     Diverted         Divider
;;Name           Elev.      Link             Type       Parameters
;;-------------- ---------- ---------------- ---------- ----------
Div-UND          0          Low-Flow         TABULAR    Und-Div          0          0          0          0

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                     Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                    Area     Frac.    Infiltration Parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- -----------------------
UND-Campus       0        6.75     0        TABULAR    UND-Campus                1672     0        6        0.1875   0.31

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
Low-Flow         Div-UND          POC-1            100        0.01       0          0          0          0
Overflow         Div-UND          POC-1            100        0.01       0          0          0          0

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet          Qcoeff/                     Flap
;;Name           Node             Node             Height     Type            QTable           Qexpon     Gate
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------- ----
U-Campus         UND-Campus       Div-UND          0          TABULAR/HEAD    U-Out-Campus                NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
Low-Flow         DUMMY        0                0          0          0          1
Overflow         DUMMY        0                0          0          0          1

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate
;;-------------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
Und-Div          Diversion  0          0
Und-Div                     0.190      0.190
Und-Div                     0.232      0.202
Und-Div                     0.330      0.214
Und-Div                     0.481      0.225
Und-Div                     0.684      0.235
Und-Div                     0.937      0.245
Und-Div                     1.236      0.255
Und-Div                     1.581      0.264
Und-Div                     1.968      0.273
Und-Div                     2.394      0.282
Und-Div                     2.857      0.290
Und-Div                     3.353      0.298
Und-Div                     3.880      0.306
Und-Div                     4.435      0.314
Und-Div                     5.014      0.322
Und-Div                     5.614      0.329
Und-Div                     6.232      0.336
Und-Div                     6.864      0.343
Und-Div                     7.508      0.350
Und-Div                     8.160      0.357
Und-Div                     8.646      0.364
Und-Div                     9.021      0.370
Und-Div                     9.381      0.377
Und-Div                     9.727      0.383
Und-Div                     10.061     0.389
Und-Div                     10.384     0.395
Und-Div                     10.698     0.401
Und-Div                     11.002     0.407
Und-Div                     11.298     0.413
```

POST_DEV_1

Und-Div		11.587	0.419
Und-Div		11.868	0.425
Und-Div		12.143	0.430
Und-Div		12.412	0.436
Und-Div		12.675	0.441
U-Out-Campus	Rating	0	0.000
U-Out-Campus		0.50	0.000
U-Out-Campus		0.58	0.008
U-Out-Campus		0.67	0.028
U-Out-Campus		0.75	0.039
U-Out-Campus		0.83	0.047
U-Out-Campus		0.92	0.055
U-Out-Campus		1.00	0.061
U-Out-Campus		1.08	0.067
U-Out-Campus		1.17	0.072
U-Out-Campus		1.25	0.077
U-Out-Campus		1.33	0.082
U-Out-Campus		1.42	0.086
U-Out-Campus		1.50	0.090
U-Out-Campus		1.58	0.094
U-Out-Campus		1.67	0.098
U-Out-Campus		1.75	0.102
U-Out-Campus		1.83	0.105
U-Out-Campus		1.92	0.109
U-Out-Campus		2.00	0.112
U-Out-Campus		2.08	0.115
U-Out-Campus		2.17	0.118
U-Out-Campus		2.25	0.121
U-Out-Campus		2.33	0.124
U-Out-Campus		2.42	0.127
U-Out-Campus		2.50	0.130
U-Out-Campus		2.58	0.133
U-Out-Campus		2.67	0.136
U-Out-Campus		2.75	0.138
U-Out-Campus		2.83	0.243
U-Out-Campus		2.92	0.434
U-Out-Campus		3.00	0.679
U-Out-Campus		3.08	0.969
U-Out-Campus		3.17	1.173
U-Out-Campus		3.25	1.322
U-Out-Campus		3.33	1.454
U-Out-Campus		3.42	1.575
U-Out-Campus		3.50	1.686
U-Out-Campus		3.58	1.790
U-Out-Campus		3.67	1.889
U-Out-Campus		3.75	1.982
U-Out-Campus		3.83	2.070
U-Out-Campus		3.92	2.155
U-Out-Campus		4.00	2.237
U-Out-Campus		4.08	2.315
U-Out-Campus		4.17	2.391
U-Out-Campus		4.25	2.464
U-Out-Campus		4.33	2.536
U-Out-Campus		4.42	2.605
U-Out-Campus		4.50	2.672
U-Out-Campus		4.58	2.738
U-Out-Campus		4.67	2.802
U-Out-Campus		4.75	2.865
U-Out-Campus		4.83	2.926
U-Out-Campus		4.92	2.986
U-Out-Campus		5.00	3.045
U-Out-Campus		5.08	3.103
U-Out-Campus		5.17	3.159
U-Out-Campus		5.25	3.215
U-Out-Campus		5.33	3.270
U-Out-Campus		5.42	3.323
U-Out-Campus		5.50	3.376
U-Out-Campus		5.58	3.428
U-Out-Campus		5.67	3.480
U-Out-Campus		5.75	3.530
U-Out-Campus		5.83	3.580
U-Out-Campus		5.92	3.629
U-Out-Campus		6.00	3.677

POST_DEV_1

U-Out-Campus		6.08	3.986
U-Out-Campus		6.17	4.511
U-Out-Campus		6.25	5.175
U-Out-Campus		6.33	5.953
U-Out-Campus		6.42	6.829
U-Out-Campus		6.50	7.792
U-Out-Campus		6.58	8.834
U-Out-Campus		6.67	9.950
U-Out-Campus		6.75	11.135
UND-Campus	Storage	0.000	1672.0
UND-Campus		0.500	1672.0
UND-Campus		0.583	1672.0
UND-Campus		0.667	1672.0
UND-Campus		0.750	1672.0
UND-Campus		0.7501	3466.7
UND-Campus		0.833	3484.8
UND-Campus		0.917	3476.3
UND-Campus		1.000	3457.5
UND-Campus		1.083	3463.2
UND-Campus		1.167	3442.3
UND-Campus		1.250	3448.7
UND-Campus		1.333	3428.2
UND-Campus		1.417	3432.4
UND-Campus		1.500	3411.0
UND-Campus		1.583	3414.2
UND-Campus		1.667	3391.7
UND-Campus		1.750	3394.1
UND-Campus		1.833	3370.8
UND-Campus		1.917	3369.4
UND-Campus		2.000	3350.0
UND-Campus		2.083	3345.0
UND-Campus		2.167	3324.6
UND-Campus		2.250	3318.5
UND-Campus		2.333	3295.8
UND-Campus		2.417	3291.0
UND-Campus		2.500	3266.0
UND-Campus		2.583	3260.0
UND-Campus		2.667	3231.9
UND-Campus		2.750	3227.3
UND-Campus		2.833	3197.5
UND-Campus		2.917	3190.8
UND-Campus		3.000	3159.9
UND-Campus		3.083	3152.1
UND-Campus		3.167	3119.1
UND-Campus		3.250	3109.9
UND-Campus		3.333	3075.3
UND-Campus		3.417	3064.4
UND-Campus		3.500	3028.2
UND-Campus		3.583	3014.1
UND-Campus		3.667	2978.7
UND-Campus		3.750	2961.5
UND-Campus		3.833	2923.8
UND-Campus		3.917	2904.8
UND-Campus		4.000	2864.6
UND-Campus		4.083	2842.8
UND-Campus		4.167	2799.7
UND-Campus		4.250	2774.9
UND-Campus		4.333	2728.3
UND-Campus		4.417	2699.6
UND-Campus		4.500	2649.8
UND-Campus		4.583	2616.5
UND-Campus		4.667	2561.9
UND-Campus		4.750	2522.7
UND-Campus		4.833	2461.4
UND-Campus		4.917	2414.2
UND-Campus		5.000	2341.4
UND-Campus		5.083	2279.8
UND-Campus		5.167	2187.3
UND-Campus		5.250	2091.6
UND-Campus		5.333	1890.5
UND-Campus		5.417	1834.0
UND-Campus		5.500	1806.1
UND-Campus		5.583	1771.6

```
UND-Campus                  5.667      1733.6
UND-Campus                  5.750      1672.0
UND-Campus                  5.833      1672.0
UND-Campus                  5.917      1672.0
UND-Campus                  6.000      1672.0
UND-Campus                  6.083      1672.0
UND-Campus                  6.167      1672.0
UND-Campus                  6.250      1672.0
UND-Campus                  6.333      1672.0
UND-Campus                  6.417      1672.0
UND-Campus                  6.500      1672.0
UND-Campus                  6.583      1672.0
UND-Campus                  6.667      1672.0
UND-Campus                  6.750      1672.0

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
FALLBROOK        FILE "Fallbrook.txt"

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

[TAGS]

[MAP]
DIMENSIONS 950.000 4925.000 2050.000 6575.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            1500.000           4600.000
Div-UND          1500.000           5000.000
UND-Campus       1500.000           5500.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Low-Flow         1319.024           4910.023
Low-Flow         1319.024           4700.340

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1-C          1500.000           6000.000
BYPASS-C         2000.000           5000.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
FALLBROOK        2000.000           6000.000
```

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.

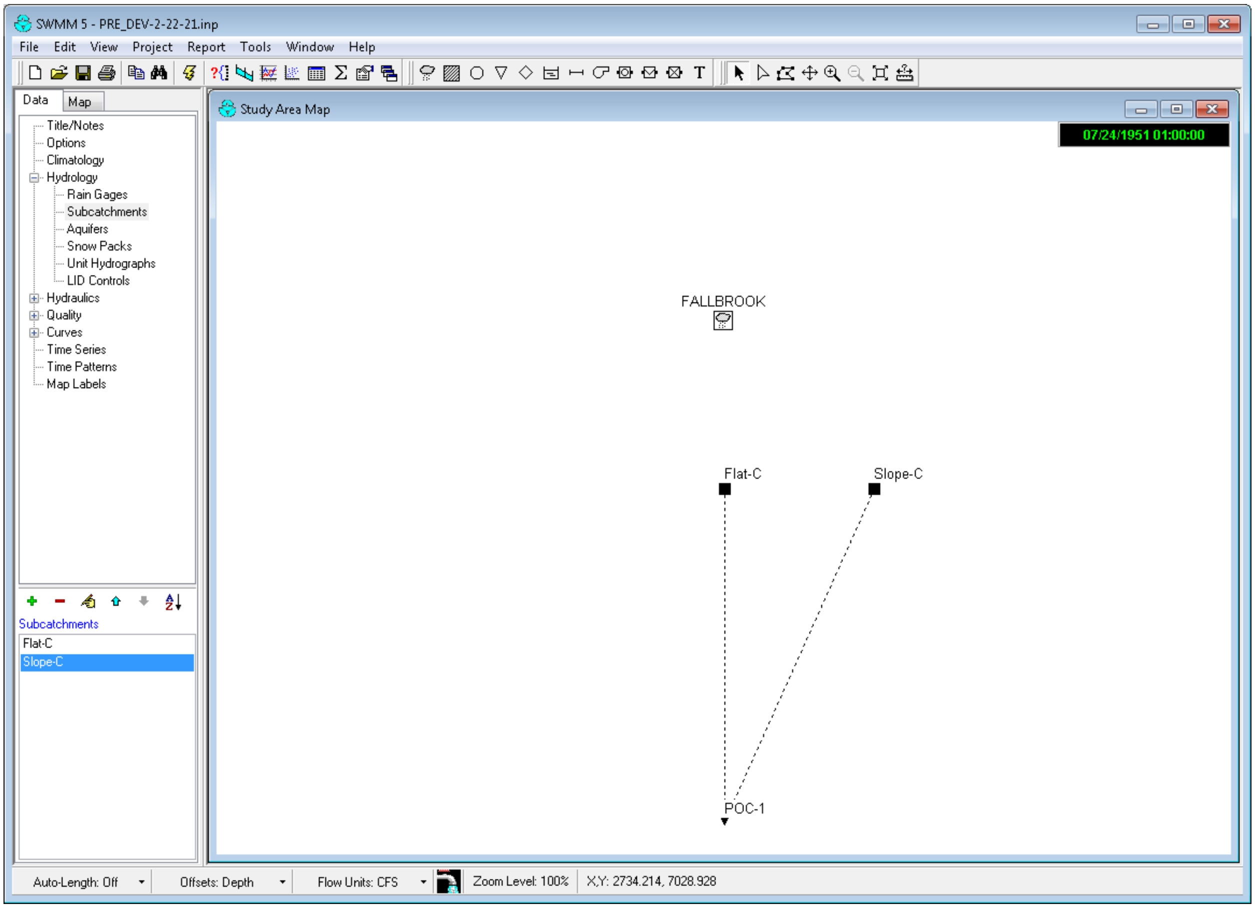
Variables for modeling are associated with typical recommended values by the EPA-SWMM model, typical values found in technical literature (such as Maidment's Handbook of Hydrology). Recommended values for the SWMM model have been attained from Appendix G of the 2020 County of San Diego BMP Design Manual.

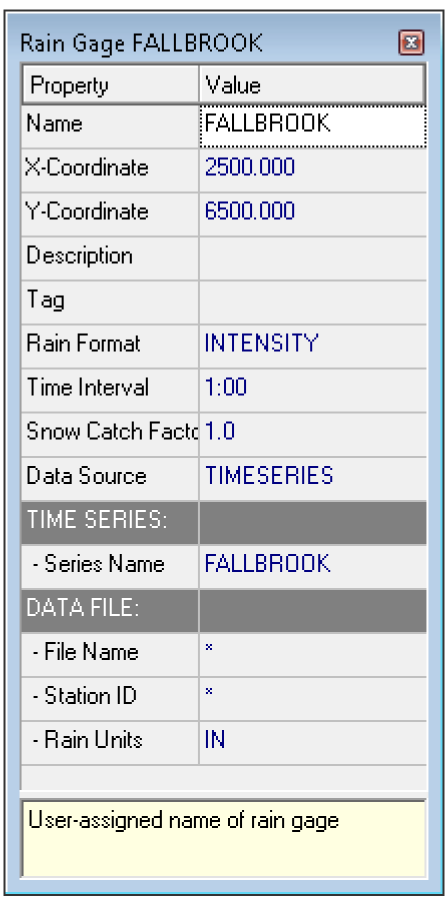
Soil characteristics of the existing soils were determined from the NRCS Web Soil Survey and site specific geotechnical report (located in Attachment 8 of this report).

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

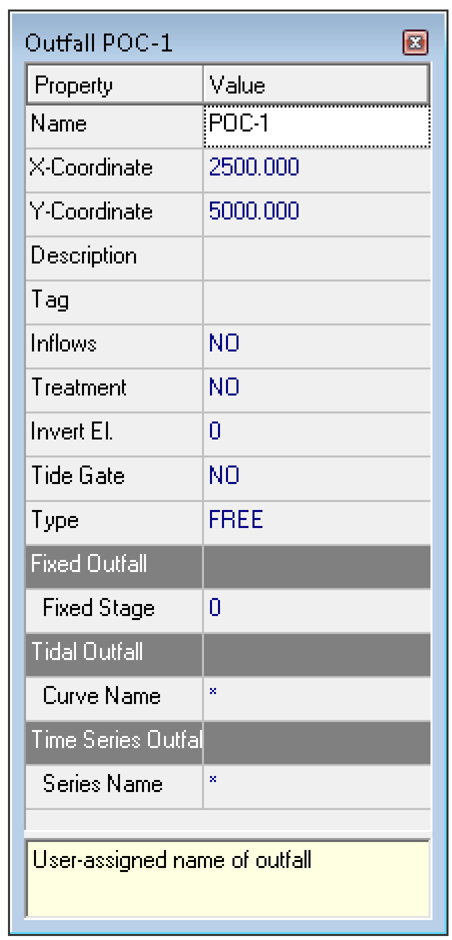




Rain Gage FALLBROOK

Property	Value
Name	FALLBROOK
X-Coordinate	2500.000
Y-Coordinate	6500.000
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Facto	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	FALLBROOK
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage



Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	2500.000
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 Outfal	
Series Name	*

User-assigned name of outfall

Subcatchment Flat-C

Property	Value
Name	Flat-C
X-Coordinate	2500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FALLBROOK
Outlet	POC-1
Area	2.6641
Width	516
% Slope	1.5
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%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 Slope-C

Property	Value
Name	Slope-C
X-Coordinate	2950.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FALLBROOK
Outlet	POC-1
Area	0.2803
Width	305
% Slope	33
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%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

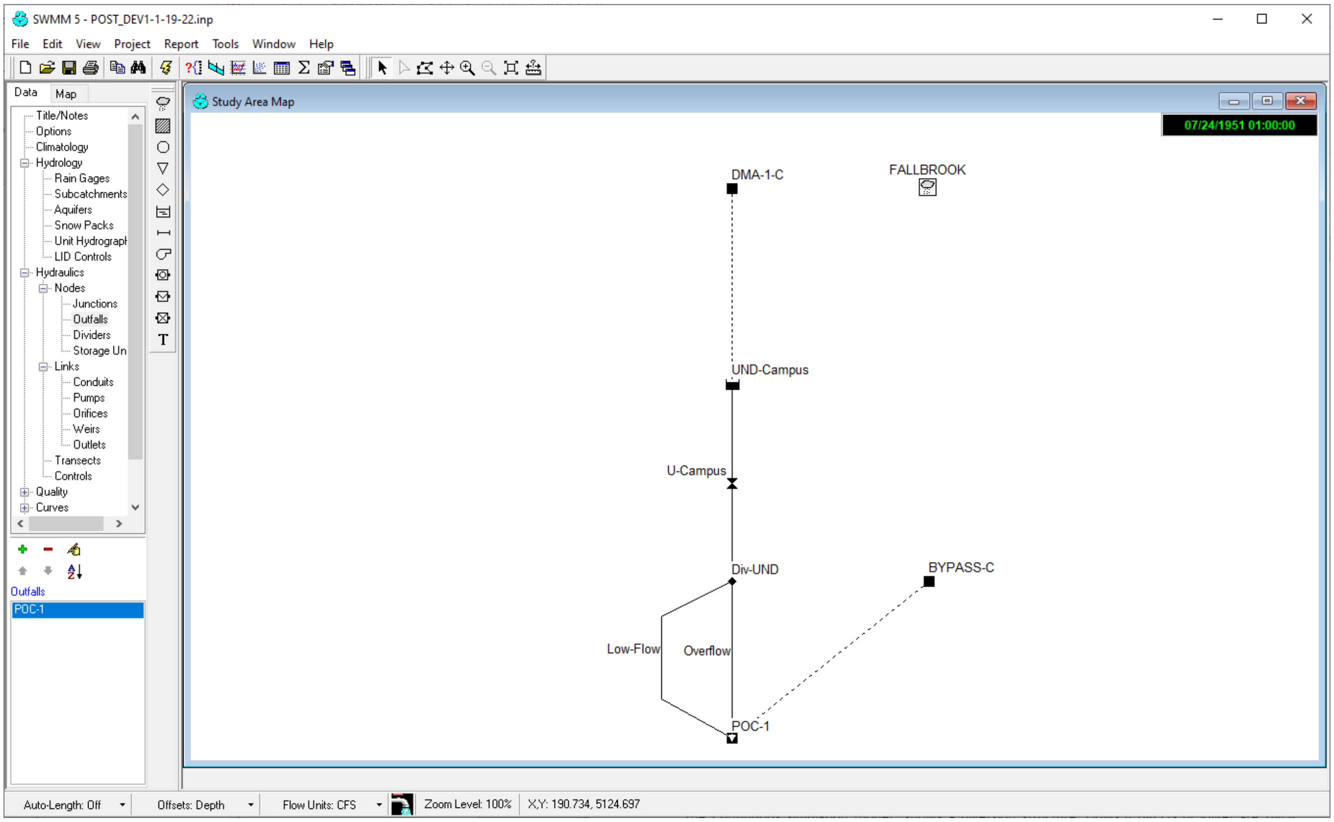
Property	Value
Suction Head	6
Conductivity	0.10
Initial Deficit	0.31

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.10
Initial Deficit	0.31

POST-DEVELOPED CONDITIONS – POC-1



Rain Gage FALLBROOK

Property	Value
Name	FALLBROOK
X-Coordinate	2000.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Facto	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	FALLBROOK
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage

Outfall POC-1

Property	Value
Name	POC-1
X-Coordinate	1500.000
Y-Coordinate	4600.000
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

Subcatchment DMA-1-C

Property	Value
Name	DMA-1-C
X-Coordinate	1500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	FALLBROOK
Outlet	UND-Campus
Area	2.7494
Width	614
% Slope	2.0
% Imperv	76.50
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%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

Mannings N for pervious area

Subcatchment BYPASS-C

Property	Value
Name	BYPASS-C
X-Coordinate	2000.000
Y-Coordinate	5000.000
Description	
Tag	
Rain Gage	FALLBROOK
Outlet	POC-1
Area	0.195
Width	305
% Slope	33
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.10
%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

Mannings N for pervious area

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.075
Initial Deficit	0.31

Infiltration Editor

Infiltration Method GREEN_AMPT

Property	Value
Suction Head	6
Conductivity	0.10
Initial Deficit	0.31

DETENTION BASIN

Storage Unit UND-Campus

Property	Value
Name	UND-Campus
X-Coordinate	1500.000
Y-Coordinate	5500.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	6.75
Initial Depth	0
Ponded Area	1672
Evap. Factor	0
Infiltration	YES
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	UND-Campus

User-assigned name of storage unit

Storage Curve Editor

Curve Name: UND-Campus

Description:

	Depth (ft)	Area (ft2)
1	0.000	1672.0
2	0.500	1672.0
3	0.583	1672.0
4	0.667	1672.0
5	0.750	1672.0
6	0.7501	3466.7
7	0.833	3484.8
8	0.917	3476.3
9	1.000	3457.5

View... Load... Save... OK Cancel Help

Outlet U-Campus

Property	Value
Name	U-Campus
Inlet Node	UND-Campus
Outlet Node	Div-UND
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/HEAD
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	U-Out-Campus

User-assigned name of outlet

Rating Curve Editor

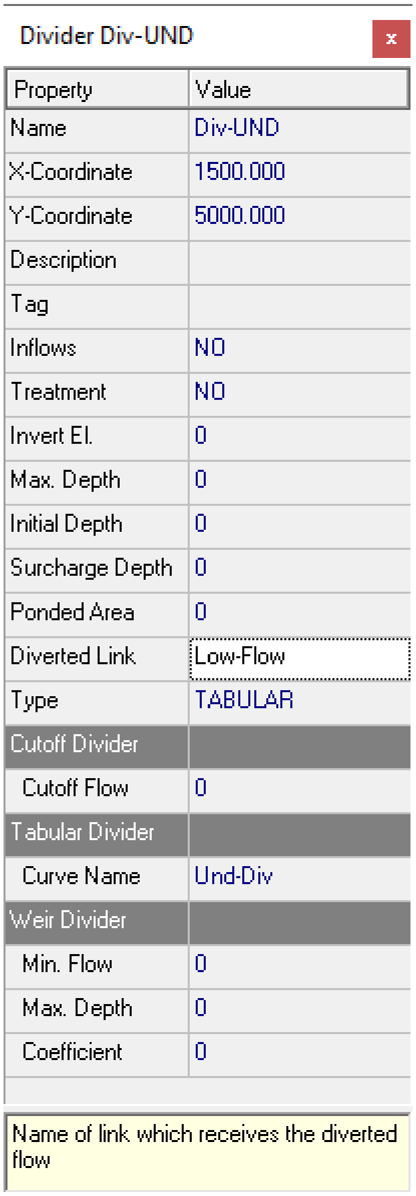
Curve Name: U-Out-Campus

Description:

	Head (ft)	Outflow (CFS)
1	0	0.000
2	0.50	0.000
3	0.58	0.008
4	0.67	0.028
5	0.75	0.039
6	0.83	0.047
7	0.92	0.055
8	1.00	0.061
9	1.08	0.067

View... Load... Save... OK Cancel Help

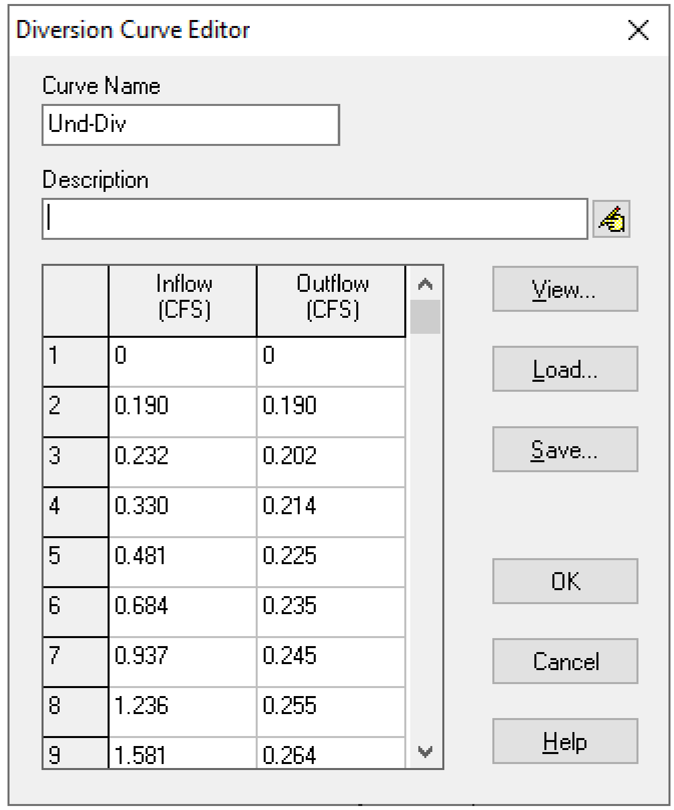
DIVERSION STRUCTURE



Divider Div-UND

Property	Value
Name	Div-UND
X-Coordinate	1500.000
Y-Coordinate	5000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	0
Initial Depth	0
Surcharge Depth	0
Ponded Area	0
Diverted Link	Low-Flow
Type	TABULAR
Cutoff Divider	
Cutoff Flow	0
Tabular Divider	
Curve Name	Und-Div
Weir Divider	
Min. Flow	0
Max. Depth	0
Coefficient	0

Name of link which receives the diverted flow



Diversion Curve Editor

Curve Name: Und-Div

Description:

	Inflow (CFS)	Outflow (CFS)
1	0	0
2	0.190	0.190
3	0.232	0.202
4	0.330	0.214
5	0.481	0.225
6	0.684	0.235
7	0.937	0.245
8	1.236	0.255
9	1.581	0.264

EXPLANATION OF SELECTED VARIABLES

Sub Catchment Areas:

Please refer to the attached diagrams that indicate the DMA and detention 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 C as determined from the NRCS websoil survey review (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 2020 County of San Diego BMP Design Manual.

For surface runoff infiltration values, REC selected infiltration values per Appendix G of the 2020 County of San Diego 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.

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).

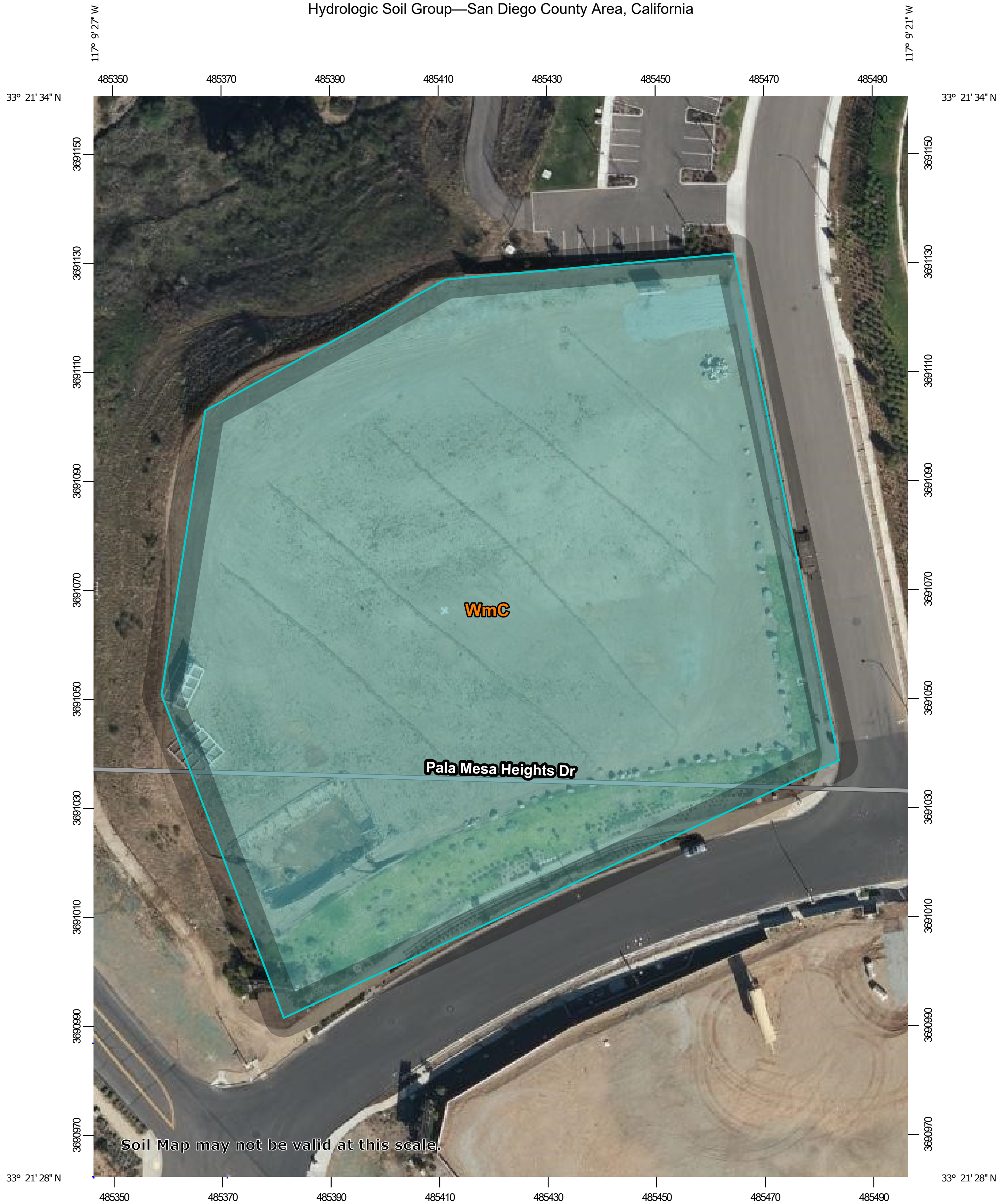
Overland Surface	Light Rain (< 0.8 in/hr)	Moderate Rain (0.8-1.2 in/hr)	Heavy Rain (> 1.2 in/hr)
Smooth asphalt pavement	0.010	0.012	0.015
Smooth impervious surface	0.011	0.013	0.015
Tar and sand pavement	0.012	0.014	0.016
Concrete pavement	0.014	0.017	0.020
Rough impervious surface	0.015	0.019	0.023
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,

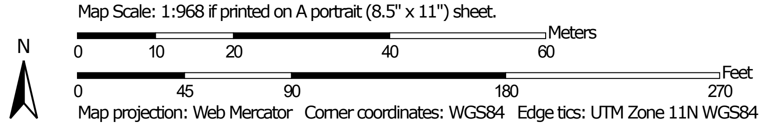
[3] Further discussion is provided on page 6 under "Discussion of Differences Between Manning's *n* Values"

ATTACHMENT 8

Geotechnical Documentation



Map Scale: 1:968 if printed on A portrait (8.5" x 11") sheet.



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 15, May 27, 2020

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

Date(s) aerial images were photographed: Jan 24, 2020—Feb 12, 2020

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
WmC	Wyman loam, 5 to 9 percent slopes	C	3.0	100.0%
Totals for Area of Interest			**3.0**	**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

PRE_DEV

```
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 ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ JUL-24-1951 00:00:00
Ending Date .............. MAY-24-2008 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       213.734       871.080
Evaporation Loss .........         2.385         9.718
Infiltration Loss ........       187.577       764.476
Surface Runoff ...........        25.426       103.623
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -0.773


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        25.426         8.285
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        25.426         8.285
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                           Total      Total      Total      Total      Total        Total     Peak  Runoff
                          Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                  in         in         in         in         in     10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
Flat-C                    871.08       0.00       9.77     765.36     102.22         7.39     3.48   0.117
Slope-C                   871.08       0.00       9.20     756.04     116.99         0.89     0.37   0.134
Analysis begun on:  Tue Feb 23 08:23:53 2021
Analysis ended on:  Tue Feb 23 08:24:10 2021
Total elapsed time: 00:00:17
```

POST_DEV

```
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 ............ JUL-24-1951 00:00:00
Ending Date .............. MAY-24-2008 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00
Routing Time Step ........ 60.00 sec


WARNING 04: minimum elevation drop used for Conduit Low-Flow

WARNING 04: minimum elevation drop used for Conduit Overflow

**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       213.734       871.080
Evaporation Loss .........        19.177        78.158
Infiltration Loss ........        52.448       213.752
Surface Runoff ...........       144.799       590.133
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -1.259


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       144.799        47.185
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        96.867        31.566
Internal Outflow .........         0.000         0.000
Storage Losses ...........        47.896        15.608
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.003         0.001
Continuity Error (%) .....         0.023


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


*************************
```

POST_DEV

Routing Time Step Summary
****
Minimum Time Step : 60.00 sec
Average Time Step : 60.00 sec
Maximum Time Step : 60.00 sec
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-1-C	871.08	0.00	83.28	175.32	623.65	46.56	3.81	0.716
BYPASS-C	871.08	0.00	5.94	755.60	117.57	0.62	0.26	0.135

****
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
Div-UND	DIVIDER	0.00	0.00	0.00	0	00:00
UND-Campus	STORAGE	0.05	5.03	5.03	9673	21:03

****
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	0.26	3.30	9673	21:00	0.623	31.563
Div-UND	DIVIDER	0.00	3.07	9673	21:03	0.000	30.941
UND-Campus	STORAGE	3.81	3.81	9673	21:00	46.559	46.559

****
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
Div-UND	DIVIDER	498239.02	0.000	0.000
UND-Campus	STORAGE	498239.02	5.032	1.718

****
Node Flooding Summary
****

No nodes were flooded.

POST_DEV

```
*********************
Storage Volume Summary
*********************

---------------------------------------------------------------------------------------------
                      Average     Avg   E&I       Maximum     Max    Time of Max    Maximum
                       Volume    Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit         1000 ft3    Full  Loss      1000 ft3    Full    days hr:min        CFS
---------------------------------------------------------------------------------------------
UND-Campus              0.113       1    34        14.554      83    9673  21:03       3.07


***********************
Outfall Loading Summary
***********************

-----------------------------------------------------------
                      Flow       Avg.      Max.       Total
                      Freq.      Flow      Flow      Volume
Outfall Node          Pcnt.       CFS       CFS    10^6 gal
-----------------------------------------------------------
POC-1                  3.46      0.07      3.30      31.563
-----------------------------------------------------------
System                 3.46      0.07      3.30      31.563


********************
Link Flow Summary
********************

-----------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type           CFS  days hr:min    ft/sec    Flow   Depth
-----------------------------------------------------------------------------
Low-Flow             DUMMY         0.29  9673  21:03
Overflow             DUMMY         2.78  9673  21:03
U-Campus             DUMMY         3.07  9673  21:03


*************************
Conduit Surcharge Summary
*************************

----------------------------------------------------------------------------
                                                          Hours        Hours
                       --------- Hours Full --------   Above Full   Capacity
Conduit                Both Ends  Upstream  Dnstream   Normal Flow   Limited
----------------------------------------------------------------------------
Low-Flow                    0.01      0.01      0.01  498239.02         0.01
Overflow                    0.01      0.01      0.01  498239.02         0.01


Analysis begun on:  Tue Feb 01 13:15:17 2022
Analysis ended on:  Tue Feb 01 13:16:05 2022
Total elapsed time: 00:00:48
```