TECHNICAL MEMORANDUM:

SWMM Modeling for Hydromodification Compliance of:

Skyline Retirement Center

Prepared For:

Skyline Wesleyan Church
October 20, 2016 (Revision)
September 15, 2017 (Update)

Prepared by:

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TECHNICAL MEMORANDUM

TO: SKYLINE WESLEYAN CHURCH

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

DATE: April 27, 2016 (Revised October 20, 2016)(Updated September 15, 2017)

RE: Summary of SWMM Modeling for Hydromodification Compliance for Skyline Retirement Center, La Mesa, CA.

INTRODUCTION

This memorandum summarizes the approach used to model the proposed residential development project site in the City of La Mesa 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 biofiltration 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 Skyline Retirement Center project comprises of single and attached proposed residential developments including associated roads and parking lots. Two (2) SWMM models were prepared for this study: the first for the pre-development and the second for the post-developed conditions. The project site drains to two (2) Points of Compliance (POC-1 and POC-2) located at two (2) existing different storm drain locations within the adjacent access road to the Skyline Church. Runoff from both storm drain systems are conveyed in a southerly direction, discharging to a creek adjacent to Campo Road at two (2) separate locations.

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

The inputs required to develop SWMM models include rainfall, watershed characteristics, and BMP configurations. The inputs required to develop SWMM models include rainfall, watershed characteristics, and BMP configurations.

In regards to the proper rainfall station to use for this project, two factors are taken into account to select the most appropriate rainfall location, in agreement with the County of San Diego BMP Manual: Proximity of the project with the rainfall station (in terms of distance), and difference in elevation between the project and the rainfall station selected. Unfortunately, section G.1.3.1 of the BMP Manual is not 100% reliable because (a) it includes rainfall stations in Figure G.1-1 whose data does not exists in the Project Clean Water web site (La Mesa) and it does not include rainfall stations in Figure G.1-1 whose data does exists (Borrego); (b) it assumes that all data sets are of the same quality, which is not the case (for example, data in Lindbergh is of much higher quality than data in the closed-by Fashion Valley station, and the later should never be used as a substitute of the former because most of its data is copied from Lindbergh and the elevation of both stations is the same; similarly quality of data for San Vicente and Santee is extremely poor and both should never be used) and (c) it lacks a methodological procedure on how to evaluate scenarios when the station that is closer in location, is not the same that the station that is closer in elevation, as in the case of this project.

As a consequence, the author of this study has decided to use a statistical methodology to evaluate the most appropriate rainfall station among a group of "n" candidates (stations), using 2 parameters: (1) the distance D_i between the station "i" and the location of the project and (2) the absolute difference in elevation between the station "i" considered and the project location, Z_i. Assuming that the importance of D_i is identical to the importance of Z_i (distance is as important as different in elevation) for each station considered the following parameter P_i is calculated:

$$P_i = \frac{D_i^{-1}}{2\sum_{i=1}^{n} D_i^{-1}} + \frac{Z_i^{-1}}{2\sum_{i=1}^{n} Z_i^{-1}}$$

The station whose parameter P_i is the highest is statistically more significant in terms of distance and difference in elevation respect to the location of the project. It should be noted that all P_i values added are equal to 1.

To evaluate the most appropriate rainfall station, the following stations were considered as potentially the most representative stations: Flinn, Lower Otay, Bonita, Santee. The distance of the project to each station is approximately 9.15 miles, 9.53 miles, 7.65 miles and 7.66 miles respectively, while the absolute difference in elevation between the station and the average elevation in the project is approximately 365 ft, 24 ft, 395 ft and 215 ft respectively. It seems evident that Lower Otay is the best station, because the distances are similar but its elevation is very close to that of the project. Applying the P_i equation we obtain the following values for Flinn, Lower Otay, Bonita and Santee: 0.142, 0.514, 0.162 and 0.182. Therefore, it is clear that the Lower Otay rain gauge is the most appropriate for this project.

In regards to evapotranspiration, per the California Irrigation Management Information System "Reference Evaporation Zones" (CIMIS ETo Zone Map), the project site is located within the Zone 9 Evapotranspiration Area. Thus evapotranspiration values for the site were modeled using Zone 9 average monthly values from Table G.1-1 from the City of San Diego 2016 BMP Design Manual. The site was modeled with Types A & D hydrologic soils as this is the existing soil determined from the NRCS Web Soil Survey. Soils have been assumed to be uncompacted in the existing condition to represent the natural condition of the site and 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 the parameters is explained in detail.

HMP MODELING

EXISTING CONDITIONS

The current site is a mass graded lot that drains in a southerly direction to two (2) different receiving storm drains located within the adjacent access road to the existing Skyline Church. There is also a portion of the existing-offsite slope along the western property boundary that drains to one (1) of the receiving storm drains.

TABLE 1 – SUMMARY OF EXISTING CONDITIONS

DMA	Tributary Area, A (Ac)	Impervious Percentage, Ip
DMA-1-D	4.42	0.34%(1)
DMA-1-A	4.09	1.46%(1)
DMA-OFFSITE-A	0.37	0.00%(1)
DMA-OFFSITE-A	0.01	0.00%(1)
TOTAL POC 1	**8.89**	**n/a**
DMA-2-D	0.60	0.00%(1)
TOTAL POC 2	**0.60**	**n/a**
TOTAL	**9.48**	--

Notes: (1) – Per the 2013 RWQCB permit, existing condition impervious surfaces are not to be accounted for in existing conditions analysis. However, as some of POC 1 will remain untouched this impervious % can be accounted for.

DEVELOPED CONDITIONS

Storm water runoff from the proposed project site is routed to two (2) POCs located at the discharge locations to the south east of the project site at the existing storm drain systems within the access road to the Skyline Church. For POC 1, the runoff from the developed project site is drained to three (3) onsite receiving biofiltration LID BMPs. Once flows are routed via the proposed LID BMPs, developed onsite flows are then conveyed to the aforementioned storm drain POC 1. Runoff from the offsite-slope previously described also drains to POC-1.

POC 2 does not need any treatment nor does it need hydromodification compliance for the following reasons. In existing conditions the area draining to POC 2 is 0.60 acres while in developed conditions the area is 0.59 acres, a reduction of 0.01 acres. Additionally the 0.59 acres draining to POC 2 remain unchanged and undisturbed from the existing condition, thus the land use is the same as in pre developed conditions. So given these two facts, there must be less runoff in post developed condition, therefore no analysis needs to undertaken for POC 2.

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

TABLE 2 – SUMMARY OF DEVELOPED CONDITIONS

POC	DMA	Tributary Area, A (Ac)(1)	Impervious Percentage %, Ip	Basin
POC-1	1-1-D	0.89	32%	BMP-1
	1-1-A	1.31	43%	
	1-D-BYPASS	0.37	0%	n/a
	1-A-BYPASS	1.07	0%	
	OFFSITE-A	0.37	27%	
	OFFSITE-D	0.01	100%	
	2-1-A	1.60	77%	BMP-2
	2-1-D	1.95	58%	
	3-1-A	0.11	100%	BMP-3
	3-1-D	1.22	33%	
POC-2	2-1-D	0.59	0%	n/a
TOTAL		**9.48**	--	

Notes: (1) – DMA areas include the area of the biofiltration.

Three (3) LID biofiltration basins with partial retention are located within the project site and are responsible for handling hydromodification requirements for the projects runoff to POC 1. In developed conditions, the basins will have a surface depth and a riser spillway structure (see dimensions in Table 3). Flows will then discharge from the basins via the outlet structure or infiltrate through the base of the facilities to the receiving amended soil and low flow orifice. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving storm drain systems.

Beneath the basins' invert lies the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of a 3-inch layer of mulch, an 18-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr) and a layer of gravel. All BMPs will be unlined to allow for infiltration into the underlying soils.

The biofiltration basins were modeled using the biofiltration LID module within SWMM. The biofiltration module can model the amended soil layer, and a surface storage pond up to the elevation of the invert of the spillway. It should be noted that detailed outlet structure location and elevations will be shown on the construction plans based on the recommendations of this study.

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMP

Three (3) LID BMP biofiltration basins are proposed for water quality treatment and hydromodification conformance for the project site. Tables 3 & 4 illustrate the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 3 – SUMMARY OF DEVELOPED DUAL PURPOSE BMP

BMP	Tributary Area (Ac)	DIMENSIONS					
		BMP Area(1), (ft^2)	Low Flow Orifice (in)	Gravel Depth (5)(in)	Depth Riser Invert (ft)(2)	Weir Perimeter Length(3) (ft)	Total Surface Depth(4) (ft)
BMP-1	2.20	1,509	1.0	27	2.25	8.00	2.50
BMP-2	3.55	4,364	1.5	27	2.00	12.00	2.50
BMP-3	1.33	1,411	0.875	30	2.00	8.00	2.50

Notes: (1): Area of amended soil = area of gravel = area of the BMP
(2): Depth of ponding beneath riser structure's surface spillway to bottom of mulch layer.
(3): Overflow length, the internal perimeter of the square riser
(4): Total surface depth of BMP from bottom of mulch layer to crest elevation.
(5): Gravel depth includes the dead storage below the LID orifice (9-inches for BMP 1 and 2. 12-inches for BMP-3) and 6 inches of gravel/sand filter layers. See Basin detail on attachment 5.

TABLE 4 – SUMMARY OF RISER DETAILS

Lower Outlet				Middle Slot		Upper Slot		Top Riser	
Basin	Type	B x H (in), #-Dia (in)	Elev. (ft)(1)	B x H (in), #-Dia (in)	Elev. (ft)(1)	B x H (in), #-Dia (in)	Elev. (ft)(1)	Length(2) (ft)	Elev.(1) (ft)
BMP 1	Orifice	2 – 0.75	0.50	6 x 2	1.00	30 x 3	1.33	8	2.25
BMP 2	Slot	36 x 3	0.75	n/a	n/a	n/a	n/a	12	2.00
BMP 3	Slot	12 x 2	0.50	n/a	n/a	n/a	n/a	8	2.00

Notes: (1): Basin ground surface elevation assumed to be 0.00 ft elevation.
(2): Overflow length is the internal perimeter of the riser structure.

FLOW DURATION CURVE COMPARISON

The Flow Duration Curve (FDC) for the site was compared at POC-1 by exporting the hourly runoff time series results from SWMM to a spreadsheet. The FDC was compared between 10% of the existing condition Q_2 up to the existing condition Q_{10} for POC-1. The 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 Figures 1a and 1b 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 graphic and also 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. However, due to the impact that n has in the continuous simulation a more accurate value of the Manning's coefficient has been chosen for pervious areas. Taken into consideration the study prepared by TRWE (Reference [6]) a value of n = 0.05 has been selected (see Table 1 of Reference [6] included in Attachment 7). An average n value between average grass plus pasture (0.04) and dense grass (0.06) 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 Skyline Retirement Center 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. Types A & D Soil is representative of the existing condition site.
2. All basins will be unlined to allow for infiltration.

ATTACHMENTS

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

REFERENCES

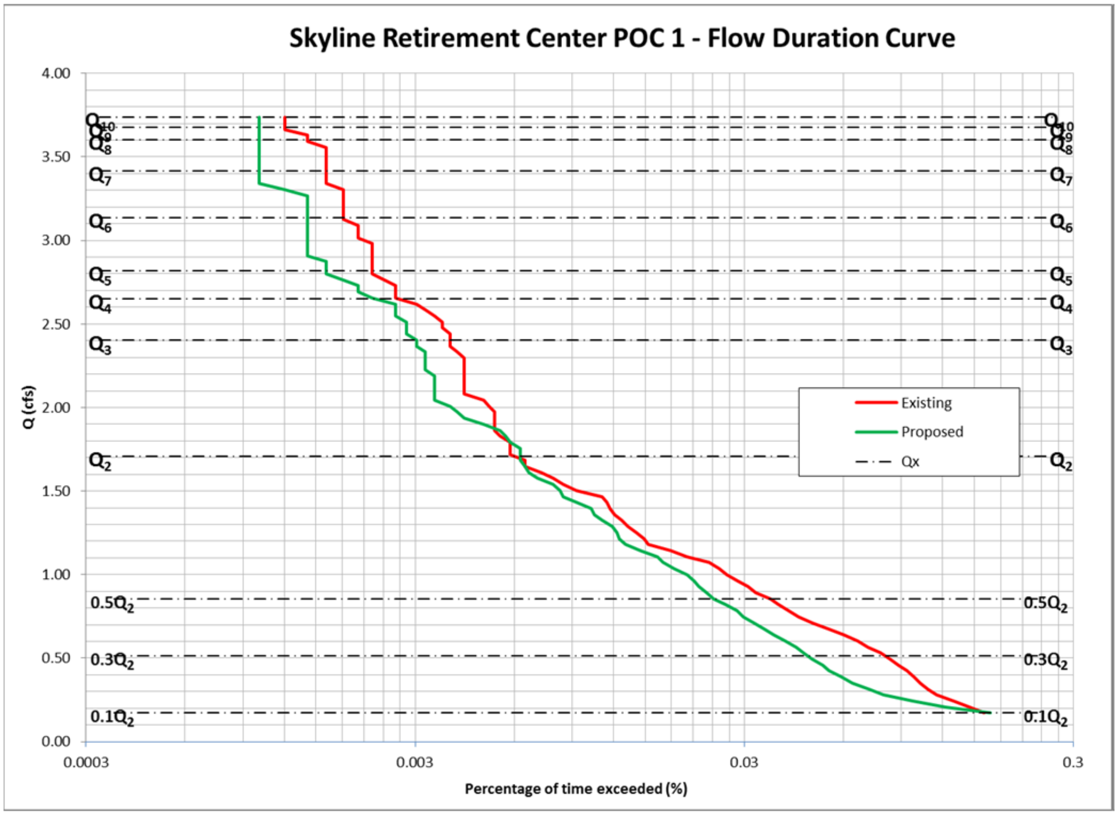
[1] – *"Review and Analysis of San Diego County Hydromodification Management Plan (HMP): Assumptions, Criteria, Methods, & Modeling Tools – Prepared for the Cities of San Marcos, Oceanside & Vista",* May 2012, TRW Engineering.

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

[3] - Order R9-2013-001, California Regional Water Quality Control Board San Diego Region (SDRWQCB).

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

[5] – "*City of San Diego BMP Design Manual*", February 2016.



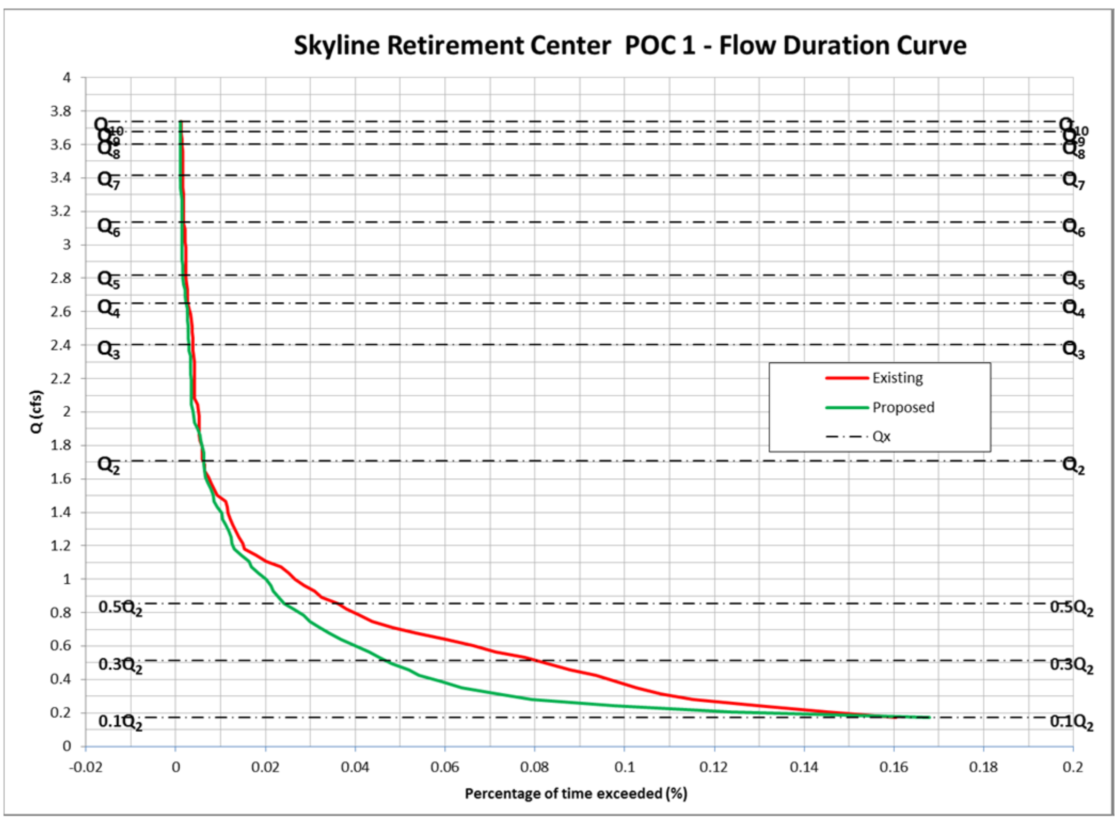


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

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	1.707	1.564	0.143
3-year	2.401	1.916	0.485
4-year	2.649	2.306	0.342
5-year	2.818	2.629	0.188
6-year	3.135	2.756	0.378
7-year	3.415	2.828	0.587
8-year	3.601	3.063	0.538
9-year	3.675	3.299	0.377
10-year	3.737	3.328	0.409

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.

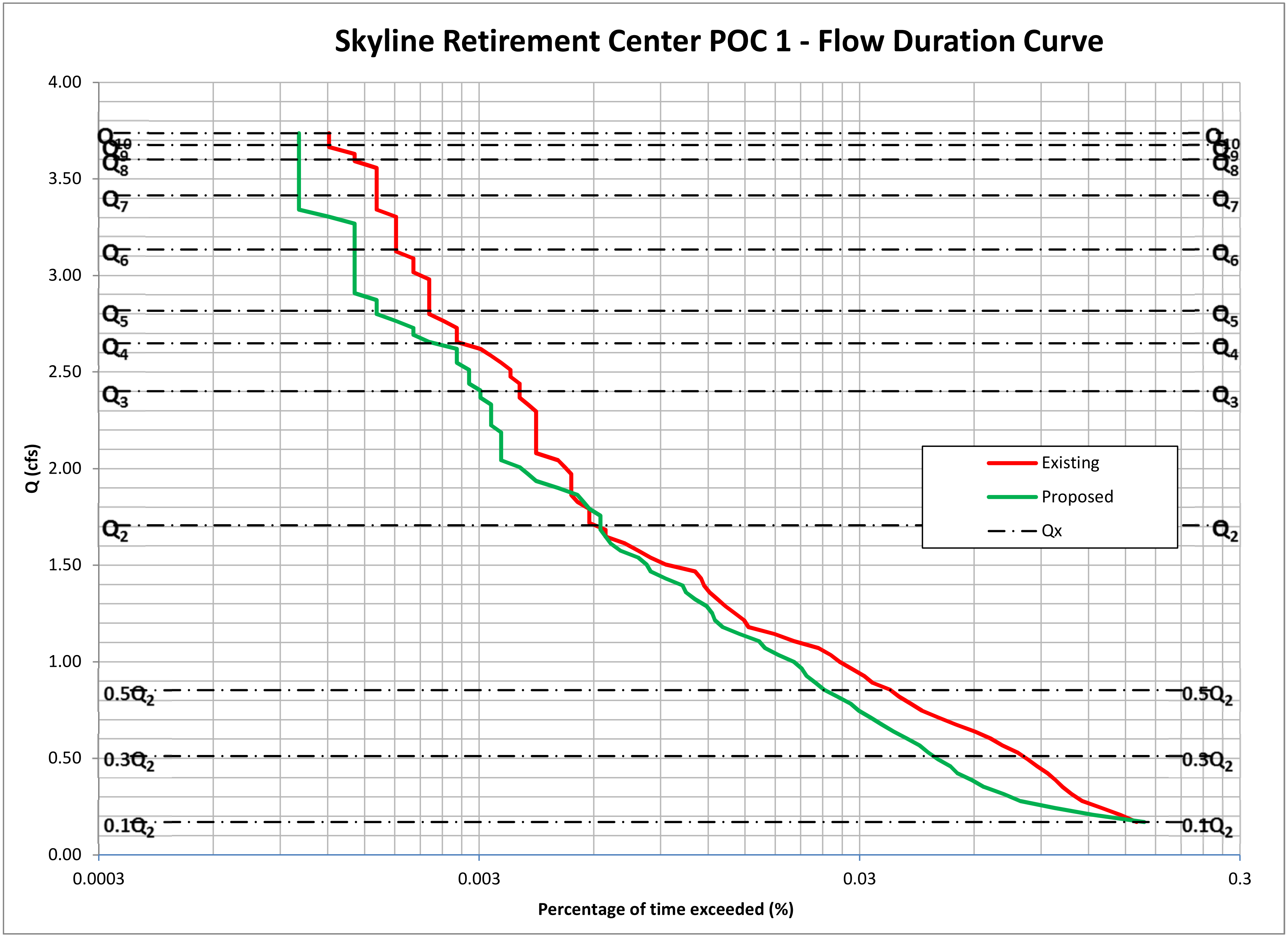
The figures on the following pages illustrate that the flow duration curve in post-development conditions after the proposed BMP is below the existing flow duration curve. The flow duration curve table following the curve shows that if the interval $0.10Q_2 – Q_{10}$ is divided in 100 sub-intervals,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

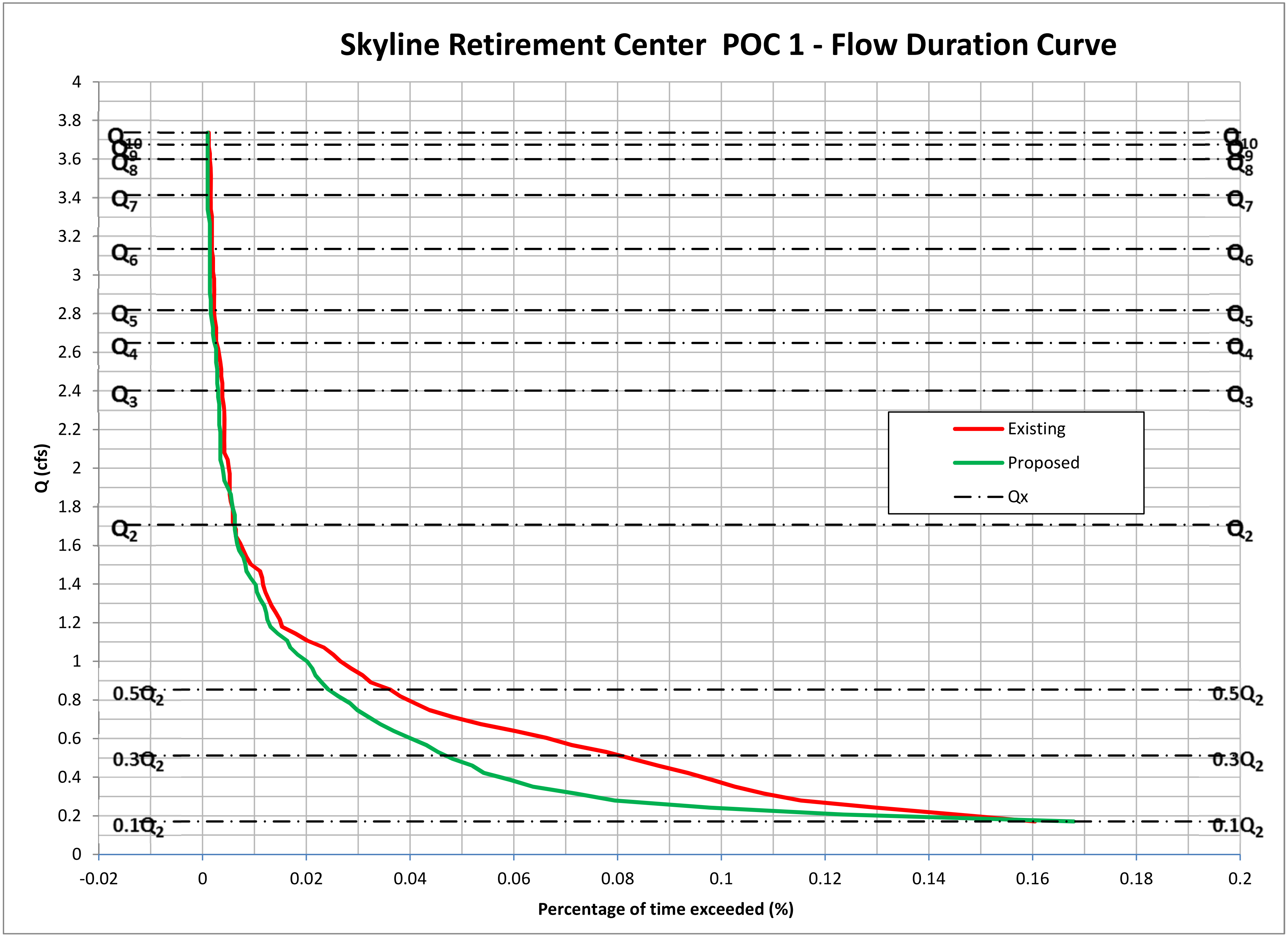
Consequently, the design passes the hydromodification test.

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 City of La Mesa 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.


Skyline Retirement Center POC 1 - Flow Duration Curve
Q (cfs)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.0003
0.003
0.03
0.3
Percentage of time exceeded (%)
Existing
Proposed
Qx
Q_{10}
Q_9
Q_8
Q_7
Q_6
Q_5
Q_4
Q_3
Q_2
$0.5Q_2$
$0.3Q_2$
$0.1Q_2$


Skyline Retirement Center 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
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2

Flow Duration Curve Data for Skyline Retirement Center POC-1, City of La Mesa, CA

Q2 =	1.71	cfs	Fraction	10 %
Q10 =	3.74	cfs		
Step =	0.0360	cfs		
Count =	496008	hours		
	56.58	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.171	796	1.60E-01	833	1.68E-01	105%	Pass
2	0.207	721	1.45E-01	613	1.24E-01	85%	Pass
3	0.243	644	1.30E-01	485	9.78E-02	75%	Pass
4	0.279	572	1.15E-01	394	7.94E-02	69%	Pass
5	0.315	537	1.08E-01	357	7.20E-02	66%	Pass
6	0.351	509	1.03E-01	316	6.37E-02	62%	Pass
7	0.387	487	9.82E-02	294	5.93E-02	60%	Pass
8	0.423	464	9.35E-02	269	5.42E-02	58%	Pass
9	0.459	436	8.79E-02	258	5.20E-02	59%	Pass
10	0.495	411	8.29E-02	239	4.82E-02	58%	Pass
11	0.531	386	7.78E-02	225	4.54E-02	58%	Pass
12	0.567	353	7.12E-02	214	4.31E-02	61%	Pass
13	0.603	329	6.63E-02	198	3.99E-02	60%	Pass
14	0.639	299	6.03E-02	183	3.69E-02	61%	Pass
15	0.675	266	5.36E-02	170	3.43E-02	64%	Pass
16	0.711	240	4.84E-02	159	3.21E-02	66%	Pass
17	0.747	217	4.37E-02	148	2.98E-02	68%	Pass
18	0.783	203	4.09E-02	141	2.84E-02	69%	Pass
19	0.819	189	3.81E-02	130	2.62E-02	69%	Pass
20	0.855	179	3.61E-02	120	2.42E-02	67%	Pass
21	0.891	161	3.25E-02	114	2.30E-02	71%	Pass
22	0.927	153	3.08E-02	108	2.18E-02	71%	Pass
23	0.963	142	2.86E-02	105	2.12E-02	74%	Pass
24	0.999	132	2.66E-02	100	2.02E-02	76%	Pass
25	1.035	125	2.52E-02	91	1.83E-02	73%	Pass
26	1.071	116	2.34E-02	84	1.69E-02	72%	Pass
27	1.107	100	2.02E-02	81	1.63E-02	81%	Pass
28	1.143	89	1.79E-02	72	1.45E-02	81%	Pass
29	1.179	76	1.53E-02	65	1.31E-02	86%	Pass
30	1.215	74	1.49E-02	62	1.25E-02	84%	Pass
31	1.251	70	1.41E-02	61	1.23E-02	87%	Pass
32	1.287	66	1.33E-02	59	1.19E-02	89%	Pass
33	1.323	63	1.27E-02	55	1.11E-02	87%	Pass
34	1.359	60	1.21E-02	52	1.05E-02	87%	Pass
35	1.395	58	1.17E-02	51	1.03E-02	88%	Pass
36	1.431	57	1.15E-02	46	9.27E-03	81%	Pass
37	1.467	55	1.11E-02	42	8.47E-03	76%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
38	1.504	46	9.27E-03	41	8.27E-03	89%	Pass
39	1.540	42	8.47E-03	39	7.86E-03	93%	Pass
40	1.576	39	7.86E-03	35	7.06E-03	90%	Pass
41	1.612	36	7.26E-03	33	6.65E-03	92%	Pass
42	1.648	32	6.45E-03	32	6.45E-03	100%	Pass
43	1.684	32	6.45E-03	31	6.25E-03	97%	Pass
44	1.720	29	5.85E-03	31	6.25E-03	107%	Pass
45	1.756	29	5.85E-03	31	6.25E-03	107%	Pass
46	1.792	29	5.85E-03	29	5.85E-03	100%	Pass
47	1.828	27	5.44E-03	28	5.65E-03	104%	Pass
48	1.864	26	5.24E-03	27	5.44E-03	104%	Pass
49	1.900	26	5.24E-03	24	4.84E-03	92%	Pass
50	1.936	26	5.24E-03	21	4.23E-03	81%	Pass
51	1.972	26	5.24E-03	20	4.03E-03	77%	Pass
52	2.008	25	5.04E-03	19	3.83E-03	76%	Pass
53	2.044	24	4.84E-03	17	3.43E-03	71%	Pass
54	2.080	21	4.23E-03	17	3.43E-03	81%	Pass
55	2.116	21	4.23E-03	17	3.43E-03	81%	Pass
56	2.152	21	4.23E-03	17	3.43E-03	81%	Pass
57	2.188	21	4.23E-03	17	3.43E-03	81%	Pass
58	2.224	21	4.23E-03	16	3.23E-03	76%	Pass
59	2.260	21	4.23E-03	16	3.23E-03	76%	Pass
60	2.296	21	4.23E-03	16	3.23E-03	76%	Pass
61	2.332	20	4.03E-03	16	3.23E-03	80%	Pass
62	2.368	19	3.83E-03	15	3.02E-03	79%	Pass
63	2.404	19	3.83E-03	15	3.02E-03	79%	Pass
64	2.440	19	3.83E-03	14	2.82E-03	74%	Pass
65	2.476	18	3.63E-03	14	2.82E-03	78%	Pass
66	2.512	18	3.63E-03	14	2.82E-03	78%	Pass
67	2.548	17	3.43E-03	13	2.62E-03	76%	Pass
68	2.584	16	3.23E-03	13	2.62E-03	81%	Pass
69	2.620	15	3.02E-03	13	2.62E-03	87%	Pass
70	2.656	13	2.62E-03	11	2.22E-03	85%	Pass
71	2.692	13	2.62E-03	10	2.02E-03	77%	Pass
72	2.728	13	2.62E-03	10	2.02E-03	77%	Pass
73	2.764	12	2.42E-03	9	1.81E-03	75%	Pass
74	2.800	11	2.22E-03	8	1.61E-03	73%	Pass
75	2.836	11	2.22E-03	8	1.61E-03	73%	Pass
76	2.872	11	2.22E-03	8	1.61E-03	73%	Pass
77	2.908	11	2.22E-03	7	1.41E-03	64%	Pass
78	2.944	11	2.22E-03	7	1.41E-03	64%	Pass
79	2.980	11	2.22E-03	7	1.41E-03	64%	Pass
80	3.016	10	2.02E-03	7	1.41E-03	70%	Pass
81	3.052	10	2.02E-03	7	1.41E-03	70%	Pass
82	3.088	10	2.02E-03	7	1.41E-03	70%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
83	3.124	9	1.81E-03	7	1.41E-03	78%	Pass
84	3.160	9	1.81E-03	7	1.41E-03	78%	Pass
85	3.197	9	1.81E-03	7	1.41E-03	78%	Pass
86	3.233	9	1.81E-03	7	1.41E-03	78%	Pass
87	3.269	9	1.81E-03	7	1.41E-03	78%	Pass
88	3.305	9	1.81E-03	6	1.21E-03	67%	Pass
89	3.341	8	1.61E-03	5	1.01E-03	63%	Pass
90	3.377	8	1.61E-03	5	1.01E-03	63%	Pass
91	3.413	8	1.61E-03	5	1.01E-03	63%	Pass
92	3.449	8	1.61E-03	5	1.01E-03	63%	Pass
93	3.485	8	1.61E-03	5	1.01E-03	63%	Pass
94	3.521	8	1.61E-03	5	1.01E-03	63%	Pass
95	3.557	8	1.61E-03	5	1.01E-03	63%	Pass
96	3.593	7	1.41E-03	5	1.01E-03	71%	Pass
97	3.629	7	1.41E-03	5	1.01E-03	71%	Pass
98	3.665	6	1.21E-03	5	1.01E-03	83%	Pass
99	3.701	6	1.21E-03	5	1.01E-03	83%	Pass
100	3.737	6	1.21E-03	5	1.01E-03	83%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	3.737	3.328	0.409
9	3.675	3.299	0.377
8	3.601	3.063	0.538
7	3.415	2.828	0.587
6	3.135	2.756	0.378
5	2.818	2.629	0.188
4	2.649	2.306	0.342
3	2.401	1.916	0.485
2	1.707	1.564	0.143

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)
Skyline Retirement Center - POC 1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**3.74**	**3.82**
9	**3.68**	**3.70**
8	**3.60**	**3.63**
7	**3.41**	**3.49**
6	**3.13**	**3.18**
5	**2.82**	**2.87**
4	**2.65**	**2.65**
3	**2.40**	**2.42**
2	**1.71**	**1.71**

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

Peaks (cfs)			Period of Return (Years)	
	Date	Posit	Weibull	Cunnane
1.293	3/14/2003	57	1.02	1.01
1.316	2/15/1992	56	1.04	1.03
1.329	3/21/1983	55	1.05	1.05
1.359	3/22/1954	54	1.07	1.07
1.364	1/18/1973	53	1.09	1.09
1.37	1/14/1969	52	1.12	1.11
1.413	2/22/1969	51	1.14	1.13
1.434	1/7/1993	50	1.16	1.15
1.467	11/21/1978	49	1.18	1.18
1.474	12/2/1952	48	1.21	1.20
1.477	1/18/1952	47	1.23	1.23
1.487	12/20/1997	46	1.26	1.25
1.492	2/20/1993	45	1.29	1.28
1.495	12/18/1967	44	1.32	1.31
1.497	3/1/1983	43	1.35	1.34
1.498	11/28/1970	42	1.38	1.38
1.5	1/11/2001	41	1.41	1.41
1.503	1/4/1995	40	1.45	1.44
1.516	3/5/1970	39	1.49	1.48
1.517	1/31/1979	38	1.53	1.52
1.532	3/27/1992	37	1.57	1.56
1.541	2/8/1976	36	1.61	1.61
1.571	3/24/1983	35	1.66	1.65
1.574	1/4/2005	34	1.71	1.70
1.584	10/19/2004	33	1.76	1.75
1.601	10/27/2004	32	1.81	1.81
1.634	2/15/1986	31	1.87	1.87
1.701	2/16/1998	30	1.93	1.93
1.707	3/2/1983	29	2.00	2.00
1.713	2/16/1959	28	2.07	2.07
1.794	10/20/2004	27	2.15	2.15
1.812	11/21/1967	26	2.23	2.23
1.838	12/30/1951	25	2.32	2.33
1.998	1/18/1955	24	2.42	2.42
2.044	11/12/1976	23	2.52	2.53
2.049	2/6/1992	22	2.64	2.65
2.051	11/15/1965	21	2.76	2.78
2.331	1/29/1983	20	2.90	2.92
2.466	11/25/1985	19	3.05	3.08
2.539	2/6/1976	18	3.22	3.25
2.566	2/23/1998	17	3.41	3.45
2.604	3/1/1970	16	3.63	3.67
2.646	11/22/1996	15	3.87	3.92
2.655	2/23/2005	14	4.14	4.21
2.737	3/1/1978	13	4.46	4.54
2.784	3/27/1971	12	4.83	4.93
3.011	3/4/1978	11	5.27	5.40
3.123	2/22/2004	10	5.80	5.96
3.317	1/3/2005	9	6.44	6.65
3.562	12/21/1970	8	7.25	7.53
3.655	2/2/1988	7	8.29	8.67
3.75	10/14/2006	6	9.67	10.21
4.154	10/19/1972	5	11.60	12.43
4.572	2/2/1998	4	14.50	15.89
4.583	10/30/1998	3	19.33	22.00
4.836	2/7/1998	2	29.00	35.75
5.2	2/13/1998	1	58.00	95.33

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

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**3.33**	**3.42**
9	**3.30**	**3.31**
8	**3.06**	**3.18**
7	**2.83**	**2.86**
6	**2.76**	**2.76**
5	**2.63**	**2.64**
4	**2.31**	**2.37**
3	**1.92**	**1.92**
2	**1.56**	**1.56**

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

Peaks (cfs)			Period of Return (Years)	
	Date	Posit	Weibull	Cunnane
0.826	3/4/1983	57	1.02	1.01
0.84	12/7/1992	56	1.04	1.03
0.855	1/23/1967	55	1.05	1.05
0.869	2/16/1959	54	1.07	1.07
0.881	3/24/1964	53	1.09	1.09
0.924	2/28/1970	52	1.12	1.11
1.008	1/29/1983	51	1.14	1.13
1.019	1/7/1957	50	1.16	1.15
1.025	3/4/1978	49	1.18	1.18
1.025	3/18/1982	48	1.21	1.20
1.038	1/5/1974	47	1.23	1.23
1.051	3/5/1995	46	1.26	1.25
1.061	1/16/1993	45	1.29	1.28
1.108	10/19/2004	44	1.32	1.31
1.161	3/1/1970	43	1.35	1.34
1.166	1/15/1978	42	1.38	1.38
1.168	2/14/1995	41	1.41	1.41
1.173	3/27/1971	40	1.45	1.44
1.177	10/20/2004	39	1.49	1.48
1.256	2/23/2004	38	1.53	1.52
1.289	1/8/1993	37	1.57	1.56
1.406	3/1/1983	36	1.61	1.61
1.421	2/23/2005	35	1.66	1.65
1.435	1/18/1955	34	1.71	1.70
1.445	12/21/1970	33	1.76	1.75
1.48	11/23/1965	32	1.81	1.81
1.538	1/13/1997	31	1.87	1.87
1.555	2/8/1976	30	1.93	1.93
1.564	12/28/1984	29	2.00	2.00
1.587	10/27/2004	28	2.07	2.07
1.625	11/15/1965	27	2.15	2.15
1.663	1/29/1980	26	2.23	2.23
1.761	10/19/1972	25	2.32	2.33
1.789	1/18/1952	24	2.42	2.42
1.851	2/23/1998	23	2.52	2.53
1.867	3/22/1954	22	2.64	2.65
1.884	3/1/1991	21	2.76	2.78
1.912	1/7/1993	20	2.90	2.92
1.92	2/15/1986	19	3.05	3.08
1.934	1/3/2005	18	3.22	3.25
2.008	1/14/1969	17	3.41	3.45
2.031	2/6/1976	16	3.63	3.67
2.218	2/22/2004	15	3.87	3.92
2.528	3/2/1983	14	4.14	4.21
2.621	1/4/1995	13	4.46	4.54
2.624	2/6/1992	12	4.83	4.93
2.661	11/25/1985	11	5.27	5.40
2.755	12/30/1951	10	5.80	5.96
2.779	11/12/1976	9	6.44	6.65
2.902	3/1/1978	8	7.25	7.53
3.289	2/2/1988	7	8.29	8.67
3.334	11/22/1996	6	9.67	10.21
3.812	10/30/1998	5	11.60	12.43
4.28	10/14/2006	4	14.50	15.89
4.547	2/2/1998	3	19.33	22.00
4.923	2/7/1998	2	29.00	35.75
5.274	2/13/1998	1	58.00	95.33

ATTACHMENT 4

AREA VS ELEVATION

The storage provided by the LID BMPs is entered into the LID Module within SWMM – please refer to Attachment 7 for further information.

Volume provided above the first surface outlet is accounted for in the basins Module within SWMM. A stage-storage relationship is provided within this Module, a copy of which is located on the following pages.

DISCHARGE VS ELEVATION

The orifices have been selected to maximize its 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 the orifices are small, to increase the size of the outlet 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 orifices and riser structures is provided in Attachment 5 of this memorandum.

A stage-discharge relationship is provided on the following pages for the surface outlet structures. The LID low flow orifice discharge relationship is addressed within the LID Module within SWMM – please refer to Attachment 7 for further information.

Stage-Area for BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	1509	**0**	**BIOFILTRATION[(1)]**
0.08	1556	51	
0.17	1603	104	
0.25	1649	158	**TOP OF MULCH[(2)]**
0.33	1694	297	
0.42	1740	440	
0.50	1784	587	**SURFACE DISCHARGE[(3)]**
0.58	1829	738	
0.67	1872	892	
0.75	1916	1050	
0.83	1959	1211	
0.92	2001	1376	
1.00	2043	1545	**SURFACE DISCHARGE**
1.08	2085	1717	
1.17	2126	1892	
1.25	2167	2071	
1.33	2207	2253	**SURFACE DISCHARGE**
1.42	2247	2439	
1.50	2287	2628	
1.58	2326	2820	
1.67	2364	3015	
1.75	2402	3214	
1.83	2440	3416	
1.92	2477	3621	
2.00	2514	3829	
2.08	2550	4039	
2.17	2586	4253	
2.25	2621	4470	**EMERGENCY WEIR[(4)]**
2.33	2656	4690	
2.42	2690	4913	
2.50	2725	5139	

SUB SURFACE STORAGE BMP 1

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	1509	679	**Amended Soil Base (0.3 voids)**
-3.75	1509	1358	**Gravel Base (0.4 voids)[(5)]**
Gravel & Amended Soil	**TOTAL =**	2037	(ft^3)
Surface Total	**TOTAL =**	1545	(ft^3)
IMP	**TOTAL =**	**3582**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes nine (9) inches of storage below the LID orifice.

Effective Depth:	4.67 in

Stage-Area for BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	4364	**0**	**BIOFILTRATION(1)**
0.08	4364	145	
0.17	4364	291	
0.25	4364	436	**TOP OF MULCH(2)**
0.33	4364	800	
0.42	4364	1164	
0.50	4364	1527	
0.58	4364	1891	
0.67	4364	2255	
0.75	4364	2618	**SURFACE DISCHARGE(3)**
0.83	4364	2982	
0.92	4364	3346	
1.00	4364	3709	
1.08	4364	4073	
1.17	4364	4437	
1.25	4364	4800	
1.33	4364	5164	
1.42	4364	5528	
1.50	4364	5891	
1.58	4364	6255	
1.67	4364	6619	
1.75	4364	6982	
1.83	4364	7346	
1.92	4364	7710	
2.00	4364	8073	**EMERGENCY WEIR(4)**
2.08	4364	8437	
2.17	4364	8801	
2.25	4364	9164	
2.33	4364	9528	
2.42	4364	9892	
2.50	4364	10255	

SUB SURFACE STORAGE BMP 2

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	4364	1964	**Amended Soil Base (0.3 voids)**
-3.75	4364	3928	**Gravel Base (0.4 voids)(5)**
Gravel & Amended Soil	**TOTAL =**	5891	(ft^3)
Surface Total	**TOTAL =**	3709	(ft^3)
IMP	**TOTAL =**	**9601**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes nine (9) inches of storage below the LID orifice.

Effective Depth:	7.20 in

Stage-Area for BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
0.00	1411	**0**	**BIOFILTRATION[(1)]**
0.08	1411	47	
0.17	1411	94	
0.25	1411	141	**TOP OF MULCH[(2)]**
0.33	1411	259	
0.42	1411	376	
0.50	1411	494	**SURFACE DISCHARGE[(3)]**
0.58	1411	611	
0.67	1411	729	
0.75	1411	847	
0.83	1411	964	
0.92	1411	1082	
1.00	1411	1199	
1.08	1411	1317	
1.17	1411	1435	
1.25	1411	1552	
1.33	1411	1670	
1.42	1411	1787	
1.50	1411	1905	
1.58	1411	2022	
1.67	1411	2140	
1.75	1411	2258	
1.83	1411	2375	
1.92	1411	2493	
2.00	1411	2610	**EMERGENCY WEIR[(4)]**
2.08	1411	2728	
2.17	1411	2846	
2.25	1411	2963	
2.33	1411	3081	
2.42	1411	3198	
2.50	1411	3316	

SUB SURFACE STORAGE BMP 3

Elevation (ft)	Area (ft^2)	Volume (ft^3)	
-1.50	1411	635	**Amended Soil Base (0.3 voids)**
-4.00	1411	1411	**Gravel Base (0.4 voids)[(5)]**
Gravel & Amended Soil	**TOTAL =**	2046	(ft^3)
Surface Total	**TOTAL =**	1199	(ft^3)
IMP	**TOTAL =**	**3245**	**(ft^3)**

(1): The area at this surface elevation corresponds to the area of gravel and amended soil (Bio-filtration layer)
(2): The volume for the first 3 inches of surface depth accounts for the voids of mulch
(3): Volume at this elevation coresponds with surface volume for WQ purposes (invert of lowest surface outlet)
(4): This elevation corresponds to the top of the riser elevation.
(5): Gravel Depth includes twelve (12) inches of storage below the LID orifice.

Effective Depth:	4.20 in

Outlet structure for Discharge of Detention Basin 1 (note: 0.0 elev = 2.75 ft actual elevation)

Discharge vs Elevation Table

Low orifice:	**0.75** "	Lower slot		Emergency Weir	
Number:	2	Invert:	0.25 ft	Invert:	1.750 ft
Cg-low:	0.61	B	0.50 ft	B:	8 ft
		h	0.167 ft		
Middle orifice:	**1** "	Upper slot			
number of orif:	0	Invert:	0.833 ft		
Cg-middle:	0.61	B:	2.50 ft		
invert elev:	0.25 ft	h	0.250 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.667	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.083	1.333	0.000	0.007	0.008	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007
0.125	2.000	0.000	0.009	0.012	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009
0.167	2.667	0.000	0.011	0.014	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011
0.208	3.333	0.000	0.013	0.014	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013
0.250	4.000	0.000	0.014	0.023	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.014
0.292	4.667	0.500	0.015	0.057	0.015	0.000	0.000	0.000	0.013	0.000	0.000	0.029
0.333	5.333	1.000	0.017	0.147	0.017	0.000	0.000	0.000	0.037	0.000	0.000	0.054
0.375	6.000	1.500	0.018	0.176	0.018	0.000	0.000	0.000	0.069	0.000	0.000	0.086
0.417	6.667	2.000	0.019	0.186	0.019	0.000	0.000	0.000	0.105	0.000	0.000	0.124
0.458	7.333	2.500	0.020	0.196	0.020	0.000	0.000	0.000	0.144	0.000	0.000	0.164
0.500	8.000	3.000	0.021	0.206	0.021	0.000	0.000	0.000	0.167	0.000	0.000	0.187
0.542	8.667	3.500	0.021	0.215	0.021	0.000	0.000	0.000	0.186	0.000	0.000	0.208
0.583	9.333	4.000	0.022	0.223	0.022	0.000	0.000	0.000	0.204	0.000	0.000	0.226
0.625	10.000	4.500	0.023	0.231	0.023	0.000	0.000	0.000	0.220	0.000	0.000	0.243
0.667	10.667	5.000	0.024	0.239	0.024	0.000	0.000	0.000	0.236	0.000	0.000	0.259
0.708	11.333	5.500	0.025	0.247	0.025	0.000	0.000	0.000	0.250	0.000	0.000	0.275
0.750	12.000	6.000	0.025	0.255	0.025	0.000	0.000	0.000	0.263	0.000	0.000	0.289
0.792	12.667	6.500	0.026	0.262	0.026	0.000	0.000	0.000	0.276	0.000	0.000	0.302
0.833	13.333	7.000	0.027	0.269	0.027	0.000	0.000	0.000	0.288	0.000	0.000	0.315
0.875	14.000	7.500	0.028	0.276	0.028	0.000	0.000	0.000	0.300	0.066	0.000	0.394
0.917	14.667	8.000	0.028	0.283	0.028	0.000	0.000	0.000	0.312	0.186	0.000	0.526
0.958	15.333	8.500	0.029	0.289	0.029	0.000	0.000	0.000	0.323	0.342	0.000	0.694
1.000	16.000	9.000	0.030	0.296	0.030	0.000	0.000	0.000	0.333	0.527	0.000	0.890
1.042	16.667	9.500	0.030	0.302	0.030	0.000	0.000	0.000	0.343	0.737	0.000	1.110
1.083	17.333	10.000	0.031	0.308	0.031	0.000	0.000	0.000	0.353	0.969	0.000	1.353
1.125	18.000	10.500	0.031	0.314	0.031	0.000	0.000	0.000	0.363	1.221	0.000	1.615
1.167	18.667	11.000	0.032	0.320	0.032	0.000	0.000	0.000	0.372	1.396	0.000	1.801
1.208	19.333	11.500	0.033	0.326	0.033	0.000	0.000	0.000	0.382	1.530	0.000	1.944
1.250	20.000	12.000	0.033	0.332	0.033	0.000	0.000	0.000	0.391	1.652	0.000	2.076
1.292	20.667	12.500	0.034	0.337	0.034	0.000	0.000	0.000	0.399	1.766	0.000	2.199
1.333	21.333	13.000	0.034	0.343	0.034	0.000	0.000	0.000	0.408	1.874	0.000	2.316
1.375	22.000	13.500	0.035	0.348	0.035	0.000	0.000	0.000	0.416	1.975	0.000	2.426
1.417	22.667	14.000	0.035	0.354	0.035	0.000	0.000	0.000	0.425	2.071	0.000	2.531
1.458	23.333	14.500	0.036	0.359	0.036	0.000	0.000	0.000	0.433	2.163	0.000	2.632
1.500	24.000	15.000	0.036	0.364	0.036	0.000	0.000	0.000	0.441	2.252	0.000	2.729
1.542	24.667	15.500	0.037	0.369	0.037	0.000	0.000	0.000	0.448	2.337	0.000	2.822
1.583	25.333	16.000	0.037	0.374	0.037	0.000	0.000	0.000	0.456	2.419	0.000	2.912
1.625	26.000	16.500	0.038	0.379	0.038	0.000	0.000	0.000	0.464	2.498	0.000	3.000
1.667	26.667	17.000	0.038	0.384	0.038	0.000	0.000	0.000	0.471	2.575	0.000	3.084
1.708	27.333	17.500	0.039	0.389	0.039	0.000	0.000	0.000	0.478	2.650	0.000	3.167
1.750	28.000	18.000	0.039	0.394	0.039	0.000	0.000	0.000	0.486	2.722	0.000	3.247
1.792	28.667	18.500	0.040	0.399	0.040	0.000	0.000	0.000	0.493	2.793	0.211	3.536
1.833	29.333	19.000	0.040	0.403	0.040	0.000	0.000	0.000	0.500	2.862	0.597	3.998
1.875	30.000	19.500	0.041	0.408	0.041	0.000	0.000	0.000	0.507	2.929	1.096	4.573
1.917	30.667	20.000	0.041	0.412	0.041	0.000	0.000	0.000	0.513	2.995	1.687	5.237
1.958	31.333	20.500	0.042	0.417	0.042	0.000	0.000	0.000	0.520	3.060	2.358	5.979
2.000	32.000	21.000	0.042	0.421	0.042	0.000	0.000	0.000	0.527	3.123	3.100	6.791

Outlet structure for Discharge of Detention Basin 2

(note: 0.0 elev = 2.75 ft actual elevation)

Discharge vs Elevation Table

Low orifice:	1.5 "	Lower slot		Emergency Weir	
Number:	0	Invert:	0.00 ft	Invert:	1.500 ft
Cg-low:	0.61	B	3.00 ft	B:	12 ft
		h	0.250 ft		
Middle orifice:	1 "	Upper slot			
number of orif:	0	Invert:	0.000 ft		
Cg-middle:	0.61	B:	0.00 ft		
invert elev:	0.25 ft	h	0.000 ft		

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.042	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.079	0.000	0.000	0.079
0.083	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.224	0.000	0.000	0.224
0.125	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.411	0.000	0.000	0.411
0.167	1.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.633	0.000	0.000	0.633
0.208	1.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.884	0.000	0.000	0.884
0.250	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.162	0.000	0.000	1.162
0.292	2.333	0.500	0.000	0.000	0.000	0.000	0.000	0.000	1.465	0.000	0.000	1.465
0.333	2.667	1.000	0.000	0.000	0.000	0.000	0.000	0.000	1.676	0.000	0.000	1.676
0.375	3.000	1.500	0.000	0.000	0.000	0.000	0.000	0.000	1.836	0.000	0.000	1.836
0.417	3.333	2.000	0.000	0.000	0.000	0.000	0.000	0.000	1.983	0.000	0.000	1.983
0.458	3.667	2.500	0.000	0.000	0.000	0.000	0.000	0.000	2.120	0.000	0.000	2.120
0.500	4.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	2.248	0.000	0.000	2.248
0.542	4.333	3.500	0.000	0.000	0.000	0.000	0.000	0.000	2.370	0.000	0.000	2.370
0.583	4.667	4.000	0.000	0.000	0.000	0.000	0.000	0.000	2.486	0.000	0.000	2.486
0.625	5.000	4.500	0.000	0.000	0.000	0.000	0.000	0.000	2.596	0.000	0.000	2.596
0.667	5.333	5.000	0.000	0.000	0.000	0.000	0.000	0.000	2.702	0.000	0.000	2.702
0.708	5.667	5.500	0.000	0.000	0.000	0.000	0.000	0.000	2.804	0.000	0.000	2.804
0.750	6.000	6.000	0.000	0.000	0.000	0.000	0.000	0.000	2.903	0.000	0.000	2.903
0.792	6.333	6.500	0.000	0.000	0.000	0.000	0.000	0.000	2.998	0.000	0.000	2.998
0.833	6.667	7.000	0.000	0.000	0.000	0.000	0.000	0.000	3.090	0.000	0.000	3.090
0.875	7.000	7.500	0.000	0.000	0.000	0.000	0.000	0.000	3.180	0.000	0.000	3.180
0.917	7.333	8.000	0.000	0.000	0.000	0.000	0.000	0.000	3.267	0.000	0.000	3.267
0.958	7.667	8.500	0.000	0.000	0.000	0.000	0.000	0.000	3.352	0.000	0.000	3.352
1.000	8.000	9.000	0.000	0.000	0.000	0.000	0.000	0.000	3.434	0.000	0.000	3.434
1.042	8.333	9.500	0.000	0.000	0.000	0.000	0.000	0.000	3.515	0.000	0.000	3.515
1.083	8.667	10.000	0.000	0.000	0.000	0.000	0.000	0.000	3.594	0.000	0.000	3.594
1.125	9.000	10.500	0.000	0.000	0.000	0.000	0.000	0.000	3.671	0.000	0.000	3.671
1.167	9.333	11.000	0.000	0.000	0.000	0.000	0.000	0.000	3.747	0.000	0.000	3.747
1.208	9.667	11.500	0.000	0.000	0.000	0.000	0.000	0.000	3.821	0.000	0.000	3.821
1.250	10.000	12.000	0.000	0.000	0.000	0.000	0.000	0.000	3.894	0.000	0.000	3.894
1.292	10.333	12.500	0.000	0.000	0.000	0.000	0.000	0.000	3.966	0.000	0.000	3.966
1.333	10.667	13.000	0.000	0.000	0.000	0.000	0.000	0.000	4.036	0.000	0.000	4.036
1.375	11.000	13.500	0.000	0.000	0.000	0.000	0.000	0.000	4.105	0.000	0.000	4.105
1.417	11.333	14.000	0.000	0.000	0.000	0.000	0.000	0.000	4.173	0.000	0.000	4.173
1.458	11.667	14.500	0.000	0.000	0.000	0.000	0.000	0.000	4.239	0.000	0.000	4.239
1.500	12.000	15.000	0.000	0.000	0.000	0.000	0.000	0.000	4.305	0.000	0.000	4.305
1.542	12.333	15.500	0.000	0.000	0.000	0.000	0.000	0.000	4.370	0.000	0.316	4.686
1.583	12.667	16.000	0.000	0.000	0.000	0.000	0.000	0.000	4.434	0.000	0.895	5.329
1.625	13.000	16.500	0.000	0.000	0.000	0.000	0.000	0.000	4.497	0.000	1.644	6.141
1.667	13.333	17.000	0.000	0.000	0.000	0.000	0.000	0.000	4.559	0.000	2.531	7.090
1.708	13.667	17.500	0.000	0.000	0.000	0.000	0.000	0.000	4.620	0.000	3.537	8.157
1.750	14.000	18.000	0.000	0.000	0.000	0.000	0.000	0.000	4.680	0.000	4.650	9.330

Outlet structure for Discharge of Detention Basin 3

(note: 0.0 elev = 2.75 ft actual elevation)

Discharge vs Elevation Table

Low orifice:	0.75 "	Lower slot			Emergency Weir		
Number:	0	Invert:	0.00	ft	Invert:	1.500	ft
Cg-low:	0.61	B	1.00	ft	B:	8	ft
		h	0.167	ft			
Middle orifice:	1 "	Upper slot					
number of orif:	0	Invert:	0.000	ft			
Cg-middle:	0.61	B:	0.00	ft			
invert elev:	0.25 ft	h	0.000	ft			

h (ft)	H/D-low -	H/D-mid -	Qlow-orif (cfs)	Qlow-weir (cfs)	Qtot-low (cfs)	Qmid-orif (cfs)	Qmid-weir (cfs)	Qtot-med (cfs)	Qslot-low (cfs)	Qslot-upp (cfs)	Qemer (cfs)	Qtot (cfs)	Total H (ft)	Total Q (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	2.750	0.026
0.042	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.000	0.026	2.792	0.052
0.083	1.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.075	0.000	0.000	0.075	2.833	0.100
0.125	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.137	0.000	0.000	0.137	2.875	0.163
0.167	2.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.211	0.000	0.000	0.211	2.917	0.236
0.208	3.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.288	0.000	0.000	0.288	2.958	0.314
0.250	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.333	0.000	0.000	0.333	3.000	0.359
0.292	4.667	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.372	0.000	0.000	0.372	3.042	0.398
0.333	5.333	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.408	0.000	0.000	0.408	3.083	0.433
0.375	6.000	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.441	0.000	0.000	0.441	3.125	0.466
0.417	6.667	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.471	0.000	0.000	0.471	3.167	0.497
0.458	7.333	2.500	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.500	3.208	0.525
0.500	8.000	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.527	0.000	0.000	0.527	3.250	0.552
0.542	8.667	3.500	0.000	0.000	0.000	0.000	0.000	0.000	0.552	0.000	0.000	0.552	3.292	0.578
0.583	9.333	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.577	0.000	0.000	0.577	3.333	0.602
0.625	10.000	4.500	0.000	0.000	0.000	0.000	0.000	0.000	0.600	0.000	0.000	0.600	3.375	0.626
0.667	10.667	5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.623	0.000	0.000	0.623	3.417	0.649
0.708	11.333	5.500	0.000	0.000	0.000	0.000	0.000	0.000	0.645	0.000	0.000	0.645	3.458	0.671
0.750	12.000	6.000	0.000	0.000	0.000	0.000	0.000	0.000	0.666	0.000	0.000	0.666	3.500	0.692
0.792	12.667	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.687	0.000	0.000	0.687	3.542	0.712
0.833	13.333	7.000	0.000	0.000	0.000	0.000	0.000	0.000	0.707	0.000	0.000	0.707	3.583	0.732
0.875	14.000	7.500	0.000	0.000	0.000	0.000	0.000	0.000	0.726	0.000	0.000	0.726	3.625	0.751
0.917	14.667	8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.745	0.000	0.000	0.745	3.667	0.770
0.958	15.333	8.500	0.000	0.000	0.000	0.000	0.000	0.000	0.763	0.000	0.000	0.763	3.708	0.789
1.000	16.000	9.000	0.000	0.000	0.000	0.000	0.000	0.000	0.781	0.000	0.000	0.781	3.750	0.807
1.042	16.667	9.500	0.000	0.000	0.000	0.000	0.000	0.000	0.799	0.000	0.000	0.799	3.792	0.824
1.083	17.333	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.816	0.000	0.000	0.816	3.833	0.841
1.125	18.000	10.500	0.000	0.000	0.000	0.000	0.000	0.000	0.833	0.000	0.000	0.833	3.875	0.858
1.167	18.667	11.000	0.000	0.000	0.000	0.000	0.000	0.000	0.849	0.000	0.000	0.849	3.917	0.875
1.208	19.333	11.500	0.000	0.000	0.000	0.000	0.000	0.000	0.865	0.000	0.000	0.865	3.958	0.891
1.250	20.000	12.000	0.000	0.000	0.000	0.000	0.000	0.000	0.881	0.000	0.000	0.881	4.000	0.907
1.292	20.667	12.500	0.000	0.000	0.000	0.000	0.000	0.000	0.897	0.000	0.000	0.897	4.042	0.922
1.333	21.333	13.000	0.000	0.000	0.000	0.000	0.000	0.000	0.912	0.000	0.000	0.912	4.083	0.938
1.375	22.000	13.500	0.000	0.000	0.000	0.000	0.000	0.000	0.927	0.000	0.000	0.927	4.125	0.953
1.417	22.667	14.000	0.000	0.000	0.000	0.000	0.000	0.000	0.942	0.000	0.000	0.942	4.167	0.968
1.458	23.333	14.500	0.000	0.000	0.000	0.000	0.000	0.000	0.957	0.000	0.000	0.957	4.208	0.982
1.500	24.000	15.000	0.000	0.000	0.000	0.000	0.000	0.000	0.971	0.000	0.000	0.971	4.250	0.997
1.542	24.667	15.500	0.000	0.000	0.000	0.000	0.000	0.000	0.985	0.000	0.211	1.196	4.292	1.222
1.583	25.333	16.000	0.000	0.000	0.000	0.000	0.000	0.000	0.999	0.000	0.596	1.596	4.333	1.621
1.625	26.000	16.500	0.000	0.000	0.000	0.000	0.000	0.000	1.013	0.000	1.096	2.109	4.375	2.134
1.667	26.667	17.000	0.000	0.000	0.000	0.000	0.000	0.000	1.027	0.000	1.687	2.714	4.417	2.739
1.708	27.333	17.500	0.000	0.000	0.000	0.000	0.000	0.000	1.040	0.000	2.358	3.398	4.458	3.424
1.750	28.000	18.000	0.000	0.000	0.000	0.000	0.000	0.000	1.053	0.000	3.100	4.153	4.500	4.179
1.792	28.667	18.500	0.000	0.000	0.000	0.000	0.000	0.000	1.066	0.000	3.906	4.973	4.542	4.998
1.833	29.333	19.000	0.000	0.000	0.000	0.000	0.000	0.000	1.079	0.000	4.773	5.852	4.583	5.877
1.875	30.000	19.500	0.000	0.000	0.000	0.000	0.000	0.000	1.092	0.000	5.695	6.787	4.625	6.812
1.917	30.667	20.000	0.000	0.000	0.000	0.000	0.000	0.000	1.105	0.000	6.670	7.775	4.667	7.800
1.958	31.333	20.500	0.000	0.000	0.000	0.000	0.000	0.000	1.117	0.000	7.695	8.812	4.708	8.838
2.000	32.000	21.000	0.000	0.000	0.000	0.000	0.000	0.000	1.130	0.000	8.768	9.897	4.750	9.923

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:

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

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

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

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

The following are the variables used above:

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

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

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

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

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

ATTACHMENT 5

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

LEGEND

DMA BOUNDARY

SOIL TYPE BOUNDARY

DEPTH TO GROUNDWATER > 20FT

NO CRITICAL COARSE SEDIMENT YIELD AREAS TO PROTECT

PRE DEVELOPED AREAS					
DMA	SOIL TYPE	IMPERVIOUS (AC)	PERVIOUS (AC)	TOTAL AREA (AC)	DRAINS TO
1-A	A	0.00	4.09	4.09	POC-1
1-D	D	0.00	4.42	4.42	
2-D	D	0.00	0.60	0.60	POC-2
OFFSITE-A	A	0.00	0.37	0.37	POC-1
OFFSITE-D	D	0.00	0.01	0.01	
TOTAL				9.48	

REVISIONS

NO.	DESCRIPTION	DATE	APP'D

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

DATE: 10-2016
SCALE: 1" = 50'
DRAWN:
CHECKED:

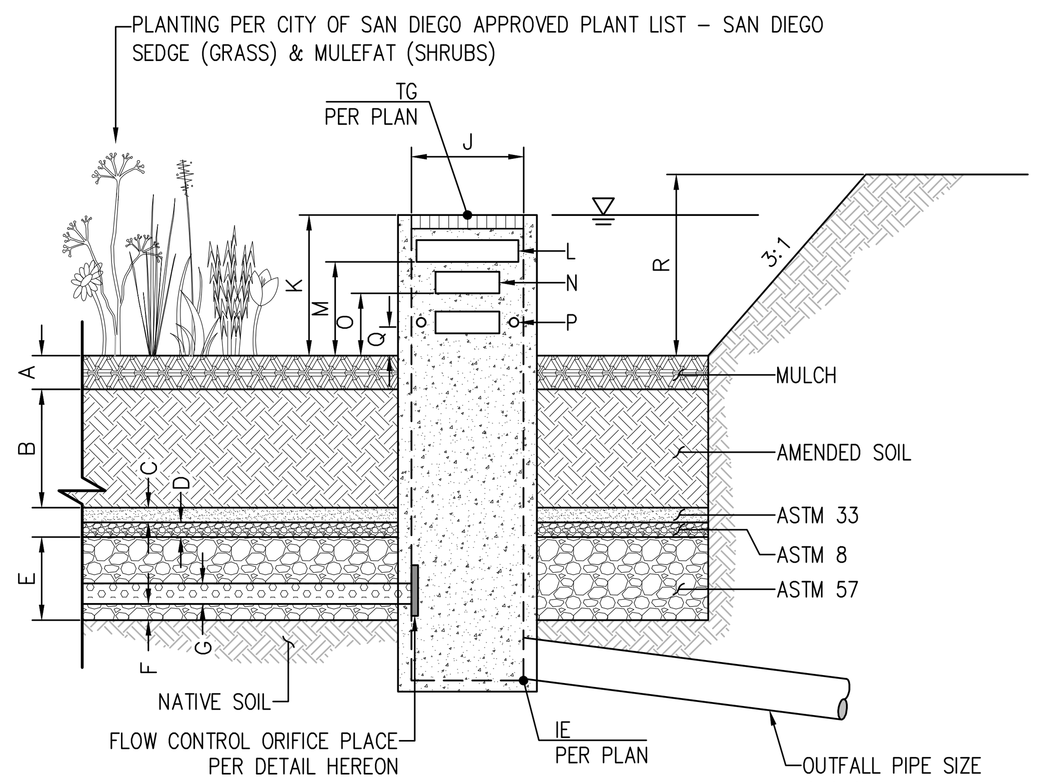
SHEET TITLE
DMA EXHIBIT - EXISITING CONDITIONS

PROJECT
SKYLINE RETIREMENT CENTER
LA MESA, CALIFORNIA 91941

SHEET 1
OF 1 SHEETS

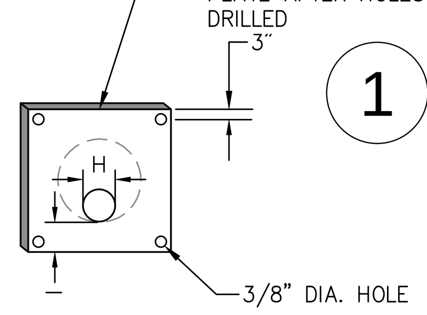
SAVE DATE: 9/18/2017 ~ PLOT DATE: 9/18/2017 ~ FILE NAME: P:\Acad\979 ~ Skyline Senior Residence\Reports\SWQMP\170911_979-DMAEXHIBITPST.dwg

SKYLINE RETIREMENT CENTER



NOTES:
1. SOIL MIX PER CITY OF SAN DIEGO LID MANUAL
2. "WELL DRAINED SOIL" SHALL BE "SANDY LOAM" SOIL MIX WITH NO MORE THAN 5% CLAY CONTENT. THE MIX SHALL CONTAIN 50–60% SAND, 20–30% COMPOST OR HARDWOOD MULCH, AND 20–30% TOPSOIL.

① BMP BASIN DETAILS
NOT TO SCALE



FLOW CONTROL ORIFICE PLATE
NTS

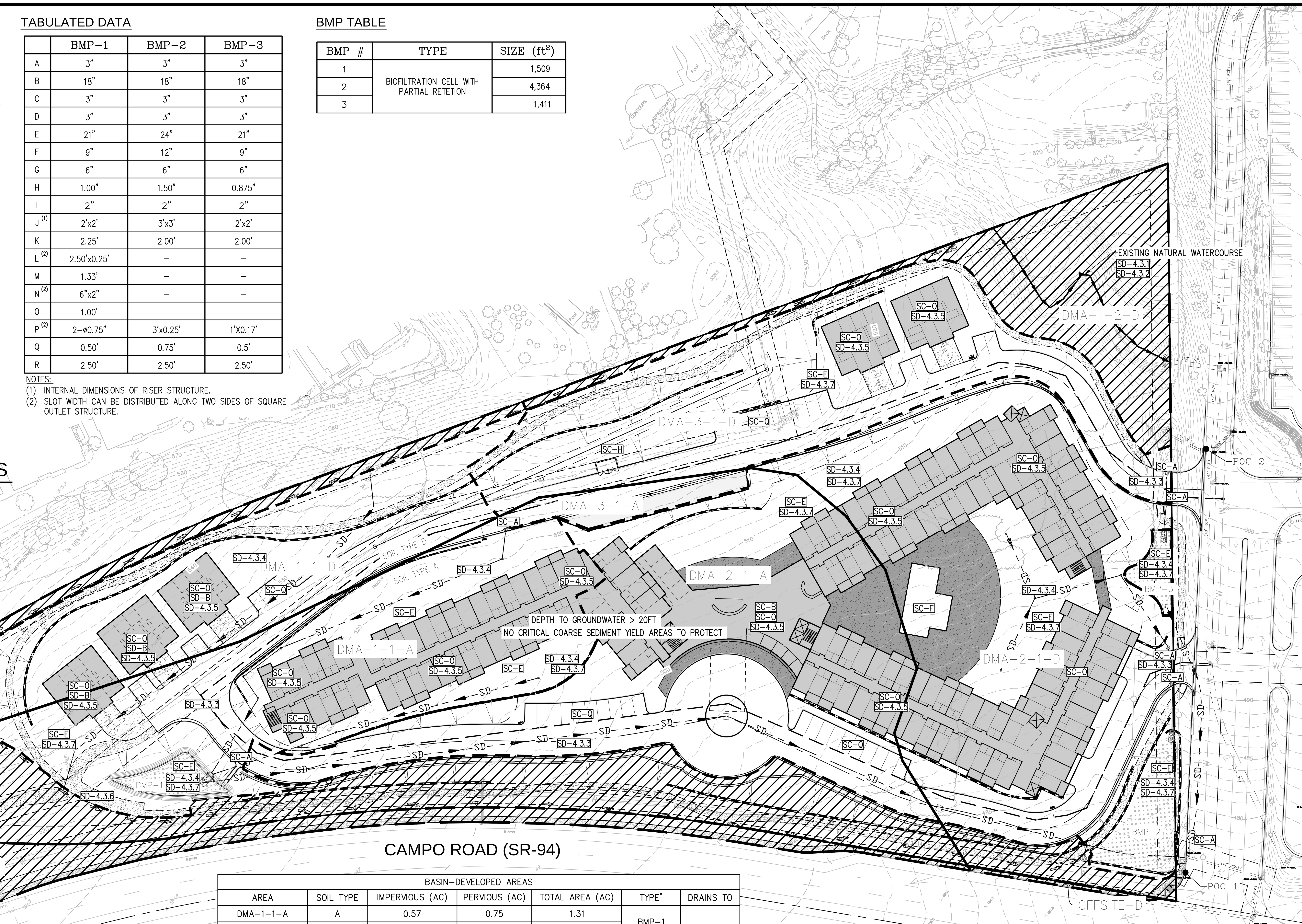
TABULATED DATA

	BMP–1	BMP–2	BMP–3
A	3"	3"	3"
B	18"	18"	18"
C	3"	3"	3"
D	3"	3"	3"
E	21"	24"	21"
F	9"	12"	9"
G	6"	6"	6"
H	1.00"	1.50"	0.875"
I	2"	2"	2"
J (1)	2'x2'	3'x3'	2'x2'
K	2.25'	2.00'	2.00'
L (2)	2.50'x0.25'	–	–
M	1.33'	–	–
N (2)	6"x2"	–	–
O	1.00'	–	–
P (2)	2–#0.75"	3'x0.25'	1'X0.17'
Q	0.50'	0.75'	0.5'
R	2.50'	2.50'	2.50'

NOTES:
(1) INTERNAL DIMENSIONS OF RISER STRUCTURE.
(2) SLOT WIDTH CAN BE DISTRIBUTED ALONG TWO SIDES OF SQUARE OUTLET STRUCTURE.

BMP TABLE

BMP #	TYPE	SIZE (ft^2)
1	BIOFILTRATION CELL WITH PARTIAL RETETION	1,509
2		4,364
3		1,411



BASIN–DEVELOPED AREAS						
AREA	SOIL TYPE	IMPERVIOUS (AC)	PERVIOUS (AC)	TOTAL AREA (AC)	TYPE*	DRAINS TO
DMA–1–1–A	A	0.57	0.75	1.31	BMP–1	POC–1
DMA–1–1–D	D	0.29	0.60	0.89		
DMA–2–1–A	A	1.24	0.36	1.60	BMP–2	
DMA–2–1–D	D	1.12	0.83	1.95		
DMA–3–1–A	A	0.11	0.00	0.11	BMP–3	
DMA–3–1–D	D	0.55	0.61	1.16		
BYPASS–1–A	A	0.00	1.07	1.07	SELF MITIGATING	
BYPASS–1–D	D	0.00	0.37	0.36		
OFFSITE–A	A	0.10	0.27	0.37		
OFFSITE–D	D	0.01	0.00	0.01		
DMA–1–2–D	D	0.00	0.66	0.66		POC–2
TOTAL		3.99	4.84	9.48		

*=BMP TYPE IS BIOFILTRATION WITH PARTIAL RETENTION (PR–1)

LEGEND

- DMA BOUNDARY
- SOIL BOUNDARY
- IMPERVIOUS AREA (STREET)
- IMPERVIOUS AREA (ROOF)
- DG TRAIL
- BMP BASIN
- BYPASS/SELF MITIGATING AREA
- BROW DITCH (D–75, TYPE A)
- SOUND WALL
- RETAILING WALL
- STORM DRAIN
- TYPE "F" INLET
- SD INLET

SOURCE CONTROL BMP'S

SC–A: ON–SITE STORM DRAIN INLETS
SC–B: INTERIOR FLOOR DRAINS AND ELEVATOR SHAFT SUMP PUMPS
SC–E: LANDSCAPE/OUTDOOR PESTICIDE USE
SC–F: POOLS, SPAS, PONDS, FOUNTAINS, AND OTHER WATER FEATURES
SC–H: INTERIOR PARKING GARAGES
SC–O: FUTURE INDOOR & STRUCTURAL PEST CONTROL
SC–Q: PLAZAS, SIDEWALKS, AND PARKING LOTS

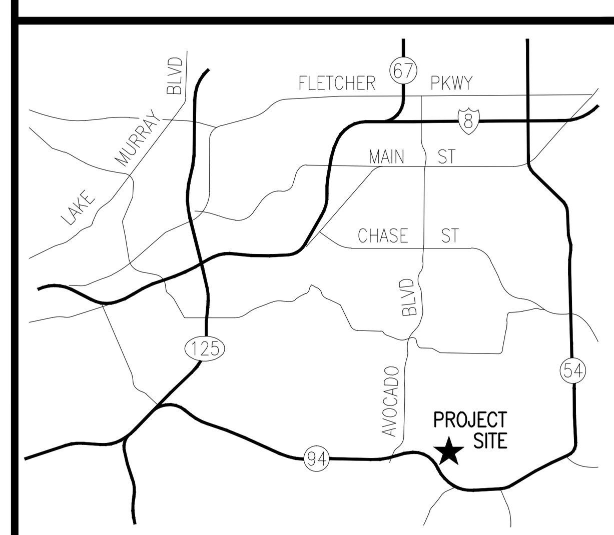
SITE DESIGN BMP'S

SD–4.3.1: EXISTING VEGETATED CHANNEL ALONG NORTHERN SITE BOUNDARY TO REMAIN UNDISTURBED.
SD–4.3.2: NATURAL AREAS, SOILS, AND VEGETATION ARE TO BE CONSERVED.
SD–4.3.3: ROAD DESIGNED TO MINIMUM WIDTH WITHOUT COMPROMISING PUBLIC SAFETY OR ALTERNATIVE TRANSPORTATION.
SD–4.3.4: PROPOSED LANDSCAPED AREAS THAT BECAME COMPACTED DURING CONSTRUCTION TO BE RE–TILLED AFTER CONSTRUCTION HAS BEEN COMPLETED.
SD–4.3.5: RUNOFF FROM ROOFS AND DRIVEWAYS WILL BE DIRECTED TOWARDS LANDSCAPED AREAS.
SD–4.3.6: PERMEABLE MATERIAL
SD–4.3.7: LANDSCAPING TO BE DONE WITH NATIVE OR DROUGHT TOLERANT SPECIES

SAMPLE PROHIBITIVE SIGNAGE
NTS

SCALE: 1" = 50'

VICINITY MAP



OWNER INFORMATION

NAME: SKYLINE WESLEYAN CHURCH
ADDRESS: 11330 CAMPO RD
CITY: LA MESA
STATE: CALIFORNIA
ZIP: 91941
PHONE: 619–660–5000
FAX: N/A
EMAIL: N/A

CONTACT INFORMATION

NAME: PASTOR DAN GRANT
ADDRESS: 11330 CAMPO RD
CITY: LA MESA
STATE: CALIFORNIA
ZIP: 91941
PHONE: 619–660–5000
FAX: N/A
EMAIL: N/A

PARCEL INFORMATION

APN: 506–140–06, 07
SITE ADDRESS: 11330 CAMPO ROAD LA MESA, CA 91941
ZONE:
SETBACK:

I CERTIFY THAT I HAVE READ ALL ZONING REGULATIONS AND BEST MANAGEMENT PRACTICES (BMPs) NOTES AND THAT I AM THE DESIGNER OF THE PROPOSED PROJECT:

BRUCE A. ROBERTSON REC NO.48529 DATE

PROJECT INFORMATION

EXISTING:
VACANT, UNDEVELOPED LOT

PROPOSED:
CENTRAL COMMON AREA (2–STORY) = 22,400 S.F.
WING 1 (ASSISTED LIVING) = 23,215 S.F. (PER FLOOR) x 3 FLOORS= 69,645 S.F.
WING 2 (ASSISTED LIVING) = 20,106 S.F. (PER FLOOR) x 3 FLOORS= 60,318 S.F.
WING 3 (INDEPENDENT LIVING) = 21,920 S.F. (PER FLOOR) x 3 FLOORS= 65,760 S.F. w/BASEMENT PARKING GARAGE
5 DUPLEX UNITS (3,000 S.F./EA) = 15,000 S.F
AC PARKING ALONG MAIN DRIVEWAY = 30 SPACES
PARKING STRUCTURE = 25,000 S.F.

GRADING AND EARTHWORK:
CUT: 35,000 CY
FILL: 35,000 CY
IMPORT/EXPORT:0.00 CY

DISTURBED AREA = 7.75 AC

REGISTERED PROFESSIONAL ENGINEER BRUCE A. ROBERTSON RCE – 48529 EXP 6/30/16 CIVIL STATE OF CALIFORNIA

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

SHEET TITLE
DMA EXHIBIT

SHEET NUMBER
2

PDS 040 (REV. 09/24/2012)
BUILDING PLOT PLAN TEMPLATE

ATTACHMENT 6

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

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           08/29/1951
START_TIME           00:00:00
REPORT_START_DATE    08/29/1951
REPORT_START_TIME    00:00:00
END_DATE             03/29/2008
END_TIME             00:00:00
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      0.07   0.10   0.13   0.17   0.19   0.22   0.24   0.22   0.19   0.13   0.09   0.06
DRY_ONLY     NO

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

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
1-1-A            Lower-Otay       POC-1            4.086    0        820      13.50    0
1-1-D            Lower-Otay       POC-1            4.417    0        796      14.10    0
OFFSITE-A        Lower-Otay       POC-1            0.367    0        28       3.50     0
OFFSITE-D        Lower-Otay       POC-1            0.012    0        20       3.90     0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
1-1-A            0.012      0.05       0.05       0.10       25         OUTLET
1-1-D            0.012      0.05       0.05       0.10       25         OUTLET
OFFSITE-A        0.012      0.05       0.05       0.10       25         OUTLET
OFFSITE-D        0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
1-1-A            1.5        0.30       0.30
1-1-D            9.0        0.025      0.33
OFFSITE-A        1.5        0.30       0.30
OFFSITE-D        9.0        0.025      0.33

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
```

```
POC-1            0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
LowerOtay        FILE "Lower Otay.txt"

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

[TAGS]

[MAP]
DIMENSIONS 1450.000 2925.000 2550.000 4575.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            2000.000           3000.000

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

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
1-1-A            1500.000           4000.000
1-1-A            1500.000           4000.000
1-1-D            2500.000           4000.000
OFFSITE-A        1500.000           3000.000
OFFSITE-D        2500.000           3000.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Lower-Otay       2000.000           4500.000
```

POST_DEV

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           08/29/1951
START_TIME           00:00:00
REPORT_START_DATE    08/29/1951
REPORT_START_TIME    00:00:00
END_DATE             03/29/2008
END_TIME             00:00:00
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      0.07   0.10   0.13   0.17   0.19   0.22   0.24   0.22   0.19   0.13   0.09   0.06
DRY_ONLY     NO

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

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet          Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
1-1-D            LowerOtay        BR-1             0.888    32.4     363      50       0
1-1-A            LowerOtay        BR-1             1.278    44.5     400      39.10    0
1-2-A            LowerOtay        BR-2             1.600    77.17    598      12.50    0
1-2-D            LowerOtay        BR-2             1.848    60.60    527      45       0
1-3-A            LowerOtay        BR-3             0.106    100      214      6.12     0
1-3-D            LowerOtay        BR-3             1.189    46.4     672      38.56    0
BR-1             LowerOtay        DIV-1            0.03464  0        10       0        0
BR-2             LowerOtay        DIV-2            0.10018  0        10       0        0
BR-3             LowerOtay        DIV-3            0.03237  0        10       0        0
1-1-D-BYPASS     LowerOtay        POC-1            0.365    0        423      14.10    0
1-1-A-BYPASS     LowerOtay        POC-1            1.067    0        865      13.50    0
OFFSITE-A        LowerOtay        POC-1            0.367    27.4     28       3.50     0
OFFSITE-D        LowerOtay        POC-1            0.012    100      20       3.90     0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
```

POST_DEV

```
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
1-1-D            0.012      0.05       0.05       0.10       25         OUTLET
1-1-A            0.012      0.05       0.05       0.10       25         OUTLET
1-2-A            0.012      0.05       0.05       0.10       25         OUTLET
1-2-D            0.012      0.05       0.05       0.10       25         OUTLET
1-3-A            0.012      0.05       0.05       0.10       25         OUTLET
1-3-D            0.012      0.05       0.05       0.10       25         OUTLET
BR-1             0.012      0.05       0.05       0.10       25         OUTLET
BR-2             0.012      0.05       0.05       0.10       25         OUTLET
BR-3             0.012      0.05       0.05       0.10       25         OUTLET
1-1-D-BYPASS     0.012      0.05       0.05       0.10       25         OUTLET
1-1-A-BYPASS     0.012      0.05       0.05       0.10       25         OUTLET
OFFSITE-A        0.012      0.05       0.05       0.10       25         OUTLET
OFFSITE-D        0.012      0.05       0.05       0.10       25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
1-1-D            9          0.01875    0.33
1-1-A            1.5        0.225      0.30
1-2-A            1.5        0.225      0.30
1-2-D            9          0.01875    0.33
1-3-A            1.5        0.225      0.30
1-3-D            9          0.01875    0.33
BR-1             1.5        0.225      0.30
BR-2             9          0.01875    0.33
BR-3             9          0.01875    0.33
1-1-D-BYPASS     9          0.025      0.33
1-1-A-BYPASS     1.5        0.3        0.30
OFFSITE-A        1.5        0.225      0.30
OFFSITE-D        9          0.01875    0.33

[LID_CONTROLS]
;;               Type/Layer Parameters
;;-------------- ---------- ----------
BR-1             BC
BR-1             SURFACE    4.67       0.05       0          0          5
BR-1             SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-1             STORAGE    27         0.67       0.1018     0
BR-1             DRAIN      0.2207     0.5        9          6

BR-2             BC
BR-2             SURFACE    7.2        0.05       0          0          5
BR-2             SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-2             STORAGE    27         0.67       0.0896     0
BR-2             DRAIN      0.1717     0.5        9          6

BR-3             BC
BR-3             SURFACE    4.20       0.05       0          0          5
BR-3             SOIL       18         0.4        0.2        0.1        5          5          1.5
BR-3             STORAGE    30         0.67       0.14       0
BR-3             DRAIN      0.1807     0.5        12         6

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSatur  FromImprv  ToPerv     Report
File
;;-------------- ---------------- ------- ---------- ---------- ---------- ---------- ---------- -------
----
BR-1             BR-1             1       1509       0          0          100        0
BR-2             BR-2             1       4364       0          0          100        0
BR-3             BR-3             1       1410       0          0          100        0
```

POST_DEV

```
[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-1            0          BYPASS-1         CUTOFF     0.03210    0          0          0          0
DIV-2            0          BYPASS-2         CUTOFF     0.07115    0          0          0          0
DIV-3            0          BYPASS-3         CUTOFF     0.02466    0          0          0          0

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                      Ponded   Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                     Area     Frac.
Infiltration Parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- -------- ----
-------------------
BASIN-1          0        2        0        TABULAR    BASIN-1                    2725     0
BASIN-2          0        1.75     0        TABULAR    BASIN-2                    4364     0
BASIN-3          0        2        0        TABULAR    BASIN-3                    1411     1

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.
Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow
Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------
- ----------
BYPASS-1         DIV-1            BASIN-1          10         0.01       0          0          0
0
U-DRAIN-1        DIV-1            POC-1            10         0.01       0          0          0
0
U-DRAIN-2        DIV-2            POC-1            10         0.01       0          0          0
0
BYPASS-2         DIV-2            BASIN-2          10         0.01       0          0          0
0
U-DRAIN-3        DIV-3            POC-1            10         0.01       0          0          0
0
BYPASS-3         DIV-3            BASIN-3          10         0.01       0          0          0
0

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet          Qcoeff/
Flap
;;Name           Node             Node             Height     Type            QTable           Qexpon
Gate
;;-------------- ---------------- ---------------- ---------- --------------- ---------------- ---------
- ----
OUTLET-1         BASIN-1          POC-1            0          TABULAR/HEAD    OUT-1
NO
OUTLET-2         BASIN-2          POC-1            0          TABULAR/HEAD    OUT-2
NO
OUTLET-3         BASIN-3          POC-1            0          TABULAR/HEAD    OUT-3
NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
BYPASS-1         DUMMY        0                0          0          0          1
```

POST_DEV

```
U-DRAIN-1        DUMMY        0                0          0          0          1
U-DRAIN-2        DUMMY        0                0          0          0          1
BYPASS-2         DUMMY        0                0          0          0          1
U-DRAIN-3        DUMMY        0                0          0          0          1
BYPASS-3         DUMMY        0                0          0          0          1

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

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
OUT-1            Rating     0.000      0.000
OUT-1                       0.042      0.003
OUT-1                       0.083      0.007
OUT-1                       0.125      0.009
OUT-1                       0.167      0.011
OUT-1                       0.208      0.013
OUT-1                       0.250      0.014
OUT-1                       0.292      0.029
OUT-1                       0.333      0.054
OUT-1                       0.375      0.086
OUT-1                       0.417      0.124
OUT-1                       0.458      0.164
OUT-1                       0.500      0.187
OUT-1                       0.542      0.208
OUT-1                       0.583      0.226
OUT-1                       0.625      0.243
OUT-1                       0.667      0.259
OUT-1                       0.708      0.275
OUT-1                       0.750      0.289
OUT-1                       0.792      0.302
OUT-1                       0.833      0.315
OUT-1                       0.875      0.394
OUT-1                       0.917      0.526
OUT-1                       0.958      0.694
OUT-1                       1.000      0.890
OUT-1                       1.042      1.110
OUT-1                       1.083      1.353
OUT-1                       1.125      1.615
OUT-1                       1.167      1.801
OUT-1                       1.208      1.944
OUT-1                       1.250      2.076
OUT-1                       1.292      2.199
OUT-1                       1.333      2.316
OUT-1                       1.375      2.426
OUT-1                       1.417      2.531
OUT-1                       1.458      2.632
OUT-1                       1.500      2.729
OUT-1                       1.542      2.822
OUT-1                       1.583      2.912
OUT-1                       1.625      3.000
OUT-1                       1.667      3.084
OUT-1                       1.708      3.167
OUT-1                       1.750      3.247
OUT-1                       1.792      3.536
OUT-1                       1.833      3.998
OUT-1                       1.875      4.573
OUT-1                       1.917      5.237
OUT-1                       1.958      5.979
OUT-1                       2.000      6.791
```

POST_DEV

OUT-2	Rating	0.000	0.000
OUT-2		0.042	0.079
OUT-2		0.083	0.224
OUT-2		0.125	0.411
OUT-2		0.167	0.633
OUT-2		0.208	0.884
OUT-2		0.250	1.162
OUT-2		0.292	1.465
OUT-2		0.333	1.676
OUT-2		0.375	1.836
OUT-2		0.417	1.983
OUT-2		0.458	2.120
OUT-2		0.500	2.248
OUT-2		0.542	2.370
OUT-2		0.583	2.486
OUT-2		0.625	2.596
OUT-2		0.667	2.702
OUT-2		0.708	2.804
OUT-2		0.750	2.903
OUT-2		0.792	2.998
OUT-2		0.833	3.090
OUT-2		0.875	3.180
OUT-2		0.917	3.267
OUT-2		0.958	3.352
OUT-2		1.000	3.434
OUT-2		1.042	3.515
OUT-2		1.083	3.594
OUT-2		1.125	3.671
OUT-2		1.167	3.747
OUT-2		1.208	3.821
OUT-2		1.250	3.894
OUT-2		1.292	3.966
OUT-2		1.333	4.036
OUT-2		1.375	4.105
OUT-2		1.417	4.173
OUT-2		1.458	4.239
OUT-2		1.500	4.305
OUT-2		1.542	4.686
OUT-2		1.583	5.329
OUT-2		1.625	6.141
OUT-2		1.667	7.090
OUT-2		1.708	8.157
OUT-2		1.750	9.330

OUT-3	Rating	0.000	0.000
OUT-3		0.042	0.026
OUT-3		0.083	0.075
OUT-3		0.125	0.137
OUT-3		0.167	0.211
OUT-3		0.208	0.288
OUT-3		0.250	0.333
OUT-3		0.292	0.372
OUT-3		0.333	0.408
OUT-3		0.375	0.441
OUT-3		0.417	0.471
OUT-3		0.458	0.500
OUT-3		0.500	0.527
OUT-3		0.542	0.552
OUT-3		0.583	0.577
OUT-3		0.625	0.600
OUT-3		0.667	0.623

POST_DEV

OUT-3		0.708	0.645
OUT-3		0.750	0.666
OUT-3		0.792	0.687
OUT-3		0.833	0.707
OUT-3		0.875	0.726
OUT-3		0.917	0.745
OUT-3		0.958	0.763
OUT-3		1.000	0.781
OUT-3		1.042	0.799
OUT-3		1.083	0.816
OUT-3		1.125	0.833
OUT-3		1.167	0.849
OUT-3		1.208	0.865
OUT-3		1.250	0.881
OUT-3		1.292	0.897
OUT-3		1.333	0.912
OUT-3		1.375	0.927
OUT-3		1.417	0.942
OUT-3		1.458	0.957
OUT-3		1.500	0.971
OUT-3		1.542	1.196
OUT-3		1.583	1.596
OUT-3		1.625	2.109
OUT-3		1.667	2.714
OUT-3		1.708	3.398
OUT-3		1.750	4.153
OUT-3		1.792	4.973
OUT-3		1.833	5.852
OUT-3		1.875	6.787
OUT-3		1.917	7.775
OUT-3		1.958	8.812
OUT-3		2.000	9.897

BASIN-1	Storage	0.00	1784
BASIN-1		0.25	1829
BASIN-1		0.50	1872
BASIN-1		0.75	1916
BASIN-1		1.00	1959
BASIN-1		1.25	2001
BASIN-1		1.50	2043
BASIN-1		1.75	2085
BASIN-1		2.00	2126

BASIN-2	Storage	0.00	4364
BASIN-2		0.25	4364
BASIN-2		0.50	4364
BASIN-2		0.75	4364
BASIN-2		1.00	4364
BASIN-2		1.25	4364
BASIN-2		1.50	4364
BASIN-2		1.75	4364

BASIN-3	Storage	0.00	1411
BASIN-3		0.25	1411
BASIN-3		0.50	1411
BASIN-3		0.75	1411
BASIN-3		1.00	1411
BASIN-3		1.25	1411
BASIN-3		1.50	1411
BASIN-3		1.75	1411

[TIMESERIES]

POST_DEV

```
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
LowerOtay        FILE "Lower Otay.txt"

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

[TAGS]

[MAP]
DIMENSIONS -400.000 175.000 8400.000 7325.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            4000.000           1000.000
DIV-1            500.000            4000.000
DIV-2            5000.000           4000.000
DIV-3            7500.000           4000.000
BASIN-1          500.000            1000.000
BASIN-2          3000.000           4000.000
BASIN-3          7500.000           1000.000

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

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
1-1-D            1000.000           6000.000
1-1-D            1000.000           6000.000
1-1-A            0.000              6000.000
1-2-A            3500.000           6000.000
1-2-D            4500.000           6000.000
1-3-A            7000.000           6000.000
1-3-D            8000.000           6000.000
BR-1             500.000            5000.000
BR-2             4000.000           5000.000
BR-3             7500.000           5000.000
1-1-D-BYPASS     7500.000           500.000
1-1-A-BYPASS     500.000            500.000
OFFSITE-A        2250.000           500.000
OFFSITE-D        5750.000           500.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
LowerOtay        4000.000           7000.000
```

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.

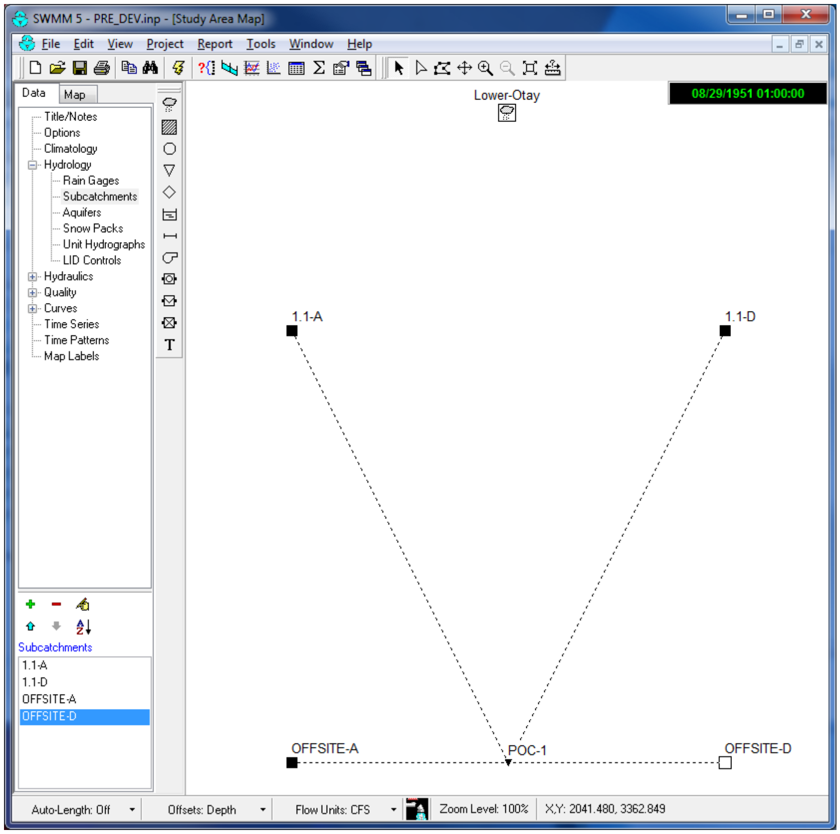
Variables for modeling are associated with typical recommended values by the EPA-SWMM model, typical values found in technical literature (such as Maidment's Handbook of Hydrology). Recommended values for the SWMM model have been attained from the Model BMP Design Manual San Diego Region.

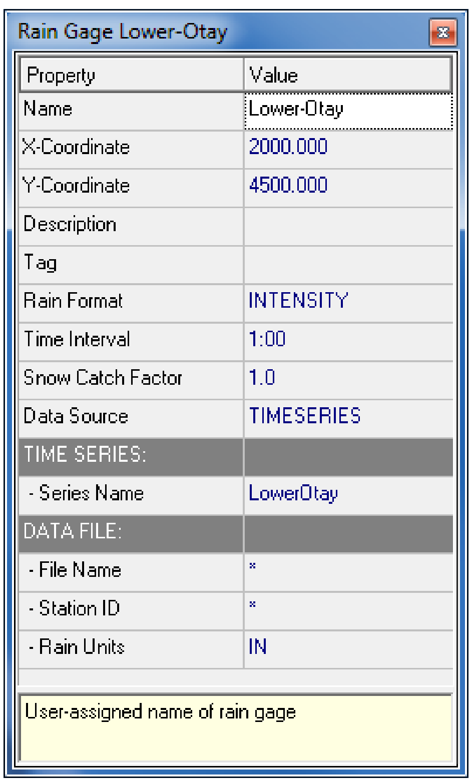
Soil characteristics of the existing soils were determined from the NRCS Web Soil Survey (located in Attachment 8 of this report).

Some values incorporated within the SWMM model have been determined from the professional experience of REC using conservative assumptions that have a tendency to increase the size of the needed BMP and also generate a long-term runoff as a percentage of rainfall similar to those measured in gage stations in Southern California by the USGS.

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.

PRE-DEVELOPED CONDITION

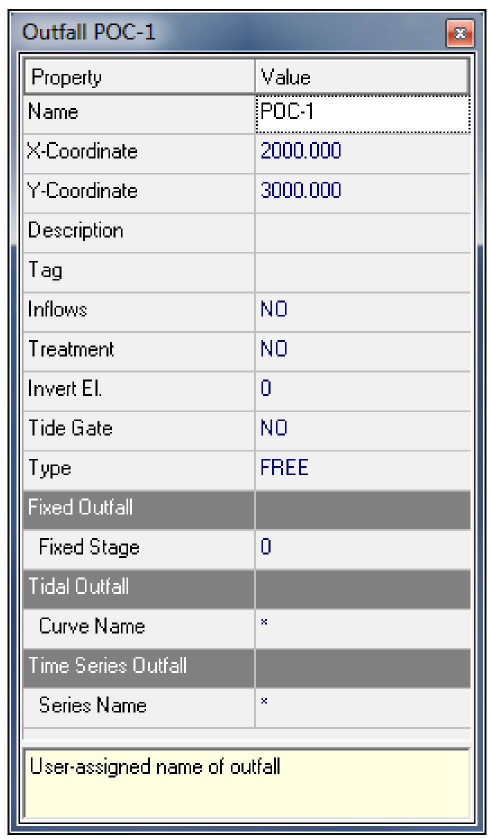




Rain Gage Lower-Otay

Property	Value
Name	Lower-Otay
X-Coordinate	2000.000
Y-Coordinate	4500.000
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	LowerOtay
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	2000.000
Y-Coordinate	3000.000
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 1-1-A

Property	Value
Name	1-1-A
X-Coordinate	1500.000
Y-Coordinate	4000.000
Description	
Tag	
Rain Gage	Lower-Otay
Outlet	POC-1
Area	4.086
Width	820
% Slope	13.50
% 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 1-1-D

Property	Value
Name	1-1-D
X-Coordinate	2500.000
Y-Coordinate	4000.000
Description	
Tag	
Rain Gage	Lower-Otay
Outlet	POC-1
Area	4.417
Width	796
% Slope	14.10
% 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	1.5
Conductivity	0.30
Initial Deficit	0.30

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9.0
Conductivity	0.025
Initial Deficit	0.33

Subcatchment OFFSITE-A

Property	Value
Name	OFFSITE-A
X-Coordinate	1500.000
Y-Coordinate	3000.000
Description	
Tag	
Rain Gage	Lower-Otay
Outlet	POC-1
Area	0.367
Width	28
% Slope	3.50
% 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

Infiltration parameters (click to edit)

Subcatchment OFFSITE-D

Property	Value
Name	OFFSITE-D
X-Coordinate	2500.000
Y-Coordinate	3000.000
Description	
Tag	
Rain Gage	Lower-Otay
Outlet	POC-1
Area	0.012
Width	20
% Slope	3.90
% 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

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

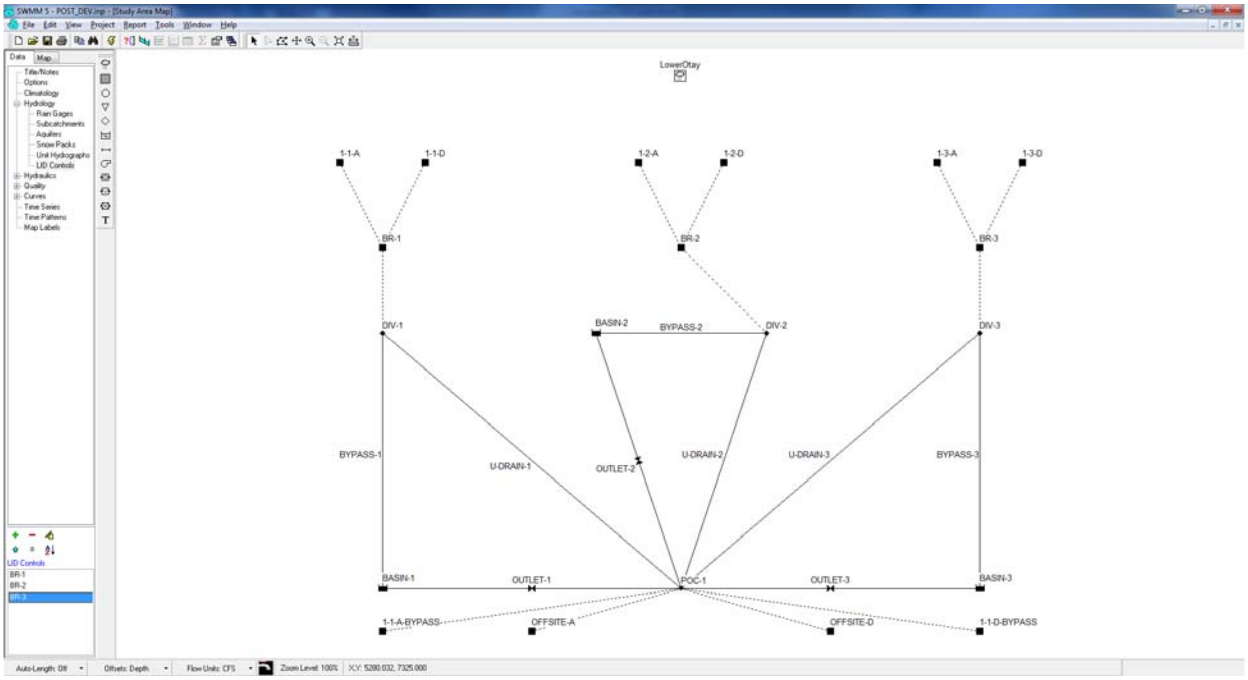
Property	Value
Suction Head	1.5
Conductivity	0.30
Initial Deficit	0.30

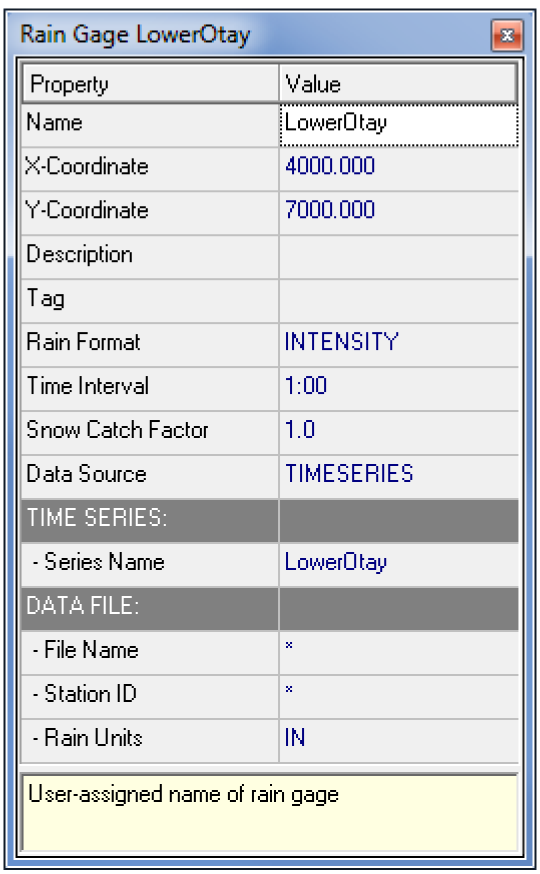
Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9.0
Conductivity	0.025
Initial Deficit	0.33

POST-DEVELOPED CONDITION

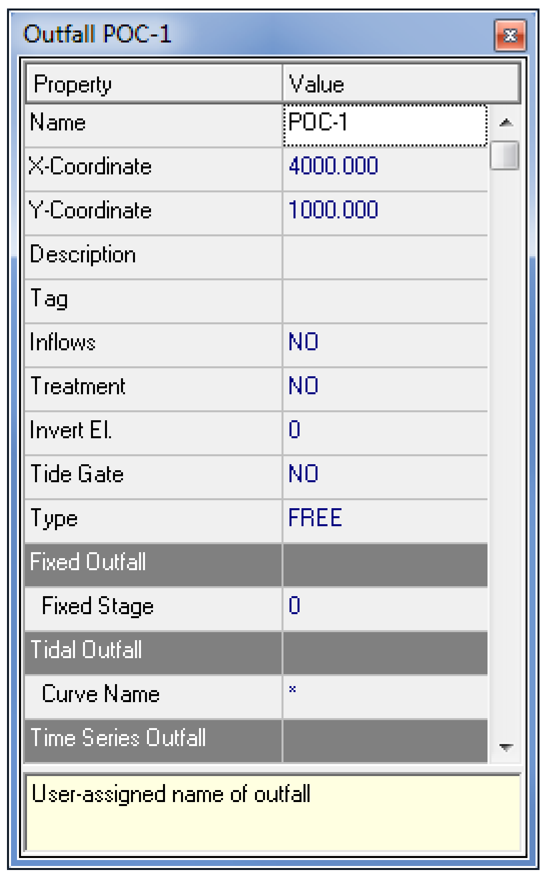




Rain Gage LowerOtay

Property	Value
Name	LowerOtay
X-Coordinate	4000.000
Y-Coordinate	7000.000
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	LowerOtay
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	4000.000
Y-Coordinate	1000.000
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	

User-assigned name of outfall

Subcatchment 1-1-A

Property	Value
Name	1-1-A
X-Coordinate	0.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-1
Area	1.278
Width	400
% Slope	39.10
% Imperv	44.5
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 1-1-D

Property	Value
Name	1-1-D
X-Coordinate	1000.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-1
Area	0.888
Width	363
% Slope	50
% Imperv	32.4
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

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	1.5
Conductivity	0.225
Initial Deficit	0.30

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Subcatchment BR-1

Property	Value
Name	BR-1
X-Coordinate	500.000
Y-Coordinate	5000.000
Description	...
Tag	
Rain Gage	LowerOtay
Outlet	DIV-1
Area	0.03464
Width	10
% Slope	0
% 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	1
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Optional comment or description

Subcatchment 1-2-A

Property	Value
Name	1-2-A
X-Coordinate	3500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-2
Area	1.600
Width	598
% Slope	12.50
% Imperv	77.17
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

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	1.5
Conductivity	0.225
Initial Deficit	0.30

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	1.5
Conductivity	0.225
Initial Deficit	0.30

Subcatchment 1-2-D

Property	Value
Name	1-2-D
X-Coordinate	4500.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-2
Area	1.848
Width	527
% Slope	45
% Imperv	60.60
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

Infiltration parameters (click to edit)

Subcatchment BR-2

Property	Value
Name	BR-2
X-Coordinate	4000.000
Y-Coordinate	5000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	DIV-2
Area	0.10018
Width	10
% Slope	0
% 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	1
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Subcatchment 1-3-A

Property	Value
Name	1-3-A
X-Coordinate	7000.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-3
Area	0.106
Width	214
% Slope	6.12
% Imperv	100
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

Infiltration parameters (click to edit)

Subcatchment 1-3-D

Property	Value
Name	1-3-D
X-Coordinate	8000.000
Y-Coordinate	6000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	BR-3
Area	1.189
Width	672
% Slope	38.56
% Imperv	46.4
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

Infiltration parameters (click to edit)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	1.5
Conductivity	0.225
Initial Deficit	0.30

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Subcatchment BR-3

Property	Value
Name	BR-3
X-Coordinate	7500.000
Y-Coordinate	5000.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	DIV-3
Area	0.03237
Width	10
% Slope	0
% 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	1
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)

Subcatchment 1-1-A-BYPASS

Property	Value
Name	1-1-A-BYPASS
X-Coordinate	500.000
Y-Coordinate	500.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	POC-1
Area	1.067
Width	865
% Slope	13.50
% 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

Percent of impervious area with no depression storage (%)

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	1.5
Conductivity	0.3
Initial Deficit	0.30

Subcatchment OFFSITE-A

Property	Value
Name	OFFSITE-A
X-Coordinate	2250.000
Y-Coordinate	500.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	POC-1
Area	0.367
Width	28
% Slope	3.50
% Imperv	27.4
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

Infiltration parameters (click to edit)

Subcatchment OFFSITE-D

Property	Value
Name	OFFSITE-D
X-Coordinate	5750.000
Y-Coordinate	500.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	POC-1
Area	0.012
Width	20
% Slope	3.90
% Imperv	100
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

Infiltration parameters (click to edit)

Infiltration Editor

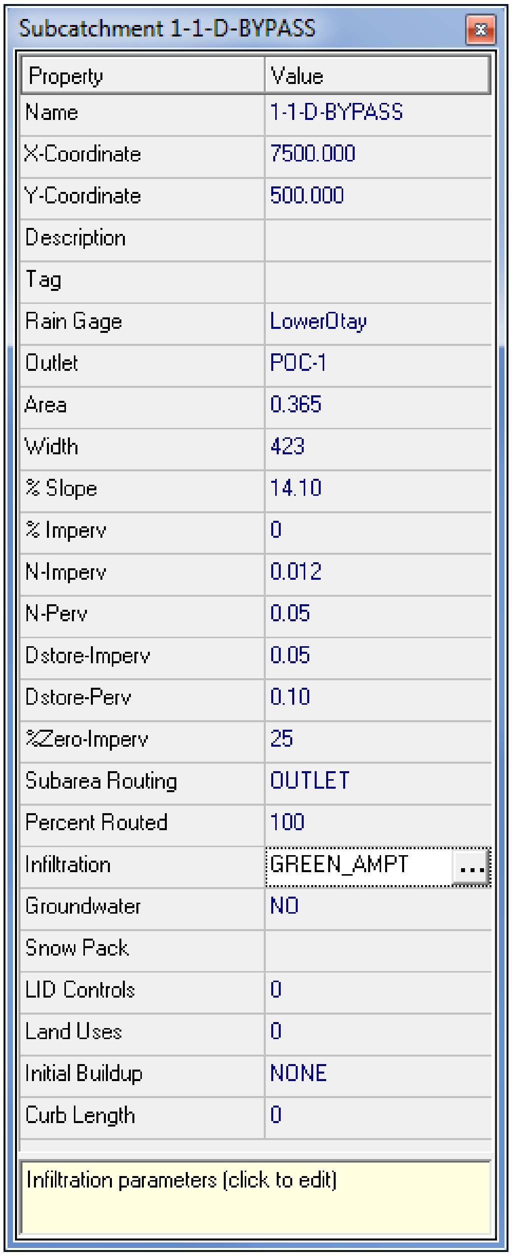
Infiltration Method: GREEN_AMPT

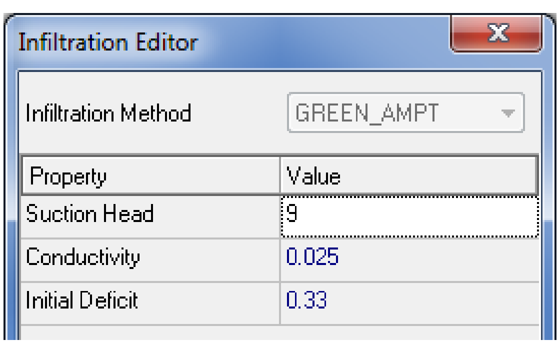
Property	Value
Suction Head	1.5
Conductivity	0.225
Initial Deficit	0.30

Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33


Subcatchment 1-1-D-BYPASS
Property
Value
Name
1-1-D-BYPASS
X-Coordinate
7500.000
Y-Coordinate
500.000
Description
Tag
Rain Gage
LowerOtay
Outlet
POC-1
Area
0.365
Width
423
% Slope
14.10
% 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
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.025
Initial Deficit
0.33

EXPLANATION OF SELECTED VARIABLES

Sub-Catchment Areas:

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

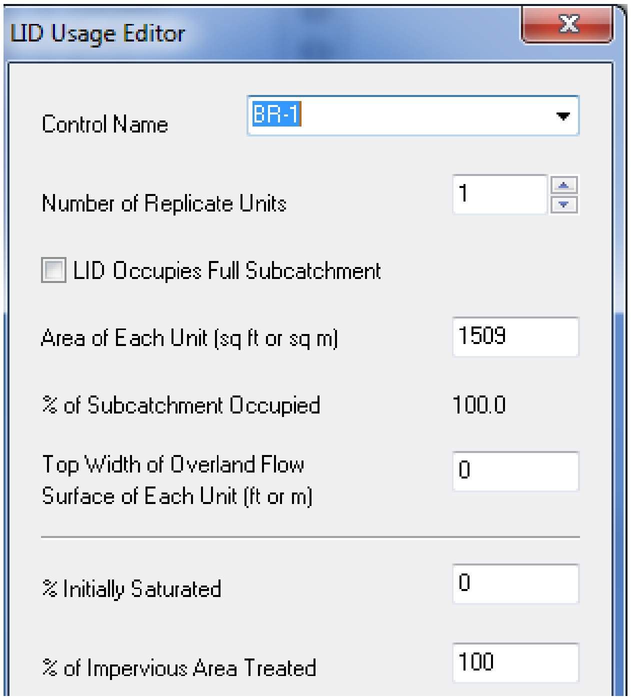
Parameters for the pre- and post-developed models include soil types A & D as determined from the site specific Natural Resources Conservation Service (NRCS) geologic review (attached at the end of this appendix). Suction head, conductivity and initial deficit corresponds to average values expected for these soils types, according to sources consulted, professional experience, and approximate values obtained by the interim Orange County modeling approach.

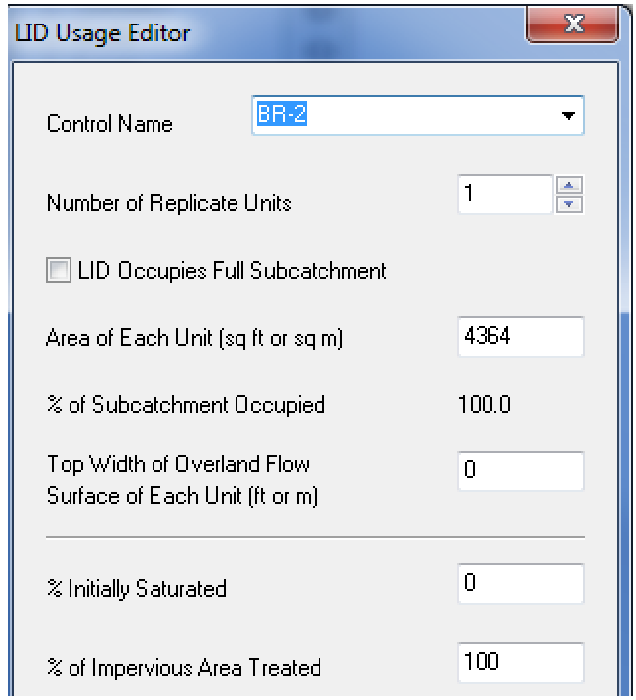
REC selected infiltration values, such that the percentage of total precipitation that becomes runoff, is realistic for the soil types and slightly smaller than measured values for Southern California watersheds.

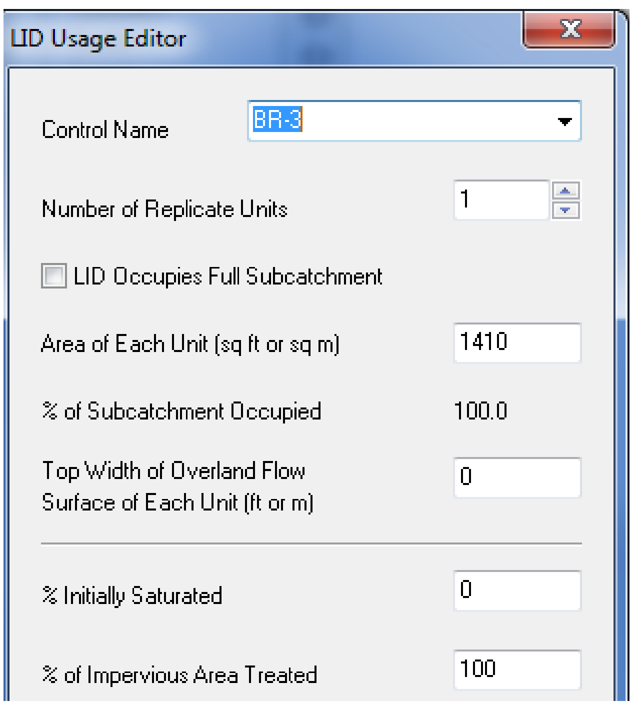
Selection of a Kinematic Approach: As the continuous model is based on hourly rainfall, and the time of concentration for the pre-development and post-development conditions is significantly smaller than 60 minutes, precise routing of the flows through the impervious surfaces, the underdrain pipe system,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

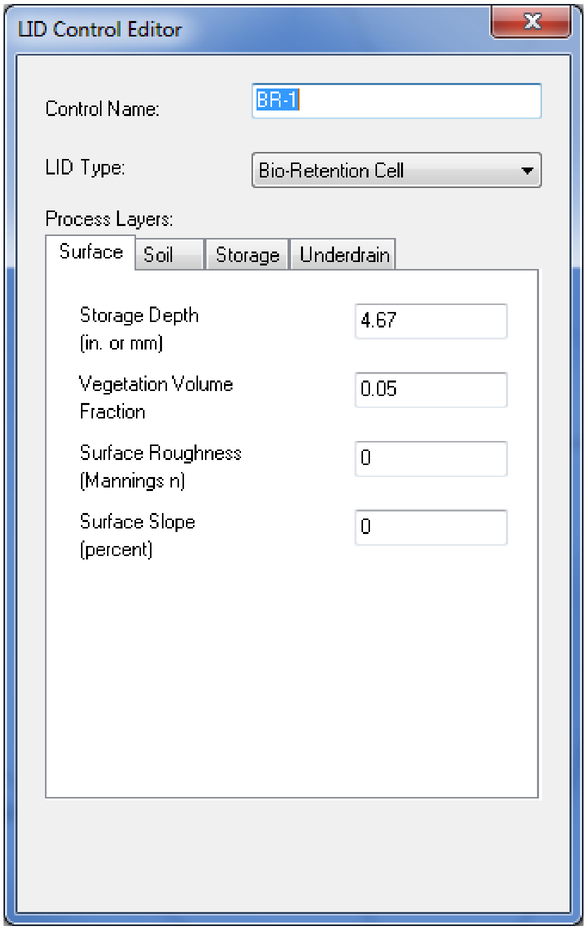
Sub-Catchment BMP:

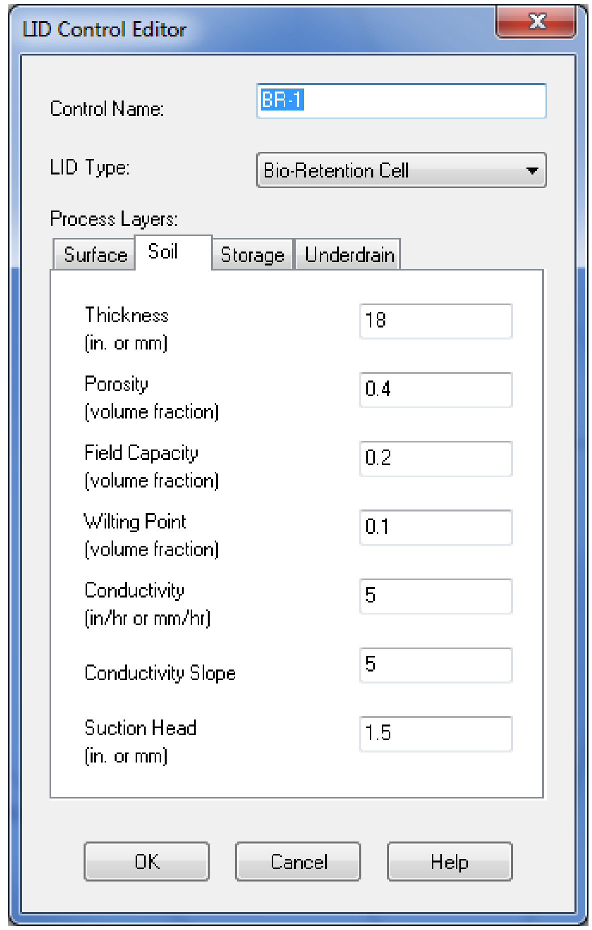
The area of bio-filtration must be equal to the area of the development tributary to the bioretention facility (area that drains into a biofiltration, equal external area plus bio-filtration itself). Five (5) decimal places were given regarding the areas of the bio-filtration to insure that the area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

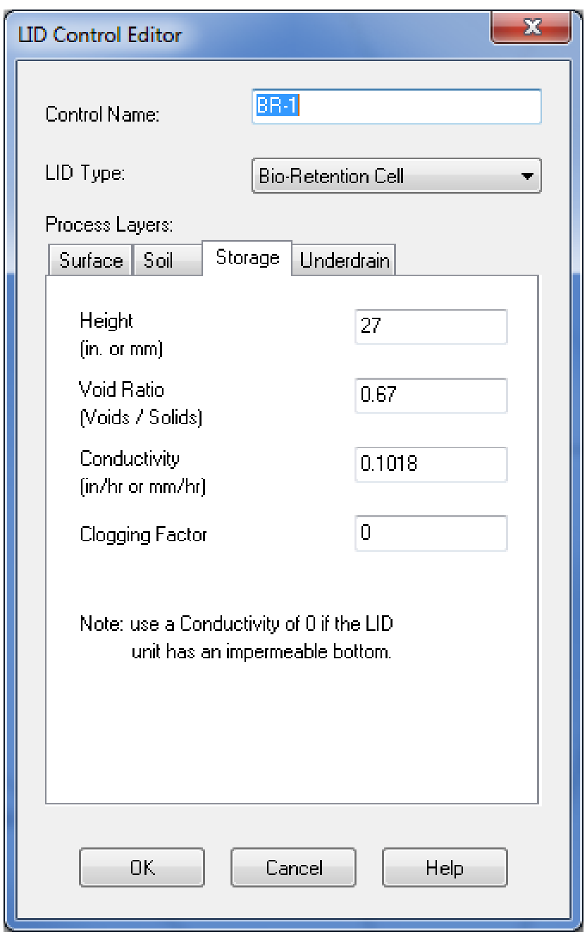

LID Usage Editor
Control Name
BR-1
Number of Replicate Units
1
LID Occupies Full Subcatchment
Area of Each Unit (sq ft or sq m)
1509
% of Subcatchment Occupied
100.0
Top Width of Overland Flow Surface of Each Unit (ft or m)
0
% Initially Saturated
0
% of Impervious Area Treated
100

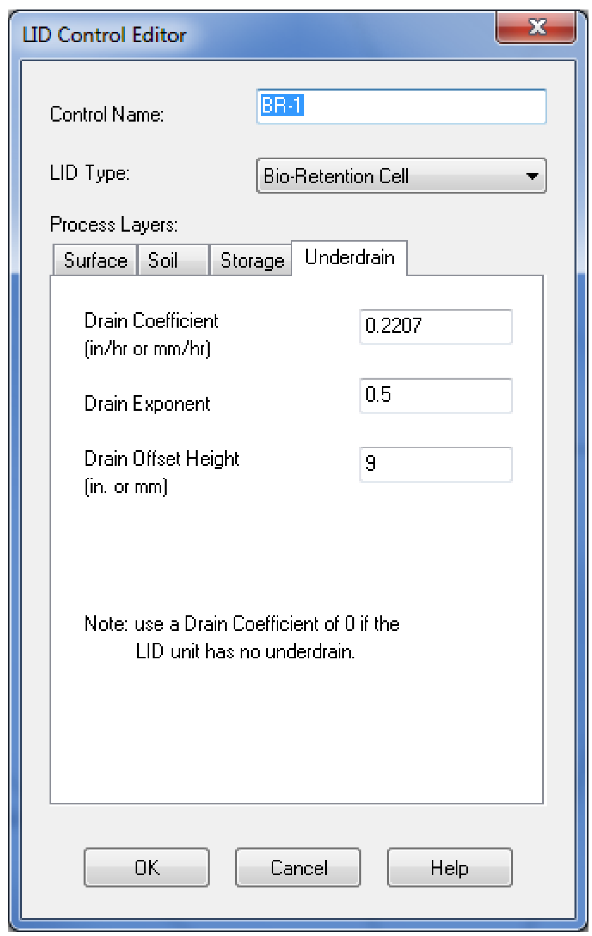

LID Usage Editor
Control Name
BR-2
Number of Replicate Units
1
LID Occupies Full Subcatchment
Area of Each Unit (sq ft or sq m)
4364
% of Subcatchment Occupied
100.0
Top Width of Overland Flow Surface of Each Unit (ft or m)
0
% Initially Saturated
0
% of Impervious Area Treated
100

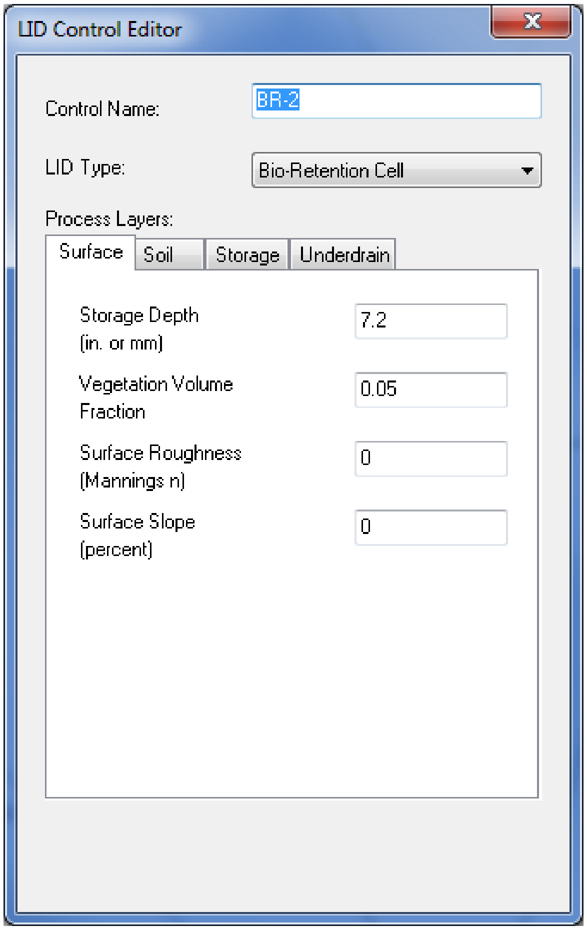

LID Usage Editor
Control Name
BR-3
Number of Replicate Units
1
LID Occupies Full Subcatchment
Area of Each Unit (sq ft or sq m)
1410
% of Subcatchment Occupied
100.0
Top Width of Overland Flow Surface of Each Unit (ft or m)
0
% Initially Saturated
0
% of Impervious Area Treated
100

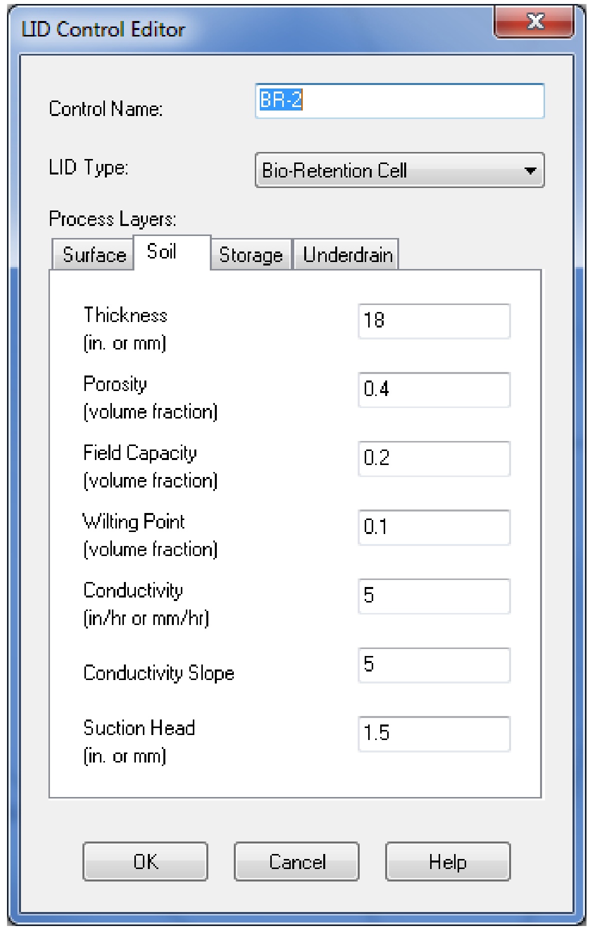

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Storage Depth
(in. or mm)
4.67
Vegetation Volume
Fraction
0.05
Surface Roughness
(Mannings n)
0
Surface Slope
(percent)
0

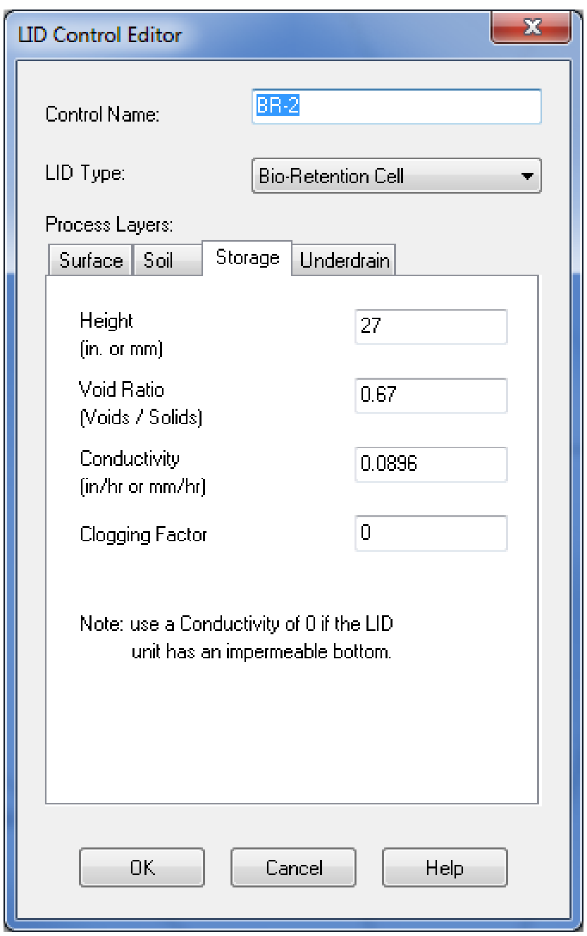

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Thickness
(in. or mm)
18
Porosity
(volume fraction)
0.4
Field Capacity
(volume fraction)
0.2
Wilting Point
(volume fraction)
0.1
Conductivity
(in/hr or mm/hr)
5
Conductivity Slope
5
Suction Head
(in. or mm)
1.5
OK
Cancel
Help

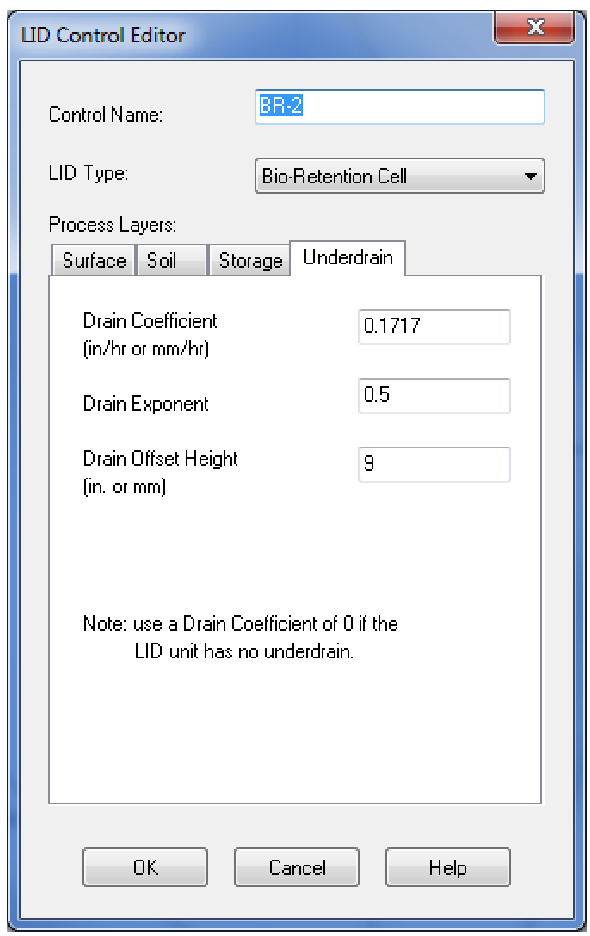

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Height
(in. or mm)
27
Void Ratio
(Voids / Solids)
0.67
Conductivity
(in/hr or mm/hr)
0.1018
Clogging Factor
0
Note: use a Conductivity of 0 if the LID
unit has an impermeable bottom.
OK
Cancel
Help

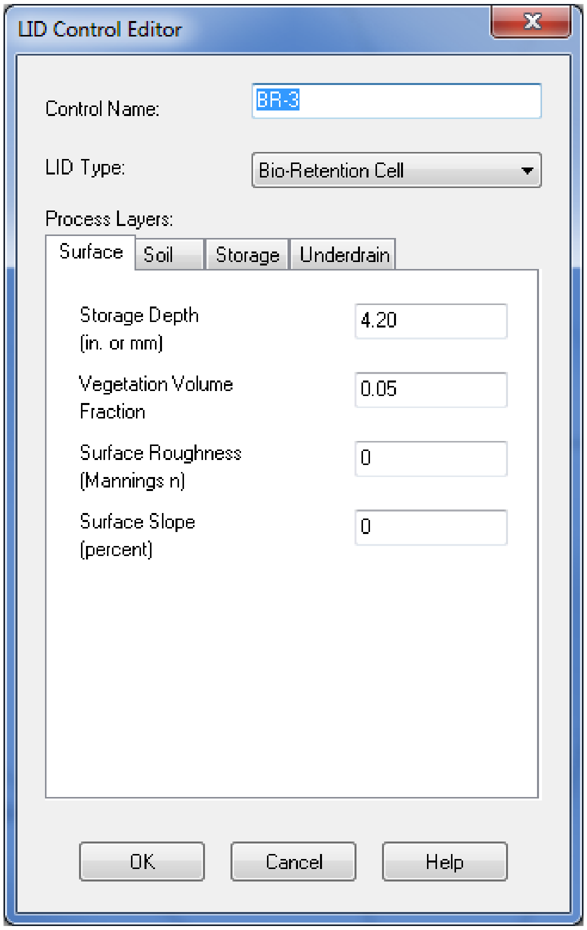

LID Control Editor
Control Name:
BR-1
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Drain Coefficient
(in/hr or mm/hr)
0.2207
Drain Exponent
0.5
Drain Offset Height
(in. or mm)
9
Note: use a Drain Coefficient of 0 if the
LID unit has no underdrain.
OK
Cancel
Help

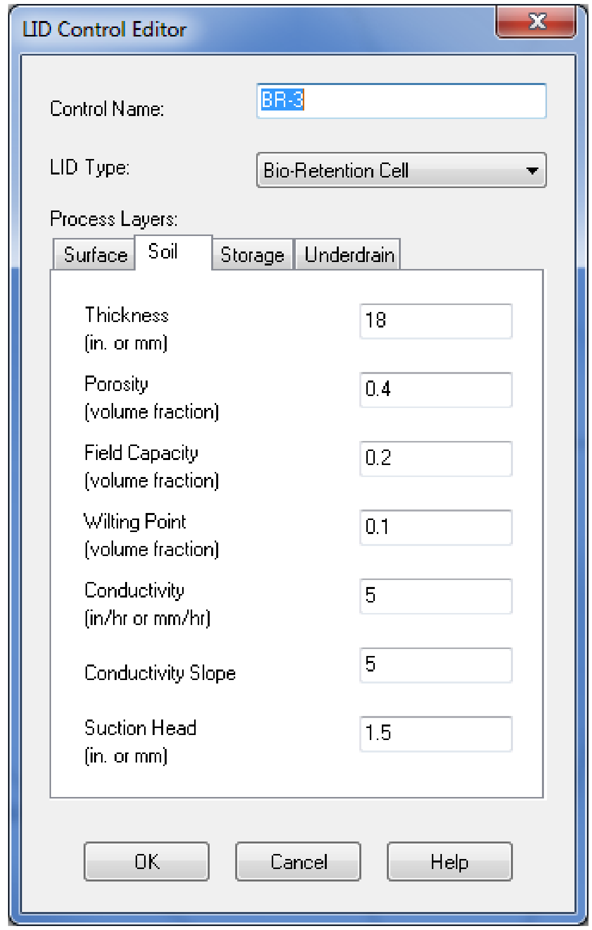

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Storage Depth
(in. or mm)
7.2
Vegetation Volume
Fraction
0.05
Surface Roughness
(Mannings n)
0
Surface Slope
(percent)
0

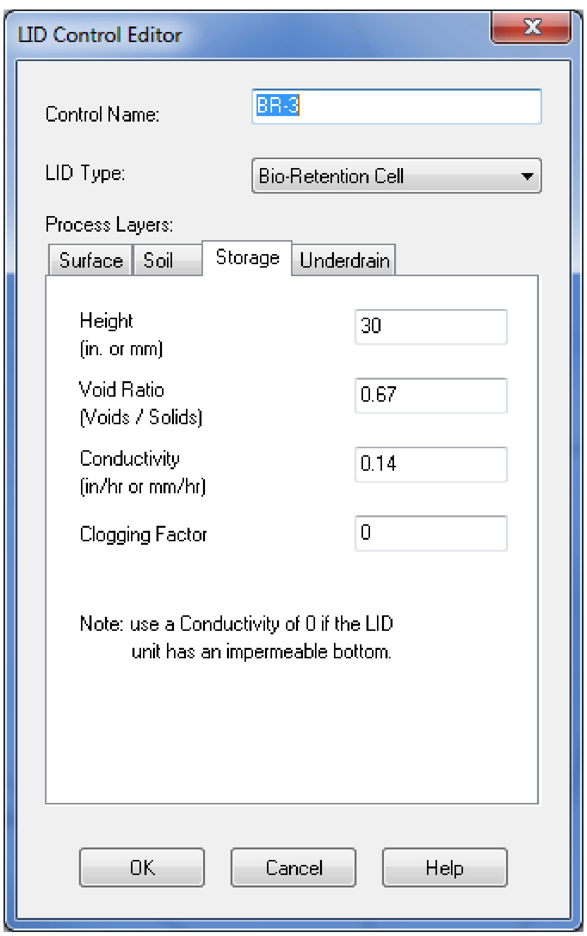

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Thickness
(in. or mm)
18
Porosity
(volume fraction)
0.4
Field Capacity
(volume fraction)
0.2
Wilting Point
(volume fraction)
0.1
Conductivity
(in/hr or mm/hr)
5
Conductivity Slope
5
Suction Head
(in. or mm)
1.5
OK
Cancel
Help

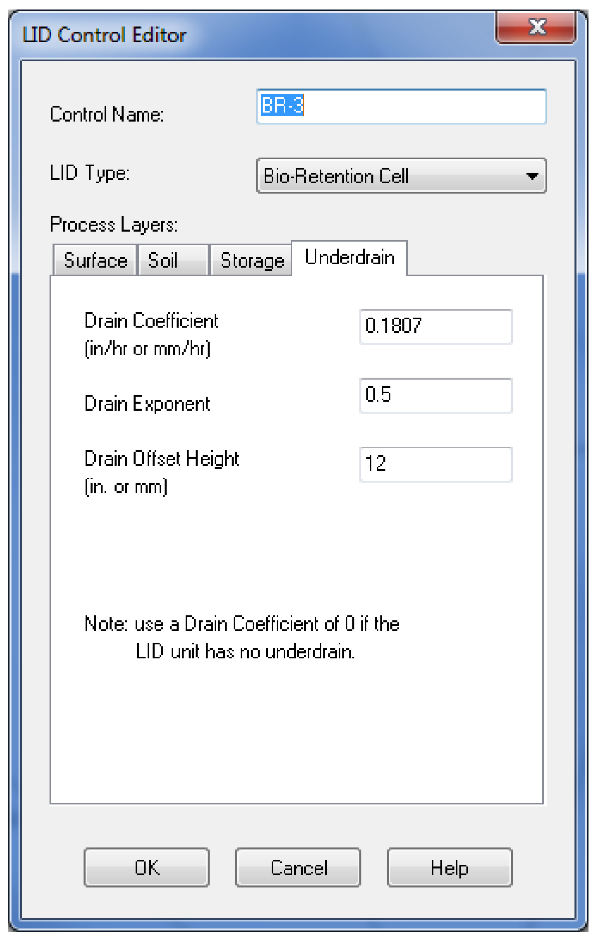

LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Height
(in. or mm)
27
Void Ratio
(Voids / Solids)
0.67
Conductivity
(in/hr or mm/hr)
0.0896
Clogging Factor
0
Note: use a Conductivity of 0 if the LID
unit has an impermeable bottom.
OK
Cancel
Help


LID Control Editor
Control Name:
BR-2
LID Type:
Bio-Retention Cell
Process Layers:
Surface
Soil
Storage
Underdrain
Drain Coefficient
(in/hr or mm/hr)
0.1717
Drain Exponent
0.5
Drain Offset Height
(in. or mm)
9
Note: use a Drain Coefficient of 0 if the
LID unit has no underdrain.
OK
Cancel
Help


LID Control Editor
Control Name: BR-3
LID Type: Bio-Retention Cell
Process Layers:
Surface Soil Storage Underdrain
Storage Depth (in. or mm) 4.20
Vegetation Volume Fraction 0.05
Surface Roughness (Mannings n) 0
Surface Slope (percent) 0
OK Cancel Help


LID Control Editor
Control Name: BR-3
LID Type: Bio-Retention Cell
Process Layers:
Surface Soil Storage Underdrain
Thickness (in. or mm) 18
Porosity (volume fraction) 0.4
Field Capacity (volume fraction) 0.2
Wilting Point (volume fraction) 0.1
Conductivity (in/hr or mm/hr) 5
Conductivity Slope 5
Suction Head (in. or mm) 1.5
OK Cancel Help


LID Control Editor
Control Name: BR-3
LID Type: Bio-Retention Cell
Process Layers:
Surface Soil Storage Underdrain
Height (in. or mm) 30
Void Ratio (Voids / Solids) 0.67
Conductivity (in/hr or mm/hr) 0.14
Clogging Factor 0
Note: use a Conductivity of 0 if the LID unit has an impermeable bottom.
OK Cancel Help


LID Control Editor
Control Name: BR-3
LID Type: Bio-Retention Cell
Process Layers:
Surface Soil Storage Underdrain
Drain Coefficient (in/hr or mm/hr) 0.1807
Drain Exponent 0.5
Drain Offset Height (in. or mm) 12
Note: use a Drain Coefficient of 0 if the LID unit has no underdrain.
OK Cancel Help

LID Control Editor: Explanation of Significant Variables

Storage Depth:

The storage depth variable within the SWMM model is representative of the storage volume provided beneath the first surface riser outlet and the engineered soil and mulch components of the bioretention facilities.

In those cases where the surface storage has a variable area that is also different to the area of the gravel and amended soil, the SWMM model needs to be calibrated as the LID module will use the storage depth multiplied by the BMP area as the amount of volume stored at the surface.

Let A_{BMP} be the area of the BMP (area of amended soil and area of gravel). The proper value of the storage depth S_D to be included in the LID module can be calculated by using geometric properties of the surface volume. Let A_0 be the surface area at the bottom of the surface pond, and let A_i be the surface area at the elevation of the invert of the first row of orifices (or at the invert of the riser if not surface orifices are included). Finally, let h_i be the difference in elevation between A_0 and A_i. By volumetric definition:

$$A_{BMP} \cdot S_D = \frac{(A_0+A_i)}{2} h_i \tag{1}$$

Equation (1) allows the determination of S_D to be included as Storage Depth in the LID module.

Porosity: A porosity value of 0.4 has been selected for the model. The amended soil is to be highly sandy in content in order to have a saturated hydraulic conductivity of approximately 5 in/hr.

REC considers such a value to be slightly high; however, in order to comply with the HMP Permit, the value recommended by the Copermittees for the porosity of amended soil is 0.4, per Appendix A of the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. Such porosity is equal to the porosity of the gravel per the same document.

Void Ratio: The ratio of the void volume divided by the soil volume is directly related to porosity as n/(1-n). As the underdrain layer is composed of gravel, a porosity value of 0.4 has been selected (also per Appendix A of the Final HMP document), which results in a void ratio of 0.4/(1-0.4) = 0.67 for the gravel detention layer.

Conductivity: All basins will be unlined to allow for infiltration into the underlying soils. Conductivity values are taken from the Percolation test found in attachment 8 and a factor of safety of 2 was applied to them. The conductivity values can be seen in the screen shot of the LID in the previous pages.

Clogging factor: A clogging factor was not used (0 indicates that there is no clogging assumed within the model). The reason for this is related to the fairness of a comparison with the SDHM model and the HMP sizing tables: a clogging factor was not considered, and instead, a conservative value of infiltration was recommended.

Drain (Flow) coefficient: The flow coefficient C in the SWMM Model is the coefficient needed to transform the orifice equation into a general power law equation of the form:

$$q = C(H - H_D)^n \qquad (2)$$

where q is the peak flow in in/hr, n is the exponent (typically 0.5 for orifice equation), H_D is the elevation of the centroid of the orifice in inches (assumed equal to the invert of the orifice for small orifices and in our design equal to 0) and H is the depth of the water in inches.

The general orifice equation can be expressed as:

$$Q = \frac{\pi}{4} c_g \frac{D^2}{144} \sqrt{2g \frac{(H - H_D)}{12}} \qquad (3)$$

where Q is the peak flow in cfs, D is the diameter in inches, c_g is the typical discharge coefficient for orifices (0.61-0.63 for thin walls and around 0.75-0.8 for thick walls), g is the acceleration of gravity in ft/s^2, and H and H_D are defined above and are also used in inches in Equation (3).

It is clear that:

$$q\ \left(\frac{in}{hr}\right) X\ \frac{A_{BMP}}{12\ X\ 3600} = Q\ (cfs) \qquad (4)$$

DETENTION BASINS

Storage Unit BASIN-1

Property	Value
Name	BASIN-1
X-Coordinate	500.000
Y-Coordinate	1000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	2
Initial Depth	0
Ponded Area	2725
Evap. Factor	0
Infiltration	NO
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	BASIN-1

Storage Curve Editor

Curve Name: BASIN-1

Description:

	Depth (ft)	Area (ft2)
1	0.00	1784
2	0.25	1829
3	0.50	1872
4	0.75	1916
5	1.00	1959
6	1.25	2001
7	1.50	2043
8	1.75	2085
9	2.00	2126

Outlet OUTLET-1

Property	Value
Name	OUTLET-1
Inlet Node	BASIN-1
Outlet Node	POC-1
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/HEAD
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	OUT-1

User-assigned name of outlet

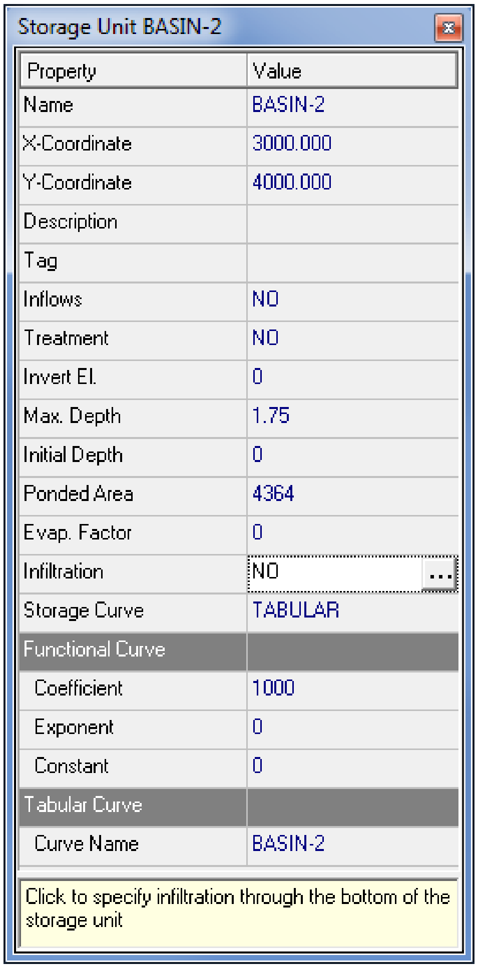
Rating Curve Editor

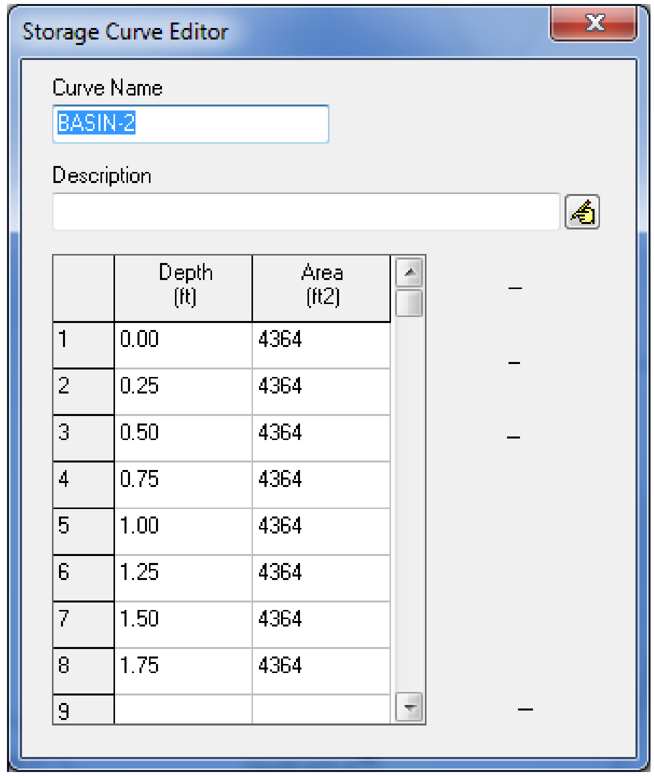
Curve Name: OUT-1

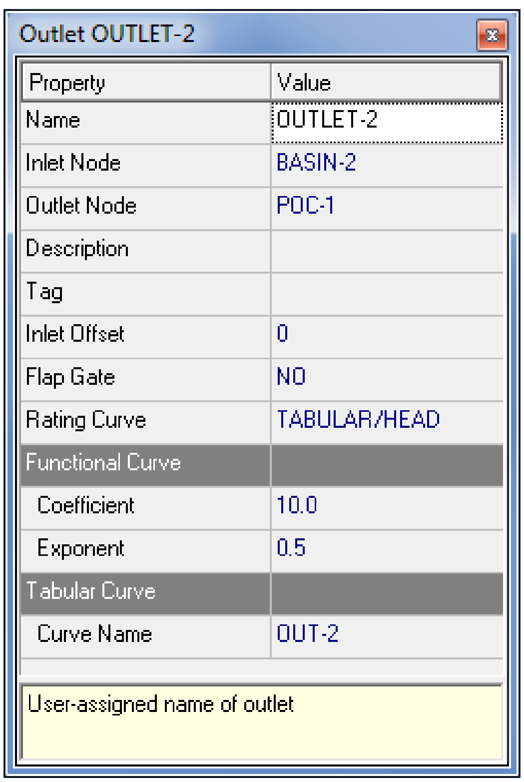
Description:

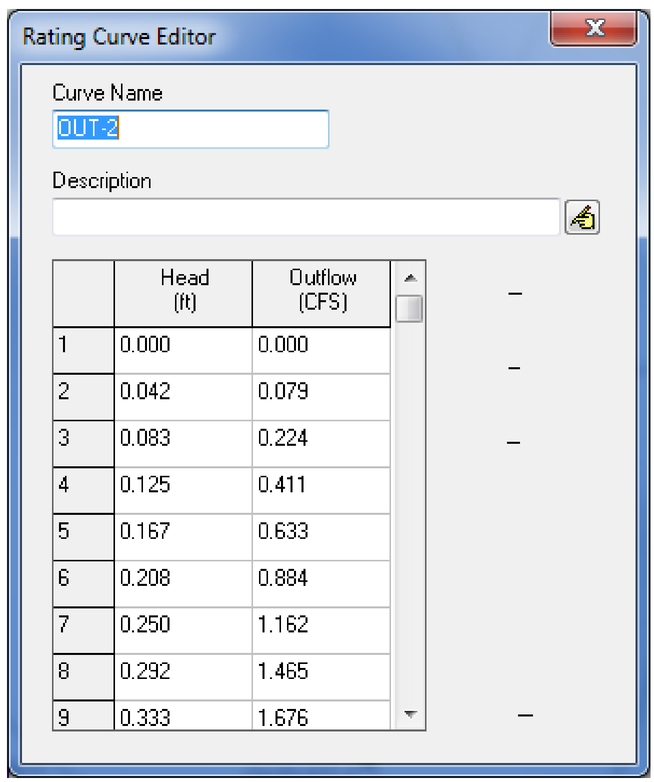
	Head (ft)	Outflow (CFS)
1	0.000	0.000
2	0.042	0.003
3	0.083	0.007
4	0.125	0.009
5	0.167	0.011
6	0.208	0.013
7	0.250	0.014
8	0.292	0.029
9	0.333	0.054

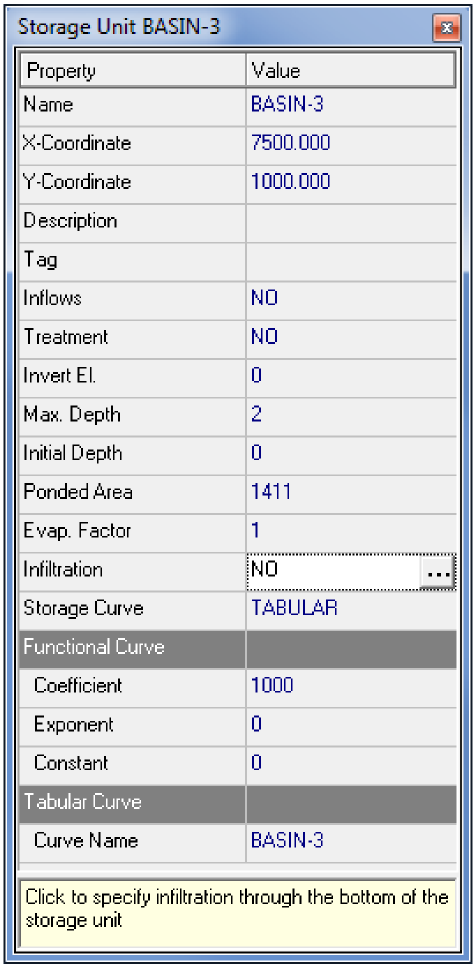
View...


Storage Unit BASIN-2
Property
Value
Name
BASIN-2
X-Coordinate
3000.000
Y-Coordinate
4000.000
Description
Tag
Inflows
NO
Treatment
NO
Invert El.
0
Max. Depth
1.75
Initial Depth
0
Ponded Area
4364
Evap. Factor
0
Infiltration
NO
Storage Curve
TABULAR
Functional Curve
Coefficient
1000
Exponent
0
Constant
0
Tabular Curve
Curve Name
BASIN-2
Click to specify infiltration through the bottom of the storage unit


Storage Curve Editor
Curve Name
BASIN-2
Description
Depth (ft)
Area (ft2)
1 0.00 4364
2 0.25 4364
3 0.50 4364
4 0.75 4364
5 1.00 4364
6 1.25 4364
7 1.50 4364
8 1.75 4364
9


Outlet OUTLET-2
Property
Value
Name
OUTLET-2
Inlet Node
BASIN-2
Outlet Node
POC-1
Description
Tag
Inlet Offset
0
Flap Gate
NO
Rating Curve
TABULAR/HEAD
Functional Curve
Coefficient
10.0
Exponent
0.5
Tabular Curve
Curve Name
OUT-2
User-assigned name of outlet

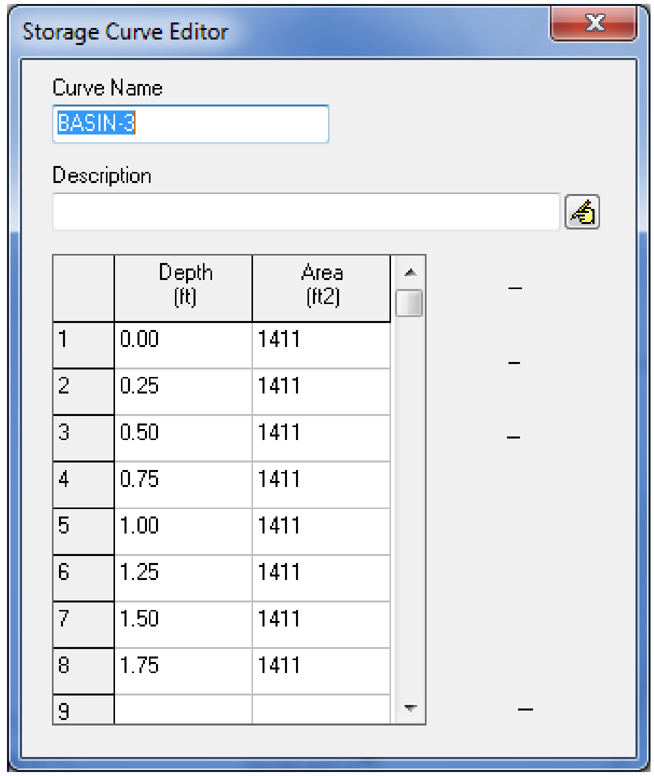

Rating Curve Editor
Curve Name
OUT-2
Description
Head (ft)
Outflow (CFS)
1 0.000 0.000
2 0.042 0.079
3 0.083 0.224
4 0.125 0.411
5 0.167 0.633
6 0.208 0.884
7 0.250 1.162
8 0.292 1.465
9 0.333 1.676



Storage Unit BASIN-3

Property	Value
Name	BASIN-3
X-Coordinate	7500.000
Y-Coordinate	1000.000
Description	
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Max. Depth	2
Initial Depth	0
Ponded Area	1411
Evap. Factor	1
Infiltration	NO
Storage Curve	TABULAR
Functional Curve	
Coefficient	1000
Exponent	0
Constant	0
Tabular Curve	
Curve Name	BASIN-3

Click to specify infiltration through the bottom of the storage unit

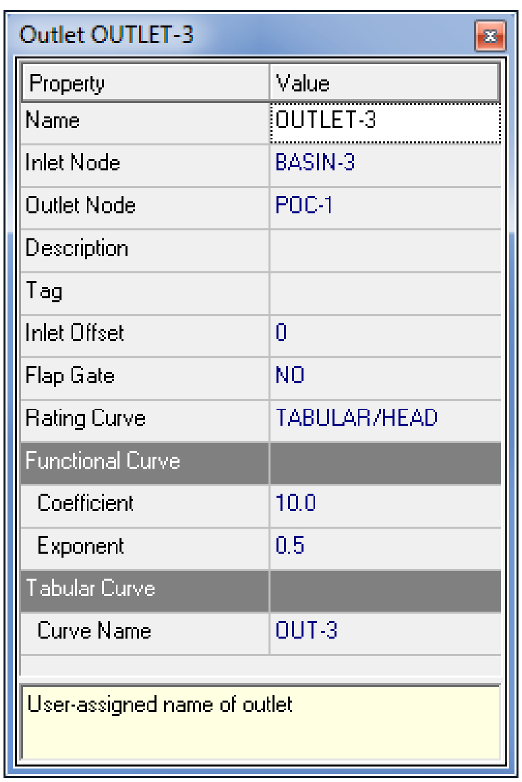


Storage Curve Editor

Curve Name: BASIN-3

Description:

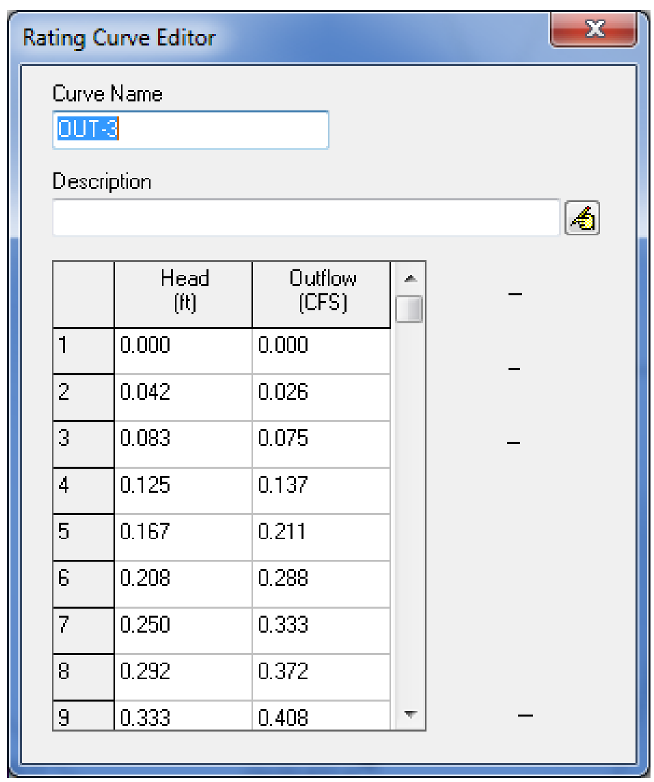
	Depth (ft)	Area (ft2)
1	0.00	1411
2	0.25	1411
3	0.50	1411
4	0.75	1411
5	1.00	1411
6	1.25	1411
7	1.50	1411
8	1.75	1411
9		



Outlet OUTLET-3

Property	Value
Name	OUTLET-3
Inlet Node	BASIN-3
Outlet Node	POC-1
Description	
Tag	
Inlet Offset	0
Flap Gate	NO
Rating Curve	TABULAR/HEAD
Functional Curve	
Coefficient	10.0
Exponent	0.5
Tabular Curve	
Curve Name	OUT-3

User-assigned name of outlet



Rating Curve Editor

Curve Name: OUT-3

Description:

	Head (ft)	Outflow (CFS)
1	0.000	0.000
2	0.042	0.026
3	0.083	0.075
4	0.125	0.137
5	0.167	0.211
6	0.208	0.288
7	0.250	0.333
8	0.292	0.372
9	0.333	0.408

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

Soils Maps

Map Scale: 1:2,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

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: http://websoilsurvey.nrcs.usda.gov
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 8, Sep 17, 2014

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

Date(s) aerial images were photographed: May 2, 2010—Jun 7, 2012

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

Hydrologic Soil Group— Summary by Map Unit — San Diego County Area, California (CA638)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	D	6.4	48.5%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	0.0	0.2%
PfC	Placentia sandy loam, thick surface, 2 to 9 percent slo pes	D	1.2	9.0%
VaB	Visalia sandy loam, 2 to 5 percent slopes	A	5.6	42.3%
Totals for Area of Interest			**13.3**	**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

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: *None Specified*

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

GEOTECHNICAL INVESTIGATION
PROPOSED SKYLINE RETIREMENT CENTER
NORTHWEST OF 11330 CAMPO ROAD
LA MESA, CALIFORNIA 91941

PREPARED FOR:

SKYLINE WESLEYAN CHURCH
ATTENTION: MR. DANIEL GRANT
11330 CAMPO ROAD
LA MESA, CALIFORNIA 91941

PREPARED BY:

CONSTRUCTION TESTING & ENGINEERING, INC.
1441 MONTIEL ROAD, SUITE 115
ESCONDIDO, CALIFORNIA 92026

CTE JOB NO. 10-13295G OCTOBER 3, 2016

Worksheet C.4-1: Categorization of Infiltration Feasibility Condition

Categorization of Infiltration Feasibility Condition			Worksheet C.4-1
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X
Provide basis: No, calculated infiltration rates for all three proposed basins were less than 0.5 inches per hour. Review the CTE document "Preliminary Geotechnical Report, Proposed Skyline Retirement Center" dated October 3, 2016 for subsurface conditions, applicable maps and cross sections, and exploration logs. Appendix E of the Preliminary Geotechnical Report provides percolation rates and infiltration rate calculations. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	X	
Provide basis: Infiltrate from proposed basins is anticipate to move downslope to the southwest where major electrical utilities such as electrical, cable service, and natural gas are located. Infiltrate over time could impact these infrastructure facilities. As such, the sidewalls of the basin should be lined at a minimum of three feet or the depth of the deepest utility or foundation excavation within 100 feet of basin to minimize such potential adverse impacts. The basin bottom should remain unlined. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: Calculated infiltration is less than 0.5 inches per hour. Groundwater is anticipated to be deeper than at least 10 feet below the bottom of planned basins bottoms based upon test borings placed within 50 feet of the basins (see the Preliminary Geotechnical Report dated October 3, 2016 for boring logs). The site and up-gradient properties are not known contaminated sites according to Geotracker, a State of California on line resource for listings of regulated contaminated sites. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: Calculated infiltration rates are less than 0.5 inches per hour. However, it is anticipated that any amount of infiltration at the site would not increase the risk of changing the seasonality of ephemeral streams or increase the risk of contaminating surface waters than currently exists. A blue line stream is approximately 150 feet southwest of the site across Campo Road. Potential impacts of the proposed basins to the blue line creek are low due to distance in combination with construction of the recommended lining of basin sidewalls to the maximum depth of adjacent utility trench and foundation excavations within 100 feet of the basins. The site and up-gradient properties are not known contaminated sites according to Geotracker, a State of California on line resource for listings of regulated contaminated sites. As such there is minimal potential contamination impacts to the blue line creek with installation of the proposed basins. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2	NO	

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Worksheet C.4-1 Page 3 of 4			
Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	X	
Provide basis: On site calculated infiltration rates are less than 0.5 inches/hour. See Appendix E of the October 3, 2016 Preliminary Geotechnical Report to which this Worksheet is attached. The recommended infiltration rates including a safety factor of 2.25 per Worksheet D.5-1 are: BMP Basin 1: 0.1018 inches/hour BMP Basin 2: 0.0896 inches/hour BMP Basin 3: 0.1400 inches/hour As such there was infiltration in all three basins. The determination of "appreciable" is a function of interpretation by the County of San Diego and project designers. CTE has stated "Yes" simply because infiltration has been recorded at the site. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	X	
Provide basis: See Question 2, Part 1. Potential adverse geotechnical impacts to geotechnical hazards may be minimized by installation of an impermeable liner on the sidewalls of the proposed BMP basins. Such impermeable liners should extend to the maximum depth of all utility infrastructure and foundations excavations within 100 feet of the closest approximation to the BMP basins. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: Groundwater is not present within at least 10 feet of the bottom of the BMP basins. The site and upslope properties are not known contaminated sites based upon reference to Geotracker, an on line source for regulatory listed known contaminated properties.Mounding and lateral infiltration of infiltrate is to be mitigated by recommended lining of BMP basin sidewalls with an impereable geotextile. The impermeable liner should extend to the maximum depth of utility infrastructure and foundation excavations for these facilities within 100 feet of the closest approximation to a BMP basin. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: To CTE's knowledge there is no downstream water rights violation as the site infiltrate is anticipated to remain within or relatively close to the property. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration. If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.		YES

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings

Worksheet D.5-1: Factor of Safety and Design Infiltration Rate Worksheet

Factor of Safety and Design Infiltration Rate Worksheet				Worksheet D.5-1	
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.0
B	Design	Level of pretreatment/ expected sediment loads	0.5	1	0.5
		Redundancy/resiliency	0.25	1	0.25
		Compaction during construction	0.25	2	0.5
		Design Safety Factor, $S_B = \Sigma p$			1.25
Combined Safety Factor, $S_{total} = S_A \times S_B$				2.25	
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)				See Below.	
Design Infiltration Rate, in/hr, $K_{design} = K_{observed} / S_{total}$				See Below	
Supporting Data					
Briefly describe infiltration test and provide reference to test forms: Reference CTE October 3, 2016 "Preliminary Geotechnical Report, Proposed Skyline Retirement Center" to include Appendix E Percolation Test Results and Calculated Infiltration Rates. Lowest of two calculated infiltration rates are: BMP Basin 1=0.1018 in/hr, BMP Basin 2=0.0896 in/hr, BMP Basin 3=0.1400 in/hr.					

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 ............ AUG-29-1951 00:00:00
Ending Date .............. MAR-29-2008 00:00:00
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 ......       437.920       591.650
Evaporation Loss .........         9.958        13.454
Infiltration Loss ........       398.914       538.952
Surface Runoff ...........        35.069        47.379
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -1.375


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        35.069        11.428
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        35.069        11.428
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
***************************
```

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
1.1-A	591.65	0.00	0.36	589.16	2.65	0.29	1.88	0.004

PRE_DEV

1.1-D	591.65	0.00	26.62	488.42	92.42	11.09	3.17	0.156
OFFSITE-A	591.65	0.00	0.38	589.89	1.58	0.02	0.15	0.003
2	591.65	0.00	26.47	485.43	98.79	0.03	0.01	0.167

Analysis begun on: Fri Sep 15 10:09:30 2017
Analysis ended on: Fri Sep 15 10:09:45 2017
Total elapsed time: 00:00:15

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 ............ AUG-29-1951 00:00:00
Ending Date .............. MAR-29-2008 00:00:00
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 BYPASS-1

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-1

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-2

WARNING 04: minimum elevation drop used for Conduit BYPASS-2

WARNING 04: minimum elevation drop used for Conduit U-DRAIN-3

WARNING 04: minimum elevation drop used for Conduit BYPASS-3

**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       438.175       591.650
Evaporation Loss .........        53.699        72.508
Infiltration Loss ........       266.988       360.502
Surface Runoff ...........       123.845       167.223
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -1.451


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       123.716        40.315
Groundwater Inflow .......         0.000         0.000
```

```
  RDII Inflow .............         0.000         0.000
  External Inflow ..........        0.000         0.000
  External Outflow .........      123.680        40.303
  Internal Outflow .........        0.000         0.000
  Storage Losses ...........        0.014         0.004
  Initial Stored Volume ....        0.000         0.000
  Final Stored Volume ......        0.000         0.000
  Continuity Error (%) .....        0.018
```

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

```
  *************************
  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
1-1-D	591.65	0.00	50.17	306.64	246.15	5.94	0.66	0.416
1-1-A	591.65	0.00	48.01	324.06	226.46	7.86	0.82	0.383
1-2-A	591.65	0.00	83.83	133.27	384.82	16.72	1.21	0.650
1-2-D	591.65	0.00	74.26	178.69	350.73	17.60	1.45	0.593
1-3-A	591.65	0.00	106.63	0.00	498.86	1.44	0.09	0.843
1-3-D	591.65	0.00	61.79	242.92	299.41	9.67	0.91	0.506
BR-1	591.65	14665.13	975.65	4284.55	10013.60	9.42	1.49	0.656
BR-2	591.65	12615.86	972.47	4121.48	8110.93	22.06	2.59	0.614
BR-3	591.65	12631.22	965.59	5051.35	7116.38	6.25	0.98	0.538
1-1-D-BYPASS	591.65	0.00	18.53	482.28	98.98	0.98	0.26	0.167
1-1-A-BYPASS	591.65	0.00	0.36	588.75	3.22	0.09	0.49	0.005

OFFSITE-A	591.65	0.00	31.19	425.33	138.47	1.38	0.21	0.234
OFFSITE-D	591.65	0.00	107.21	0.00	497.81	0.16	0.01	0.841

****
LID Performance Summary
****

Subcatchment	LID Control	Total Inflow in	Evap Loss in	Infil Loss in	Surface Outflow in	Drain Outflow in	Init. Storage in	Final Storage in	Pcnt. Error
BR-1	BR-1	15256.78	975.63	4284.48	2718.49	7294.94	0.00	0.00	-0.11
BR-2	BR-2	13207.51	972.47	4121.48	1370.10	6740.83	0.00	0.00	0.02
BR-3	BR-3	13222.87	965.65	5051.67	2141.37	4975.46	0.00	0.00	0.67

****
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-1	DIVIDER	0.00	0.00	0.00	0	00:00
DIV-2	DIVIDER	0.00	0.00	0.00	0	00:00
DIV-3	DIVIDER	0.00	0.00	0.00	0	00:00
BASIN-1	STORAGE	0.00	1.10	1.10	16970	17:12
BASIN-2	STORAGE	0.00	0.52	0.52	16970	17:18
BASIN-3	STORAGE	0.00	0.92	0.92	16970	17:23

****
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	0.97	5.27	16970	17:00	2.616	40.300
DIV-1	DIVIDER	1.49	1.49	16970	17:00	9.406	9.406
DIV-2	DIVIDER	2.59	2.59	16970	17:00	22.037	22.037
DIV-3	DIVIDER	0.98	0.98	16970	17:00	6.253	6.253
BASIN-1	STORAGE	0.00	1.46	16970	17:00	0.000	2.508
BASIN-2	STORAGE	0.00	2.52	16970	17:00	0.000	3.847
BASIN-3	STORAGE	0.00	0.96	16970	17:00	0.000	1.835

****
Node Surcharge Summary
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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-1	DIVIDER	496008.02	0.000	0.000
DIV-2	DIVIDER	496008.02	0.000	0.000
DIV-3	DIVIDER	496008.02	0.000	0.000
BASIN-1	STORAGE	496008.02	1.099	0.901
BASIN-2	STORAGE	496008.02	0.524	1.226
BASIN-3	STORAGE	496008.02	0.922	1.078

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Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
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Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	E&I Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
BASIN-1	0.002	0	0	2.067	53	16970 17:11	1.45
BASIN-2	0.001	0	0	2.289	30	16970 17:17	2.32
BASIN-3	0.000	0	0	1.302	46	16970 17:22	0.75

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow CFS	Max. Flow CFS	Total Volume 10^6 gal
POC-1	3.57	0.08	5.27	40.300
System	3.57	0.08	5.27	40.300

****
Link Flow Summary
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	Maximum |Flow|	Time of Max Occurrence	Maximum |Veloc|	Max/ Full	Max/ Full

POST_DEV

Link	Type	CFS	days hr:min	ft/sec	Flow	Depth
BYPASS-1	DUMMY	1.46	16970 17:00			
U-DRAIN-1	DUMMY	0.03	123 09:30			
U-DRAIN-2	DUMMY	0.07	123 09:59			
BYPASS-2	DUMMY	2.52	16970 17:00			
U-DRAIN-3	DUMMY	0.02	123 09:40			
BYPASS-3	DUMMY	0.96	16970 17:00			
OUTLET-1	DUMMY	1.45	16970 17:12			
OUTLET-2	DUMMY	2.32	16970 17:18			
OUTLET-3	DUMMY	0.75	16970 17:23			

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Conduit Surcharge Summary
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	--------- Hours Full --------			Hours	Hours
				Above Full	Capacity
Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
BYPASS-1	0.01	0.01	0.01	496008.02	0.01
U-DRAIN-1	0.01	0.01	0.01	496008.02	0.01
U-DRAIN-2	0.01	0.01	0.01	496008.02	0.01
BYPASS-2	0.01	0.01	0.01	496008.02	0.01
U-DRAIN-3	0.01	0.01	0.01	496008.02	0.01
BYPASS-3	0.01	0.01	0.01	496008.02	0.01

Analysis begun on: Fri Sep 15 14:20:38 2017
Analysis ended on: Fri Sep 15 14:21:28 2017
Total elapsed time: 00:00:50