GENERAL REQUIRED INFORMATION FOR REASONABLE ASSURANCE ANALYSIS FOR EACH WATER BODY-COMBINATION ADDRESSED BY THE WATERSHED MANAGEMENT PROGRAM

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permittees shall classify and list water body-pollutant combinations into one of the following three categories:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
    - Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1] & prior to December 28, 2017)
    - Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2] & prior to December 28, 2017)
    - Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022
    - Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022
    - Category 1E: **Interim & final** deadlines after December 28, 2022
    - Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
    - Category 2A: Non-legacy priority pollutants
    - Category 2B: Bacterial indicators
    - Category 2C: Legacy priority pollutants
    - Category 2D: Other pollutants
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
    - Category 2A: Non-legacy priority pollutants
    - Category 2B: Bacterial indicators
    - Category 2C: Legacy priority pollutants
    - Category 2D: Other pollutants

[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.

[2] *Ibid.*

[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5] (including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6] At a minimum, baseline pollutants loading shall be provided for each sub-watershed that was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each catchments identified in the WMMS and area that will be covered under other watershed control measures. Pollutant loading shall be calculated based on event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which are reflected in the current loading.[7]

[4] Per definition in federal regulations.
[5] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.
[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.
[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based. Mass-based allowable loading will be calculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The different between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed management strategies within that sub-watershed area.
- Estimated pollutant loading may vary using a single fixed value based on annual average loading or may be estimated based on pollutant load reduction from year-to-year based on watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide detail description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, approximate system size, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STORM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all reaches and named tributaries identified in the Basin Plan, and all compliance points required in the TMDLs that are applicable to the proposed WMP.
- Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan MS4 to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall, runoff, and groundwater processes of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA TMDL Modeling Toolbox
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model
* Empirically based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, a 1 acre or smaller grid cell is recommended to satisfy the assumption that all properties such as soil, land use, vegetation, crop ~~management~~ ,management, and climate are homogeneous within each computational grid cell. For temporal scale, the model should use varying time steps with a minimum 1-minute time step during rainfall events and a daily time step between rainfall events.

Table 2. General Required Model Input Data For Both Process Based BMP Model and Empirically Based BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• Wind and others	NCDC or locally derived data	At least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for	SSURGO or	Most recent

[8] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly
• In-stream Depth	USGS and locally derived data	Daily/monthly
• Groundwater Flow?	USGS and locally derived data	Monthly/annually
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the mode parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Required Model Parameters for Process Based BMP Model

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#[9]6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Manning's n (roughness) for overland flow	EPA BTN#6	0.01-0.15
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for	EPA BTN#6	0.0-10.0

[9] EPA BTN # : EPA Basins Technical Note #

[10] LA County Report[*]: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

sediment associated constituent (lb/ton)		
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Required Model Parameters for Empirically Based BMP Model

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Average EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Table 4.1 BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3

• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

***** Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Table 4-2: BMP Performance Parameters for Empirically Based BMP Model

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Table 5: Model Output for both Process Based BMP Model and Empirically Based BMP Model

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use	Table

Model Output	Output Content	Output Format
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario	Graphics
	Pollutagraphs at compliance points for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storage distribution for each BMP scenario	Table and Graphics

GENERAL ~~REQUIRED INFORMATION~~GUIDELINES FOR THE REASONABLE ASSURANCE ANALYSIS FOR ~~EACH WATER BODY-COMBINATION ADDRESSED BY~~ THE WATERSHED MANAGEMENT PROGRAM AND THE ENHANCED WATERSHED MANAGEMENT PROGRAM

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A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permittees shall classify and list water body-pollutant combinations into one of the following three categories:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
  - ~~Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1] & prior to December 28, 2017)~~
  - ~~Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2] & prior to December 28, 2017)~~
  - ~~Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022~~
  - ~~Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022~~
  - ~~Category 1E: **Interim & final** deadlines after December 28, 2022~~
  - ~~Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]~~
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
  - ~~Category 2A: Non-legacy priority pollutants~~
  - ~~Category 2B: Bacterial indicators~~
  - ~~Category 2C: Legacy priority pollutants~~
  - ~~Category 2D: Other pollutants~~
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
  - ~~Category 2A: Non-legacy priority pollutants~~
  - ~~Category 2B: Bacterial indicators~~

~~[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.~~

~~[2] *Ibid.*~~

~~[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.~~

- ~~Category 2C: Legacy priority pollutants~~
- ~~Category 2D: Other pollutants~~

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5] (including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6] At a minimum, baseline pollutants loading shall be provided for each sub-watershed that was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each catchments identified in the WMMS and area that will be covered under other watershed control measures. Pollutant loading shall be calculated based on event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Comment [MT1]: Why only EWMP?

Comment [MT2]: WMMS doesn't use EMCs. It's calibrated with some land use EMC data but enhanced with MES data. There is no place in the model to drop these values in.

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County ~~2006~~ 1996 EMC Report

[4] Per definition in federal regulations.
[5] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.
[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which are reflected in the current loading.[7]
- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based. Mass-based allowable loading will be calculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The ~~different~~ difference between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed management strategies within that sub-watershed area.
- Estimated pollutant loading may vary using a single fixed value based on annual average loading or may be estimated based on pollutant load reduction from year-to-year based on watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, approximate system size, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing

[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

BMPs. Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all reaches and named tributaries identified in the Basin Plan, and all compliance points required in the TMDLs that are applicable to the proposed WMP.
- Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan MS4 to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn ~~only~~ from peer-reviewed sources or other credible sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data when they become available.

Comment [MT3]: Allow non-peer reviewed sources such as Army Corps or County studies to be used for BMP effectiveness.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

  The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and , runoff, and groundwater processes of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA TMDL Modeling Toolbox
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model
* Empirically based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model

parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. ~~With regard to the spatial scale, a 1 acre or smaller grid cell is recommended to satisfy the assumption that all properties such as soil, land use, vegetation, crop management , and climate are homogeneous within each computational grid cell. For temporal scale, the model should use varying time steps with a minimum 1-minute time step during rainfall events and a daily time step between rainfall events.~~

Table 2. General Required Model Input Data For Both Process Based BMP Model and Empirically Based BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or	at least 10 years hourly

[8] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
	locally derived data	
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• ~~Wind and others~~	~~NCDC or locally derived data~~	~~At least 10 years daily/monthly~~
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly
• In-stream Depth	USGS and locally derived data	Daily/monthly
• ~~Groundwater Flow?~~	~~USGS and locally derived data~~	~~Monthly/annually~~
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the mode parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model parameters	% Difference between simulated and observed values		
	Very Good	Good	Fair
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Required Model Parameters for Process Based BMP Model

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
~~• Fraction forest cover~~	~~EPA BTN#[9]6~~	~~0-0.95~~
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0

Comment [MT4]: Most of these parameters will never be used. I question if we should present them as it may confuse people.

[9] ~~EPA BTN # : EPA Basins Technical Note #~~

• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
~~• Variable Groundwater Recession (1/in)~~	~~EPA BTN#6~~	~~0.0-5.0~~
~~• Base Groundwater Recession~~	~~EPA BTN#6~~	~~0.85-0.999~~
~~• Temp below which ET is reduced by half (°F)~~	~~EPA BTN#6~~	~~32.0-48.0~~
~~• Temp below which ET is set to zero (°F)~~	~~EPA BTN#6~~	~~30.0-40.0~~
~~• Manning's n (roughness) for overland flow~~	~~EPA BTN#6~~	~~0.01-0.15~~
~~• Fraction of GW inflow to deep recharge~~	~~EPA BTN#6~~	~~0.0-0.50~~
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss	SUSTAIN manual	0.2

Comment [MT5]: I don't see the need for any groundwater parameters

Comment [MT6]: This is already on the four bullet

Comment [MT7]: Questioning the need for these tables. Where would this information be inputted. Is there a place in SUSTAIN?

[10] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

rate of constituent (1/day)		
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Required Model Parameters for Empirically Based BMP Model

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
~~• Fraction forest cover~~	~~EPA BTN#6~~	~~0-0.95~~
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0

Comment [MT8]: Many of these parameters were already in Table 3.1.1 What is the difference? Why is it stated twice? Values are exactly the same

Comment [MT9]: This is from the SBPAT report, not LA County report.

Comment [MT10]: This is a repeat of Table 3.1.3 . I think the tables can be combined to make the document shorter

• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Average EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Table 4.1 BMP Performance Parameters for Process Based BMP Model

Comment [MT11]: FYI: These are SUSTAIN inputs and match the default values used in WMMS.

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5

• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Table 4-2: BMP Performance Parameters for Empirically Based BMP Model

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetl Chan
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Comment [MT12]: I don't understand the results of this. The effluent concentration is dependent on the influent concentration and volume of water. I don't think an effluent concentration is appropriate. Would a reduction percentage range be more effective?

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Table 5: Model Output for both Process Based BMP Model and Empirically Based BMP Model

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use	Table
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario	Graphics
	Pollutagraphs at compliance points for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storage distribution for each BMP scenario	Table and Graphics

Comment [MT13]: Why are we trying to reduce runoff? Only pollutants no?

~~GENERAL REQUIRED INFORMATION~~GUIDELINES FOR REASONABLE ASSURANCE ANALYSIS FOR EACH WATER BODY-COMBINATION ADDRESSED BY THE WATERSHED MANAGEMENT PROGRAM

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permitteesshall classify and list water body-pollutant combinations into one of the following three categories:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
  - Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1]& prior to December 28, 2017)
  - Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2]& prior to December 28, 2017)
  - Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022
  - Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022
  - Category 1E: **Interim & final** deadlines after December 28, 2022
  - Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants

[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.

[2] *Ibid.*

[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.

Comment [CS1]: The inclusion of the word "Required" in the title of the document suggests the document is meant to specify strict requirements for the RAA.The RAA process is not one-size-fits-all and while many EWMP groups may benefit from RAA guidelines, strict requirements for the RAA may prevent innovative approaches to the RAA. It is understood that straying from these guidelines should be done cautiously

Comment [MWH2]: Water quality priorities are clearly linked to the RAA approach. If Section A is retained in this document, we suggest including text explaining its relation to the RAA

Comment [CS3]: The categories appear to be headed in the right direction. However, as currently proposed they constrain the ability to categorize based on current water quality data and the Permittees potential desire to address both past due and current Permit term deadlines with a consistent approach. As an alternative, it might help prioritization to establish similar categories but incorporate current water quality (i.e., recent vs. historical exceedances) as well as notation of when a Category 2 or 3 pollutant is in a similar class as an existing TMDL. Additionally, the subcategories (particularly those beyond the current Permit term) should be consolidated such that a WBPC does not appear in multiple (or in some cases) all of the subcategories (because there are milestones in the next several permit cycles).

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving watersand any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5](including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other ~~catchbasin~~catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6]At a minimum, baseline pollutants loading shall be provided for each sub-watershedthat was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each ~~catchments identified in the WMMS and area that will be covered under other watershed control measures.~~HUC-12 catchment. Pollutant loading shall be ~~calculated based on~~consistent with event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- Permittees shall provide list of BMPs/MCMs that are currently implemented (or implemented at the time the TMDLs became effective) , the results of which are reflected in the current loading~~.~~ (or loading at the time the TMDLs became effective).[7]
- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

[4]Per definition in federal regulations.

[5] Spatial metadata for existing BMPs must include ~~delineation~~a per-jurisdiction estimate of ~~drainage area~~ number of BMPs, BMP types, and total treated~~, maximum volume of non-stormwater/stormwater treated,~~area per BMP type~~ of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.~~.

[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.

[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

Comment [CS4]: For footnote #5, while the number and type of existing BMPs may be relevant to the RAA, this level of information for all structural control measures is unnecessary. Compiling this information for each structural control would be a massive undertaking for many agencies.

Recommendation: recommend an estimate of the numbers, types of control measures, and area treated in the jurisdictions rather than detailed reporting BMP-by-BMP.

Comment [MWH5]: The third sentence of the second bullet in Section B refers to WMMS, however WMMS will not necessarily be used by all WMGs. Suggest "WWMS" be replaced by "HUC12".

Comment [CS6]: WMMS includes estimates of continuous and variable water quality concentrations for each modeled subwatershed that build upon sources for EMCs by calibrating to instream monitoring data throughout the region. This calibration was fully documented, and is consistent with methods used in LSPC modeling efforts previously performed by EPA to support TMDL development. A review of regional data show that pollutant delivery varies spatially and temporally with storm size. Because the WMMS-LSPC calibration uses continuous simulation (rather than only using EMCs that are static), it predicts long-term, continuous, hourly water quality concentrations in robust and representative way.

Recommendation: delete last sentence (bold, italics) of reference, and removing associated table of EMC sources. At a minimum, the guidelines should state that pollutant loading shall be "consistent" with EMCs as opposed to "calculated based on" EMCs. Alternatively, sentence can be restructured to state ""Pollutant loading may be calculated based on event mean concentrations (EMCs) available for different land use sites as referenced in the list of example sources below (this list is not exhaustive, as more recent datasets may be available):"

Comment [MWH7]: Suggest changing "current loading" to "loading at the time of the TMDL effective date" or "baseline loading".

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadingsfrom MS4 discharges expressed as concentration-based or mass-based~~.~~, recognizing concentrationand/or mass may serve as an indicator for conformance with TMDL requirements (e.g., exceedance-days for Fecal Indicator Bacteria). Mass-based allowable loading will ~~be~~~~calculated~~becalculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The different between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed managementstrategies within that sub-watershed area.
- Estimated pollutant loading ~~may varyusing a single fixed value~~ maybe based on annual average loading or may be estimated based on pollutant load ~~reduction from year-to-year based on~~reductions, accounting for variations in watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions, for those constituents and BMPs that can be quantified with robust datasets, should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide detail description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, and approximate system size~~, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)~~.

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs.Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

Comment [MWH8]: Modified to allow for stochastic methods and deterministic approaches

Comment [CS9]: For each project, detailed descriptions should be limited to information pertinent to planning purposes, including retention system type and storage volume. The remaining information ("number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.") will be very rough estimates and can only be determined through more thorough design processes, which should not be a requirement of the EWMP. Further, this information is not critical to the EWMP, which only needs to specify what will be implemented, and how much volume it should retain. The remaining parameters are useful for design, but that information is not necessary to understand the benefits of the project.

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permitand potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF ~~STROM~~STORM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMsas defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permitteesshall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all ~~reaches and named tributaries identified in the Basin Plan, and all~~ compliance points required in the TMDLs that are applicable to the proposed WMP.
- ~~Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan -MS4 to the Receiving Water(s)~~

Comment [CS10]: This clause suggests that TMDL compliance points will be extended to all waterbodies in the watershed, including those not named in TMDLs. While upstream waterbodies will be relevant to the RAA for impaired downstream waterbodies, this statement could have far reaching implications on the RAA. Furthermore, extending WLAs to waterbodies not named in the TMDL could be a challenging undertaking for TMDLs with complicated targets, WLAs, etc.

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources, such as the International BMP Database.
- The estimated effectiveness of BMPs in pollutant removal and/or reductionwill ~~served~~serve as a ~~default~~startingvalue that can be updated through the adaptive management process with BMP monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water ~~limitationsper~~limitationsper Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF ~~MILESTONE~~MILESTONES ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

Comment [MWH11]: This section may not be specific to the RAA, and perhaps is better included in the EWMP work plan document.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall, runoff, and ~~groundwater processes~~baseflow contributions of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Comment [CS12]: The models being used do not comprehensively predict groundwater processes. They only track and use subsurface storages to predict baseflow contributions (flow and pollutant load).

Table 1. List of Available Models

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA ~~TMDL Modeling Toolbox~~SUSTAIN
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model City of Los Angeles SBPAT model
* Combined Process based (for hydrology) and Empirically based(for water quality)models	EPA TMDL Modeling Toolbox

Comment [CS13]: EPA SUSTAIN should be listed.

Comment [CS14]: The TMDL Modeling Toolbox should be listed under "Integrated BMP Modeling Systems"

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5).For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board.With regard to the spatial scale, ~~a 1 acre or smaller grid cell is recommended~~high-resolution, publicly available GIS layers should be used to satisfy the assumption that all properties such as soil, land use, vegetation, crop management , and climate are homogeneous within each computational grid cell. ~~For temporal scale, the model should use varying time steps with a minimum 1-minute time step during rainfall events and a daily time step between rainfall events.~~

Comment [CS15]: None of the models listed under E.1 Land/Watershed Models in the previous table are grid-based, and "grids" are not an appropriate term to describe the spatial scale to be modeled. The models are based on subwatersheds that follow hydrologic boundaries to define flow paths. For models previously developed for the watershed (e.g., LSPC, SBPAT, WMMS), model subwatershed sizes varied and were based on urban density, receiving water compliance points, and other factors relevant to planning. It is unclear what is being required at a 1-acre resolution. If the 1-acre or smaller resolution is referring to the subwatershed size, this introduces unnecessary model complexity and spatial resolution. This will create several thousand subwatersheds that will be complicated for reporting purposes, and not required for planning purposes or demonstration that projects will achieve the necessary load reductions to meet targets.
If the 1-acre resolution is referring to the resolution of the GIS layers that compose the watershed model, then the guideline should emphasize using the highest-quality GIS layers that are publicly available.

Table 2.General Required Model Input Data~~For~~forBoth Process Based BMP Model and EmpiricallyBased BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/~~CERESand~~CERESand other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/~~LandCover~~LandCover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• Wind and others	NCDC or locally derived data	At least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	~~SSURGOor~~ SSURGOor locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	~~SSURGOor~~ SSURGOor locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly
• In-stream Depth	USGS and locally derived data	Daily/monthly
• Groundwater Flow?	USGS and locally derived data	Monthly/annually

[8] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
2.5 Point Source Data		
• Point ~~SourceLocation~~SourceLocation	EPA STORET ~~dataCIWQS~~dataCIWQS/SMARTS or local sampling	All available data
• Point ~~SourceDischarge~~SourceDischarge	EPA ~~STORETdata~~STORETdataCIWQS/SMARTS or local sampling	Daily/monthly
• Point ~~SourceConcentration~~Source Concentration	EPA STORET ~~dataCIWQS~~dataCIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the mode parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 ~~Recommended~~ **Model Calibration Criteria**

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

Comment [MWH16]: Suggest Table 3.0 be titled, "***Recommended*** Model Calibration Criteria", particularly given the wide range of models and POCs being used. In most cases these data do not exist for calibration, so we suggest that the use of all available and technically defensible calibration data be considered sufficient. The calibration data in Table 3.0 is referencing HSPF or LSPC (process-based models), but other models that are empirically based directly use all available data in the modeling analysis.

Table 3.1 ~~Required~~Example Model Parameters for Process Based BMP Model

Comment [MWH17]: Suggest that Table 3.1 be renamed to "***Example*** Model Parameters for Process Based BMP Models."

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#[9]6	0-0.95
• Interception storage capacity(in)	EPA BTN#6	0.01-0.40
• Retention storage capacity(in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity(fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity(fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half(^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero(^{o}F)	EPA BTN#6	30.0-40.0
• Manning's n (roughness) for overland flow	EPA BTN#6	0.01-0.15
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for ~~sedimentassociated~~sedimentassociated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for ~~sedimentassociated~~sedimentassociated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes	EPA BTN#6	0.0-0.5

[9] EPA BTN # : EPA Basins Technical Note #

[10] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

90% of stored water quality constituent(in/hr)		
• General first order in-stream loss ~~rateof~~rateof constituent (1/day)	SUSTAIN manual	~~0.2~~Pollutant/calibration-dependent
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-~~offequation~~offequation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment ~~scourequation~~scourequation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-~~offequation~~offequation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from ~~landsurface~~landsurface per day (1/day)	EPA BTN#8	0.01-1.0

Comment [CS18]: Specifying a single value is arbitrary because it is pollutant specific and calibration dependent.

Table 3.2 Example Required Model Parameters for Empirically Based BMP Model

Comment [MWH19]: Suggest Table 3.2 be revised to "*Example* Model Parameters for Empirically Based BMP Model".

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash ~~offequation~~offequation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment ~~scourequation~~scourequation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from	EPA BTN#8	0.01-1.0

~~landsurface~~landsurface per day (1/day)		

Table 3.3 ~~Average~~ Example average EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Comment [MWH20]: Suggest renaming Table 3.3 to "***Example*** Average EMCs by land use for selected pollutants." Also suggest adding a footnote after "average" that says, "Log-transformed arithmetic mean values shown" (since SBPAT samples from lognormal distributions that are represented using transformed log statistics).

Comment [MWH21]: Perhaps indicate these are initial estimates, to be supplemented by more recently collected Southern California data and to be adjusted based on calibration studies.

Table 4.1 Example BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

*Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Comment [MWH22]: We suggest that Table 4.1 be renamed "***Example*** BMP Performance Parameters for Process Based BMP Model." Some models have both empirical and process based components.

Table 4-2: Example BMP Performance Parameters for Empirically Based BMP Model

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,andNO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Comment [MWH23]: Suggest this be presented as values that should be augmented with more recently collected SoCal data and calibration studies.

Comment [MWH24]: Suggest that references be added to all tables, specifically year of publication. Some models have been updated since 2008 or 2009, so we recommend adding some text noting that the values in this document are subject to change, pending more recent model updates.

Comment [MWH25]: Suggest renaming Table 4-2 to "Example BMP Performance Parameters for Empirically Based BMP Model." This would allow for other BMPs to be modeled which are not explicitly listed, such as subsurface flow wetlands.

Table 5:Suggested Example Model ~~Output~~Outputs for both Process-Based and Empirical BMP Model ~~and Empirically Based BMP Models~~

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant ~~Loadings~~Loadingsat time of TMDL effective date		
	Current pollutant loadings at each sub-watershed , HUC-12 and/or each land use	Table
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points within the EWMP/WMP area	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario	Graphics
	Pollutagraphs at compliance points within the EWMP/WMP area for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storagedistribution for each BMP scenario	Table and Graphics

Comment [MWH26]: Suggest Table 5 be renamed to "***Example*** Model Output for both Process Based and Empirically Based BMP Model." This would better suit the wide range of models being used (not all models have the same output).

Comment [CS27]: On Model Outputs….
(5.2a) Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions
(5.2b) Time series plot of pollutant load reduction for each BMP scenario at compliance points.
(5.4a) Flow hydrographs at compliance points for each BMP scenario
(5.4b) Pollutographs at compliance points for each BMP scenario

Depending on (1) the selected representative temporal averaging period and (2) spatial/jurisdictional area subset resampling, showing time series at TMDL compliance points that are outside of the EWMP/WMP area may not be reasonable. Instead, the WMP/EWMP should only be required to show that (1) BMP scenario loads and load reductions are consistent with the defined averaging periods for compliance (i.e. wet/dry weather criteria) and (2) that load reductions satisfy the management requirements of associated downstream compliance points that are *within* those resampled jurisdictional areas.

Comment [MWH28]: Suggest that Section 5.1 of Table 5 be revised to remove the word "Current/" from "Current/Existing Pollutant Loadings". The TMDLs define the existing condition as the effective date of the specific TMDL (not current). Since the technical basis for the TMDLs is analyses and land uses from the time of adoption, we believe that should that be the appropriate baseline condition

Comment [MWH29]: Suggest that the "current pollutant loadings at each subwatershed and each land use" be revised to "each HUC12 and each land use."

GENERAL REQUIRED INFORMATION FOR REASONABLE ASSURANCE ANALYSIS FOR EACH WATER BODY-COMBINATION ADDRESSED BY THE WATERSHED MANAGEMENT PROGRAM

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permittees shall classify and list water body-pollutant combinations into one of the following three categories:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
    - Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1]& prior to December 28, 2017)
    - Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2]& prior to December 28, 2017)
    - Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022
    - Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022
    - Category 1E: **Interim & final** deadlines after December 28, 2022
    - Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
    - Category 2A: Non-legacy priority pollutants
    - Category 2B: Bacterial indicators
    - Category 2C: Legacy priority pollutants
    - Category 2D: Other pollutants
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
    - Category 2A: Non-legacy priority pollutants
    - Category 2B: Bacterial indicators
    - Category 2C: Legacy priority pollutants
    - Category 2D: Other pollutants

[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.

[2] *Ibid.*

[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5](including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6]At a minimum, baseline pollutants loading shall be provided for each sub-watershed that was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each catchments identified in the WMMS and area that will be covered under other watershed control measures. Pollutant loading shall be calculated based on event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which are reflected in the current loading.[7]

[4]Per definition in federal regulations.

[5] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.

[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based. Mass-based allowable loading will be calculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The different between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed management strategies within that sub-watershed area.
- Estimated pollutant loading may vary using a single fixed value based on annual average loading or may be estimated based on pollutant load reduction from year-to-year based on watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide detail description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, approximate system size, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permitand potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified inTMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all reaches and named tributaries identified in the Basin Plan, and all compliance points required in the TMDLs that are applicable to the proposed WMP.
- Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan MS4 to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall, runoff, and groundwater processes of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA TMDL Modeling Toolbox
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model
* Empirically based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5).For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, a 1 acre or smaller grid cell is recommended to satisfy the assumption that all properties such as soil, land use, vegetation, crop management , and climate are homogeneous within each computational grid cell. For temporal scale, the model should use varying time steps with a minimum 1-minute time step during rainfall events and a daily time step between rainfall events.

Table 2.General Required Model Input DataFor Both Process Based BMP Model and EmpiricallyBased BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERESand other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/LandCover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• Wind and others	NCDC or locally derived data	At least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	SSURGOor locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGOor locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for	SSURGO or	Most recent

[8] Satellite imagery may be utilized but is not required. Can the minimum resolution be specified?

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly
• In-stream Depth	USGS and locally derived data	Daily/monthly
• Groundwater Flow?	USGS and locally derived data	Monthly/annually
2.5 Point Source Data		
• Point SourceLocation	EPA STORET dataCIWQS/SMARTS or local sampling	All available data
• Point SourceDischarge	EPA STORETdata CIWQS/SMARTS or local sampling	Daily/monthly
• Point SourceConcentration	EPA STORET dataCIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

(Do these values apply to instantaneous conditions or average conditions? What about situations when these criteria are not met?

Table 3.1 Required Model Parameters for Process Based BMP Model

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#[9]6	0-0.95
• Interception storage capacity(in)	EPA BTN#6	0.01-0.40
• Retention storage capacity(in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity(fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity(fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half(^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero(^{o}F)	EPA BTN#6	30.0-40.0
• Manning's n (roughness) for overland flow	EPA BTN#6	0.01-0.15
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for	EPA BTN#6	0.0-10.0

[9] EPA BTN # : EPA Basins Technical Note #

[10] LA County Report[*]: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

sedimentassociated constituent (lb/ton)		
• Scour potency factor for sedimentassociated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent(in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rateof constituent (1/day)	SUSTAIN manual	0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-offequation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scourequation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-offequation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from landsurface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Required Model Parameters for Empirically Based BMP Model

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash offequation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment scourequation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from landsurface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Average EMC by land use for selected pollutants (What about other pollutants such as Total Phosphorus?) Can other sources for EMCs be considered?

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Table 4.1 BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3

• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

*****Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Table 4-2: BMP Performance Parameters for Empirically Based BMP Model

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Table 5: Model Output for both Process Based BMP Model and Empirically Based BMP Model

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use	Table
5.2 Load Reduction Output		

Model Output	Output Content	Output Format
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario	Graphics
	Pollutagraphs at compliance points for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storagedistribution for each BMP scenario	Table and Graphics

GENERAL REQUIRED INFORMATION FOR REASONABLE ASSURANCE ANALYSIS FOR EACH WATER BODY-COMBINATION ADDRESSED BY THE WATERSHED MANAGEMENT PROGRAM

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permittees shall classify and list water body-pollutant combinations into one of the following three categories:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
  - Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1] & prior to December 28, 2017)
  - Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2] & prior to December 28, 2017)
  - Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022
  - Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022
  - Category 1E: **Interim & final** deadlines after December 28, 2022
  - Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants

Comment [KJ1]: How does this section tie to RAA?

Comment [KJ2]: What actions will ensue as a result of this?

Comment [KJ3]: In terms of what?

Comment [KJ4]: What do these mean?

Comment [KJ5]: Why is bacteria less of a priority?

[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.

[2] *Ibid.*

[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5] (including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6] At a minimum, baseline pollutants loading shall be provided for each sub-watershed that was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each catchments identified in the WMMS and area that will be covered under other watershed control measures. Pollutant loading shall be calculated based on event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which are reflected in the current loading.[7]

Comment [KJ6]: Presents an unconfirmed assumption of full implementation of 2001 Permit elements that must be justified to be accepted.

Comment [KJ7]: What does 10 year period mean? Are they calibrating models over this period? Calibrate over half and then validate over the other half? Perhaps this 10-year period doesn't capture the true precipitation variability of the region.

Comment [KJ8]: Incorrect reference?

[4] Per definition in federal regulations.
[5] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.
[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.
[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based. Mass-based allowable loading will be calculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The different between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed management strategies within that sub-watershed area.
- Estimated pollutant loading may vary using a single fixed value based on annual average loading or may be estimated based on pollutant load reduction from year-to-year based on watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

Comment [KJ9]: This should not be an "or" situation. Average annual is insufficient. Should only be allowed to look at the year to year, which includes all of the climate variable drivers.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

Comment [KJ10]: Info needed on how to demonstrate infeasibility of retention of 85th percentile storm.

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide detail description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, approximate system size, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

Comment [KJ11]: How do we ensure that green infrastructure is prioritized?

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

Comment [KJ12]: What does this mean? Ensure New and Redevelopment not included.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

Comment [KJ13]: What TMDL wouldn't have final limits?

Comment [KJ14]: How defined?

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all reaches and named tributaries identified in the Basin Plan, and all compliance points required in the TMDLs that are applicable to the proposed WMP.
- Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan MS4 to the Receiving Water(s)

Comment [KJ15]: Are dates really the best way to define interim compliance? What if there are fewer storms or lower precip years for 5 years in a row, thus not a huge amount of loading. Would they be considered compliant even though in year 6 a return to average or above precip pushes over to non-compliance?

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data when they become available.

Comment [KJ16]: What is going to be acceptable BMP efficiencies? What metrics?

Comment [KJ17]: How is this defined? Need more detail here, as this can be a large range.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall, runoff, and groundwater processes of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Comment [KJ18]: explain

Comment [KJ19]: Need a backstop here.

Comment [KJ20]: Need public process

Comment [KJ21]: Best to run both WMMS and SBPAT. This strategy would allow the widest range of comparisons on an identical basis and take advantage of complementary features offered by different models.

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA TMDL Modeling Toolbox
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model
* Empirically based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, a 1 acre or smaller grid cell is recommended to satisfy the assumption that all properties such as soil, land use, vegetation, crop management , and climate are homogeneous within each computational grid cell. For temporal scale, the model should use varying time steps with a minimum 1-minute time step during rainfall events and a daily time step between rainfall events.

Table 2. General Required Model Input Data For Both Process Based BMP Model and Empirically Based BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• Wind and others	NCDC or locally derived data	At least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for	SSURGO or	Most recent

Comment [KJ22]: Not covered: what about "baseflow" and/or dry weather flow calcs?

Comment [KJ23]: What is the method for calculating evap? Penman? CIMIS data?

[8] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly
• In-stream Depth	USGS and locally derived data	Daily/monthly
• Groundwater Flow?	USGS and locally derived data	Monthly/annually
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

Comment [KJ22]: Not covered: what about "baseflow" and/or dry weather flow calcs?

Comment [KJ24]: Instream hydrologic data needs to be hourly, not daily in order to coincide with the hourly preceip data required.

Comment [KJ25]: May need point source data at hourly time step instead of daily, or at least disaggregate to coincide with the other hourly data.

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the mode parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model parameters	% Difference between simulated and observed values		
	Very Good	Good	Fair
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

Comment [KJ26]: Does not specify if this is for volume or Q. Is it for individual storms or annually? Should we be using a different objective function than % difference? Also the table breaks into Fair, Good and Very good but does not qualify what these mean. Do we only have to get results that fall into the Fair category? What do we do if we can't calibrate to this accuracy?

Table 3.1 Required Model Parameters for Process Based BMP Model

Comment [KJ27]: Inconsistency regarding Manning's n

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#[9]6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Manning's n (roughness) for overland flow	EPA BTN#6	0.01-0.15
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for	EPA BTN#6	0.0-10.0

[9] EPA BTN # : EPA Basins Technical Note #

[10] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

sediment associated constituent (lb/ton)		
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Required Model Parameters for Empirically Based BMP Model

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Average EMC by land use for selected pollutants

Comment [KJ28]: EMC table should list ranges. Perhaps standard deviations or quartiles.

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Table 4.1 BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3

• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Table 4-2: BMP Performance Parameters for Empirically Based BMP Model

Comment [KJ29]: Need citations. Also need more detail. Is it better to use local subset of data? More recent data?

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Table 5: Model Output for both Process Based BMP Model and Empirically Based BMP Model

Comment [KJ30]: More detail needed here.

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use	Table

Model Output	Output Content	Output Format
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario	Graphics
	Pollutagraphs at compliance points for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storage distribution for each BMP scenario	Table and Graphics

GENERAL REQUIRED INFORMATION FOR REASONABLE ASSURANCE ANALYSIS FOR EACH WATER BODY-COMBINATION ADDRESSED BY THE WATERSHED MANAGEMENT PROGRAM

Comment [A1]: Rephrase to reflect that this is a guidance document (not a requirement for providing information)

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Permittees shall classify and list water body-pollutant combinations into one of the following three categories:

Comment [A2]: Please provide a rationale for classifying the pollutants into subcategories (1A,1B…)

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
  - Category 1A: **Final** deadlines within permit term (after approval of E/WMP[1] & prior to December 28, 2017)
  - Category 1B: **Interim** deadlines within permit term (after approval of E/WMP[2] & prior to December 28, 2017)
  - Category 1C: **Final** deadlines between December 29, 2017 - December 28, 2022
  - Category 1D: **Interim** deadlines between December 29, 2017 - December 28, 2022
  - Category 1E: **Interim & final** deadlines after December 28, 2022
  - Category 1F: **Past final** deadlines (final deadlines due prior to approval of E/WMP)[3]
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.
  - Category 2A: Non-legacy priority pollutants
  - Category 2B: Bacterial indicators
  - Category 2C: Legacy priority pollutants
  - Category 2D: Other pollutants

Comment [A3]: Not clear if this is sub-prioritization or parts of category 1. If sub-prioritization, this one would not impact Malibu, since both bacteria and trash have compliance dates past due.

Comment [A4]: Same comment as above. If sub-prioritization, bacteria would fall under category 1. So this would prioritize non-legacy, then legacy, then other pollutants.

Comment [A5]: Same comment as above. If sub-prioritization, bacteria would fall under category 1. So this would prioritize non-legacy, then legacy, then other pollutants.

[1] For WMP, upon approval and no later than April 28, 2015; for EWMP, upon approval and no later than April 28, 2016.

[2] *Ibid.*

[3] These should have been identified in the Notification of Intent and must be addressed outside of the E/WMP framework. Permittees may request a TSO to address WQBELs and RWLs with final deadlines that have passed.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 major outfalls[4], major structural controls of storm and non-storm water[5] (including, but not limited to: low flow diversions, urban runoff treatment facilities, detention and retention basins used for stormwater treatment, VSS devices, other catchbasin inserts/screens) that discharge to receiving water within the watershed management areas
- Permittees shall provide initial assessment of current/baseline pollutants loading for identified water body-pollutant combinations based on relevant sub-watershed data collected within the last 10 years including land use and pollutant loading data.[6] At a minimum, baseline pollutants loading shall be provided for each sub-watershed that was breakdown and identified in the TMDLs. If EWMP is selected to be implemented, baseline loading shall be estimated for each area covered under each catchments identified in the WMMS and area that will be covered under other watershed control measures. Pollutant loading shall be calculated based on event meant concentrations (EMCs) available for different land use site as referenced in dependable sources as listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LTiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which are reflected in the current loading.[7]

[4] Per definition in federal regulations.
[5] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.
[6] See Tables X - X for appropriate data sources for use in assessment of baseline pollutant loading.
[7] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

Comment [A6]: LAFCD is required to list all facilities; other Permittees should only list catch basins (see page 131 of Permit)

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Comment [A7]: Are EMCs applicable to wet-weather & dry-weather conditions?
Also, if using a HSPF-based model – this statement precludes the use of accumulation & washoff processes.

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- Existing pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period / duration as expressed in the TMDL and Attachments L-Q.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE FINAL LOADING (IF APPLICABLE FOR THE PERMIT CYCLE)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based. Mass-based allowable loading will be calculated based on its share on an area basis of the required WQBELs. Mass-based allowable loading should be calculated for each sub-watershed area.
- The ~~different~~ difference between the current and allowable pollutant loading is the required pollutant reduction. The required pollutant reduction shall be used to set targets/goals for BMPs/Watershed management strategies within that sub-watershed area.
- Estimated pollutant loading may vary using a single fixed value based on annual average loading or may be estimated based on pollutant load reduction from year-to-year based on watershed/climate/rainfall conditions.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period/duration as expressed in the TMDL and Attachments L-Q.

Comment [A8]: Define the term – based on total area? Imperviousness? Other factors?

Comment [A9]: What if TMDLs or WQ objectives are concentration-based only?

Comment [A10]: Are single-event methods allowed over continuous simulation? Please clarify.

D. SELECTED IMPLEMENTATION/BMPS OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below:

I. ENHANCE WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEM

If the permittees select to develop a EWMP that wherever feasible retains all storm and non-storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide detail description of the selected retention system including type (bio retention system, sub-surface chamber, etc.), storage volume, approximate system size, number headers, header diameter, excavation (width, length, disturbed surface area, excavation, etc.)

Comment [A11]: Is WMMS capable of identifying potential locations where retention is feasible?
If not, please provide guidance on the GIS or equivalent exercise to identify feasible retention system.

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (WCM) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations, receiving water limitations in Part VI.E and/or Attachments L through Q;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

Comment [A12]: Provide guidance on how to quantify the benefits of rehabilitation/restoration projects towards TMDL compliance or WQOs.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of control measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER
The permittees are required to provide (i) list of current BMPs that have been implemented to control storm and non-storm water discharge; (ii) list of selected watershed control measures that are planned to be implemented in addition to the existing BMPs. Watershed control measures (See section D.I.b. for detail) shall be selected to prevent or eliminate non-storm water discharges, achieve all applicable interim and final water quality-based effluent limitations.

Comment [A13]: Specify Permit reference

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)
Permittees shall identify MCMs as defined in Part VI.D.4 to Part VI.D.10 of the MS4 Permit and potential modifications that will address priority issues in each watershed.

If non-stormwater discharges from the MS4 were identified as source of pollutants, permittees shall include list of contrail measures, BMPs, or strategies to effectively eliminate the source of pollutants.

Permittees shall also compile list of control measures that have been identified in TMDLs and corresponding implementation plans, and /or identified control measures to be modified to effectively address TMDL requirements.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedule of selected BMPs into a combined schedule for achievement of the interim and final water quality-based effluent limitations and/or receiving water limitations per the waterbody classification/prioritization above. Permittees shall align schedule with milestones and final compliance dates specified in the permit and TMDLs, as applicable, and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- At a minimum, TMDL compliance points shall be located at all reaches and named tributaries identified in the Basin Plan, and all compliance points required in the TMDLs that are applicable to the proposed WMP.
- Permittees shall include an appropriate compliance point(s) to assess the effluent from the Watershed Mangement Plan MS4 to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PLAN/BMPs PERFORMANCE

- Permittees shall provide detail description of individual BMPs performance and /or suite of selected BMPs performances to reduce pollutants loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data when they become available.

Comment [A14]: Link to further table with local examples

Comment [A15]: Should this data be peer-reviewed? By whom?

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on BMPs performance analysis using selected modeling system, permittee shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) Re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT SELECTED BMPS OPTIONS, CURRENT LOADINGS, AND REQUIRED LOAD REDUCTIONS

Permittees shall provide a modeling system to support the estimated current loadings, required load reduction that are used to set targets/goals for selected BMPs/Watershed management strategies, and to demonstrate that the activities and control measures identified/selected in the Watershed Control Measures and/or EWMP will achieve applicable water quality-based effluent limitations and/or receiving water limitations.

The models selected for developing a BMP stormwater management system are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall, runoff, and groundwater processes of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Comment [A16]: Please clarify: interflow, subsurface, deep aquifer. A subsurface flow model is not recommended by the Permit.

Table 1. List of Available Models

Model Type	Available Models
E.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
E.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K,WASP, HSPF, LSPC, SWMM
E.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA TMDL Modeling Toolbox
* Empirically based models	International Stormwater BMP Database
E.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model
* Empirically based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for process based BMP model and empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, a 1 acre or smaller grid cell is recommended to satisfy the assumption that all properties such as soil, land use, vegetation, crop management-, and climate are homogeneous within each computational grid cell. For temporal scale, the model should use varying time steps with a minimum ~~1-minute time step~~1-hour or shorter time step during rainfall events and a daily or shorter time step between rainfall events.

Comment [A17]: Homogeneous for all cells? The size of grid cells may be defined by the size of parcels.

Comment [A18]: This is unnecessary. 1-hour time steps should be sufficient.

Table 2. Suggested General ~~Required~~ Model Input Data For Both Process Based BMP Model and Empirically Based BMP Model

For General Model	Data Source	Data Period
2.1 Geometric Data		
• ~~GIS Data Layer~~National & state-wide data sources	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	The most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[8]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	The most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
• Wind and others	NCDC or locally derived data	At least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	The most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for	SSURGO or	Most recent

Comment [A19]: Add column with weblink to the different sources

Comment [A20]: Unclear / broad

Comment [A21]: Identify minimum definition

Comment [A22]: This data source has previously proven not to be in line with State Board delineation.

Comment [A23]: Add temperature

Comment [A24]: Parts of LA County are not covered under the NRCS database. Please provide an alternative option.

[8] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based on availability
• Groundwater Flow?	USGS and locally derived data	Monthly/annually/daily based on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

Note: Data guidelines are subject to availability

Comment [A19]: Add column with weblink to the different sources

Comment [A25]: CALVEG ?

Comment [A26]: POTWs ?

To demonstrate the ability to predict the effect of watershed process and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the mode parameters and modeling conditions which can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration ~~Criteria~~Objectives

Model parameters	% Difference between simulated and observed values		
	Very Good	Good	Fair
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S.Donigian, Jr., prepared for USEPA (2000)

Comment [A27]: Based on daily/monthly data? Also, what type of statistics were computed to derive the difference?

Table 3.1 ~~Required~~ Recommended Model Parameters for Process Based BMP Model

ADD some language supporting values outside of the range of recommended values. Indicate that these values should be supported with technical justification.

Model Parameters	Data Source	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#[9]6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (°F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (°F)	EPA BTN#6	30.0-40.0
• Manning's n (roughness) for overland flow	EPA BTN#6	0.01-0.15
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		

Comment [A28]: Or Suggested

Comment [A29]: Add column with values from an existing HSPF model within the covered area. This may be beneficial to all Permittee and serve as a starting point before calibration.

[9] EPA BTN # : EPA Basins Technical Note #

• Initial storage of water quality constituent on land surface (lb)	LA County Report[10]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

[10] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

Table 3.2 ~~Required~~ Recommended Model Parameters for Empirically Based BMP Model

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.50
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Variable Groundwater Recession (1/in)	EPA BTN#6	0.0-5.0
• Base Groundwater Recession	EPA BTN#6	0.85-0.999
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	Los Angeles County 2006 EMC data Report & local monitoring & local data	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Average EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization And Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: Model calibration / validation should be based on local data as available.

Table 4.1 BMP Performance Parameter Guidances for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5

Comment [A30]: Identify specific concentrations for horses ranches (significant influence in Malibu Creek) versus cattle versus crop.

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Comment [A31]: Ensure that all design parameters are consistent with those identified in the Los Angeles County BMP Design & Maintenance Manual, as well as the LID Design Manual.

• Vegetative parameter, A	NA	0.6-1.0	1	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Table 4-2: BMP Performance Parameters for Empirically Based BMP Model

C.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform Per 100 mL	NA	2852-18572	196-3647	NA	1438-3431	101-464	NA	35-411	NA	NA
TSS (mg/L)	6.0-13.0	7.0-11.0	19.0-27.0	14.0-20.0	19.0-25.0	6.0-8.0	10.0-17.0	10.0-12.0	6.0-9.0	8.0-16.0
Total Phosphorus (mg/L)	0.1-0.16	0.17-0.20	0.18-0.23	0.16-0.23	0.11-0.14	0.08-0.11	0.07-0.11	0.08-0.11	0.06-0.08	0.11-0.15
Dissolved Phosphorus (mg/L)	NA	0.21-0.35	0.06-0.11	0.16-0.26	0.05-0.08	0.08-0.11	NA	0.04-0.06	0.03-0.04	0.07-0.10
Total Nitrogen (mg/L)	0.98-1.24	0.54-0.66	1.77-2.75	NA	1.85-2.34	0.67-0.91	NA	1.16-1.35	1.06-1.21	1.40-2.00
Total Kjeldahl Nitrogen (mg/L)	0.84-1.30	0.43-0.62	1.20-1.80	1.10-1.40	1.40-1.60	0.61-0.80	0.91-1.35	1.00-1.15	0.95-1.13	0.90-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.17-0.27	0.23-0.30	0.22-0.47	0.33-0.51	0.38-0.45	0.45-0.63	0.83-1.23	0.11-0.16	0.05-0.10	0.33-0.96
Total Copper (µg/L)	5.8-10.5	6.5-8.5	4.5-9.0	6.4-7.9	9.4-12.0	5.1-7.5	8.8-11.1	5.0-6.0	3.0-4.0	5.0-10.0
Total Lead (µg/L)	NA	2.0-2.0	2.5-7.9	1.3-2.2	5.0-5.0	1.1-1.5	2.5-2.5	2.0-3.0	1.0-1.0	3.6-10.0
Total Zinc (µg/L)	10.0-26.0	30-30.0	15.0-34.5	16.9-27	52.5-64.5	15.0-20.0	14.6-20.0	17.0-20.0	16.1-24.0	11.0-20.0
Total Arsenic (µg/L)	NA	1.0-1.3	1.2-1.8	0.5-1.0	1.3-2.4	0.7-1.0	2.5-2.5	0.5-1.0	NA	NA
Total Cadmium (µg/L)	NA	0.3-0.3	0.5-0.5	0.2-0.2	0.6-1.0	0.1-0.2	0.3-0.3	0.3-0.5	0.1-0.5	0.5-0.5
Total Nickel (µg/L)	NA	2.4-4.3	2.4-4.5	2.4-3.2	4.0-5.0	2.0-2.8	1.55-2.1	2.1-5.0	NA	2.0-3.0

Comment [A32]: 1.Name source, preferably these statistics are derived from BMPs implemented in California or the arid Southwest.
2.
3.Provide median AND 90% confidence interval, if available.

Table 5: Model Output for both Process Based BMP Model and Empirically Based BMP Model

Model Output	Output Content	Output Format

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use	Table
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Time series plot of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff at each sub-watershed for each BMP scenario in dry and wet weather conditions	Table
	Percent reduction at each sub-watershed for each BMP scenario	Table
5.4 Hydrographs and Pollutagraphs		
	Flow hydrographs at compliance points for each BMP scenario that are representative of the baseline period	Graphics
	Pollutagraphs at compliance points for each BMP scenario that are representative of the baseline period	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMP and graphs for each BMP scenario	Table and Graphics
	BMP storage distribution for each BMP scenario	Table and Graphics

Comment [A33]: For a specific period? Could be a large amount of data/results.

Comment [A34]: For a specific period? Could be a large amount of data/results.

Comment [A35]: For a specific period? Could be a large amount of data/results.

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

The Regional Board adopted Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Order No. R4-2012-0175 (NPDES Permit No. CAS004001). As required in the permit, Part VI.C.5.b.iv.(5), permittees electing to develop a watershed management program (WMP) or enhanced watershed management program (EWMP) are required to submit a Reasonable Assurance Analysis (RAA) as part of their draft E/WMP to demonstrate that applicable water quality based effluent limitations and receiving water limitations shall be achieved through implementation of the watershed control measures proposed in the E/WMP. This guidance document is prepared to provide information and guidance to assist permittees in development of the RAA. This document provides clarification of the regulatory requirements of the RAA along with recommended criteria for the permittees to follow to prepare an appropriate RAA for Regional Board approval.

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Per Part VI.C.5.a of the permit, and based on an evaluation of existing water quality conditions, permittees shall classify and list water body-pollutant combinations into one of the following three categories within their draft E/WMP:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

Permittees shall identify the water quality priorities within each watershed management area (WMA) that will be addressed by the E/WMP in order to achieve applicable water quality limitations (i.e., WQBELs and RWLs) within the timeframes established by the corresponding compliance schedules set forth in Attachments L-R, or where there is no specific compliance schedule contained in Attachments L-R, the compliance schedule set forth in the E/WMP. For watershed priorities related to addressing exceedances of RWLs in Part V.A and not otherwise addressed by Part VI.E, proposed compliance schedules must adhere to the requirements of Part VI.C.5.c.iii.(3). For watershed priorities related to achieving WLAs in USEPA established TMDLs, proposed compliance schedules must adhere to the requirements of Part VI.E.3.c.iii-v.

Permittees may choose to further subcategorize water body-pollutant combinations within the three main categories above for purposes of sequencing implementation of watershed control measures in the most effective manner possible, taking into consideration compliance deadlines and opportunities to address multiple pollutants within a water body with similar watershed control measures. This is consistent with the

permit provisions in Parts VI.C.2 and VI.C.3, which group pollutants for purposes of complying with the RWLs Provisions according to whether the pollutant is being addressed by a TMDL, is similar in its fate/transport characteristics and effective implementation measures to a pollutant being addressed by a TMDL, is currently listed on the 303(d) list, or exhibits only occasional exceedances in the receiving water. For example, permittees may wish to identify which water body-pollutant combinations in Categories 2 and 3 above are similar to a water body-pollutant combination in Category 1, and could therefore be addressed simultaneously with the water body-pollutant combination in Category 1. Permittees are invited to discuss with Regional Board staff, and solicit early input on, approaches to further subcategorization of water body-pollutant combinations.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 "major outfalls"[1], major structural controls of storm and non-storm water[2] (including, but not limited to, low flow diversions, urban runoff treatment facilities, detention and retention basins used for storm water treatment, VSS devices, other catch basin inserts/screens) that discharge to receiving waters within the watershed management area.
- Permittees shall provide an initial assessment of current/baseline pollutants loading for water body-pollutant combinations identified in A. above based on relevant subwatershed data collected within the last 10 years including land use and pollutant loading data. Appropriate data sources for use in assessment of baseline pollutant loading are identified in the tables below. At a minimum, baseline pollutant loadings shall be provided considering variability in pollutant loading at a spatial and temporal (including critical condition) scale consistent with that used in the TMDL and in the approved monitoring plan (i.e., for each subwatershed that was identified/analyzed/modeled in the TMDL and for each compliance monitoring location identified in the approved monitoring plan). Baseline loading shall be estimated based on calibrated dynamic model results for each subwatershed area including a) baseline loading for wet weather based on the 90th percentile of annual flow rates from estimated/modeled flow rates or other established critical condition in the TMDL; and b) annual baseline loading based on a 10-year long term average that also considers the coefficient of variation as described in Section C. below, to provide the necessary information on the range of pollutant loadings for the permittees to select adequate watershed control measure options to address pollutants of concern and achieve the required pollutant load reductions.
- The estimated pollutant loading shall be consistent with event meant concentrations (EMCs) obtained from different land use site as referenced in dependable sources, some of which are listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa

[1] Per definition in federal regulations.

[2] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LL Tiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

If a permittee(s) selects to use other independent sources of pollutant loading data in the RAA, the permittee(s) shall assure that the source(s) selected has appropriate documentation, is current, and is publicly available. The permittee(s) shall be required to provide the rationale used to support their selection of baseline pollutant loading data as well as the raw data and all associated QA/QC information for Regional Board review and approval.

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which will be assumed to be reflected in the baseline pollutant loading.[3]
- Baseline pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s) / duration as expressed in the TMDL and Attachments L-Q. If the pollutant is not addressed by a TMDL, but TMDLs for that pollutant exist for other water bodies, permittees should express pollutant loading in terms of time period(s) / duration consistent with those other TMDLs.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE INTERIM AND/OR FINAL ALLOWABLE POLLUTANT LOADING(S)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based in consideration of critical conditions. Mass-based allowable loading will be calculated based on a permittee's proportion of the watershed management area for required WQBELs. Mass-based allowable loading should be calculated for each subwatershed area identified in B. above.
- The difference between the current and allowable pollutant loading is the required pollutant reduction. This difference and the resultant pollutant reduction must be calculated for a range of conditions, including the critical condition as defined in the TMDL. The required pollutant reduction shall be used to set targets/goals for BMPs/watershed control measures within that subwatershed area.
- Estimated pollutant loading may vary in temporal scale, reflecting various factors of pollutant sources in watershed system, and may be described using a long term average loading with a coefficient of variation (CV) to take the variability of pollutant loading into account. Consideration of variability must be sufficient to capture the condition and required pollutant reductions under the critical condition. The reported pollutant loading in each subwatershed should be established by using a variability factor (VF) obtained from the long term average and CV with the selected probability distribution of the pollutant loading. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991).
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s)/duration as expressed in the TMDL and Attachments L-Q, including the critical condition identified in the TMDL. Where a TMDL has not been developed for the water body-pollutant combination, permittees should select a time period/duration/critical condition

[3] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

consistent with that used in other TMDLs that have been developed for the pollutant in other water bodies within the region.

D. SELECTED IMPLEMENTATION/BMPs OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below. As a starting point, selected control measurements should be designed and maintained to treat storm water runoff from the 85th percentile, 24-hour storm where feasible and necessary to achieve applicable WQBELs and receiving water limitations.

I. ENHANCED WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEMS

If the permittees select to develop a EWMP that wherever feasible retains all non-storm water runoff and all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of each regional multi-benefit retention system including type (bioretention system, sub-surface chamber, etc.), drainage area addressed, storage volume, and approximate system size as well as a description and quantification, where possible, of other benefits (e.g., amount of water recharged to groundwater for water supply, etc.).

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. Watershed control measures may include:

- **i.** Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations and receiving water limitations;
- **ii.** Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and
- **iii.** Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to, demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

Per Part VI.C.5.b.iv.(1), permittees shall assess the MCMs as defined in Part VI.D.4, Part VI.D.5, Part VI.D.6, Part VI.D.8, Part VI.D.9 and Part VI.D.10 of the MS4 Permit and potential modifications that will most effectively address priority issues in each watershed. Based on this assessment, permittees shall propose customized actions and corresponding schedules within each minimum control measure category.

Per Part VI.C.5.b.iv.(2), where non-storm water discharges from the MS4 are identified as source of pollutants, permittees shall identify and list control measures, BMPs, and other strategies to effectively eliminate the source of pollutants consistent with the requirements of Part III.A and Part VI.D.4.d (for the LACFCD) and Part VI.D.10 (for all other permittees).

Per Part VI.C.5.b.iv.(3), permittees shall also compile a list of control measures that have been identified in TMDLs and corresponding implementation plans, and identify those control measures within these TMDLs/implementation plans to be modified, if any, to most effectively address TMDL requirements in Part VI.E and Attachments L-Q. If not sufficiently identified in previous documents (TMDLs/implementation plans), the permittees shall evaluate and identify the control measures that will be implemented to achieve the applicable WQBELs/WLAs/RWLs associated with these TMDLs. Initially, control measures should be designed to address the volume within the drainage area associated with the 85th percentile, 24-hour storm event at the correspondence compliance point.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER

The permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. (See section D.I.b. for detail.)

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

See section D.I.c. for detail.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedules for selected BMPs into a combined schedule for achievement of the applicable interim and final water quality-based effluent limitations and/or receiving water limitations per the water body classification/prioritization above. Permittees shall align the combined schedule with interim milestones and interim and final compliance deadlines specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible. Per Part VI.C.5.c.ii and Part VI.C.4.c.iii.(3), Permittees must propose milestones based on measurable criteria and a schedule with dates for achieving the milestones that will allow progress to be measured once every two years.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- Compliance points shall be located at all compliance points required in the TMDLs that are within the area covered by the E/WMP.

- For a Permittee implementing an individual WMP, appropriate compliance point(s) within their jurisdiction shall be identified for Regional Board approval.
- Permittees shall include an appropriate compliance point(s) to assess the MS4 discharge(s) from the area covered by the Watershed Management Program to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PROGRAM/BMPs PERFORMANCE

- Permittees shall provide a detailed description of individual BMPs performance and /or suite of selected BMPs performance to reduce pollutant loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data and outfall monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on the analysis of BMP performance using the selected modeling system, Permittees shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

  The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

Permittees shall provide model output for each deadline specified in the Table X.X to demonstrate compliance with each deadline will be achieved.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program or coordinated integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval to assess progress toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and then implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT ESTIMATION OF CURRENT LOADINGS, REQUIRED LOAD REDUCTIONS AND ANALYSIS OF WATER QUALITY OUTCOMES OF SELECTED BMPs OPTIONS

Permittees shall provide a modeling system to support the estimation of baseline loadings, required load reductions that are used to set targets/goals for selected BMPs/watershed control measures, and to demonstrate that the activities and watershed control measures identified/selected in the E/WMP will achieve applicable water quality-based effluent limitations and receiving water limitations.

The models appropriate for conducting the required RAA described above are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and runoff processes above soil surface, and baseflow contributions in subsurfaces of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope.
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance
Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
1.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
1.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K, WASP, HSPF, LSPC, SWMM
1.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA SUSTAIN model
* Empirically based models	International Stormwater BMP Database
1.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model

Model Type	Available Models
* Empirical based models	EPA TMDL Modeling Toolbox City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for a process based BMP model and an empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, the highest resolution GIS layers should be used to satisfy the homogeneous assumption in a computational subwatershed. For temporal scale, the model should use varying time steps with a minimum 1-hour or shorter time step during rainfall events to capture peak flow and a daily or shorter time step between rainfall events.

The RAA associated with the permittee(s) draft E/WMP should include a detailed description/itemization of model inputs and outputs as indicated in Table 2 through Table 5 and should include model input files (in an electronic format that can be manipulated) as part of the draft E/WMP package submitted to Regional Board for review and approval.

Table 2. General Model Input Data for Both Process Based BMP Models and Empirically Based BMP Models

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	Most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[4]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium	SCAG Land use data (2005 or most recent); NLCD (2006

[4] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
	(MRLC) National Land Cover Database (NLCD) or locally derived data	or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	Most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	Most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based

For General Model	Data Source	Data Period
		on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed processes and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model calibration is necessary to ensure that the calibrated model properly assesses all the variables and conditions in a watershed system. Calibration should result in model parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period. Table 3.0 is a list of model calibration tolerances for different levels of agreement or accuracy based on extensive past experience with the HSPF model. The lower bound of "fair" level of agreement listed in Table 3.0 is considered a target tolerance for the model calibration process. If model calibration results do not satisfy the target tolerances, additional efforts should be completed to investigate all possible errors in, and the accuracy of, input data, model formulations, and field observations. Upon completion of the investigation, the permittee(s) should report the findings to the Regional Board for approval to proceed to the model application step for BMP effectiveness evaluation.

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair (lower bound, upper bound)**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18

Model parameters	% Difference between simulated and observed values		
	Very Good	Good	Fair (lower bound, upper bound)
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S. Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Model Parameters for Process Based BMP Models

Model Parameters	Data Source[5]	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.01-0.15
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0

[5] EPA BTN # : EPA Basins Technical Note #

• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[6]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2-0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off	EPA BTN#8	0.1-10.0

[6] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

equation		
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Model Parameters for Empirically Based BMP Models

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.5
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.3.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	SBPAT User's Guide t	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		

• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Suggested Average[i] EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: These suggested average EMC values can be adjusted based on calibration studies by using more recently collected Southern California data.

Table 4.1 Suggested BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1.0
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1.0	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095
Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 4-2: Suggested BMP Performance Parameters for Empirically Based BMP Model

4.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform # Per 100 mL	NA	2600-6200	500-1900	300-39600	(10,20)-D (200-3000)-F (1400-5000)-P	200-625	NA	200-1160	230-11800	NA
Enterococcus # Per 100 mL	58-437	NA	NA	NA	(10,10)-D (1750-12000)-F NA-P	NA	NA	NA	56-300	NA
E. Coli # Per 100 mL	6-137	1200-5900	82-720	NA	NA	NA	NA	31-387	199-1160	NA
TSS (mg/L)	5.0-9.0	11.8-15.3	19.0-26.0	16.0-21.5	15.0-19.9	7.4-10.0	11.0-14.4	12.0-15.0	7.0-10.9	10.0-16.0
Total Phosphorus (mg/L)	0.07-0.1	0.17-0.20	0.19-0.24	0.15-0.20	0.10-0.13	0.08-0.10	0.08-0.09	0.12-0.14	0.07-0.09	0.13-0.17
Dissolved	0.05-0.18	0.05-0.11	0.08-012	0.16-0.26	0.04-0.07	0.06-	0.04-0.05	0.06-0.07	0.03-0.06	0.07-0.10

Phosphorus (mg/L)						0.09				
Total Nitrogen (mg/L)	0.74-0.99	0.63-0.82	1.75-2.69	1.0-1.23	1.90-2.41	0.68-0.99	1.28-1.65	1.19-1.36	1.04-1.21	1.05-1.56
Total Kjeldahl Nitrogen (mg/L)	0.46-0.72	0.50-0.70	1.16-1.78	0.97-1.12	1.32-1.55	0.50-0.61	0.74-0.90	0.98-1.10	0.92-1.09	1.10-1.30
NOx(NO2+NO3,andNO3) (mg/L)	0.19-0.25	0.20-0.28	0.24-0.45	0.24-0.31	0.35-0.44	0.46-0.57	0.59-0.77	0.15-0.20	0.05-0.11	0.15-0.22
Total Copper (µg/L)	4.6-9.85	5.7-7.7	4.0-6.80	6.4-7.9	7.94-11.0	5.1-6.6	6.8-8.1	4.06-5.0	3.0-4.0	3.61-5.20
Total Lead (µg/L)	2.5-2.5	1.8-2.29	2.15-4.3	1.3-2.2	3.8-5.16	1.3-2.0	1.38-2.21	2.0-3.0	1.0-1.55	1.40-3.11
Total Zinc (µg/L)	7.7-25.0	20-26.6	17.1-38.2	16.0-26.0	52.8-63.5	15.0-20.0	12.5-16.8	20.0-23.0	16.7-24.3	11.0-20.0
Total Arsenic (µg/L)	NA	0.95-1.30	1.29-1.80	0.55-1.20	1.0-2.4	0.61-1.0	2.5-2.5	0.54-1.15	NA	NA
Total Cadmium (µg/L)	0.25-1.0	0.27-0.34	0.25-0.35	0.09-0.20	0.20-0.31	0.1-0.2	0.25-0.25	0.20-0.29	0.10-0.20	0.19-0.50
Total Nickel (µg/L)	NA	2.3-4.2	2.2-3.75	2.4-3.1	3.11-5.0	2.0-2.6	1.40-1.80	2.0-2.60	NA	2.0-2.40

Source: International Stormwater BMP Database (BMPDB), July 2012

Note that for bacteria, manufactured devices are broken down into three subcategories: disinfection devices (Manufactured Device – D), inlet insert/filtration devices (Manufactured Device – F), and physical settling/straining devices (Manufactured Device – P)

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 5: Model Output for both Process Based BMP Models and Empirically Based BMP Models

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use, under range of temporal conditions (including applicable TMDL critical condition)	Tables
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario (corresponding to applicable compliance deadlines) in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Time series plots of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff volume at each subwatershed for each BMP scenario in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Absolute and percent reduction in runoff volume at each subwatershed for each BMP scenario	Tables

Model Output	Output Content	Output Format
5.4 Hydrographs and Pollutographs		
	Flow hydrographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
	Pollutographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMPs and graphs for each BMP scenario	Tables and Graphics
	BMP storage distribution for each BMP scenario	Tables and Graphics

[i] Log-transformed arithmetic mean values shown

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

The Regional Board adopted Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Order No. R4-2012-0175 (NPDES Permit No. CAS004001). As required in the permit, Part VI.C.5.b.iv.(5), permittees electing to develop a watershed management program (WMP) or enhanced watershed management program (EWMP) are required to submit a Reasonable Assurance Analysis (RAA) as part of their draft E/WMP to demonstrate that applicable water quality based effluent limitations and receiving water limitations shall be achieved through implementation of the watershed control measures proposed in the E/WMP. This guidance document is prepared to provide information and guidance to assist permittees in development of the RAA. This document provides clarification of the regulatory requirements of the RAA along with recommended criteria for the permittees to follow to prepare an appropriate RAA for Regional Board approval.

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Per Part VI.C.5.a of the permit, and based on an evaluation of existing water quality conditions, permittees shall classify and list water body-pollutant combinations into one of the following three categories within their draft E/WMP:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

Permittees shall identify the water quality priorities within each watershed management area (WMA) that will be addressed by the E/WMP in order to achieve applicable water quality limitations (i.e., WQBELs and RWLs) within the timeframes established by the corresponding compliance schedules set forth in Attachments L-R, or where there is no specific compliance schedule contained in Attachments L-R, the compliance schedule set forth in the E/WMP. For watershed priorities related to addressing exceedances of RWLs in Part V.A and not otherwise addressed by Part VI.E, proposed compliance schedules must adhere to the requirements of Part VI.C.5.c.iii.(3). For watershed priorities related to achieving WLAs in USEPA established TMDLs, proposed compliance schedules must adhere to the requirements of Part VI.E.3.c.iii-v.

Permittees may choose to further subcategorize water body-pollutant combinations within the three main categories above for purposes of sequencing implementation of watershed control measures in the most effective manner possible, taking into consideration compliance deadlines and opportunities to address multiple pollutants within a water body with similar watershed control measures. This is consistent with the

permit provisions in Parts VI.C.2 and VI.C.3, which group pollutants for purposes of complying with the RWLs Provisions according to whether the pollutant is being addressed by a TMDL, is similar in its fate/transport characteristics and effective implementation measures to a pollutant being addressed by a TMDL, is currently listed on the 303(d) list, or exhibits only occasional exceedances in the receiving water. For example, permittees may wish to identify which water body-pollutant combinations in Categories 2 and 3 above are similar to a water body-pollutant combination in Category 1, and could therefore be addressed simultaneously with the water body-pollutant combination in Category 1. Permittees are invited to discuss with Regional Board staff, and solicit early input on, approaches to further subcategorization of water body-pollutant combinations.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 "major outfalls"[1], major structural controls of storm and non-storm water[2] (including, but not limited to, low flow diversions, urban runoff treatment facilities, detention and retention basins used for storm water treatment, VSS devices, other catch basin inserts/screens) that discharge to receiving waters within the watershed management area.
- Permittees shall provide an initial assessment of current/baseline pollutants loading for water body-pollutant combinations identified in A. above based on relevant subwatershed data collected within the last 10 years at a minimum for rainfall data and ~~including~~ the best available land use and pollutant loading data. Appropriate data sources for use in assessment of baseline pollutant loading are identified in the tables below. At a minimum, baseline pollutant loadings shall be provided considering variability in pollutant loading at a spatial and temporal (including critical condition) scale consistent with that used in the TMDL and in the approved monitoring plan (i.e., for each subwatershed that was identified/analyzed/modeled in the TMDL and for each compliance monitoring location identified in the approved monitoring plan). Baseline loading shall be estimated based on calibrated dynamic model results for each subwatershed area including a) baseline loading for wet weather based on the 90th percentile of annual flow rates from estimated/modeled flow rates or other established critical condition in the TMDL; and b) annual baseline loading based on a 10-year long term average that also considers the coefficient of variation as described in Section C. below, to provide the necessary information on the range of pollutant loadings for the permittees to select adequate watershed control measure options to address pollutants of concern and achieve the required pollutant load reductions.
- The estimated pollutant loading shall be consistent with event meant concentrations (EMCs) obtained from different land use site as referenced in dependable sources, some of which are listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa

Comment [MT1]: We don't understand the need to estimate a baseline loading for the 90th percentile annual flow rate. This is an extreme case and does not represent typical loading. What is the basis for this percentile?

Comment [MT2]: Ten years of data can be analyzed in order to determine the average or "typical" year as done in the County LA River, Ballona Creek, & MDR Implementation Plans. The typical year can have a wide variety of storms from the 90th percentile to the 20th percentile. The typical year should be chosen from the rainfall dataset to run the analysis, not a 90th percentile year which is considered a very wet year.

[1] Per definition in federal regulations.

[2] Spatial metadata must include delineation of ~~drainage area treated~~, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LL Tiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

If a permittee(s) selects to use other independent sources of pollutant loading data in the RAA, the permittee(s) shall assure that the source(s) selected has appropriate documentation, is current, and is publicly available. The permittee(s) shall be required to provide the rationale used to support their selection of baseline pollutant loading data as well as the raw data and all associated QA/QC information for Regional Board review and approval.

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which will be assumed to be reflected in the baseline pollutant loading.[3]
- Baseline pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s) / duration as expressed in the TMDL and Attachments L-Q. If the pollutant is not addressed by a TMDL, but TMDLs for that pollutant exist for other water bodies, permittees should express pollutant loading in terms of time period(s) / duration consistent with those other TMDLs.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE INTERIM AND/OR FINAL ALLOWABLE POLLUTANT LOADING(S)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based in consideration of critical conditions. Mass-based allowable loading will be calculated based on a permittee's proportion of the watershed management area for required WQBELs. Mass-based allowable loading should be calculated for each subwatershed area identified in B. above.
- The difference between the current and allowable pollutant loading is the required pollutant reduction. This difference and the resultant pollutant reduction must be calculated for a range of conditions, including the critical condition as defined in the TMDL. The required pollutant reduction shall be used to set targets/goals for BMPs/watershed control measures within that subwatershed area.
- Estimated pollutant loading may vary in temporal scale, reflecting various factors of pollutant sources in watershed system, and may be described using a long term average loading with a coefficient of variation (CV) to take the variability of pollutant loading into account. Consideration of variability must be sufficient to capture the condition and required pollutant reductions under the critical condition. The reported pollutant loading in each subwatershed should be established by using a variability factor (VF) obtained from the long term average and CV with the selected probability distribution of the pollutant loading. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991).

Season (July 1-June 30)	Total Inches of Rainfall

Comment [MT3]:
CV and VF are unit-less numbers that show how much variability there is in the data. What is the goal of providing this information? What is the basis for this analysis?

See table on left for LA area annual rainfall. CV and VF were calculated but how are they supposed to be considered?
http://www.laalmanac.com/weather/we13.htm

Since rainfall is variable, as expected, the CV is not very close to the value of 1.2 as referenced in Appendix E because sewage effluent is less variable.

EWMP Groups should have the flexibility to design BMPs based considering cost and risk management with proper justification.

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[3] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

2011-2012	8.69
2010-2011	20.2
2009-2010	16.36
2008-2009	9.08
2007-2008	13.53
2006-2007	3.21
2005-2006	13.19
2004-2005	37.96
2003-2004	9.25
2002-2003	16.42
2001-2002	4.42
2000-2001	17.94
-	-
Average	**14.19**
Max	**37.96**
90th percentile	**19.97**
Standard Deviation	**9.16**
CV	**0.65**
VF	**2.68**

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- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s)/duration as expressed in the TMDL and Attachments L-Q, including the critical condition identified in the TMDL. Where a TMDL has not been developed for the water body-pollutant combination, permittees should select a time period/duration/critical condition consistent with that used in other TMDLs that have been developed for the pollutant in other water bodies within the region.

D. SELECTED IMPLEMENTATION/BMPs OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below. As a starting point, selected control measurements should be designed and maintained to treat storm water runoff from the 85th percentile, 24-hour storm where feasible and necessary to achieve applicable WQBELs and receiving water limitations.

I. ENHANCED WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEMS

If the permittees select to develop a EWMP that wherever feasible retains all non-storm water runoff and all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of each regional multi-benefit retention system including type (bioretention system, sub-surface chamber, etc.), drainage area addressed, storage volume, and approximate system size as well as a description and quantification, where possible, of other benefits (e.g., amount of water recharged to groundwater for water supply, etc.).

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations and receiving water limitations;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to, demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

Per Part VI.C.5.b.iv.(1), permittees shall assess the MCMs as defined in Part VI.D.4, Part VI.D.5, Part VI.D.6, Part VI.D.8, Part VI.D.9 and Part VI.D.10 of the MS4 Permit and potential modifications that will most effectively address priority issues in each watershed. Based on this assessment, permittees shall propose customized actions and corresponding schedules within each minimum control measure category.

Per Part VI.C.5.b.iv.(2), where non-storm water discharges from the MS4 are identified as source of pollutants, permittees shall identify and list control measures, BMPs, and other strategies to effectively eliminate the source of pollutants consistent with the requirements of Part III.A and Part VI.D.4.d (for the LACFCD) and Part VI.D.10 (for all other permittees).

Per Part VI.C.5.b.iv.(3), permittees shall also compile a list of control measures that have been identified in TMDLs and corresponding implementation plans, and identify those control measures within these TMDLs/implementation plans to be modified, if any, to most effectively address TMDL requirements in Part VI.E and Attachments L-Q. If not sufficiently identified in previous documents (TMDLs/implementation plans), the permittees shall evaluate and identify the control measures that will be implemented to achieve the applicable WQBELs/WLAs/RWLs associated with these TMDLs. Initially, control measures should be designed to address the volume within the drainage area associated with the 85th percentile, 24-hour storm event at the correspondence compliance point.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER

The permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. (See section D.I.b. for detail.)

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

See section D.I.c. for detail.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedules for selected BMPs into a combined schedule for achievement of the applicable interim and final water quality-based effluent limitations and/or receiving water limitations per the water body classification/prioritization above. Permittees shall align the combined schedule with interim milestones and interim and final compliance deadlines specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible. Per Part VI.C.5.c.ii and Part VI.C.4.c.iii.(3), Permittees must propose milestones based on measurable criteria and a schedule with dates for achieving the milestones that will allow progress to be measured once every two years.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- Compliance points shall be located at all compliance points required in the TMDLs that are within the area covered by the E/WMP.
- For a Permittee implementing an individual WMP, appropriate compliance point(s) within their jurisdiction shall be identified for Regional Board approval.
- Permittees shall include an appropriate compliance point(s) to assess the MS4 discharge(s) from the area covered by the Watershed Management Program to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PROGRAM/BMPs PERFORMANCE

- Permittees shall provide a detailed description of individual BMPs performance and /or suite of selected BMPs performance to reduce pollutant loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.

- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data and outfall monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on the analysis of BMP performance using the selected modeling system, Permittees shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

  The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

Permittees shall provide model output for each deadline specified in the Table X.X to demonstrate compliance with each deadline will be achieved.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program or coordinated integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval to assess progress toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and then implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT ESTIMATION OF CURRENT LOADINGS, REQUIRED LOAD REDUCTIONS AND ANALYSIS OF WATER QUALITY OUTCOMES OF SELECTED BMPs OPTIONS

Permittees shall provide a modeling system to support the estimation of baseline loadings, required load reductions that are used to set targets/goals for selected BMPs/watershed control measures, and to demonstrate that the activities and watershed control measures identified/selected in the E/WMP will achieve applicable water quality-based effluent limitations and receiving water limitations.

The models appropriate for conducting the required RAA described above are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and runoff processes above soil surface, and baseflow contributions in subsurfaces of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope.
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
1.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
1.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K, WASP, HSPF, LSPC, SWMM
1.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA SUSTAIN model
* Empirically based models	International Stormwater BMP Database
1.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model EPA TMDL Modeling Toolbox
* Empirical based models	City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for a process based BMP model and an empirically based BMP model. It

should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, the highest resolution GIS layers should be used to satisfy the homogeneous assumption in a computational subwatershed. For temporal scale, the model should use varying time steps with a minimum 1-hour or shorter time step during rainfall events to capture peak flow and a daily or shorter time step between rainfall events.

The RAA associated with the permittee(s) draft E/WMP should include a detailed description/itemization of model inputs and outputs as indicated in Table 2 through Table 5 and should include model input files (in an electronic format that can be manipulated) as part of the draft E/WMP package submitted to Regional Board for review and approval.

Table 2. General Model Input Data for Both Process Based BMP Models and Empirically Based BMP Models

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	Most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[4]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	Most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		

[4] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	Most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data	Daily/monthly

For General Model	Data Source	Data Period
	CIWQS/SMARTS or local sampling	

To demonstrate the ability to predict the effect of watershed processes and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model calibration is necessary to ensure that the calibrated model properly assesses all the variables and conditions in a watershed system. Calibration should result in model parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period. Table 3.0 is a list of model calibration tolerances for different levels of agreement or accuracy based on extensive past experience with the HSPF model. The lower bound of "fair" level of agreement listed in Table 3.0 is considered a target tolerance for the model calibration process. If model calibration results do not satisfy the target tolerances, additional efforts should be completed to investigate all possible errors in, and the accuracy of, input data, model formulations, and field observations. Upon completion of the investigation, the permittee(s) should report the findings to the Regional Board for approval to proceed to the model application step for BMP effectiveness evaluation.

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair (lower bound, upper bound)**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S. Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Model Parameters for Process Based BMP Models

Model Parameters	Data Source[5]	Range of Initial Values

[5] EPA BTN # : EPA Basins Technical Note #

3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.01-0.15
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		

• Initial storage of water quality constituent on land surface (lb)	LA County Report[6]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2-0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0

[6] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Model Parameters for Empirically Based BMP Models

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.5
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.3.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	SBPAT User's Guide t	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		

• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Suggested Average[i] EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: These suggested average EMC values can be adjusted based on calibration studies by using more recently collected Southern California data.

Table 4.1 Suggested BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5	0.5-1.0	1.0
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1.0	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 4-2: Suggested BMP Performance Parameters for Empirically Based BMP Model

4.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform # Per 100 mL	NA	2600-6200	500-1900	300-39600	(10,20)-D (200-3000)-F (1400-5000)-P	200-625	NA	200-1160	230-11800	NA
Enterococcus # Per 100 mL	58-437	NA	NA	NA	(10,10)-D (1750-12000)-F NA-P	NA	NA	NA	56-300	NA
E. Coli # Per 100 mL	6-137	1200-5900	82-720	NA	NA	NA	NA	31-387	199-1160	NA
TSS (mg/L)	5.0-9.0	11.8-15.3	19.0-26.0	16.0-21.5	15.0-19.9	7.4-10.0	11.0-14.4	12.0-15.0	7.0-10.9	10.0-16.0
Total Phosphorus (mg/L)	0.07-0.1	0.17-0.20	0.19-0.24	0.15-0.20	0.10-0.13	0.08-0.10	0.08-0.09	0.12-0.14	0.07-0.09	0.13-0.17
Dissolved	0.05-0.18	0.05-0.11	0.08-012	0.16-0.26	0.04-0.07	0.06-	0.04-0.05	0.06-0.07	0.03-0.06	0.07-0.10

Phosphorus (mg/L)						0.09				
Total Nitrogen (mg/L)	0.74-0.99	0.63-0.82	1.75-2.69	1.0-1.23	1.90-2.41	0.68-0.99	1.28-1.65	1.19-1.36	1.04-1.21	1.05-1.56
Total Kjeldahl Nitrogen (mg/L)	0.46-0.72	0.50-0.70	1.16-1.78	0.97-1.12	1.32-1.55	0.50-0.61	0.74-0.90	0.98-1.10	0.92-1.09	1.10-1.30
NOx(NO2+NO3,andNO3) (mg/L)	0.19-0.25	0.20-0.28	0.24-0.45	0.24-0.31	0.35-0.44	0.46-0.57	0.59-0.77	0.15-0.20	0.05-0.11	0.15-0.22
Total Copper (µg/L)	4.6-9.85	5.7-7.7	4.0-6.80	6.4-7.9	7.94-11.0	5.1-6.6	6.8-8.1	4.06-5.0	3.0-4.0	3.61-5.20
Total Lead (µg/L)	2.5-2.5	1.8-2.29	2.15-4.3	1.3-2.2	3.8-5.16	1.3-2.0	1.38-2.21	2.0-3.0	1.0-1.55	1.40-3.11
Total Zinc (µg/L)	7.7-25.0	20-26.6	17.1-38.2	16.0-26.0	52.8-63.5	15.0-20.0	12.5-16.8	20.0-23.0	16.7-24.3	11.0-20.0
Total Arsenic (µg/L)	NA	0.95-1.30	1.29-1.80	0.55-1.20	1.0-2.4	0.61-1.0	2.5-2.5	0.54-1.15	NA	NA
Total Cadmium (µg/L)	0.25-1.0	0.27-0.34	0.25-0.35	0.09-0.20	0.20-0.31	0.1-0.2	0.25-0.25	0.20-0.29	0.10-0.20	0.19-0.50
Total Nickel (µg/L)	NA	2.3-4.2	2.2-3.75	2.4-3.1	3.11-5.0	2.0-2.6	1.40-1.80	2.0-2.60	NA	2.0-2.40

Source: International Stormwater BMP Database (BMPDB), July 2012

Note that for bacteria, manufactured devices are broken down into three subcategories: disinfection devices (Manufactured Device – D), inlet insert/filtration devices (Manufactured Device – F), and physical settling/straining devices (Manufactured Device – P)

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 5: Model Output for both Process Based BMP Models and Empirically Based BMP Models

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use, under range of temporal conditions (including applicable TMDL critical condition)	Tables
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario (corresponding to applicable compliance deadlines) in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Time series plots of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff volume at each subwatershed for each BMP scenario in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Absolute and percent reduction in runoff volume at each subwatershed for each BMP scenario	Tables

Model Output	Output Content	Output Format
5.4 Hydrographs and Pollutographs		
	Flow hydrographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
	Pollutographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMPs and graphs for each BMP scenario	Tables and Graphics
	BMP storage distribution for each BMP scenario	Tables and Graphics

[i] Log-transformed arithmetic mean values shown

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

The Regional Board adopted Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Order No. R4-2012-0175 (NPDES Permit No. CAS004001). As required in the permit, Part VI.C.5.b.iv.(5), permittees electing to develop a watershed management program (WMP) or enhanced watershed management program (EWMP) are required to submit a Reasonable Assurance Analysis (RAA) as part of their draft E/WMP to demonstrate that applicable water quality based effluent limitations and receiving water limitations shall be achieved through implementation of the watershed control measures proposed in the E/WMP. This guidance document is prepared to provide information and guidance to assist permittees in development of the RAA. This document provides clarification of the regulatory requirements of the RAA along with recommended criteria for the permittees to follow to prepare an appropriate RAA for Regional Board approval.

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS:

Per Part VI.C.5.a of the permit, and based on an evaluation of existing water quality conditions, permittees shall classify and list water body-pollutant combinations into one of the following three categories within their draft E/WMP:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

Permittees shall identify the water quality priorities within each watershed management area (WMA) that will be addressed by the E/WMP in order to achieve applicable water quality limitations (i.e., WQBELs and RWLs) within the timeframes established by the corresponding compliance schedules set forth in Attachments L-R, or where there is no specific compliance schedule contained in Attachments L-R, the compliance schedule set forth in the E/WMP. For watershed priorities related to addressing exceedances of RWLs in Part V.A and not otherwise addressed by Part VI.E, proposed compliance schedules must adhere to the requirements of Part VI.C.5.c.iii.(3). For watershed priorities related to achieving WLAs in USEPA established TMDLs, proposed compliance schedules must adhere to the requirements of Part VI.E.3.c.iii-v.

Permittees may choose to further subcategorize water body-pollutant combinations within the three main categories above for purposes of sequencing implementation of watershed control measures in the most effective manner possible, taking into consideration compliance deadlines and opportunities to address multiple pollutants within a water body with similar watershed control measures. This is consistent with the

permit provisions in Parts VI.C.2 and VI.C.3, which group pollutants for purposes of complying with the RWLs Provisions according to whether the pollutant is being addressed by a TMDL, is similar in its fate/transport characteristics and effective implementation measures to a pollutant being addressed by a TMDL, is currently listed on the 303(d) list, or exhibits only occasional exceedances in the receiving water. For example, permittees may wish to identify which water body-pollutant combinations in Categories 2 and 3 above are similar to a water body-pollutant combination in Category 1, and could therefore be addressed simultaneously with the water body-pollutant combination in Category 1. Permittees are invited to discuss with Regional Board staff, and solicit early input on, approaches to further subcategorization of water body-pollutant combinations.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 "major outfalls"[1], major structural controls of storm and non-storm water[2] (including, but not limited to, low flow diversions, urban runoff treatment facilities, detention and retention basins used for storm water treatment, VSS devices, other catch basin inserts/screens) that discharge to receiving waters within the watershed management area.
- Permittees shall provide an initial assessment of current/baseline pollutants loading for water body-pollutant combinations identified in A. above based on relevant subwatershed data collected within the last 10 years including land use and pollutant loading data. Appropriate data sources for use in assessment of baseline pollutant loading are identified in the tables below. At a minimum, baseline pollutant loadings shall be provided considering variability in pollutant loading at a spatial and temporal (including critical condition) scale consistent with that used in the TMDL and in the approved monitoring plan (i.e., for each subwatershed that was identified/analyzed/modeled in the TMDL and for each compliance monitoring location identified in the approved monitoring plan). Baseline loading shall be estimated based on calibrated dynamic model results for each subwatershed area including a) baseline loading for wet weather based on the 90th percentile annual flow rates from estimated/modeled flow rates or other established critical condition in the TMDL; and b) annual baseline loading based on a 10-year long term average that also considers the coefficient of variation as described in Section C. below, to provide the necessary information on the range of pollutant loadings for the permittees to select adequate watershed control measure options to address pollutants of concern and achieve the required pollutant load reductions.
- The estimated pollutant loading shall be consistent with event meant concentrations (EMCs) obtained from different land use site as referenced in dependable sources, some of which are listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa

[1] Per definition in federal regulations.
[2] Spatial metadata must include delineation of drainage area treated, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LL Tiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

If a permittee(s) selects to use other independent sources of pollutant loading data in the RAA, the permittee(s) shall assure that the source(s) selected has appropriate documentation, is current, and is publicly available. The permittee(s) shall be required to provide the rationale used to support their selection of baseline pollutant loading data as well as the raw data and all associated QA/QC information for Regional Board review and approval.

- Permittees shall provide list of BMPs/MCMs that are currently implemented, the results of which will be assumed to be reflected in the baseline pollutant loading.[3]
- Baseline pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s) / duration as expressed in the TMDL and Attachments L-Q. If the pollutant is not addressed by a TMDL, but TMDLs for that pollutant exist for other water bodies, permittees should express pollutant loading in terms of time period(s) / duration consistent with those other TMDLs.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE INTERIM AND/OR FINAL ALLOWABLE POLLUTANT LOADING(S)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based in consideration of critical conditions. Mass-based allowable loading will be calculated based on a permittee's proportion of the watershed management area for required WQBELs. Mass-based allowable loading should be calculated for each subwatershed area identified in B. above.
- The difference between the current and allowable pollutant loading is the required pollutant reduction. This difference and the resultant pollutant reduction must be calculated for a range of conditions, including the critical condition as defined in the TMDL. The required pollutant reduction shall be used to set targets/goals for BMPs/watershed control measures within that subwatershed area.
- Estimated pollutant loading may vary in temporal scale, reflecting various factors of pollutant sources in watershed system, and may be described using a long term average loading with a coefficient of variation (CV) to take the variability of pollutant loading into account. Consideration of variability must be sufficient to capture the condition and required pollutant reductions under the critical condition. The reported pollutant loading in each subwatershed should be established by using a variability factor (VF) obtained from the long term average and CV with the selected probability distribution of the pollutant loading. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991).
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant time period(s)/duration as expressed in the TMDL and Attachments L-Q, including the critical condition identified in the TMDL. Where a TMDL has not been developed for the water body-pollutant combination, permittees should select a time period/duration/critical condition

[3] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

consistent with that used in other TMDLs that have been developed for the pollutant in other water bodies within the region.

D. SELECTED IMPLEMENTATION/BMPs OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below. As a starting point, selected control measurements should be designed and maintained to treat storm water runoff from the 85th percentile, 24-hour storm where feasible and necessary to achieve applicable WQBELs and receiving water limitations.

I. ENHANCED WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEMS

If the permittees select to develop a EWMP that demonstrates whenever feasible retains all non-storm water runoff and all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of each regional multi-benefit retention system including type (bioretention system, sub-surface chamber, etc.), drainage area addressed, storage volume, and approximate system size as well as a description and quantification, where possible, of other benefits (e.g., amount of water recharged to groundwater for water supply, etc.).

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not feasible, the permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations and receiving water limitations;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to, demonstrable improvements in the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

Per Part VI.C.5.b.iv.(1), permittees shall assess the MCMs as defined in Part VI.D.4, Part VI.D.5, Part VI.D.6, Part VI.D.8, Part VI.D.9 and Part VI.D.10 of the MS4 Permit and potential modifications that will most effectively address priority issues in each watershed. Based on this assessment, permittees shall propose customized actions and corresponding schedules within each minimum control measure category.

Per Part VI.C.5.b.iv.(2), where non-storm water discharges from the MS4 are identified as source of pollutants, permittees shall identify and list control measures, BMPs, and other strategies to effectively eliminate the source of pollutants consistent with the requirements of Part III.A and Part VI.D.4.d (for the LACFCD) and Part VI.D.10 (for all other permittees).

Per Part VI.C.5.b.iv.(3), permittees shall also compile a list of control measures that have been identified in TMDLs and corresponding implementation plans, and identify those control measures within these TMDLs/implementation plans to be modified, if any, to most effectively address TMDL requirements in Part VI.E and Attachments L-Q. If not sufficiently identified in previous documents (TMDLs/implementation plans), the permittees shall evaluate and identify the control measures that will be implemented to achieve the applicable WQBELs/WLAs/RWLs associated with these TMDLs. Initially, control measures should be designed to address the volume within the drainage area associated with the 85th percentile, 24-hour storm event at the correspondence compliance point.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER

The permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. (See section D.I.b. for detail.)

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

See section D.I.c. for detail.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedules for selected BMPs into a combined schedule for achievement of the applicable interim and final water quality-based effluent limitations and/or receiving water limitations per the water body classification/prioritization above. Permittees shall align the combined schedule with interim milestones and interim and final compliance deadlines specified in the permit and demonstrate that the required loading reduction and timeline specified are expected to be achieved.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L and Q. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines during the permit term, Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible. Per Part VI.C.5.c.ii and Part VI.C.4.c.iii.(3), Permittees must propose milestones based on measurable criteria and a schedule with dates for achieving the milestones that will allow progress to be measured once every two years.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- Compliance points shall be located at all compliance points required in the TMDLs that are within the area covered by the E/WMP.

- For a Permittee implementing an individual WMP, appropriate compliance point(s) within their jurisdiction shall be identified for Regional Board approval.
- Permittees shall include an appropriate compliance point(s) to assess the MS4 discharge(s) from the area covered by the Watershed Management Program to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PROGRAM/BMPs PERFORMANCE

- Permittees shall provide a detailed description of individual BMPs performance and /or suite of selected BMPs performance to reduce pollutant loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data and outfall monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on the analysis of BMP performance using the selected modeling system, Permittees shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-Q.

  The emphasis shall be on WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

Permittees shall provide model output for each deadline specified in the Table X.X to demonstrate compliance with each deadline will be achieved.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program or coordinated integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval to assess progress toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and then implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT ESTIMATION OF CURRENT LOADINGS, REQUIRED LOAD REDUCTIONS AND ANALYSIS OF WATER QUALITY OUTCOMES OF SELECTED BMPs OPTIONS

Permittees shall provide a modeling system to support the estimation of baseline loadings, required load reductions that are used to set targets/goals for selected BMPs/watershed control measures, and to demonstrate that the activities and watershed control measures identified/selected in the E/WMP will achieve applicable water quality-based effluent limitations and receiving water limitations.

The models appropriate for conducting the required RAA described above are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and runoff processes above soil surface, and baseflow contributions in subsurfaces of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope.
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance
Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
1.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
1.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K, WASP, HSPF, LSPC, SWMM
1.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA SUSTAIN model
* Empirically based models	International Stormwater BMP Database
1.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model Los Angeles County WMMS model

Model Type	Available Models
* Empirical based models	EPA TMDL Modeling Toolbox City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for a process based BMP model and an empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, the highest resolution GIS layers should be used to satisfy the homogeneous assumption in a computational subwatershed. For temporal scale, the model should use varying time steps with a minimum 1-hour or shorter time step during rainfall events to capture peak flow and a daily or shorter time step between rainfall events.

Comment [IR1]: I'm not sure I get the meaning as written.

The RAA associated with the permittee(s) draft E/WMP should include a detailed description/itemization of model inputs and outputs as indicated in Table 2 through Table 5 and should include model input files (in an electronic format that can be manipulated) as part of the draft E/WMP package submitted to Regional Board for review and approval.

Table 2. General Model Input Data for Both Process Based BMP Models and Empirically Based BMP Models

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	Most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[4]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium	SCAG Land use data (2005 or most recent); NLCD (2006

[4] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
	(MRLC) National Land Cover Database (NLCD) or locally derived data	or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	Most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	Most recent
• Percent of area distribution for different soil groups.	SSURGO or locally derived data	Most recent
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based

For General Model	Data Source	Data Period
		on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed processes and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Table 3.0 Model Calibration Criteria

Model calibration is necessary to ensure that the calibrated model properly assesses all the variables and conditions in a watershed system. Calibration should result in model parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period. Table 3.0 is a list of model calibration tolerances for different levels of agreement or accuracy based on extensive past experience with the HSPF model. The lower bound of "fair" level of agreement listed in Table 3.0 is considered a target tolerance for the model calibration process. If model calibration results do not satisfy the target tolerances, additional efforts should be completed to investigate all possible errors in, and the accuracy of, input data, model formulations, and field observations. Upon completion of the investigation, the permittee(s) should report the findings to the Regional Board for approval to proceed to the model application step for BMP effectiveness evaluation.

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair (lower bound, upper bound)**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18

Model parameters	% Difference between simulated and observed values		
	Very Good	Good	Fair (lower bound, upper bound)
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S. Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Model Parameters for Process Based BMP Models

Model Parameters	Data Source[5]	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.01-0.15
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0

[5] EPA BTN # : EPA Basins Technical Note #

• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[6]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2-0.2
3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off	EPA BTN#8	0.1-10.0

[6] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

equation		
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Model Parameters for Empirically Based BMP Models

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.5
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (°F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (°F)	EPA BTN#6	30.0-40.0
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture Storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.3.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	SBPAT User's Guide t	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		

• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Suggested Average[i] EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: These suggested average EMC values can be adjusted based on calibration studies by using more recently collected Southern California data.

Table 4.1 Suggested BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5-0.5	0.5-1.0	1.0-1.0
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05-0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1.0	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

* Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 4-2: Suggested BMP Performance Parameters for Empirically Based BMP Model

4.2 Median (95% Conf. Interval) Statistics of BMP Effluent Concen.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform # Per 100 mL	NA	2600-6200	500-1900	300-39600	(10,20)-D (200-3000)-F (1400-5000)-P	200-625	NA	200-1160	230-11800	NA
Enterococcus # Per 100 mL	58-437	NA	NA	NA	(10,10)-D (1750-12000)-F NA-P	NA	NA	NA	56-300	NA
E. Coli # Per 100 mL	6-137	1200-5900	82-720	NA	NA	NA	NA	31-387	199-1160	NA
TSS (mg/L)	5.0-9.0	11.8-15.3	19.0-26.0	16.0-21.5	15.0-19.9	7.4-10.0	11.0-14.4	12.0-15.0	7.0-10.9	10.0-16.0
Total Phosphorus (mg/L)	0.07-0.1	0.17-0.20	0.19-0.24	0.15-0.20	0.10-0.13	0.08-0.10	0.08-0.09	0.12-0.14	0.07-0.09	0.13-0.17
Dissolved	0.05-0.18	0.05-0.11	0.08-012	0.16-0.26	0.04-0.07	0.06-	0.04-0.05	0.06-0.07	0.03-0.06	0.07-0.10

Phosphorus (mg/L)						0.09				
Total Nitrogen (mg/L)	0.74-0.99	0.63-0.82	1.75-2.69	1.0-1.23	1.90-2.41	0.68-0.99	1.28-1.65	1.19-1.36	1.04-1.21	1.05-1.56
Total Kjeldahl Nitrogen (mg/L)	0.46-0.72	0.50-0.70	1.16-1.78	0.97-1.12	1.32-1.55	0.50-0.61	0.74-0.90	0.98-1.10	0.92-1.09	1.10-1.30
NOx(NO2+NO3,andNO3) (mg/L)	0.19-0.25	0.20-0.28	0.24-0.45	0.24-0.31	0.35-0.44	0.46-0.57	0.59-0.77	0.15-0.20	0.05-0.11	0.15-0.22
Total Copper (µg/L)	4.6-9.85	5.7-7.7	4.0-6.80	6.4-7.9	7.94-11.0	5.1-6.6	6.8-8.1	4.06-5.0	3.0-4.0	3.61-5.20
Total Lead (µg/L)	2.5-2.5	1.8-2.29	2.15-4.3	1.3-2.2	3.8-5.16	1.3-2.0	1.38-2.21	2.0-3.0	1.0-1.55	1.40-3.11
Total Zinc (µg/L)	7.7-25.0	20-26.6	17.1-38.2	16.0-26.0	52.8-63.5	15.0-20.0	12.5-16.8	20.0-23.0	16.7-24.3	11.0-20.0
Total Arsenic (µg/L)	NA	0.95-1.30	1.29-1.80	0.55-1.20	1.0-2.4	0.61-1.0	2.5-2.5	0.54-1.15	NA	NA
Total Cadmium (µg/L)	0.25-1.0	0.27-0.34	0.25-0.35	0.09-0.20	0.20-0.31	0.1-0.2	0.25-0.25	0.20-0.29	0.10-0.20	0.19-0.50
Total Nickel (µg/L)	NA	2.3-4.2	2.2-3.75	2.4-3.1	3.11-5.0	2.0-2.6	1.40-1.80	2.0-2.60	NA	2.0-2.40

Source: International Stormwater BMP Database (BMPDB), July 2012

Note that for bacteria, manufactured devices are broken down into three subcategories: disinfection devices (Manufactured Device – D), inlet insert/filtration devices (Manufactured Device – F), and physical settling/straining devices (Manufactured Device – P)

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 5: Model Output for both Process Based BMP Models and Empirically Based BMP Models

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each sub-watershed and each land use, under range of temporal conditions (including applicable TMDL critical condition)	Tables
5.2 Load Reduction Output		
	Pollutant load reduction at each sub-watershed for each BMP scenario (corresponding to applicable compliance deadlines) in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Time series plots of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff volume at each subwatershed for each BMP scenario in dry and wet weather conditions (including applicable TMDL critical condition)	Tables
	Absolute and percent reduction in runoff volume at each subwatershed for each BMP scenario	Tables

Model Output	Output Content	Output Format
5.4 Hydrographs and Pollutographs		
	Flow hydrographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
	Pollutographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMPs and graphs for each BMP scenario	Tables and Graphics
	BMP storage distribution for each BMP scenario	Tables and Graphics

[i] Log-transformed arithmetic mean values shown

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

The Regional Board adopted Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Order No. R4-2012-0175 (NPDES Permit No. CAS004001). As required in the permit, Part VI.C.5.b.iv.(5), permittees electing to develop a watershed management program (WMP) or enhanced watershed management program (EWMP) are required to submit a Reasonable Assurance Analysis (RAA) as part of their draft E/WMP to provide an *ex ante* demonstration that applicable water quality based effluent limitations (WQBELs) and receiving water limitations (RWLs) shall be achieved through implementation of the watershed control measures proposed in the E/WMP. This guidance document is prepared to provide information and guidance to assist permittees in development of the RAA. This document provides clarification of the permit requirements regarding the RAA along with recommended criteria for the permittees to follow to prepare an appropriate RAA for Regional Board approval.

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS

Permittees shall identify the water quality priorities within each watershed management area (WMA) that will be addressed by the E/WMP in order to achieve applicable water quality limitations (i.e., WQBELs and RWLs) within the timeframes established by the corresponding compliance schedules set forth in Attachments L-R, or the compliance schedule set forth in the E/WMP, where there is no specific compliance schedule contained in Attachments L-R or the compliance deadlines occur outside the permit term. For example, for watershed priorities related to achieving WLAs in USEPA established TMDLs that do not have a companion State-adopted program of implementation, proposed compliance schedules must adhere to the requirements of Part VI.E.3.c.iii-v. For watershed priorities related to addressing exceedances of RWLs in Part V.A and not otherwise addressed by Part VI.E, proposed compliance schedules must adhere to the requirements of Part VI.C.5.c.iii.(3).

Per Part VI.C.5.a of the permit, and based on an evaluation of existing water quality conditions, permittees shall classify and list water body-pollutant combinations into one of the following three categories within their draft E/WMP and include these water body-pollutant combinations it their RAA:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

Permittees may choose to further subcategorize water body-pollutant combinations within the three main categories above for purposes of sequencing implementation of watershed control measures in the most effective manner possible, taking into consideration compliance deadlines and opportunities to address multiple pollutants within a water body with similar watershed control measures. This is consistent with the permit provisions in Parts

VI.C.2 and VI.C.3, which group pollutants for purposes of complying with the RWLs Provisions according to whether the pollutant is being addressed by a TMDL; is similar in its fate/transport characteristics and effective implementation measures to a pollutant being addressed by a TMDL; is currently listed on the 303(d) list; or exhibits only occasional exceedances in the receiving water. For example, permittees may wish to identify which water body-pollutant combinations in Categories 2 and 3 above are similar to a water body-pollutant combination in Category 1, and could therefore be addressed simultaneously with the water body-pollutant combination in Category 1. Permittees are invited to discuss with Regional Board staff, and solicit early input on, approaches to further subcategorization of water body-pollutant combinations.

Sections B through D of these guidelines discuss the general process and options for estimation of current pollutant loading, required pollutant reductions, and analysis of BMP scenarios to achieve required reductions. There are several important considerations in this process.

- First, the compliance schedules included in the permit (both those based on TMDL implementation schedules and those required to be proposed absent TMDL derived compliance deadlines), anticipate phased pollutant reductions; therefore, the RAA must be adequate to identify the required reduction for each water body-pollutant combination at each compliance deadline and analyze the BMP scenario to achieve that deadline. While many compliance deadlines fall outside of the current permit term, the permit requires in these cases that measurable interim milestones within the permit term are included and analyzed. In some cases, it may be possible to identify a 'limiting pollutant' that can be used as the focus of the analysis – i.e., to estimate necessary pollutant reductions and to analyze the BMP scenario to achieve the required reduction – which will result in achievement of required reductions in other pollutants. Where this approach is taken, adequate justification must be provided. (See **Appendix A** for Interim and Final TMDL Compliance Deadlines through December 28, 2017.)
- Second, because the purpose of the RAA is to provide a demonstration that WQBELs derived from TMDL WLAs will be achieved, and TMDL WLAs are required to consider critical conditions, the RAA must also consider critical conditions consistent with those used in the TMDL(s) in estimating current pollutant loading and required pollutant reductions and analyzing BMP scenarios to achieve applicable WQBELs.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 "major outfalls"[1], major structural controls of storm and non-storm water[2] (including, but not limited to, low flow diversions, urban runoff treatment facilities, detention and retention basins used for storm water treatment, VSS devices, other catch basin inserts/screens) that discharge to receiving waters within the watershed management area. A separate tabular list of major structural controls should also be provided. Permittees shall also provide list of non-structural controls that are currently implemented within the area(s), the results of which will be assumed to be reflected in the baseline pollutant loading.[3]

[1] Per definition in federal regulations.

[2] Spatial metadata must include delineation of drainage area treated where available, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

[3] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

- Permittees shall provide an initial assessment of current/baseline pollutant loading for water body-pollutant combinations identified in Section A. Current/baseline pollutant loading shall based on relevant subwatershed data and the best available representative land use and pollutant loading data collected within the last 10 years. Appropriate data sources for use in assessment of baseline pollutant loading are identified in the tables below. At a minimum, baseline pollutant loadings shall be assessed and reported considering variability in pollutant loading at a spatial and temporal (including critical condition) scale consistent with that used in the TMDL and in the approved monitoring plan (i.e., for each subwatershed that was identified/analyzed/modeled in the TMDL and for each compliance monitoring location identified in the approved monitoring plan).
- Baseline loading shall be estimated using metrics derived from long-term historical data (e.g., rainfall, flow/runoff volume, pollutant loading, pollutant concentrations) using calibrated dynamic model results for each subwatershed area. Such baseline loading estimates shall be generated at a minimum for (1) critical conditions (consistent with applicable TMDLs – see **Appendix B** for a summary of TMDL critical conditions), and (2) may also be generated for average conditions for metrics related to quantity and quality (see examples of metrics, above). Critical conditions for baseline pollutant loading estimates shall be based on the two components listed below:

I. Baseline flow rates/runoff volumes shall be based on one of the following:
   a) 90th percentile of long term estimated/modeled flow rates (per TMDL WLA expression); or
   b) Other established hydrologic critical condition in the applicable TMDL; or
   c) Runoff volume from the 85th percentile, 24-hour rainfall event (for modeled drainage areas where retention based BMPs will capture 100% of the required volume).
   d) Long-term average estimated/modeled flow rates that also incorporates the coefficient of variation so as to take variability in flow rates into account. Consideration of variability must be sufficient to capture the critical condition as expressed in applicable TMDL(s). Where long-term average flow rate is used, critical conditions may be described using the long-term average flow rate with a coefficient of variation (CV) to take the variability in flow rate into account. For this type of critical condition, the reported flow rate/volume for each subwatershed should be established by using a variability factor (VF) for model-predicted flow rates/volumes obtained from the long-term average and CV with the selected probability distribution of the flow rates/volumes. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991). It is anticipated that log-normal distributions will be assumed. If a different type of critical condition is applied (e.g. 90th percentile wet year), then CV and VF calculations are not required.

II. Baseline pollutant concentration shall be based on one of the following:
   a) 90th percentile of estimated/modeled long term pollutant concentration (considering the most recent 10 years of available data); or
   b) Long-term average pollutant concentration (considering the most recent 10 years of available data) that also incorporates the coefficient of variation so as to take variability into account. Consideration of variability must be sufficient to capture the critical condition as expressed in applicable TMDL(s). Where long-term average pollutant concentration is used, critical conditions may be described using the long-term average concentration with a coefficient of variation (CV) to take the variability of pollutant concentration into account. For this type of critical condition, the reported pollutant loading in each subwatershed should be established by using a variability factor (VF) for model-predicted

concentrations, and/or concentrations obtained from the long-term average and CV with the selected probability distribution of the pollutant concentration. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991). It is anticipated that log-normal distributions will be assumed. If a different type of critical condition is applied (e.g. 90th percentile as in (a) above), then CV and VF calculations are not required.

c) Until sufficient data are available, pollutant event mean concentrations (EMCs) based on land use types from recommended data sources as referenced in table below may be used to estimate baseline pollutant loading; however, where this option is selected, they must be used in combination with one of the critical conditions for flow rate/runoff volume identified in Part I, above. Once sufficient data are collected, either (a) or (b) should be used in future iterations of the reasonable assurance analysis.

- The estimated pollutant loading and/or concentrations shall be consistent with event mean concentrations (EMCs) obtained from different land use site as referenced in dependable sources, some of which are listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LL Tiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- If a permittee(s) selects to use other independent sources of data to calculate pollutant loading in the RAA, the permittee(s) shall assure that the source(s) selected has appropriate documentation, is current, and is publicly available. The permittee(s) shall be required to provide the rationale used to support their selection of baseline data as well as the raw data and all associated QA/QC information for Regional Board review and approval.
- Baseline pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant averaging period(s) / duration as expressed in the TMDL and Attachments L-R.
- For pollutants included in the RAA but for which there is no TMDL, permittees should consider expressing pollutant loading in terms of averaging periods/duration/critical conditions consistent with those used in TMDLs for that pollutant in order to proactively address the water quality problem in such a way as to avoid the need for a TMDL in the future if possible.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE INTERIM AND/OR FINAL ALLOWABLE POLLUTANT LOADING(S)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based in consideration of critical conditions. Mass-based allowable loading will be calculated based on

a permittee's proportion of the watershed management area for required WQBELs. Mass-based allowable loading should be calculated for each subwatershed area identified in Section B, above.

- The difference between the current and allowable pollutant loading at each implementation deadline is the required pollutant reduction at each implementation deadline. The required pollutant reduction should be calculated based on both long-term average condition and the selected critical condition (as described in Section B). For modeled drainage areas where 100% of the runoff volume from the 85th percentile, 24-hour storm event is not retained, the required pollutant reduction shall be used to set targets/goals for BMPs/watershed control measures within that subwatershed area. The percent reductions to be used to set targets/goals will be dependent on the phase(s) of implementation to be addressed, as described in Section E.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant averaging period(s)/duration (including the selected critical condition) in applicable TMDLs and Attachments L-R.

D. SELECTED IMPLEMENTATION/BMPs OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below. As a starting point, selected control measurements should be designed and maintained to treat storm water runoff from the 85th percentile, 24-hour storm where feasible and necessary to achieve applicable WQBELs and receiving water limitations.

I. ENHANCED WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEMS

If the permittees select to develop a EWMP that includes projects that retain all non-storm water runoff and all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of each regional multi-benefit retention system including type (bioretention system, sub-surface chamber, etc.), drainage area addressed, storage volume, and approximate system size as well as a description and quantification, where possible, of other benefits (e.g., amount of water recharged to groundwater for water supply, etc.).

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not pursued, the permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations and receiving water limitations;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to, demonstrable improvements in

the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs), NON-STORM WATER DISCHARGE CONTROLS, AND OTHER STRUCTURAL CONTROL MEASURES

Per Part VI.C.5.b.iv.(1), permittees shall assess the MCMs as defined in Part VI.D.4, Part VI.D.5, Part VI.D.6, Part VI.D.8, Part VI.D.9 and Part VI.D.10 of the MS4 Permit and potential modifications that will most effectively address priority issues in each watershed. Based on this assessment, permittees may choose to propose customized actions and corresponding schedules within each of the abovementioned minimum control measure categories. (Alternatively, permittees may choose to implement the baseline provisions within one or more of the abovementioned MCM categories.)

Per Part VI.C.5.b.iv.(2), where non-storm water discharges from the MS4 are identified as source of pollutants, permittees shall identify and list control measures, BMPs, and other strategies to effectively eliminate the source of pollutants consistent with the requirements of Part III.A and Part VI.D.4.d (for the LACFCD) and Part VI.D.10 (for all other permittees).

For TMDL related control measures, per Part VI.C.5.b.iv.(3), permittees shall also compile a list of control measures that have been identified in TMDLs and corresponding implementation plans, and identify those control measures within these TMDLs/implementation plans to be modified, if any, to most effectively address TMDL requirements in Part VI.E and Attachments L-R. If actions identified in the E/WMP are wholly replacing the control measures identified in the TMDL implementation plan, it can be noted as such and this list is not necessary. If not sufficiently identified in previous documents (TMDLs/implementation plans), the permittees shall evaluate and identify the control measures that will be implemented to achieve the applicable WQBELs/WLAs/RWLs associated with these TMDLs. At a minimum where possible, control measures should be designed to address the volume within the drainage area associated with the 85th percentile, 24-hour storm event at the correspondence compliance point.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER

The permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. (See section D.I.b. for detail.)

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

See section D.I.c. for detail.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedules for selected BMPs into a combined schedule for achievement of the applicable interim and final water quality-based effluent limitations and/or receiving water limitations per the water body classification/prioritization above. Permittees shall align the combined schedule

with interim milestones and interim and final compliance deadlines specified in the permit and demonstrate through the RAA that the required loading reductions will be achieved in the timeline(s) specified.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L - R. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines *during the permit term*, Permittees shall identify interim milestones and dates for their achievement and include these in the RAA to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- For interim WQBELs and/or receiving water limitations, the percent reduction based on annual average baseline loading may be used to set targets/goals for BMPs/watershed control measures where such percent reduction based on the annual average baseline loading is consistent with interim requirements as set forth in Part VI.E and Attachments L-R. A gradual phasing of percent load reduction for interim WQBELs/RWLs to final WQBELs/RWLs shall be applied over the course of the implementation schedule. For areas to be addressed through retention of the runoff volume from the 85th percentile, 24-hour storm, volume reductions over time shall be related to the interim and final milestones/deadlines.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible. Per Part VI.C.5.c.ii and Part VI.C.4.c.iii.(3), Permittees must propose milestones based on measurable criteria and a schedule with dates for achieving the milestones that will allow progress to be measured once every two years.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- Compliance points shall be located at all compliance points required in the TMDLs that are within the area covered by the E/WMP.
- For a Permittee implementing an individual WMP, appropriate compliance point(s) within their jurisdiction shall be identified for Regional Board approval.
- Permittees shall include an appropriate compliance point(s) to assess the MS4 discharge(s) from the area covered by the Watershed Management Program to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PROGRAM/BMPs PERFORMANCE

- Permittees shall provide a detailed description of individual BMPs performance and /or suite of selected BMPs performance to reduce pollutant loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data and outfall monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on the analysis of BMP performance using the selected modeling system, Permittees shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-R.

  Although the Permit only requires the RAA to consider WQBELs and receiving water limitations with interim and final deadlines/milestones that fall within the Permit term, it is strongly recommended that the RAA assess WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022. Additionally, where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines *during the permit term*, Permittees must identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term and must include these in the RAA.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

Permittees shall provide model output for each deadline specified in Attachments L-R within the permit term to demonstrate compliance with each deadline will be achieved.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program or coordinated integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval to assess progress toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and then implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT ESTIMATION OF CURRENT LOADINGS, REQUIRED LOAD REDUCTIONS AND ANALYSIS OF WATER QUALITY OUTCOMES OF SELECTED BMPs OPTIONS

Permittees shall provide a modeling system to support the estimation of baseline loadings, required load reductions that are used to set targets/goals for selected BMPs/watershed control measures, and to demonstrate that the activities and watershed control measures identified/selected in the E/WMP will achieve applicable water quality-based effluent limitations and receiving water limitations by applicable compliance deadlines.

The models appropriate for conducting the required RAA described above are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and runoff processes above soil surface, and baseflow contributions in subsurfaces of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope.
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance
Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
1.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
1.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K, WASP, HSPF, LSPC, SWMM
1.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA SUSTAIN model
* Empirically based models	International Stormwater BMP Database
1.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model

Model Type	Available Models
* Empirical based models	Los Angeles County WMMS model EPA TMDL Modeling Toolbox City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for a process based BMP model and an empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, the highest resolution GIS layers should be used to satisfy the homogeneous assumption in a computational/modeled subwatershed. (See **Appendix C** for a technical memorandum on the use of the County of Los Angeles' Proposed HUC-12 Equivalent Boundaries in the RAA.) For temporal scale, the model should use varying time steps with a minimum 1-hour or shorter time step during rainfall events to capture peak flow and a daily or shorter time step between rainfall events.

The RAA associated with the permittee(s) draft E/WMP should include a detailed description/itemization of model inputs and outputs as indicated in Table 2 through Table 5 and should include model input files (in an electronic format that can be manipulated) as part of the draft E/WMP package submitted to Regional Board for review and approval.

Table 2. General Model Input Data for Both Process Based BMP Models and Empirically Based BMP Models

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	Most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[4]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	Most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	Most recent
• Percent of area distribution for	SSURGO or	Most recent

[4] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed processes and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Model calibration is necessary to ensure that the calibrated model properly assesses all the variables and conditions in a watershed system. Calibration should result in model parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period. Table 3.0 is a list of model calibration tolerances for different levels of agreement or accuracy based on extensive past experience with the HSPF model. The

lower bound of "fair" level of agreement listed in Table 3.0 is considered a target tolerance for the model calibration process. If model calibration results do not satisfy the target tolerances, additional efforts should be completed to investigate possible errors in, and the accuracy of, input data, model formulations, and field observations. The findings of this investigation should be presented in the RAA description, along with any immediate remedial actions to address the issues and/or recommended approaches to improve the calibration in the future. Permittees are strongly encouraged to engage Regional Board staff prior to the draft E/WMP submittal, in order to facilitate review and approval.

Table 3.0 Model Calibration Criteria

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair (lower bound, upper bound)**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S. Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Model Parameters for Process Based BMP Models

Model Parameters	Data Source[5]	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.01-0.15
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0

[5] EPA BTN # : EPA Basins Technical Note #

• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[6]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2-0.2

[6] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Model Parameters for Empirically Based BMP Models

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.5
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.3.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	SBPAT User's Guide	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Suggested Average[7] EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: These suggested average EMC values can be adjusted based on calibration studies by using more recently collected Southern California data.

[7] The average values are based on arithmetic statistics. The related log-form statistics are referred to in Appendix C of the SBPAT technical report.

Table 4.1 Suggested BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5-0.5	0.5-1.0	1.0-1.0
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05-0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1.0	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 4-2: Suggested BMP Performance Parameters for Empirically Based BMP Model

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform # Per 100 mL	NA	2600-6200	500-1900	300-39600	(10,20)-D (200-3000)-F (1400-5000)-P	200-625	NA	200-1160	230-11800	NA
Enterococcus # Per 100 mL	58-437	NA	NA	NA	(10,10)-D (1750-	NA	NA	NA	56-300	NA

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
					12000)-FNA-P					
E. Coli # Per 100 mL	6-137	1200-5900	82-720	NA	NA	NA	NA	31-387	199-1160	NA
TSS (mg/L)	5.0-9.0	11.8-15.3	19.0-26.0	16.0-21.5	15.0-19.9	7.4-10.0	11.0-14.4	12.0-15.0	7.0-10.9	10.0-16.0
Total Phosphorus (mg/L)	0.07-0.1	0.17-0.20	0.19-0.24	0.15-0.20	0.10-0.13	0.08-0.10	0.08-0.09	0.12-0.14	0.07-0.09	0.13-0.17
Dissolved Phosphorus (mg/L)	0.05-0.18	0.05-0.11	0.08-012	0.16-0.26	0.04-0.07	0.06-0.09	0.04-0.05	0.06-0.07	0.03-0.06	0.07-0.10
Total Nitrogen (mg/L)	0.74-0.99	0.63-0.82	1.75-2.69	1.0-1.23	1.90-2.41	0.68-0.99	1.28-1.65	1.19-1.36	1.04-1.21	1.05-1.56
Total Kjeldahl Nitrogen (mg/L)	0.46-0.72	0.50-0.70	1.16-1.78	0.97-1.12	1.32-1.55	0.50-0.61	0.74-0.90	0.98-1.10	0.92-1.09	1.10-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.19-0.25	0.20-0.28	0.24-0.45	0.24-0.31	0.35-0.44	0.46-0.57	0.59-0.77	0.15-0.20	0.05-0.11	0.15-0.22
Total Copper (µg/L)	4.6-9.85	5.7-7.7	4.0-6.80	6.4-7.9	7.94-11.0	5.1-6.6	6.8-8.1	4.06-5.0	3.0-4.0	3.61-5.20
Total Lead (µg/L)	2.5-2.5	1.8-2.29	2.15-4.3	1.3-2.2	3.8-5.16	1.3-2.0	1.38-2.21	2.0-3.0	1.0-1.55	1.40-3.11
Total Zinc (µg/L)	7.7-25.0	20-26.6	17.1-38.2	16.0-26.0	52.8-63.5	15.0-20.0	12.5-16.8	20.0-23.0	16.7-24.3	11.0-20.0
Total Arsenic (µg/L)	NA	0.95-1.30	1.29-1.80	0.55-1.20	1.0-2.4	0.61-1.0	2.5-2.5	0.54-1.15	NA	NA
Total Cadmium (µg/L)	0.25-1.0	0.27-0.34	0.25-0.35	0.09-0.20	0.20-0.31	0.1-0.2	0.25-0.25	0.20-0.29	0.10-0.20	0.19-0.50

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Total Nickel (µg/L)	NA	2.3-4.2	2.2-3.75	2.4-3.1	3.11-5.0	2.0-2.6	1.40-1.80	2.0-2.60	NA	2.0-2.40

Source: International Stormwater BMP Database (BMPDB), July 2012
Note that for bacteria, manufactured devices are broken down into three subcategories: disinfection devices (Manufactured Device – D), inlet insert/filtration devices (Manufactured Device – F), and physical settling/straining devices (Manufactured Device – P)
Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 5: Model Output for both Process Based BMP Models and Empirically Based BMP Models

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each modeled sub-watershed and each land use, under range of temporal conditions (i.e., average and critical conditions)	Tables
5.2 Load Reduction Output		
	Pollutant load reduction at each modeled sub-watershed for each BMP scenario (corresponding to applicable compliance deadlines) in dry and wet weather conditions (i.e., average and critical conditions)	Tables
	Time series plots of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff volume at each modeled subwatershed for each BMP scenario in dry and wet weather conditions (i.e., average and critical conditions)	Tables
	Absolute and percent reduction in runoff volume at each modeled subwatershed for each BMP scenario	Tables
5.4 Hydrographs and Pollutographs		
	Flow hydrographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics

Model Output	Output Content	Output Format
	Pollutographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMPs and graphs for each BMP scenario	Tables and Graphics
	BMP storage distribution for each BMP scenario	Tables and Graphics

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Environmental Protection

Los Angeles Regional Water Quality Control Board

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

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This report was prepared by technical staff of the Los Angeles Regional Water Quality Control Board with input and review by members of the Technical Advisory Committee and RAA Subcommittee formed under the Los Angeles County MS4 Permit, Order No. R4-2012-0175.

GUIDELINES FOR CONDUCTING REASONABLE ASSURANCE ANALYSIS IN A WATERSHED MANAGEMENT PROGRAM, INCLUDING AN ENHANCED WATERSHED MANAGEMENT PROGRAM

The Regional Board adopted Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Order No. R4-2012-0175 (NPDES Permit No. CAS004001). As required in the permit, Part VI.C.5.b.iv.(5), permittees electing to develop a watershed management program (WMP) or enhanced watershed management program (EWMP) are required to submit a Reasonable Assurance Analysis (RAA) as part of their draft E/WMP to provide an *ex ante* demonstration that applicable water quality based effluent limitations (WQBELs) and receiving water limitations (RWLs) shall be achieved through implementation of the watershed control measures proposed in the E/WMP. This guidance document is prepared to provide information and guidance to assist permittees in development of the RAA. This document provides clarification of the permit requirements regarding the RAA along with recommended criteria for the permittees to follow to prepare an appropriate RAA for Regional Board approval.

A. APPLICABLE INTERIM AND FINAL REQUIREMENTS

Permittees shall identify the water quality priorities within each watershed management area (WMA) that will be addressed by the E/WMP in order to achieve applicable water quality limitations (i.e., WQBELs and RWLs) within the timeframes established by the corresponding compliance schedules set forth in Attachments L-R, or the compliance schedule set forth in the E/WMP, where there is no specific compliance schedule contained in Attachments L-R or the compliance deadlines occur outside the permit term. For example, for watershed priorities related to achieving WLAs in USEPA established TMDLs that do not have a companion State-adopted program of implementation, proposed compliance schedules must adhere to the requirements of Part VI.E.3.c.iii-v. For watershed priorities related to addressing exceedances of RWLs in Part V.A and not otherwise addressed by Part VI.E, proposed compliance schedules must adhere to the requirements of Part VI.C.5.c.iii.(3).

Per Part VI.C.5.a of the permit, and based on an evaluation of existing water quality conditions, permittees shall classify and list water body-pollutant combinations into one of the following three categories within their draft E/WMP and include these water body-pollutant combinations it their RAA:

- Category 1 (Highest Priority): Water body-pollutant combinations for which water quality-based effluent limitations and/or receiving water limitations are established in Part VI.E TMDL Provisions and Attachments L through R of the MS4 Permit.
- Category 2 (High Priority): Pollutants for which data indicate water quality impairment in the receiving water according to the State Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (State Listing Policy) and for which MS4 discharges may be causing or contributing to the impairment.
- Category 3 (Medium Priority): Pollutants for which there are insufficient data to indicate water quality impairment in the receiving water according to the State's Listing Policy, but which exceed applicable receiving water limitations contained in this Order and for which MS4 discharges may be causing or contributing to the exceedance.

Permittees may choose to further subcategorize water body-pollutant combinations within the three main categories above for purposes of sequencing implementation of watershed control measures in the most effective manner possible, taking into consideration compliance deadlines and opportunities to address multiple pollutants within a water body with similar watershed control measures. This is consistent with the permit provisions in Parts

VI.C.2 and VI.C.3, which group pollutants for purposes of complying with the RWLs Provisions according to whether the pollutant is being addressed by a TMDL; is similar in its fate/transport characteristics and effective implementation measures to a pollutant being addressed by a TMDL; is currently listed on the 303(d) list; or exhibits only occasional exceedances in the receiving water. For example, permittees may wish to identify which water body-pollutant combinations in Categories 2 and 3 above are similar to a water body-pollutant combination in Category 1, and could therefore be addressed simultaneously with the water body-pollutant combination in Category 1. Permittees are invited to discuss with Regional Board staff, and solicit early input on, approaches to further subcategorization of water body-pollutant combinations.

Sections B through D of these guidelines discuss the general process and options for estimation of current pollutant loading, required pollutant reductions, and analysis of BMP scenarios to achieve required reductions. There are several important considerations in this process.

- First, the compliance schedules included in the permit (both those based on TMDL implementation schedules and those required to be proposed absent TMDL derived compliance deadlines), anticipate phased pollutant reductions; therefore, the RAA must be adequate to identify the required reduction for each water body-pollutant combination at each compliance deadline and analyze the BMP scenario to achieve that deadline. While many compliance deadlines fall outside of the current permit term, the permit requires in these cases that measurable interim milestones within the permit term are included and analyzed. In some cases, it may be possible to identify a 'limiting pollutant' that can be used as the focus of the analysis – i.e., to estimate necessary pollutant reductions and to analyze the BMP scenario to achieve the required reduction – which will result in achievement of required reductions in other pollutants. Where this approach is taken, adequate justification must be provided. (See **Appendix A** for Interim and Final TMDL Compliance Deadlines through December 28, 2017.)
- Second, because the purpose of the RAA is to provide a demonstration that WQBELs derived from TMDL WLAs will be achieved, and TMDL WLAs are required to consider critical conditions, the RAA must also consider critical conditions consistent with those used in the TMDL(s) in estimating current pollutant loading and required pollutant reductions and analyzing BMP scenarios to achieve applicable WQBELs.

B. CURRENT/EXISTING POLLUTANT LOADING ASSOCIATED WITH CURRENT BEST MANAGEMENT PRACTICES (BMPs)/MINIMUM CONTROL MEASURES (MCMs)

- Permittees shall provide a list and map of known and suspected storm water and non-storm water pollutant sources discharging to MS4 and from the MS4 to receiving waters and any other stressors related to MS4 discharges causing or contributing to the impairments. The map must include all MS4 "major outfalls"[1], major structural controls of storm and non-storm water[2] (including, but not limited to, low flow diversions, urban runoff treatment facilities, detention and retention basins used for storm water treatment, VSS devices, other catch basin inserts/screens) that discharge to receiving waters within the watershed management area. A separate tabular list of major structural controls should also be provided. Permittees shall also provide list of non-structural controls that are currently implemented within the area(s), the results of which will be assumed to be reflected in the baseline pollutant loading.[3]

[1] Per definition in federal regulations.

[2] Spatial metadata must include delineation of drainage area treated where available, maximum volume of non-stormwater/stormwater treated, type of control, pollutants addressed, name and contact information of owner and, if different, operator in charge of O&M.

[3] It is assumed that these BMPs include full implementation of the 2001 Permit Storm Water Management Program elements as well as the structural BMPs identified in the first bullet.

- Permittees shall provide an initial assessment of current/baseline pollutant loading for water body-pollutant combinations identified in Section A. Current/baseline pollutant loading shall based on relevant subwatershed data and the best available representative land use and pollutant loading data collected within the last 10 years. Appropriate data sources for use in assessment of baseline pollutant loading are identified in the tables below. At a minimum, baseline pollutant loadings shall be assessed and reported considering variability in pollutant loading at a spatial and temporal (including critical condition) scale consistent with that used in the TMDL and in the approved monitoring plan (i.e., for each subwatershed that was identified/analyzed/modeled in the TMDL and for each compliance monitoring location identified in the approved monitoring plan).
- Baseline loading shall be estimated using metrics derived from long-term historical data (e.g., rainfall, flow/runoff volume, pollutant loading, pollutant concentrations) using calibrated dynamic model results for each subwatershed area. Such baseline loading estimates shall be generated at a minimum for (1) critical conditions (consistent with applicable TMDLs – see **Appendix B** for a summary of TMDL critical conditions), and (2) may also be generated for average conditions for metrics related to quantity and quality (see examples of metrics, above). Critical conditions for baseline pollutant loading estimates shall be based on the two components listed below:

I. Baseline flow rates/runoff volumes shall be based on one of the following:
   a) 90th percentile of long term estimated/modeled flow rates (per TMDL WLA expression); or
   b) Other established hydrologic critical condition in the applicable TMDL; or
   c) Runoff volume from the 85th percentile, 24-hour rainfall event (for modeled drainage areas where retention based BMPs will capture 100% of the required volume).
   d) Long-term average estimated/modeled flow rates that also incorporates the coefficient of variation so as to take variability in flow rates into account. Consideration of variability must be sufficient to capture the critical condition as expressed in applicable TMDL(s). Where long-term average flow rate is used, critical conditions may be described using the long-term average flow rate with a coefficient of variation (CV) to take the variability in flow rate into account. For this type of critical condition, the reported flow rate/volume for each subwatershed should be established by using a variability factor (VF) for model-predicted flow rates/volumes obtained from the long-term average and CV with the selected probability distribution of the flow rates/volumes. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991). It is anticipated that log-normal distributions will be assumed. If a different type of critical condition is applied (e.g. 90th percentile wet year), then CV and VF calculations are not required.

II. Baseline pollutant concentration shall be based on one of the following:
   a) 90th percentile of estimated/modeled long term pollutant concentration (considering the most recent 10 years of available data); or
   b) Long-term average pollutant concentration (considering the most recent 10 years of available data) that also incorporates the coefficient of variation so as to take variability into account. Consideration of variability must be sufficient to capture the critical condition as expressed in applicable TMDL(s). Where long-term average pollutant concentration is used, critical conditions may be described using the long-term average concentration with a coefficient of variation (CV) to take the variability of pollutant concentration into account. For this type of critical condition, the reported pollutant loading in each subwatershed should be established by using a variability factor (VF) for model-predicted

concentrations, and/or concentrations obtained from the long-term average and CV with the selected probability distribution of the pollutant concentration. Procedures for the detailed calculation of variability factors for different probability distributions are described in Appendix E of the Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001, March 1991). It is anticipated that log-normal distributions will be assumed. If a different type of critical condition is applied (e.g. 90th percentile as in (a) above), then CV and VF calculations are not required.

c) Until sufficient data are available, pollutant event mean concentrations (EMCs) based on land use types from recommended data sources as referenced in table below may be used to estimate baseline pollutant loading; however, where this option is selected, they must be used in combination with one of the critical conditions for flow rate/runoff volume identified in Part I, above. Once sufficient data are collected, either (a) or (b) should be used in future iterations of the reasonable assurance analysis.

- The estimated pollutant loading and/or concentrations shall be consistent with event mean concentrations (EMCs) obtained from different land use site as referenced in dependable sources, some of which are listed below:

Source No.	Reference
1.	**Sources, patterns and mechanisms of storm water pollutant loading from watersheds and land uses of the greater Los Angeles area, California, USA.** 2007. ED Stein, LL Tiefenthaler, KC Schiff. Technical Report 510. Southern California Coastal Water Research Project. Costa Mesa
2.	**Levels and patterns of fecal indicator bacteria in stormwater runoff from homogenous land use sites and urban watersheds. Request Only.** 2011. LL Tiefenthaler, ED Stein, KC Schiff. Journal of Water and Health 9:279-290
3.	Los Angeles County 2006 EMC Report

- If a permittee(s) selects to use other independent sources of data to calculate pollutant loading in the RAA, the permittee(s) shall assure that the source(s) selected has appropriate documentation, is current, and is publicly available. The permittee(s) shall be required to provide the rationale used to support their selection of baseline data as well as the raw data and all associated QA/QC information for Regional Board review and approval.
- Baseline pollutant loading should be expressed on a pollutant-by-pollutant basis consistent with the relevant averaging period(s) / duration as expressed in the TMDL and Attachments L-R.
- For pollutants included in the RAA but for which there is no TMDL, permittees should consider expressing pollutant loading in terms of averaging periods/duration/critical conditions consistent with those used in TMDLs for that pollutant in order to proactively address the water quality problem in such a way as to avoid the need for a TMDL in the future if possible.

C. ESTIMATED REQUIRED POLLUTANT REDUCTIONS TO MEET THE INTERIM AND/OR FINAL ALLOWABLE POLLUTANT LOADING(S)

- Permittees shall provide estimated allowable loadings from MS4 discharges expressed as concentration-based or mass-based in consideration of critical conditions. Mass-based allowable loading will be calculated based on

a permittee's proportion of the watershed management area for required WQBELs. Mass-based allowable loading should be calculated for each subwatershed area identified in Section B, above.

- The difference between the current and allowable pollutant loading at each implementation deadline is the required pollutant reduction at each implementation deadline. The required pollutant reduction should be calculated based on both long-term average condition and the selected critical condition (as described in Section B). For modeled drainage areas where 100% of the runoff volume from the 85th percentile, 24-hour storm event is not retained, the required pollutant reduction shall be used to set targets/goals for BMPs/watershed control measures within that subwatershed area. The percent reductions to be used to set targets/goals will be dependent on the phase(s) of implementation to be addressed, as described in Section E.
- Estimated allowable loading and required reductions should be expressed on a pollutant-by-pollutant basis consistent with the relevant averaging period(s)/duration (including the selected critical condition) in applicable TMDLs and Attachments L-R.

D. SELECTED IMPLEMENTATION/BMPs OPTIONS

Permittees shall identify strategies, control measures, and BMPs to implement through their selected storm water management programs as listed below. As a starting point, selected control measurements should be designed and maintained to treat storm water runoff from the 85th percentile, 24-hour storm where feasible and necessary to achieve applicable WQBELs and receiving water limitations.

I. ENHANCED WATERSHED MANAGEMENT PROGRAM (EWMP)

a) DETAILED DESCRIPTION OF DRAINAGE AND RETENTION SYSTEMS

If the permittees select to develop a EWMP that includes projects that retain all non-storm water runoff and all storm water runoff from the 85th percentile, 24-hour storm event for the drainage areas tributary to the projects, the permittees are required to provide a detailed description of each regional multi-benefit retention system including type (bioretention system, sub-surface chamber, etc.), drainage area addressed, storage volume, and approximate system size as well as a description and quantification, where possible, of other benefits (e.g., amount of water recharged to groundwater for water supply, etc.).

b) PROPOSED WATERSHED CONTROL MEASURES TO CONTROL STORM AND NON-STORM WATER DISCHARGES

In drainage areas within the EWMP area where retention of 85th percentile, 24-hour storm event is not pursued, the permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. Watershed control measures may include:

i. Structural and/or non-structural controls and operation and maintenance procedures that are designed to achieve applicable water quality-based effluent limitations and receiving water limitations;

ii. Retrofitting areas of existing development known or suspected to contribute to the highest water quality priorities with regional or sub-regional controls or management measures; and

iii. Stream and/or habitat rehabilitation or restoration projects where stream and/or habitat rehabilitation or restoration are necessary for, or will contribute to, demonstrable improvements in

the physical, chemical, and biological receiving water conditions and restoration and/or protection of water quality standards in receiving waters.

c) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs), NON-STORM WATER DISCHARGE CONTROLS, AND OTHER STRUCTURAL CONTROL MEASURES

Per Part VI.C.5.b.iv.(1), permittees shall assess the MCMs as defined in Part VI.D.4, Part VI.D.5, Part VI.D.6, Part VI.D.8, Part VI.D.9 and Part VI.D.10 of the MS4 Permit and potential modifications that will most effectively address priority issues in each watershed. Based on this assessment, permittees may choose to propose customized actions and corresponding schedules within each of the abovementioned minimum control measure categories. (Alternatively, permittees may choose to implement the baseline provisions within one or more of the abovementioned MCM categories.)

Per Part VI.C.5.b.iv.(2), where non-storm water discharges from the MS4 are identified as source of pollutants, permittees shall identify and list control measures, BMPs, and other strategies to effectively eliminate the source of pollutants consistent with the requirements of Part III.A and Part VI.D.4.d (for the LACFCD) and Part VI.D.10 (for all other permittees).

For TMDL related control measures, per Part VI.C.5.b.iv.(3), permittees shall also compile a list of control measures that have been identified in TMDLs and corresponding implementation plans, and identify those control measures within these TMDLs/implementation plans to be modified, if any, to most effectively address TMDL requirements in Part VI.E and Attachments L-R. If actions identified in the E/WMP are wholly replacing the control measures identified in the TMDL implementation plan, it can be noted as such and this list is not necessary. If not sufficiently identified in previous documents (TMDLs/implementation plans), the permittees shall evaluate and identify the control measures that will be implemented to achieve the applicable WQBELs/WLAs/RWLs associated with these TMDLs. At a minimum where possible, control measures should be designed to address the volume within the drainage area associated with the 85th percentile, 24-hour storm event at the correspondence compliance point.

II. WATERSHED MANAGEMENT PROGRAM (WMP)/INDIVIDUAL WMP

a) PROPOSED WATERSHED CONTROL MEASURES TO ADDRESS CONTRIBUTIONS OF STROM WATER DISCHARGES TO RECEIVING WATER

The permittees are required to identify watershed control measures that will be implemented in addition to existing BMPs to prevent or eliminate non-storm water discharges that are a source of pollutants to receiving waters, and to achieve all applicable interim and final water quality-based effluent limitations and all receiving water limitations. (See section D.I.b. for detail.)

b) STORM WATER MANAGEMENT PROGRAM MINIMUM CONTROL MEASURES (MCMs)

See section D.I.c. for detail.

E. SPECIFIED SCHEDULE OF SELECTED WATERSHED MANAGEMENT STRATEGIES

Permittees shall translate corresponding schedules for selected BMPs into a combined schedule for achievement of the applicable interim and final water quality-based effluent limitations and/or receiving water limitations per the water body classification/prioritization above. Permittees shall align the combined schedule

with interim milestones and interim and final compliance deadlines specified in the permit and demonstrate through the RAA that the required loading reductions will be achieved in the timeline(s) specified.

- Permittees shall identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations deadlines identified in TMDL provisions in Part VI.E and attachments L - R. If selected BMPs will address multiple pollutants then BMPs must be implemented within time frame that is consistent with the most critical/closest deadline.
- Where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines *during the permit term*, Permittees shall identify interim milestones and dates for their achievement and include these in the RAA to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term.
- For interim WQBELs and/or receiving water limitations, the percent reduction based on annual average baseline loading may be used to set targets/goals for BMPs/watershed control measures where such percent reduction based on the annual average baseline loading is consistent with interim requirements as set forth in Part VI.E and Attachments L-R. A gradual phasing of percent load reduction for interim WQBELs/RWLs to final WQBELs/RWLs shall be applied over the course of the implementation schedule. For areas to be addressed through retention of the runoff volume from the 85th percentile, 24-hour storm, volume reductions over time shall be related to the interim and final milestones/deadlines.
- Permittees shall demonstrate that the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations for water body-pollutant combinations not addressed by TMDLs as soon as possible. Per Part VI.C.5.c.ii and Part VI.C.4.c.iii.(3), Permittees must propose milestones based on measurable criteria and a schedule with dates for achieving the milestones that will allow progress to be measured once every two years.

F. POLLUTANT REDUCTION PLAN

a) COMPLIANCE DETERMINATION

- Compliance points shall be located at all compliance points required in the TMDLs that are within the area covered by the E/WMP.
- For a Permittee implementing an individual WMP, appropriate compliance point(s) within their jurisdiction shall be identified for Regional Board approval.
- Permittees shall include an appropriate compliance point(s) to assess the MS4 discharge(s) from the area covered by the Watershed Management Program to the Receiving Water(s)

b) EVALUATION OF SELECTED MANAGEMENT PROGRAM/BMPs PERFORMANCE

- Permittees shall provide a detailed description of individual BMPs performance and /or suite of selected BMPs performance to reduce pollutant loadings that are used as model inputs. Data on performance of watershed control measures shall be drawn only from peer-reviewed sources.
- The estimated effectiveness of BMPs in pollutant removal and/or reduction will served as a default value that can be updated through the adaptive management process with BMP monitoring data and outfall monitoring data when they become available.

c) ANALYSIS TO DEMONSTRATE SELECTED BMPs HAVE REASONABLE ASSURANCE TO MEET INTERIM/FINAL REQUIREMENTS

Based on the analysis of BMP performance using the selected modeling system, Permittees shall demonstrate that:

- Implementation of current/selected activities and control measures identified in section D above will achieve applicable water quality-based effluent limitations and/or receiving water limitations in Part VI.E and Attachments L-R.

  Although the Permit only requires the RAA to consider WQBELs and receiving water limitations with interim and final deadlines/milestones that fall within the Permit term, it is strongly recommended that the RAA assess WQBELs and RWLs with deadlines occurring between program approval and December 28, 2022. Additionally, where the TMDL does not include interim or final water quality-based effluent limitations and/or receiving water limitations with compliance deadlines *during the permit term*, Permittees must identify interim milestones and dates for their achievement to ensure adequate progress toward achieving interim and final water quality-based effluent limitations and/or receiving water limitations with deadlines beyond the permit term and must include these in the RAA.

- For water-body pollutant combinations not addressed by TMDLs, the activities and control measures identified in the Watershed Control Measures will achieve applicable receiving water limitations per Part V.A.

Permittees shall provide model output for each deadline specified in Attachments L-R within the permit term to demonstrate compliance with each deadline will be achieved.

d) PROCESS OF INCORPORATING ADDITIONAL BMPs IF MILESTONE ARE NOT MET AS SCHEDULED

- Permittees in each WMA shall develop an integrated monitoring program or coordinated integrated monitoring program to assess progress toward achieving the water quality-based effluent limitations and/or receiving water limitations per the compliance schedules, and progress toward addressing the water quality priorities for each WMA.
- Permittees in each WMA shall implement an adaptive management process every two years after program approval to assess progress toward (i) achieving interim and/or final water quality-based effluent limitations and/or receiving water limitations; (ii) achievement of interim milestones; (iii) re-evaluation of the water quality priorities identified for the WMA based on more recent water quality data and reassessment of sources of pollutants in MS4 discharges; and (iv) evaluation of effectiveness of the control measures based on new information and data.
- Permittees shall report and then implement any modifications to the WMP or EWMP based on the results of the adaptive management process to improve the effectiveness of WMP or EWMP in reducing pollutant loading upon approval by the Regional Executive Officer, or within 60 days of submittal if the Regional Water Board Executive Officer expresses no objections.

G. MODELING REQUIREMENTS FOR REASONABLE ASSURANCE ANALYSIS TO SUPPORT ESTIMATION OF CURRENT LOADINGS, REQUIRED LOAD REDUCTIONS AND ANALYSIS OF WATER QUALITY OUTCOMES OF SELECTED BMPs OPTIONS

Permittees shall provide a modeling system to support the estimation of baseline loadings, required load reductions that are used to set targets/goals for selected BMPs/watershed control measures, and to demonstrate that the activities and watershed control measures identified/selected in the E/WMP will achieve applicable water quality-based effluent limitations and receiving water limitations by applicable compliance deadlines.

The models appropriate for conducting the required RAA described above are listed in **Table 1.** These models are selected based on the following model capabilities:

(1) Dynamic continuous long-term simulation for modeling pollutant loadings, flows, and concentrations in receiving water from lands in a watershed system.
(2) Can represent rainfall and runoff processes above soil surface, and baseflow contributions in subsurfaces of urban and natural watershed systems.
(3) Can represent variability in pollutant loadings, based on land use, soil hydrologic group, and slope.
(4) BMP process based approach or empirically based BMP approach.
(5) Decision support to evaluate BMP performance

Permittees may select a combination of the models listed in model type 1.1-1.3 of Table 1 for land/watershed, receiving water, and BMP performance models, or select one of the modeling systems from integrated modeling systems listed in model type 1.4 of Table 1.

Table 1. List of Available Models

Model Type	Available Models
1.1 Land/Watershed Models	
	HSPF, LSPC, SWMM, WARMF
1.2 Receiving Water Models	
	EFDC, CE-QUAL-ICM/TOXI, QUAL2K, WASP, HSPF, LSPC, SWMM
1.3 BMP Performance Models	
* Process based models	SWMM BMP model BASINS BMP model EPA SUSTAIN model
* Empirically based models	International Stormwater BMP Database
1.4 Integrated BMP Modeling Systems	
* Process based models	EPA SUSTAIN model

Model Type	Available Models
* Empirical based models	Los Angeles County WMMS model EPA TMDL Modeling Toolbox City of Los Angeles SBPAT model

The modeling requirements consist of four primary components which are described as in the following Tables. The four components of modeling requirements are general model input data (Table 2), model parameters (Tables 3.1-3.3), BMP performance parameters (Tables 4.1-4.2), and model output (Table 5). For model parameters and BMP performance parameters, two separate tables are provided for a process based BMP model and an empirically based BMP model. It should be noted that the model requirements are the minimum requirements for a BMP performance evaluation since the specific performance measures vary depending on the designated use of the water body and the condition of the water body. Permittees shall cover all necessary requirements for a BMP performance evaluation based on input and recommendations from the TAC as approved by the Regional Board. With regard to the spatial scale, the highest resolution GIS layers should be used to satisfy the homogeneous assumption in a computational/modeled subwatershed. (See **Appendix C** for a technical memorandum on the use of the County of Los Angeles' Proposed HUC-12 Equivalent Boundaries in the RAA.) For temporal scale, the model should use varying time steps with a minimum 1-hour or shorter time step during rainfall events to capture peak flow and a daily or shorter time step between rainfall events.

The RAA associated with the permittee(s) draft E/WMP should include a detailed description/itemization of model inputs and outputs as indicated in Table 2 through Table 5 and should include model input files (in an electronic format that can be manipulated) as part of the draft E/WMP package submitted to Regional Board for review and approval.

Table 2. General Model Input Data for Both Process Based BMP Models and Empirically Based BMP Models

For General Model	Data Source	Data Period
2.1 Geometric Data		
• GIS Data Layer	State of California GeoPortal, Cal-Atlas Geospatial Data Library (previously CalSIL – California Spatial Information Library)/CERES and other public agencies	Most recent
• Topography Layer (DEM Data)	USGS National Elevation Dataset (NED) or locally derived data	Most recent
• Land Use/Land Cover Layer[4]	SCAG Land use data; Multi-Resolution Land Characteristics Consortium (MRLC) National Land Cover Database (NLCD) or locally derived data	SCAG Land use data (2005 or most recent); NLCD (2006 or most recent)
• Stream Network	USGS National Hydrography Dataset (NHD) or locally derived data	Most recent
• Drainage areas	USGS Watershed Boundary Dataset (WBD) or locally derived data	Most recent
2.2 Meteorological Data		
• Precipitation	NOAA National Climatic Data Center (NCDC) or locally derived data	at least 10 years hourly
• Evaporation	NCDC or locally derived data	at least 10 years daily/monthly
2.3 Soil Hydrologic Data		
• Hydrologic soil groups	USDA/NRCS - Soil Survey Geographic Database (SSURGO)/ STATSGO2 or locally derived data	Most recent
• Percent of area distribution for	SSURGO or	Most recent

[4] Satellite imagery may be utilized but is not required.

For General Model	Data Source	Data Period
different soil groups.	locally derived data	
• Fraction of sand, silt, and clay for different soil groups.	SSURGO or locally derived data	Most recent
• Average Slope	SSURGO or locally derived data	Most recent
• Vegetative cover for different soil groups.	SSURGO or locally derived data	Most recent
2.4 Hydrologic Data		
• In-stream Flow	USGS and locally derived data	Daily/monthly/hourly based on availability
• In-stream Depth	USGS and locally derived data	Daily/monthly/hourly based on availability
2.5 Point Source Data		
• Point Source Location	EPA STORET data CIWQS/SMARTS or local sampling	All available data
• Point Source Discharge	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly
• Point Source Concentration	EPA STORET data CIWQS/SMARTS or local sampling	Daily/monthly

To demonstrate the ability to predict the effect of watershed processes and management on land, soil, and receiving water body, model calibration and validation are necessary and critical steps in model application. The acceptable model calibration criteria as listed in Table 3.0 are provided to ensure the calibrated model properly assesses all the model parameters and modeling conditions that can affect model results. In addition, some valuable sources of initial starting values for many of the key calibration parameters are provided in Table 3.1 through Table 4.2 to facilitate model calibration efforts.

Model calibration is necessary to ensure that the calibrated model properly assesses all the variables and conditions in a watershed system. Calibration should result in model parameter values that produce the best overall agreement between simulated and observed values throughout the calibration period. Table 3.0 is a list of model calibration tolerances for different levels of agreement or accuracy based on extensive past experience with the HSPF model. The

lower bound of "fair" level of agreement listed in Table 3.0 is considered a target tolerance for the model calibration process. If model calibration results do not satisfy the target tolerances, additional efforts should be completed to investigate possible errors in, and the accuracy of, input data, model formulations, and field observations. The findings of this investigation should be presented in the RAA description, along with any immediate remedial actions to address the issues and/or recommended approaches to improve the calibration in the future. Permittees are strongly encouraged to engage Regional Board staff prior to the draft E/WMP submittal, in order to facilitate review and approval.

Table 3.0 Model Calibration Criteria

Model parameters	**% Difference between simulated and observed values**		
	Very Good	**Good**	**Fair (lower bound, upper bound)**
Hydrology/Flow	<10	10-15	15-25
Sediment	<20	20-30	30-45
Water Temperature	<7	8-12	13-18
Water Quality/Nutrients	<15	15-25	25-35
Pesticides/Toxics	<20	20-30	30-40

Based on HSPF experience by A.S. Donigian, Jr., prepared for USEPA (2000)

Table 3.1 Model Parameters for Process Based BMP Models

Model Parameters	Data Source[5]	Range of Initial Values
3.1.1 Hydrology Parameters		
• Fraction forest cover	EPA BTN#6	0-0.95
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.01-0.15
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0

[5] EPA BTN # : EPA Basins Technical Note #

• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of GW inflow to deep recharge	EPA BTN#6	0.0-0.50
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Fraction of remaining ET from active GW	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
3.1.2 Water Quality Parameters		
• Initial storage of water quality constituent on land surface (lb)	LA County Report[6]	0.0-0.0005
• Wash-off potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	0.0-10.0
• Scour potency factor for sediment associated constituent (lb/ton)	EPA BTN#6	NA
• Accumulation rate of water quality constituent of land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Maximum storage of water quality • constituent on land surface(lb/acre/day)	EPA BTN#6	0.0-0.0005
• Rate of surface runoff that removes 90% of stored water quality constituent (in/hr)	EPA BTN#6	0.0-0.5
• General first order in-stream loss rate of constituent (1/day)	SUSTAIN manual	0.2-0.2

[6] LA County Report*: "Evaluation of Existing Watershed Models for the County of Los Angeles", August 29, 2008

3.1.3 Sediment Parameters		
• For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
• For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.2 Model Parameters for Empirically Based BMP Models

Model Parameters	Data Source	Range of Values
3.2.1 Hydrology Parameters		
• Interception storage capacity (in)	EPA BTN#6	0.01-0.40
• Retention storage capacity (in)	EPA BTN#6	0.01-0.30
• Manning's n for overland flow	EPA BTN#6	0.05-0.5
• Upper zone nominal soil moisture storage (in)	EPA BTN#6	0.05-2.0
• Saturated hydraulic conductivity (in/hr)	Green-Ampt Parameters	0.01-4.74
• Wetting front suction head (in)	Green-Ampt Parameters	1.93-12.6
• Upper zone soil porosity (fraction)	Green-Ampt Parameters	0.398-0.501
• Field capacity (fraction)	Green-Ampt Parameters	0.062-0.378
• Wilting point (fraction)	Green-Ampt Parameters	0.024-0.265
• Temp below which ET is reduced by half (^{o}F)	EPA BTN#6	32.0-48.0
• Temp below which ET is set to zero (^{o}F)	EPA BTN#6	30.0-40.0
• Fraction of remaining ET from baseflow	EPA BTN#6	0.0-0.20
• Lower zone nominal soil moisture storage (in)	EPA BTN#6	2.0-15.0
• Interflow inflow parameter	EPA BTN#6	1.0-10.0
• Interflow recession parameter	EPA BTN#6	0.3-0.85
• Lower zone ET parameter	EPA BTN#6	0.1-0.9
B.3.2.2 Water Quality Parameters		
• Event Mean Concentration (EMC)	SBPAT User's Guide	See Table 3.3
B3.2.3 Sediment Parameters		
For pervious land		
• Coefficient in the soil detachment equation	EPA BTN#8	0.05-0.75
• Exponent in the soil detachment equation	EPA BTN#8	1.0-3.0

• Coefficient in the sediment wash off equation	EPA BTN#8	0.1-10.0
• Exponent in the sediment wash-off equation	EPA BTN#8	1.0-3.0
• Coefficient in the sediment scour equation	EPA BTN#8	0.0-10.0
• Exponent in the sediment scour equation	EPA BTN#8	1.0-5.0
For impervious land		
• Coefficient in the solids wash-off equation	EPA BTN#8	0.1-10.0
• Exponent in the solids wash-off equation	EPA BTN#8	1.0-3.0
• Solids accumulation rate on the land surface (lb/ac-day)	EPA BTN#8	0.0-30.0
• Fraction of solids removed from land surface per day (1/day)	EPA BTN#8	0.01-1.0

Table 3.3 Suggested Average[7] EMC by land use for selected pollutants

Land Use	Nitrate (mg/L)	Total Copper (µg/L)	Total Lead (µg/L)	Total Zinc (µg/L)	Fecal Coliform (MPN/100ml)	TSS (mg/L)
Agriculture	34.4	100.1	30.2	274.8	6.03E+4	999
Commercial	0.55	31.4	12.4	237.1	7.99E+4	67.0
Educational	0.61	19.9	3.6	117.6	7.99E+4	99.6
Industrial	0.87	34.5	16.4	537.6	3.76E+3	219
Transportation	0.74	52.2	9.2	292.9	1.68E+3	77.8
Open Space	1.17	10.6	3.0	26.3	6.31E+3	216.6
SF Residential	0.78	18.7	11.3	71.9	3.11E+4	124.2
MF Residential	1.51	12.1	4.5	125.1	1.18E+4	39.9

Source: Technical Appendices "A User's Guide for the Structural BMP Prioritization and Analysis Tool (SBPAT v1.0)" for Los Angeles City, County, and Heal the Bay, December 2008

Note: These suggested average EMC values can be adjusted based on calibration studies by using more recently collected Southern California data.

[7] The average values are based on arithmetic statistics. The related log-form statistics are referred to in Appendix C of the SBPAT technical report.

Table 4.1 Suggested BMP Performance Parameters for Process Based BMP Model

4.1 BMP Performance Parameters	Rain Barrel	Bio-Retention	Porous Pavement	Dry Infiltration Basin
• Media final constant infiltration rate (in/h)	NA	0.5-0.5	0.5-1.0	1.0-1.0
• Substrate layer porosity	NA	0.4-0.5	0.45-0.5	0.3-0.4
• Substrate layer field capacity	NA	0.25-0.3	0.055-0.2	0.06-0.3
• Substrate layer wilting point	NA	0.1-0.15	0.05-0.05	0.02-0.15
• Underdrain gravel layer porosity	NA	0.5	0.5	0.5
• Vegetative parameter, A	NA	0.6-1.0	1.0	0.6
• Underdrain background infiltration Rate (in/hr)	NA	0.1-0.3	0.1	0.25-0.3
• TSS 1st order decay rate (1/day)	0.2-0.8	0.2-0.8	0.2-0.8	0.2-0.8
• Fecal Coliform 1st order decay rate (1/day)	0.5	0.5	0.5	0.5
• TSS Filtration removal rate (%)	NA	85	60	85

Source: PA Report "SUSTAIN-A Framework for Placement of Best Management Practices in Urban Watersheds to Protect Water Quality, September 2009, EPA/600/R-09/095

Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 4-2: Suggested BMP Performance Parameters for Empirically Based BMP Model

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Fecal Coliform # Per 100 mL	NA	2600-6200	500-1900	300-39600	(10,20)-D (200-3000)-F (1400-5000)-P	200-625	NA	200-1160	230-11800	NA
Enterococcus # Per 100 mL	58-437	NA	NA	NA	(10,10)-D (1750-	NA	NA	NA	56-300	NA

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
					12000)-F NA-P					
E. Coli # Per 100 mL	6-137	1200-5900	82-720	NA	NA	NA	NA	31-387	199-1160	NA
TSS (mg/L)	5.0-9.0	11.8-15.3	19.0-26.0	16.0-21.5	15.0-19.9	7.4-10.0	11.0-14.4	12.0-15.0	7.0-10.9	10.0-16.0
Total Phosphorus (mg/L)	0.07-0.1	0.17-0.20	0.19-0.24	0.15-0.20	0.10-0.13	0.08-0.10	0.08-0.09	0.12-0.14	0.07-0.09	0.13-0.17
Dissolved Phosphorus (mg/L)	0.05-0.18	0.05-0.11	0.08-012	0.16-0.26	0.04-0.07	0.06-0.09	0.04-0.05	0.06-0.07	0.03-0.06	0.07-0.10
Total Nitrogen (mg/L)	0.74-0.99	0.63-0.82	1.75-2.69	1.0-1.23	1.90-2.41	0.68-0.99	1.28-1.65	1.19-1.36	1.04-1.21	1.05-1.56
Total Kjeldahl Nitrogen (mg/L)	0.46-0.72	0.50-0.70	1.16-1.78	0.97-1.12	1.32-1.55	0.50-0.61	0.74-0.90	0.98-1.10	0.92-1.09	1.10-1.30
NOx(NO2+NO3,and NO3) (mg/L)	0.19-0.25	0.20-0.28	0.24-0.45	0.24-0.31	0.35-0.44	0.46-0.57	0.59-0.77	0.15-0.20	0.05-0.11	0.15-0.22
Total Copper (µg/L)	4.6-9.85	5.7-7.7	4.0-6.80	6.4-7.9	7.94-11.0	5.1-6.6	6.8-8.1	4.06-5.0	3.0-4.0	3.61-5.20
Total Lead (µg/L)	2.5-2.5	1.8-2.29	2.15-4.3	1.3-2.2	3.8-5.16	1.3-2.0	1.38-2.21	2.0-3.0	1.0-1.55	1.40-3.11
Total Zinc (µg/L)	7.7-25.0	20-26.6	17.1-38.2	16.0-26.0	52.8-63.5	15.0-20.0	12.5-16.8	20.0-23.0	16.7-24.3	11.0-20.0
Total Arsenic (µg/L)	NA	0.95-1.30	1.29-1.80	0.55-1.20	1.0-2.4	0.61-1.0	2.5-2.5	0.54-1.15	NA	NA
Total Cadmium (µg/L)	0.25-1.0	0.27-0.34	0.25-0.35	0.09-0.20	0.20-0.31	0.1-0.2	0.25-0.25	0.20-0.29	0.10-0.20	0.19-0.50

Median (95% Conf. Interval) Statistics of BMP Effluent Concentration.	Bio-Retention	Bio-Swale	Detention Basin	Filter Strip	Manu-fractured Device	Media Filter	Porous Pavement	Retention Pond	Wetland Basin	Wetland Channel
Total Nickel (µg/L)	NA	2.3-4.2	2.2-3.75	2.4-3.1	3.11-5.0	2.0-2.6	1.40-1.80	2.0-2.60	NA	2.0-2.40

Source: International Stormwater BMP Database (BMPDB), July 2012
Note that for bacteria, manufactured devices are broken down into three subcategories: disinfection devices (Manufactured Device – D), inlet insert/filtration devices (Manufactured Device – F), and physical settling/straining devices (Manufactured Device – P)
Note that values in this Table can be adjusted based on calibration studies with recently collected Southern California data.

Table 5: Model Output for both Process Based BMP Models and Empirically Based BMP Models

Model Output	Output Content	Output Format
5.1 Current/Existing Pollutant Loadings		
	Current pollutant loadings at each modeled sub-watershed and each land use, under range of temporal conditions (i.e., average and critical conditions)	Tables
5.2 Load Reduction Output		
	Pollutant load reduction at each modeled sub-watershed for each BMP scenario (corresponding to applicable compliance deadlines) in dry and wet weather conditions (i.e., average and critical conditions)	Tables
	Time series plots of pollutant load reduction for each BMP scenario at compliance points	Graphics
5.3 Surface Runoff Output		
	Surface runoff volume at each modeled subwatershed for each BMP scenario in dry and wet weather conditions (i.e., average and critical conditions)	Tables
	Absolute and percent reduction in runoff volume at each modeled subwatershed for each BMP scenario	Tables
5.4 Hydrographs and Pollutographs		
	Flow hydrographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics

Model Output	Output Content	Output Format
	Pollutographs at compliance points within the EWMP/WMP for each BMP scenario	Graphics
5.5 BMP Performance Summary		
	Load comparison for with and without BMPs and graphs for each BMP scenario	Tables and Graphics
	BMP storage distribution for each BMP scenario	Tables and Graphics

APPENDIX A

Appendix A
Interim and Final TMDL Compliance Deadlines
(Through December 28, 2017)

TOTAL MAXIMUM DAILY LOADS (TMDL)	Final Compliance date has Passed	Interim Deadlines prior to Permit effective date (Dec. 28, 2012)	Interim Deadline within 6 months of Permit effective date (June 28, 2013)	Interim Deadline within 12 months of Permit effective date (Dec. 28, 2013)	Interim Deadline within 18 months of Permit effective date (June 28, 2014)	Interim Deadline within 22 months of Permit effective date (Oct. 28, 2014)	Interim Deadline within 28 months of Permit effective date (April 28, 2015)	Interim Deadline within 36 months of Permit effective date (Dec. 28, 2015)	Interim Deadline within 40 months of Permit effective date (April 28, 2016)	Interim Deadline within 48 months of Permit effective day (Dec. 28, 2016)	Interim Deadline within 60 months of Permit effective date (Dec. 28, 2017)
Santa Clara River Nitrogen Compounds TMDL	March 23, 2004										
Upper Santa Clara River Chloride TMDL	April 6, 2010										
Lake Elizabeth, Munz Lake, and Lake Hughes Trash TMDL (Lake Elizabeth only)		March 6, 2012	March 6, 2013		March 6, 2014		March 6, 2015		March 6, 2016*		
Santa Clara River Estuary and Reaches 3, 5, 6, and 7 Indicator Bacteria TMDL											
Dry Weather									March 21, 2016		
Wet Weather									March 21, 2016		
Santa Monica Bay Beaches Bacteria TMDL											
Summer Dry Weather	July 15, 2006										
Winter Dry Weather	July 15, 2009										
Wet Weather - 10%, 25% Reduction (respectively)											
Jurisdictional Groups 1 and 4		July 15, 2009		July 15, 2013							
Jurisdcitional Groups 2 and 3		July 15, 2009		July 15, 2013							
Jurisdictional Groups 5 and 6		July 15, 2009		July 15, 2013							
Jurisdictional Group 7											
Santa Monica Bay Nearshore and Offshore Debris TMDL									March 20, 2016		March 20, 2017
Santa Monica Bay TMDL for DDTs and PCBs	March 26, 2012										
Malibu Creek and Lagoon Bacteria TMDL											
Summer Dry Weather	January 24, 2009										
Winter Dry Weather	January 24, 2012										
Wet Weather											
Malibu Creek Watershed Trash TMDL				July 7, 2013		July 7, 2014		July 7, 2015		July 7, 2016	July 7, 2017*
Malibu Creek Watershed Nutrients TMDL	March 21, 2003										
Ballona Creek Trash TMDL		September 30, 2012		September 30, 2013		September 30, 2014		Septmeber 30, 2015*			
Ballona Creek Estuary Toxic Pollutants TMDL			January 11, 2013				January 11, 2015				January 11, 2017
Ballona Creek, Ballona Estuary and Sepulveda Channel Bacteria TMDL											
Dry Weather	April 27, 2013										
Wet Weather											
Ballona Creek Metals TMDL											
Dry Weather		January 11, 2012			January 11, 2014				January 11, 2016*		
Wet Weather		January 11, 2012							January 11, 2016		
Ballona Creek Wetlands TMDL for Sediment and Invasive Exotic Vegetation	March 26, 2012										
Marina del Rey Harbor Mothers' Beach and Back Basins Bacteria TMDL											
Dry Weather	March 18, 2007										
Wet Weather											
Marina del Rey Harbor Toxic Pollutants TMDL - TMDL Specific Implementation					March 22, 2014				March 22, 2016*		
Marina del Rey Harbor Toxic Pollutants TMDL - Integrated Resources Approach			March 22, 2013				March 22, 2015				March 22, 2017
Los Angeles Harbor Bacteria TMDL	March 10, 2010										
Machado Lake Trash TMDL		March 6, 2012	March 6, 2013		March 6, 2014		March 6, 2015		March 6, 2016*		
Machado Lake Nutrient TMDL		March 11, 2009			March 11, 2014						
Machado Lake Pesticides and PCBs TMDL											
Dominguez Channel and Greater LA and LB Harbor Waters Toxic Pollutants TMDL		March 23, 2012									
Los Angeles River Watershed Trash TMDL		September 30, 2012		September 30, 2013		September 30, 2014		September 30, 2015		September 30, 2016*	
Los Angeles River Nitrogen Compounds and Related Effects TMDL	March 23, 2004										
Los Angeles River and Tributaries Metals TMDL											
Dry Weather		January 11, 2012									
Wet Weather		January 11, 2012									
Los Angeles River Watershed Bacteria TMDL											
Dry Weather (Interim Compliance dates range from 10 to 25 years)											
Wet Weather (March 23, 2037)											
Legg Lake Trash TMDL		March 6, 2012	March 6, 2013		March 6, 2014		March 6, 2015		March 6, 2016*		
Long Beach City Beaches and Los Angeles River Estuary Bacteria TMDL	March 26, 2012										
Los Angeles Area Lakes TMDLs	March 26, 2012										
San Gabriel River and Impaired Tributaries Metals and Selenium TMDL	March 26, 2007										
Los Cerritos Channel Metals TMDL	March 17, 2010										
Colorado Lagoon OC Pesticides, PCBs, Sediment Toxicity, PAHs, and Metals TMDL		July 28, 2011									

Final Compliance Date has Passed

7 Trash TMDLs

USEPA established TMDLs

* Final Complinace Date

APPENDIX B

Appendix B
Summary of TMDL Critical Conditions Relevant to MS4 Discharges

TMDL Name	Type of Pollutant(s)	Critical Condition	Critical Condition Metric	WLA Expression
SANTA CLARA RIVER WATERSHED MANAGEMENT AREA				
Santa Clara River Nitrogen Compounds	Nutrients	Low flow condition (driest 6 months of the year)	Flow 7Q10	Daily maximum and thirty-day average
Upper Santa Clara River Chloride	Chloride	Low flow/drought condition; when water supply in Castaic Lake is >=80 mg/L	Flow	Daily maximum; monthly-average (3-month or 12-month average depending on specific reach)
Lake Elizabeth, Munz Lake, and Lake Hughes Trash	Trash	Major rain event; National Weather Service wind advisories; and high visitation conditions	>0.25 inch rain event; NWS wind advisories	Zero trash (annual discharge)
Santa Clara River Estuary and Reaches 3,5,6, and 7 Indicator Bacteria	Bacteria	90th percentile year in term of wet days (1995; 81 wet days)	# wet days in year (>=0.1 inch of precip + 3 days following event)	Exceedance day (daily); geometric mean
SANTA MONICA BAY WATERSHED MANAGEMENT AREA				
Santa Monica Bay Beaches	Bacteria	90th percentile year in term of wet days (1993; 75 wet days and 290 dry days)	# wet days in year	Exceedance day (daily); geometric mean
Santa Monica Bay Nearshore and Offshore Debris	Debris	Major rain event; NWS wind advisories; and high visitation conditions (weekends/holidays from Apr 15 - Oct 15)	>0.25 inch rain event; NWS wind advisories	Zero trash (annual discharge)/Zero plastic pellets
Santa Monica Bay DDT and PCBs	DDTs and PCBs	30-year long term condition/critical consumption rate 116g/d	excess cancer risks over a life time	annual load
Malibu Creek and Lagoon Bacteria	Bacteria	90th percentile year in terms of wet days (1993; 75 wet-weather days and 290 dry-weather days)	# wet and dry days in year	exceedance day (daily); geometric mean (6 weeks)
Malibu Creek Watershed Trash	Trash	Major rain event; NWS wind advisories; and high visitation conditions	>0.25 rain event; NWS wind advisories	Zero trash (annual discharge)

Appendix B
Summary of TMDL Critical Conditions Relevant to MS4 Discharges

TMDL Name	Type of Pollutant(s)	Critical Condition	Critical Condition Metric	WLA Expression
Malibu Creek Nutrient	Nutrients	Summer months from April 15 to November 15	Median summer flow value for 1998-2001 period (5.2 cfs)	Summer - daily load/ winter - concentration based
BALLONA CREEK SUBWATERSHED				
Ballona Creek Trash	Trash	Major rain event	>0.25 inch rain event	annual load
Ballona Metals	Metals in water	dry: median dry weather flow (17 cfs/6.3 cfs); wet: load duration curve	flow	daily load
Ballona Toxic Pollutants	Toxics (metals and organics) in sediment	long term average sediment deposition (10-year, 1991-2001)	sediment deposition	annual load
Ballona Bacteria	Bacteria	90th percentile year in terms of wet days (1993; 75 days)	# wet days in year	exceedance day (daily); geometric mean (6 weeks)
Ballona Creek Wetlands Sediment and Invasive Exotic Vegetation	Sediment and Invasive Exotic Vegetation	Not specified for purpose of meeting allocations	NA	annual and average daily mass load
MARINA DEL REY SUBWATERSHED				
Marina del Rey Harbor Mother's Beach and Back Basin Bacteria	Bacteria	90th percentile year in terms of wet days (1993; 75 days)	# wet days in year	exceedance day (daily); geometric mean (6 weeks)
Marina del Rey Harbor Toxic Pollutants	Toxics (metals, PCBs, and sediment)	Long-term average rainfall (1948-2000)	TSS average annual load	annual load
DOMINGUEZ CHANNEL WATERSHED MANAGEMENT AREA				
Los Angeles Harbor Bacteria	Bacteria	90th percentile year in terms of wet days (1993; 75 days)	# wet days in year	exceedance day (daily); geometric mean (6 weeks)
Machado Lake Trash	Trash	Major rain event; NWS wind advisories; and high visitation conditions (May 15-Oct 15)	>0.25 inch rain event; NWS wind advisories	Zero trash (annual load)
Machado Lake Nutrient	Nutrient	winter and spring in conjunction with storm events	Not specified	concentration-based (monthly average)

Appendix B
Summary of TMDL Critical Conditions Relevant to MS4 Discharges

TMDL Name	Type of Pollutant(s)	Critical Condition	Critical Condition Metric	WLA Expression
Machado Lake Pesticides and PCBs	Pesticides and PCBs	Wet-weather events	Not specified	concentration based (three-year average)
Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants	Toxics (metals, chlordane, dieldrin, toxaphene, Dodd, PCBs, PAHs, benthic, and toxicity)	Wet-weather events	90th percentile of annual flow rates from the estimated modeled flow rates (62.7 cfs for Dominguez Channel)	daily (Dominguez Channel freshwater/metals only) or annual load
LOS ANGELES RIVER WATERSHED MANAGEMENT AREA				
Los Angeles River Trash	Trash	major rain event	>0.25 inch rain event	annual discharge
Los Angeles River Nitrogen Compounds and Related Effects	Nutrients	Low flow condition during summer (driest 6 months of the year)	Not specified	Daily maximum and monthly average concentration
Los Angeles River Metals	Metals in water	1) Dry weather: dry-weather non-WRP flow; 2) Wet weather	Flow (wet weather is >=500 cfs)	daily load
Los Angeles River Bacteria	Bacteria	90th percentile year in terms of wet days in storm year - Nov 1 to Oct 31 (1993; 75 days)	# wet days in year	Annual allowable exceedance days (dry weather/wet weather)
Legg Lake Trash	Trash	Major rain event; NWS wind advisories; and high visitation on weekends and holiday from May 15 to October 15	>0.25 inch rain event; NWS wind advisories	Zero trash (annual discharge)
Long Beach City Beaches and Los Angeles River Estuary Bacteria	Bacteria	90th percentile year in terms of wet days (1993; 75 days)	# wet days in year	exceedance day (daily); geometric mean (rolling 30-day)
Los Angeles Area Lakes TMDLs	Nitrogen, phosphorus, mercury, trash, OC pesticides, and PCBs	refer to EPA TMDL for specific pollutant and waterbody	refer to EPA TMDL for specific pollutant and waterbody	refer to EPA TMDL for specific pollutant and waterbody
SAN GABRIEL RIVER WATERSHED MANAGEMENT AREA				
San Gabriel River and Impaired Tributaries Metals and Selenium	Metals and selenium	1) Dry weather: dry-weather non-WRP flow; 2) Wet weather (SGR R2 >=260 cfs; Coyote Ck >=156 cfs)	Flow	daily load

Appendix B
Summary of TMDL Critical Conditions Relevant to MS4 Discharges

TMDL Name	Type of Pollutant(s)	Critical Condition	Critical Condition Metric	WLA Expression
Los Angeles Area Lakes TMDLs	Nitrogen, phosphorus, mercury, trash, OC pesticides, and PCBs	refer to EPA TMDL for specific pollutant and waterbody	refer to EPA TMDL for specific pollutant and waterbody	refer to EPA TMDL for specific pollutant and waterbody
LOS CERRITOS CHANNEL AND ALAMITOS BAY WATERSHED MANAGEMENT AREA				
Los Cerritos Channel Metals	Metals	Wet weather (max daily flow >=23 cfs/90th percentile flow)	Flow	Daily load (based on Load duration curve)
Colorado Lagoon OC Pesticides, PCBs, Sediment Toxicity, PAHs, and Metals	OC Pesticides, PCBs, Sediment Toxicity, PAHs, and Metals	Not specified	Not specified	Concentration-based monthly average and mass-based annual load

Note: This is for informational purposes only; please consult the LA County MS4 Permit and the applicable Basin Plan TMDL language for regulatory requirements regarding critical conditions and application of waste load allocations.

APPENDIX C

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

Los Angeles Regional Water Quality Control Board

To: Los Angeles County MS4 Permittees

FROM: Renee Purdy RAP
Section Chief
Regional Programs

DATE: March 24, 2014

SUBJECT: LOS ANGELES COUNTY HUC-12 EQUIVALENT TECHNICAL MEMORANDUM

As discussed at the October 23, 2013 Technical Advisory Committee meeting of the LA County MS4 Permit, the County of Los Angeles has refined the USGS Watershed Boundary Dataset (WBD) hydrologic unit delineations within Los Angeles County based on local data and has developed HUC-12 equivalent boundaries that are more hydrologically accurate. The California Regional Water Quality Control Board, Los Angeles Region (Regional Board) has reviewed the County's proposed HUC-12 equivalent boundaries relative to the national HUC-12 boundaries. The Regional Board has also reviewed the two sets of boundaries in comparison with the watershed group boundaries that have been established by the MS4 Permittees in their notifications of intent to develop a WMP or EWMP.

Through this memorandum, the Regional Board hereby accepts the use of the HUC-12 equivalent boundaries for purposes of conducting reasonable assurance analysis (RAA) and monitoring pursuant to requirements of the LA County MS4 Permit with the following conditions. First, Permittees must use either the national HUC-12 boundaries or the County's HUC-12 equivalent boundaries for both their RAA and monitoring program. Second, Permittees must clearly state in their draft WMP/EWMP whether their RAA and monitoring program is based on the national HUC-12 boundaries or the County's HUC-12 equivalent boundaries. Third, where Permittees elect to use the HUC-12 equivalents, they must coordinate with the neighboring WMP/EWMP groups to ensure that there are no gaps in the geographic areas addressed in the RAA or monitoring programs.

Regarding the third condition, the Regional Board notes that there are discrepancies in the areal coverage between the original HUC-12 and the HUC-12 equivalent areas that could lead to gaps in geographic coverage if neighboring WMP/EWMP groups are not using the same boundaries (see Attachment 1). Therefore, Permittees in the following WMP/EWMP groups (see Attachment 2) must coordinate to ensure coverage of all areas in the RAA:

1. Groups 2, 11, 13, 14, 16, 17, 19 and individual WMPs
2. Groups 3, 4, 8, 9 and 18
3. Groups 5, 6, 7 and individual WMPs

The boundaries of Groups 1, 10, 12, and 15 do not appear to be impacted by the use of the HUC-12 equivalent boundaries; however, groups should confirm this. There are subwatershed boundary changes within each of the groups, which may need to be considered in the RAA and in the development of CIMPs.

Should you have any questions, please do not hesitate to call me at (213) 576-6622 or Ivar Ridgeway at (213) 620-2150.

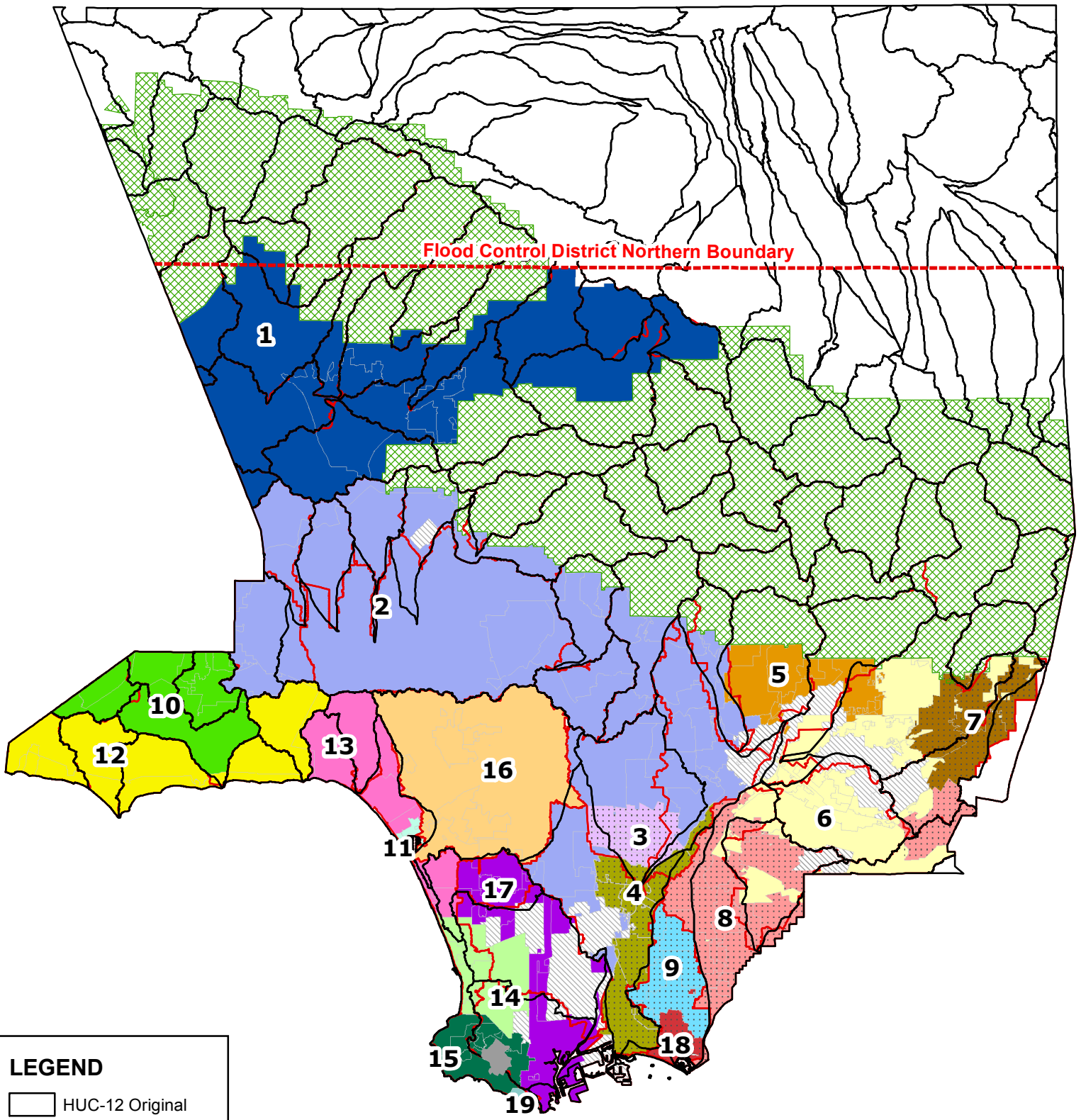
cc: Jun Zhu, RWQCB

Attachment 1 - EWMP/WMP Groups

Status as of 04/15/2014

N

0 3 6 Miles



LEGEND

- HUC-12 Original
- HUC-12 Equivalent
- Individual WMP
- Collaborative WMP
- No WMP

RB-AR1804

Attachment 2 - WMP/EWMP GROUPS and INDIVIDUAL CITIES

Status as of 03/24/2014

Bold = Lead/Coordinator

	Group Name	Cities/Permittees Involved	Selected Plan	SD
1	Upper Santa Clara River Watershed	**Santa Clarita**, County, LACFCD	EWMP	5
2	Upper Los Angeles River Watershed Group	Alhambra, Burbank, Calabasas, Glendale, Hidden Hills, La Canada Flintridge, **Los Angeles**, Montebello, Monterey Park, Pasadena, Rosemead, San Gabriel, San Marino, South Pasadena, Temple City, County, LACFCD	EWMP	1, 2, 3, 5
3	Los Angeles River Upper Reach 2 Sub Watershed	Bell, Bell Gardens, Commerce, Cudahy, Maywood, **Huntington Park**, Vernon, LACFCD	WMP	1
4	Lower Los Angeles River Watershed	Downey, Long Beach, Lynwood, Paramount, Pico Rivera, **Signal Hill**, South Gate, LACFCD	WMP (w/ option to switch to EWMP)	1, 2, 4
5	Rio Hondo/San Gabriel River Water Quality Group	Arcadia, Azusa, Bradbury, Duarte, Monrovia, **Sierra Madre**, County, LACFCD	EWMP	1, 5
6	Upper San Gabriel River	Baldwin Park, Covina, Glendora, Industry, La Puente, **County,** LACFCD	EWMP	1, 4, 5
7	East San Gabriel Valley Watershed Management Area	Claremont, **La Verne**, Pomona, San Dimas	WMP	1, 5
8	Lower San Gabriel River	Artesia, Bellflower, Cerritos, Diamond Bar, Downey, Hawaiian Gardens, La Mirada, Lakewood, Long Beach, **Norwalk**, Pico Rivera, Santa Fe Springs, Whittier, LACFCD	WMP (w/ option to switch to EWMP)	4
9	Los Cerritos Channel Watershed Group	Bellflower, Cerritos, Downey, Lakewood, **Long Beach**, Paramount, Signal Hill, LACFCD	WMP (w/ option to switch to EWMP)	4
10	Malibu Creek Watershed Group	Agoura Hills, **Calabasas**, Hidden Hills, Westlake Village, County, LACFCD	EWMP	3
11	Marina del Rey	Culver City, Los Angeles, **County**, LACFCD	EWMP	2, 3, 4
12	North Santa Monica Bay Coastal Watersheds	**Malibu**, County, LACFCD	EWMP	3
13	Santa Monica Bay Watershed Jurisdictions 2 & 3	El Segundo, **Los Angeles,** Santa Monica, County, LACFCD	EWMP	3, 4
14	Beach Cities Watershed Management Group	Hermosa Beach, Manhattan Beach, **Redondo Beach**, Torrance, LACFCD	EWMP	4
15	Peninsula EWMP Agencies	Palos Verdes Estates, **Rancho Palos Verdes**, Rolling Hills Estates, County, LACFCD	EWMP	4
16	Ballona Creek	Beverly Hills, Culver City, Inglewood, **Los Angeles**, Santa Monica, West Hollywood, County, LACFCD	EWMP	2, 3, 4
17	Dominguez Channel Watershed Management Area Group	El Segundo, Hawthorne, Inglewood, **Los Angeles**, County, LACFCD	EWMP	2, 4
18	Alamitos Bay/Los Cerritos Channel Group	**County**, LACFCD	WMP	4
19	Santa Monica Bay Watershed Jurisdiction 7	**Los Angeles**, LACFCD	WMP	4

	City	Watershed Management Area	Compliance Method	SD
a	Carson	Dominguez Channel WMA	Individual WMP	2
b	Compton	LA River (Compton Creek) & Dominguez Channel	Individual WMP	2
d	El Monte	LA River and San Gabriel River	Individual WMP	1
e	Gardena	Dominguez Channel WMA	Individual WMP	2
g	Irwindale	LA River and San Gabriel River	Individual WMP	1
h	La Habra Heights	San Gabriel River	Individual WMP	4
i	Lawndale	Dominguez Channel WMA	Individual WMP	2
j	Lomita	Dominguez Channel WMA (Machado Lake)	Individual WMP	4
k	Rolling Hills	Dominguez Channel WMA (Machado Lake, LA Harbors) & Santa Monica Bay Watershed Jurisdiction 7	No WMP	4
l	San Fernando	Los Angeles River	Individual WMP	3
m	South El Monte	LA River and San Gabriel River	Individual WMP	1
n	Walnut	San Gabriel River	Individual WMP	1
o	West Covina	San Gabriel River	Individual WMP	1

National Forest Area