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Los Angeles River Watershed Bacteria TMDL – Technical Report Section 3: Numeric Targets

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3.1 Introduction

The purpose of the LA River Watershed Bacteria TMDL is to protect users of recreational waters within the LA River Watershed from waterborne pathogens that could cause illness. Numeric TMDL targets identify specific goals for the TMDL that equate to attainment of water quality standards and provide the basis for data analysis and final TMDL allocations. Monitoring of all waterborne pathogens is infeasible and therefore "indicators" are used to predict the presence of pathogens and/or fecal sources. The Water Quality Control Plan for the Los Angeles Region (Basin Plan) contains numeric and narrative water quality objectives (WQOs) based on indicator bacteria to protect recreational beneficial uses, as presented in Section 2 (Problem Statement) and **Table 1**. Therefore, the numeric targets for this TMDL will also be based on indicator bacteria.

The Basin Plan currently includes REC-1 WQOs based on *E. coli* and fecal coliform concentrations. To implement the single sample bacteria objectives for waters designated REC-1, an allowable number of exceedance days are assigned as TMDL targets for the LA River reaches and tributaries. The allowable numbers of exceedance days for the LA River Watershed Bacteria TMDL are based on *E. coli* measurements. Targets based on *E. coli* are also considered to be protective of fecal coliform WQOs, as follows:

1. *E. coli* are a subset of fecal coliform. It is common in the Los Angeles region to use a 1:1 "translator" between *E. coli* and fecal coliform (e.g., see Section 4.3 of the Ballona Creek Bacteria TMDL). If a 1:1 translator were applied for this TMDL, then attainment of the *E. coli* WQO directly equates to attainment of the fecal coliform WQO.
2. *E. coli* is the preferred indicator for freshwater as identified in the 1986 *USEPA Ambient Water Quality Criteria for Bacteria*, which is the basis of the Basin Plan WQOs.
3. *E. coli* provides equivalent (or superior) protection to recreational users as fecal coliform (USEPA, 1986; Wade et al, 2006).

The 1986 USEPA bacteria criteria allow for different WQOs based on the intensity of use; however, the Basin Plan does not currently recognize differences between the intensity of use observed at a bathing beach and the intensity of use likely to be found at inland surface waters.

Table 1. Los Angeles Region Basin Plan Water Quality Objectives for Recreational Beneficial Uses in Fresh Waters

Beneficial Use	Single Sample Density Limits[1]		Geometric Mean Density Limits[2]	
	Fecal Coliform	*E. coli*	Fecal Coliform	*E. coli*
Water Contact Recreation (REC-1)	≤ 400/100mL	≤ 235/100mL	≤ 200/100mL	≤ 126/100mL
Non-Contact Water Recreation (REC-2)	≤ 4000/100mL	NA	≤ 2000/100mL	NA

1 – Maximum value of a single grab sample **2** – The geometric mean values should be calculated based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period).
NA – Water quality objective does not apply for this indicator.

3.2 Reference Watershed Approach

As allowed by the Basin Plan, the LA River Watershed Bacteria TMDL uses a "reference system/anti-degradation approach" which means that based on historical exceedance levels at reference system monitoring locations, a certain frequency of WQO exceedance is permitted. This approach recognizes there are natural sources of bacteria that may cause or contribute to exceedances of the bacteriological WQOs, and that it is neither the intent of the Los Angeles Regional Water Quality Control Board (Regional Board) to require treatment or diversion of natural creeks nor to require treatment of natural sources of bacteria. The numeric target in this TMDL will be expressed as 'allowable exceedance days' of the utilized indicator because bacterial density and the frequency of exceedances is most relevant to public health. The USEPA allows states to select the most appropriate measure to express the TMDL; and allowable exceedance days are considered an 'appropriate measure' consistent with the definition in 40 CFR 130.2(i). This is consistent with previous bacteria TMDLs in the region.

3.2.1 GENERAL DESCRIPTION OF REFERENCE WATERSHED APPROACH

The determination of the number of allowable exceedance days used for TMDL targets and allocations in Bacteria TMDLs in Region 4 are based on a reference watershed (RW) approach. The RW approach uses the WQO exceedance probabilities in a reference/background system to calculate a number of allowable exceedances days for impaired watersheds. The number of allowable exceedance days is based on two requirements: (1) bacteriological water quality at any site is *at least* as good as at a designated reference site, and (2) there is no degradation of existing bacteriological water quality if historical water quality at a particular site is *better than* the designated reference site. None of the LA River reaches or tributaries exhibit water quality better than the reference system. The LA River reaches and tributaries addressed under this TMDL (as discussed in Section 2) will be assigned an allowable number of WQO exceedance days for the following two conditions:

1. Dry weather days
2. Wet-weather days

Wet weather is defined as days with 0.1 inches of rain or more plus three days following the rain event. REC-1 uses associated with the swimmable goal as expressed in the federal Clean Water Act are suspended through the High Flow Suspension (HFS) Basin Plan Amendment (BPA) (LARWQCB, 2003), which is applied to certain reaches and tributaries that are concrete-lined channels during days with greater than or equal to 0.5 inches of rain and the following 24 hours (**Table 2**). Previous Bacteria TMDLs completed in the region have not defined the rain gage used to evaluate wet weather or HFS conditions during TMDL implementation.

Table 2. Los Angeles River Reaches and Tributaries Addressed by High Flow Suspension (HFS) Basin Plan Amendment [1,2]

Stream Reach	Hydro Unit	Corresponding Reach
Los Angeles River to Estuary	405.12	LA River Reach 1
Los Angeles River	405.15 [a]	LA River Reach 2
Los Angeles River	405.21	LA River Reach 3, 4, 5, and 6
Rio Hondo below Spreading Grounds	405.15	Rio Hondo Reach 1 and 2
Rio Hondo to Spreading Grounds	405.15	Rio Hondo [3]
Rio Hondo	405.41	Rio Hondo [3]
Verdugo Wash	405.24	Verdugo Wash Reach 1 and 2 [4]
Burbank Western Channel	405.21	Burbank Western Channel [5]
Tujunga Wash	405.21	Tujunga Wash [5]

1 – This table is in the process of being updated and will be finalized in the TMDL Staff Report.

2 – The High Flow Suspension (HFS) only applies to water contact recreational activities associated with the swimmable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use; non-contact water recreation involving incidental water contact regulated under the REC-2 use; and the associated bacteriological objectives set to protect those activities. Water quality objectives set to protect (1) other recreational uses associated with the fishable goal as expressed in the federal Clean Water Act section 101(a)(2) and regulated under the REC-1 use and (2) other REC-2 uses (e.g., uses involving aesthetic aspects of water) shall remain in effect at all times for waters where the HFS applies.

3 – Rio Hondo above the Spreading Grounds does not have distinct reaches. Rio Hondo Reach 2 ends in Hydro Unit 405.15. It is unclear whether the HFS BPA applies to the tributaries that form the "headwaters" of Rio Hondo, including Alhambra Wash, Arcadia Wash, Eaton Wash, Santa Anita Wash, and Sawpit Wash. All of these tributaries are in Hydro Unit 405.41.

4 – The HFS BPA likely applies to both Reach 1 and 2 of Verdugo Wash. However, Verdugo Wash Reach 1 is in Hydro Unit 415.15.

5 – This tributary does not have distinct reaches in the Basin Plan.

a – The HFS BPA lists Hydro Unit 415.16, but this Hydro Unit was not found in the available GIS information. It is assumed that 405.15 is the corresponding Hydro Unit, as it covers a majority of the LA River mainstem.

3.2.2 REFERENCE SYSTEM

As discussed previously, the RW approach uses the WQO exceedance probabilities at a reference/background site to calculate a number of allowable exceedances days for impaired watersheds. Specifically, the RW approach uses the product of (1) exceedance probabilities of WQOs at a reference/background site and (2) the number of days during a critical year. Previous TMDLs used 1993 as a critical (90th percentile) 'storm year' to determine the number of allowable exceedance days, based on data from the LAX rainfall station (LARWQCB, 2003).[1] This TMDL will also use 1993 as a critical year.

Previous TMDLs in the region have relied on exceedance probabilities based on samples collected from the ocean wave wash of Leo Carrillo Beach. However, the use of an inland freshwater, rather than marine, reference system would be more appropriate for the determination of the reference exceedance probability for bacteria TMDLs for inland watersheds. The Malibu Creek and Ballona Creek Bacteria TMDLs acknowledged the shortcoming of the use of a marine beach as a reference site for inland watersheds and recommended monitoring of freshwater reference sites. This TMDL will utilize a freshwater reference system based on monitoring by the Southern California Coastal Water Research Program (SCCWRP), which has conducted three studies that included bacteria monitoring of freshwater reference sites. Each of the following datasets was compiled into the LA River Bacteria TMDL database and utilized for development of the TMDL targets herein (also see Section 6.4 of the Source Assessment Appendix):

- **Natural Landscapes Study** (SCCWRP Technical Report 500) – monitored 22 reference sites distributed throughout Southern California, from Ventura County to San Diego County, between spring 2005 and spring 2006. Both dry and wet weather were sampled and analyzed herein.
- **Fecal Indicator Bacteria in Reference Streams** ("FIB Study"; SCCWRP Technical Report 542) – monitored 15 reference sites distributed throughout Southern California, from Ventura County to San Diego County, approximately weekly between spring 2006 and spring 2007. Some samples were collected during wet days, but SCCWRP recommended that these data not be used to represent wet weather conditions. Thus only dry weather samples from this dataset are analyzed herein.
- **Reference Beaches during Wet Weather** (SCCWRP Technical Report 448) – monitored four reference beach sites and nearby freshwater outlets from fall 2004 to winter 2005. Monitoring was only conducted during wet weather and freshwater samples were collected prior to mixing with the ocean. All wet weather data from this dataset are analyzed herein.

3.2.3 ANALYSIS OF REFERENCE SYSTEM DATA

During data processing, SCCWRP identified three sites from the FIB Study that exhibited exceptionally-high concentrations of *E. coli* and *Enterococcus* and re-categorized them as "minimally impacted" sites: Cheseboro Canyon (LA County), Stone Creek (San Diego County), and Cajon Creek (San Bernardino County). Retrospectively, SCCWRP identified conditions at

[1] The 'storm year' is defined as November 1 to October 31 to be consistent with the periods specified in AB411.

each of these sites that may have led to them having worse water quality than the reference sites. For instance, Cajon Creek is nearby a major highway and Cheseboro Canyon was subject to a fire and has heavily-used trails. The "minimally impacted" sites were removed from the dataset used for calculation of the reference exceedance probability and the targets in this TMDL. The details of the differences in exceedance probabilities can be found in the Source Assessment Appendix. An optional special study could be developed during the implementation phase of the TMDL to assess whether the minimally-impacted sites (and possibly others) should be utilized to develop TMDL targets.

Additionally, SCCWRP found that perennial sites typically exhibited lower indicator bacteria concentrations than ephemeral sites during dry weather. Data from ephemeral streams were included in the calculation of the reference exceedance probability for this TMDL because many of the natural streams in the LA River watershed and Southern California are ephemeral.

The censored SCCWRP dataset (i.e., with minimally impacted sites removed) was analyzed using the methodology of previous TMDLs in order to calculate exceedance probabilities of the single sample maximum (SSM) and geometric mean ("geomean") WQOs. The data in the SCCWRP dataset were separated into dry weather and wet weather conditions for the calculation of exceedance probabilities. A geomean was calculated in all cases where five samples were collected from a site within 30 days. Dry weather geomean calculations do not include wet weather samples and geomeans were not calculated for wet weather conditions. Exceedance probabilities were separated into weather conditions rather than seasons because this is how stormwater BMPs in the region often operate (i.e., as long as weather is dry, dry weather BMPs operate even during winter). The results of the SCCWRP analysis are presented in **Table 3**. For a more detailed presentation of the analysis and results see **Section 6.6** of Appendix A.

Table 3. Dry Weather Exceedance Probability of Single Sample Maximum and Geometric Mean WQOs (2005-2007) and Wet Weather Exceedance Probability of Single Sample Maximum WQOs (2004-2006) based on SCCWRP's Freshwater Reference Sites without Minimally Impacted Sites [1]

Statistic	All Dry Weather Dates		Wet Weather Events
	E. coli **Single Samples**	***E. coli*** **30-day Geomeans**	***E. coli*** **Single Samples**
Number of Data Points	450	263	70
Number > WQO[2]	7	4	13
% WQO Exceedance Probability	1.6%	1.5%	19%

1 – This table is based on the dry weather data collected during the studies that are summarized in SCCWRP Technical Reports 500 and 542 (21 sites) and the wet weather data that were collected during the studies that are summarized in SCCWRP Technical Reports 500 and 448 (11 sites) but does not include "minimally impacted sites".

2 – *E. coli* Single Sample WQO = 235 MPN/100 mL and *E. coli* 30-day Geometric Mean WQO = 126 MPN/100 mL

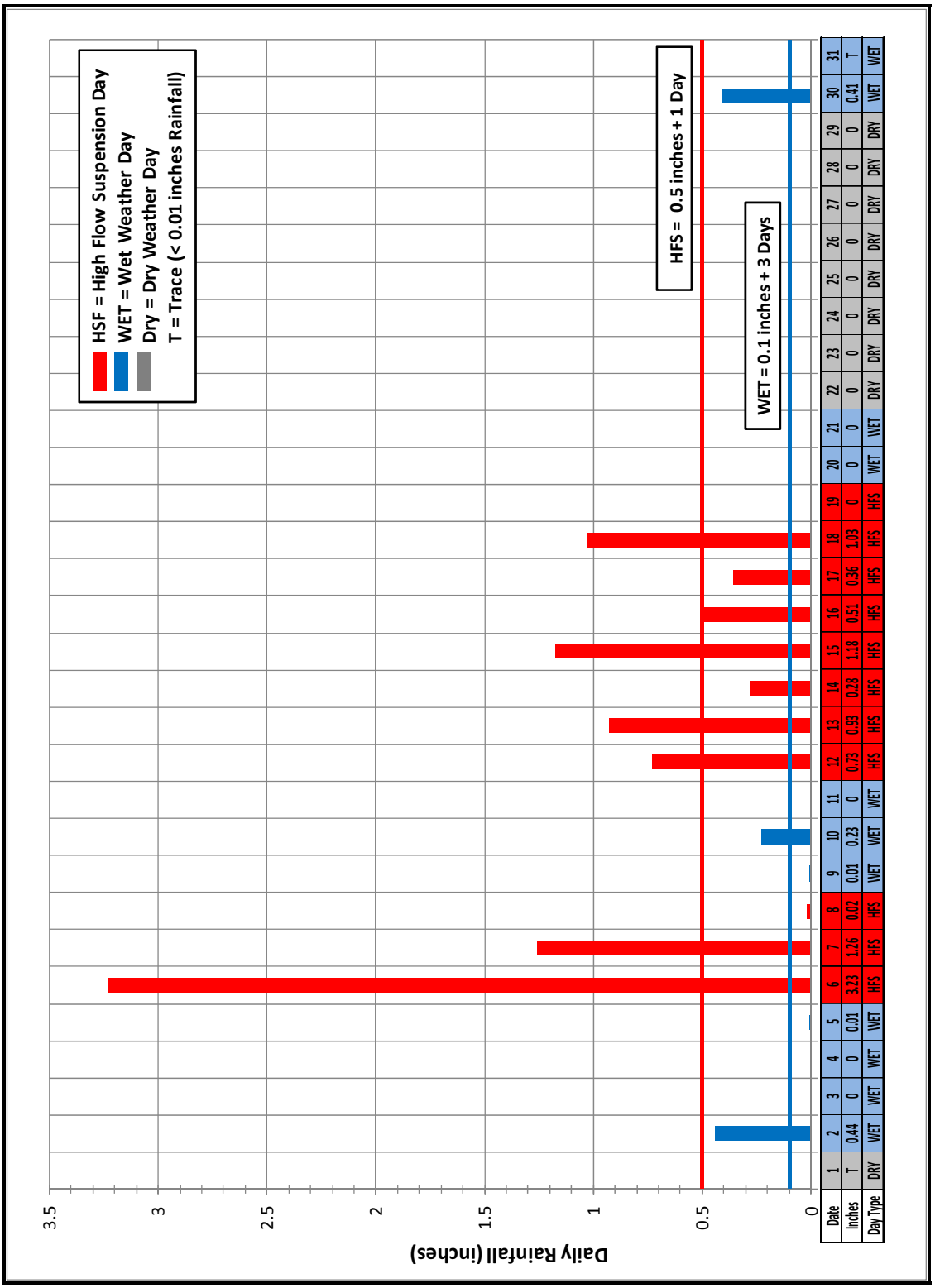
The analysis of the reference system data indicates that inland freshwater reference sites are subject to exceedances of geometric mean WQOs, and apparently at similar exceedance probabilities as dry weather single sample exceedances. However, previous Region 4 Bacteria TMDLs have not allowed any exceedances of the geometric mean WQO, and the Basin Plan limits the reference system approach to the single sample maximum. At this time, the data and low exceedance probabilities presented herein are not considered by Regional Board staff to be sufficient to support a revision to the Basin Plan to allow exceedances of geometric mean WQOs. An optional special study could be conducted during the implementation phase of the TMDL to collect data to further evaluate the appropriateness of allowable exceedances of the freshwater geometric mean WQO in inland reference watersheds.

Using the SCCWRP datasets, the reference system exceedance probabilities for the SSM were determined (**Table 3**). To calculate the number of allowable exceedance days, the calculated exceedance probability of the reference sites (**Table 3**) is multiplied by the number of days (wet or dry) during a critical year, as follows:

Allowable Exceedance Days = WQO Exceedance Probability in Reference System x Number of Days during a Critical Year that Recreational Uses would have Existed

In the critical year 1993, there were 75 wet days at the LAX rainfall station. To calculate allowable exceedance days for reaches and tributaries to which the HFS applies (**Table 1**), it is important to consider the number of days that would not have been suspended by the HFS during the critical year. In 1993, there were 26 wet weather days that would have been subject to the HFS BPA. Thus for calculation of allowable exceedance days, the number of wet weather days in a critical year is 75 for reaches/tributaries to which the HFS BPA does not apply, and 49 (75 – 26 = 49) for reaches/tributaries to which the HFS BPA applies.

In order to demonstrate the outcome of categorizing days as dry, wet, or suspended by the HFS, **Figure 1** analyzes example daily rainfall data from the LAX rainfall gage for the month of January 1993. Each day is categorized as wet, dry, or "HFS". The size and duration of storm events affects the categorization of wet versus HFS because the definition of an HFS day is based on 0.5 inches of rainfall and a 24-hour post-rainfall period, while the definition of wet day is based on 0.1 inches of rainfall and a three (3)-day post-rainfall period. Days that are neither wet nor HFS are categorized as dry.



Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Inches	T	0.44	0	0	0.01	3.23	1.26	0.02	0.01	0.23	0	0.73	0.93	0.28	1.18	0.51	0.36	1.03	0	0	0	0	0	0	0	0	0	0	0	0.41	T
Day Type	DRY	WET	WET	WET	WET	HFS	HFS	HFS	WET	WET	WET	HFS	HFS	HFS	HFS	HFS	HFS	HFS	HFS	WET	WET	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	WET	WET

Figure 1. Graphical Representation the Applicability of Wet Weather and High Flow Suspension Days (HFS). Daily Rainfall Totals as Measured at the LAX Rain Gage for the Month of January 1993.

3.3 Final TMDL Targets

The calculations of final TMDL targets are based on the RW approach, as generally described in **Section 3.2**, and detailed below. All reaches and tributaries addressed through this TMDL have REC-1 beneficial use designations. The REC-1 WQOs for *E. coli* are protective of REC-2, and thus REC-2 targets are not necessary.

For determination of dry and wet weather conditions during TMDL implementation, the Los Angeles County DPW real-time rainfall gage at the University of Southern California (USC gage #375) will be used. This gage is appropriate because (1) it is near the geographic center of the LA River watershed and (2) it has been used historically by LA area agencies for determination of dry and wet weather conditions, including advisory postings of LA County marine beaches.

3.3.1 DETERMINATION OF DRY WEATHER EXCEEDANCE DAYS

The dry weather TMDL targets are expressed as a number of allowable exceedance days of the *E. coli* SSM WQO (235 MPN/100mL), as shown in **Table 4**. The number of SSM allowable exceedance days are calculated using the equation presented above. The dry weather SSM exceedance probability of the WQO in the SCCWRP dataset is 1.6% (from **Table 3**). Per the Santa Monica Bay Beaches TMDL there are 290 dry weather days during a 90th percentile critical wet year (1993). Therefore, using the calculation methodology of previous TMDLs, and presented above, the number of allowable dry weather SSM exceedance days is 5 (290 days * 1.6%).[2] Zero geomean exceedance days are allowed because the Basin Plan amendment that describes the RW approach is limited to the single sample maximum WQO.

For the purposes of this TMDL, calculation of the geometric mean will likely be based on one of the following: rolling 30-day periods or consecutive calendar months. Both of these options are included herein because the Regional Board is currently considering the methodology for calculation of the geometric mean during reconsideration of the Santa Monica Bay Bacteria TMDL. The geometric mean calculation is an issue that affects the entire Los Angeles region. As such, this Technical Report simply includes the two options for the TMDL Staff Report (rolling and calendar month). In either case, generally five samples will be used to calculate geometric mean concentrations during TMDL implementation, though weekly sampling is considered sufficiently frequent for determination of geometric mean concentrations. Note that this threshold does not necessitate that weekly monitoring be conducted; instead, less frequent grab samples can be compared to the SSM TMDL target. The methodology for monitoring and calculating 30-day geometric mean concentrations during TMDL implementation is further described in the Monitoring section (Section 8 not yet developed).

[2] Consistent with the Santa Monica Bay Beaches TMDL, where the fractional remainder for the calculated allowable exceedance days exceeds 1/10th then the number of days are rounded up (e.g., 4.12 is rounded up to 5). In instances where the tenth decimal place for the allowable exceedance days (or weeks or months) is lower than 1/10th then the number of days are rounded down (e.g., 4.02 is rounded down to 4).

3.3.2 DETERMINATION OF WET WEATHER EXCEEDANCE DAYS

The wet weather TMDL targets are expressed as a number of allowable exceedance days of the *E. coli* SSM WQO (235 MPN/100mL), as shown in **Table 5**. The wet weather exceedance probability of the WQO in the SCCWRP dataset is 19% (from **Table 3**). During a 90th percentile critical wet year (1993), there are there are 75 wet days, of which 49 would not have been subject to the HFS BPA. Therefore, using the calculation methodology of previous TMDLs, and presented above, the number of allowable wet weather exceedance days is 15 (75 days * 19%) for reaches and tributaries to which the HFS BPA does not apply.[2] For reaches and tributaries to which the HFS BPA applies, the number of allowable wet weather exceedance days is 10 (49 days * 19%).[2]

While the geometric mean WQO applies to all 30-day periods, a geometric mean TMDL target is not included in the Table 5 because it is very unlikely that wet weather conditions would extend over 30-days. The incorporation of wet weather samples for geometric mean calculations during TMDL implementation is an important consideration. The 1986 criteria on which the bacteria WQOs are based were developed using long-term seasonal epidemiological studies and "steady state" conditions. The criteria document (USEPA, 1986) states the following:

> It is recommended that sampling frequency be related to the intensity of use of the water body. […] In general, samples should be collected during dry weather periods to establish so-called "steady state" conditions. Special studies may be necessary to evaluate the effects of wet weather conditions on waters of interest especially if sanitary surveys indicate the area may be subject to storm water effects.

Thus it is questionable whether samples collected during short-duration storm events should be included in 30-day geometric mean calculations. Ultimately, it is a policy decision by the Regional Board to establish whether or not wet weather samples will be incorporated in the calculation of the geometric mean during TMDL implementation. For the purposes of this Technical Report, two options are provided for the TMDL Staff Report: wet weather samples will either be included or they will not be included in geometric mean calculations during TMDL implementation. In the case that wet weather samples are included in geometric mean calculations, the calculation methodology could allow for time-based "weighting" of samples to account for the fact that storm events are generally short duration compared to the 30-day calculation period. The methodology for calculating 30-day geometric mean concentrations during TMDL implementation, including periods subject to wet weather, is further described in the Monitoring section (Section 8 not yet developed).

Table 4. Dry Weather Los Angeles River Watershed Bacteria TMDL Final Numeric Targets

Condition	Geometric Mean *E. coli* WQO (MPN/100mL)	Single Sample Maximum *E. coli* WQO (MPN/100mL)	Geometric Mean TMDL Target: Annual Allowable Exceedance Days [a]	Single Sample Maximum TMDL Target: Annual Allowable Exceedance Days [2, 3, 4, 5]
Dry Weather [1]	126 [a]	235	0 [b]	5

a – Geometric mean calculations will be based on either rolling 30-day periods or consecutive calendar months. Each geomean will be calculated using a minimum of four (4) samples. If insufficient data are available to calculate a geometric mean to compare to the geometric mean TMDL target, individual data points will be compared to the SSM TMDL target. When sufficient data exist to calculate a geometric mean, samples will be compared only to the geometric mean target. The methodology for calculating 30-day geometric mean concentrations during TMDL implementation, including periods subject to wet weather, is further described in the Monitoring section (Section 8 not yet developed).

b – Exceedances of the geometric mean WQO are not allowable. The BPA that incorporates the implementation provisions (RW approach) for the Region's bacteria WQOs is limited to the SSM WQO (LARWQCB, 2002).

1 – Dry weather is defined as days that are not "wet". Wet weather during TMDL implementation is defined as 0.1 inches of rainfall and the following three (3) days at the USC rain gage (#375).

2 – SSM annual allowable exceedance days calculated by the following equation: *Allowable Exceedance Days = WQO Exceedance Probability in Reference Watershed(s) x Number of Days during a Critical Year that Recreational Uses would have Existed.* The number of wet days in a critical year (1993) = 75 wet days, of which 49 days would not have been suspended by the HFS. Thus for calculation of allowable exceedance days, the number of days in a critical year is 75 for reaches/tributaries to which the HFS does not apply, and 49 for reaches/tributaries to which the HFS applies.

3 – Consistent with the Santa Monica Bay Beaches TMDL, where the fractional remainder for the calculated allowable exceedance days exceeds 1/10th then the number of days are rounded up (e.g., 4.12 is rounded up to 5). In instances where the tenth decimal place for the allowable exceedance days (or weeks or months) is lower than 1/10th then the number of days are rounded down (e.g., 4.02 is rounded down to 4).

4 – The calculated number of dry weather exceedance days assumes that daily sampling is conducted. To determine the number of allowable dry weather exceedances for less frequent sampling, a ratio is used. For example, in the case of weekly sampling, the number of weeks associated with dry conditions is determined as follows: (290 dry weather days/365 total days) x 52 weeks = 41.32 dry weeks in a year. The number of allowable dry weather weeks SSM exceedances is as follows: 41.32 dry weather weeks x 1.6% SSM exceedance probability = 1 exceedance day. In the case of monthly sampling: The number of months associated with a dry conditions is determined as follows: (290 dry weather days/365 total days) x 12 months = 9.53 dry months in a year. The number of allowable dry weather month SSM exceedances is as follows: 9.53 dry weather months x 1.6 % SSM exceedance probability = 1 dry weather exceedance day.

5 – The allowable number of exceedance days does not include days on which the HFS applies. The WQO does not apply during the HFS. Thus there is a difference in allowable exceedance days based on whether or not the HFS BPA applies to the reach or tributary.

Table 5. Final Wet Weather Numeric Targets for the Los Angeles River Bacteria TMDL [1,2]

Condition	Single Sample Maximum *E. coli* WQO (MPN/100mL)	Single Sample Maximum TMDL Target: Annual Allowable Exceedance Days [3, 4, 5, 6]
Wet Weather for Reaches and Tributaries Subject to High Flow Suspension Basin Plan Amendment[2,7]	235	10
Wet Weather for Reaches and Tributaries **not** Subject to High Flow Suspension Basin Plan Amendment[2]	235	15

1 – Geometric mean targets are not included in Table 5 because it is improbable that wet weather would extend over 30-day periods. However the geometric mean targets in Table 4 apply to all 30-day periods. This Technical Report provides two options for the the TMDL Staff report: wet weather samples will either be included or they will not be included in geometric mean calculations during TMDL implementation. The methodology for calculating 30-day geometric mean concentrations during TMDL implementation, including periods subject to wet weather, is further described in the Monitoring section (Section 8 not yet developed).

2 – Wet weather during TMDL implementation is defined as 0.1 inches of rainfall and the following three (3) days at the USC rain gage (#375).. For the purposes of this TMDL, the HFS will apply on days with rainfall greater than 0.5 inches at the USC rain gage, plus the following (1) one day. Applying HFS to 1 following day, as opposed to the 24 hours following the end of a 0.5 inches or greater rainfall event, is intended to simplify TMDL implementation.

3 – SSM annual allowable exceedance days calculated by the following equation: *Allowable Exceedance Days = WQO Exceedance Probability in Reference Watershed(s) x Number of Days during a Critical Year that Recreational Uses would have Existed.* The number of wet days in a critical year (1993) = 75 wet days, of which 49 days would not have been suspended by the HFS. Thus for calculation of allowable exceedance days, the number of days in a critical year is 75 for reaches/tributaries to which the HFS does not apply, and 49 for reaches/tributaries to which the HFS applies.

4 – Consistent with the Santa Monica Bay Beaches TMDL, where the fractional remainder for the calculated allowable exceedance days exceeds 1/10th then the number of days are rounded up (e.g., 4.12 is rounded up to 5). In instances where the tenth decimal place for the allowable exceedance days (or weeks or months) is lower than 1/10th then the number of days are rounded down (e.g., 4.02 is rounded down to 4).

5 – The calculated number of dry weather exceedance days assumes that daily sampling is conducted. To determine the number of allowable dry weather exceedances for less frequent sampling, a ratio is used. For example, in the case of weekly sampling, the number of weeks associated with dry conditions is determined as follows: (290 dry weather days/365 total days) x 52 weeks = 41.32 dry weeks in a year. The number of allowable dry weather weeks SSM exceedances is as follows: 41.32 dry weather weeks x 1.6% SSM exceedance probability = 1 exceedance day. In the case of monthly sampling: The number of months associated with a dry conditions is determined as follows: (290 dry weather days/365 total days) x 12 months = 9.53 dry months in a year. The number of allowable dry weather month SSM exceedances is as follows: 9.53 dry weather months x 1.6 % SSM exceedance probability = 1 dry weather exceedance day.

6 – The allowable number of exceedance days does not include days on which the HFS applies. The WQO does not apply during the HFS. Thus there is a difference in allowable exceedance days based on whether or not the HFS BPA applies to the reach or tributary.

7 – For reaches or tributaries subject to the HFS, the WQO only applies on non-HFS days. During TMDL implementation, the observed number of annual exceedance days is based on samples collected during non-HFS days, and the number of annual HFS days does not affect the number of annual allowable exceedance days.

3.4 Continuing Process

The science of recreational water quality is rapidly advancing. The federal BEACH Act (40 CFR 32.1) requires USEPA to conduct a *Criteria Development Plan* (R/7-097-432). Under the ongoing *Plan*, the USEPA is conducting additional epidemiological studies and quantitative microbial risk assessments (QMRAs) for fresh- and marine waters impacted by point- and non-point sources (Boehm et al., 2009). The assays being utilized by USEPA include *Enterococcus*, *E. coli*, and *Bacteroidales*. Under a legal settlement, USEPA is committed to issuing new and/or revised criteria by October 15, 2012. The State will likely have at least two years to implement these new/revised criteria before promulgation by USEPA. In addition, the expected timeframe for implementation of this TMDL (which will likely be subject to additional criteria revisions by USEPA and the SWRCB) supports the use of indicators that evolve with the latest science of recreational water quality. During TMDL implementation and reopeners (see **Section 7** for a schedule for TMDL reopeners), the state of the science will be used to evaluate the most appropriate indicator(s) to protect existing recreational uses, and the target for this TMDL may be revised by the Regional Board through a Basin Plan Amendment, if appropriate. The iterative evaluation of the utilized target may include consideration of available USEPA criteria, epidemiological studies and/or QMRAs that are representative of site-specific conditions, conditions in natural/reference waters, and other relevant information.

3.5 References

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