DRAFT POLLUTION PREVENTION PLAN

FOR

TIME SCHEDULE ORDER
ORDER NO. R4-2015-0108
NPDES PERMIT NO. CAS004001

PREPARED BY:

BALLONA CREEK WATERSHED TSO PARTICIPANTS

City of Beverly Hills
City of Culver City
City of Inglewood
City of Los Angeles
County of Los Angeles
Los Angeles County Flood Control District
City of West Hollywood

Submitted on: July 13, 2015






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1 Introduction

In June 2006, the Los Angeles Regional Water Quality Control Board (Regional Board) adopted a Basin Plan Amendment (BPA) establishing the Ballona Creek Bacteria Total Maximum Daily Load (Bacteria TMDL). The TMDL became effective on April 27, 2007. The TMDL was amended in June 2012 and the amendment became effective on July 2, 2014. The requirements of the TMDL were incorporated into the 2012 MS4 Permit (Order No. R4-2012-0175; National Pollutant Discharge Elimination System [NPDES] Permit No. CAS004001). These requirements included receiving water limitations (RWLs) based on the TMDL targets, water quality based effluent limitations (WQBELs) based on the TMDL wasteload allocations (WLAs), as well as a schedule to attain the RWLs and WQBELs. The final compliance date to attain the RWLs and WQBELs during dry weather was April 27, 2013. The cities of Los Angeles, Beverly Hills, Culver City, Inglewood, and West Hollywood, the County of Los Angeles and Los Angeles County Flood Control District (LACFCD) anticipated that additional time would be necessary to comply with bacteria WQBELs and RWLs during dry weather as set forth in the MS4 Permit, and requested and were granted a time schedule order (TSO) by the Regional Board. The TSO is effective from May 14, 2015 to December 15, 2019.

As the TSO is longer than one year, interim requirements and dates for their achievement are included in the TSO. These requirements include interim water quality-based effluent limitations, interim receiving water limitations, and actions and corresponding milestones. One of the TSO requirements is the submittal of a Pollution Prevention Plan (PPP) by July 13, 2015. This Pollution Prevention Plan (PPP) was prepared and submitted on behalf of all TSO Participants (Los Angeles, Beverly Hills, Culver City, Inglewood, and West Hollywood, the County of Los Angeles and LACFCD) to satisfy the TSO requirements.

2 Watershed Background

The Ballona Creek watershed is approximately 128 square miles (82,000 acres) in area and comprises the cities of Beverly Hills and West Hollywood, and portions of the cities of Los Angeles, Inglewood, Culver City, and Santa Monica, as well as unincorporated areas of the County of Los Angeles. Additionally, the Los Angeles County Flood Control District (LACFCD) owns and operates drainage infrastructure within incorporated and unincorporated areas in the watershed. The cities of Beverly Hills, Culver City, Inglewood, Los Angeles, and West Hollywood, and the County of Los Angeles and LACFCD are party to the TSO and collectively developed this PPP. A breakdown of the area by MS4 Permittee and other agencies is provided in **Table 1**. Collectively, the MS4 permittees in the Ballona Creek watershed have jurisdiction over approximately 123 square miles or 96 percent of the total watershed area. The TSO Participants have no jurisdiction over the land that is owned by the State of California (i.e., California Department of Fish and Wildlife, the State Lands Commission, and California Department of Transportation) and the United States Government. **Figure 1** provides a map of the watershed boundaries and the delineations of the jurisdictions of the MS4 permittees and other entities within the watershed.

Ballona Creek is an open channel for approximately 10 miles. Reaches 1 and 2 make up the freshwater portion of this 10-miles stretch. Below Reach 2, Ballona Creek becomes an estuary and reaches the Pacific Ocean at Playa del Rey. Ballona Creek originates from storm drains above Cochran Avenue. These storm drains, and the additional tributaries that meet up with Ballona Creek (Sepulveda Canyon Channel and Centinela Creek), drain the watershed. During dry weather flows in Ballona Creek upstream of Ballona Creek Estuary (Estuary) average approximately 16 cubic feet per second (cfs); however, during a 100-year storm event, these flows can reach 36,000 cfs (LARWQCB and USEPA, 2005).

Reach 1 (above National Boulevard) is the most northern portion of Ballona Creek. It stretches two miles from Cochran Avenue in Los Angeles, where it stems from a network of underground storm drains, to National Boulevard in Culver City. It is channelized with vertical concrete walls and base. Reach 2 (which extends from the Estuary to National Boulevard) is four miles long and ends at Centinela Ave. It is also channelized with concrete walls and base. The Estuary runs three and a half miles from Centinela Avenue to the Pacific Ocean at Playa del Rey. The Estuary portion of Ballona Creek has sloped concrete or riprap and concrete banks, and unlike Reaches 1 and 2, this section of Ballona Creek has a soft bottom and features tidal exchange. Sediments accumulate at the base of the sloped banks in areas with riprap. The freshwater in this section comes from upstream Reaches 1 and 2, and from Centinela Creek (including water diverted through the Ballona Freshwater Marsh), which is mainly storm-drain run off (LARWQCB and USEPA 2005, BCWMG 2014).

Table 1. Ballona Creek Watershed Land Area Distribution and Time Schedule Order (TSO)/Pollution Prevention Plan (PPP) Participation

TSO Participants	Land Area (sq. mi.)	% of Watershed Area
City of Beverly Hills	5.7	4.5%
County of Los Angeles	4.9	3.8%
Culver City	4.9	3.8%
City of Inglewood	3	2.3%
City of Los Angeles	102	80%
City of West Hollywood	1.8	1.4%
LACFCD	NA	
Other Agencies		
Caltrans	2.6	2.0%
State of California	1.4	1.1%
United States Government	1.1	0.9%
City of Santa Monica	0.3	0.2%
Total Watershed Area	**127.7**	**100%**

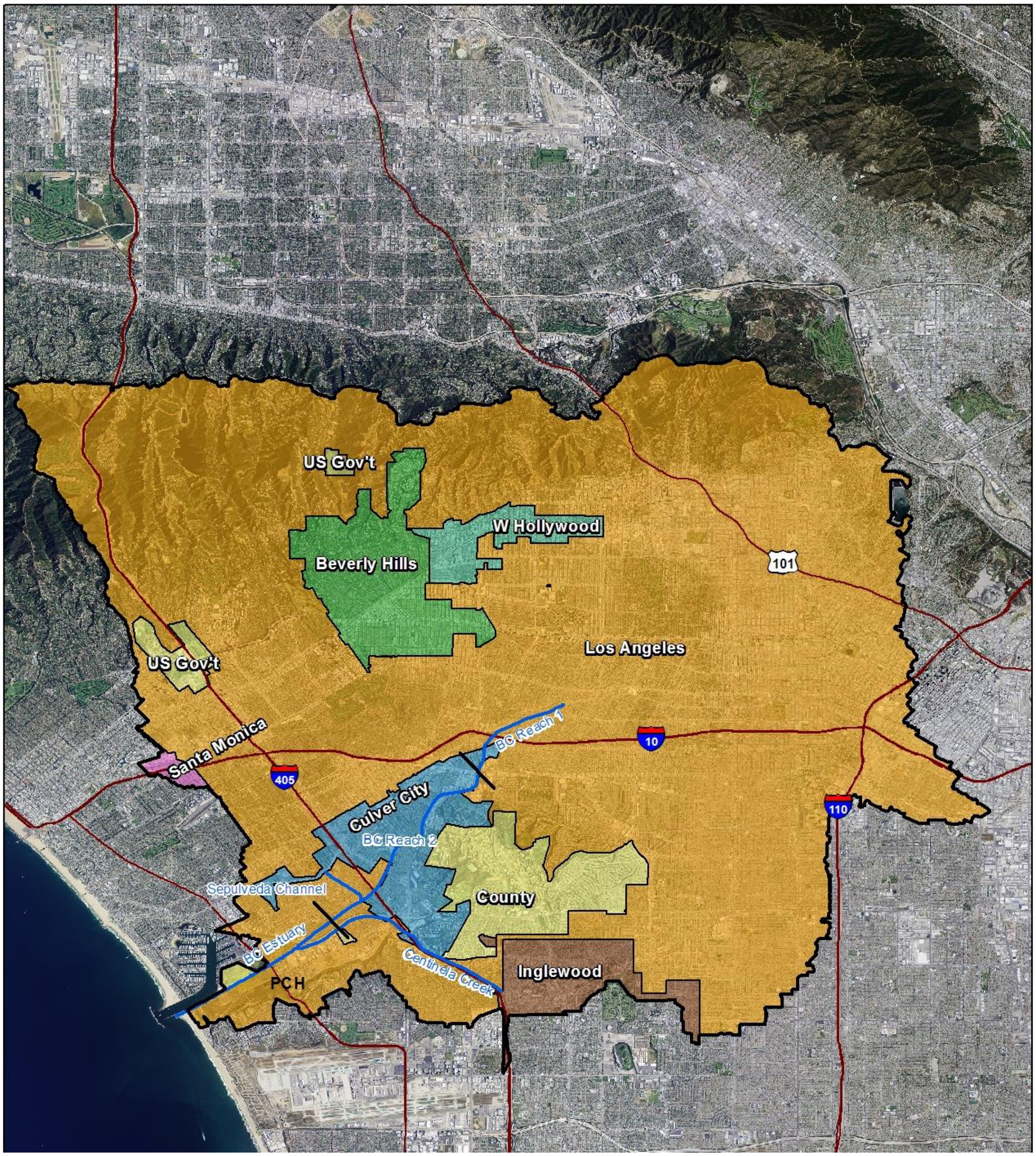

Figure 1. Jurisdictional Boundaries for Ballona Creek

3 Bacteria TMDL, Conditions, and TSO Requirements

On June 8, 2006, the Regional Board adopted the Ballona Creek, Ballona Estuary and Sepulveda Channel Bacteria TMDL (Bacteria TMDL) to address bacteria impairments in Ballona Creek and Ballona Estuary (Resolution No. R06-011). This TMDL became effective on April 27, 2007. The TMDL assigned wasteload allocations (WLAs) to the cities of Los Angeles, Beverly Hills, Culver City, Inglewood, Santa Monica, and West Hollywood, the County of Los Angeles and

LACFCD for bacteria during summer and winter dry weather, which were to be achieved by April 27, 2013. On June 7, 2012, the Los Angeles Water Board revised the Ballona Watershed Bacteria TMDL (Resolution No. R12-008). The revisions adjusted the reference system for freshwaters addressed in the TMDL, the allowable exceedance days, the method and time period for calculating geometric means, and corresponding WLAs and load allocations (LAs) in the TMDL. The revised TMDL became effective on July 2, 2014. The requirements of the TMDL were incorporated into the 2012 MS4 Permit. These requirements included WQBELs based on the TMDL WLAs and RWLs based on the TMDL targets. **Table 2** presents the WQBELs and **Table 3** and **Table 4** present the single sample and geometric mean RWLs, respectively.

Table 2. Water Quality-Based Effluent Limitations incorporated into the MS4 Permit based on the Ballona Creek Bacteria TMDL

Waterbody and Constituent	Effluent Limitations (MPN or CFU)	
	Daily Maximum	Geometric Mean
Ballona Creek Estuary		
Total coliform*	10,000 / 100 mL	1,000 / 100 mL
Fecal coliform	400 / 100 mL	200 / 100 mL
Enterococcus	104 / 100 mL	35 / 100 mL
Sepulveda Channel		
E. coli	235 / 100 mL	126 / 100 mL
Ballona Creek Reach 2		
E. coli	576 / 100 mL	126 / 100 mL
Ballona Creek Reach 1		
Fecal Coliform	4000 / 100 mL	2000 / 100 mL

* Total coliform density shall not exceed a daily maximum of 1,000 / 100 mL, if the ratio of fecal-to-total coliform exceeds 0.1.

Table 3. Single Sample Receiving Water Limitations incorporated into the MS4 Permit based on the Ballona Creek Bacteria TMDL

Waterbody and Time Period	Annual allowable exceedance days of single sample objectives	
	Daily sampling	Weekly sampling
Ballona Creek Estuary (includes Reach 2 and Centinela Creek at the confluence with the Estuary)		
Summer dry weather (April 1 to October 31)	0	0
Winter dry weather (November 1 to March 31)	9	2
Wet weather (year round)	17	3
Sepulveda Channel		
Dry weather	5	1
Wet weather (year round)	15	2

Waterbody and Time Period	Annual allowable exceedance days of single sample objectives	
	Daily sampling	Weekly sampling
Ballona Creek Reach 2 (includes Reach 1 and Benedict Canyon Channel at the confluence with Reach 2)		
Dry weather	5	1
Wet weather (year round)	15	2
Ballona Creek Reach 1		
All conditions (year round)	4000 / 100 mL Permittees shall not exceed the fecal coliform objective of 4,000/100 mL in more than 10% of samples collected from Ballona Creek Reach 1 during any 30-day period.	

Table 4. Geometric Mean Receiving Water Limitations incorporated into the MS4 Permit based on the Ballona Creek Bacteria TMDL

Waterbody and Constituent	Geometric Mean
Ballona Creek Estuary (includes Reach 2 and Centinela Creek at the confluence with the Estuary)	
Total coliform*	1,000 / 100 mL
Fecal coliform	200 / 100 mL
Enterococcus	35 / 100 mL
Sepulveda Channel	
E. coli	126 / 100 mL
Ballona Creek Reach 2 (includes Reach 1 and Benedict Canyon Channel at the confluence with Reach 2)	
E. coli	126 / 100 mL
Ballona Creek Reach 1	
Fecal Coliform	2000 / 100 mL

*Total coliform density shall not exceed a daily maximum of 1,000/100 ml, If the ratio of fecal-to-total coliform exceeds 0.1

3.1 Monitoring and Exceedances

Monitoring of indicator bacteria concentrations in receiving waters of the Ballona Creek watershed is currently conducted per the Coordinated Monitoring Plan (CMP) for the BC Bacteria TMDL submitted to the Regional Board in January 2009. The Ballona Creek Coordinated Integrated Monitoring Program (CIMP), submitted to the Regional Board on July 3, 2015, will replace and fully meet the Bacteria TMDL monitoring requirements once approved. Through a cost-sharing agreement by all watershed agencies, monitoring stations BCB-1 to BCB-8 (**Figure 2**) have been sampled on a weekly basis since June 2009. **Table 5** and **Table 6** summarizes the annual number of exceedance days observed of the single sample receiving water limitations in freshwater and marine waters, respectively.

Table 5. Summary of Ballona Creek, Benedict Canyon Channel and Sepulveda Channel Annual Dry Weather Exceedance Days of Single Sample Objectives

Year	Monitoring Site Names and Waterbodies				
	BCB-1	BCB-2	BCB-3	BCB-4	BCB-5
	Reach 1	Reach 2	Benedict Canyon Channel	Sepulveda Channel	Reach 2
2009	4	22	22	32	23
2010	2	18	25	36	22
2011	6	20	16	40	17
2012	8	25	25	38	23
2013	6	28	23	46	21
Average	5	23	22	38	21
Allowable Exceedances	*	1	1	1	1

* For Reach 1, Permittees shall not exceed the fecal coliform objective of 4,000/100 mL in more than 10% of samples collected from Ballona Creek Reach 1 during any 30-day period. Therefore, where weekly sampling is conducted, there are no allowable exceedances of this objective.

Table 6. Summary of Ballona Creek Estuary Annual Dry Weather Exceedance Days of Single Sample Objectives

Summer Dry Weather				Winter Dry Weather			
Year	Monitoring Site Names and Waterbodies			Year	Monitoring Site Names and Waterbodies		
	BCB-6	BCB-7	BCB-8		BCB-6	BCB-7	BCB-8
	Estuary	Centinela Creek	Estuary		Estuary	Centinela Creek	Estuary
2009	18	18	5	2009-10	15	15	5
2010	26	27	6	2010-11	12	12	3
2011	27	27	6	2011-12	13	12	5
2012	25	27	7	2012-13	15	14	4
2013	27	30	6	2013-14	18	17	4
Average	25	26	6	Average	15	14	4
Allowed	0	0	0	Allowed	2	2	2

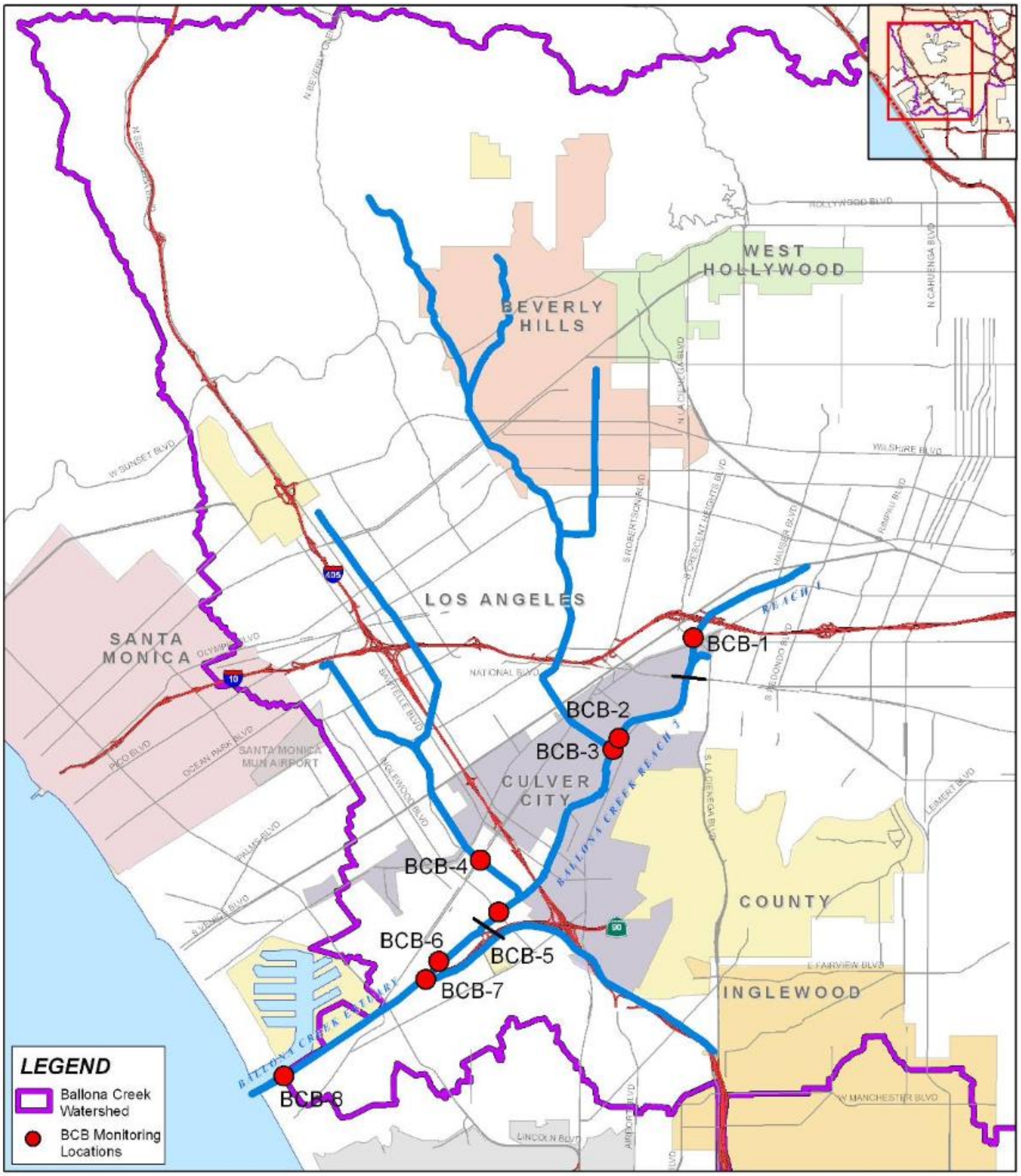

Figure 2. Ballona Creek Bacteria TMDL Coordinated Monitoring Plan Monitoring Stations

3.2 TSO Requirements

The TSO Participants anticipated that additional time would be necessary to comply with bacteria WQBELs and RWLs applicable to Ballona Creek, Ballona Creek Estuary, and Sepulveda Channel during dry weather as set forth in the MS4 Permit, and requested a TSO. The TSO Participants were granted a TSO by the Regional Board. The TSO is effective from May 14, 2015 to December 15, 2019. The TSO includes interim requirements for WQBELs and RWLs, and provides a schedule for of tasks for the implementation of watershed control measures. The requirements and schedule are described in the following sections.

3.2.1 Interim Limitations

The TSO specifies interim limitations during dry weather for fresh and marine waters from May 14, 2015 to September 30, 2019. The freshwater interim limitations apply to dry weather year-round, while the marine water limitations are differentiated for summer dry weather (April-October) and winter dry weather (November-March). The freshwater and marine water interim limitations are presented in **Table 7** and **Table 8**, respectively.

Table 7. Interim Water-Quality Based Effluent Limitations and Receiving Water Limitations for Freshwater Waterbodies

Waterbody	Annual Allowable Exceedance Days of Single Sample Bacteria Water Quality Objectives (Weekly Sampling)	
	Compliance Monitoring Location (Receiving Water)	Dry-Weather
Ballona Creek Reach 1	BCB-1	12
Ballona Creek Reach 2 (upper)	BCB-2	30
Benedict Canyon Channel at confluence with Ballona Creek Reach 2	BCB-3	30
Sepulveda Channel	BCB-4	48
Ballona Creek Reach 2 (lower)	BCB-5	26

Table 8. Interim Water-Quality Based Effluent Limitations and Receiving Water Limitations for Marine Waterbodies

Waterbody	Annual Allowable Exceedance Days of Single Sample Bacteria Water Quality Objectives (Weekly Sampling)		
	Compliance Monitoring Location (Receiving Water)	Summer Dry-Weather (Apr 1-Oct 31)	Winter Dry-Weather (Nov 1-Mar 31)
Ballona Creek Estuary (upper)	BCB-6	33	19
Centinela Creek at confluence with Ballona Estuary	BCB-7	36	18
Ballona Estuary (lower)	BCB-8	8	6

3.2.2 TSO Schedule

The TSO requires the Agencies subject to the TSO to complete a number of tasks, including watershed control measures, and provides a schedule for tasks to be implemented. The tasks required in the TSO as well as the responsible parties and schedule are shown in **Table 9**.

Table 9. Ballona Creek Bacteria TMDL Time Schedule Order Tasks and Schedule

Task	Description	Responsible Permittee	Completion Date
Monitor Ballona Creek Watershed	Continue to monitor the Ballona Creek Watershed in accordance with the Coordinated Monitoring Plan and Coordinated Integrated Monitoring Plan to determine compliance.	All Permittees	Ongoing
Submit Feasibility Study for Centinela Creek Project	Submit feasibility study for a Centinela Creek treatment or diversion project at Jefferson Boulevard.	City of Culver City	June 15, 2015
Submit Low Flow Reconnaissance Study	Submit completed report on Low Flow Reconnaissance Study.	County	June 15, 2015
Submit PPP	Submit a Pollution Prevention Plan. The PPP shall include proposed control measures identified in Findings 33 and 35-38, control measures identified based on the results of the Low Flow Reconnaissance Study, and any additional control measures needed to achieve compliance with limitations for bacteria during dry weather. The PPP shall identify interim tasks and associated schedules for task completion for each project.	All Permittees	July 13, 2015
Submit Evaluation of Diversion Alternative	Submit an evaluation of the alternative to construct a diversion to the sanitary sewer system at or downstream of proposed LFTF-1 site.	City of Los Angeles	May 16, 2016
Update PPP, as necessary, based on the Evaluation of Diversion Alternative	Update PPP, as necessary, based on Evaluation of Diversion Alternative. If diversion to the sanitary sewer (Schedule B} is selected as the recommended alternative, establish, at a minimum, annual subtasks in the updated PPP that include permitting, CEQA, design, and construction of the diversion facility.	All Permittees	July 13, 2016
Select LFTF-1 (Schedule A), or complete the diversion to sanitary sewer alternative (Schedule B)	Indicate whether the responsible Permittees will complete LFTF-1 (Schedule A presented in **Table 10**) or complete the diversion to sanitary sewer alternative (Schedule B presented in **Table 11**).	All Permittees	July 13, 2016
Completion of LFTF-1 or low flow diversion to sanitary sewer	Complete selected alternative as described in Schedule A (**Table 10**) or Schedule B (**Table 11**).	All Permittees	September 30, 2019
Complete PPP Subtasks	Complete subtasks outlined in PPP related to control measures identified in Findings 33-34 and control measures identified based on the results of the Low Flow Reconnaissance Study.	All Permittees	As specified in the PPP

Table 10. Ballona Creek Bacteria TMDL Time Schedule Order Schedule A (applicable if LFTF-1 is selected alternative)

Task	Description	Responsible Permittee	Completion Date
LFTF-1 Permitting and CEQA	Obtain all appropriate permits and complete CEQA requirements for LFTF-1. Submit a status update.	All Permittees	October 1, 2017
LFTF-1 Design	Complete and submit final design and construction schedule for LFTF-1.	All Permittees	April 1, 2018
LFTF-1 Construction	Complete construction of LFTF-1.	All Permittees	April 1, 2019
LFTF-1 Completion	Complete post-construction monitoring at LFTF-1. Submit preliminary results of post-construction monitoring.	All Permittees	September 30, 2019

Table 11. Ballona Creek Bacteria TMDL Time Schedule Order Schedule B (applicable if diversion to sanitary sewer is selected alternative)

Task	Description	Responsible Permittee	Completion Date
Compete Annual Diversion Subtasks	Complete annual subtasks related to permitting, CEQA, design, and construction of the diversion as outlined in the updated PPP.	All Permittees	As specified in the PPP
Diversion Project Completion	Complete Diversion to Sanitary Sewer System.	All Permittees	September 30, 2019

4 Sources of Bacteria

The TSO specifies that the PPP shall include a description of the sources of bacteria, and a comprehensive review of the processes and activities that result in the generation and discharge of bacteria. The TSO Participants reviewed studies related to bacteria sources in southern California, and the Ballona Creek Watershed specifically, and studies related to bacteria sources and transport mechanisms in general. The following subsections summarize the information.

4.1 Special Study Findings

The Ballona Creek Agencies reviewed the following publications and submittals for summary of special study findings in this section:

- Ballona Creek and Sepulveda Channel Reconnaissance: Results, Analysis, and Conclusions" (BC Recon Study) by the City of Los Angeles
- Characterization of Dry Weather Metals and Bacteria in Ballona Creek" (Characterization Study) by Eric D. Stein and Liesl L. Tiefenthaler. Southern California Coastal Water Research Project (SCCWRP). May 29, 2004.
- Low Flow Reconnaissance Study in Centinela Creek Sub-Watershed" (Centinela Recon Study) published by County of Los Angeles Department of Public Works. March 2015.
- Contemporary and Historical Hydrologic Analysis of the Ballona Creek Watershed by Shu-wan Liu, Terri Hogue, Eric D. Stein and Janet Barco. SCCWRP. December 2011

4.1.1 Ballona Creek Reconnaissance Study (Recon Study) by City of LA

In June 2012, a three-day field effort (reconnaissance) was conducted along Ballona Creek and Sepulveda Channel to document the locations and bacteriological water quality (*E. coli* concentrations) of dry-weather discharges. The recon was conducted during the dry season after several weeks had passed since the last measurable rainfall event. The goals of the recon were to:

- Improve the understand of the number, locations, and types of dry-weather discharges to Ballona Creek and Sepulveda Channel,
- Expend datasets regarding flow rates and bacteria water quality of dry-weather discharges to Ballona Creek and Sepulveda Channel.
- Support the future TMDL implementation planning efforts and development of water quality models.

During the recon, a total of 34 discharge sites were sampled, and another 40 discharge sites were surveyed (**Figure 3**) along Ballona Creek and Sepulveda Channel. Note that not all of Sepulveda Channel (portion upstream of where the channel initially goes underground) and Centinela Creek were included in the study due to logistical issues. *E. coli* concentrations at the discharge sites ranged from non-detect at a detection limit of 10 MPN/100 mL to 14,000 MPN/100 mL. Flow rates at the discharge sites ranged from 0.0002 to 5.89 cfs, with loading rates ranging from 0.0002×10^9 to 162×10^9 MPN/day. The *E. coli* loading was calculated as average volume multiplied by the *E. coli* concentration (most probable number of coliform forming units per day).

Approximately 84% of the flow discharges and 93% of *E. coli* loading into the receiving water originated from five drains. The concentrations of these drains ranged from 1,900 to 14,000 MPN/100mL. Shown in **Table 12** are the five highest ranked discharges in terms of flow rate, concentration, and *E. coli* loading rate. The results show the highest-ranked sites represent a majority of flow and *E. coli* loading from all outfalls. These data, in conjunction with additional outfall data that will be collected as part of CIMP implementation will support source identification and abatement efforts during the TSO.

Table 12. Top 5 Ranked Discharges in Flow Rate, *E. coli* Concentration, and *E. coli* Loading Rate (1)

Rank	**Discharge ID**	**Flow Rate** (cfs)	**Discharge ID**	***E. coli* Concentration** (MPN/100mL)	**Discharge ID**	***E. coli* Loading Rate** (10^9 MPN/day)
Highest	Wed_07	5.89	Tue_07	14,000	Wed_10+11 (2)	162
2nd	Benedict	3.36	Wed_10+11 (2)	5,683	Sep. Chan.	130
3rd	Sep. Chan.	1.59	Sep. Chan.	3,300	Wed_07	61
4th	Wed_08+09 (2)	1.36	Wed_02	2,200	Wed_02	28
5th	Wed_10+11 (2)	1.16	Adams	1,900	Benedict	27
Total	---	13.36	---	---	---	408
% of All Discharges	---	84%	---	---	---	93%

1. Note that Centinela Channel was not measured during the recon. It would likely be one of the highest-ranked discharges in terms of flow rate, concentration, and loading rate.
2. These results represent the combined measurements from two adjacent outfalls at a double outfall structure. It is likely that flows from these two outfalls originate from the same source (i.e., the divider wall between the two outfalls likely only extends a short way upstream of the discharge point).

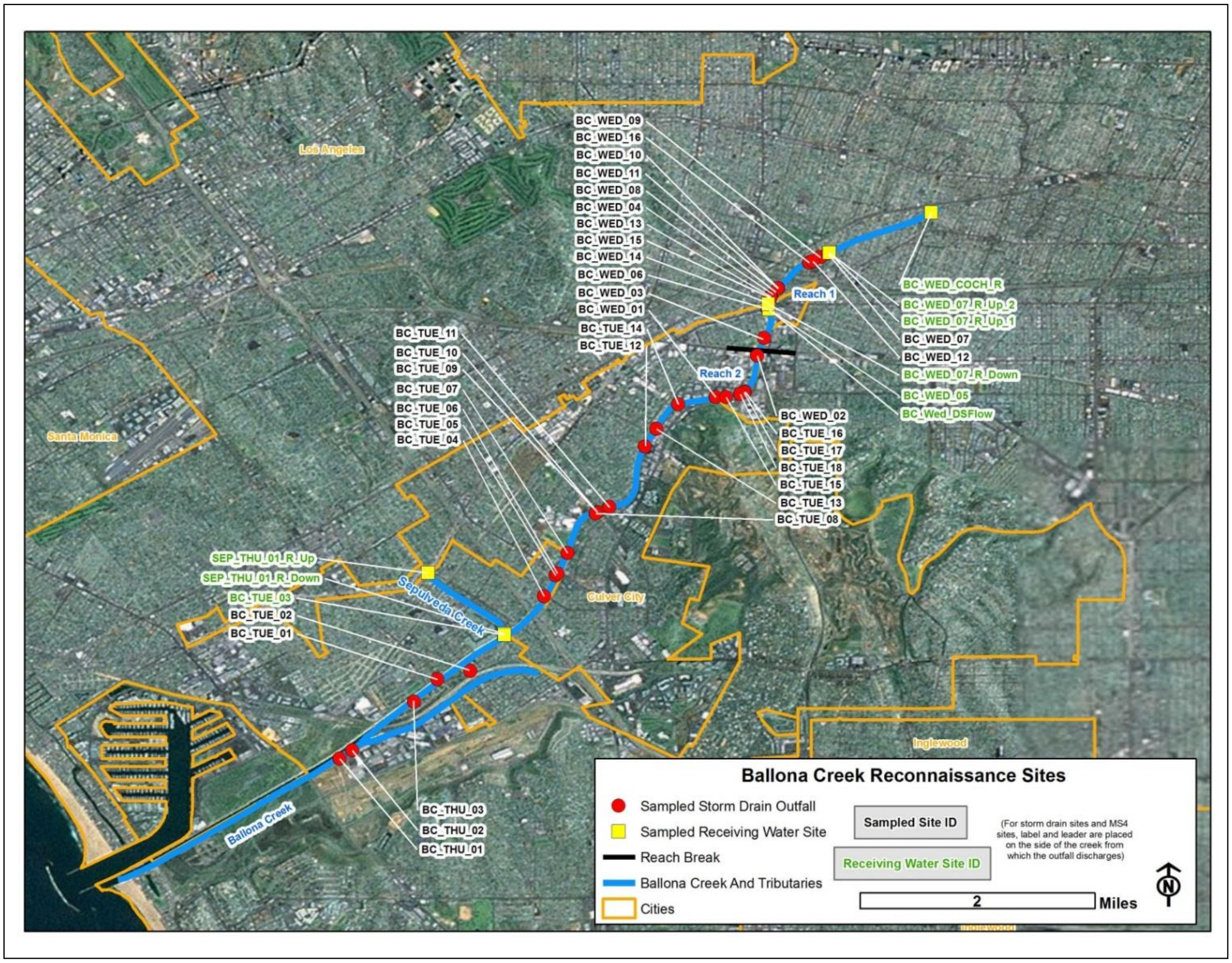

Figure 3. Storm Drain Outfalls and Receiving Water Sites Sampled During June 2012 Ballona Creek Reconnaissance Study

4.1.2 Dry Weather Characterization Study by the SCCWRP

The Southern California Coastal Water Research Project (SCCWRP) conducted a study to evaluate the relative contribution of various storm drain sources of metals and bacteria in the Ballona Creek watershed (Stein, 2005). The goal of the study was to characterize the dry-weather concentration of metals and bacteria, and to identify the relative contribution of various portions of the watershed to total dry season loading of these constituents. The distinction between wet and dry season pollutant loading characteristics is important because management strategies differ for those two sources. For example, storm water management typically focuses on detention or retention, whereas dry season runoff control focuses on treatment, diversion, infiltration, and source control.

Water quality sampling consisted of sampling both storm drain inputs and in-river samples along the entire day-lighted length of Ballona Creek. Approximately 40 actively flowing storm drains and 12 in-river sites were sampled for flow and water quality three times during the spring and summer of 2003, during May, July and September. There were at least 14 antecedent dry days prior to the sampling events, and the three events represent typical dry weather conditions Samples were analyzed for indicator bacteria (*E. coli*, Enterococcus, and Total coliform) and metals.

The bacteria data were analyzed in terms of mean concentration, temporal variability, and spatial distribution of substantial inputs to the creek. The average flow in Ballona Creek was 12±6 cubic feet per second (cfs). Of 40 drains sampled, 9 drains were flowing above 0.4 cfs. Four out of the 40 discharge sites sampled accounted for approximately 85% of the daily storm drain volume: Centinela Channel, Sepulveda Channel, BC300, and BC310.

Bacteria concentrations at the majority of storm drains and in-river sites were consistently above AB411 water quality standards and vary by up to five orders of magnitude on an intra-annual basis. In-river *E. coli* concentrations were highest between km 4 and km 5 (between Sepulveda Channel and Centinela Creek) and between km 9 and km 11. Two of the drains with the highest concentration of *E. coli* were between km 4 (drain BC24 and BC26) and km 5, while the other one is at km 8 (BC130). Enterococcus levels were consistently high in storm drain samples along most of the length of Ballona Creek, with the highest levels detected between km 4 and km 12.

Despite the variability in indicator bacteria concentrations, the low number of storm drains contributing significant flow suggests that managing a relatively small number of storm drain inputs has the potential to result in substantial improvement in water quality in Ballona Creek.

4.1.3 Los Angeles County Low Flow Reconnaissance Study

The County of Los Angeles conducted a low flow reconnaissance study in the Ballona Creek watershed to characterize dry-weather flows and bacteria levels discharging to Centinela Creek from the Ladera Heights and West Fox Hills area of unincorporated Los Angeles County. The study was conducted in accordance with the County's April 25, 2013 request for a TSO submitted to the Regional Board, and was submitted to the Regional Board on June 15, 2015 to meet the submittal deadline provided in the TSO. Along with a determination of dry weather flow rates within the unincorporated areas of Ladera Heights and West Fox Hills, the study included the determination of bacteria levels at a key storm drain/channel confluence to gauge compliance with applicable TMDL dry weather requirements, and bacteria levels associated with different land use categories within the watershed.

Flow monitoring was conducted at 15 sub-watershed locations in the Ballona Creek watershed using flow meters, and field observations were conducted upstream of the monitoring locations to document dry weather flow. Peak flow rates were observed from 5:00 to 7:00 AM. Field observations indicated that the peak flow rates were due to irrigation overspray and irrigation runoff. Irrigation was primarily observed in residential and open space areas, which account for 50% and 5% of the watershed, respectively.

The water quality sampling program was performed in an attempt to identify contributing bacteria levels from different land uses, including: commercial, single family residential, high density residential, open space and mixed land use (**Figure 4**). The results of the revised sampling program showed that single family residential contributed the highest levels of bacteria, followed by mixed land use (**Table 13**).

Table 13. Land Use Sampling Results

<table>
<tr><th>Land Use Type</th><th>Sampling Site Location ID</th><th>Monitoring Location</th><th>Fecal coliform (MPN/100 mL)</th><th>E. coli (MPN/100 mL)</th></tr>
<tr><td>Commercial</td><td>62nd_Condon_LaBrea_S</td><td>FR-11</td><td>30,000</td><td>170</td></tr>
<tr><td>Single Family Residential</td><td>5441 South Garth Avenue</td><td>FR-04</td><td>>160,000</td><td>2,300</td></tr>
<tr><td rowspan="2">High Density Residential (duplicate samples collected)</td><td rowspan="2">5724 South Corning Avenue</td><td rowspan="2">FR-06</td><td>230</td><td>80</td></tr>
<tr><td>300</td><td>22</td></tr>
<tr><td>Open Space</td><td>Rueben Ingold Park</td><td>FR-03</td><td>50,000</td><td>800</td></tr>
<tr><td>Mixed</td><td>62nd_Condon_LaBrea_N</td><td>FR-11</td><td>90,000</td><td>24,000</td></tr>
</table>

The County's Low Flow Reconnaissance Study indicated that residential areas, followed by mixed use land uses, contribute the majority of bacteria loading. Sources of bacteria within residential and mixed use land uses, as discussed in **Section 4.2**, are summarized in **Table 14**. Pollution prevention programs (projects) in these priority areas will bring the most water quality benefits.

Table 14. Sources of Bacteria by land use

Source	Land Use Origin
Irrigation runoff	Residential/Mixed Use
Runoff from curb-side car washing	Residential
Improperly disposed pet waste	Residential/Mixed Use
Illicit discharges/illicit connections	Residential/Mixed Use
Sanitary sewer overflows/exfiltration	Residential/Mixed Use
Trash	Residential/Mixed Use
Improperly disposed food waste	Residential/Mixed Use
Regrowth	In-stream

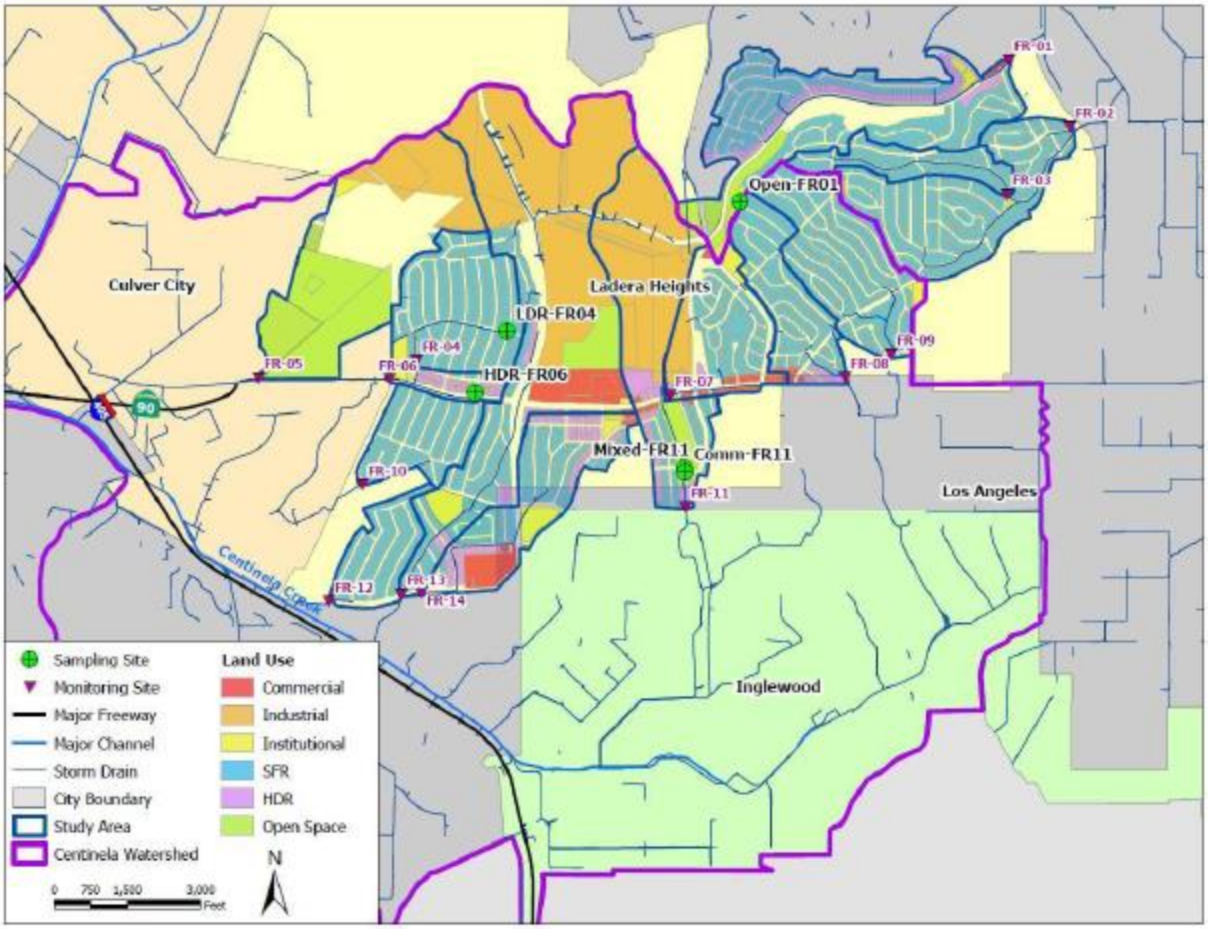

Figure 4. Refined Water Quality Monitoring Sites

4.1.4 Contemporary and Historical Hydrologic Analysis of the Ballona Creek Watershed

A study was conducted by researchers from SCCWRP and the University of California, Los Angeles to investigate imported water impacts on the spatial and temporal hydrologic cycle for the Ballona Creek watershed, and to develop conceptual models of the system from pre-development (pre-1938) through the current time (2010) (Liu et al, 2011). The conceptual models accounted for hydrologic fluxes including precipitation, recharge, spring contribution, and landscape runoff, among others.

Field measurements were taken to measure watershed and sub-watershed runoff and spring flow contribution to runoff. The watershed scale runoff determinations recognized that native, precipitation sources, and non-native, imported water sources contribute to runoff in urban systems. The annual runoff:precipitation ratios were calculated, providing an indication of the level of development (and associated landscape irrigation). The runoff ration have increased over time, with the ratio exceeding the theoretical threshold of one for natural systems three times from 2000-2010.

Natural springs and urban runoff were the contributors to dry season runoff. Spring measurements were performed during the dry season. Based on data from July 2011, springs were estimated to contribute 2% of runoff, with the remaining 98% estimated to originate from excess landscape irrigation or other human activities. Outdoor water use increased substantially along with population growth and demand over the study period. Imported water for outdoor uses, along with increases in impervious surface cover caused an increase in runoff year-round. The post-development water balance is shown in **Figure 5**, which provides an indicator of the contribution of runoff relative to other hydrologic fluxes.

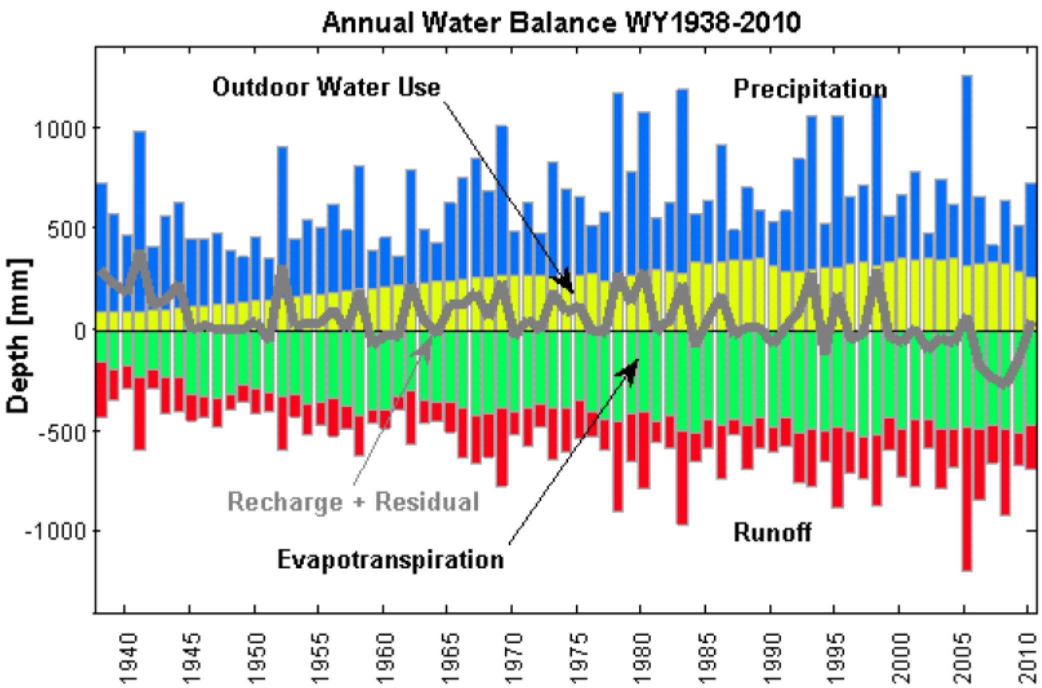

Figure 5. Post-Development Water Balance, showing outdoor water use (yellow), precipitation (blue), evapotranspiration (green), runoff (red), and recharge plus residuals (grey)

4.2 Sources, Generation, and Discharge of Bacteria

Fecal indicator bacteria are ubiquitous in urban watersheds. Both human and non-human sources contribute bacteria. These sources include urban litter, contamination from recreational areas, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines. Fecal indicator bacteria densities are directly related to the density of housing, population, development level, percent impervious area, and the density of domestic animals (Armitage et al., 1999). Indicator bacteria in the environment can persist and reproduce long after they are initially deposited in fecal material. Sources of bacteria, and bacterial persistence/regrowth are discussed in the following subsections.

4.2.1 Sources of Bacteria in Urban Watersheds

There are several potential sources of bacteria in urbanized watersheds, with both human and non-human sources contributing to bacteria loads. Potential sources are listed below, with the more significant of those sources discussed briefly in the following subsection.

Human Sources

- Illicit discharges/illicit connections to the storm drain system
- Sanitary sewer overflows/exfiltration and malfunctioning sewage disposal systems
- Recreational/bather defecation
- Improper disposal of wastes from boats and recreational vehicles
- Urban refuse (litter, dumpsters)
- Illegal public urination/defecation

Non-Human Sources

- Domestic pet feces (cats, dogs)
- Wildlife feces
  - Birds – Seagulls, ducks, Canada Geese, pigeons
  - Raccoons, rats
- Agricultural activity (livestock) adjacent to the urban area

Sewage can be introduced into the storm drain system through improper connections between storm and sanitary sewer pipes. In addition, bacteria from the sanitary sewer system can be introduced into stormwater through sanitary sewer overflows (SSOs), when capacity of the sanitary sewer system in exceeded, or where infiltration or blockages occur. Bacteria can also be contributed by public defecation activities in the waterways as well as in the watershed, or can be contained in refuse/litter.

In the absence of an inappropriate sewage discharge, non-human sources contribute the majority of bacteria in storm runoff. Dogs can be a major source of indicator bacteria in urban watersheds due to their prevalence and high daily defecation rates (CWP, 1999). Pets and wildlife deposit fecal matter that washes off paved surfaces and soils. Urban wildlife, particularly birds, can contribute high levels of bacteria to stormwater where large resident populations are established. In more suburban areas, raccoons can adapt to live in the underground habitat within storm drain pipes, and have been identified as contributors to high indicator bacteria levels (Blankenship, 1996).

4.2.2 Persistence and Regrowth of Bacteria

Drainage from storm drains during dry weather periods contribute to the bacteria levels in receiving waters. Storm drains provide protection from temperature fluctuations, and shield bacteria from the sun's ultraviolet radiation. Bacteria released in the environment can be transported with water flow, and partition to soil particles. They are typically in the size range of 2 to 6 μm long, and 0.5 to 2 μm wide, with densities close to that of water. Fecal indicator bacteria have shown an affinity for attachment to fine particles, providing survival advantages and increasing the rate of deposition to sediment (Fries et al., 2008).

Generally, the density of indicator bacteria and pathogens is much higher in sediment than in overlying water (USEPA, 2001). There is evidence that sediments may contain 2 to 3 orders of magnitude more bacteria than the associated water column (Davies et al., 1995). This higher density is likely due to a combination of factors, including the tendency of bacteria to settle out of the water column as individual cells and associated with particles, and extended survival due to favorable conditions in sediments. Cells in sediments are protected from UV and high salinity, and may be able to obtain nutrients associated with sediment particles. Studies investigating the survival of indicator bacteria and pathogens in sediments have determined survival times ranging from a half-life of 30 days (Sherer et al., 1992), to 68 days with no measurable decrease in viability (Davies et al., 1995).

Bacteria persist and regrow, and populations of indicator bacteria become established within the environment and the storm drain system. There is evidence that a subset of fecal indicator bacteria is capable of surviving and establishing populations in the environment. Numerous studies have shown that indicator bacteria, including *E. coli*, are ubiquitous in watersheds (Davies et al., 1995; Byappanahalli et al., 2003; Ishii et al., 2006). *E. coli* can survive and establish populations in environments, including freshwater lakes and streams (Power et al., 2005), beach sand (Whitman et al., 2004), and soils and sediment (Ishii et al., 2006). Fecal indicator bacteria are present in high concentrations in sediments in storm drain infrastructure (Reeves et al., 2004).

4.3 Summary of Studies and Data Regarding Sources of Bacteria

The special studies and scientific literature, when considered all together, provide insight into bacteria sources and loading in the Ballona Creek watershed. Relatively few storm drains contribute the majority of storm drain flow and bacteria loading into Ballona Creek:

- The City of LA's Ballona Creek Reconnaissance Study noted that five to six large storm drains are responsible for more than 90% of *E. coli* loading during dry weather.
- The SCWWRP Dry Weather Characterization Study noted that four drains contribute the majority of the storm drain flow into Ballona Creek. Bacteria levels were highly variable, but concentrations at the majority of storm drains and in-river sites were consistently above AB411 water quality standards.

The main implication for these two studies is that, despite the variability in indicator bacteria concentrations, the low number of storm drains contributing significant flow and bacteria loading suggest that managing a relatively small number of storm drain inputs has the potential to substantially reduce loading to the Estuary. However, because nearly all the dry weather inputs to Ballona Creek, including over 40 storm drains, that tend to flow during dry weather exceed applicable bacteria RWLs, management of a large number of outfalls would likely be necessary to address dry weather exceedances. A more efficient management approach could be to address the instream flows directly through regional treatment and diversion facilities, as described in the next section.

5 Pollution Prevention Projects and Control Measures

The overarching goal of the PPP is to meet the dry weather TMDL targets in the receiving waters to protect recreational beneficial uses. Additional goals of the PPP include:

- Utilize existing non-structural BMPs / Minimum Control Measures (MCMs) to continue to eliminate or minimize sources of bacteria and reduce bacteria transported to the MS4 system and the receiving waters.
- To implement new cost effective, innovative, technologically feasible, and economically sustainable projects that are supported by the TSO Participants and stakeholders.
- To the extent feasible, support local and sustainable water resources to offset the need of imported water.

To attain these goals, the TSO Participants have reviewed their existing programs and identified additional control measures that are expected to reduce levels of bacteria in receiving waters. The following subsections provide additional details on the path forward to attain the TMDL targets. **Section 5.1** summarizes the TSO Participants existing non-structural programs and structural BMPs. **Sections 5.2** and **5.3** outline the proposed new projects and control measures and summarize the short-term and long-term actions and schedules as they relate to reducing levels of bacteria in the receiving water. **Sections 5.4** provide a quantitative demonstration of the effectiveness of the propose projects. **Section 5.5** describes the feasibility, respectively, of the proposed projects.

5.1 Existing Pollution Prevention Methods

This section summarizes existing pollution prevention activities conducted by the TSO Participants. TSO Participants have developed and implemented a number of non-structural and structural control measures that support the prevention of discharges of bacteria to receiving watershed in the Ballona Creek Watershed. **Table 15** presents a summary of existing non-structural pollution prevention measures that affect bacteria implemented by the various TSO Participants. Several of these measures are mandated by the MS4 Permit, such as street sweeping, while others have been implemented based on a TSO Participants specific approach.

Table 16 summarizes existing structural control measures that support the prevention of discharges of bacteria to receiving watershed in the Ballona Creek Watershed. The structural controls range from a low flow diversion to urban runoff capture and reuse facilities. Each of these controls has specific operation and maintenance (O&M) requirements. The O&M manuals for the existing structural control measures presented in **Table 16** are provided in a separate submittal due to the size of the files.

Table 15. Summary of Existing Non-Structural Pollution Prevention Measures that Affect Bacteria

Non-Structural Pollution Prevention Measure	Los Angeles	Beverly Hills	Culver City	Inglewood	West Hollywood	County of Los Angeles	Los Angeles County Flood Control District (LACFCD)
Street sweeping	X	X	X	X	X	X	
Catch basin cleaning	X	X	X	X	X	X	X
Outreach and Education	X	X	X	X	X	X	
LID Ordinance	X	X	X	X	X	X	
Green Streets Ordinance/ Policy	X	X	X		X	X	
Green Building Ordinance		X	X		X		
Hand litter pick up			X		X		
Street-side Trash receptacles	X	X	X		X		
Homeless and social service outreach program	X				X		
Access to Public Restrooms	X	X	X	X	X		
NPDES requirements for small sites	X	X			X		
Sewer system Inspection/Monitoring	X	X	X	X	X	X	
Pressure washing/steam cleaning of sidewalks in commercial areas commercial streets	X	X			X		
Annual inspection and maintenance of channels, box culverts, and ongoing operation and maintenance of the trash boom in Ballona Creek at Lincoln Blvd crossing							X(1)

1. Los Angeles County Flood Control District has the primary responsibility for conducting the annual inspection and maintenance of the channels and box culverts for the entire Ballona Creek Watershed.

Table 16. Summary of Existing Structural Pollution Prevention Measures that Affect Bacteria

Structural Pollution Prevention Measure	Lead Agency	Description
Mar Vista Recreation Center Water Quality Improvement Project	City of Los Angeles	The Mar Vista Recreation Center Retrofit Project is a stormwater pollution abatement project targeting a drainage area of approximately 243 acres. The project diverts and treats flow from a nearby storm drain. The diverted stormwater is pumped to a hydrodynamic separator for removal of heavy sediments, oil and grease and floatable wastes. The pretreated stormwater runoff is then stored in the 270,000 gallon underground detention tank. The stored water is transferred to a small chlorination/de-chlorination unit, which provides the required contact time to disinfect the stored water. A recirculation pump circulates the stored water through the detention tank in order to enhance the quality of the water and maintain an aerobic environment that reduces odors. The disinfected water is then available for irrigating the park and reducing the demand for potable water. When the detention tank is at maximum capacity the water is still diverted and "pretreated" by the hydrodynamic separator and then returned to the storm drain system.
Westside Park Rainwater Harvesting and Beneficial Use Project	City of Los Angeles	The Westside Park Rainwater Irrigation project is part of the City of Los Angeles' Proposition O, clean water bond program approved by voters in November. Stormwater from a drainage area of approximately 3,700 acres is conveyed to the project. The project will use on-site runoff and divert off-site dry weather flow from the existing County storm drain. The main components of the system are a floatables screening well, pumps, subsurface irrigation system, and a dry creek. The system will clean approximately 1 million gallons annually. The treated runoff will be distributed to new turf areas via a subsurface irrigation system. Excess subsurface irrigation water will flow into a dry creek with under-drain piping. The pipe system will collect water and return it to the existing storm drain for release into Ballona Creek. The subsurface irrigation system has been designed per reclaimed water guidelines in the event that reclaimed water is available for this site in the future. The project provides recreational opportunities in the form of a Universally Accessible Playground area and exercise equipment. Other features include jogging/walking paths, a demonstration/sensory garden, park fencing, and solar security lighting (that will be installed in August by RAP).
George C. Page Museum Low Flow Diversion Project	Los Angeles County	The County has experienced difficulties with controlling the discharge of clarified water from the area around the George C. Page Museum to the MS4 system. To address the issue, the County installed a permanent connection to the City of Los Angeles' sanitary sewer system by constructing a new dedicated underground pipeline. An underground pipeline was installed that originates at the west side of the lake pit and travels across the site to connect to an existing 18-inch diameter underground sanitary sewer main on Wilshire Boulevard. A new lift station concrete vault was installed at the Lake pit shoreline containing two submersible pumps to transfer water from the lake pit into the existing underground clarifiers. After the *raw* lake pit water is treated by the clarifiers, the purified water drains into a new underground concrete vault. The clarified water is then gravity drained through the new underground pipeline for disposal in the City of Los Angeles' sanitary sewer system.

Structural Pollution Prevention Measure	Lead Agency	Description
Catch Basin Trash Devices	All TSO Participants	All TSO Participants are implementing the Ballona Creek Trash and Santa Monica Marine Debris TMDLs either through the installation of full capture devices (County of Los Angeles and the cities of Beverly Hills, Inglewood, and Los Angeles) or through a combination of full capture, partial capture systems, and/or institutional controls (Culver City, and West Hollywood).

5.2 Proposed Projects and Control Measures

In addition to the existing pollution prevention measures described in **Section 5.1**, TSO Participants have proposed the following three key structural control measures that cover the drainage area of approximately 75,000 acres (over 90%) of the Ballona Creek Watershed:

- Low Flow Treatment Facility 1 (led by City of Los Angeles): Located on Ballona Creek Reach 2, this project will address a drainage area of approximately 54,000 acres (or 66%) of the watershed.
- Low Flow Treatment Facility 2 (led by City of Los Angeles): Located on Sepulveda Channel, this project will address a drainage area of approximately 14,500 acres (or 18%) of the watershed.
- Mesmer Low Flow Diversion Facility (led by Culver City): Located on Centinela Creek, this project will address a drainage area of approximately 6,500 acres (or 8%) of the watershed.

The location and drainage areas covered by the three key TSO projects are presented in **Figure 6**. The key projects are described in detail in the following subsections. Per the TSO, operation and maintenance plans for these three future structural BMPs, which are being implemented to achieve the final WQBELs and corresponding RWLs, will be developed and submitted to the Regional Board within 60 days of project completion.

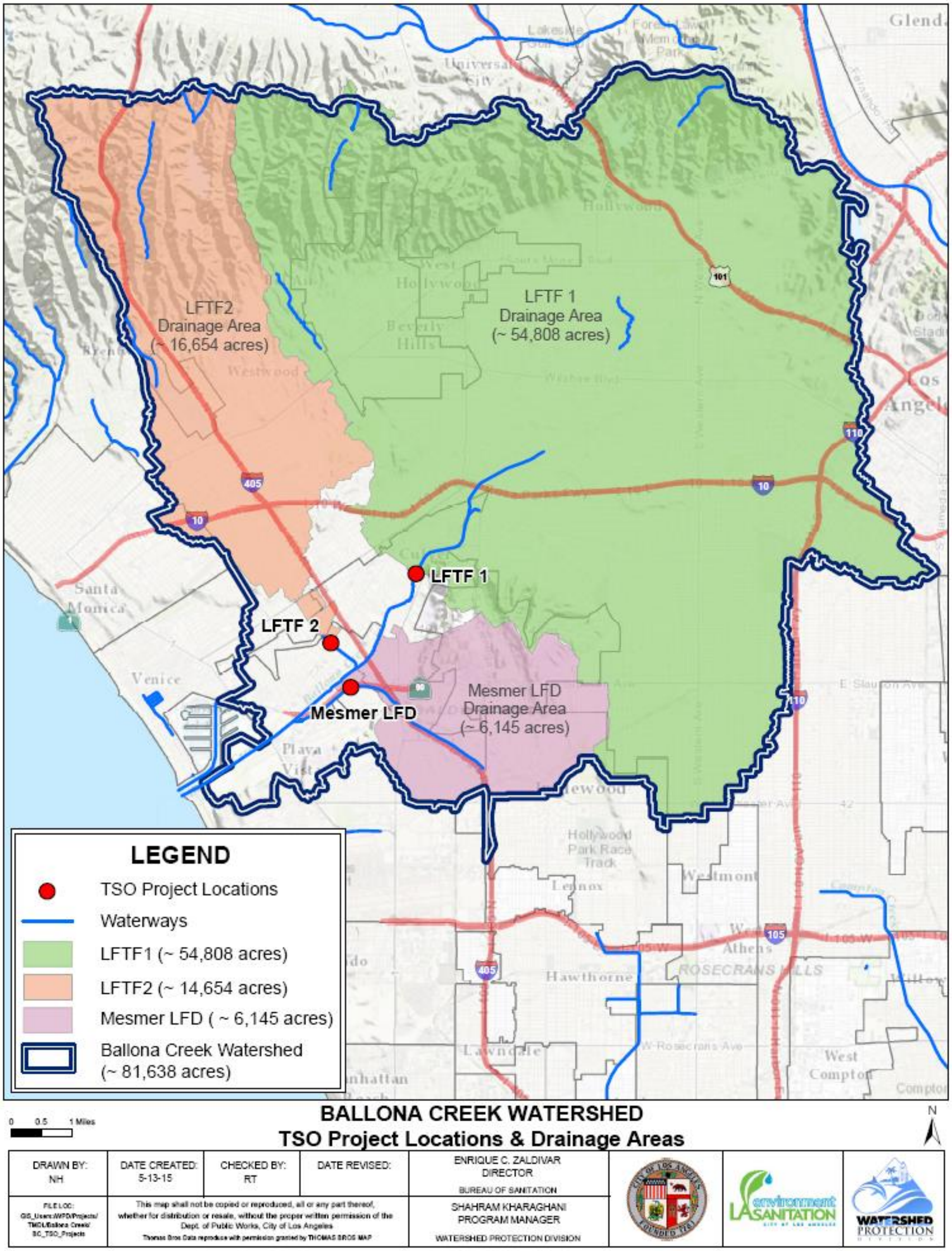

Figure 6. Location and Drainage Areas Covered by Three Key Time Schedule Order Projects

5.2.1 Low Flow Treatment Facility #1 (LFTF-1) and Diversion for Reuse

The Low Flow Treatment Facility #1 (LFTF-1) is located at 10201 West Jefferson Ave in Culver City where the North Outfall Sewer (a 102 inch diameter major sewer line) passes through a City of Los Angeles' North Outfall Treatment Facility (NOTF). The NOTF is located on 0.8 acres of land, adjacent to Ballona Creek Reach 2. The NOTF was completed in 1987 to retain and provide partial treatment of sanitary sewer overflows from the North Outfall Sewer during peak sewer flow conditions. The completion of the North Outfall Relief Sewer provided the capacity needed to convey high flows, which resulted in the elimination of the need for the NOTF.

The City of Los Angeles is evaluating two possible approaches to utilize LFTF-1 to comply with the dry weather bacteria TMDL requirements as identified in the TSO. The two possible approaches for LFTF-1 are:

- Option 1: Treat instream flows and release clean water back to Ballona Creek.
- Option 2: Divert instream flows to the Hyperion Treatment Plant (HTP) via NOS for treatment and beneficial reuse to offset potable water demand.

The treat-and-release approach of Option 1 is to divert all dry-weather flow by use of a diversion structure located in Ballona Creek Reach 2, treat the flow to remove sediment and fecal indicator bacteria using conventional treatment method, and release all the treated water back into the creek. A concept report was completed in April 2013. The key components of the LFTF-1 divert and treat option, plan view, and process flow diagram are presented in **Table 17** and **Figure 7**, respectively.

The diversion approach of Option 2 would be to divert all or a portion of the flow from Ballona Creek to HTP via the North Outfall Sewer. HTP has the capacity to treat the urban runoff and distribute the reclaimed water to potential users and offset the need for imported fresh water. The City of Los Angeles is in the process of evaluating this option for feasibility and its potential impact on the downstream reaches and beneficial uses. Hybrid options which incorporate both diversion and treat-and-release scenarios are also being considered as described in **Section 5.4**.

The TSO requires the City of Los Angeles to submit an evaluation of the alternative (Option 2) to construct a diversion to the sanitary sewer system at or downstream of proposed LFTF-1 site by May 16, 2016. LASAN intends to evaluate scientific data and publications, gather stakeholders' input, analyze the operation and maintenance requirements, and select the final alternative by May 16, 2016. The PPP would be updated, as necessary, based on the evaluation by July 13, 2016. If the treat-and-release option (Option 1) is selected then the TSO schedule presented in **Table 18** applies (referenced as Schedule A in the TSO). If diversion to HTP (Option 2) is selected then the schedule presented in **Table 19** applies (referenced as "Schedule B" in the TSO). Additionally, if Option 2 is selected as the recommended alternative, then annual subtasks, at a minimum, would be added in an updated PPP that included permitting, CEQA, design, and construction of the diversion facility.

Figure 8 and **Figure 9** present detailed schedules, inclusive of interim tasks, for Option 1 and Option 2, respectively. The schedule and interim milestones may be updated in July 2016 based on the evaluation of alternatives.

Table 17. Major Project Components of the LFTF-1 Option 1 (Treat-and-Release)

Unit Process	Function	Method
1. Flow diversion	Intercept and divert dry weather flow from Ballona Creek	Inflatable rubber dam/channel conduit
2. Flow Conveyance	Convey the diverted flow via a 5-ft diameter Reinforced Concrete Pipe (RCP) (tunneled and pipe jacked underneath the side slope) into NOTF for further treatment.	Collection well with trash rack and a 5-ft diameter RCP
3. Influent Pumping	Lift the flow to the NOTF treatment processes using suitable pumps.	Deep well with submersible pumps
4. Screening	Screen out fine particles using fine screens with 2 mm opening.	Above ground internally fed drum screens
5. Sedimentation	Using Alum as coagulant, settle suspended solids in sedimentation basins.	Modified existing holding tanks with Alum as coagulant
6. Disinfection	Provide disinfection to achieve *E. coli* concentration of less than 50 MPN/100 ml.	Sodium hypochlorite for disinfection and Sodium bisulfite for dechlorination
7. Final Effluent Discharge	Discharge final effluent to Ballona Creek.	Connected to existing 72-in RCP to discharge final effluent to Ballona Creek

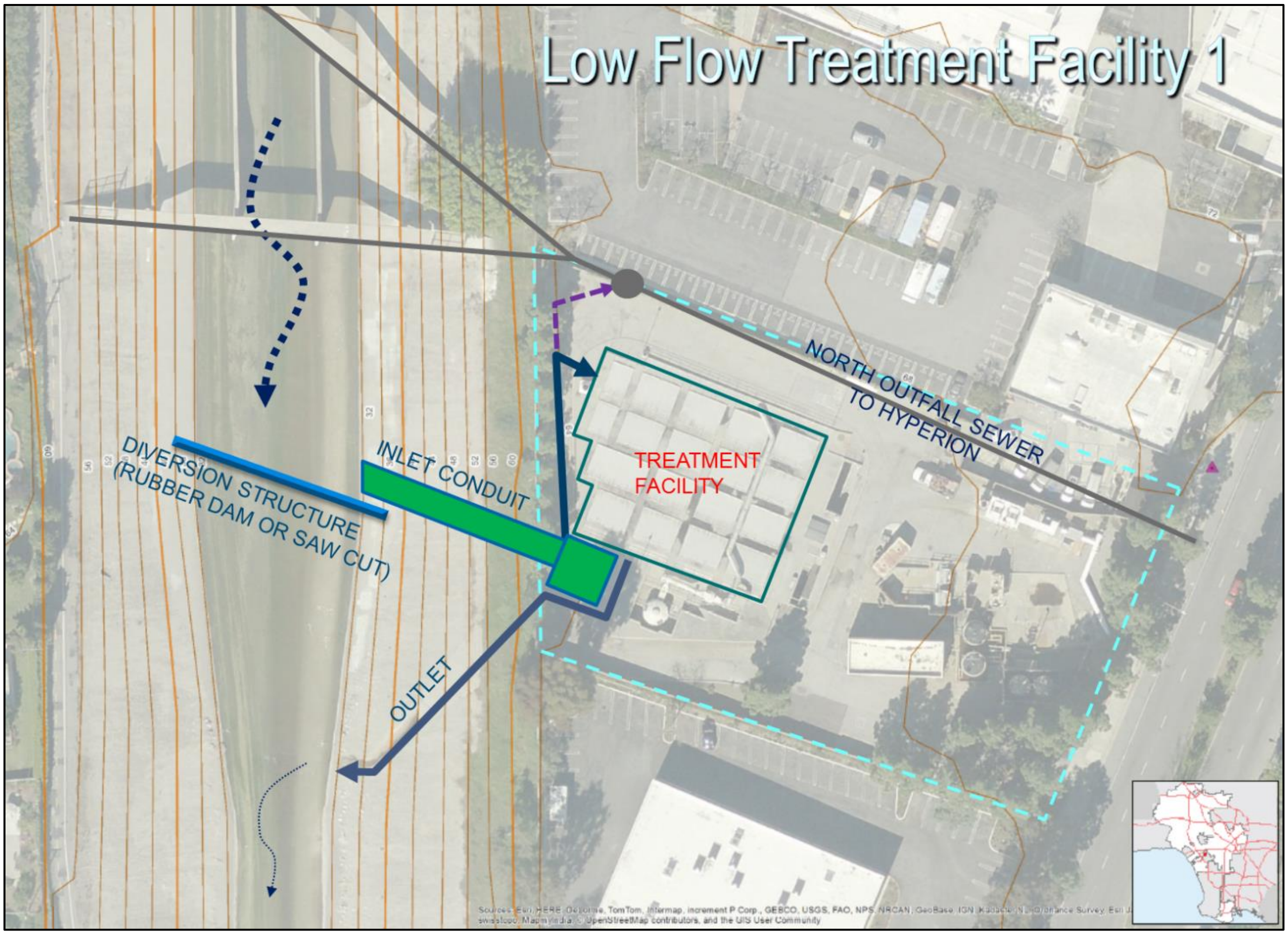

Figure 7. Plan View of the LFTF #1

Table 18. Ballona Creek Bacteria TMDL Time Schedule Order Schedule A (applicable if Option 1, treat and release, is selected alternative)

Task	Description	Responsible Permittee	Completion Date
LFTF-1 Permitting and CEQA	Obtain all appropriate permits and complete CEQA requirements for LFTF-1. Submit a status update.	All Permittees	October 1, 2017
LFTF-1 Design	Complete and submit final design and construction schedule for LFTF-1.	All Permittees	April 1, 2018
LFTF-1 Construction	Complete construction of LFTF-1.	All Permittees	April 1, 2019
LFTF-1 Completion	Complete post-construction monitoring at LFTF-1. Submit preliminary results of post-construction monitoring.	All Permittees	September 30, 2019

Table 19. Ballona Creek Bacteria TMDL Time Schedule Order Schedule B (applicable if Option 2, diversion to sanitary sewer, is selected alternative)

Task	Description	Responsible Permittee	Completion Date
Compete Annual Diversion Subtasks	Complete annual subtasks related to permitting, CEQA, design, and construction of the diversion as outlined in the updated PPP.	All Permittees	As specified in the PPP
Diversion Project Completion	Complete Diversion to Sanitary Sewer System.	All Permittees	September 30, 2019

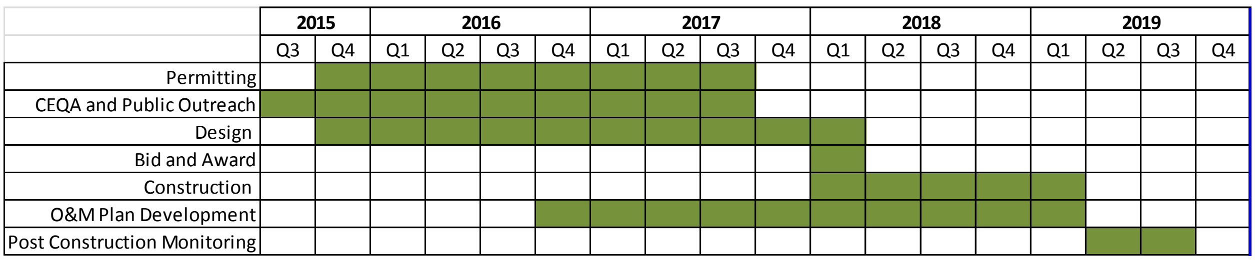

Figure 8. Interim Tasks and Schedule for LFTF-1 Option 1 (Treat and Release)

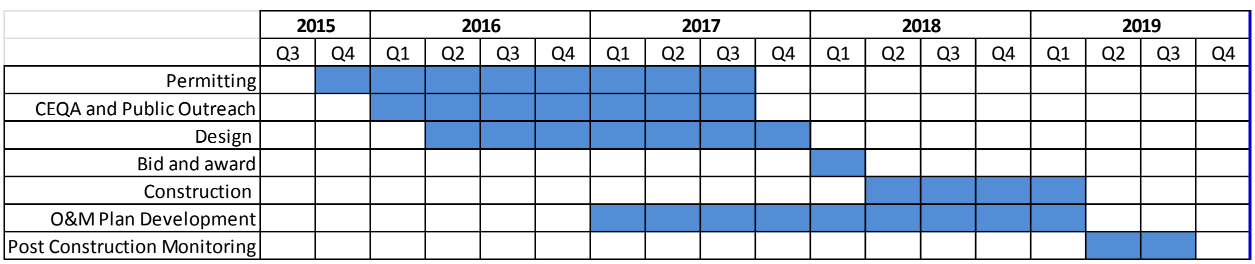

Figure 9. Interim Tasks and Schedule for LFTF-1 Option 2 (Diversion to Hyperion Treatment Plant)

5.2.2 Low Flow Treatment Facility #2 (LFTF-2)

The proposed Low Flow Treatment Facility #2 (LFTF-2) is located at the bank of the Sepulveda Channel at Culver Blvd. crossing. The initial concept design drafted by the City of Los Angeles in July 2013 indicates that the project site is located where runoff from 95% of the Sepulveda Channel drainage area (14,500 acres) can be intercepted. The concept proposes to install a diversion structure, similar to a rubber dam or a channel saw-cut to capture all dry-weather flow of approximately 2 cfs. Options to treat and/or divert the flow to the sanitary sewer, and thereby reduce the level of FIBs, sediments, and trash in Sepulveda Channel, are being considered. The project is currently in the concept design stage in which various options are being analyzed by LASAN. **Figure 10** presents the interim tasks and schedule for the LFTF-2.

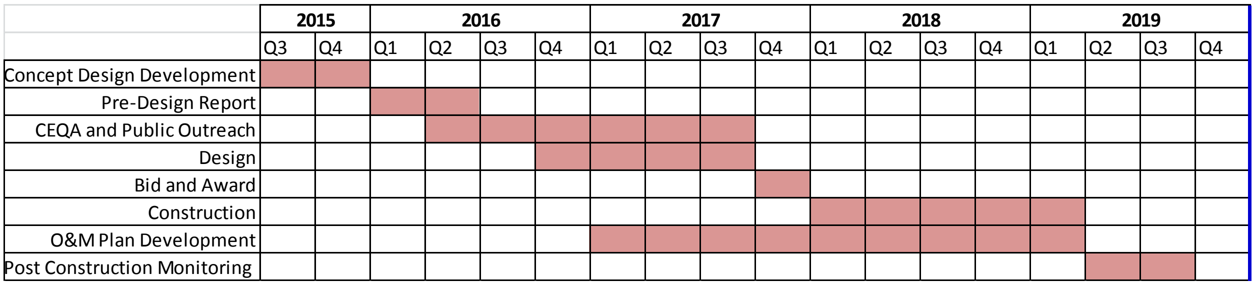

Figure 10. Interim Tasks and Schedule for LFTF-2

5.2.3 Mesmer Low Flow Diversion Project

The Mesmer Pump Station is located at Mesmer Avenue one block northwest of Jefferson Boulevard in Culver City adjacent to Centinela Creek. **Figure 11** presents the project site's boundaries. Currently, the Mesmer Pump Station pumps sewage demands through a force main to the City of Los Angeles' NOS. In 2018, Culver City anticipates the Bankfield Pump Station will be completed to redirect all of Mesmer Pump Station's flow from the northerly service area. The minor contributing flows from the southerly service area will be directed into the existing City of Los Angeles collection sewers.

The 2015 Mesmer Low Flow Diversion/Pump Station Project Feasibility Study (PRP Engineering Inc, 2015) determined the existing facility, with additional improvements, can be modified to pump the current dry-weather flow (approximately 1.5 cfs) from Centinela Creek. The Feasibility Study outlines the necessary improvements to divert the channel low flow into the pump station and found that the same operation presently in use will provide the ability to match the inflow rate from the channel.

Once Mesmer Pump Station is decommissioned, the improvements to the Mesmer Pump Station and modifications to Centinela Creek can be completed to provide a low flow diversion from Centinela Creek into the Mesmer Pump Station. The modifications to Centinela Creek require an inflatable dam be constructed across from channel wall to channel wall to pond the low flow and divert it to the Mesmer Pump Station. The inflatable dam is a rubber type of material that is capable of being installed and secured in Centinela Creek on the channel bottom. During the wet-weather events, the dam will be deflated and channel flows will be capable of flowing over the deflated dam without impacting the channel's flow capacity or operation. **Figure 12** presents the interim tasks and schedule for the Mesmer Pump Station Diversion Project.

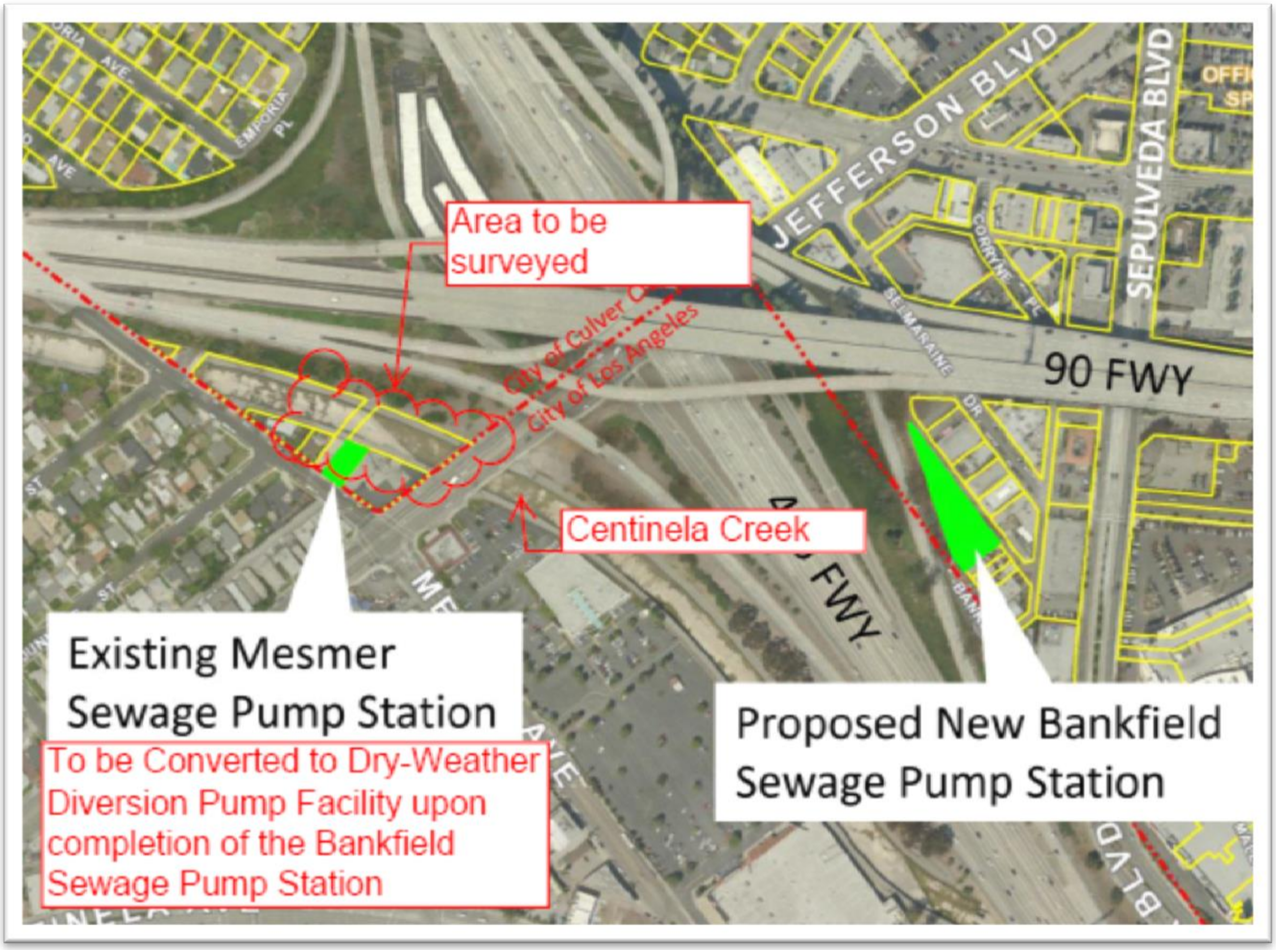

Figure 11. Site Map of Mesmer Pump Station Diversion Project

	FY 2015-16				FY 2016-17				FY 2017-18				FY 2018-19				F Y 2019-20			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2*	Q3	Q4
Concept Design Development (Feasibility Study Completed)																				
Develop & Execute Cost Sharing MOU (Environmental & Design)																				
Environmental & Design (RFP Process and Contract Award)																				
Public Outreach																				
CEQA																				
Design Phase																				
Develop & Execute Cost Sharing MOU (Construction)																				
Bid and Award																				
Anticipate Completion (Bankfield Pump Station & Related Sewer																				
Construction Phase																				
O&M Plan Development																				
Post Construction Monitoring																				

Figure 12. Interim Tasks and Schedule for Mesmer Pump Station Diversion Project, subject to the Bankfield Pump Station's schedule.

5.2.4 Low Flow Reconnaissance Study

As described in **Section 4.1.3**, the County of Los Angeles submitted a Ballona Creek Watershed Low Flow Reconnaissance Study Report in June 2015. The report investigated recommendations for mitigating dry weather flows and bacteria levels.

Recommended next steps include the review of the current water efficient ordinance, followed by an alternatives evaluation comparing the green streets/alleys alternative with the sanitary sewer diversion alternative. The alternatives evaluation would use a ranking matrix that would compare different weighted criteria, such as risk of failure, capital costs, operation and maintenance costs, permitting requirements, public perception and others for each alternative, in order to identify a preferred alternative. Included as part of the Recommendations section are County planned green streets project descriptions for bioretention tree wells and infiltration planters along numerous streets and a brief description of a planning study prepared by the City of Culver City for the diversion of Centinela Creek, which would address portions of the unincorporated County.

Based on an analysis of the various alternatives, it was concluded that implementation of the low flow diversions/ treatment facilities at Ballona Creek and Centinela Creek would be the most optimal solution as it would result in mitigation of all non-stormwater flows from the unincorporated County area of Ladera Heights. The County will partner with the lead agencies of Culver City and Los Angeles to ensure that both projects are successfully implemented.

However, as a parallel effort, the water conservation ordinance and green streets will also be pursued. On February 10, 2015, the County water conservation ordinance was expanded by the County Board of Supervisors and resulted in an increase in the fines for water conservation violations. With regards to green streets, the County is also pursuing and developing green street projects in their jurisdiction in Ballona Creek.

5.3 Summary of the Schedule for Project Implementation (include description of priorities for short and long term action)

Table 20 summarizes the schedule for implementation of the proposed projects and control measures and delineates between the short-term and long-term actions within the term of the TSO. The short-term actions for the three key structural control measures are focused on the planning elements of such control measures, which includes the completion of environmental documentation (i.e., CEQA/NEPA), engineering design, and required permits. The long-term for the three key structural control measures actions include the initiation and completion of construction as well as the post-construction activities.

Table 20. Summary of Schedule for Proposed Projects and Control Measures (completion dates in MM/YYYY)

Action	Near Term Actions			Long Term Actions	
	2015	2016	2017	2018	2019
LFTF 1-Schedule A					
CEQA Completion			10/2017		
Outreach			5/2017		
Design				4/2018	
Const.					3/2019
Post Const.					10/2019
LFTF 1-Schedule B					
CEQA Completion			10/2017		
Outreach			5/2017		
Design			12/2017		
Const.					3/2019
Post Const.					10/2019
LFTF-2					
Pre Design		6/2016			
CEQA Completion			5/2017		
Design			9/2017		
Const.					3/2019
Post Const.					9/2019
Mesmer LFD					
CEQA Completion			6/2017		
Design			12/2017		
Const.					3/2019
Post Const.					7/2019

5.4 Demonstration of Effectiveness of Projects and Control Measures

The TSO requires demonstration of the effectiveness of proposed projects and control measures. Over the recent years, modeling of dry weather project effectiveness has been conducted to support development of previous TMDL implementation plans, the Ballona Creek Enhanced Watershed Management Program, and now this PPP. This section describes the modeling approach and results for potential project scenarios, which demonstrates the potential for pollution prevent activities to reduce the generation of bacteria.

5.4.1 Approach for Effectiveness Demonstration

For the mainstem Ballona Creek, dry weather modeling was conducted using QUAL2K, which is a river and stream water quality model that simulates fully-mixed one-dimensional flow. The applied QUAL2K modeling approach was steady-state, based on a defined set of boundary conditions, using median (typical) flows and concentrations under typical baseline conditions. QUAL2K is currently supported by the USEPA and has been widely applied throughout the United States for various TMDL studies. For Sepulveda Channel and Centinela Creek, the effect of project effectiveness was based on estimates of project effectiveness for LFTF-2 and Mesmer Avenue, respectively.

The typical baseline conditions used for the effectiveness demonstration were generated based on the following datasets:

- Long-term receiving water monitoring data in Ballona Creek under the Status & Trends program and the Coordinated Monitoring Program for the Bacteria TMDL;
- Storm drain flow rates and concentrations measured by the Ballona Creek Reconnaissance Study (see Section 4.1.1);
- Special studies conducted by SCCRWP which measured stream velocities (Noble et al., 2006); and
- Flow measurements at Sawtelle Avenue by the LACFCD.

In most cases, the long-term median flows and concentrations were calculated and used to represent typical boundary conditions for project planning. For the mainstem Ballona Creek, based on the specified boundary conditions, QUAL2K was used to simulate instream concentrations and flow rates; shown in **Figure 13** are the simulated typical baseline instream Ballona Creek flows from its headwaters (Cochran Avenue, left side of figure) to the confluence with the Estuary (Centinela Boulevard, right side of figure). The effectiveness of proposed project LFTF-1 and LFTF-2, as described in the next subsection, was based on implementing and operating those projects during these typical baseline conditions.

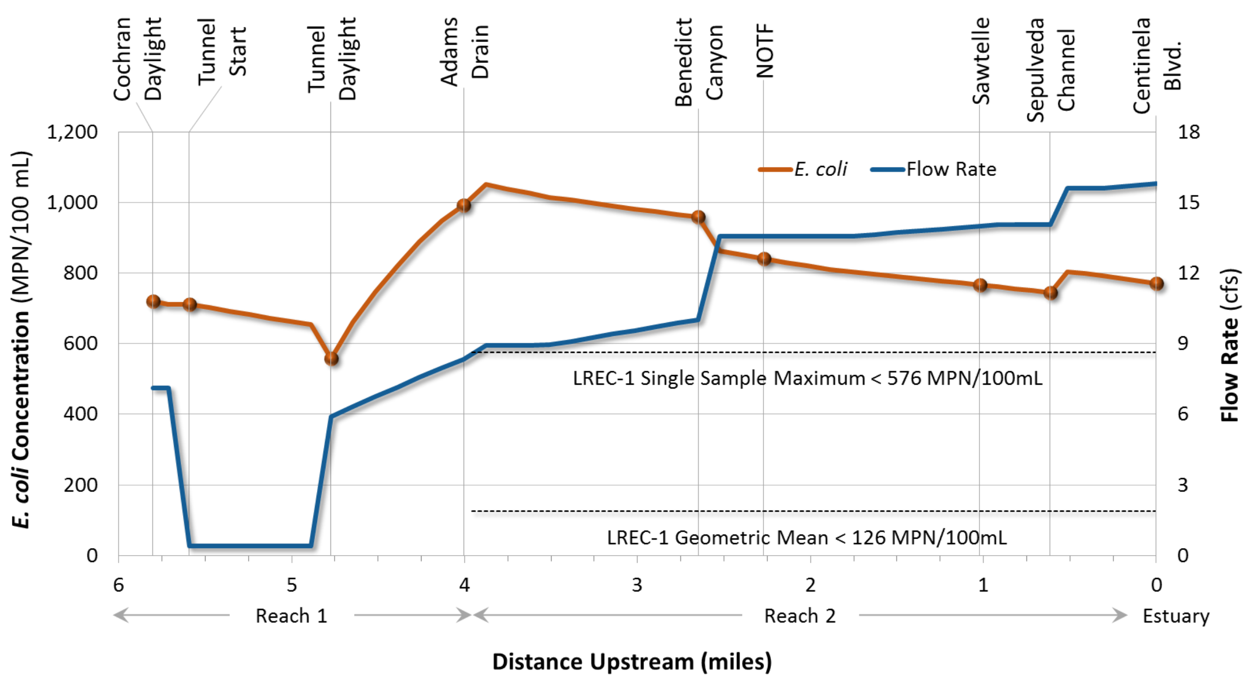

Figure 13. Simulated Typical Baseline Dry Weather Flows and Concentrations in Ballona Creek

5.4.2 Results of Effectiveness Demonstration

The demonstration of effectiveness is based on attainment of *E. coli* RWLs or elimination of flows at the downstream ends of Ballona Creek, Sepulveda Channel and Centinela Creek. Attainment of water quality goals at these locations protects beneficial uses in both the freshwater areas of the Ballona Creek watershed and the Estuary. For Ballona Creek and Sepulveda Channel, a few different alternatives for LFTF-1 and LFTF-2 were evaluated, in terms of the amount of runoff that is treated-and-released versus diverted (as described in Section 5.2.1 and 5.2.2). Selected options will be determined prior to May 2016, as specified by the TSO.

The results of the effectiveness demonstration for attainment of RWLs are presented in **Table 21** (Ballona Creek) and **Table 22** (Sepulveda Channel and Centinela Creek). Each presented option results in either attainment of *E. coli* RWLs or elimination of flows in Ballona Creek, Sepulveda Channel and Centinela Creek.

These findings demonstrate the control measures and pollution prevention activities will be effective for achieving the requirements of the TSO. In fact, the analysis is conservative because other efforts in the Ballona Creek watershed are expected to further improve water quality, including the following:

- Implementation of wet weather projects identified by the EWMP that may also capture dry weather flows;
- Source identification and abatement under the non-stormwater outfall screening program by the CIMP; and
- Water conservation efforts.

These efforts will provide an additional margin of safety to assure that RWLs will be attained.

Table 21. Demonstration of Effectiveness for Select Scenarios of Projects along Ballona Creek and Sepulveda Channel

Component or Condition	Typical Current Conditions	Implementation Scenario [1]		
		Scenario #1	Scenario #2	Scenario #3
Option for LFTF-1	N/A	100% treat-and-release	14% treat-and-release, 86% diversion	22% treat-and-release, 78% diversion
Option for LFTF-2	N/A	100% diversion	100% treat-and-release	100% diversion
***E. coli* concentration in Ballona Creek at Confluence with Estuary** (BCB-5) [MPN per 100mL]	771	< 126	< 126	< 126
Flow Rate in Ballona Creek at Confluence with Estuary (BCB-5) [cubic feet per sec.]	15.8	14.3	3.6	3.7

1 – These implementation scenarios are for informational purposes and are not exhaustive; other options may ultimately be selected. The selected option will be determined prior to May 16, 2016. The LFTF-1 and LFTF-2 options represent the percentage of Ballona Creek flows that are treated-and-released versus diverted to the sanitary sewer. Permitting and CEQA considerations will also play into the selected option.

Table 22. Demonstration of Effectiveness for Select Scenarios of Centinela Creek

Component or Condition	Sepulveda Channel			Centinela Creek	
	Typical Current Conditions	Scenario #1	Scenario #2	Typical Current Conditions	Scenario #1
Implementation Option [1]	N/A	100% treat-and-release at LFTF-2	100% divert at LFTF-2	N/A	100% divert at Mesmer LFD
***E. coli* concentration at Confluence with Ballona Creek** [MPN per 100mL]	1400	< 126	0	980	0
Flow Rate at Confluence with Ballona Creek [cubic feet per sec.]	1.5	1.5	0	0.8	0

1 – These implementation scenarios are for informational purposes and are not exhaustive; other options may ultimately be selected.

5.5 Technical Feasibility, Economically Practicable, and Cost Benefit Evaluation of Pollution Prevention Measures

The TSO requires a consideration of the technical feasibility, economic practicability and cost-benefits of the proposed control measures in the PPP. For the control measures identified in **Section 5.2**, the following considerations are addressed:

- **Technical feasibility:** as shown by the detailed concept designs discussed in **Section 5.2**, the pollution prevention measures are technically feasible.
- **Economic practicability:** the control measures LFTF-1, LFTF-2 and Mesmer LFD represent nearly $25M in infrastructure retrofits to address the Bacteria TMDL requirements. Securing funding for these projects will strain the resources of the Ballona Creek TSO Participants, but at this time the projects are considered to be economically practicable.
- **Cost-benefit evaluation**: this PPP incorporates many previous implementation planning efforts that considered a wide array of options to address the dry weather Bacteria TMDL requirements. The selected projects are considered to be the most cost-effective compared to other options such as widespread low flow diversion at a large number of stormwater outfalls.

6 Additional Information Requested by the Regional Board

The TSO requires the PPP to include proposed projects identified in Finding 34 and, for each project, include tasks and associated schedules for task completion. Of the eight projects identified in Finding 34, two specifically target and address non-stormwater discharges (LFTF-1 and LFTF-2). The remaining six not previously addressed within the PPP are listed in **Table 23** and all have been developed to target wet weather flows. These projects are not considered required for completion to attain the dry weather Bacteria TMDL and corresponding MS4 Permit requirements addressed by the TSO; instead their implementation will be separate as a component of the Enhanced Watershed Management Program and will be implemented as funding/resources become available, per the EWMP implementation schedule. **Figure 14** presents a typical project schedule for the proposed projects.

Table 23. City of Los Angeles Projects Identified in Finding 34 of the TSO that are Planned to be implemented as a Component of the Ballona Creek EWMP and not the TSO

Project Name	Notes
Del Rey Lagoon Water Quality Improvement Project	Concept Report completed in April 2012. Cost estimate to complete the project is $2.0M.
McArthur Park Stormwater BMP	Concept Report completed in March 2010. Cost estimate to complete the project is $3.0M.
Westwood Neighborhood Greenway Project	Concept Report completed in August 2011. Cost estimate to complete the project is $3.2M.
Rancho Cienega Sports Complex Regional BMP Project	Concept Report completed in August 2011. Cost estimate to complete the project is $11.8M.
Vermont Avenue Storm water BMP Project	Concept Report completed in May 2013. Cost estimate to complete the project is $4.0M.
USC University Park Neighborhood Rain Gardens	Pre-design completed in 2014. Cost estimate to complete the project is $600K.

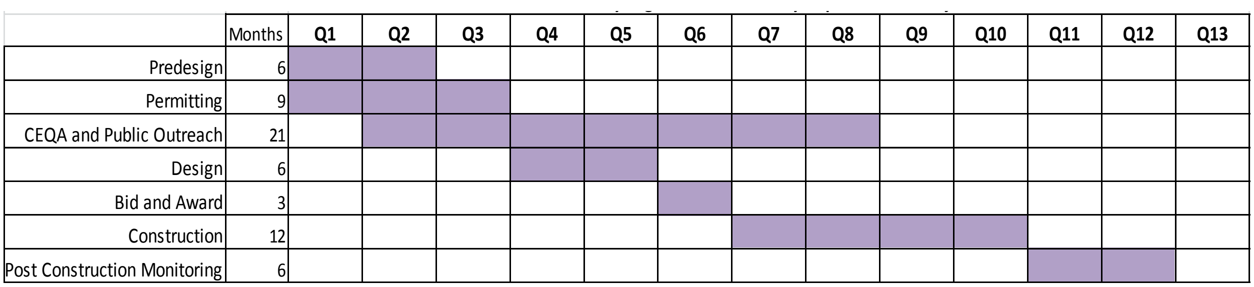

Figure 14. Typical Project Schedule for Projects Identified in Finding 34 of the TSO that are Planned to be implemented as a Component of the Ballona Creek EWMP and not the TSO

7 Reporting

The TSO requires both annual progress reports and a final report. The annual progress reports will be submitted as part of the BCWMG's Annual Report required under the MS4 Permit. Consistent with the Annual Reporting requirements and the TSO, the progress report will be submitted, by December 15th of each year. The first progress report will be submitted on December 15, 2016, and will cover May 2015 through June 2016. The Annual Report will summarize:

- The efforts taken by each TSO Participant towards achieving compliance with the final WQBELs and achieving corresponding RWLs for bacteria.
- The progress to date, activities conducted during that fiscal year (i.e., July 1-June 30), including a summary and documentation of non-structural BMPs (e.g., street and parking lot sweeping locations and frequency, catch basin cleaning, restaurant inspections) and structural BMP operation and maintenance activities outlined in the PPP.
- The activities planned for the upcoming fiscal year.

Additionally, each TSO Participant will state whether or not they were in compliance with the interim WQBELs and RWLs for bacteria during the reporting period.

By December 15, 2019 a Final Report will be submitted by the TSO Participants, as either part of that year's Annual Report or as a standalone report. The report will include:

- A description of the actions/measures implemented;
- The monitoring data collected after the implementation of the selected actions/measures including treatment process, if any; and
- An evaluation of the effectiveness of the selected actions/measures, including comparison to final WQBELs and RWLs.

8 Conclusions

This PPP presents a path forward for addressing the dry weather requirements of the Bacteria TMDL. The sources of bacteria are complex, but special studies by the TSO Participants have increased understanding of the key sources that are causing RWL exceedances during dry weather. As a result of many years of previous implementation planning efforts, the identified control measures to address dry weather bacteria TMDL requirements – LFTF-1, LFTF-2 and the Mesmer LFD – are relatively efficient compared to other options (such as widespread LFDs at storm drain outfalls) and are expected to result in attainment of RWLs. During the coming months, the TSO Participants will engage the public on the details of the projects to be implemented including options for treat-and-release and diversion to sanitary sewer. Other efforts by TSO Participants (outside the scope of the TSO) are expected to further improve water quality and provide an additional margin of safety to the projects identified by the PPP.

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