4.0 RESULTS, ANALYSES, AND RECOMMENDATIONS

This section describes the results and data analysis and includes a discussion of probable constituent sources and recommendations.

4.1 Hydrology – Precipitation and Flow

4.1.1 Analysis of Precipitation and Flow Data and a Discussion of the Hydrographs

This subsection discusses the precipitation and flow data and the hydrologic analysis of the monitoring area. Precipitation data and hydrographs can be used to address the following management question:

How did the 2013-2014 storm season differ in comparison to previous storm seasons?

This management question is answered in the following two ways:

1. Figure 4-1 illustrates total precipitation by storm season, observed in downtown Los Angeles at Station 716, Ducommun Street. The total annual rainfall during the 2013-2014 storm season in downtown Los Angeles was less than half of the 142-year average annual rainfall and was the driest storm season since the 2006-2007 storm season.

2. Figure 4-2 is a comparison of the total monthly rainfall for the 2013-2014 storm season and the long-term pattern of rainfall observed in downtown Los Angeles at Station 716, Ducommun Street. During the 2013-2014 storm season, rainfall was less than the 142-year historic rainfall average for every month. The month of January, historically the wettest month, was the driest winter month during the 2013-2014 monitoring year. The historic seasonal pattern of rainfall includes an increase in precipitation in October, November, and December that peaks in January and February before decreasing during March, April, and May. The seasonal pattern observed for the 2013-2014 monitoring year differed from the historic pattern, due to the dry conditions observed in December and January.

4.1.2 Hydrographs for Monitoring Stations

Hydrographs are provided for all monitoring station events for which flow-weighted composite samples were collected during the 2013-2014 monitoring season (Appendix A). Each hydrograph includes the known times of the composite sample aliquot collection, including the first and last aliquots, sample volume interval, runoff volume, and percent of storm sampled. A summary of the hydrologic data for the MES is provided in Table 4-1.

The hydrographs and composite sampling start and end times can be used to address the following management question:

What percentage and what portion of the storm event were sampled?

This question is answered by examining the hydrographs (Appendix A). Each hydrograph contains the percent of the storm that was sampled and the first and last composite samples, which provides a visual representation of the sampled portion of the storm, in most cases.

To the extent possible, the initial portion of the event was sampled, rather than the tailing end of the hydrographs. Good faith effort was made to capture composite samples most representative of the full duration of each monitored storm event. In general, the monitored storm events did meet this goal, suggesting that the water quality results are an accurate representation of the storm events.

4.2 Stormwater Quality

4.2.1 Comparison to Water Quality Objectives

The monitoring results were compared to applicable water quality standards by evaluating and compiling a list of applicable numeric water quality objectives and by comparing results measured to the applicable objectives. The number of wet weather and dry weather sampling events at each MES and tributary station is summarized in Tables 4-2a and 4-2b, respectively. The number of sampling events where toxicity was assessed is summarized by station in Table 4-3.

This subsection addresses the following key management question:

What constituents were measured at concentrations that do not meet water quality objectives?

Water quality standards consist of defined beneficial uses of water, and numeric or narrative water quality objectives used to evaluate whether beneficial uses are protected. Numeric water quality objectives are expressed in the following terms:

- Magnitude – Defined as the threshold concentration at which beneficial uses are threatened or impaired.
- Frequency – Defined as the number of exceedances of threshold concentrations in a given time period that indicates impairment.
- Duration – Defined as the length of time the ecosystem is exposed to concentrations above the threshold.

Analyses that compare measurements to objectives consider magnitude. Aquatic life objectives established in the California Toxics Rule (CTR) also allow an exceedance frequency of no more than once every 3 years (EPA, 2000). Human-health-based objectives, such as mercury in the CTR or maximum contaminant levels (MCLs) cited in the Water Quality Control Plan for the Los Angeles Region (Basin Plan), do not specify an exceedance frequency.

The duration for many aquatic life objectives (e.g., WARM and COLD) is usually expressed as acute (i.e., 1-hour exposure) or chronic (i.e., 4-day exposure). Some objectives (e.g., ammonia) are expressed as 30-day averages, or other averaging periods. Some objectives (e.g., human health criteria in the CTR) are expressed as instantaneous thresholds. For this assessment, analyses performed were based on instantaneous grab samples or composite samples. For dry weather analyses, 24-hour composite samples were used. Comparisons to acute water quality objectives were made for all samples.

Applicable water quality objectives (see tables below) are those for which there is no uncertainty regarding the applicable objectives or the implementation with respect to frequency and duration.

In Tables 4-4 and Table 4-5, numeric objectives listed as ranges are calculated values based on sample-specific conditions. Ammonia water quality objectives are sample-specific, based on pH, and were calculated using measured pH and Table 3-1 of the Basin Plan. Dissolved metals water quality objectives are sample-specific and were calculated using measured hardness and procedures set forth in the CTR. Pentachlorophenol water quality objectives are sample-specific and were calculated based upon pH values and procedures set forth in the CTR.

Water quality objectives that are not sample specific are summarized in the tables below.

Acute Water Quality Objectives at Mass Emission Stations

Constituent	Units	Water Quality Objective Source	Station ID						
			S01	S02	S10	S13	S14	S28	S29
4-4'-DDT	µg/L	CTR	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Aldrin	µg/L	CTR	3	3	3	3	3	3	3
Chloride	mg/L	Basin Plan	NA	500	150	NA	150	NA	150
Cyanide	mg/L	CTR	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Dieldrin	µg/L	CTR	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Dissolved arsenic	µg/L	CTR	340	340	340	340	340	340	340
Dissolved oxygen (DO)	mg/L	Basin Plan	5	7	5	5	5	5	5
E. coli	MPN/ 100 mL	Basin Plan	576	235	235	235	235	235	235
alpha-Endosulfan	µg/L	CTR	0.22	0.22	0.22	0.22	0.22	0.22	0.22
beta-Endosulfan	µg/L	CTR	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Endrin	µg/L	CTR	0.086	0.086	0.086	0.086	0.086	0.086	0.086
gamma-BHC (lindane)	µg/L	CTR	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heptachlor	µg/L	CTR	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Heptachlor epoxide	µg/L	CTR	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Nitrate (NO_3)	mg/L	Basin Plan	45	45	45	45	45	45	45
Nitrate-N	mg/L	Basin Plan	10	10	10	10	10	10	10
Nitrite-N	mg/L	Basin Plan	1	1	1	1	1	1	1
pH	pH units	Basin Plan	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5
Sulfate	mg/L	Basin Plan	NA	500	350	NA	300	NA	600
Total dissolved solids (TDS)	mg/L	Basin Plan	NA	2,000	1,500	NA	750	NA	1,200
Toxaphene	µg/L	CTR	0.73	0.73	0.73	0.73	0.73	0.73	0.73

µg/L = microgram per liter.
mg/L = milligram per liter.
mL = milliliter.
MPN = most probable number.
NA = not applicable.
CTR = California Toxics Rule.

Acute Water Quality Standards at Tributary Stations

Constituent	Units	Water Quality Objective Source	Station ID					
			TS25	TS26	TS27	TS28	TS29	TS30
4-4'-DDT	µg/L	CTR	1.1	1.1	1.1	1.1	1.1	1.1
Aldrin	µg/L	CTR	3	3	3	3	3	3
Chloride	mg/L	Basin Plan	500	500	500	500	500	500
Cyanide	mg/L	CTR	0.022	0.022	0.022	0.022	0.022	0.022
Dieldrin	µg/L	CTR	0.24	0.24	0.24	0.24	0.24	0.24
Dissolved arsenic	µg/L	CTR	340	340	340	340	340	340
Dissolved Oxygen (DO)	mg/L	Basin Plan	5	5	5	5	5	5
E. coli	MPN/100 mL	Basin Plan	235	235	235	235	235	235
alpha-Endosulfan	µg/L	CTR	0.22	0.22	0.22	0.22	0.22	0.22
beta-Endosulfan	µg/L	CTR	0.22	0.22	0.22	0.22	0.22	0.22
Endrin	µg/L	CTR	0.086	0.086	0.086	0.086	0.086	0.086
gamma-BHC (lindane)	µg/L	CTR	0.95	0.95	0.95	0.95	0.95	0.95
Heptachlor	µg/L	CTR	0.52	0.52	0.52	0.52	0.52	0.52
Heptachlor epoxide	µg/L	CTR	0.52	0.52	0.52	0.52	0.52	0.52
Nitrate (NO_3)	mg/L	Basin Plan	45	45	45	45	45	45
Nitrate-N	mg/L	Basin Plan	10	10	10	10	10	10
Nitrite-N	mg/L	Basin Plan	1	1	1	1	1	1
pH	pH units	Basin Plan	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5
Sulfate	mg/L	Basin Plan	500	500	500	500	500	500
Total Dissolved Solids (TDS)	mg/L	Basin Plan	2,000	2,000	2,000	2,000	2,000	2,000
Toxaphene	µg/L	CTR	0.73	0.73	0.73	0.73	0.73	0.73

µg/L = microgram per liter.
mg/L = milligram per liter.
mL = milliliter.
MPN = most probable number.
CTR = California Toxics Rule.

This subsection summarizes the constituents that did not meet applicable water quality objectives at MES and tributary stations sampled during the 2013-2014 Monitoring Program. Results are grouped by wet weather or dry weather, and by watershed. Specific results are available in Appendix B for all stations and sampling events.

Basin Plan Amendment – Resolution No. R10-005 (Update of the Bacteria Objectives for Freshwaters Designated for Water Contact Recreation) adopted December 5, 2011, removed the fecal coliform water quality objectives for the recreation (REC) beneficial uses REC-1 and LREC-1.

A suspension of the recreational beneficial uses (REC-1 and REC-2) and of the associated bacteria water quality objectives is applied in some urban watersheds during wet weather storm events greater than 0.5 inch over 24 hours. The High Flow Suspension only applies to concrete lined engineered channels; as detailed in the Basin Plan Amendment – Resolution No. 2003-010 (High-Flow Suspension of Recreational Uses), adopted November 2, 2004 (Los Angeles Regional Water Quality Control Board (LARWQCB), 2003).

The storm events for which the high flow suspension applied in 2013-2014 are identified in the exceedance summary for each drainage area as well as in Table 4-1, Summary of Hydrologic Data for Mass Emissions Stations. The high-flow suspension was applied at one or more of the MES during four storms events monitored during the 2013-2014 season. Measurements above the bacteria water quality objective were not highlighted for these events.

The following laboratory analytical qualifiers are noted on data review:

- Detected not quantified (DNQ).
- Not detected (ND).

Values reported as ND are below the method detection limit (MDL). Values reported with the qualifier of DNQ indicate that the result was between the MDL and the reporting limit (RL). In this analysis, reported values higher than the water quality objective are not discounted based on the three qualifiers above. Rather, the qualifiers are provided so that decision-makers can understand the reliability of data used to assess any impairment and can identify whether improved analytical methods are warranted.

A summary of the water quality monitoring data is presented in Table 4-4 and Table 4-5 for the MES and tributary stations, respectively. Figures 4-3.1 through 4-6.6 provide a graphical summary of water quality data for all MES and tributary stations, respectively. Wet weather monitoring data are shown on Figures 4-3.1 through 4-4.6, and dry weather monitoring data are shown on Figures 4-5.1 through 4-6.6. For each station, the constituents are represented as the ratio of the concentration measured during the monitoring event to the applicable water quality objective. For instance, if the total dissolved solids (TDS) concentration for a given storm was 2,000 milligrams per liter (mg/L) and the water quality objective was 2,000 mg/L at that location, then the ratio would be 1 on the graph.

Water quality objectives for indicator bacteria are based on the REC beneficial use designation at each station. Since the adoption of Resolution R10-005 in 2011, the REC-1 water quality objective (water contact recreation – full immersion) for bacteria is 235 most probable number (MPN)/100 milliliters (mL) of *E. coli*, and the LREC-1 (limited contact recreation) water quality objective for bacteria is 576 MPN/100 mL of *E. coli*. The REC-2 water quality objective (non-contact recreation) of 4,000 MPN/100 mL of fecal coliform applies to waters that are not also designated for water contact recreation (REC-1). The table below summarizes the recreational beneficial uses by station among the watersheds monitored.

Summary of Recreational Beneficial Uses and Applicable Bacteria Water Quality Objectives

Station ID	Station Name	High Flow Suspension	REC-1	LREC-1	REC-2	Applicable *E. coli* WQO (MPN/100 mL)
S01	Ballona Creek	X	P*	E	E	576
S02	Malibu Creek		E		E	235
S10	Los Angeles River	X	E		E	235
S13	Coyote Creek	X	P		I	235
S14	San Gabriel River	X	E		E	235
S28	Dominguez Channel	X	P		E	235
S29	Santa Clara River		E		E	235
TS25	Upper Las Virgenes		E		E	235
TS26	Cheseboro Canyon		E		E	235
TS27	Lower Lindero Creek		I		I	235
TS28	Medea Creek		E		E	235
TS29	Liberty Canyon Channel		E		E	235
TS30	PD 728		I		I	235

*- The REC-1 use designation does not apply to recreational activities associated with the swimmable goal or the associated bacteriological objectives.
E- Existing beneficial use
P – Potential beneficial use
I – Intermittent beneficial use
WQO = water quality objective.
MPN = most probable number.
mL = milliliter.

4.2.2 Mass Emission Stations During Wet Weather

4.2.2.1 Ballona Creek (S01)

A summary of the constituents that did not meet applicable water quality objectives at the Ballona Creek MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.1 and Figure 4-3.1.

E. coli concentrations ranged from 6,310 to 47,200 MPN/100 mL and were above the water quality objective of 576 MPN/100 mL during all five events monitored for bacteria. During wet weather high-flow periods, Ballona Creek is subject to a suspension of the LREC-1 beneficial use (i.e., limited contact recreation). As a result of this suspension, *E. coli* concentrations above

576 MPN/100 mL are not highlighted for 2013-14Event13. Based on this assessment, four of the five wet weather events analyzed for bacteria (2013-2014Event09, 2013-14Event10, 2013-14Event12, and 2013-14Event15) did not meet the *E. coli* water quality objective (Table 4-4.1 and Figure 4-3.1).

Several metals were above their corresponding hardness-based water quality objectives for at least one wet weather sample collected at Ballona Creek (Table 4-4.1). Dissolved copper concentrations ranged from 48.4 to 94.7 micrograms per liter (µg/L) and were above the water quality objective for all four of the wet weather samples collected at Ballona Creek. Dissolved zinc was also above the hardness-based water quality objective for all four wet weather samples, with concentrations ranging from 284 to 535 µg/L. Dissolved lead concentrations ranged from 23.5 to 47.8 µg/L, and one of the four concentrations (2013-14Event13) was above the hardness-based water quality objective. Hardness values for samples collected during wet weather at Ballona Creek ranged from 45 to 235 mg/L.

Dissolved oxygen concentrations ranged from 4.62 to 9.8, and one of the five values (2013-14Event15) was below the water quality objective of 5 mg/L.

All other applicable water quality objectives in Ballona Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.2 Malibu Creek (S02)

A summary of the constituents that did not meet applicable water quality objectives at the Malibu Creek MES during the 2013–2014 Wet Weather Monitoring Season is presented in Table 4-4.2 and Figure 4-3.2.

E. coli bacteria concentrations ranged from 214 to 677 MPN/100 mL, and one of the two values (2013-14Event13) was above the applicable water quality objective of 235 MPN/100 mL. Malibu Creek is not subject to the wet weather suspension of the REC-1 beneficial use.

All other applicable water quality objectives in Malibu Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.3 Los Angeles River (S10)

A summary of the constituents that did not meet applicable water quality objectives at the Los Angeles River MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.3 and Figure 4-3.3.

E. coli concentrations ranged from 3,255 to 137,600 MPN/100 mL and were above the water quality objective of 235 MPN/100 mL during all four storm events monitored for bacteria at Los Angeles River. During wet weather high-flow periods, Los Angeles River is subject to a suspension of the REC-1 beneficial use (i.e., water contact recreation – full immersion). As a result of this suspension, *E. coli* concentrations above 235 MPN/100 mL are not highlighted for 2013-14Event10 or 2013-14Event13. Based on this assessment, two of the four wet weather events analyzed for bacteria (2013-14Event09 and 2013-14Event12) did not meet the *E. coli* water quality objective (Table 4-4.3 and Figure 4-3.3).

Cyanide concentrations ranged from 0.0025 to 0.03 mg/L, and one of the four values (2013-14Event09) was above the water quality objective of 0.022 mg/L (Table 4-4.3).

pH was outside of the water quality objective range of 6.5–8.5 pH units for one of the four wet weather samples collected at Los Angeles River (Table 4-4.3). The water sample collected during 2013-14Event10 had a pH value of 6.45, slightly below the lower limit of the water quality objective range.

Dissolved copper concentrations ranged from 24.2 to 92 μg/L and were above the hardness-based water quality objective for all four of the wet weather samples collected at Los Angeles River. Dissolved zinc was also above the hardness-based water quality objective for all four wet weather samples, with concentrations ranging from 117 to 988 μg/L. Hardness values for samples collected during wet weather at Los Angeles River ranged from 50 to 170 mg/L (Table 4-4.3).

All other applicable water quality objectives in Los Angeles River were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.4 Coyote Creek (S13)

A summary of the constituents that did not meet applicable water quality objectives at the Coyote Creek MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.4 and Figure 4-3.4.

E. coli concentrations ranged from 6,130 to 40,400 MPN/100 mL and were above the water quality objective of 235 MPN/100 mL during all four storm events monitored for bacteria at Coyote Creek. During wet weather high-flow periods, Coyote Creek is subject to a suspension of the REC-1 beneficial use (i.e., water contact recreation – full immersion). As a result of this suspension, *E. coli* concentrations above 235 MPN/100 mL are not highlighted for 2013-14Event13. Based on this assessment, three of the four wet weather events analyzed for bacteria (2013-2014Event09, 2013-14Event10, and 2013-14Event12) did not meet the *E. coli* water quality objective (Table 4-4.4 and Figure 4-3.4).

pH was outside of the water quality objective range of 6.5–8.5 pH units for one of the four wet weather samples collected at Coyote Creek (Table 4-4.4). The water sample collected during 2013-14Event10 had a pH value of 6.41, slightly below the lower limit of the water quality objective range.

Dissolved copper concentrations ranged from 24.9 to 72.8 μg/L and were above the hardness-based water quality objective for all four of the wet weather samples collected at Coyote Creek. Dissolved zinc was also above the hardness-based water quality objective for all four wet weather samples, with concentrations ranging from 145 to 765 μg/L. Hardness values for samples collected during wet weather at Coyote Creek ranged from 45 to 220 mg/L (Table 4-4.4).

All other applicable water quality objectives in Coyote Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.5 San Gabriel River (S14)

A summary of the constituents that did not meet applicable water quality objectives at the San Gabriel River MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.5 and Figure 4-3.5.

E. coli concentrations ranged from 6,131 to 14,670 MPN/100 mL and were above the water quality objective of 235 MPN/100 mL during all three storm events monitored for bacteria at San Gabriel River. During wet weather high-flow periods, San Gabriel River is subject to a suspension of the REC-1 beneficial use (i.e., water contact recreation – full immersion). As a result of this suspension, *E. coli* concentrations above 235 MPN/100 mL are not highlighted for events 2013-14Event09 or 2013-14Event13. Based on this assessment, one of the three wet weather events (2013-14Event15) did not meet the *E. coli* water quality objective (Figure 4-3.5).

Dissolved oxygen concentrations ranged from 4.4 to 10.9, and one of the three values (2013-14Event15) was below the water quality objective of 5 mg/L (Table 4-4.5).

All other applicable water quality objectives in San Gabriel River were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.6 Dominguez Channel (S28)

A summary of the constituents that did not meet applicable water quality objectives at the Dominguez Channel MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.6 and Figure 4-3.6.

E. coli concentrations ranged from 6,770 to 33,600 MPN/100 mL and were above the water quality objective of 235 MPN/100 mL during all five storm events monitored for bacteria at Dominguez Channel. During wet weather high-flow periods, Dominguez Channel is subject to a suspension of the REC-1 beneficial use (i.e., water contact recreation – full immersion). As a result of this suspension, *E. coli* concentrations above 235 MPN/100 mL are not highlighted for 2013-14Event13. Based on this assessment, four of the five wet weather events analyzed for bacteria (2013-14Event09, 2013-14Event10, 2013-14Event12, and 2013-14Event15) did not meet the *E. coli* water quality objective (Table 4-4.6 and Figure 4-3.6).

Dissolved oxygen concentrations ranged from 4.35 to 10.4, and one of the five values (2013-14Event15) was below the water quality objective of 5 mg/L (Table 4-4.6).

pH was outside of the water quality objective range of 6.5–8.5 pH units for one of the four wet weather samples analyzed for general constituents at Dominguez Channel (Table 4-4.6). The water sample collected during 2013-14Event10 had a pH value of 6.33, slightly below the lower limit of the water quality objective range.

Dissolved copper concentrations ranged from 34.9 to 69.2 μg/L and were above the hardness-based water quality objective for all four of the wet weather samples collected at Dominguez

Channel. Dissolved zinc was also above the hardness-based water quality objective for all four wet weather samples, with concentrations ranging from 218 to 600 µg/L. Hardness values for samples collected during wet weather at Dominguez Channel ranged from 50 to 190 mg/L (Table 4-4.6).

All other applicable water quality objectives in Dominguez Channel were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.2.7 Santa Clara River (S29)

A summary of the constituents that did not meet applicable water quality objectives at the Santa Clara River MES during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-4.7 and Figure 4-3.7.

E. coli bacteria concentrations ranged from 260 to 4,130 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during all three of the sampled storm events at Santa Clara River (Table 4-4.7). Santa Clara River is not subject to the wet weather high-flow suspension of the REC-1 beneficial use.

All other applicable water quality objectives in Santa Clara River were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3 Tributary Stations During Wet Weather

4.2.3.1 Upper Las Virgenes Creek (TS25)

A summary of the constituents that did not meet applicable water quality objectives at the Upper Las Virgenes Creek Tributary Station (TS25) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.1 and Figure 4-4.1.

E. coli bacteria concentrations ranged from 7,270 to 14,136 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both wet weather events monitored for bacteria (Table 4-5.1 and Figure 4-4.1). Malibu Creek tributaries are not subject to a high-flow suspension of the REC-1 beneficial use.

All other applicable water quality objectives at Upper Las Virgenes Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3.2 Cheseboro Canyon (TS26)

A summary of the constituents that did not meet applicable water quality objectives at the Cheseboro Canyon Tributary Station (TS26) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.2 and Figure 4-4.2.

E. coli bacteria concentrations ranged from 1,580 to 13,960 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both wet weather events monitored for bacteria (Table 4-5.2 and Figure 4-4.2). Malibu Creek tributaries are not subject to a high-flow suspension of the REC-1 beneficial use.

Dissolved metals were measured during one wet weather event (2013-14Event13) at Cheseboro Canyon. The dissolved copper concentration was 19.9 µg/L, which was above the hardness-based water quality objective of 16.6 µg/L. Dissolved zinc was also above the hardness-based water quality objective for the wet weather sample, with a concentration of 151 µg/L. The hardness value for the sample collected during wet weather at Cheseboro Canyon was 125 mg/L (Table 4-5.2).

All other applicable water quality objectives at Cheseboro Canyon were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3.3 Lower Lindero Creek (TS27)

A summary of the constituents that did not meet applicable water quality objectives at the Lower Lindero Creek Tributary Station (TS27) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.3 and Figure 4-4.3.

E. coli bacteria concentrations ranged from 4,500 to 8,130 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both of the wet weather events monitored for bacteria (Table 4-5.3 and Figure 4-4.3). Malibu Creek tributaries are not subject to a high-flow suspension of the REC-1 beneficial use.

All other applicable water quality objectives at Lower Lindero Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3.4 Medea Creek (TS28)

A summary of the constituents that did not meet applicable water quality objectives at the Medea Creek Tributary Station (TS28) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.4 and Figure 4-4.4.

E. coli bacteria concentrations ranged 3,448 and 14,136 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both of the wet weather events monitored for bacteria (Table 4-5.4). Malibu Creek tributaries are not subject to a suspension of the REC-1 beneficial use.

The sulfate concentration was above the water quality objective of 500 mg/L for one of the two monitored wet weather events (2013-14Event09). Sulfate concentrations ranged from 195 to 635 mg/L (Table 4-5.4).

All other applicable water quality objectives at Medea Creek were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3.5 Liberty Canyon Channel (TS29)

A summary of the constituents that did not meet applicable water quality objectives at the Liberty Canyon Channel Tributary Station (TS29) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.5 and Figure 4-4.5.

E. coli bacteria concentrations ranged from 17,300 to 150,000 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both wet weather events monitored for bacteria at Liberty Canyon Channel (Table 4-5.5 and Figure 4-4.5). Malibu Creek tributaries are not subject to a suspension of the REC-1 beneficial use.

Dissolved copper concentrations ranged from 21.3 to 78.2 μg/L and were above the hardness-based water quality objective for both wet weather samples collected at Liberty Canyon Channel. Hardness values for samples collected during wet weather ranged from 160 to 175 mg/L (Table 4-5.5).

All other applicable water quality objectives at Liberty Canyon Channel were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.3.6 PD 728 at Foxfield Drive (TS30)

A summary of the constituents that did not meet applicable water quality objectives at the PD 728 at Foxfield Drive Tributary Station (TS30) during the 2013-2014 Wet Weather Monitoring Season is presented in Table 4-5.6 and Figure 4-4.6.

E. coli bacteria concentrations ranged from 2,160 and 4,884 MPN/100 mL and were above the applicable water quality objective of 235 MPN/100 mL during both monitored wet weather events at the PD 728 at Foxfield Drive Tributary Station (Table 4-5.6 and Figure 4-4.6). Malibu Creek tributaries are not subject to a suspension of the REC-1 beneficial use.

All other applicable water quality objectives at PD 728 at Foxfield Drive were met during the 2013-2014 Wet Weather Monitoring Season.

4.2.4 Mass Emission Stations During Dry Weather

4.2.4.1 Ballona Creek (S01)

All applicable water quality objectives at the Ballona Creek MES were met during the 2013-2014 Dry Weather Monitoring Season (Table 4-4.1 and Figure 4-5.1).

4.2.4.2 Malibu Creek (S02)

A summary of constituents that did not meet applicable water quality objectives at the Malibu Creek MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.2 and Figure 4-5.2.

Dissolved oxygen concentrations ranged from 4.2 to 7.93, and one of the two values (2013-14Event14) was below the water quality objective of 5 mg/L (Table 4-4.2).

All other applicable water quality objectives in Malibu Creek were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.4.3 Los Angeles River (S10)

A summary of constituents that did not meet applicable water quality objectives at the Los Angeles River MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.3 and Figure 4-5.3.

The pH value was outside of the water quality objective range of 6.5–8.5 pH units during both of the dry weather events at Los Angeles River (Figure 4-5.3). pH values ranged from 8.54 to 8.69 (Table 4-4.3).

All other applicable water quality objectives in the Los Angeles River were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.4.4 Coyote Creek (S13)

A summary of constituents that did not meet applicable water quality objectives at the Coyote Creek MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.4 and Figure 4-5.4.

E. coli bacteria concentrations ranged from non-detect to 1,172 MPN/100 mL (2013-14Event08) which was above the applicable water quality objective of 235 MPN/100 mL (Table 4-4.4).

All other applicable water quality objectives at Coyote Creek were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.4.5 San Gabriel River (S14)

A summary of constituents that did not meet applicable water quality objectives at the San Gabriel River MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.5 and Figure 4-5.5. Only one dry weather event (2013-14Event14) was sampled due to lack of flow during the first dry weather event.

The dissolved oxygen concentration at the San Gabriel River MES was 3.37, which was below the water quality objective of 5 mg/L.

Chloride was measured at 151 mg/L, which was slightly above the water quality objective of 150 mg/L (Table 4-4.5).

All other applicable water quality objectives in the San Gabriel River were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.4.6 Dominguez Channel (S28)

A summary of constituents that did not meet applicable water quality objectives at the Dominguez Channel MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.6 and Figure 4-5.6.

E. coli bacteria concentrations ranged from non-detect to 886 MPN/100 mL, and one of the two values (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-4.6).

All other applicable water quality objectives at Dominguez Channel were met during the 2013-2014 Dry Weather Monitoring Season. (Table 4-4.6 and Figure 4-5.6).

4.2.4.7 Santa Clara River (S29)

A summary of constituents that did not meet applicable water quality objectives at the Santa Clara River MES during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-4.7 and Figure 4-5.7.

Dissolved oxygen concentrations ranged from 3.45 to 7.58, and one of the two values (2013-14Event14) was below the water quality objective of 5 mg/L (Table 4-4.7).

All other applicable water quality objectives at the Santa Clara River MES were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5 Tributary Stations During Dry Weather

4.2.5.1 Upper Las Virgenes Creek (TS25)

A summary of the constituents that did not meet applicable water quality objectives at Upper Las Virgenes Creek (TS25) during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-5.1 and Figure 4-6.1.

E. coli bacteria concentrations ranged from non-detect to 2,850, and one of the two values (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-5.1, Figure 4-6.1).

Sulfate concentrations ranged from 849 to 1,400 mg/L and were above the water quality objective of 500 mg/L for both of the dry weather events at Upper Las Virgenes Creek (Table 4-5.1, Figure 4-6.1).

Concentrations of TDS ranged from 2,290 to 2,910 mg/L and were above the water quality objective of 2,000 mg/L during both monitored dry weather events at Upper Las Virgenes Creek (Table 4-5.1, Figure 4-6.1).

All other applicable water quality objectives in Upper Las Virgenes Creek were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5.2 Cheseboro Canyon (TS26)

A summary of the constituents that did not meet applicable water quality objectives at the Cheseboro Canyon Tributary Station (TS26) during the 2013-2014 Dry Weather Monitoring Season is presented in Table 4-5.2 and Figure 4-6.2.

E. coli bacteria concentrations ranged from non-detect to 384 MPN/100 mL, and one of the two concentrations (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-5.2, Figure 4-6.2).

Dissolved oxygen values ranged from 4.24 to 10.7 mg/L, and one of the two concentrations measured at Cheseboro Canyon during 2013-14Event14 was slightly below the water quality objective of 5 mg/L.

Sulfate concentrations ranged from 1,420 to 1,490 mg/L and were above the water quality objective of 500 mg/L during both dry weather events at Cheseboro Canyon (Table 4-5.2, Figure 4-6.2).

The TDS concentration was 2,990 mg/L, which is above the water quality objective of 2,000 mg/L, during both dry weather events at Cheseboro Canyon (Table 4-5.2, Figure 4-6.2).

All other applicable water quality objectives in Cheseboro Canyon were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5.3 Lower Lindero Creek (TS27)

A summary of the constituents that did not meet applicable water quality objectives at the Lower Lindero Creek Tributary Station (TS27) during the 2013-2014 dry weather monitoring is presented in Table 4-5.3 and Figure 4-6.3.

E. coli bacteria concentrations ranged from non-detect to 693 MPN/100 mL, and one of the two values (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-5.3, Figure 4-6.3).

Dissolved oxygen values ranged from 4.62 to 10.5 mg/L, and one of the two concentrations measured at Lower Lindero Creek during 2013-14Event14 was slightly below the water quality objective of 5 mg/L.

Sulfate concentrations ranged from 659 to 864 and were above the water quality objective of 500 mg/L for both of the dry weather events at Lower Lindero Creek (Table 4-5.3, Figure 4-6.3).

Concentrations of TDS ranged from 1,690 to 2,040 mg/L and were above the water quality objective of 2,000 mg/L during one of the two dry weather events (2013-14Event08) at Lower Lindero Creek (Table 4-5.3, Figure 4-6.3).

All other applicable water quality objectives in Lower Lindero Creek were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5.4 Medea Creek (TS28)

A summary of the constituents that did not meet applicable water quality objectives at the Medea Creek Tributary Station (TS28) during the 2013-2014 dry weather monitoring is presented in Table 4-5.4 and Figure 4-6.4.

Sulfate concentrations ranged from 1,150 to 1,190 and were above the water quality objective of 500 mg/L for both of the dry weather events at Medea Creek (Table 4-5.4, Figure 4-6.4).

Concentrations of TDS ranged from 2,510 to 2,540 and were above the water quality objective of 2,000 mg/L for both of the dry weather events at Medea Creek (Table 4-5.4, Figure 4-6.4).

All other applicable water quality objectives in Medea Creek were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5.5 Liberty Canyon Channel (TS29)

A summary of the constituents that did not meet applicable water quality objectives at the Liberty Canyon Channel Tributary Station (TS29) during the 2013-2014 dry weather monitoring is presented in Table 4-5.5 and Figure 4-6.5.

E. coli bacteria concentrations ranged from non-detect to 2,050 MPN/100 mL, and one of the two values (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-5.5, Figure 4-6.5).

Dissolved oxygen concentrations ranged from 4.63 to 10.9 mg/L, and one of the two concentrations measured at Liberty Canyon Channel during 2013-14Event14 was slightly below the water quality objective of 5 mg/L.

Sulfate concentrations ranged from 342 to 812 mg/L, and the concentration measured during one of the two events (2013-14Event14) was above the water quality objective of 500 mg/L (Table 4-5.5, Figure 4-6.5).

The dissolved copper concentration was above the hardness-based water quality objective during one of the two dry weather monitoring events (2013-14Event14) at Liberty Canyon Channel (Table 4-5.5, Figure 4-6.5). Dissolved copper concentrations ranged from 11.2 to 56.2 μg/L and hardness values ranged from 440 to 815 mg/L.

All other applicable water quality objectives in Liberty Canyon Channel were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.5.6 PD 728 at Foxfield Drive (TS30)

A summary of constituents that did not meet applicable water quality objectives at the PD 728 at Foxfield Drive Tributary Station (TS30) during the 2013-2014 dry weather monitoring is presented in Table 4-5.6 and Figure 4-6.6.

E. coli bacteria concentrations ranged from non-detect to 788 MPN/100 mL, and one of the two values (2013-14Event08) was above the applicable water quality objective of 235 MPN/100 mL (Table 4-5.6, Figure 4-6.6).

Sulfate concentrations ranged from 509 to 695 mg/L and were above the water quality objective of 500 mg/L during both of the dry weather events at PD 728 at Foxfield Drive (Table 4-5.6, Figure 4-6.6).

All other applicable water quality objectives in PD 728 at Foxfield Drive were met during the 2013-2014 Dry Weather Monitoring Season.

4.2.6 Summary of Constituents That Did Not Meet Water Quality Objectives

A summary of the constituents that did not meet the water quality objectives listed in the Basin Plan at the MES and tributary stations is presented in this subsection.

4.2.6.1 Mass Emission Stations

This subsection summarizes the constituents that were measured above Basin Plan water quality objectives at the MES monitoring stations during the 2013–2014 Monitoring Season.

During wet weather, indicator bacteria did not meet water quality objectives at all seven MES. Following the application of high-flow suspensions of *E. coli* water quality objectives (where appropriate), *E. coli* was above the water quality objectives during four of five wet weather events at Ballona Creek and Dominguez Channel, three of four events at Coyote Creek, two of four events at Los Angeles River, all three events at Santa Clara River, one of three events at San Gabriel River, and one of two events at Malibu Creek.

At the MES located in urbanized watersheds (i.e., Ballona Creek, Los Angeles River, and Dominguez Channel) and at the Coyote Creek MES, dissolved copper and dissolved zinc did not meet water quality objectives during all four wet weather events. In addition, dissolved lead did not meet the water quality objective during one of the four wet weather events at Ballona Creek.

pH, dissolved oxygen, and cyanide also did not meet water quality objectives at one or more MES locations during wet weather. pH was slightly below the water quality objective range during one of four events at Los Angeles River, Coyote Creek, and Dominguez Channel. Dissolved oxygen was slightly below the water quality objective range during one of five events at Ballona Creek and Dominguez Channel, and one of three events at San Gabriel River. Cyanide did not meet the water quality objective during one of four wet weather events at Los Angeles River.

During dry weather conditions, dissolved oxygen was the analyte that most frequently did not meet water quality objectives. Dissolved oxygen was slightly below the water quality objective during the one monitored event at San Gabriel River and one of two events at Malibu Creek and Santa Clara River. *E. coli* bacteria generally met water quality objectives during dry weather with the exceptions of one dry weather event at the Coyote Creek MES and one event at the Dominguez Channel MES.

pH and chloride also did not meet water quality objectives at one MES location each during dry weather. pH was slightly above the water quality objective range during both dry events at Los Angeles River, and chloride was slightly above the water quality objective during the one monitored event at San Gabriel River.

Summary of Constituents that Did Not Meet Water Quality Objectives at Mass Emission Stations during 2013-2014 for One or More Events

Mass Emission Station/Watershed	Wet	Dry
Ballona Creek (S01)[1,2,3]	*E. coli* Dissolved copper Dissolved zinc Dissolved lead Dissolved oxygen	NA
Malibu Creek (S02)	*E. coli*	Dissolved oxygen
Los Angeles River (S10)[1,2,3]	*E. coli* Cyanide pH Dissolved copper Dissolved zinc	pH
Coyote Creek (S13)[2,3]	*E. coli* pH Dissolved copper Dissolved zinc	*E. coli*
San Gabriel River (S14)[2,3]	*E. coli* Dissolved oxygen	Dissolved oxygen Chloride
Dominguez Channel (S28)[1,2,3]	*E. coli* Dissolved oxygen pH Dissolved copper Dissolved zinc	*E. coli*
Santa Clara River (S29)	*E. coli*	Dissolved oxygen

NA – all applicable water quality objectives were met.
[1]More urbanized watersheds.
[2]Subject to the bacteria water quality objective high-flow suspension (LARWQCB, 2003).
[3]The high flow suspension did not apply to Ballona Creek during 2013-14Event09, 2013-14Event10, 2013-14Event12, and 2013-14Event15; to Los Angeles River during 2013-14Event09 and 2013-14Event12; to Coyote Creek during 2013-14Event09, 2013-14Event10, and 2013-14Event12; to San Gabriel River during 2013-14Event15; and to Dominguez Channel during 2013-14Event09, 2013-14Event10, 2013-14Event12, and 2013-14Event15.

4.2.6.2 Tributary Monitoring Stations

This subsection summarizes the constituents that were measured above the Basin Plan water quality objectives at the tributary monitoring stations during the 2013–2014 Monitoring Season.

During wet weather, *E. coli* concentrations did not meet the water quality objective during both monitored wet weather events at all six tributary stations. In addition, dissolved copper did not meet the hardness-based water quality objective during both wet weather events at Liberty Canyon Channel and one of the two events at Cheseboro Canyon. Dissolved zinc also did not meet the hardness-based water quality objective during one of two events at Cheseboro Canyon.

The only other analyte that did not meet water quality objectives during wet weather was sulfate, which was above the water quality objective during one of two wet weather events at Medea Creek. There were no sulfate exceedances during wet weather at the Malibu Creek MES.

During dry weather, *E. coli*, sulfate, and TDS were the analytes that most frequently did not meet water quality objectives. *E. coli* was above the water quality objective during one of the two dry weather events at all of the tributary stations except Medea Creek. Sulfate was above the water quality objective during both dry weather events at Upper Las Virgenes Creek, Cheseboro Canyon, Lower Lindero Creek, Medea Creek, and PD 728 at Foxfield Drive and during one of the two events at Liberty Canyon Channel. TDS also frequently did not meet water quality objectives. TDS was measured above the water quality objective during both dry weather events at Upper Las Virgenes Creek, Cheseboro Canyon, and Medea Creek and during one of the two events at Lower Lindero Creek.

The only remaining analytes that did not meet water quality objectives during dry weather were dissolved oxygen, which was slightly below the water quality objective range during one of the two events at Cheseboro Canyon, Lower Lindero Creek, and Liberty Canyon Channel, and dissolved copper, which was above the hardness-based water quality objective during one of the two dry weather events at Liberty Canyon Channel. There were no sulfate, TDS, or dissolved copper exceedances during dry weather at the Malibu Creek MES.

Summary of Constituents That Did Not Meet Water Quality Objectives at Tributary Stations during 2013-2014 for One or More Events

Tributary/Sub-Watershed	Wet	Dry
Upper Las Virgenes Creek (TS25)	*E. coli*	*E. coli* Sulfate TDS
Cheseboro Canyon (TS26)	*E. coli* Dissolved copper Dissolved zinc	*E. coli* Dissolved oxygen Sulfate TDS
Lower Lindero Creek (TS27)	*E. coli*	*E. coli* Dissolved oxygen Sulfate TDS
Medea Creek (TS28)	*E. coli* Sulfate	Sulfate TDS
Liberty Canyon Channel (TS29)	*E. coli* Dissolved copper	*E. coli* Dissolved oxygen Sulfate Dissolved copper
PD 728 at Foxfield Dr. (TS30)	*E. coli*	*E. coli* Sulfate

TDS – total dissolved solids.

4.3 Total Suspended Solids Analyses

A Spearman's Rank Test was used to determine whether a significant positive or negative correlation existed between analyte results and TSS concentrations at each MES, with the exception of the Malibu Creek MES, during wet weather conditions. Too few samples were collected at Malibu Creek MES and at the tributary stations to allow for analysis of correlations. The TSS concentrations from composite samples collected during wet weather events are summarized in Table 4-6. Other constituents analyzed that had significant correlations to TSS are detailed in Table 4-7 and discussed below. Scatter plots of selected constituents that had significant correlations with TSS are presented in Figure 4-7.

Spearman's Rank Test is a rank-based correlation that uses the ranks of the data instead of the actual sample results. This non-parametric test is employed when the data are not normally distributed. The ranks of each data set to be correlated are ordered from highest to lowest, with the highest number in each set given a rank of "1" and so on to the lowest value in each data set. The Spearman rank correlation coefficient, r_s, is then calculated using the ranks and compared to the critical r_s value. The critical r_s value is based on the number of samples and the required alpha (0.05 or 0.10). If the r_s is greater than the critical r_s, then the correlation is considered "significant," or the result has a less than 5% chance (or less than 10% if the alpha is 0.10) of occurring randomly (there is a 95% confidence that this result did not occur by chance or 90% if the alpha is 0.10).

4.3.1 Correlations to Total Suspended Solids

Wet Weather – Mass Emission Stations

Consistent relationships were not observed in correlations between TSS and priority constituents (those constituents that did not meet water quality objectives in one or more monitoring events) across MES during wet weather. Priority constituents evaluated for relationships with TSS included *E. coli*, dissolved metals (copper, zinc, and lead), and dissolved oxygen at Ballona Creek; *E coli*, cyanide, pH, and dissolved metals (copper and zinc) at Los Angeles River; *E. coli*, pH, and dissolved metals (copper and zinc) at Coyote Creek; *E. coli* and dissolved oxygen at San Gabriel River; *E. coli*, dissolved oxygen, pH, and dissolved metals (copper and zinc) at Dominguez Channel; and *E. coli* at Santa Clara River. The only positive correlation of TSS to a priority constituent was dissolved lead at Ballona Creek, and the only negative correlation to a priority constituent was *E. coli* at San Gabriel River.

Lead and dissolved lead (a priority constituent) at Ballona Creek, selenium (with a p value of < 0.10) at Los Angeles River, and 2-4-D (with a p value of < 0.10) and methylene blue active substances (MBAS) at Dominguez Channel were positively correlated with TSS. No positive correlations with TSS were observed at the Coyote Creek MES, and there were too few wet weather events at the Malibu Creek MES to perform correlation analyses. Negative correlations were also observed between TSS and constituents analyzed at MES during wet weather. Dissolved antimony and Kjeldahl nitrogen at Ballona Creek, and ammonia and NH_3-N at Dominguez Channel, were negatively correlated with TSS. No negative correlations with TSS were observed at the Los Angeles River or Coyote Creek MES, and there were too few wet weather events at the Malibu Creek MES to perform correlation analyses. The results of the correlation analyses are summarized in the table below.

The statistical findings of the correlation analysis indicated that several constituents were significantly correlated with TSS at the San Gabriel River and Santa Clara River MES locations, but these findings should be considered in the context of the small sample size (n=3) during the 2013-2014 monitoring season. At San Gabriel River, likely positive correlations with TSS included arsenic and dissolved arsenic, chromium, copper, dissolved aluminum, dissolved iron, lead and dissolved lead, zinc and dissolved zinc, nickel, turbidity, and volatile suspended solids (VSS). Likely negative correlations with TSS included alkalinity, biochemical oxygen demand (BOD), chloride, *E. coli* (a priority constituent), fecal enterococcus, fecal streptococcus, hardness, nitrite-N, pH, specific conductance, sulfate, TDS, and total organic carbon (TOC). At Santa Clara River, likely positive correlations included aluminum and dissolved aluminum, antimony and dissolved antimony, barium, chemical oxygen demand (COD), chromium and dissolved chromium, copper and dissolved copper, iron and dissolved iron, lead dissolved lead, zinc and dissolved zinc, nickel, nitrate (NO_3), nitrate-N, nitrite-N, total phosphorus, TOC, turbidity, and VSS. Likely negative correlations included alkalinity, chloride, hardness, sulfate, and TDS.

Many constituents have a strong binding affinity for sediment particles in stormwater effluent, particularly bacteria, metals, organics, and TOC. It is important to note that the correlations discussed above were based on a small data set and may not be representative of true conditions during a storm.

Correlations Between Constituents and Total Suspended Solids at Mass Emission Stations

Mass Emission/Watershed	Wet	
	Positively Correlated with TSS	Negatively Correlated with TSS
Ballona Creek (S01)	Dissolved lead*, lead	Dissolved antimony, Kjeldahl N
Malibu Creek (S02)[1]	NA	NA
Los Angeles River (S10)	Selenium[2]	None
Coyote Creek (S13)	None	None
San Gabriel River (S14)[3]	Arsenic, chromium, copper, dissolved aluminum, dissolved arsenic, dissolved iron, dissolved lead, dissolved zinc, lead, nickel, turbidity, VSS, zinc	Alkalinity, BOD, chloride, *E. coli**, fecal enterococcus, fecal streptococcus, hardness, nitrite-N, pH, specific conductance, sulfate, TDS, TOC
Dominguez Channel (S28)	2-4-D[2], MBAS	Ammonia, NH_3-N
Santa Clara River (S29)[3]	Aluminum, antimony, barium, COD, chromium, copper, dissolved aluminum, dissolved antimony, dissolved chromium, dissolved copper, dissolved iron, dissolved lead, dissolved zinc, iron, lead, nickel, nitrate (NO_3), nitrate-N, nitrite-N, total phosphorus, TOC, turbidity, VSS, zinc	Alkalinity, chloride, hardness, sulfate, TDS

* Priority constituent.
[1] Too few wet weather events to perform correlation analyses.
[2] Significant with p value of <0.10 rather than <0.05.
[3] Likely correlations; too few wet weather events for confirmation.
TDS = total dissolved solids.
TOC = total organic carbon.
VSS = volatile suspended solids.
BOD = biochemical oxygen demand.
COD = chemical oxygen demand.
MBAS = methylene blue active substances.
NA = not applicable.

4.3.2 Watershed Load Analysis

Constituent loads at each MES were calculated for storm events that occurred during the 2013-2014 Wet Weather Monitoring Season. An estimate of the total constituent loads for each MES is shown in Table 4-9. TSS loads were also calculated for storm events of at least 0.25 inch of total rainfall at all MES equipped with automated samplers. The TSS concentration for each event is shown in Table 4-6 and depicted in Figures 4-9 through 4-12. The total TSS load for each MES is shown in Table 4-8.

Sample loads were calculated using the following equation:

$$concentration\ x\ volume\ (cf)\ x\ conversion\ factor\ = load\ (pounds\ or\ MPN)$$

The sample concentration was multiplied by the volume of water sampled for each event, or in the case of the dry weather monitoring, the base flow for a 24-hour period in October (2013-14Event08) and March (2013-14Event14) at all stations. Volumes used in the calculation are included in Table 4-1. Concentration units were µg/L, mg/L, or MPN/100 mL. The unit conversion factors were 0.0000000624, 0.0000624, or 283.17, respectively.

4.3.2.1 Wet Weather and Dry Weather Constituent Loads for Each Mass Emission Station

Constituent loads were calculated to determine whether there was a relationship between storm event size and the total load for a given constituent. Calculated loads varied between stations and storm events. First-flush loading signatures (i.e., higher loads during the first monitored storm of the season than would be expected based on rainfall totals) were observed for at least one constituent at the following five of the seven MES locations: Ballona Creek MES, Los Angeles River MES, Coyote Creek MES, Dominguez Channel MES, and Santa Clara River MES. Rainfall totals were much higher during 2013-14Event13 (February 27, 2014), the event during which the greatest loads were observed at all MES, compared to the other wet weather events. Rainfall totals during 2013-14Event13 ranged from 1.84 to 5.20 inches, whereas the rainfall totals during the other events, including the first flush, were all under 1 inch.

Dry weather loads were calculated for Event 2013-14Event08 (October 15, 2013) and 2013-14Event14 (March 5, 2014) at each MES and tributary. During dry weather, constituent loads varied between stations and between sampling events. In general, the highest variability was observed in *E. coli* loads and TSS loads, which were generally higher during the first dry event compared to the second. TSS loads were much greater at Los Angeles River during both dry weather events than at any of the other MES. Overall, constituent loads were lower at Santa Clara River MES than at other MES.

For discussion purposes, a limited constituent list comprised of *E. coli*, nitrate, total phosphorus, total petroleum hydrocarbons (TPHs), total Kjeldahl nitrogen (TKN), TDS, TSS, dissolved chromium, copper, and zinc is discussed for each MES. These constituents were chosen because of their prevalence in stormwater runoff.

Ballona Creek (S01)

The wet weather event with the highest rainfall total at Ballona Creek MES was 2013-14Event13 (2.88 inches). Rainfall totals for the other four wet weather events monitored at Ballona Creek MES ranged from 0.12 to 0.31 inches. During 2013-14Event13, loads for *E. coli*, nutrients, TPH, TDS, TSS, and dissolved metals were all the highest observed at Ballona Creek during the 2013-2014 wet weather season. Nitrate, total phosphorus, and dissolved chromium loads were relatively high during the first storm event (2013-14Event09, 0.16 inch) compared to other events which is indicative of a first-flush loading signature for these constituents.

Dry weather loads at Ballona Creek were higher during the first event (2013–14Event08) than the second event (2013-14Event14) for *E. coli*, nutrients, TPH, TDS, TSS, and dissolved metals. Loads varied between the two events, with the highest variability observed for *E. coli* and TSS. The *E. coli* load during 2013-14Event08 was 776 times greater than during 2013-14Event14, and the TSS load during 2013-14Event08 was 20 times greater than during 2013-14Event14. The event volumes for the two dry weather events were 56.6 and 29.7 acre feet, respectively.

Malibu Creek (S02)

Due to the dry conditions during the 2013-2014 monitoring season, only two storm events were monitored as this station. The wet weather event with the highest rainfall total at Malibu Creek MES was 2013-14Event13 (5.12 inches). The rainfall total for the other wet weather event monitored at Malibu Creek MES (2013-14Event09) was 0.35 inches. During 2013-14Event13, loads for *E. coli*, nutrients, TPH, TDS, TSS, and dissolved metals were higher than those observed at Malibu Creek MES during the first event of the season (2013-14Event09); therefore, a first-flush loading signature was not indicated at Malibu Creek MES.

Dry weather loads in Malibu Creek were higher during the first event (2013-14Event09) than during the second event (2013-14Event13) for *E. coli* and TSS. Loads of nutrients, TPH, TDS, and dissolved metals were higher during the second event. Loads varied between the two events with the highest variability observed for dissolved zinc, which was more than 10 times greater during 2013-14Event13 than during 2013-14Event09. Loads for dissolved chromium and copper, nutrients, TDS, and TPH were about 5.5 to 8.0 times greater during 2013-14Event13 than during 2013-14Event09. Loads for *E. coli* and TSS, the two constituents with higher loads during the first event, were less variable (2.3 to 3.7 times greater during the first event). The event volumes for the dry weather events 2013-14Event08 and 2013-14Event14 were 2.6 and 21.0 acre feet, respectively.

Los Angeles River (S10)

The highest rainfall total at the Los Angeles River MES occurred during 2013-14Event13 (1.84 inches). Rainfall totals during the other five monitored events (2013-14Event09, 2013-14Event10, 2013-14Event11, 2013-14Event12, and 2013-14Event15) ranged from 0.15 to 0.51 inches. During 2013-14Event13, loads for nutrients, TPH, TDS, TSS, and dissolved metals were the highest and the load for *E. coli* among the highest observed at Los Angeles River MES during the 2013-14 wet weather season. Loads calculated for *E. coli*, nitrate, total phosphorus, TDS, TPH, TSS, dissolved chromium, and dissolved copper loads were relatively high during the first storm (2013-14Event09, 0.18 inch) compared to other events, which is indicative of a first-flush loading signature for these constituents.

Dry weather loads for *E. coli*, nitrate, TPH, TKN, TDS, TSS, dissolved metals were higher during the first event (2013-14Event09) than during the second event (2013-14Event13), whereas the load for total phosphorus was higher during the second event. Load variability was generally low (up to three times) between the two dry weather events with the exceptions of the TSS load, which was approximately eight times greater during the first dry weather event, and the *E. coli* load, which was about 700 times greater during the first dry weather event. Event volumes during dry weather events 2013-14Event08 and 2013-14Event14 were 672.0 and 383.7 acre feet, respectively.

Coyote Creek (S13)

At Coyote Creek MES, the rainfall total was highest during 2013-14Event13 (2.33 inches). Rainfall totals were similar for 2013-14Event09, 2013-14Event10, 2013-14Event12, and 2013-14Event16 (0.31, 0.23, 0.36, and 0.21 inches, respectively) but were lower during 2013-14Event11 and 2013-14Event15 (0.14 and 0.02 inches, respectively). Loads for *E. coli*, nutrients, TPH, TDS, TSS, and dissolved metals were all highest during 2013-14Event13. The second-highest loads observed for each of these constituents was during the first event of the season, 2013-14Event09, which is indicative of a first-flush loading signature.

Dry weather loads for *E. coli*, TKN, and TSS were higher during the first dry event (2013-14Event08) compared to the second dry event (2013-14Event14). Nitrate, total phosphorus, TDS, TPH, and dissolved metal loads were higher during the second dry event. Load variability was generally low (up to three times) between the two dry weather events with the exception of the *E. coli* load, which was over 1,000 times greater during the first event. Event volumes for dry weather events 2013-14Event08 and 2013-14Event14 were 11.2 and 22.5 acre feet, respectively.

San Gabriel River (S14)

The rainfall total at San Gabriel River MES was highest during 2013-14Event13 (5.20 inches). Rainfall totals for the remaining monitored events (2013-14Event09, 2013-14Event12, 2013-14Event15, and 2013-14Event16) were similar, ranging from 0.31 to 0.78 inches. Loads for *E. coli*, nutrients, TPH, TDS, TSS, and dissolved metals were all highest during 2013-14Event13. Constituent loads for the first monitored storm event (2013-14Event09) were similar to those for 2013-14Event09, 2013-14Event12, 2013-14Event15, and 2013-14Event16, which indicates that first-flush loading signatures were not observed at San Gabriel River MES.

Flow was only observed during one dry weather event (2013-14Event14) at San Gabriel River MES. The event volume was 59.2 acre feet.

Dominguez Channel (S28)

The rainfall total at Dominguez Channel MES was highest during 2013-14Event13 (3.20 inches). Rainfall totals for the remaining five monitored wet weather events at Dominguez Channel MES were similar, ranging from 0.25 to 0.49 inches. Loads for E. coli, nutrients, TPH, TDS, TSS, and dissolved metals were all highest during 2013-14Event13. The second-highest loads observed for TKN, nitrate, TDS, and dissolved chromium were during the first event of the season, 2013-14Event09, which is indicative of a first-flush loading signature for those constituents.

Dry weather loads for nutrients, TPH, and dissolved metals were very similar during the first event (2013-14Event09) and the second event (2013-14Event13), with slightly greater concentrations occurring during the first event with the exception of total phosphorus. However, loads for *E. coli* and TSS were much greater during the first event. The *E. coli* load was over 1900 times greater and the TSS load was approximately 29 times greater during the first event. The event volumes were similar for dry weather events 2013-14Event08 and 2013-14Event14 (8.5 and 7.9 acre feet, respectively).

Santa Clara River (S29)
The rainfall total during 2013-14Event13 (5.16 inches) was much higher than rainfall totals during the other two monitored wet weather events, 2013-14Event09 and 2013-14Event15 (0.67 and 0.24 inches, respectively). Loads for *E. coli* and TKN were greater during the first wet event of the monitoring year (2013-14Event09), whereas loads for nitrate, total phosphorus, TSS, TDS, TPH, and dissolved metals were all much greater during the event with the greatest rainfall (2013-14Event13). First flush loading signatures were observed at Santa Clara MES for *E. coli* and TKN. In addition, loads for nitrate and TSS were greater during the first wet weather event than 2013-14Event15, which is indicative of first flush signatures for those constituents as well.

Dry weather loads for nutrients, TPH, TDS, and dissolved metals were greater during the second event (2013-14Event14) than the first (2013-14Event08), whereas loads for *E. coli* and TSS were greater during the first event. Load variability was generally low (up to 2.2 times) between the two dry weather events with the exceptions of the *E. coli* and TSS loads, which were 27.3 and 8.6 times greater during the first event, respectively. Event volumes for dry weather events 2013-14Event08 and 2013-14Event14 were 0.5 and 1.0 acre feet, respectively.

4.3.3 Total Suspended Solids Trend Analysis

TSS concentrations from 2000 to 2014 were evaluated for normality and log-normal distributions separately for wet and dry weather at each MES using the Shapiro-Wilk test. If the TSS concentrations were normal or log-normally distributed, then a regression analysis was used to evaluate trends. Multiple samples during each monitoring season were treated as replicates. If a normal or log-normal distribution was not found, then it was determined that the distribution of the data was not known. These results were evaluated for trends using the Mann-Kendall non-parametric method. The summary table below presents the method used for trend evaluation and the statistical trend information on TSS data collected at each MES over the past 14 years. The data are shown graphically in Figures 4-13.1 through 4-13.4.

Two significant trends for TSS were identified for wet weather, based on an alpha of 0.05. TSS was identified as a significantly decreasing trend at San Gabriel MES and Santa Clara River MES. The TSS trend analysis of dry weather data identified one significant trend based on an alpha of 0.05, a significantly decreasing trend in TSS at Santa Clara River MES (Table 4-11). The p values indicating significant trends are bolded in the tables below.

Trend Analysis of Wet Weather Total Suspended Solids Concentrations at Mass Emission Stations from 2000–2014

Station	p-value	Method	Trend
Ballona Creek at Sawtelle (S01)	0.498	Mann-Kendall	Not significant
Malibu Creek at Piuma (S02)	0.069	Regression	Not significant
Los Angeles River at Wardlow (S10)	0.806	Regression	Not significant
Coyote Creek at Spring (S13)	0.428	Mann-Kendall	Not significant
San Gabriel River (S14)	**0.019**	Regression	Significant Decreasing
Dominguez Channel at Artesia (S28)	0.116	Mann-Kendall	Not significant
Santa Clara River (S29)	**0.001**	Mann-Kendall	Significant Decreasing

Bold text indicates significant trend

Trend Analysis of Dry Weather Total Suspended Solids Concentrations at Mass Emission Stations from 2000–2014

Station	p-value	Method	Trend
Ballona Creek at Sawtelle (S01)	0.631	Regression	Not significant
Malibu Creek at Piuma (S02)	0.051	Regression	Not significant
Los Angeles River at Wardlow (S10)	0.600	Regression	Not significant
Coyote Creek at Spring (S13)	0.451	Regression	Not significant
San Gabriel River (S14)	0.274	Regression	Not significant
Dominguez Channel at Artesia (S28)	0.688	Regression	Not significant
Santa Clara River (S29)	**0.005**	Mann-Kendall	Significant Decreasing

Bold text indicates significant trend

4.4 Water Column Toxicity Analysis

Water column toxicity monitoring was performed at all MES. In total, four samples were analyzed for toxicity at each station (i.e., two wet weather samples and two dry weather samples). The only exception was San Gabriel River (S14), where only one dry weather sample was collected due to the absence of flow during the first dry weather monitoring event. Wet weather samples were collected during the first rain event of the season on November 21, 2013 (2013–14Event09) for all seven MES locations. The second wet weather samples were collected on February 26, 2014 (2013–14Event14) for all seven MES locations. Dry weather samples were collected on October 21, 2013 (2013–14Event08) and March 5, 2014 (2013–14Event14) for all MES except San Gabriel River; due to dry conditions (no flow) in October. The toxicity results from these samples are provided in Table 4-10a (dry weather) and Table 4-10b (wet weather).

One freshwater species (water flea) and one marine species (sea urchin) were used for toxicity testing. The water flea, *Ceriodaphnia dubia*, was used in chronic 7-day reproduction and survival bioassays. The sea urchin, *Strongylocentrotus purpuratus*, was used in chronic fertilization bioassays.

4.4.1.1 Toxicity Results – Wet Weather

Bioassay tests exposing *C. dubia* to wet weather effluent samples from each of the seven MES indicated that no toxicity to *C. dubia* survival or reproduction was observed for both events. All of the IC_{25} and IC_{50} values were greater than 100%, the NOEC values were 100%, and the TUs (100/ $IC_{50})$ were calculated as less than 1.

Toxicity tests measuring *S. purpuratus* fertilization in exposures to wet weather effluent samples from all seven MES indicated that no toxicity to *S. purpuratus* fertilization was observed in the test samples. All of the NOEC values were 100%, IC_{25} and IC_{50} values were greater than 100%, and the TUs were calculated as less than 1.

4.4.1.2 Toxicity Results – Dry Weather

Bioassay tests exposing *C. dubia* to dry weather effluent samples from each MES indicated that slight toxicity to *C. dubia* reproduction was observed in dry weather samples collected from Malibu Creek. During 2013-2014Event08, the concentration resulting in a 25% inhibition (IC_{25}) in the selected sublethal endpoint (e.g., reproduction) was 20%, indicating that at 20% concentration, a 25% reduction in neonate production was observed. The NOEC value was 100%, the IC_{50} value was greater than 100%, and the TU was calculated to be less than 1. Therefore, a TIE was not necessary. During 2013-14Event14, the IC_{25} value was 5.49, indicating that at 5.49% concentration, a 25% reduction in survival was observed. The IC_{50} value was greater than 100%, the NOEC was 100%, and the TU was calculated to be less than 1. Therefore, a TIE was not necessary.

Toxicity tests measuring *S. purpuratus* fertilization in exposures to dry weather effluent samples from each MES indicated that no toxicity to slight toxicity to *S. purpuratus* fertilization was observed in the test samples. All of the IC_{25} and IC_{50} values were greater than 100% test substance, the NOEC values ranged from 50 to 100% test substance, and the TUs were less than 1.

4.4.2 Trash Monitoring Analysis

During the 2013-2014 monitoring season, visual observations of trash were made, and at least one photograph was taken at each MES after the first storm event. In addition, photographs were taken at each MES after at least three additional storm events, with the exception of the Santa Clara MES, which was monitored during two additional storm events, and the Malibu Creek MES, which was monitored during one additional storm event. Photographs are presented in Appendix C. Ballona Creek Watershed and Los Angeles River Watershed Trash Compliance Monitoring Reports are presented in Appendices I and J, respectively.

4.4.3 Identification of Possible Constituent Sources

This subsection summarizes some of the key points regarding known or suspected sources of constituents that did not meet applicable water quality objectives.

4.4.3.1 Indicator Bacteria

Multiple studies have found urban runoff to be a source of indicator bacteria in the municipal separate storm sewer system (MS4). The SCCWRP conducted bacteria source identification studies of Ballona Creek, and the results were published in 2005 in the journal *Water, Air, and Soil Pollution* (Stein and Tiefenthaler, 2005). The City of Los Angeles conducted a bacteria source identification study of the Los Angeles River, and the results were published in November 2008. Both of these studies found urban runoff to be a source of indicator bacteria. According to the *Draft Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches* (LARWQCB, 2001), published on November 8, 2001, urban runoff from the storm drain system may have elevated levels of indicator bacteria as a result of sanitary sewer leaks and spills, illicit connections of sanitary lines to the storm drain system, runoff from homeless encampments, illegal discharges from recreational vehicle holding tanks, and/or malfunctioning septic tanks. Fecal matter from animals, including pets, livestock, and birds, can also elevate bacteria levels. A July 2007 report by ENSR International for EPA New England Region 1, *Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts* (ENSR International, 2007) also discussed the previously mentioned sources.

Bacteria have a strong binding affinity for sediment particles in stormwater effluent. A recent study published in *Environmental Toxicology and Chemistry* examined stormwater particle size distribution in Ballona Creek (Brown et al., 2013). The study suggested that commonly employed best management practices (BMPs) designed to capture larger particles ($\geq 250\ \mu m$) may not capture the majority of the bacterial contaminant load because of the association of bacteria with small particles ($\leq 6\ \mu m$).

The report, Total Maximum Daily Loads (TMDL) for Bacteria, Malibu Creek Watershed (LARWQCB, 2004), identified surface runoff loads from residential and commercial areas as the largest source of bacteria loads in the Malibu Creek watershed during both wet and dry weather. The TMDL report also indicated that failing septic systems and birds were significant contributors to the fecal coliform loads in the watershed. Other sources of bacteria in the watershed include contributions from undeveloped areas (wildlife) and horses/livestock.

In addition to bacteria sources, certain factors can amplify bacteria concentrations by promoting bacteria growth. Organic carbon provides food for bacteria. Sunlight can kill bacteria; therefore, covered water can promote bacterial growth. Slow-moving, stagnant water also can promote bacterial growth.

4.4.3.2 Copper, Lead, and Zinc

According to the article "Regulating Copper in Urban Stormwater Runoff" (Lee and Lee, 2000), copper can come from brake pads or industrial (e.g., the textile industry) and mining sources. A metals source study is discussed in the article "Loadings of Lead, Copper, Cadmium, and Zinc in Urban Runoff from Specific Sources" (Davis et al., 2001). The study concludes that elevated levels of metals were found from urban areas, especially in highway runoff. The abstract identifies important sources, such as building siding for lead, copper, cadmium, and zinc; vehicle brake emissions for copper; and tire wear for zinc. Atmospheric deposition was also identified as an important source of cadmium, copper, and lead. Details behind those findings are presented in the May 2005 Technical Report from SCCWRP entitled *Contributions of Trace Metals from Atmospheric Deposition to Stormwater Runoff in a Small Impervious Urban Catchment* (Sabin et al., 2005). Additionally, a historic comparison completed by SCCWRP (Sabin and Schiff, 2008) indicated atmospheric deposition sources of copper and zinc have increased near harbor and urban sites over the past 30 years.

4.4.3.3 Sulfate

Large quantities of greenish rock with amphiboles and sediment are found near the MES in the Malibu Creek Watershed. The hillside is composed primarily of what appears to be decomposed, somewhat grainy, greenish marine or lagoon sediment/glauconite and less decomposed, greenish-brown shale with clear fossils and embedded detritus. These sediments are known to be sulfur bearing. Representative field samples gathered initially had a distinct moderate sulfur (e.g., musty, rotten eggs) odor. Sulfate concentrations in the Malibu Creek Watershed can be largely attributable to the presence of eroded sulfur-rich sediment (Orton, 2011). Fungal and bacterial processes within the creek and surrounding areas may facilitate the release of sediment-bound sulfur into the water column.

Another potential sulfur source may be effluent from the nearby Tapia Water Reclamation Facility, located just upstream from the sampling station. Sulfur is used in wastewater processes such as flocculation. However, other MES close to wastewater treatment plants did not show highly elevated sulfur concentrations. Tests and/or a review of effluent reports would be necessary to determine whether effluent from the plant is a significant contributor to the raised sulfur concentrations of these waters.

4.4.3.4 pH

The pH value is a measure of the acid (or H+ ion) concentration in solutions. When the concentrations of acid and base (or OH- ion) are exactly equal, the pH is equal to 7.0. Natural rainwater has a pH of approximately 5.5 (i.e., slightly acidic). As minerals dissolve into rainwater, the pH increases because of the “buffering” effect of minerals such as calcium and magnesium carbonate. Sources that can decrease pH below the water quality objective of 6.5 include illicit discharges (e.g., swimming pools, battery acid, and other light and heavy industrial chemicals).

Two pH exceedances during the 2013-2014 monitoring year were slightly above the water quality objective range (slightly basic), and three were slightly below the water quality objective (slightly acidic). A pH above 8.5 could indicate highly mineralized waters; for example, groundwater seepages that are not as diluted, especially during dry weather. Each of the basic readings measured during the 2013-2014 monitoring year were measured during dry conditions. Common human factors that can cause high pH in surface waters include the discharge of concrete wash water, surfactants in cleaning agents, and illicit washing. Algal blooms can also cause elevated pH during the day as they use carbon dioxide for photosynthesis and decreased pH at night as they respire.

It is possible that sudden rain events can bring the pH below 6.5, if the water sampled is not heavily mineralized. This would be expected in a watershed that is mostly hardscape, with little vegetation to provide detention or interaction with soils. The sudden influx of rainwater is the most likely explanation for the three slightly low pH values observed during wet weather.

4.4.3.5 Cyanide

Sources of cyanide include industrial operations such as manufacturing of synthetic fabrics, plastics, and metal processing or electroplating operations. Fumigation operations can also contribute to cyanide in the environment as can commercial printers and pharmaceutical manufacturers. Additionally, incomplete combustion during forest fires can also contribute a large amount of cyanide to the environment. Only one cyanide exceedance was measured during the 2013-2014 monitoring year.

4.5 Recommendations

On November 8, 2012, the LARWQCB adopted a new NPDES MS4 Permit (Order R4-2012-0175) for the coastal watersheds of Los Angeles County. The new 2012 Permit, which became effective on December 28, 2012, provides a watershed management approach to address water quality protection. Under the 2012 Permit, the protocols of the 2001 Permit Monitoring and Reporting Program are to continue to be used until the Integrated Monitoring Programs (IMPs) and Coordinated Integrated Monitoring Program (CIMPs) submitted by the Watershed Management Groups throughout the Los Angeles Basin are approved by the Executive Officer of the LARWQCB. Due to the timing of the approval of the CIMPs, MES monitoring will be conducted during the 2014-2015 monitoring season in accordance with the monitoring protocols of the 2001 monitoring program.

The 2001 Permit Monitoring and Reporting Program included provisions for tributary monitoring in sub-watersheds where stormwater discharges and non-stormwater (dry weather) discharges are causing or contributing to exceedances of water quality standards, and to prioritize drainage and sub-drainage areas requiring management actions. The 2012 permit does not require tributary monitoring. However, monitoring in the tributaries will be continued until CIMPs submitted by the Watershed Management Groups are approved by the LARWQCB.

It is recommended that the field monitoring of DO and pH continue to be incorporated into in the monitoring program. DO measurements in samples may be impacted through sample handling and transportation, and sampling guidelines generally call for the measurement of DO as soon as possible after sampling. It is possible that the change in DO levels between the field and the laboratory may cause or contribute to observed DO readings outside the water quality objective range. Measuring pH in the field may limit effects of water hardness and alkalinity on changes to the pH levels measured in the analytical laboratory.