12.0 CONCLUSIONS

12.1 Core Monitoring Program Conclusions by Watershed

12.1.1 San Gabriel River Watershed

The San Gabriel River Watershed Management Area is the third largest watershed in the study area, comprising 107.3 square miles (434,421 acres). Land use within the watershed consists primarily of vacant (greater than 50%) and residential areas. There are two mass emission stations (MES) within the San Gabriel River WMA. One station is located on the San Gabriel River and the second MES is located at the confluence of Coyote Creek and the San Gabriel River. The following discussion will first present the conclusions for the San Gabriel River. The San Gabriel River MES is located in the middle portion of the watershed. Based on the mean exceedances ratios (mean concentration for all years monitored divided by the water quality objective) over the past ten years, water quality monitoring at this location suggest that the following constituents are the primary COCs in the watershed: indicator bacteria (total and fecal coliform, and enterococci), total aluminum, total copper, total lead and cyanide. The term COC used in this report is based on a comparison of mean annual concentrations to WQO. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0. Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance. Based on the 2004-2005 monitoring data, only the indicator bacteria concentrations out of the COC identified indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event samples.

Oil and grease and total boron concentrations indicated a significant increasing trend over the ten-year monitoring period. These constituents did not exceed the mean exceedance ratio of 1.0.

Annual mean indicator bacterial densities exceeded water quality objectives every year in which samples were collected from 1995 through 2005 and had the highest mean exceedance ratios of any constituents monitored. Exceedances of the indicator bacteria water quality objectives were common throughout all of the monitoring stations throughout the study area. Annual mean concentrations of total coliform, fecal coliform, and enterococci at the San Gabriel River MES and the corresponding ratios to water quality objectives were similar to those measured in other watersheds within the study area. Based on total mean annual loadings for indicator bacteria in 2004-2005, San Gabriel River had some of the lowest densities as compared to other watersheds. In addition, the San Gabriel River MES had the lowest bacteria loadings per acre as well as Malibu Creek and Santa Clara River. These three watersheds have a greater percentage of vacant land and are less urbanized than the other watersheds. The results of the loading estimates per acre indicate a correlation between lower loadings per acre for less urbanized watersheds.

The mean exceedance ratio for total aluminum was greater than 1.0 at several of the mass emission stations, including San Gabriel River, Los Angeles River, Malibu Creek, and Santa Clara River. For all of these watersheds except Los Angeles River, the annual mean total aluminum concentration exceeded the WQO only during the 1997-1998 season or the 2004-2005 season, or both (the annual mean aluminum concentration at the Los Angeles River MES

exceeded during these two seasons and three others). The annual mean total aluminum concentrations at the Coyote Creek, Ballona Creek, and Santa Clara River MES were also high during these seasons (typically exceeding the WQO), but over the ten-year monitoring period did not exceed the mean exceedance ratio. The annual rainfall was greater during the 1997-1998 and the 2004-2005 seasons than any others in the ten-year monitoring period. Thus, the elevated aluminum concentrations at the San Gabriel River MES may have been a result of heavy flows rather than a persistent problem in the watershed. This is supported by the ANOVA results, which indicated that the mean concentration of total aluminum at the San Gabriel River MES was not significantly greater than that at any other MES.

The mean exceedance ratios for total copper and total lead were also greater than 1.0 at the San Gabriel River MES as well as all other watersheds monitored in the study area except Malibu Creek. Concentrations of these constituents were elevated consistently over the ten-year monitoring period. However, the mean concentrations and total loads of these constituents over that time were similar to or less than those found in the other watersheds monitored. Elevated levels of copper and lead, as well as zinc, are common in urbanized watersheds such as the San Gabriel River (MEC-Weston 2005). The sources of these metals are numerous in the urban landscape, but three non-point sources have been identified as some of the greatest contributors (Woodward-Clyde 1992): atmospheric emissions (stationary and mobile sources, such as automobile emissions), automotive (other than emissions, such as wear and tear on tires and brake pads), and water supply (such as corrosion from distribution infrastructure). These non-point sources can be ubiquitous in urbanized watersheds and difficult to eliminate from surface waters.

The results of the land use monitoring reported in the 2000 Integrated Receiving Waters Impact Report (LADPW, 2000), indicated that light industrial, transportation, and retail/commercial land uses displayed the highest medium values for total and dissolved zinc, with light industrial being the highest. Light industrial and transportation land uses displayed the highest medium values for total and dissolved copper. These urbanized land uses therefore can be associated with higher concentrations of these metals in urban runoff. The previous results appear to collaborate the conclusions of this report using all available years of monitoring data. A list of critical sources was also developed under the 1996 NPDES Permit. Critical sources were identified and ranked by their potential significance to stormwater quality in the *Critical Source Selection and Monitoring Report* (Woodward-Clyde, 1997) discussed in the 2000 Integrated Receiving Waters Impact Report (LADPW, 2000). These critical sources included: wholesale trade (including scrap yards and auto dismantling); automotive repair/parking, fabricated metal products; motor freight; chemical manufacturing facilities; automotive dealers/gas stations; electric/gas/sanitary; and miscellaneous manufacturing. These may be potential sources for the metal exceedances depending on their number and distribution in the watershed.

Mean total loading estimates for total copper and lead were among the lowest estimates of all the watersheds. Based on mean total loadings per acre for total copper and lead, San Gabriel River had the lowest loadings, along with Malibu Creek and Santa Clara River. These results correlate with the loadings per acre for indicator bacteria, in which less urbanized watersheds have lower loading estimates.

The mean exceedance ratio for cyanide was greater than 1.0 at the San Gabriel River MES. Annual mean concentrations exceeded water quality objectives every year that samples were collected from 1995-2005. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at the San Gabriel River was not as high as those measured in other watersheds, including Coyote Creek, Los Angeles River and Dominguez Channel; however, it was higher than those measured at Ballona Creek, Malibu Creek and Santa Clara River. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources, including stormwater runoff from metal plating and finishing operations and pesticide use. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low. Potential natural sources of cyanide include incomplete combustion from forest fires, decomposition of plant material and fungi. Water concentrations of cyanide tend to breakdown within days, but may bind to organic matter in sediments carried by stormwater and remain more persistent (www.eco-usa.net, www.dsf.health.state.pa, www.cynaidecode.org, www.npi.gov).

Oil & grease and total boron did not exceed WQOs at the San Gabriel River MES; however, they were included in the COC discussion as potential pollutant issues because of significant increasing trends in concentrations. Annual mean oil and grease levels in the watershed increased from less than 1.0 mg/L from 1996 through 2000 to greater than 2.0 mg/L from 2001 through 2005. The reason for the increase is unclear. The annual mean concentration of total boron also increased over the ten-year monitoring period (no such trend was found for any of the other watersheds in the study area). Boron enters the aquatic environment through two main pathways: natural weathering of borate-containing rock and release of borates in cleaning products through disposal of wastewater treatment systems (Dyer and Caprarai 1997). However, the reason for the increasing trend in borate in the San Gabriel River Watershed is unclear.

Wet and dry weather samples were analyzed for toxicity to cladoceran (*Ceriodaphnia dubia)* survival and reproduction and/or sea urchin fertilization. Toxicity monitoring at the San Gabriel River MES determined that stormwater samples collected in 2004-2005 did not affect *C. dubia* survival or reproduction, however, the samples inhibited sea urchin fertilization. Dry weather samples collected in 2004-2005 affected *C. dubia* and sea urchin reproduction. Prior to 2004-2005, wet and dry weather samples were not toxic to the organisms. Toxicity Identification Evaluations (TIEs) were unable to determine the stormwater pollutant causing the toxicity due to insufficient volumes of water.

In addition to the water quality monitoring conducted at the MES, stream bioassessment and monitoring of the San Gabriel River Estuary has also been conducted. The results of the stream bioassessment indicated that three sites located in tributaries to the main channel of the San Gabriel River had CFG Index of Biotic Integrity scores between 2 and 13, and quality ratings of Very Poor while an upstream reference site had IBI scores of 30 and 40, and was rated Fair. These scores are consistent with the other urbanized watersheds in the region. In the San Gabriel River Estuary, sediments were analyzed for chemistry, toxicity and benthic macroinvertebrate diversity. In general, concentrations of COCs were low (either not detected or below the ER-L values) and the mean percent survival of test organisms was high, suggesting that that the San Gabriel River sediments were not toxic.

The mass emission station for Coyote Creek is located in the lower portion of the watershed near the confluence of Coyote Creek and San Gabriel River. Based on the mean exceedances ratios over the past ten years, water quality monitoring at this location suggests that the following constituents are the primary COCs at this MES: indicator bacteria (total and fecal coliform, and enterococci), total copper, total lead, dissolved lead and cyanide.

Annual mean indicator bacterial densities exceeded water quality objectives every year in which samples were collected from 1995 through 2005 and had the highest mean exceedance ratios of any constituents monitored (samples were not analyzed for bacteria from 1996-2000). Mean exceedance ratios of total coliform, fecal coliform, and enterococci at the Coyote Creek MES were among some of the highest within the study area. Mean total loading estimates for all three indicator bacteria from 2004-2005 were among the highest for Coyote Creek. Based on mean total loadings per acre, Coyote Creek had some of the highest loadings for indicator bacteria, along with the other more urbanized watersheds, including Los Angeles River, Dominguez Channel and Ballona Creek. These results indicate a correlation between higher loadings per acre from more urbanized watersheds.

Similar to the San Gabriel River MES, the mean exceedance ratios for total copper and total lead were also greater than 1.0 at the Coyote Creek MES as well as all other watersheds monitored in the study area except Malibu Creek. Concentrations of these constituents were elevated consistently over the ten-year monitoring period. The mean exceedance ratio for dissolved lead was also greater than 1.0 at the MES; however, annual mean concentrations only exceeded objectives in two of the ten monitoring years. Elevated levels of copper and lead are common in heavily-urbanized watersheds (MEC-Weston 2005). Based on mean total loading estimates from 2004-2005, total loads for total copper and lead for Coyote Creek were among the highest of all watersheds monitored, in addition to Los Angeles River and Ballona Creek. Mean total loadings per acre for total copper and lead were also among the highest at Coyote Creek, following Dominguez Channel and Ballona Creek. These results further indicate a correlation between higher loadings per acre for more urbanized watersheds.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Coyote Creek MES. Annual mean concentrations exceeded water quality objectives since 2000. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at Coyote Creek was the highest ratio among all other watersheds monitored. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions.

Water column toxicity monitoring determined that stormwater samples collected in 2004-2005 affected *C. dubia* survival and reproduction and sea urchin reproduction. 2004-2005 dry weather samples only inhibited sea urchin fertilization. Historical toxicity testing determined that stormwater samples collected in 2002-2003 inhibited *C. dubia* survival and reproduction and decreased sea urchin fertilization and stormwater samples collected in 2003-2004 affected sea urchin fertilization. Only dry weather samples from 2003-2004 affected sea urchin fertilization. TIEs identified the toxic pollutant in 2002-2003 as one or more non-polar organic compounds

(i.e. propane, butanol), cationic metals (i.e. zinc, copper), and organophosphates. In 2003-2004 the toxic pollutant was believed to be a volatile compound (i.e. household cleaning products, gasoline).

12.1.2 Los Angeles River Watershed

The Los Angeles River Watershed is the second largest watershed in the study area, comprising 131.9 square miles (533,853 acres). It consists primarily of residential land use. The mass emission station is located at the bottom of the watershed. Based on the mean exceedances ratios over the past ten years, water quality monitoring at the MES suggests that the following constituents are the primary COCs in the watershed: indicator bacteria, total and dissolved copper, lead and zinc, total aluminum and cyanide. In addition, regression analyses indicated increasing trends in the concentrations of alkalinity and bicarbonate over that period of time, which can reduce the bioavailibility of metals in stormwater.

As with all sampling locations in the study area, annual mean indicator bacterial densities at the Los Angeles River MES exceeded water quality objectives every year in which samples were collected from 1994 through 2005. In general, annual mean concentrations of total coliform, fecal coliform, and enterococci tended to be higher at the Los Angeles River MES than those measured in other watersheds (particularly for enterococci). However, the overall mean concentrations of these indicators from 1994 through 2005 were not significantly greater at this site compared to the other watersheds. This is likely due to the ubiquitous nature of these indicators in urban drainages and the inherent variability in surface water concentrations. Mean total loading estimates for 2004-2005 for all three indicator bacteria were the highest for the Los Angeles River. Similarly, mean total loadings per acre for bacteria were also the highest for Los Angeles River, in addition to the other more urbanized watersheds, including Coyote Creek, Dominguez Channel and Ballona Creek.

Exceedances of WQO for total and dissolved copper, lead, and zinc were common to all the watersheds monitored except Malibu Creek. Although there were no statistically significant differences among watersheds between the overall mean concentrations from 1994 through 2005 of these COCs, the highest annual mean concentrations were typically observed at the Los Angeles River MES. Exceedances of WQO for all of these COCs were a consistent problem in the watershed throughout the monitoring period. In addition, the ratios of the mean concentrations to the water quality objectives for each of these COCs were greater at the Los Angeles River MES than at any other stations monitored. The elevated ratios are a result of both high concentrations of these COCs in the surface water at this station and low hardness values (since the WQOs for metals are hardness based). The overall mean hardness (1994 through 2005) at this station was the second lowest of any station monitored in the study area. Finally, the mean loadings of total copper, lead, and zinc (as well as total chromium and total nickel) were greater at the Los Angeles River MES than at any other station monitored. Taken together, these results suggest that elevated levels of copper, lead, and zinc are a persistent issue in the Los Angeles River Watershed. In urban settings there are numerous non-point sources of copper, lead, and zinc, including automobiles and atmospheric deposition. A list of critical sources were identified and ranked by their potential significance to stormwater quality in the *Critical Source Selection and Monitoring Report* (Woodward-Clyde, 1997) discussed in the 2000 Integrated Receiving Waters Impact Report (LADPW, 2000). The high levels found at the Los Angeles

River MES likely reflect the large size of the watershed and the extensive degree of urbanization. 2004-2005 mean total loading estimates for total copper, lead, and zinc were highest for Los Angeles River followed by Coyote Creek and Ballona Creek. In addition, based on mean total loadings per acre for total copper, lead and zinc, Los Angeles River had some of the highest loadings of the watersheds monitored. These results are similar to the indicator bacteria loadings, in which higher loadings per acre correlated with higher percentages of urbanization.

The mean exceedance ratio for total aluminum was greater than 1.0 at the Los Angeles River MES as well as the San Gabriel River, Malibu Creek, and Santa Clara River sites. At the Los Angeles River MES, the annual mean total aluminum concentration exceeded the WQO during five of the nine seasons in which it was analyzed, including the last two seasons. This suggests that high levels of total aluminum may be a persistent problem in the Los Angeles River drainage. However, the overall mean total aluminum concentration at the Los Angeles River MES was not significantly greater than those at other stations.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Los Angeles River MES. Annual mean concentrations exceeded water quality objectives every year that samples were collected from 1995-2005. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at the Los Angeles River was the second highest after Coyote Creek among all watersheds monitored. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources, including stormwater runoff from metal plating and finishing operations and pesticide use. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low. Because the greatest source of cyanide is likely from vehicle emissions, this constituent will remain widespread and persistent in this highly urbanized WMA.

The annual mean concentrations of alkalinity and bicarbonate increased significantly from 1994 to 2005 at the Los Angeles River MES. Alkalinity is a measure of the buffering capacity of the water (the ability to resist changes in pH). It is typically expressed in units of mg/L of calcium carbonate and its concentration is due primarily to the presence of bicarbonate, carbonate, and hydroxide ions in the sample. Thus, it is not surprising that an increasing trend in alkalinity was found along with an increasing trend in bicarbonate. Elevated levels of alkalinity and bicarbonate may originate from several sources in a watershed, including natural weathering of rocks that contain calcium carbonate (such as limestone), areas of significant algae blooms (carbonates and hydroxide are byproducts of algal respiration), and industrial wastewater. Higher alkalinity tends to mitigate metal toxicity (bicarbonates and carbonates take metals out of solution and reduce their bioavailability), thereby reducing the toxicity of the metals identified as COC. The reason for the increasing trends in these COCs in the Los Angeles River Watershed is unclear.

Water column toxicity monitoring determined that stormwater collected from the Los Angeles River MES during one sampling event in 2004-2005 affected *Ceriodaphnia dubia* survival and inhibited sea urchin fertilization, while stormwater collected from the second sampling event only inhibited sea urchin fertilization. Dry weather samples collected in 2004-2005 only inhibited sea urchin fertilization. Prior to 2004-2005, sea urchin fertilization was reduced by

exposure to wet and dry weather samples collected in 2003-2004. A Phase I TIE was initiated in July 2005 based on the toxicity results for the two dry weather samples collected from the Los Angeles River. The results indicated that metal toxicity is likely to be responsible for the reduction in urchin fertilization. Although copper has been detected at concentrations above the WQO, the results indicate that copper is not the sole contributor to toxicity. Synergistic effects from the metals identified as potential COC may be occurring between the multiple compounds found in the sample.

Water quality monitoring at the tributary stations identified constituents that consistently exceeded WQOs at some or all of the stations, including all indicator bacteria, total copper and total zinc. Total lead, total aluminum, dissolved copper, cyanide and diazinon exceeded WQOs less frequently. All exceedances at the tributary stations coincided with exceedances at the mass emission station.

In addition to the water quality monitoring discussed above, stream bioassessment and monitoring of the Los Angeles River Estuary was also conducted. Stream bioassessment surveys were conducted at eight sites in the Los Angeles River Watershed. Three of the sites were located in the main channel of the Los Angeles River, and five of the sites were located in tributaries. The benthic macroinvertebrate communities of all of the sites in the Los Angeles River Watershed had CFG Index of Biotic Integrity scores between 1 and 20, and quality ratings of Very Poor and Poor. These scores are similar to those in other watersheds in the region. The results of the Los Angeles River Estuary sediment monitoring indicated that four metals were detected above ER-L values at one station. Total detectable PAHs exceeded the ER-L at two stations, and total DDT, total chlordane and total PCBs exceeded the ER-M at two stations within the Estuary. These two stations had mean ERM-Q values above the 0.10 threshold. Sediment toxicity was determined to be highly toxic to the test organisms at these two stations.

Trash monitoring was also conducted during the 2002-2003 and 2003-2004 storm seasons. For both seasons, the first storm event of the season produced the most amount of trash, particularly from commercial land use areas. In subsequent storms, industrial land use was the largest contributor of trash, followed by commercial land use. Low density single family produced the least amount of trash during both storm seasons.

12.1.3 Dominguez Channel Watershed

The Dominguez Channel Watershed is the smallest watershed in the study area, comprising 20.2 square miles (81,764 acres). It is also the most developed watershed (on a percentage basis) and consists primarily of residential and industrial land use areas. The mass emission station is located near the middle of the watershed because of the flatness of the watershed and tidal influence. Based on the mean exceedances ratios over the past ten years, water quality monitoring at this location suggests that the following constituents are COCs in the watershed: indicator bacteria (total and fecal coliform, and enterococci), dissolved and total copper and lead, total zinc, cyanide and diazinon. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0. Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance. In addition, there was an increasing trend in the concentration of total lead at this site. Based on the 2004-2005 monitoring data, only dissolved zinc of the COC

identified indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event.

As with the other watersheds monitored in the region, annual mean indicator bacterial densities at the Dominguez Channel MES exceeded water quality objectives every year in which samples were collected from 1995 through 2005. Annual mean concentrations of total coliform, fecal coliform, and enterococci at the Dominguez Channel MES and the corresponding ratios to water quality objectives were similar to or slightly lower than those measured in other watersheds in the region. The results reflect the ubiquitous nature of indicator bacteria in urban watersheds. Mean total loading estimates from 2004-2005 for indicator bacteria were intermediate as compared to the other watersheds. Based on mean total loadings per acre for indicator bacteria, Dominguez Channel loadings were among the highest of all watersheds, along with Los Angeles River, Coyote Creek and Ballona Creek. These results further indicate the correlation between a higher percentage of urbanized land and higher pollutant loadings.

Exceedances of WQO for total and dissolved copper, lead, and zinc were found at the Dominguez Channel MES as well as all the watersheds monitored except Malibu. For total and dissolved copper and zinc, the ratios to water quality objectives at this site were second only to those found at the Los Angeles River MES (the ratios for total and dissolved lead were intermediate compared to other watersheds). Although concentrations of these metals were high compared to WQO, the Dominguez Channel also had the lowest mean hardness value of any of the watersheds monitored, which will tend to increase the number of exceedances of WQO for metals. The mean loads of total copper, lead, and zinc from the Dominguez Channel Watershed were lower than most other watersheds in the study area, which reflects the relatively small drainage upstream of the MES at this site. Mean total loading estimates for total copper, lead and zinc were intermediate compared to the other watersheds. Total loading estimates per acre were highest for Dominguez Channel, followed by Ballona Creek, Los Angeles River and Coyote Creek, which are the most urbanized watersheds. Similar to bacteria loadings, these results also indicate a correlation between higher loadings per acre from more urbanized watersheds as compared to lower loading estimates from the least urbanized watersheds.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Dominguez Channel MES. Annual mean concentrations exceeded water quality objectives every year that samples were collected from 2001-2005. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at the Dominguez Channel was the third highest among all watersheds monitored. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources, including stormwater runoff from metal plating and finishing operations and pesticide use. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low.

The mean diazinon concentration exceeded the WQO at the Dominguez Channel MES in two of the four seasons in which monitoring was conducted (2001 through 2005). The exceedances occurred during the 2001-2002 and the 2002-2003 seasons, but not during the 2003-2004 and 2004-2005 seasons. These results suggest that diazinon concentrations in the watershed may be decreasing over time, but the sample size was too small to show a statistically significant trend.

The sale of diazinon has been banned for residential use since 2002 for indoor use and 2004 for outdoor use, so concentrations in surface waters of urban watersheds should decrease over time.

Water column toxicity monitoring determined that stormwater collected in 2004-2005 affected the survival of *C. dubia* and the fertilization of sea urchins. 2004-2005 dry weather samples affected *C. dubia* and sea urchin reproduction. Toxicity monitoring conducted prior to 2004-2005 determined that stormwater samples from 2002-2003 affected *C. dubia* survival and reproduction and both wet and dry weather samples from 2003-2004 affected sea urchin fertilization. In 2002-2003, TIEs identified the toxic pollutant as one or more non-polar organic compounds (i.e. propane, butanol), cationic metals (i.e. zinc, copper), and organophosphates. In 2003-2004, the toxic pollutant was believed to be a volatile compound (i.e. household cleaning products, gasoline).

In addition to the water quality monitoring discussed above, stream bioassessment and monitoring of the Dominguez Channel Estuary were also conducted. The benthic macroinvertebrate community in Dominguez Channel had CFG Index of Biotic Integrity scores of three and six, and a quality rating of Very Poor. Similar scores were found in other urbanized watersheds throughout the region. In the Dominguez Channel Estuary, sediments from six stations were analyzed for chemistry, toxicity and benthic macroinvertebrate diversity. The results of the chemistry assessment indicated that nine metals exceeded either the ER-L or ER-M at the majority of the stations. Total detectable chlordane, total detectable DDT, total detectable PAHs, and total detectable PCBs all exceeded either ER-L or ER-M values at the majority of the stations. ERM-Q values were all above the threshold of 0.10 for all six stations monitored in the Dominguez Channel Estuary. Sediment toxicity was determined to be highly toxic to the test organisms at three of the stations. These results indicate the greatest impact compared to the other estuaries monitored in the region.

12.1.4 Ballona Creek Watershed

The Ballona Creek Watershed is the fourth largest watershed monitored in the study area, comprising 33.8 square miles (137,073 acres). It is nearly entirely developed, consisting primarily of residential land use. The mass emission station for Ballona Creek watershed is located approximately four miles upstream of the ocean outlet. Based on the mean exceedances ratios over the past ten years, water quality monitoring at this location suggests that the following constituents are the COCs in the watershed: indicator bacteria (total and fecal coliform, and enterococci), total copper and total and dissolved lead and cyanide. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0. Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance. These results are similar to those found in the other watersheds throughout the region. Based on the 2004-2005 monitoring data, only enterococcus concentrations out of the COC identified indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event. In addition, the mean concentrations of bicarbonate and potassium increased significantly in the watershed from 1996 through 2005. In contrast, the mean concentration of total petroleum hydrocarbons significantly decreased during the same time period.

As with the other watersheds monitored in the study area, annual mean indicator bacterial densities at the Ballona Creek MES exceeded water quality objectives every year in which

samples were collected from 1995 through 2005. Annual mean concentrations of total coliform, fecal coliform, and enterococci tended to be slightly higher at the Ballona Creek MES (along with the Los Angeles River MES) compared to other watersheds in the region. Mean total loading estimates for indicator bacteria were intermediate compared to the other watersheds monitored. Mean total loadings per acre for indicator bacteria were among the highest for Ballona Creek, along with Los Angeles River, Coyote Creek and Dominguez Channel, which are the most urbanized watersheds.

Total copper and total lead exceeded the respective WQOs consistently at the Ballona Creek MES (the exceedance frequency for dissolved lead was more sporadic). Mean concentrations of these constituents and the corresponding ratios to water quality objectives were intermediate compared to other mass emission sites monitored in the study area (as was the mean hardness value). In addition, the mean loads of these metals were intermediate compared to other sites monitored. As discussed above, there are numerous sources of copper and lead in urbanized areas and they frequently exceeded water quality objectives throughout the region. Mean total loading estimates and total loadings per acre for total copper and total lead were among the highest for Ballona Creek, as well as Los Angeles River, Coyote Creek and Dominguez Channel, which are the most urbanized watersheds.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Ballona Creek MES. Annual mean concentrations exceeded water quality objectives since 2001. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at Ballona Creek was among one of the lowest throughout all watersheds. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources as discussed previously. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions.

The annual mean concentrations of bicarbonate and potassium increased significantly at the Ballona Creek MES from 1996 through 2005. The mean bicarbonate concentration was low in 1996-1997, increased dramatically from 1997 through 2002, then increased again in 2004-2005 (there are no results available from 2002 through 2004). A similar pattern was observed for potassium. Bicarbonate is a constituent of alkalinity, which is a measure of the buffering capacity of the water. Although there was no statistically significant increase in the alkalinity at the Ballona Creek MES, the same general pattern in the annual mean concentration described above for bicarbonate was also observed for alkalinity. The sources of elevated levels of alkalinity and bicarbonate include natural weathering of rocks that contain calcium carbonate, areas of significant algae blooms, and industrial wastewater. The reason for the increasing bicarbonate trend in the Ballona Creek Watershed is unclear. In contrast to bicarbonate, the annual mean concentration of total petroleum hydrocarbons (TPH) decreased in the Ballona Creek Watershed form 1996 through 2005. Statistically significant decreasing trends in TPH were also observed in the Santa Clara River and Coyote Creek Watersheds, but the relationship was strongest in Ballona Creek.

Water column toxicity monitoring determined that stormwater and dry weather samples collected in 2004-2005 affected *C. dubia* and sea urchin reproduction. Prior to 2004-2005, stormwater samples collected during 2002-2003 and 2003-2004 inhibited sea urchin fertilization. TIEs determined the toxicity in the 2002-2003 stormwater was due to particulate-bound toxicants, one

or more non-polar organic compounds (i.e. propane, butanol) and cationic metals (i.e. zinc, copper). In 2003-2004 the toxic pollutant in stormwater was believed to be a volatile compound (i.e. household cleaning products, gasoline).

The magnitude of exceedances for each of the tributary stations based on the ratio of the mean concentrations for all the sampling events to date, were compared to the applicable water quality objectives. Indicator bacteria, total copper, and total lead exceeded WQOs at the mass emission station (S01) on nearly every monitoring date and exceedances coincided at many, if not all tributaries. For bacteriological indicators, the magnitude of exceedance of the WQO is similar for all the tributary stations and the mass emission station. No one or set of tributaries appear to be a primary source of bacterial indicator exceedances based on concentration. Table 12-1 presents the tributary station names and the corresponding station numbers.

Table 12-1 . Tributary Stations in the Ballona Creek Watershed and the Corresponding Station Numbers.

Tributary Station Name	Tributary Station Number
Centinela	TS07
Sepulveda	TS08
Benedict	TS09
Adams	TS10
Fairfax	TS11
Cochran	TS12

Based on concentration, Sepulveda and the further upstream tributaries appear to exhibit greater exceedances of the WQO for the selected metals. For these metals, the magnitude of exceedance of the WQO is higher for total copper and lead at the Centinela station compared to further upstream tributary and channel locations that include Sepulveda, Benedict, and the MES. The farthest upstream tributary locations are characterized by greater exceedances than Centinela and the other downstream locations. Based on concentration, Centinela and the farthest upstream tributaries appear to exhibit greater exceedances of the WQO for the selected metals. Total zinc had exceedances at the mass emission station during the October 26th and the December 5th storms with many associated tributary exceedances.

Based on constituent loadings, a similar pattern was observed for indicator bacteria and metals (total and dissolved copper and lead) at the Ballona Creek tributary stations. Figure 12-1 illustrates the loadings for total and fecal coliforms and enterococci and Figure 12-2 presents loadings for total and dissolved copper and lead. Loadings for each constituent were highest at the MES (S01) and at TS12 (Cochran). The MES is located at the bottom of the watershed and receives drainage from most of the other tributaries, while TS12 is the uppermost station in the watershed. TS07, the farthest downstream station, and TS10, located in the upper portion of the watershed, had the next highest loadings for indicator bacteria and metals. Based on these results, pollutant loadings were highest in the upper and lower reaches of the watershed, while the middle portion had the lowest pollutant loadings. Figures 12-3 and 12-4 illustrate the loadings per acre for indicator bacteria and total and dissolved copper and lead, respectively. These results are consistent with the findings of the dry weather characterization study of Ballona Creek conducted by the Southern California Coastal Water Research Project: results of this study also indicated that the highest concentrations were detected in the upper and lower reaches of the watershed.

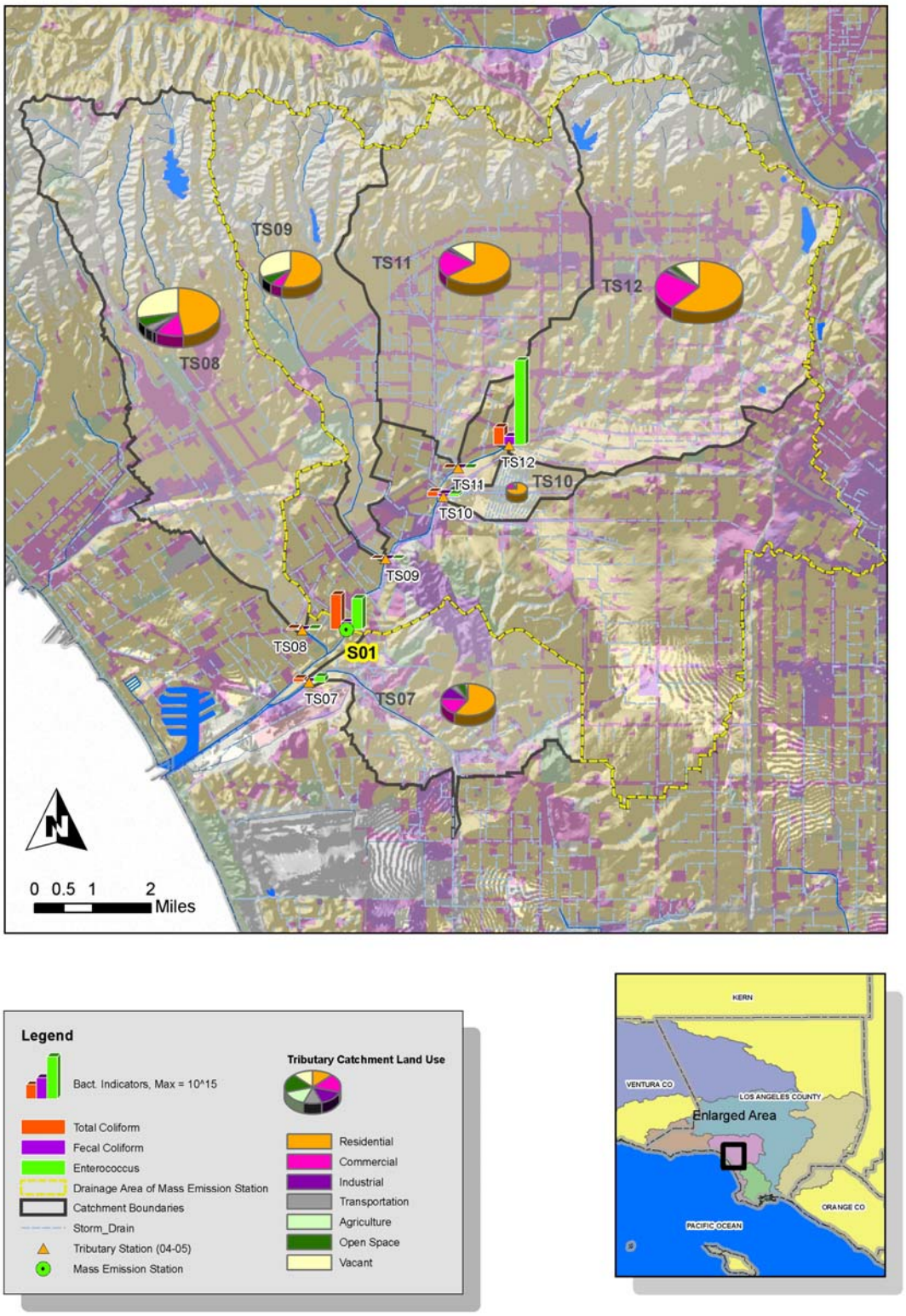

Figure 12-1. Summary of Indicator Bacterial Loadings (MPN) at the Ballona Creek Tributary Stations.

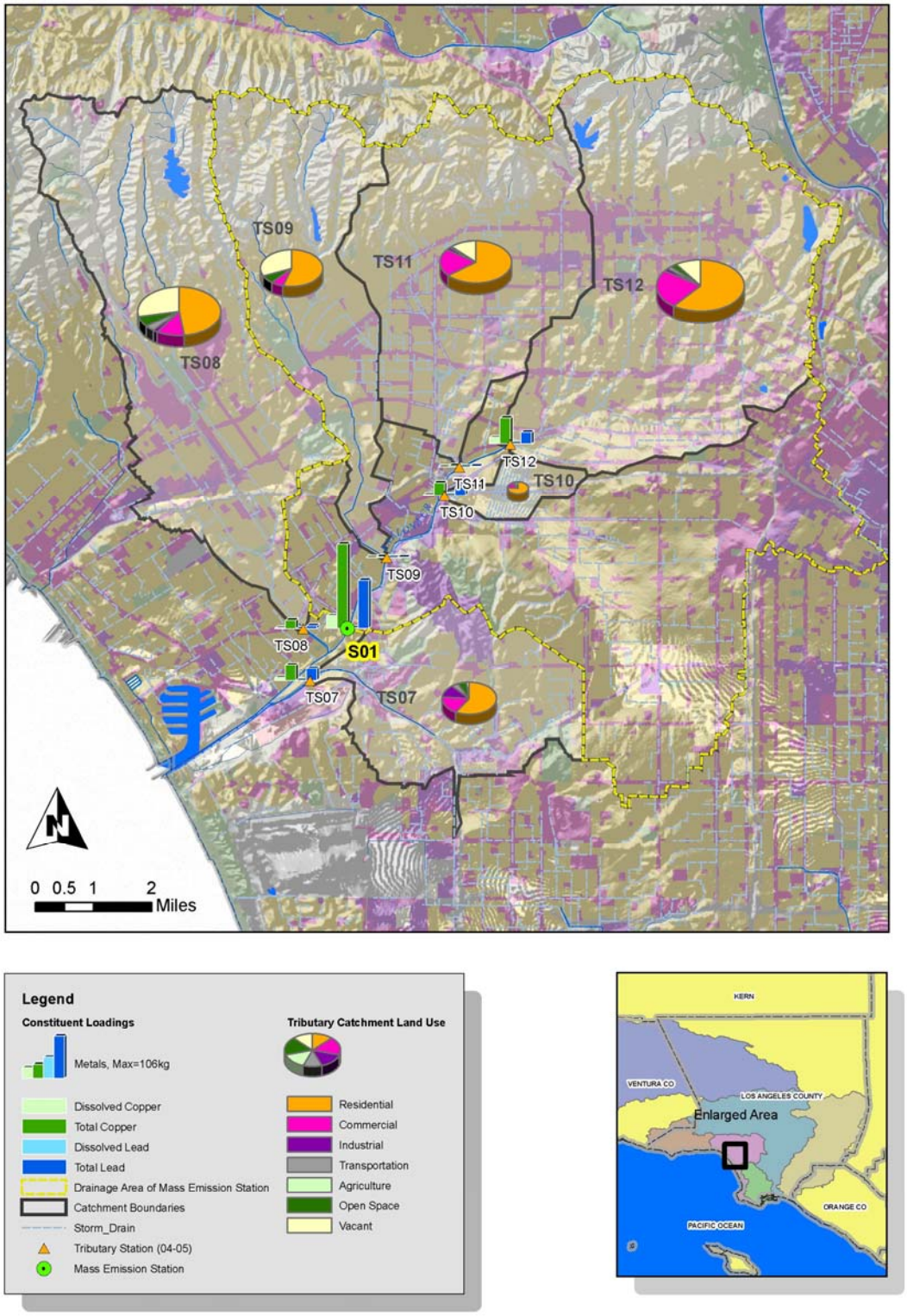

Figure 12-2. Summary of Metal Loadings (Kg) at the Ballona Creek Tributary Stations.

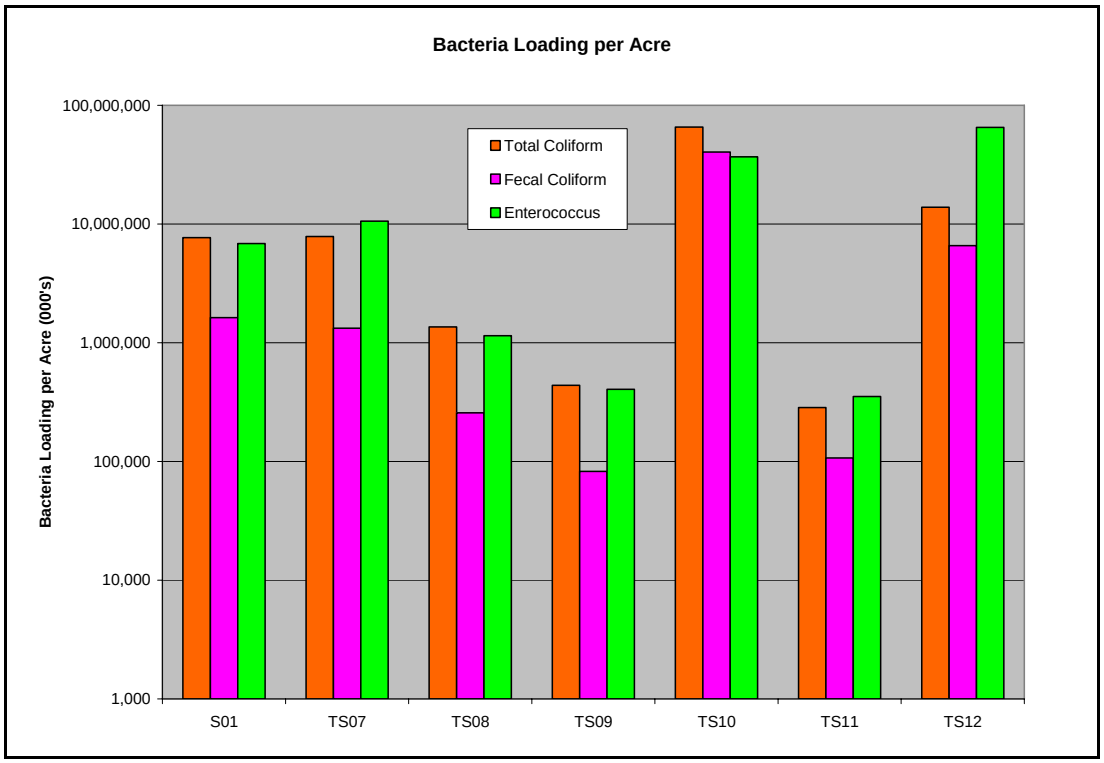

Figure 12-3. Summary of Loadings (MPN) Per Acre for Indicator Bacteria at the Ballona Creek Tributary Stations.

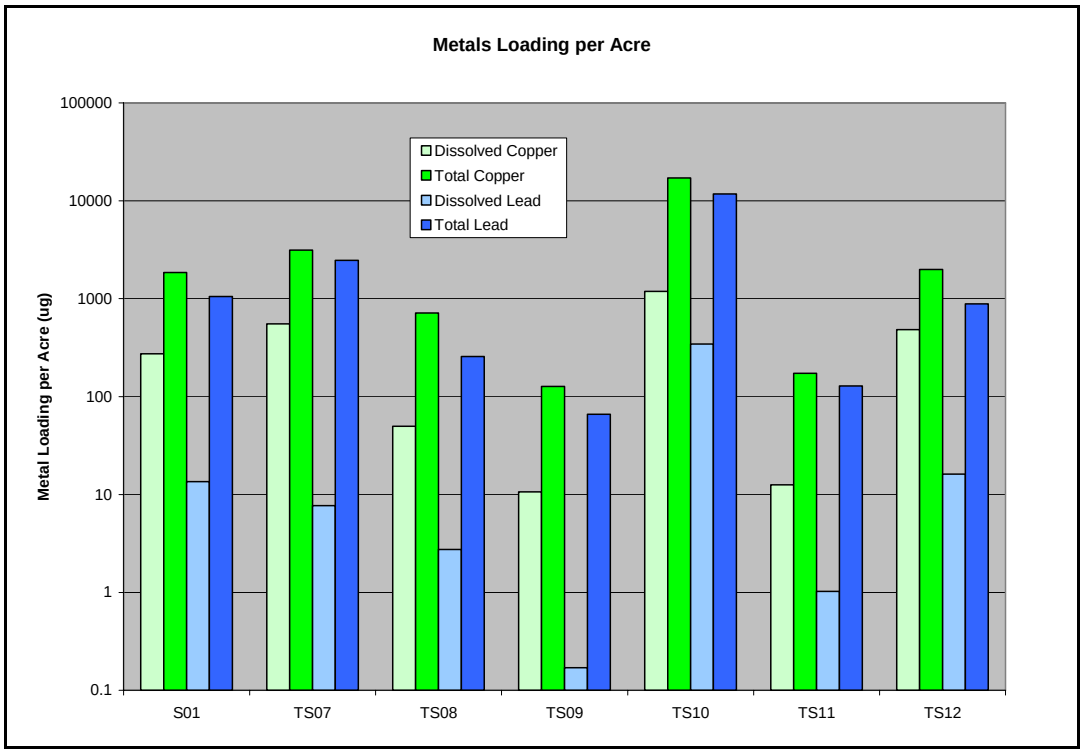

Figure 12-4. Summary of Loadings (Kg) Per Acre for Total and Dissolved Copper and Lead at the Ballona Creek Tributary Stations.

Trash monitoring was also conducted in the Ballona Creek Watershed. In 2002-2003, the first storm event of the season produced the largest amount of trash, and, in contrast to the trash monitoring conducted in the Los Angeles River Watershed, low density single family residential and commercial land uses produced the greatest amount of trash. During the 2003-2004 monitoring season, the second storm event contributed the largest amount of trash, most of which was associated with commercial land use areas.

In addition to the water quality monitoring discussed above, stream bioassessment and monitoring of the Ballona Creek Estuary was also conducted. The stream bioassessment was conducted in the concrete lined channel section of Ballona Creek. The benthic macroinvertebrate community at the Ballona Creek sites had CFG Index of Biotic Integrity scores of 6 and 10, and quality ratings of Very Poor for both monitoring years. These results are consistent with other urban sites monitored throughout the region. In the Ballona Creek Estuary sediments, three metals commonly found in the watershed (copper, lead, and zinc) were detected above the ER-L or ER-M values. In addition, total DDT and total chlordane were found in high concentrations. Three stations had ERM-Q values above the 0.10 threshold. Sediment toxicity was identified as moderately toxic to the test organisms at one station and highly toxic at three stations.

12.1.5 Malibu Creek Watershed

The Malibu Creek Watershed is one of the least developed watersheds in the region (second only to the Santa Clara River Watershed). It comprises 32.1 square miles (130,094 acres), consisting primarily of vacant and residential land use areas. The Mass Emission Station is located in the lower portion of the watershed. Based on the mean exceedances ratios over the past ten years, water quality monitoring at this location suggests that indicator bacteria (total and fecal coliform, and enterococci), total aluminum and cyanide are the COCs in the watershed. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0. Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance. These results are similar to those found in the other watersheds throughout the region. Based on the 2004-2005 monitoring data, none of the identified COCs indicated a "first flush" phenomena. In addition, the annual mean concentrations of total selenium, sulfate and potassium increased significantly during the monitoring period, while dissolved chromium and turbidity significantly decreased.

Malibu Creek was similar to other watersheds in the region in that annual mean indicator bacterial densities exceeded water quality objectives every year in which samples were collected from 1995 through 2005. Annual mean concentrations of total coliform, fecal coliform, and enterococci as well as the ratios to water quality objectives were intermediate compared to other watersheds monitored in the region. Mean total loading estimates for indicator bacteria were lowest for Malibu Creek. Based on total loadings per acre for bacteria, Malibu Creek had the lowest loadings along with San Gabriel River and Santa Clara River, which are the least urbanized. These results indicate lower loading estimates for watersheds with higher percentages of vacant land.

From 1997 through 2005, the annual mean total aluminum concentration exceeded WQO at the Malibu Creek Watershed MES during two seasons: 1997-1998 and 2004-2005. Rainfall was greater during these two seasons than other seasons over the past ten years, which may account for the high total aluminum concentrations. Annual mean total aluminum concentrations were

greatest during these two seasons at nearly all of the watersheds monitored in the region. These results suggest that the elevated total aluminum levels at the Malibu Creek MES are related to high flows rather than specific sources within the Malibu Creek Watershed.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Malibu Creek MES. Annual mean concentrations exceeded water quality objectives every year samples were collected since 1997. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at Malibu Creek was the lowest along with Santa Clara River. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources as discussed previously. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions.

Aside from the patterns observed for indicator bacteria and total aluminum, water quality at the Malibu Creek MES appears to be distinctly different compared to other watersheds in the region. From 1997 through 2005 there were no exceedances of the WQO for copper, lead, or zinc (dissolved or total) in the Malibu Creek MES. These objectives were exceeded frequently during the same time period at the other mass emission sties. Annual mean concentrations of these metals in the Malibu Creek samples were similar to those in other watersheds, but the hardness values in the Malibu Creek Watershed were much greater than those measured at any other site in the region. Since the WQO for metals are hardness based, there were fewer exceedances at Malibu than at the other sites. In addition to hardness, the overall mean concentrations were greatest at Malibu Creek for a suite of constituents, including alkalinity, bicarbonate, calcium, chloride, magnesium, nitrate, nitrate-N, pH, sodium, specific conductance, sulfate, total dissolved solids, dissolved boron, dissolved selenium, and total selenium. For most of these constituents, the mean concentrations at Malibu Creek were significantly different from those at all the other watersheds in the region (See pg. 10-22).

Many of these constituents are co-related. For instance, high levels of the ions calcium, chloride, magnesium, and sodium will result in an increase in hardness, alkalinity, specific conductance, TDS, and pH.

Water column toxicity monitoring determined that stormwater and dry weather samples collected in 2004-2005 affected *Ceriodaphnia dubia* and sea urchin reproduction, whereas wet and dry weather samples collected in 2002-2003 and 2003-2004 were not toxic to the organisms.

Shoreline monitoring within the Malibu Creek Watershed from 2001-2004 indicated that bacterial densities were higher during wet weather than dry weather. There were exceedances of all indicator bacteria during dry and wet weather in all three sampling years. These exceedances corresponded with the bacteria exceedances that occurred at the mass emission station.

In addition to the water quality monitoring discussed above, stream bioassessment and monitoring of Malibu Creek was also conducted. The benthic macroinvertebrate community at the Malibu Creek sites had CFG Index of Biotic Integrity scores ranging from 2 to 52, and quality ratings ranging from Very Poor to Good. These results are consistent with other urban sites monitored throughout the region. In the Malibu Lagoon sediments, four metals (cadmium, copper, nickel, and zinc) were detected above the ER-L or ER-M values. Three stations had

ERM-Q values above the 0.10 threshold. Sediments in this lagoon were not toxic to the test organisms.

12.1.6 Santa Clara River Watershed

The Santa Clara River Watershed is the largest watershed in the region comprising 256.3 square miles (1,037,176 acres). However, the lower potion of the watershed is west of Los Angeles County and unmonitored. The watershed consists primarily of vacant land, followed by residential areas.

The mass emission station is located in the upper reaches of the watershed near the county boundary. Based on the mean exceedances ratios over the past ten years, water quality monitoring at this location suggests that indicator bacteria (total and fecal coliform, and enterococci), total aluminum, cyanide and diazinon are the COCs in the watershed. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0. Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance. These results are similar to those found in the other watersheds throughout the region. Based on the 2004-2005 monitoring data, only indicator bacteria concentrations out of the COC identified indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event. In addition, the annual mean concentration of total petroleum hydrocarbons decreased significantly during the monitoring period, but the results are based on only three data points.

Santa Clara River was similar to other watersheds in the region in that annual mean indicator bacterial densities exceeded water quality objectives every year in which samples were collected from 2002 through 2005. Annual mean concentrations of total coliform, fecal coliform, and enterococci as well as the ratios to water quality objectives were intermediate compared to other watersheds monitored in the region. Mean total loading estimates and total loadings per acre for indicator bacteria were among the lowest of the watersheds along with Malibu Creek and San Gabriel River. These results further indicate a correlation between lower loadings from less urbanized watersheds.

From 2002 through 2005, the annual mean total aluminum concentration exceeded WQO at the Santa Clara River Watershed MES during two seasons: 2003-2004 and 2004-2005 and was the highest in 2004-2005. Rainfall was greater during this season than other seasons over the past ten years, with the exception of 1997-1998, which may account for the high total aluminum concentrations. Annual mean total aluminum concentrations were greatest during 1997-1998 and 2004-2005 at nearly all of the watersheds monitored in the region. These results suggest that the elevated total aluminum levels at the Santa Clara River MES are related to high flows rather than specific sources within the Santa Clara River Watershed.

The mean exceedance ratio for cyanide was also greater than 1.0 at the Santa Clara River MES. Annual mean concentrations exceeded water quality objectives every year since 2002. Exceedances of cyanide water quality objectives were common throughout all of the monitoring stations throughout the study area. The mean exceedance ratio of cyanide at Santa Clara River was the lowest along with Malibu Creek. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources as

discussed previously. The largest likely source of cyanide in the watersheds is air-borne deposition from motor vehicle emissions.

The mean diazinon concentration exceeded the WQO at the Santa Clara River MES in two of the monitoring years from 2002 through 2005. The exceedances occurred during the 2002-2003 and the 2004-2005 seasons. Dominguez Channel was the only other watershed that had a mean exceedance ratio greater than 1.0. The sale of diazinon has been banned for residential use since 2002 for indoor use and 2004 for outdoor use, so concentrations in surface waters of urban watersheds should decrease over time.

Water column toxicity monitoring determined that stormwater collected in 2004-2005 affected sea urchin reproduction, but not *Ceriodaphnia dubia* survival or reproduction. 2004-2005 dry weather samples inhibited *C. dubia* and sea urchin reproduction. Prior to 2004-2005, stormwater samples collected in 2003-2004 inhibited *C. dubia* survival. TIEs determined that the toxicity in 2003-2004 stormwater was caused by a volatile compound (i.e. household cleaning products, gasoline).

In addition to the water quality monitoring discussed above, stream bioassessment was also conducted. The benthic macroinvertebrate community at the Santa Clara River sites had Index of Biotic Integrity scores of 21 and 19, and quality ratings of Poor for both monitoring years. These results are consistent with other sites monitored throughout the region.

12.1.7 Regional Assessment

The overall conclusions that can be made from the regional assessment include:

Bacterial Indicators - The highest concentrations for the bacterial indicators generally occurred at the Los Angeles River and Ballona Creek mass emission stations. The lowest mean concentrations were indicated for Dominquez Channel and Santa Clara River; however, the data from these MES was limited (2-3 years). The regression analysis did not indicate any significant trends with regard to the bacterial indicators. Regionally, these indicators remained well above the WQO throughout the watersheds and the monitoring period from 1994-2005. The regional evaluation of the ratios of the mean concentrations to the WQO, indicated that the highest WQO ratios were observed for the Los Angeles River, Ballona Creek and Coyote Creek Watersheds. The lowest ratios were observed for the Santa Clara River and Malibu Creek Watersheds. The magnitude of the WQO ratios for the bacterial indicators corresponded to the percentage of land use that relates to urbanization (use other than vacant lands or recreational uses) of the watersheds. A lower percentage of urbanization resulted in a lower WQO ratio.

The mean total loading estimates for all three bacteriological indicators were highest for the Los Angeles River followed by Coyote Creek. The total loads for all the other MES were lower and similar in totals, with the exception of Malibu Creek, which was the lowest. The mean total loadings for the bacteriological indicators on a per acre basis indicate that Los Angeles River, Coyote Creek, Dominguez Channel and Ballona Creek had the highest loadings per acre, and correspond to more urbanized watersheds. The lowest loadings per acre were determined for Malibu Creek, Santa Clara River and San Gabriel River Watersheds that are characterized by a greater percentage of vacant land of the total drainage area. The results of the loading estimates

on a per acre basis indicate a correlation between higher loadings per acre for more urbanized watersheds compared to watersheds with higher percentages of total drainage area that remains undeveloped (vacant). The conclusions for the loading estimates are consistent with those summarized above regarding a relationship with the magnitude of exceedances with percent urbanization.

Metals - The highest mean concentrations for total and dissolved copper, lead and zinc on a regional basis were observed in the Los Angeles River. The lowest concentrations were generally observed for the Santa Clara River and Malibu Creek Watersheds. These two watersheds are the least urbanized of the watersheds under the Core Monitoring program. Exceedances of the WQO for total and dissolved lead, copper and zinc were observed regionally in all the watersheds monitored with the exception of the Santa Clara River and Malibu Creek Watersheds. The highest WQO ratios were observed for the Los Angeles River, followed by the Dominguez Channel, Ballona Creek and Coyote Creek Watersheds. The Santa Clara River and Malibu Creek Watersheds had the lowest WQO ratios. The ranking of the magnitude of these WQO ratios for lead, copper and zinc generally corresponded to a greater percentage of urbanization of the watersheds. It was also indicated that the highest annual mean concentrations for dissolved and total copper, lead and zinc for several watersheds occurred in 1997-1998. This year corresponded with the highest monthly rainfall, as recorded at the Los Angeles Civic Center. The higher intensity storms recorded for that period could have resulted in the mobilization and transport of greater sediment/particle loads into the watersheds that likely resulted in higher copper and other metal concentrations at the MES.

No trends (increasing or decreasing over time) in the annual mean concentrations as measured at the MES were observed for copper, lead and zinc on a watershed basis with the exception of Dominguez Channel. An increasing trend in total lead concentrations was observed in Dominguez Channel. The annual data at this MES was however limited to four annual sampling periods.

The mean total loading estimates for total copper, lead and zinc were highest for the Los Angeles River followed by Coyote Creek and Ballona Creek MES. The total loads for all the other MES were lower and similar in totals, with the exception of Malibu Creek, which was the lowest. These results are similar to those of the bacteriological indicators which represent constituents often associated with urban runoff. As discussed previously, the source of these metals is often identified with non-point urban sources that include vehicle emissions and wear of automobile tires and brake pads. The mean total loadings for total copper, lead and zinc on a per acre basis indicate that Dominguez Channel and Ballona Creek have the highest loadings per acre, followed by the Los Angeles River and Coyote Creek, which corresponds to more urbanized watersheds. The lowest loadings per acre were determined for Malibu Creek, Santa Clara River and San Gabriel River watersheds that are characterized by a greater percentage of vacant land of the total drainage area. The results of the loading estimates on a per acre basis for total copper, lead and zinc indicate a correlation between higher loadings per acre for more urbanized watersheds compared to watersheds with higher percentages of total drainage area that remains undeveloped (vacant). These results correlate with the loadings per acre for the bacterial indicators, and are also consistent with the findings of the comparison of the water quality exceedance ratio for these constituents to the percent urbanization within the WMA monitored.

Based on the evaluation of inter-relationships between TSS and metals, the greatest number of trends was identified for the Santa Clara River Watershed compared to the other watersheds. The Santa Clara River Watershed is the least urbanized (over 80% vacant lands) of the watersheds in the County. These results may indicate that correlations between TSS and metal concentrations were evident in the Santa Clara River Watershed, possibly due to a less diverse source of metals within the watershed and a better correlation between sediment load and total metal concentrations in stormwater.

Nutrients - The results of the ANOVA comparisons indicated a grouping of watersheds that include Malibu Creek, San Gabriel River and Coyote Creek with regard to higher mean values for nitrate and nitrate-N. The means for these watersheds were significantly different than the other watersheds. The mean for Malibu Creek MES was the highest of the watersheds. Higher nitrate concentrations could be the result of greater use of fertilizers in agricultural, golf courses or nursery activities, and seepage from in-ground septic systems near and up-stream of the MES. Further evaluation of land use near and upstream of the MES at these watersheds compared to the others is needed to determine if the higher means at these MES can be correlated to land activities upstream of the MES.

Based on the cluster analysis, there was a cluster for both wet and dry weather sampling at the Malibu Creek MES corresponding to higher concentrations compared to the overall mean for the constituents of ammonia, nitrate, nitrate-N, sulfate, total dissolved solids, specific conductance, hardness and chloride. This finding correlates to the conclusions for the Malibu Creek Watershed based on the ANOVA analysis and WQO ratio comparisons. This cluster appeared to also include numerous dry weather annual means for most of the other watersheds. Nutrients and constituents related to dissolved minerals were clustered with the Malibu Creek Watershed possibly due to potentially higher nitrate and dissolved minerals in groundwater seepage. The cluster around dry weather sampling at the various MES likely corresponds to a larger load of nutrients and dissolved mineral salts during dry weather flows.

The highest mean loadings for nutrients based on the 2004-2005 results from the MES were determined for the Los Angeles River, which is the second largest watershed in the County. The total nutrient loadings were lower and similar for Coyote Creek, Ballona Creek and San Gabriel River. The lowest total loadings were calculated for Malibu Creek, Dominguez Channel and Santa Clara River. The highest total phosphorus per acre was determined for Ballona Creek. The next set of watersheds that are characterized by slightly lower loads per acre included Coyote Creek, Dominguez Channel and Los Angeles River. The lowest was calculated for Santa Clara River. The results for nitrogen (Kjeldahl-N) were similar. The highest nitrate (as nitrogen) loads per acre were determined for Coyote Creek and Dominguez Channel, followed by Malibu Creek. These results indicate a relatively high load per acre estimate for Malibu Creek, compared to more urbanized watersheds such as the Los Angeles River. These results are collaborated by the ANOVA analysis which indicated a significant difference in the nutrient results for Malibu Creek. As mentioned previously, the potential sources of nitrates in the Malibu Creek watershed may include greater use of fertilizer per acre and seepage from in-ground septic systems which are prevalent in this watershed.

Other Water Quality Parameters - The means of several constituents measured at the Malibu Creek MES were significantly different compared to the other MES. These constituents included

alkalinity, calcium, chloride, hardness, magnesium, sodium, specific conductance, sulfate, and total suspended solids. This comparison indicated a greater mean concentration in mineral salts and ions in wet and dry weather runoff at the Malibu Creek MES. This may indicate a contribution from natural minerals from groundwater seepage that contains higher dissolved mineral concentrations potentially due to natural geologic sources within this watershed compared to the other watersheds in the County. Further evaluation of any potential differences in geology and soil types within the Malibu Creek Watershed is needed to draw any definitive conclusions.

Solids (TDS, TSS, TOC) – The highest mean total loadings for TDS were determined for the Los Angeles River, however, the total loads were only slightly lower for Ballona Creek, Coyote Creek, Malibu Creek and San Gabriel River. The Los Angeles River is the second largest watershed in the County. The highest TDS loadings per acre were calculated for Ballona Creek, Malibu Creek, and Coyote Creek. The lowest TDS per acre was indicated for Santa Clara River. Both Malibu Creek and the Santa Clara River Watersheds are the least urbanized. The much higher TDS loadings from Malibu Creek suggest possible greater contributions from natural sources such as groundwater seepage into the creek that contains higher dissolved salts and metals than in Santa Clara River. These findings are collaborated by the ANOVA and Cluster Analysis results which indicated significant differences in the Malibu Creek water quality compared to the other watersheds with regard to TDS and other parameters that would suggest these same inputs and sources.

TSS total mean loads were highest for the Santa Clara River and lowest for Malibu Creek. The higher TSS for Santa Clara River may indicate greater suspended sediment loads due to erosion of stream banks and disturbed areas. Special Studies being conducted in the Santa Clara River WMA are investigating both the impact from development and increases in peak discharge. The mean loading of TSS per acre is highest for Ballona Creek, Los Angeles River, Coyote Creek and Santa Clara River. The lowest was for Malibu Creek. The higher TSS loadings per acre for most of these watersheds represent contributions from various urban sources within the more urbanized watersheds. As discussed above, the higher TSS loadings per acre for Santa Clara River, may be related to erosion. This is also indicated by a low TDS loading per acre compared to the high TSS loading per acre for Santa Clara River, which correspond to a larger particle source such as soils (measured by the TDS) compared to dissolved constituents (measured by TSS).

The TOC mean loadings for 2004-2005 were highest in the Los Angeles River, followed by Coyote Creek and Ballona Creek. The lowest was for Malibu Creek. The highest mean loading per acre was determined for Coyote Creek, followed by Ballona Creek, Dominguez Channel and Los Angeles River. The lowest was for Santa Clara River. The lower relative loading per acre compared to the total mean loading for the Los Angeles River is likely due to large drainage area of this watershed. The higher TOC loadings both as totals and on a per acre basis correspond to greater urbanized areas of the total drainage area. TOC loadings appear to be an indicator of greater urbanization within the watershed.

Pesticides - The only pesticide that was detected above its WQO as part of the wet and dry weather Core Program monitoring was diazinon. The WQO was exceeded in 2001-2002 in the

Dominguez Channel and Coyote Creek Watersheds, and in the Santa Clara River Watershed during the 2004-2005 period, based on the annual mean of the samples collected at the MES.

TPH - Other notable trends that were observed in mean annual concentrations included a decreasing concentration in total petroleum hydrocarbons (TPH) for Ballona Creek, Coyote Creek and Santa Clara River Watersheds.

Toxicity – No strong patterns in toxicity were observed. The fewest toxic responses for all three tests performed were at San Gabriel River, Malibu Creek, and Santa Clara River. *Ceriodaphnia* survival may have decreased due to high concentrations of dissolved copper and zinc in the wet weather runoff.

Peak and High Intensity Storm Events – The potentially greater impact of high intensity storm events on water quality was indicated in the cluster analysis. Clusters for numerous COCs and key constituents were observed across watersheds, with the exception of Malibu Creek Watershed, for the 2004-2005 and 1997-1998 annual wet weather sampling. The greatest monthly precipitation occurred during these same years. High peak and intensity storm events resulted in greater mobilization and transport of sediment and particles that can increase turbidity, suspended solids, BOD and total metals when compared to the overall mean. Clusters were observed across multiple watersheds for the wet weather sampling for BOD, COD, turbidity, total volatile suspended solids, total iron, bacterial indicators, total and dissolved phosphorus, total copper, and total zinc. This analysis indicated that the high intensity and long-duration storm events, as experienced in the monitoring years 1997-1998 and 2004-2005, resulted in some of the greater overall impacts to water quality as measured at the MES.

12.2 Conclusions on Finding of Regional Monitoring and Special Studies

The following subsections provide summaries of the Regional Monitoring and Special Studies that are required under the current Municipal Stormwater Permit, including the Bioassessment Study conducted throughout Los Angeles County, the Estuary Sampling completed under the Bight 03 program, the BMP Effectiveness Study, the Peak Discharge Impact Study and the New Development Impacts Study.

12.2.1 Bioassessment

Twenty bioassessment monitoring sites were located in six watersheds throughout Los Angeles County: Santa Clara River Watershed, Ballona Creek Watershed, Malibu Creek Watershed, Dominguez Channel Watershed, Los Angeles River Watershed and San Gabriel River Watershed.

Based on total CFG IBI scores, there were essentially three categories of sites: The Cold Creek and San Gabriel reference sites that were rated Fair or Good, Station 18-Triunfo Creek, Station 1-Santa Clara River, and Station 9-Zone 1 Ditch which were rated Poor, and the remaining sites that were rated Very Poor. It is notable that CFG IBI scores were quite consistent for the two survey years, with most sites differing by only two or three points. It appears that there may be a

correlation between high amounts of urbanization and low CFG IBI scores, in that the most urbanized sites had the lowest CFG IBI scores.

The sites scoring in the Very Poor range do not show a correlation between physical habitat quality and IBI score. An analysis of variance (ANOVA) between lined and non-lined channels did not show a trend between the two habitat factors and IBI scores. Station 12-Los Angeles River (concrete lined) was the highest rated of the Very Poor sites and Station 8-Compton Creek and Station 8-Medea Creek (soft bottom) were rated much lower than many of the lined channel sites.

12.2.2 Estuary Sampling – Bight 03

The San Gabriel River, Los Angeles River, Dominguez Channel, Ballona Creek and Malibu Creek Estuaries were monitored to estimate the extent and magnitude of ecological change in the Southern California Bight (SCB) and to determine the mass balance of pollutants that currently reside within the SCB. Samples were analyzed for sediment chemistry, sediment toxicity and benthic macroinvertebrate diversity.

In summary, there were exceedances of sediment quality objectives at all five estuaries. Dominguez Channel Estuary had the most number of exceedances, with fifty-eight, and San Gabriel River Estuary had the least, with only five exceedances. In general, the constituents that often exceeded the sediment objectives at the majority of the estuaries included four metals (cadmium, copper, nickel and zinc) and total detectable DDT and total detectable chlordane. Copper and zinc consistently exceeded WQOs in stormwater samples; however, cadmium and nickel were detected less frequently. In addition, even though total detectable DDT and chlordane exceeded objectives in the estuary sediments, they were not detected in any stormwater/urban runoff samples. Mean ERM-Q values were above the 0.10 threshold in at least two stations within each estuary except San Gabriel River Estuary, which had ERM-Q values all below the threshold. The sediments at all stations within San Gabriel River Estuary and Malibu Lagoon were identified as not toxic to the test organisms, while sediments in some stations within the other three estuaries were either identified as moderately toxic or highly toxic. It appeared that San Gabriel River Estuary was the least impacted as it had the least amount of exceedances, low ERM-Q values and high survival rate of *E. estuarius*. Dominguez Channel Estuary appeared to be the most impacted estuary due to the high number of exceedances, high ERM-Q values at all stations and toxic sediments.

12.2.3 BMP Effectiveness Study

In this study, the removal effectiveness of BMPs was found to vary for the constituents of concern. The statistical results showed that higher removal was achieved at higher inflow concentrations except for bacteria and nutrients. The removal efficiencies for the inflow and the outflow concentrations for metals, bacteria, and nutrients were negative or otherwise relatively low for catch basin inserts, a hydrodynamic separator, a wet vault and an enhanced manhole. The statistical analyses showed that the confidence intervals around the mean inflow and the mean outflow concentrations for all the constituents tested overlapped implying that the removal effectiveness for the constituents of concern were not statistically significant. The removal

effectiveness for the infiltration trench and the bioswale are subject of further studies as more storm data needs to be collected and statistically analyzed.

The complete BMP Effectiveness Study is presented in Appendix H.

12.2.4 Peak Discharge Impact Study

The Peak Discharge Impact Study was conducted to assess the potential connection between stream erosion and urbanization. The Peak Discharge Impact Study resulted in the following findings:

(1) Channel width increases as the discharge rate increases.
(2) Ephemeral streams in southern California appear to be more sensitive to changes in the percent of impervious cover than streams in other areas: enlargement of streams occurs at a lower value of impervious surface area.
(3) There is a natural level of channel degradation occurring in all stream channels investigated, even in the absence of development within then drainage area.
(4) Streams appear to be sensitive to changes in flow rates associated with increased impervious cover and they appear to have a low resistance to erosion, which results in increased channel enlargement.

The relationships established in this investigation can be used to evaluate potential effects of development on the stability of natural streams. Three general strategies should be considered when attempting to manage increases in peak flow, including limiting impervious area, controlling runoff and allowing for channel movement. This investigation presents an important step in understanding the relationship between channel response and changes in impervious cover. The entire technical report is available at ftp://ftp.sccwrp.org/pub/download/pdfs/450_peak_flow.pdf.

12.2.5 New Development Impact Study in the Santa Clara River Watershed

A water quality model has been selected to evaluate the possible changes that Standard Urban Stormwater Management Plan (SUSMP) implementation might have on stormwater quality. The drainage area of a specific development will be selected for modeling and monitoring. Regional data will used to calibrate the water quality calculations. The model will be validated with site specific water quality monitoring data. The monitoring approach will involve monitoring the selected development site during three storms by collecting and analyzing flow-weighted composite samples. Work on the modeling plan is on going. Water quality monitoring is scheduled to occur during the 2005-2006 wet weather season.

12.3 Program Review – Attainment of the Primary Objectives of the Monitoring Program

As stated in Section 1, the stormwater monitoring requirements under NPDES Permit No. CAS004001, which was granted to the Los Angeles County Flood Control District (LAFCD) in 2001, are described in Monitoring and Reporting Program No. 6948 (MRP). The primary objectives of the 2001 MRP include:

1) assessing compliance with the NPDES Permit granted to Los Angeles County;
2) measuring and improving the effectiveness of the SQMPs;
3) assessing the chemical, physical, and biological impacts from urban runoff on receiving waters;
4) characterizing stormwater discharges;
5) identifying sources of pollutants; and
6) assessing the overall health and evaluating long-term trends in receiving water quality.

Table 12-2 presents these objectives, the current monitoring program that addresses these objectives and a summary of the findings and conclusions for these programs that have been presented in this report. Recommended modifications to the program to more effectively address the objectives with available resources are highlighted in the last column of the table, and form the basis for recommendations in Section 13.

Table 12-3 presents a summary of the Monitoring and Reporting Program Requirements and notes any exceptions to the MRP requirements. The last column provides an explanation for the exception and any anticipated activities that may be necessary to modify the program requirements.

Table 12-2. MRP Objectives, Corresponding 2001 Monitoring Programs and Summary of Current Findings and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Current Findings/Conclusions that Address Objectives
1) Assessing compliance with the NPDES Permit granted to Los Angeles County	The Permit includes the monitoring program activities that are required by LACDPW.	• Objective has been successfully addressed by the monitoring program. • Section 3 presented a summary of the MRP requirements for Core Monitoring (Mass Emissions, Water Column Toxicity Monitoring, Tributary Monitoring, Shoreline Monitoring & Trash Monitoring), Regional Monitoring (Estuary Sampling and Bioassessment) and Special Studies; and, the verification of compliance with these requirements for field and analytical methods. Minor exceptions are noted and summarized in Table 12-3; however, primary permit requirements have been met. Table 12-4 provides the total number of events sampled from 2001 to the present and provides a comparison to the permit requirements in the Remarks column. Permit requirements have been met.

Table 12-2. MRP Objectives, Corresponding 2001 Monitoring Programs and Summary of Current Findings and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Current Findings/Conclusions that Address Objectives
2) Measuring and improving the effectiveness of the SQMPs	The SQMP contains programs in the areas of 1) Public Information; 2) Industrial/Commercial Control; 3) Development Planning; 4) Development Construction; 5) Public Agency Activities; 6) Illicit Connection/ Illicit Discharge Elimination Program. Emphasis of the SQMP is pollution prevention through education, inspection, public outreach, planning, and implementation of BMPs.	• Measurement of the effectiveness of the SQMP is currently performed on a watershed management area basis through the Core Monitoring program. Overall long- term trends in water quality are discussed in Sections 4-9 for each watershed, and summarized in Section10. The conclusions of the integrated data set related to long-term reductions of constituents indicate isolated cases of overall reductions on a watershed basis. One significant trend is the decrease in TPH in the Ballona Creek, Santa Clara River, and Coyote Creek Watersheds. Decreasing trends are also indicated for dissolved chromium and turbidity at the Malibu Creek MES. No significant trends are indicated for the constituents that consistently exceed WQO in these urbanized watersheds. These constituents include bacteriological indicators and several metals including total copper, lead and zinc. • Section 11 provides a summary of the BMP effectiveness studies that assess goals of the MRP through BMP implementation. This BMP study is part of the Special Studies program of the MRP that focus on this objective of measuring effectiveness of the SQMP. • *In order to more efficiently meet this objective, it is recommended to modify the monitoring program to reduce the frequency of base of watershed (MES) monitoring since no significant short-term trends are indicated for the primary COCs, and use resources on more focused sampling up into the watershed. Discussion of these and other recommendations presented in Section 13.*
3) Assessing the chemical, physical, and biological impacts from urban runoff on receiving waters	The Core Monitoring program as required under the MRP includes water quality monitoring of the mass loading stations and tributaries for wet and dry weather. It also includes water quality toxicity monitoring at the mass emission stations. Bioassessments have also been conducted as part of the monitoring program to study the impact on the ecology of the receiving waters. Estuary sampling that includes toxicity analysis of sediments was conducted to assess the impacts to the estuary environment from the watersheds. The results from this program provide the basis for assessing the chemical, physical and biological impacts to the receiving waters.	• The Monitoring Program has successfully addressed this objective through the Core Monitoring Program, Regional Monitoring and Special Studies. • Sections 4-10 present the wet and dry weather chemical analysis and compare the concentrations to WQO. Constituents of Concern based on frequency and magnitude of exceedance of the WQO are identified in these Sections for each of the WMA based on the sampling at the MES. The identification of these COCs provides an assessment of the impacts to the receiving waters. The biological impacts are assessed through the bioassessment and toxicity testing conducted of the receiving waters. Impacts to the estuary sediment and shoreline receiving waters are assessed by the Bight 03 program and shoreline sampling programs, respectively.

Table 12-2. MRP Objectives, Corresponding 2001 Monitoring Programs and Summary of Current Findings and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Current Findings/Conclusions that Address Objectives
3) Assessing the chemical, physical, and biological impacts from urban runoff on receiving waters (continued)		• The results of these monitoring programs indicate continued impacts to the receiving creeks and rivers from urban runoff by bacteriological indicators and several metals (predominantly copper, lead and zinc). The greatest loadings on a per acre basis of these constituents are from more urbanized watersheds. Aluminum and cyanide were also found to exceed WQO in most of the watersheds. The likely predominant sources of these metal constituents and cyanide are from non-point sources that include vehicle emissions and wear and tear of tires and brake pads. The results of the bioassessment using preliminary IBI scores indicate poor to very poor ratings for the site in most of the watersheds with the exception of the reference sites. The results of the estuary sampling indicated exceedances of sediment quality objectives at all five estuaries. The constituents that often exceeded sediment quality objectives at most of the estuaries were cadmium, copper, nickel and zinc, and total detectable DDT and chlordane. • Section 10 provides a regional assessment of water quality using the results of the Core monitoring program to assess regional chemical, physical and biological impacts on receiving waters. • Dry weather sampling results presented in Sections 4-10 provide for a direct evaluation of the impact of urban runoff, because the dry weather flow is predominantly urban runoff for most urbanized watersheds with lined channelized receiving waters. The specific contribution of urban runoff to wet weather flows needs to be further studied to determine base flow characteristics. • *In order to better address this program objective, it is recommended to continue the dry weather program at the MES.*

Table 12-2. MRP Objectives, Corresponding 2001 Monitoring Programs and Summary of Current Findings and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Current Findings/Conclusions that Address Objectives
4) Characterization of stormwater discharges	The Core Monitoring program as required under the MRP includes characterization of the stormwater at the mass loading and tributary stations for wet and dry weather. It also includes water quality toxicity monitoring at the mass emission stations.	• Wet weather sampling at the MES has been conducted in accordance with the permit over the last five years (wet weather data at some MES has been collected for the past 10 years). The characteristics of stormwater have been successfully addressed by this monitoring program. • Sections 4-9 provide water quality results summary for each watershed. • Section 11 provides a regional assessment of water quality using the results of the core monitoring program. • Specific sampling of storm drains during wet weather events to assess the characterization of stormwater discharges to receiving waters has been conducted as part of the tributary sampling where the sampling location has been located at the storm drain outfalls. • *Further sampling of storm drains is needed to better assess stormwater contributions to loadings and exceedances of WQO.*
5) Identifying sources of pollutants	The tributary monitoring program provides initial data to better define potential sources of higher constituent loading within the watersheds sampled. Tributary sampling has been conducted on Los Angeles River and Ballona Creek (Previous studies have only hypothesized about the potential sources of pollutants in the tributaries).	• This objective has begun to be addressed through the tributary sampling program conducted in the Los Angeles River and Ballona Creek. The tributary results have been used to better define the sub-watersheds that are contributing the greatest loads and contributions to exceedances of the WQO. These studies form the basis for more specific source identification studies that include sampling of storm drains within the sub-watershed that have been shown to contribute the greatest constituent loadings. As presented in this Section, the tributary sampling at Ballona Creek identified the sections of the Creek and specific sub-watersheds that contribute the largest loads. • *Continued tributary sampling should be conducted on designated watersheds to first identify the sub-watersheds that are contributing the greatest loadings and contributions to exceedances of the WQO. The tributary sampling should be coordinated with any required TMDL studies and compliance monitoring to best use available resources. A trade-off of reduction of the frequency of sampling at the MES, should be made with increased tributary monitoring.*

Table 12-2. MRP Objectives, Corresponding 2001 Monitoring Programs and Summary of Current Findings and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Current Findings/Conclusions that Address Objectives
6) Assessing the overall health and evaluating long-term trends in receiving water quality	The Core Monitoring program consisting of water quality monitoring at the mass emission stations at each of the seven watersheds and tributary monitoring provide for an assessment of overall health and long-term trends in the receiving water quality. Additional intra-regional and special studies including the bioassessment program and the estuary sampling also provide the basis for an overall assessment.	• The Monitoring Program has been successful in assessing the overall health of the receiving waters through the sampling and analysis of wet and dry samples at the MES, toxicity testing at the MES, estuary monitoring and bioassessment. The last 10 years of wet weather data has been compiled in this report and trend analysis performed to assess long-term term trends. Statistical trends are identified in Section 10 for the combined data sets. • Sections 4-9 provide assessment for each watershed on the long-term trends (1995-2005) related to quality of receiving waters. • Section 10 provides an assessment of intra-regional monitoring and presents conclusions regarding overall health and long-term trends as applicable to the data and time-frame of the sampling program. • *Wet weather sampling at the MES does not indicate statistically significant short term trends at the MES. Until significant management actions and subsequent reductions in the loadings of the COC are implemented, the frequency of the wet weather MES sampling should be reduced. These reductions provide a tradeoff of resources to allow for continued dry weather monitoring at the MES (only 3-4 years of dry weather monitoring has been conducted), and continued monitoring up in the watershed on a sub-watershed basis.*

Table 12-3. Summary of Monitoring and Reporting Program Requirements and Noted Exceptions/Modifications.

Monitoring and Reporting Program Requirements	Exceptions/Modifications	Explanation/Anticipated Activity
Mass Emission Monitoring MRP Requirements A.1-A.6 were fulfilled with exception of: A.2. • All storm events of at least 0.25 inches of rainfall shall be analyzed for TSS A.5. • Samples shall be analyzed for constituents listed in Attachment U-1	• A small percentage of events were not analyzed for TSS due to problems with samplers. However, this did not result in inability to perform comparisons of TSS with COCs. • Sample analysis did not include Benzo(g,h,i)perylene and 3,4 Benzofluoranthene • MTBE only analyzed in 2004-2005 from one dry weather event	• This did not result in the inability to perform comparisons of TSS with COCs. • Bacteriological indicators were analyzed for all events. Benzo(b and k) fluoranthene, a carcinogenic PAH, was analyzed in samples in 2000-2001 and 2001-2002, and was not detected. Benzo(k) fluoranthene was included in the analyte list in 2002-2003 and 2003-2004, and also not detected.
Toxicity Water Column Monitoring MRP Requirements B.1-B.3 were fulfilled with exception of: B.1. • Analyze samples from 7 mass emission stations • Monitor first storm event and one additional storm • Monitor two dry weather events each year • Use one freshwater and one marine species for testing B.2. • Begin Phase I TIE on all toxic samples	• Program became effective in December 2001. Therefore, first storm event not captured in 2000-2001 and 2001-2002 season. • There was insufficient flow to collect water required to conduct TIEs for first monitoring period of 2001-2002.	• TIEs have been conducted on all samples starting in 2002-2003 season
Tributary Monitoring MRP Requirements C.1-C.4 were fulfilled with exception of: C.4. • Analyze for constituents listed in Attachment U-1	• Sample analysis did not include *E.coli*, benzo(g,h,i)perylene and 3,4 Benzofluoranthene	• Bacteriological indicators were analyzed for all events. Benzo(b and k) fluoranthene, a carcinogenic PAH, was analyzed in samples in 2000-2001 and 2001-2002, and was not detected. Benzo(k) fluoranthene was included in the analyte list in 2002-2003 and 2003-2004, and also not detected.
Shoreline Monitoring MRP Requirements D.1 were fulfilled with exception of: • None	None Reported	

Monitoring and Reporting Program Requirements	Exceptions/Modifications	Explanation/Anticipated Activity
Trash Monitoring MRP Requirements E.1 were fulfilled with exception of: • None	None Reported	
Analytical MRP Requirements were fulfilled with exception of: • See above for Core and Tributary Monitoring	• See above for Core and Tributary Monitoring	

Table 12-4 summarizes the MRP frequency requirements and the actual sampling frequencies that occurred from 2000-2005 at the mass emission and tributary stations.

Table 12-4. Summary of Monitoring and Reporting Program Frequency Requirements and Actual Sampling Frequencies from 2000-2005.

Sampling Site	MRP Required Frequency				2000-2001				2001-2002				2002-2003				2003-2004				2004-2005			
	W	D	TOX	TSS	W	D	TOX	TSS	W	D	TOX	TSS	W	D	TOX	TSS	W	D	TOX	TSS	W	D	TOX	TSS
Mass Emission Station																								
Ballona Creek (S01)	3	2	4		10				6				4	2	4		3	2	4		4	2	2	3
Malibu Creek (S02)	3	2	4		10				6				4	2	4		3	2	4		4	2	2	3
Los Angeles River (S10)	3	2	4		11				6		1		4	2	4		3	2	4		4	2	2	3
Coyote Creek (S13)	3	2	4		10				6		1		4	2	4		3	2	4		4	2	2	3
San Gabriel River (S14)	3	2	4		9				6		1		4	2	4		3	2	4		4	2	2	3
Dominguez Channel (S28)	3	2	4						7		1		4	2	4		3	2	4		4	2	2	3
Santa Clara River (S29)	3	2	4										4	2	4		3	2	4		4	2	2	
Tributary Site																								
Aliso Creek (TS01)	4	1											5	1			4	2						
Bull Creek (TS02)	4	1											5	1			4	2						
Burbank Western (TS03)	4	1											5	1			4	2						
Verdugo Wash (TS04)	4	1											5	1			4	2						
Arroyo Seco Channel (TS05)	4	1											5	1			4	2						
Rio Hondo Channel (TS06)	4	1											5	1			4	2						
Centinela (TS07)	4	1																			5	2		
Sepulveda (TS08)	4	1																			5	2		
Benedict (TS09)	4	1																			5	2		
Adams (TS10)	4	1																			5	2		
Fairfax (TS11)	4	1																			5	2		
Cochran(TS12)	4	1																			5	2		

MRP required frequencies began in 2002

W = Wet Weather Samples

D = Dry Weather Samples

TOX = Toxicity (Bioassay) Study [number of storms sampled]

TSS = Total Suspended Solids Study [number of storms sampled], TSS required for all storms >0.25 in. of rainfall

12.3.1 Comparison of Past and Current Constituents of Concern

The primary constituents of concern identified in the Integrated Receiving Water Impacts Report for the period from 1994 to 2000 included:

- Cyanide
- Indicator Bacteria
- Total Dissolved Solids
- Turbidity
- Total Suspended Solids
- Nutrients
- Total Aluminum
- Dissolved Cadmium
- Dissolved Copper
- Dissolved Lead
- Total Mercury
- Total Nickel
- Total Zinc
- Bis(2-ethyhexyl)phthalate
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Diazinon
- Chlorpyrifos

Based on the review and comparison of the wet and dry weather results at the MES for the 2000-2005 data set to the WQO, the following COC that are listed above were not identified as COCs in this Report:

- Dissolved Cadmium – Not detected above the WQO
- Total Mercury – The laboratory reporting limit is above the WQO. All the results indicated that mercury was not detected; however, an exceedance is shown since one half the PQL is above the WQO. It is recommended in Section 13 to use a analytical method that obtains the lowest practical quantitation limit.
- Total Nickel – Nickel was not detected above the WQO.
- Bis(2-ethyhexyl)phthalate – This compound was detected at a low frequency in wet and dry samples. This compound is associated with common laboratory and sample handling contamination. It is often associated with plastics used in laboratories and gloves used by technicians.
- Polycyclic Aromatic Hydrocarbons (PAHs)- A very low frequency of detections of several PAH were reported in stormwater samples, however, they were all below the WQO.
- Chlorpyrifos – No detections of this pesticide were reported in the wet and dry samples.