ES.1 Introduction

This document presents the results of the 2005-2006 municipal urban runoff monitoring conducted by Weston Solutions, Inc. on behalf of the San Diego County Municipal Copermittees identified as dischargers of urban runoff in Order No. 2001-01 of the San Diego Regional Water Quality Control Board (RWQCB). This report fulfills the requirements of Order No. 2001-01 Attachment B, IV. *Submittal of Receiving Waters Monitoring Requirements* for Long-term Mass Loading Monitoring; Urban Stream Bioassessment Monitoring; Ambient Bay and Lagoon Monitoring, and Coastal Receiving Water Monitoring. A general overview of coastal storm drain outfall monitoring is provided in Section 13. Coastal storm drain outfall monitoring and San Diego Bay toxic hotspots monitoring, also required in Attachment B of Order 2001-01, (carried out by the appropriate jurisdictions and not conducted by Weston) are included as attachments to this document.

This report discusses activities and findings comprised of the following:

- Chemical and toxicity testing of storm water runoff from 11 mass loading stations located within major watersheds of the County of San Diego.
- Rapid stream bioassessments at 27 stations in Fall 2005 and Spring 2006.
- Phase I and II results of Ambient Bay and Lagoon monitoring at 12 coastal embayments.
- Dry weather, coastal outfall, and (limited) third party data as it relates to watershed water quality assessment.

The main objectives of this monitoring program are to comply with NPDES Order 2001-01 and determine the ecological health of receiving waters in the region based on chemical, physical, and biological evidence.

ES.2 Methods

ES.2.1 Storm Water Methods

Mass loading stations were located at the base of each selected watershed as far downstream as possible in each watershed and upstream of any tidal influence. Mass loading stations for this season were located along the Santa Margarita River (by Camp Pendleton), San Luis Rey River, Agua Hedionda Creek, Escondido Creek, San Dieguito River, Peñasquitos Creek, Tecolote Creek, San Diego River, Chollas Creek, Sweetwater River, and Tijuana River. Three storm events were monitored during the 2005-2006 wet-weather monitoring season at each mass loading station with the exception of the Santa Margarita River, which is voluntarily monitored by the Navy, and was monitored during one storm event.

ES.2.1.1 Stream Flow Rating

During storms, the flow rate at each of the monitoring sites was determined by water velocity and stream stage (water level) sensors that are typically secured to the bottom of the channel. However, to better quantify flow rates and produce a more complete rating curve, each of the streams was also assessed using the classical stream rating method developed by the U.S. Geological Survey.

ES.2.1.2 Storm Water Analyses

Storm water samples were analyzed for conventional chemical analytes, total and dissolved metals (antimony, arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc), organophosphate pesticides (Diazinon and Chlorpyrifos), and toxicity to bioassay test organisms. These analyses were performed on flow-weighted composite samples. Grab samples were used to measure some of the general physical parameters (pH, conductivity, biochemical oxygen demand, and oil and grease) and bacterial indicators (total coliform, fecal coliform, and enterococcus).

ES.2.1.3 Toxicity Testing

Toxicity testing was performed to assess the potential toxicity of storm water runoff at mass loading stations. Freshwater species used in acute and chronic tests included a freshwater cladoceran (*Ceriodaphnia dubia*), acute tests with a freshwater amphipod (*Hyalella azteca*), and chronic tests with a freshwater alga (*Selenastrum capricornutum*).

ES.2.2 Stream Bioassessment Monitoring

Weston conducted stream bioassessments pursuant to RWQCB Order No. 2001-01 to assess the ecological health of the watershed units in San Diego County. The assessments were undertaken utilizing a protocol that samples and analyzes populations of benthic macroinvertebrates. A total of 24 different stream monitoring reaches were assessed in San Diego County in the surveys of October 2005 and May 2006. Four of these sites were considered to represent reference conditions.

The stream bioassessment monitoring includes sampling and identification of benthic macroinvertebrates present, assessment of the physical habitat of the stream, and water quality measurements, including water temperature, specific conductance, pH, dissolved oxygen, and chlorophyll.

ES.2.3 Ambient Bay and Lagoon Monitoring

Under the NPDES permit issued to the County of San Diego by the RWQCB, the Copermittees are required to develop and implement a program to assess the overall health of the receiving waters and monitor the impact of urban runoff on ambient receiving water quality. To implement the Ambient Bay and Lagoon Monitoring Program (ABLM), evaluations of sediment chemistry, sediment toxicity, and ecological community (benthic infauna) structure in 12 coastal embayments in San Diego County were monitored. The data assessed in this report were from samples collected in the summer of 2005. The program was conducted in two phases:

- **Phase I – Contaminant Targeting:** three areas in each embayment with the finest grain size and highest total organic carbon (TOC) concentration were identified using a stratified random design.

- **Phase II – Sediment Assessment:** the areas identified in Phase I were assessed using the same "triad" approach that is being utilized for the storm water runoff program: chemistry, toxicity, and biology of the sediments.

ES.2.4 Watershed Management Area Assessment Methods

The watershed assessment included an identification and prioritization of constituents of concern (COC) based upon the prioritization system developed in the interim guidance document "Watershed Data Assessment Framework" (June 2004). Wet weather results were compared to water quality objectives to identify constituents that were above criteria and persistently occurred within the watershed to determine if they were a COC. Dry weather information was assessed from locations upstream of the mass loading stations and compared to wet weather constituents of concern. Toxicity was evaluated for persistence in each watershed and the triad data assessment approach was applied to determine if Toxicity Identification Evaluations were needed in the watersheds.

Frequency of occurrence within each watershed was examined and developed to prioritize COCs as high, medium, or low. The intent of the identification of frequency of occurrence is to provide a tool to watershed groups for prioritizing water quality concerns and identifying activities and actions.

Water quality priority ratings are also presented based on the methodology presented in the Baseline Long-Term Effectiveness Assessment (BLTEA) report (WESTON, MOE, & LWA, 2005). Constituent groups and stressor groups were given a ranking from A to D with A being the highest priority rating and D the lowest priority rating. Items ranked with a D indicated that the constituent group or stressor is a low priority or does not have sufficient data to support a higher ranking. The ratings were based on the data from the BLTEA report and included current results presented in this 2005-2006 annual report.

Statistical Methods

Relationships between toxicity and COC were examined by MLS to determine which COC may have an effect on toxicity. Additionally, long-term trends in the data were examined by regression analysis to determine whether an observed upward or downward tendency of the data was statistically significant.

ES.3 Cross Watershed Comparison Statistical Methods

A cross-watershed comparison was performed to assess all information from each watershed together in order to evaluate and rank watersheds across the region. Statistical tools used for the cross watershed comparison include scatterplot analysis, regression analysis, analysis of variance (ANOVA), and multivariate cluster analysis.

The relationship between toxicity and constituents of concern for the cross watershed analysis was evaluated by two methods. The first method uses a multiple regression model to correlate changes in toxicity to changes in COC levels in the water. The second method, a threshold analysis, was used to clarify relationships following the regression analyses using the COC that were significant components of the final multiple regressions.

ES.4 Urban Runoff Monitoring Results

Results of the monitoring and assessment conducted for the 2005-2006 program are presented on a watershed basis, which meets the requirements set forth in Order 2001-01. It is important to note that value can also be derived through examination of region-wide trends and relationships presented in Section 13, Regional Assessments, in this report.

ES.4.1 Santa Margarita River Watershed Management Area

The Santa Margarita River Watershed is the second largest in the San Diego hydrologic region. About 73.5% of the Santa Margarita River Watershed lies within Riverside County. Most of the remainder of the watershed lies within unincorporated San Diego County. The City of Oceanside has jurisdiction over about 155 acres. The southwestern portion of the watershed is dominated by Camp Pendleton Naval Reservation and Marine Corps Base. This has kept the lower river and estuary from being developed and therefore, this region supports a variety of valuable habitats and other beneficial uses. Most of the WMA, about 63.4%, is undeveloped. The next highest land uses are agriculture (10.3%), residential (7.7%), military (7.5%), and parks (6.8%). The Santa Margarita River WMA has one mass loading station established in 2001 to characterize storm water runoff within the watershed. Marine Corps Base Camp Pendleton is not a named Copermittee under the MS4 Permit (Order 2001-01). However, Camp Pendleton voluntarily contributes to the monitoring effort by providing sample collection and analysis in the Santa Margarita River. Sample collection is coordinated by the US Navy for Camp Pendleton through separate contractors and the results are provided to the Copermittees.

ES.4.1.1 Storm Water Monitoring

The Navy collected samples from one storm event at the Santa Margarita River MLS during the 2005-2006 wet weather monitoring period on February 28, 2006.

Concentrations of conventional constituents, bacterial indicators, pesticides, and metals in storm water were relatively low. Turbidity and TSS have continuously been above their respective WQO by high ratios, and an upward trend in dissolved metals may be appearing. A more complete assessment may be possible in future years if the limited water quality information in the watershed is expanded. As previously mentioned, Marine Corps Base Camp Pendleton voluntarily provides monitoring data for the Santa Margarita WMA.

Loading values for each constituent sampled were derived using the event mean concentration (EMC) values obtained from composite samples collected at the Santa Margarita MLS site and the recorded volume of water discharged during the sampling period. The constituent loads at the Santa Margarita MLS site were compared to the water quality objective load, which was estimated using the water quality objective multiplied by the storm volume. This comparison shows that fecal coliform, total copper, total lead, dissolved copper and dissolved lead calculated loads were above the WQO load. These results are consistent with the EMC exceedances for fecal coliform, total copper, dissolved copper, and dissolved lead. The EMC for total lead did not exceed the WQO, but did exceed the WQO load. However, the load for total lead only exceeded the WQO load by 0.18 kg/day, while the load for total copper exceeded the WQO load nearly two times. All other constituents were below the calculated WQO load.

Loads based on measured concentrations were all higher than those based on modeled land use concentrations, although only one storm event was monitored in the Santa Margarita River during 2005-

2006. Several constituents have higher measured loads than would be expected from the land use characteristics and include dissolved lead, dissolved copper, dissolved zinc, total dissolved solid (TDS) and total suspended solids (TSS).

ES.4.1.2 Stream Bioassessment

The Santa Margarita River WMA was sampled at a total of three monitoring sites, including a reference site in Sandia Creek. All of the sites had mostly undisturbed conditions, and the Index of Biotic Integrity quality ratings ranged from Poor to Good. As in past surveys, the monitoring sites in Santa Margarita River were among the highest rated of the urban affected sites in San Diego County, with lower IBI scores in May. Biological metric values and water quality measures indicated that this watershed is one of the least impacted in San Diego County.

ES.4.1.3 Ambient Bay and Lagoon Monitoring

Sediments in Santa Margarita River Estuary and Oceanside Harbor were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COC were most likely to be found. These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

For the Santa Margarita River Estuary, the results of the chemistry assessment indicated that only six metals were found above the detection limits in the Estuary sediments, all at very low concentrations. Concentrations were low and none exceeded their respective ERL and ERM sediment quality values. The mean ERM-Q value for the Estuary was 0.05 and below the threshold of 0.10. Percent survival of test organisms exposed to the Santa Margarita River Estuary sediments was 93%, which was not significantly different from that of the Control and therefore test organisms displayed a non-toxic response. The indices calculated from the species collected were similar among the three sites sampled. In comparison with the 2004 ABLM Program results, the benthic infauna sampled differed between years from an assemblage of mollusks, polychaetes and crustaceans observed in the 2004 survey to a community mainly comprised of polychaete and oligochaete worms in the 2005 survey. For the 2005 ABLM sampling, the Santa Margarita River Estuary scored good for toxicology, poor for biology and good for chemistry.

For Oceanside Harbor, the results of the chemistry assessment indicated that six metals were found in the Harbor sediments. Concentrations were low and none exceeded their respective ERM sediment quality values. Copper exceeded the respective ERL value. For pesticides, 4,4'-DDE was detected with a concentration that exceeded the ERL value for this constituent. The mean ERM-Q value for the Harbor was 0.12, which is above the published threshold value of 0.10 and therefore suggests a potential for increased toxicity. The percent survival of test organisms exposed to Oceanside Harbor sediments was 74%, which was significantly different from that of the Control and indicates a toxic response. Correlated with the SEM:AVS ratio, it is possible that bioavailable metals found in Oceanside Harbor sediment are responsible for the observed toxicity. The benthic community in Oceanside Harbor community was dominated by polychaete worms, especially *Capitella sp.* and nematodes. For the 2005 ABLM sampling, Oceanside Harbor scored fair for toxicology, biology and chemistry.

ES.4.1.4 WMA Assessment

For the Santa Margarita River WMA, turbidity and fecal coliform were identified as high frequency of occurrence COC, TSS was identified as a medium frequency of occurrence COC, and nitrate and total copper were identified as low frequency of occurrence COC. There was no evidence of persistent toxicity found in Santa Margarita River. However, toxicity was observed for *Hyalella azteca* during the one event monitored during the 2005-2006 wet weather season. In addition, the ability to evaluate this watershed monitoring data is difficult due to the limited data collected over the past two monitoring seasons. There were no statistically significant increasing or decreasing trends observed for the Santa Margarita River WMA.

Based on the triad matrix, there was evidence of persistent water quality objective exceedances (turbidity), no evidence of persistent toxicity, and no indications of benthic alteration.

In addition to the WMA assessment findings, the water quality priority ratings for the overall Santa Margarita River WMA identified only dissolved minerals as a high priority (A) rated constituent. Several B ratings were identified which include heavy metals, sediments, pesticides, nutrients, gross pollutants, bacteria, benthic alterations, and toxicity. The two remaining constituent groups (organics and oil & grease) were assigned the lowest priority (D) rating.

ES.4.2 San Luis Rey River Watershed Management Area

The San Luis Rey River Watershed is the third largest watershed in San Diego County. The San Luis Rey WMA contains the most unincorporated land in San Diego County: 95.2% is unincorporated. The City of Oceanside comprises about 4.4% of the watershed. Small portions of Escondido, Vista, and Riverside County make up the remainder. Land use within the watershed is classified primarily as undeveloped (39.6%). Other uses include agricultural (20.6%), tribal lands (13.4%), residential (11%), and parks (8%)

ES.4.2.1 Storm Water Monitoring Summary

Total dissolved solids continue to be the primary water quality concern in the watershed. There is also an increasing trend in indicator bacteria concentration, specifically for fecal coliform, as well as for nitrate and dissolved phosphorus, although neither nitrate nor dissolved phosphorus has been detected at concentrations above the WQO. Other constituents including TSS, turbidity, BOD, pH, and Diazinon have been detected at levels above the WQO occasionally. There is no clear link between dry weather results and mass loading station data. The cause of occasional, infrequent toxicity during mass loading station monitoring is unknown.

Loading values for each constituent sampled were derived using the event mean concentration (EMC) values obtained from composite samples collected at the San Luis Rey River MLS site and the recorded volume of water discharged during the sampling period. The constituent loads were compared to the water quality objective (WQO) load, calculated using the mean flow multiplied by the WQO. The EMC load at the San Luis Rey River MLS was higher than the WQO load for fecal coliform and TDS. This corresponds to EMC exceedances for these two constituents. All other constituents were below the calculated WQO load.

The mean modeled loads calculated in GIS for the San Luis Rey River Watershed indicate that the total dissolved solids load based on measured values is more than an order of magnitude higher than what

might be expected from the land uses in the watershed. In addition, measured nitrate loads also appear high. Higher than expected TDS may be attributable to naturally occurring dissolved minerals, or from groundwater discharges as a result of increased irrigation, importation of water, dry weather flows, and agricultural water use. In addition, agricultural practices may be contributing to higher than expected nitrate loads.

ES.4.2.2 Stream Bioassessment

The San Luis Rey River WMA was sampled at three sites, two urban affected sites in the San Luis Rey River, and one reference site in Doane Creek, a small tributary on Mt. Palomar. The San Luis Rey River sites had Index of Biotic Ratings of Very Poor for both sites and both surveys. The in-stream physical habitat of these sites was marginal, which could limit macroinvertebrate colonization, but it may be noted that the sites are quite similar to the Santa Margarita site on Camp Pendleton, which had a substantially higher IBI scores. The reference site in Doane Creek was the highest rated site in the county program, with the greatest taxonomic diversity and many infrequently encountered organisms.

ES.4.2.3 Ambient Bay and Lagoon Monitoring Program

Sediments in San Luis Rey River Estuary were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found. These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that six of the nine metals assessed were detected in the San Luis Rey River Estuary sediments; none exceeded ERL or ERM values in 2005. For pesticides, 4,4'-DDE was detected with a concentration that exceeded the ERL value for this constituent but not its respective ERM value. The mean ERM-Q value for the Estuary was 0.05 and below the threshold of 0.10. Percent survival of test organisms exposed to San Luis Rey River Estuary sediments was 90%; therefore test organisms displayed a non-toxic response. Correlated with the SEM:AVS ratio, it was determined that bioavailable metals found in the San Luis Rey River Estuary sediment were not toxic to the amphipod *E. estuarius*. The benthic community was dominated by three polychaete worms: *Polydora cornuta*, *Scolelepsis sp*. SD1, and the *Capitella capitata* complex. For the 2005 ABLM sampling, the San Luis Rey River Estuary scored good for toxicology, fair for biology and good for chemistry.

ES.4.2.4 WMA Assessment

For the San Luis Rey River WMA, TDS and fecal coliform were the only high frequency of occurrence COC followed by turbidity, nitrate, and total coliform which were all low frequency of occurrence COC. There was no evidence of persistent toxicity in San Luis Rey River; however, the benthic community appeared to be limited by unknown factors. A review of the scatterplots and trends shows statistically significant increasing trends for nitrate, dissolved phosphorus, and total and fecal coliform. Of these four significantly increasing trends, only fecal coliform has been detected at levels above the WQO. Nitrate and dissolved phosphorus have only been detected at levels well below the WQO, while no WQO exists for total coliform.

Fecal coliform and TDS were identified as having a high frequency of occurrence. However, both TDS and fecal coliform are not considered in the triad decision making process since they are not believed to induce a toxic response to aquatic organisms. Therefore, based on the triad decision matrix, there is no

evidence of persistent water quality objective exceedances, no evidence of persistent toxicity, and indications of benthic alteration.

In addition to the WMA assessment findings which indicate TDS and fecal coliform as constituents of concern, the water quality priority ratings resulted in no high priority (A) ratings for the San Luis Rey River WMA. Several B priority ratings were identified and include dissolved minerals, bacteria and benthic alteration. All other constituents were given either a C or D rating.

ES.4.3 Carlsbad Watershed Management Area

The Carlsbad Watershed is the third most densely populated watershed in the San Diego region. The most common land use within the watershed management area is residential (32%), followed by undeveloped (24%), parks (12%), transportation (11%), and agriculture (9%). This program monitors mass loading stations in the Agua Hedionda and Escondido Creek sub-watershed areas. For the Agua Hedionda sub-watershed which accounts for 11% of the Carlsbad Watershed, land use within the contributing runoff area is primarily residential (33%), undeveloped (25%), and agriculture (11%). For the Escondido Creek sub-watershed which accounts for approximately 33% of the Carlsbad Watershed, land use within the contributing runoff area is predominantly undeveloped (35%), residential (25%), and parks (16%).

ES.4.3.1 Storm Water Monitoring Summary

Both the Escondido Creek sub-watershed and the Agua Hedionda sub-watershed have similar water quality concerns. Bacteria, turbidity, and total suspended solids have persistently exceeded WQOs. Diazinon has exceeded WQOs, but has shown signs of a decreasing trend, especially in the Escondido Creek sub-watershed. There appears to be significantly increasing trends for turbidity, COD, TSS, nitrate, fecal coliform, total lead, and dissolved arsenic concentrations in Agua Hedionda Creek and for nitrate and total coliform in Escondido Creek. The increasing trends for nitrate in both Agua Hedionda and Escondido Creeks are below WQO. Decreasing trends were found for Diazinon and *Ceriodaphnia* toxicity in Escondido Creek.

Third party data collected in 2002 under SWAMP, indicated that sulfate, manganese and toxicity were consistent problems throughout the Carlsbad Watershed. Sulfate and manganese are dissolved minerals and are likely associated with naturally occurring elements, but may also be compounded by land use activities.

The storm event constituent loads at the Agua Hedionda Creek MLS site were compared to water quality objective (WQO) loads calculated by multiplying the constituent WQOs by the mean flow. This comparison shows that mean EMC loads for fecal coliform, TSS, and TDS were above the WQO load estimates. These results correspond to fecal coliform, TDS, and TSS exceedances for EMCs. This result indicates that the load exceedances were most likely due to the EMC and not storm flow volume. All other constituent loads were lower than the calculated WQO load. For the Escondido Creek MLS site, fecal coliform, TDS, and TSS mean EMC loads were greater than the mean WQO loads. The TDS EMC load was nearly two times greater than the WQO load for that constituent, while the EMC loads for fecal coliform and TSS were of a smaller magnitude. This result corresponds to EMC exceedances for fecal coliform, TDS, and TSS. All other constituent loads were lower than the calculated WQO load.

The mean modeled loads calculated in GIS for the Agua Hedionda Watershed indicate that the total suspended solids load based on measured concentrations is about 10 times higher than what might be

expected from the land use characteristics of the watershed. Total dissolved solids, total Kjeldahl nitrogen, and nitrate all show higher measured loads than expected. The mean modeled loads calculated in GIS for the Escondido Creek Watershed indicate that the loads based on measured concentrations and land use based concentrations are generally similar. However, the measured loads for total dissolved solids, nitrate, and fecal coliform stand out above loads estimated based on land use.

ES.4.3.2 Stream Bioassessment

Bioassessment monitoring in the Carlsbad WMA occurred at four bioassessment monitoring sites, two on Agua Hedionda Creek and two on Escondido Creek. Index of Biotic Integrity scores rated the benthic communities Very Poor at all four sites, with the exception of Escondido Creek in Elfin Forest, which was rated Poor in the October 2005 survey. A substantial amount of substrate alteration occurred between the October and May surveys in Escondido Creek. The Aqua Hedionda Creek sites both had marginal in-stream habitat conditions, which may have limited macroinvertebrate colonization.

ES.4.3.3 Ambient Bay and Lagoon Monitoring Program

The 2005 ABLM program included monitoring in four lagoons in the Carlsbad WMA. The lagoons are Buena Vista Lagoon, Agua Hedionda Lagoon, Batiquitos Lagoon, and San Elijo Lagoon.

For the 2005 ABLM sampling, Buena Vista Lagoon sediments were not toxic to the test species. The ERM-Q value for the Buena Vista Lagoon was the highest among the embayments assessed in the 2005 ABLM program with a value of 0.24. There were no PAHs, PCBs, or pesticides found above the detection limit in the Buena Vista Lagoon. Only 4 taxa were found in the Buena Vista Lagoon, most of which were freshwater organisms. Buena Vista Lagoon scored good for toxicology, poor for biology, and poor for chemistry.

Agua Hedionda Lagoon sediments were found to display a toxic response to test organisms. The pesticide 4,4'-DDE was detected (5.67 μg/kg) at this site. This concentration exceeds the ERL sediment quality value for 4,4'-DDE but is below the respective ERM value. Correlated with the SEM:AVS ratio, it is possible that bioavailable metals found in the Lagoon sediment are responsible for the observed toxicity. The infaunal community was dominated by the horse-shoe worm, *Phoronida sp.,* which accounted for 68% of the taxa collected. For the 2005 ABLM sampling, Agua Hedionda Lagoon scored fair for toxicology, fair/good for biology, and fair for chemistry.

Batiquitos Lagoon sediments showed a toxic response to test organisms. There were no PAHs, PCBs, or pesticides found above the detection limit in the Batiquitos Lagoon samples. Correlated with the SEM:AVS ratio, it was determined that bioavailable metals found in Lagoon sediment are possibly responsible for the observed toxicity. Three taxa dominated the infaunal community in the Batiquitos Lagoon: *Capitella capitata Complex*, *Molgula sp.*, and the sea slug *Acteocina inculta*. For the 2005 ABLM sampling, Batiquitos Lagoon scored fair for toxicology, biology and chemistry.

San Elijo Lagoon sediments were toxic to test organisms. There were no PAHs, PCBs, or pesticides found above the detection limit in the San Elijo Lagoon. Correlated with the SEM:AVS ratio, it was determined that bioavailable metals found in the Lagoon sediment are possibly responsible for the observed toxicity. The infaunal community was dominated by the bryozoan *Disporella sp.* Oligochaetes were also abundant in the Lagoon, along with the crustacean, *Lagunogammarus sp.* For the 2005 ABLM sampling, the Lagoon scored fair for toxicology, fair/poor for biology, and good for chemistry.

ES.4.3.4 WMA Assessment

For Agua Hedionda Creek, TSS, turbidity, total coliform, fecal coliform, and enterococci were identified as high frequency of occurrence COC. TDS and Diazinon were identified as medium frequency of occurrence COC. Conductivity, COD, nitrate, and total copper were identified as low frequency of occurrence COC. Significant increasing trends were observed for several high frequency COC including TSS, turbidity, and fecal coliform; as well as for the low frequency constituents COD and nitrate, although nitrate has never been detected at levels above WQO. Total lead and dissolved arsenic were shown to have significantly increasing trends, which may indicate a future problem.

For Escondido Creek, TDS, turbidity, total coliform, fecal coliform, and enterococci were identified as high frequency of occurrence COC. Surfactants (MBAS), TSS, and nitrate were identified as low frequency of occurrence COC. Analysis of scatterplots shows a significant increasing trend for total coliform and nitrate, although nitrate has never been detected at levels above the WQO during wet weather monitoring events. Diazinon and toxicity to the *Ceriodaphnia* chronic endpoint both show significant decreasing trends.

Based on the triad matrix for Agua Hedionda, there was evidence of persistent water quality objective exceedances (TSS and turbidity), no evidence of persistent toxicity, and indications of benthic alteration. For Escondido Creek, there was evidence of persistent water quality objective exceedances (turbidity), no evidence of persistent toxicity, and indications of benthic alteration.

The WMA assessment findings agreed with the water quality priority ratings, which identified dissolved minerals, sediments, nutrients, and bacteria as high priority (A) rated constituents for the overall Carlsbad WMA. Benthic alteration and toxicity were assigned B ratings. All other constituents were given either a C or D rating.

ES.4.4 San Dieguito River Watershed Management Area

The San Dieguito River Watershed Management land area is 221,307 acres. The watershed drains into the San Dieguito Lagoon located between the cities of Del Mar and Solana Beach. The San Dieguito Lagoon provides 260 acres of wetland habitat, of which 86 acres are characterized as open water. Land use in the watershed is primarily vacant/undeveloped land (42%). Other major uses are agriculture (18%), parks/open space (15%), and residential (14%). The San Dieguito River MLS runoff area accounts for only 8% of the overall San Dieguito WMA. Approximately 86% of the watershed lies behind dams (Coastal Conservancy, 2001). The major land uses within the contributing runoff area are undeveloped (24%), parks (24%), residential (21%), and agricultural (18%).

ES.4.4.1 Storm Water Monitoring Summary

Total dissolved solids and elevated levels of bacterial indicators, specifically fecal coliform, appear to be the primary water quality concerns within the watershed. There is also some indication of an emergent toxicity water quality concern in the watershed based on the toxic results of the 2005-2006 monitoring period. The sample collected during the January 2, 2006 event showed both a chronic and acute toxic response to the test organisms.

The constituent loads at the San Dieguito River MLS site were compared to the mean water quality objective (WQO) loading estimated by multiplying the mean flow by the constituent WQOs. This comparison shows that fecal coliform and TDS mean EMC loads were greater than their corresponding

mean WQO loads. The result corresponds to the EMC exceedances for fecal coliform and TDS. Event mean concentration fecal coliform results exceeded the WQO two of three sampling events, but the magnitude of exceedance was great enough to result in a mean EMC load greater than the mean WQO load. However, both results were of the same magnitude. In contrast, the TDS mean EMC load was four times greater than the TDS WQO load.

The mean modeled loads calculated in GIS for the San Dieguito River WMA indicate that the total dissolved solids (TDS) load based on the measured values are roughly one order of magnitude higher than the predicted TDS loads based on the land use concentrations found in the NSQD. However, measurement based fecal coliform loads were lower than might be expected. Higher than expected TDS may be attributable to naturally occurring dissolved minerals, or from groundwater discharges as a result of increased irrigation, importation of water, dry weather flows, and agricultural water use.

ES.4.4.2 Stream Bioassessment

Bioassessment monitoring at San Dieguito River WMA occurred at two monitoring sites Green Valley Creek at West Bernardo Drive and San Dieguito River below Lake Hodges Dam in October 2005 and May 2006. The macroinvertebrate community of Green Valley Creek had an Index of Biotic Integrity rating of Very Poor for both surveys. San Dieguito River was also rated Very Poor for both surveys.

ES.4.4.3 Ambient Bay and Lagoon Monitoring

Sediments in San Dieguito Lagoon were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found (i.e., those with the highest TOC and smallest grains size). These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that six metals common to all embayments were also detected in the San Dieguito Lagoon sediments. Concentrations were low and none exceeded their respective ERL and ERM sediment quality values. However, the mean ERM-Q value for the San Dieguito Lagoon exceeded the threshold of 0.10, which suggests a higher potential for toxicity. There were no PAHs, PCBs, or pesticides found above the detection limit in the San Dieguito Lagoon samples. Test organisms did not display a toxic response to the Lagoon sediment collected. Correlated with the SEM:AVS ratio, it was determined that bioavailable metals found in the Lagoon sediment were not toxic to the amphipod *E. estuarius*. For the 2005 ABLM sampling, the San Dieguito Lagoon scored good for toxicology, poor for biology and fair for chemistry.

ES.4.4.4 WMA Assessment

For the San Dieguito River WMA, total dissolved solids was identified as a high frequency COC, fecal coliform was identified as a medium frequency COC, and turbidity was identified as a low frequency COC. A review of the scatterplots and trends shows a significant increasing trend for dissolved and total phosphorus and total arsenic, however, these constituents were measured below their respective WQO.

Based on the triad decision matrix, there was no evidence of persistence exceedances of WQO (TDS not considered based on the methods section), no evidence of persistent toxicity, but there was evidence of benthic alteration.

In addition to the WMA assessment findings, the water quality priority ratings did not find any high priority (A) rated constituent for the San Dieguito River WMA. Several constituents received B ratings which include dissolved minerals, gross pollutants, bacteria, benthic alteration, and toxicity. All other constituents were given either a C or D priority rating.

ES.4.5 Los Peñasquitos Creek Watershed Management Area

The Los Peñasquitos Creek Watershed Management Area (WMA) includes two hydrologic areas: Miramar Reservoir (HA 906.10) and Poway (HA 906.20) and is the second smallest watershed in the San Diego region. The Los Peñasquitos Creek WMA land area is 60,418 acres. Land use within the watershed is relatively equally divided between residential (24.7%), vacant/undeveloped (17.8%), and parks and recreation (29.2%). The Los Peñasquitos Creek runoff area accounts for approximately 60% of the Los Peñasquitos WMA. The major land uses within the contributing runoff area are parks (29%), residential (28%), and undeveloped (24%).

ES.4.5.1 Storm Water Monitoring Summary

Total dissolved solids and elevated levels of bacterial indicators, specifically fecal coliform, appear to be the primary water quality concerns within the watershed. Based on the period of record, there appears to be a significant downward trend in Diazinon concentrations at the MLS.

Three sites were sampled under the SWAMP program within Los Peñasquitos Watershed in 2002, including Los Peñasquitos Creek, Soledad Canyon Creek and Poway Creek. At the station located in Los Peñasquitos Creek in the same vicinity as the mass loading station, parameters with results above the water quality objective (WQO) include turbidity, pH, sulfate, Diazinon, methyl parathion, and toxicity. Results from the other two stations within Los Peñasquitos Watershed were similar to those found in Los Peñasquitos Creek. Sulfate, manganese and toxicity were above the WQO at all sites. Turbidity and Diazinon concentrations were above the WQO sporadically.

The constituent EMC loads at the Los Peñasquitos Creek MLS site were compared to the mean WQO loads, calculated using the mean flow multiplied by constituent WQOs. This comparison shows that fecal coliform, TDS, and TSS EMC loads were greater than the corresponding mean WQO loads. This corresponds to EMC WQO exceedances for all three constituents. The TDS EMC was above its WQO during two of three wet weather sampling events, and TSS during one of three events. However, the magnitude of constituent concentrations was such that the EMC load was still greater than the WQO load.

The mean modeled loads calculated in GIS for the Los Peñasquitos Watershed indicate total dissolved solids loads based on measured concentrations are several times higher than those based on land use. Total dissolved solids was also a listed constituent of concern in the water quality priority ratings and watershed assessment. The metals loads are all less than what might be expected from the land use in the Los Peñasquitos Creek Watershed.

ES.4.5.2 Stream Bioassessment

Bioassessment monitoring in the Los Peñasquitos WMA occurred at two sites. The upstream site was in Los Peñasquitos Creek in Poway, and the downstream site was in Carroll Canyon Creek in Sorrento Valley. Both of the sites had Index of Biotic Integrity ratings that were in the Very Poor or Poor

categories. The Carroll Canyon Creek site was rated slightly higher than the upstream site on Los Peñasquitos Creek, possibly due to different watershed areas contributing to the different streams.

ES.4.5.3 Ambient Bay and Lagoon Monitoring

Sediments in Los Peñasquitos Lagoon were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found (i.e., those with the highest TOC and smallest grains size). These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that seven of the nine metals assessed were detected in the Los Peñasquitos sediments collected. No ERL or ERM sediment quality values were exceeded. The mean ERM-Q value for the Los Peñasquitos Lagoon was 0.10, which is at the published threshold value of 0.10 and therefore suggests no potential for increased toxicity. There were no PAHs, PCBs, or pesticides found above the detection limit in the Los Peñasquitos Lagoon during the 2005 Program. Percent survival of test organisms exposed to Los Peñasquitos Lagoon sediments was 91%, which was not significantly different from that of the Control (97%) and therefore test organisms displayed a non-toxic response. Correlated with the SEM:AVS Ratio, it was determined that bioavailable metals found in the Los Peñasquitos Lagoon sediment were not toxic to the amphipod *E. estuarius*. The benthic community was dominated by the mollusk *Acteocina inculta,* while the polychaete worms *Capitella capitata* and *Polydora nuchalis* made up the rest of the community collected at the Lagoon. For the 2005 ABLM sampling, the Lagoon scored good for toxicology, poor/fair for biology and good for chemistry.

ES.4.5.4 WMA Assessment

For the Los Peñasquitos Creek MLS, total dissolved solids was identified as a high frequency of occurrence COC. Fecal coliform was identified as a medium frequency of occurrence COC. Turbidity, total coliform and enterococci were all identified as low frequency COC. A review of the scatterplots and trends shows a statistically significant decreasing trend for both pH and Diazinon. Third party data collected in 2002 under SWAMP indicated that sulfate, manganese, and toxicity were frequently above the water quality objectives (WQO) at the three sites monitored in the Los Peñasquitos Watershed. Sulfate was above the WQO in 10 of the 12 samples collected, manganese was above the WQO in 8 of the 12 samples collected, and toxicity was observed in 11 of the 12 samples collected.

Based on the triad decision matrix, there was no evidence of persistence exceedances of WQO (TDS not considered based on the methods section), no evidence of persistent toxicity, but there was evidence of benthic alteration.

In addition to the WMA assessment findings, the water quality priority ratings identified high priority (A) ratings for dissolved minerals, sediments, bacteria and benthic alteration. All other constituents were given either a C or D priority rating.

ES.4.6 Mission Bay Watershed Management Area

The Mission Bay Watershed Management Area (WMA) includes three hydrologic areas: Scripps, Miramar, and Tecolote. The Mission Bay WMA is entirely contained within the City of San Diego. Land use within the watershed is primarily parks (26.2%) and residential (26.2%). This program monitors a mass loading

station only in the Tecolote Creek sub-watershed. For the Tecolote Creek sub-watershed, which accounts for approximately 14% of the Mission Bay WMA, the primary land uses within the contributing runoff area are residential (43%) and transportation (21%).

ES.4.6.1 Storm Water Monitoring Summary

Turbidity, total suspended solids and elevated levels of bacterial indicators, specifically fecal coliform, appear to be the primary water quality concerns within the watershed. Based on the period of record, there appears to be a significant downward trend in surfactants, ammonia, total lead and Diazinon concentrations at the MLS. A significant increasing trend for enterococci concentrations was also observed. Third party data collected under the SWAMP program in 2002 was conducted at two sites within the Mission Bay Watershed, one in Tecolote Creek near the mass loading station and the other in Rose Canyon Creek. Constituents with results above the water quality objective (WQO) include sulfate, manganese and toxicity at the Tecolote Creek station. Constituents with results above the WQO at Rose Canyon Creek included sulfate, manganese, turbidity, pH, Diazinon and toxicity.

The constituent EMC loads at the Tecolote Creek MLS site were compared to the mean WQO load, calculated by multiplying the mean flow by constituent WQOs. This comparison shows that fecal coliform, TDS, TSS, total copper, and total lead mean EMC loads were greater than their corresponding mean WQO loads. These results correspond to the EMC exceedances reported in the wet weather chemistry tables, except for TDS. Total dissolved solids was not above the water quality objective for any one wet weather sampling event, but due to the volume of storm water runoff the mean EMC load was 213 kg/day greater than the WQO load. This is 0.32% greater than the WQO load, a negligible amount. Fecal coliform EMC load results were an order of magnitude greater than the WQO load, while loads for total copper and total lead were less extreme.

The mean modeled loads calculated in GIS for the Mission Bay Watershed indicate that loads of total suspended and total dissolved solids based on measured concentrations are higher than might be expected from the land use characteristics in the Tecolote Creek Watershed.

ES.4.6.2 Stream Bioassessment

The Mission Bay WMA was sampled at two sites. One site was in Rose Creek, downstream of Highway 52, and the other site was in Tecolote Creek in Tecolote Canyon Natural Park. The macroinvertebrate community of Rose Creek had Index of Biotic Integrity ratings of Poor in October and Very Poor in May, and Tecolote Creek had ratings of Very Poor for both surveys. Both of these sites had substantial seasonal variation in the total IBI scores, a pattern that has been consistent throughout the duration of the program.

ES.4.6.3 Ambient Bay and Lagoon Monitoring

Sediments in Mission Bay were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found (i.e., those with the highest TOC and smallest grain size): Site 1R-1 in the outer Stratum, Site 2M-1 in the middle region, and Site 3R-3 in the inner stratum. These sites were sampled in Phase II of the assessment and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that seven of the nine metals assessed were found in Mission Bay sediments. No ERL or ERM sediment quality values were exceeded. The mean ERM-Q value for Mission Bay was 0.09, which is below the published threshold value of 0.10 and therefore suggests no potential for increased toxicity. There were no PAHs, PCBs, or pesticides found above the detection limit in Mission Bay samples collected during the 2005 Program. Test organisms exposed to the sediments of the Mission Bay displayed a non-toxic response. Correlated with the SEM:AVS Ratio, it was determined that bioavailable metals found in Mission Bay sediment were not toxic to the amphipod *E. estuarius*. The infaunal community was dominated by polychaete worms and a genus of barley snail. For the 2005 ABLM sampling, the Bay scored good for toxicology, biology and chemistry.

ES.4.6.4 WMA Assessment

For the Mission Bay WMA, turbidity, total coliform, fecal coliform and enterococcus were identified as high frequency of occurrence COC followed by TSS and the total metal lead, which was identified as a medium frequency of occurrence COC.

Based on the triad decision matrix, there was evidence of persistent exceedances of WQO (turbidity), no evidence of persistent toxicity, and evidence of benthic alteration.

In addition to the WMA assessment findings, the water quality priority ratings identified high priority (A) ratings for the heavy metals, dissolved minerals, nutrients, bacteria, and toxicity categories but found a B priority rating for the sediments category. The heavy metals priority rating found in the water quality priority rating was primarily due to the 303(d) listings for metals in the Miramar and Tecolote sub-watersheds even though the WMA assessment did not indicate metals were an overall priority.

ES.4.7 San Diego River Watershed Management Area

The San Diego River Watershed is the second largest watershed in San Diego County. The San Diego River WMA land area is 277,543 acres and includes four hydrologic areas: Lower San Diego, San Vicente, El Capitan, and Boulder Creek. Land use within the watershed is primarily undeveloped (44.3%), parks and recreation (18.1%), and residential (15.4%). The contributing runoff area to the MLS is approximately 39% of the San Diego watershed land area. The major land uses within the contributing runoff area are residential (29%), parks (24%), and undeveloped (21%).

ES.4.7.1 Storm Water Monitoring Summary

Turbidity and elevated levels of bacterial indicators, specifically fecal coliform, appear to be the primary water quality concerns within the watershed. The Padre Dam data for TDS confirms previous work that shows that storm water runoff concentrations of TDS during wet weather events are considerably lower than during dry weather periods. Based on the period of record, there appears to be a significant downward trend in Diazinon concentrations at the MLS.

The constituent EMC loads at the San Diego River MLS site were compared to the mean water quality objective (WQO) loads, calculated by multiplying the mean flow by constituent WQOs. This comparison shows that fecal coliform, TDS, and total cadmium mean EMC loads were above the mean WQO loads. The fecal coliform EMC load was two orders of magnitude greater than the WQO load, while the TDS EMC load was twice the WQO load. The total cadmium mean EMC load was only marginally larger than its WQO load, this is most likely due to one wet weather sampling event having results above the WQO. Two of the three sampling events resulted in non-detect values for total cadmium.

The mean modeled loads calculated in GIS for the San Diego River Watershed indicate total that the dissolved solids load based on measured values is more than an order of magnitude higher than what might be expected from the land uses in the watershed. Dissolved minerals were also identified as a priority constituent in the water quality priority rating table. Higher than expected TDS may be attributable to naturally occurring dissolved minerals, or from groundwater discharges as a result of increased irrigation, importation of water, dry weather flows, and agricultural water use.

Third party data results from the San Diego River Watershed under the Surface Water Ambient Monitoring Program (SWAMP) in May 2004 found turbidity, sulfate, and manganese above the WQO. Results from the analyses of pesticides, herbicides, PAHs and PCBs were all below their respective WQO with only a few detections of herbicides and one pesticide compound.

ES.4.7.2 Stream Bioassessment

The San Diego River WMA was sampled at three monitoring sites, including two urban sites and one reference site. The urban sites were in Mission Trails Regional Park and near Morena Blvd. in Mission Valley. The Mission Trails site had an Index of Biotic Integrity rating of Poor and Very Poor, and the Mission Valley site had an IBI rating of Very Poor. The reference site on Boulder Creek had IBI ratings of Poor and Fair. The Poor rating was near the threshold of the Fair rating, and the site supported numerous sensitive taxa indicating that the water quality was likely very good.

ES.4.7.3 Ambient Bay and Lagoon Monitoring

No sampling was performed at the mouth of the San Diego River as part of the Ambient Bay and Lagoon Monitoring program.

ES.4.7.4 WMA Assessment

For the San Diego River WMA, turbidity, total coliform, and fecal coliform were identified as high frequency of occurrence COC followed by TDS, which was identified as a medium frequency of occurrence COC. TDS during wet weather monitoring and monthly monitoring within the watershed by Padre Dam showed a medium frequency of occurrence but appears to be related to groundwater influences and local conditions. Enterococcus was identified as a low frequency of occurrence COC. Dissolved oxygen in samples collected by Padre Dam was above the Basin Plan water quality objective 33% of the time. A review of the scatterplots and trends shows only a statistically significant decreasing trend for Diazinon.

Based on the triad decision matrix, there was evidence of persistent exceedances of WQO (turbidity), no evidence of persistent toxicity, and evidence of benthic alteration.

In addition to the WMA assessment findings, the water quality priority ratings identified a high priority (A) rating for bacteria and found a B priority rating for the sediments category. All other constituents were given either a C or D priority rating.

ES.4.8 San Diego Bay Watershed Management Area

The San Diego Bay Watershed Management Area (WMA) consists of three major watersheds, including the Pueblo San Diego Watershed, the Sweetwater Watershed, and the Otay Watershed. The Chollas sub-watershed within the Pueblo San Diego Watershed and the Sweetwater Watershed are currently

monitored in this program. The Otay Watershed has not been sampled during this monitoring program since the majority of runoff is captured in the Otay Reservoir and is prevented from flowing downstream. The differences in water quality between the Pueblo San Diego and Sweetwater Watersheds likely reflect the differences in land uses. The Chollas sub-watershed within the Pueblo San Diego Watershed drains a very densely populated, urban area. Nearly 65% of the drainage area is residential and another 17% is commercial. The Sweetwater Watershed drainage area consists of 50% vacant or undeveloped land, 30% residential and only 10% commercial.

ES.4.8.1 Storm Water Monitoring Summary

The differences in land use between the Pueblo and Sweetwater Watersheds likely reflect the differences in observed water quality. The Pueblo Watershed is highly urbanized in comparison to the Sweetwater Watershed. Water quality problems within Chollas Creek are typical of dense residential and commercial areas with frequent water quality exceedances of turbidity, TSS, bacterial indicators, total and dissolved copper, total lead, and total zinc. In addition, a noticeable shift in the use of pesticide compounds is evident in the Chollas Creek sub-watershed, resulting in a notable shift in the observed toxicity. Diazinon is no longer a high frequency constituent of concern and acute or chronic toxicity to *Ceriodaphnia dubia* has not been observed since the 2002-2003 monitoring season. However, persistent toxicity to *Hyalella azteca* is observed in Chollas Creek storm water samples. Toxicity identification analyses performed on Chollas Creek samples during the 2005-2006 monitoring season identified synthetic pyrethroids as the causative agent of toxicity. Aside from bacterial indicators and total dissolved solids, the Sweetwater River does not have persistent water quality problems. Toxicity to *S. capricornutum* has declined below a frequency of 50% indicating that toxicity in storm water samples from the Sweetwater River MLS is no longer persistent. Diazinon and Chlorpyrifos have not been detected in storm water samples at the Chollas Creek or Sweetwater River MLS over the past two monitoring seasons. Malathion, which is commonly used for mosquito control, has been detected in every sample over the past two monitoring season at the Chollas Creek MLS including two results over the WQO. In comparison, the Sweetwater River MLS has not had detections of Malathion over the past two monitoring seasons. The Otay Watershed is one of the three least populated watersheds in the San Diego Region but has not been sampled during this monitoring program since the majority of runoff is captured in the Otay Reservoir and is prevented from flowing downstream.

Results of the toxicity identification evaluation studies indicate that synthetic pyrethroids are the likely cause of toxicity towards *Hyalella azteca* in Chollas Creek storm water samples collected during the 2005-2006 monitoring season. A total of six synthetic pyrethroids and one synergistic compound were detected in Chollas Creek samples during the 2005-2006 monitoring season. It is interesting to note that this finding is consistent with recent changes in residential insecticide formulations where pyrethroids (e.g., bifenthrin) have replaced traditional organophosphate pesticides (e.g., diazinon and chlorpyrifos).

A review of the scatterplots and trends indicates statistically significant increasing trends for nitrite, total coliform, and acute and chronic survival (meaning samples are less toxic) for *Ceriodaphnia dubia.* The statistically significant increasing trend for nitrite in Chollas Creek is notable but values are well below the water quality objective at this time. The statistically significant increasing trend for total coliform is also observed, however, there is no water quality objective for total coliform. There was no statistically significant increasing or decreasing trend observed for fecal coliform which has a water quality objective based on the REC-2 Basin Plan standard. Every storm water sample collected in Chollas Creek since the 1994 monitoring season has been above the REC-2 standard. The increasing trend in the acute and survival endpoints (meaning samples are less toxic) for *C. dubia* are likely a result of the marked decrease in the concentrations of Diazinon. This is also expected since *C. dubia* is a filter feeder and is likely more

susceptible to water column concentrations of Diazinon. In comparison to *H. azteca* which feeds on the sediments (as a grazer), would be more susceptible to synthetic pyrethroids which are extremely hydrophobic compounds, and are more likely associated with particulate matter. The findings of the TIE study for Chollas Creek showed that filtration of the water samples removed nearly all of the toxicity present, which may assist in the management actions needed to reduce the observed toxicity. A significant decreasing trend is evident for total lead in Chollas Creek.

Results of the TIE study performed for Sweetwater River for *Selenastrum capricornutum* provide some evidence that the causative agent of toxicity may have been due to elevated TDS or other ions comprising TDS in the Sweetwater River sample collected in October 18, 2005. No additional toxicity was found in Sweetwater River samples in subsequent standard *S. capricornutum* tests during the 2005-2006 monitoring period, indicating that the causative agent was not persistent during this monitoring period. Additional studies would be necessary to confirm whether elevated TDS or other ions comprising TDS in Sweetwater River water were the causative agent of toxicity to *S. capricornutum*. However, based WMA assessment of the five years of available data, persistent toxicity to *S. capricornutum* is no longer evident. In light of this finding, TIEs are no longer recommended for the Sweetwater River MLS.

The wet weather constituent loads at the Chollas Creek MLS site were compared to the mean water quality objective (WQO) loads calculated by multiplying the mean flow by the constituent WQOs. This comparison shows that fecal coliform, TSS, total copper, total lead, total zinc, and dissolved copper had mean EMC loads greater than the mean WQO load. The mean EMC load results for fecal coliform, TSS, total copper, total lead, total zinc, and dissolved copper ranged from a small difference (dissolved copper) to ten times greater than the mean WQO load (total lead). The wet weather constituent loads at the Sweetwater River MLS site were also compared to the mean WQO loadings. This comparison shows fecal coliform and TDS mean EMC loads were greater than the mean WQO load for each constituent. The mean EMC load for fecal coliform was one order of magnitude greater than the mean WQO load, and the mean EMC load for TDS was approximately four times greater than the mean WQO load. These results correspond to EMC exceedances for fecal coliform and TDS.

The mean modeled loads calculated in GIS for the Chollas Creek Watershed indicate that loads based on measured concentrations are generally slightly higher than those based on land use based concentrations. The high loads for most constituents appears to confirm the findings of the water quality priority ratings that most constituent categories in the Chollas Creek Watershed rank at the highest priority level. The fecal coliform load based on 2005-2006 measurements in Chollas Creek is about ten times the load that was predicted from using land use concentrations in the National Stormwater Quality Database. The mean modeled loads calculated in GIS for the Sweetwater River Watershed indicate that the total dissolved solids load based on measured concentrations is more than ten times greater than land use based loads. However, the measurement based total suspended solids load is several times less than what might be expected considering the watershed's land use characteristics. This may be a function of the low gradient and low velocity conditions of the site. The high total dissolved solids load could be due to naturally occurring groundwater discharges as a result of increased irrigation, importation of water, dry weather flows, and agricultural water use may contribute to increases in dissolved minerals throughout the watershed.

Third party data collected under the SWAMP program from the Otay Watershed was also included. Samples were collected from one monitoring location during January, April, and May, 2003. A full suite of constituents were analyzed including organochlorine pesticides, triazine herbicides, PAHs, and PCBs in

addition to metals, inorganics, and physical measurements. Manganese was the only constituent found above the WQO during one of the three monitoring events.

ES.4.8.2 Stream Bioassessment

Three monitoring sites were sampled in the San Diego Bay WMA. One site was in Chollas Creek at Federal Blvd., and two sites were in Sweetwater River, at Highway 94 in Rancho San Diego and along Bonita Road in near Highway 805. Chollas Creek had Index of Biotic Integrity ratings of Very Poor. The upstream Sweetwater River site was rated Poor and Very Poor, and the downstream site was rated Very Poor in both surveys. The Sweetwater River monitoring sites were low-gradient, depositional reaches of the river, and the specific conductance increased between the upstream and downstream site.

ES.4.8.3 Ambient Bay and Lagoon Monitoring Program

Sediments in the Sweetwater River Estuary were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found (i.e., those with the highest TOC and smallest grains size). These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that seven of the nine metals assessed were detected in the Sweetwater River sediments. Arsenic, copper and zinc exceeded the ERL sediment quality values. No concentrations exceeded the respective ERM values. Fluoranthane and pyrene were detected at concentrations below the respective ERL and ERM sediment quality values; 4,4'-DDE was found at a concentration between the ERL and the ERM. Mean percent survival of test organisms exposed to Sweetwater River Estuary sediments was 70% and statistically lower than the Control value (97%) indicating a toxic response. Correlated with the SEM:AVS Ratio, it was determined that bioavailable metals found in the Sweetwater River Estuary sediment are possibly responsible for the observed toxicity. As in the 2003 and 2004 samplings of the Estuary, the infaunal community was dominated by a genus of barley snail, followed by polychaete worms. For the 2005 ABLM sampling, the Estuary scored fair for toxicology, fair/good for biology and fair for chemistry.

No sampling was performed at the mouth of Chollas Creek as part of the Ambient Bay and Lagoon Monitoring program.

ES.4.8.4 WMA Assessment

The Chollas sub-watershed within the Pueblo San Diego Watershed drains a very densely populated, urban area. Turbidity, all three indicator bacteria, total copper, total lead, and total zinc were identified as high frequency of occurrence COC. Medium frequency of occurrence COC were identified for TSS and dissolved copper. BOD, COD, MBAS, Diazinon, and dissolved zinc were identified as low frequency of occurrence COC.

Based on the triad decision matrix for Chollas Creek, there was evidence of persistent water quality objective exceedances, there was evidence of persistent toxicity, and evidence of benthic alteration. Results of the toxicity identification indicate that synthetic pyrethroids are the likely primary cause of toxicity towards *Hyalella azteca* in Chollas Creek storm water samples collected during the 2005-2006 monitoring season.

The Sweetwater watershed drainage area consists of 50% vacant or undeveloped land, 30% residential, and only 10% commercial. The contrast in land use compared to Chollas Creek may likely be the reason for better observed (based on data assessed) water quality in Sweetwater River. Only fecal coliform was identified as a high frequency of occurrence COC within Sweetwater River. TDS was identified as a medium frequency of occurrence COC, followed by turbidity, total coliform, and enterococcus, which were identified as low frequency of occurrence COC. Diazinon is no longer a COC in the Sweetwater River MLS.

Based on the triad decision matrix for Sweetwater River, there was no evidence of persistent water quality objective exceedances (fecal coliform not considered in triad assessment), there was no evidence of persistent toxicity, and evidence of benthic alteration.

The water quality priority ratings for the overall San Diego Bay WMA resulted in no high priority (A) ratings based on the BLTEA rating method. Only dissolved minerals, bacteria, and toxicity were designated with B priority ratings. The WMA assessment for Chollas Creek is relatively comparable to the water quality priority rating for the Pueblo sub-watershed but is not representative of the overall WMA. Specific water quality issues are likely related to the land use found in this highly urbanized setting. Turbidity, bacteria, and total copper, lead and zinc had a high frequency of occurrence in Chollas Creek, while only fecal coliform had a high frequency of occurrence in the Sweetwater River. There was evidence of benthic alteration in both sub-watersheds. In comparison, the water quality priority ratings identified a D rating for the heavy metals category, a C rating for the sediment category, and a B priority rating for the bacteria category, for the overall WMA, suggesting that the major water quality concerns are primarily focused in the lower and more urbanized areas of the sub-watershed.

ES.4.9 Tijuana River Watershed Management Area

The Tijuana River Watershed Management Area (WMA) is the largest of the San Diego watersheds covering over 1.1 million acres. Mexico governs the majority of the Tijuana River Watershed (73%) with the remaining areas belonging to the United States. Undeveloped areas account for 58% of U.S. lands, with another 25% devoted to parks. The River flows through Tijuana, Mexico and runoff contributions come from both Mexico and the United States.

ES.4.9.1 Storm Water Monitoring Summary

Constituents most prevalent in Tijuana River that pose the greatest concern are typical of conditions found with untreated wastewater. BOD, COD, TSS, turbidity, and nutrients (un-ionized ammonia-N and total phosphorus) consistently exceeded water quality objectives. Although total coliform and enterococci do not have corresponding water quality objectives, they consistently have highly elevated densities and are also indicative of conditions found with untreated wastewater. In addition, pesticides are also prevalent in elevated concentrations. Diazinon, in particular, has exceeded water quality objectives in 14 of the last 15 storms and has been identified as the likely cause of toxicity in the Tijuana River. A review of the scatterplots and trends shows statistically significant increasing trends for TSS, enterococci, total coliform, and the acute survival endpoint for *Ceriodaphnia dubia*. The increasing trend for *C. dubia* survival indicates a decrease in the toxicity to this species. Statistically significant decreasing trends are evident for total phosphorus and dissolved nickel.

The storm event constituent loads at the Tijuana River MLS site were compared to the mean water quality objective (WQO) load calculated by multiplying the mean flow by the WQO for each constituent. This comparison shows that mean EMC loads were greater than the mean WQO loads for fecal coliform,

TDS, TSS, total phosphorus, COD, Diazinon, total copper, total lead, and total zinc. EMC values for total phosphorus, total copper, total lead, and total zinc were above their respective WQOs only one time out of three wet weather events (the second event, 02/19/2006). This result was of great enough magnitude to cause the mean EMC loads to exceed the mean WQO loads. The fecal coliform mean EMC load exceeded the mean WQO load by three orders of magnitude, and the diazinon mean EMC load exceeded the mean WQO by a slight margin

The mean modeled loads calculated in GIS for the Tijuana River Watershed indicate that almost every constituent load based on measured constituent concentrations is higher than might be expected given the Tijuana River Watershed's land use distribution. The numerous constituents on the 303(d) list for the Tijuana Valley Sub-watershed appears to confirm this broad pollutant loading problem. The fecal coliform load is a thousand times greater than the load estimated from land use. The total suspended solids load is more than a hundred times greater than what might be predicted from land use concentrations in the National Stormwater Quality Database.

ES.4.9.2 Stream Bioassessment

Two stream bioassessment monitoring sites were sampled in the Tijuana River WMA. One site in Campo Creek was sampled in October and May and one site in the Tijuana River at Dairy Mart Road was sampled in May 2006 only. The Index of Biotic Integrity rating for the Campo Creek site was Poor for both surveys, and there were several organisms collected that were otherwise found only at reference sites, and specific conductance was relatively low. The Tijuana River site was rated Poor, but based on an assessment of individual metrics and observations made in the field, the investigators in this study feel that this rating is much higher than the actual benthic community quality.

ES.4.9.3 Ambient Bay and Lagoon Monitoring

Sediments in the Tijuana River Estuary were monitored as part of the 2005 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COCs were most likely to be found (i.e., those with the highest TOC and smallest grain size). These sites were sampled in Phase II of the assessment and sediments were composited and analyzed for sediment chemistry, toxicity, and benthic community structure.

The results of the chemistry assessment indicated that seven metals common to all embayments were also found in the Tijuana River Estuary sediments. Concentrations were low and none exceeded their respective ERL and ERM sediment quality values. In addition, there were no PAHs found in the Estuary above the detection limit. 4,4'-DDE was detected at the Estuary at a concentration below the ERL sediment quality value. The mean ERM-Q value for the Estuary was 0.09 and below the threshold of 0.10. The mean percent survival of test organisms exposed to the Tijuana River Estuary sediments was 94%; therefore test organisms displayed a non-toxic response to the Estuary sediment collected. Correlated with the SEM:AVS Ratio, it was determined that bioavailable metals found in the Tijuana River Estuary sediment were not toxic to the amphipod *E. estuarius*. The infaunal community was dominated by a gammarid amphipod and a common polychaete worm. For the 2005 ABLM sampling, the Tijuana River Estuary scored good for toxicology, fair for biology and good for chemistry.

ES.4.9.4 WMA Assessment

For the Tijuana River WMA, all three bacterial indicators, TSS, turbidity, and Diazinon were identified as high frequency of occurrence COC, followed by COD, un-ionized ammonia, and total phosphorus which

were identified as medium frequency of occurrence COC. BOD, MBAS, Malathion, and total copper were identified as low frequency of occurrence COC. The elevated densities of all three bacterial indicators and elevated levels of BOD, COD, un-ionized ammonia, and nutrients (total phosphorus) are indicative of raw wastewater discharges. Pesticides (primarily Diazinon) are also persistently found above WQOs in the watershed and are likely the major cause of toxicity observed towards the freshwater amphipods *Ceriodaphnia dubia* and *Hyalella azteca*.

Based on the triad decision matrix, there was evidence of persistent water quality objective exceedances, there was evidence of persistent toxicity, and indications of benthic alteration. The TIEs conducted in 2003-2004 confirmed initial results performed in 2002-2003 indicating Diazinon and methyl dihydrojasmonate were the primary contributors of toxicity in the Tijuana River.

The water quality priority ratings agreed with the WMA assessment findings for the Tijuana Valley sub-watershed but since this sub-watershed is only 7% of the entire Tijuana River WMA, it suggests that the high priorities and COCs may be more localized to the area near the MLS. The overall Tijuana River WMA did not have any high priority (A) ratings. The highest rated constituents were heavy metals, sediments, pesticides, bacteria, benthic alteration, and toxicity which were all assigned a B priority rating. All other categories received either a C or D priority rating.

ES.5 Regional Assessments

This section presents a regional assessment of the Receiving Waters Monitoring Program results. Whereas the previous sections presented the results on a watershed management area basis, this regional assessment provides for an analysis of inter-relationships across watersheds, and identifies characteristics of certain watersheds that indicate differences or similarities with the other watersheds in the County.

ES.5.1 Cross Watershed Comparison

Statistical analyses for cross watershed comparisons included the magnitude of the ratio of observed concentration to the WQOs, regression (trend) analysis, analysis of variance (ANOVA), and multivariate cluster analysis.

ES.5.1.1 Summary of Statistical Analyses

The single event and annual mean concentrations for key constituents and toxicity at the Tijuana River MLS were statistically different and had higher magnitude of exceedances of WQO compared to all the other MLS, particularly those associated with untreated wastewater and highly urbanized land use. The constituents that consistently exceeded the WQO include fecal coliform, TSS, turbidity, BOD, ammonia, total phosphorus, and Diazinon. This is a finding that has been consistent throughout the past five years of monitoring. This MLS has also had the most consistent toxicity results with toxic reactions for all tests except those for *Selenastrum*.

On a regional basis, TSS annual mean concentrations have exceeded the WQO in 7 of the 11 MLS over the last five years indicating that TSS, which is an indicator of sediment loading, is a regional water quality issue. Across watersheds (except Tijuana River), the highest exceedances were observed for the 2004-2005 period which corresponds to the year of greatest precipitation. Larger and greater intensity storm events will mobilize a greater amount of sediment that would then correlate to greater TSS

concentrations. Higher TSS may be associated with an increase in land disturbance activities in the watershed and increased impervious areas upstream of creek and river sections that may be subject to bank erosion from greater and more sustained peak flows. Temporal patterns in TSS concentrations indicate higher concentrations during greater intensity storm events.

Notable long-term trends at other MLS include:

- Bacteria - Results of regression analysis of wet-weather data for bacteriological indicators demonstrated increasing trends for enterococci in Tecolote Creek and the Tijuana River; for fecal coliform in the San Luis Rey River and Agua Hedionda Creek; and for total coliform in the San Luis Rey River, Escondido Creek, and Chollas Creek. Concentrations of fecal coliform were generally above the WQO. Concentrations at the MLS in the San Luis Rey River have increased from below to above the WQO.

- Sedimentation -Increasing TSS in Agua Hedionda Creek and Tijuana River where TSS was extremely high during 2005-2006 storm events. TSS concentrations at these MLS were well above the WQO.

- Nutrients - Increasing nitrate concentration in the San Luis Rey River, Agua Hedionda Creek, and Escondido Creek. Increasing total and dissolved phosphorus concentrations in the San Dieguito and Sweetwater Rivers, as well as dissolved phosphorus in San Luis Rey River. Total phosphorus was observed to have an increasing trend in the Tijuana River. However, concentrations of these three nutrients at all of the MLS with increasing trends were below the WQO.

- Pesticides - Diazinon concentrations indicate a significant decreasing trend for Escondido Creek, Peñasquitos Creek, Tecolote Creek, San Diego River, and Sweetwater River. Concentrations have decreased from above to below the WQO. Only Tijuana River continues to have concentrations above the WQO.

- Metals - Trend analysis of the wet-weather data indicate significant trends for total metals in more than one watershed for total arsenic and total lead. A decreasing trend in total lead concentrations was noted for Chollas Creek while increasing trends for total arsenic were observed at San Dieguito and Sweetwater Rivers. The highest concentrations of total arsenic at these sites are below WQOs.

Cluster analysis showed the differences between the Tijuana River and the other MLS primarily, followed by differences between years, which may be related to the differing amounts of rainfall in the past five years. Secondarily, the clusters for each year broke into two or three subgroups based on relative concentrations of total hardness, TDS, and conductivity. The MLS with consistently higher concentrations of these three constituents are San Luis Rey, San Dieguito, and Sweetwater Rivers. Agua Hedionda and Chollas Creeks are consistently lower in these constituents while the remainder of the MLS, Escondido Creek, Peñasquitos Creek, Tecolote Creek, and San Diego River are more variable.

Relationships between *Ceriodaphnia dubia* toxicity and COC based on the five years of data showed strong relationships for increasing toxicity with higher concentrations of Diazinon, ammonia, dissolved phosphorus, and TSS. Strong relationships based on the threshold analysis were also found for Diazinon.

ES.5.2 Storm Water Modeling

ES.5.2.1 Static Storm Water Modeling

Static storm water modeling, described here, predicts average flows and contaminant concentrations based on watershed characteristics.

Predicted pollutant loads and event mean concentrations (EMCs) expected from mass loading stations were calculated using GIS and a spreadsheet model. Both load estimates base the runoff volume on the storm rainfall interpolated across the watershed from the County's ALERT rain gage network and the watershed's imperviousness. The loads represent the average amount during the monitored events. The measured loads are calculated by using the mean measured concentrations found during the 2005-2006 storm season. The modeled loads are calculating by assuming the concentrations running off of the different land uses in the watershed correspond to the median land use event mean concentrations found in the National Stormwater Quality Database.

The utility of the model comparison to measured results at mass loading stations during storm events is to provide a comparison to anticipated results based upon land uses. If the measured results are significantly higher than the model results (EMC values), it suggests that there is a higher concentration of the constituent in the watershed during storm events than expected. This would also be confirmed by comparison to historical measures within that watershed. Alternatively, when EMC values are higher than measured results it provides an additional tool to document reductions in constituent loads that may be a result of BMPs within the watershed. This tool would also complement the long-term trend analysis that indicates constituent reductions through time that may possibly be a result of a BMPs success.

Measured total suspended solid loads for the Tijuana River, Santa Margarita River, Agua Hedionda Creek, and Tecolote Creek watersheds were much higher than the predicted loads based on the land use distributions.

All watersheds had higher TDS loads based on measured concentrations than loads based on predicted land use based concentrations. The highest estimated loads were in the Santa Margarita River, San Luis Rey River, San Diego River, and Tijuana River watersheds.

The annual total phosphorus load ranged from below 1000 kilograms in Tecolote Creek (TC) to about 100,000 kilograms in the Tijuana River watershed. The measured loads were relatively similar to the modeled loads with the exception of the Tijuana River, which was an order of magnitude higher than the predicted load, and the Santa Margarita River which was roughly an order of magnitude lower than the predicted load. The Tijuana River Watershed (TJR) had the highest total Kjeldahl nitrogen load based on measured concentrations. Total Kjeldahl nitrogen load estimates are generally similar between land use based loads and measured concentration based loads. The nitrate watershed loads based on measured concentrations are all lower than might be expected from the modeled loads based on land use distributions.

Annual measured total lead loads are generally lower than the predicted loads based on watershed land use. However, the Tijuana River Watershed was one exception with a load estimate based on measured concentrations of 7,800 kilograms being seven times greater than the predicted load. The Santa Margarita River and the Tijuana River Watersheds had the highest modeled and measured copper loads. The Sweetwater River Watershed had the lowest modeled and measured annual copper loads. The

Tijuana River Watershed had the highest modeled and measured annual zinc load followed next by the Santa Margarita River Watershed.

The Tijuana River Watershed measured fecal coliform load that is 1,000 times greater than the modeled or predicted load based on its land use. The Escondido Creek Watershed had the next highest fecal coliform load with bacterial concentrations based on measured values.

Improvements to the estimates from the model may provide a predictive tool to allow for estimating improvements to water quality from different BMPs. Future land use patterns can be also be explored to find their effects on the estimates of pollutant loads and concentrations.

These observations help provide quantitative support to the intuitive concept that pollutant reduction strategies should:

1. Focus on improving water quality emanating from particular watersheds by developing and implementing BMPs that are designed to specifically reduce pollutants associated with certain land uses.
2. Focus sediment and pollutant accumulation monitoring activities below areas that drain large watersheds where the largest potential pollutant loads are expected.
3. Encourage pollution prevention, storm water educational outreach, and source control measures.

It should be noted that uncertainty in the EMCs estimated for the study area results from inaccuracies in rainfall and land use data. The pollutant EMCs calculated for each land use and input into the model were computed from measured storm events assuming that the constituent concentrations are solely dependent on the land use characteristics of a given basin and that runoff from similar land uses throughout the study area has the same water quality.

ES.5.3 Rapid Stream Bioassessment Results

A total of 24 different stream monitoring reaches were assessed in San Diego County in the surveys of October 2005 and May 2006. Three of these sites were considered to represent reference conditions. A total of 50 different monitoring reaches have been sampled since May 2001.

Taxonomic identification of samples collected in October 2005 produced 105 taxa from a total of 19,912 individuals. The May 2006 samples produced 108 taxa from 20,906 individuals.

The most abundant organisms in October 2005 in the study region were non-biting midges (Diptera: Chironomidae), *Simulium* (Diptera: Simuliidae), *Baetis* (Ephemeroptera: Baetidae), *Fallceon quilleri* (Ephemeroptera: Baetidae), and *Hyalella* (Amphipoda: Hyalellidae). The most abundant organisms in May 2006 in the study region were non-biting midges (Diptera: Chironomidae), *Simulium* (Diptera: Simuliidae), *Baetis* (Ephemeroptera: Baetidae). The majority of organisms from the urban affected sites were moderately or highly tolerant to stream impairments. Organisms highly intolerant to impairments were encountered infrequently at the urban affected sites, but their presence even in low numbers is significant. Non-reference sites that supported highly intolerant organisms included Campo Creek in Campo and Santa Margarita River at Willow Glen Road.

The Index of Biotic Integrity ratings of the monitoring sites ranged from Good to Very Poor in October 2005 and from Very Good to Very Poor in May 2006. IBI scores for the reference sites were always

higher than the scores for the urban influenced sites, although several non-reference sites were very close in score to the reference sites in the October 2005 survey. The May 2006 survey produced consistently lower IBI scores across the entire region than in the October 2005 survey.

For the May 2006 survey, analysis of the ratio of observed organisms to expected organisms (based on a predictive model) indicates that most of the urban sites have lost approximately 50 to 67 percent of the native biodiversity. Under this model, Campo Creek had the greatest number of expected organisms and other lower watershed sites such as those in San Luis Rey River and Sweetwater River were ranked better than when analyzed with the IBI.

Of all of the watersheds in San Diego County, the Santa Margarita River watershed had the least impaired benthic macroinvertebrate communities. Campo Creek in the upper Tijuana River WMA was also relatively unimpaired, as evidenced by the presence of highly intolerant organisms. The remaining watersheds have substantially greater amounts of urbanization, and the IBI results generally indicate that greater water quality impairment occurs in the lower portions of the watersheds as the impacts of urban runoff become cumulative and/or the stream type becomes warmer and more depositional.

After 5½ years of bioassessment surveys, the most significant observation is that the macroinvertebrate community quality has not shown any significant trend towards degradation or improvement. IBI scores for most of the San Diego sites were similar in May 2006 to May 2001. Individual seasons or years have produced better conditions for the macroinvertebrates, and many of the monitoring sites have shown a consistent response to the variability of ecological conditions.

ES.5.4 Ambient Bay and Lagoon Monitoring

Overall, the lagoon sediment health across San Diego County is fair. Sediment metals mean ERM-Q values are low, as well as sediment toxicity. However, benthic infauna scores are generally only in the mid-range and do not score well. The method for benthic infauna health estimation may be biased by the freshwater influence in some lagoons, and may account for some of the lack of consistency between the three metrics of the Triad method.

The three years of data provide a baseline of information that can be used to characterize the health of estuaries and provide a benchmark for comparison of future sampling results. Based on these results, we now have a better understanding of the health of San Diego County estuaries and lagoons, as represented by sampling in portions of each bay/lagoon/estuary determined to have the highest potential for contamination.

The pattern between sediment conditions observed in the lagoon monitoring and upstream MLS storm water monitoring for the three year study period is weak. Several lagoons and upstream MLS data exhibit tentative patterns common to both datasets, but several of the watersheds exhibit no upstream/downstream pattern. Overall, Triad results from each watershed display patterns between chemistry, toxicity, and biological health that do not correspond to any general (county-wide) pattern. It is possible that factors affecting lagoon and receiving water health are independent between watersheds and future studies should be designed accordingly.

ES.5.5 Dry Weather Data Analysis Results

During 2005 dry weather monitoring program, out of 9,103 analytical tests conducted both upstream and downstream of the MLS, 687 samples had results measured above the dry weather action levels. The constituent with the highest rate of exceedance for 2005 for all land uses and conveyance types was total coliform. Agriculture was the exception to this pattern, with nitrates as the constituent with the highest rate of exceedance, and total coliform second.

Analysis of the several years of dry weather data (2002-2005), as related to land use, reveals that total coliform has been the constituent with the greatest rate of exceedance. Turbidity ranked second and enterococcus third. This pattern is relevant for the entire County of San Diego, and for the four years of dry weather data evaluation.

ES.5.6 Coastal Outfall Data

The data used in this assessment was collected from April 1, 2005 through September 30, 2006 by the Copermittees.

ES.5.6.1 Coastal Outfall Data Analysis Results for San Diego County

During this period, paired samples were collected from 32 stations located at coastal beaches throughout San Diego County and analyzed for bacterial indicators. A paired sample is defined as one sample collected from a designated storm drain with an additional sample collected concurrently in the adjacent receiving water. Approximately 26 stations sampled during this period were at the same location as those monitored last year. The total number of stations included in the assessment decreased from 35 to 32.

A total of 380 paired samples were collected during the 2005-06 monitoring period. The majority of the sample pairs (287) were collected during dry weather (April 1, 2005 through October 31, 2005 and April 1, 2006 through September 30, 2006). Out of 380 sample pairs, only 13 (3.4%) had a receiving water sample which exceeded AB 411 criteria and simultaneously exceeded the storm drain criterion for any of the bacterial indicators. The majority of sample pairs (274 or 72.1%) did not exceed either the receiving water or the storm drain criteria.

ES.5.6.2 Coastal Lagoon Outfall Data Analysis Results for San Diego County

During this period, 17 storm drain outfall stations were monitored in San Diego County lagoons for bacterial indicators. Efforts were made to collect paired samples from the storm drain and at the shore, however, limited access at some sites prevented the collection of receiving water samples. For this reason, there were 7 sites where paired samples were collected, whereas only storm drain samples were collected at the other 10 stations.

A total of 81 paired samples were collected during this period. The majority of the samples (59 or 72.8%) were collected during the dry period (April 1, 2005 through October 31, 2005 and April 1, 2006 through September 20, 2006). Of these, there were only four receiving water exceedances and three storm drain exceedances. Wet weather samples accounted for 27.2% of the total samples. There were two receiving water and no storm drain exceedances during wet weather. Out of 81 total paired samples, 2 (2.5%) had a receiving water sample which exceeded Basin Plan and/or AB 411 criteria and simultaneously exceeded the storm drain criterion for any of the bacterial indicators. For both of these

samples, storm drain flow was observed to reach the receiving water. A total of 74 samples (91.4%) did not exceed receiving water or storm drain criteria.

ES.5.7 Third Party Regional Data

The SWAMP data show persistent problems with sulfate and manganese in most of the watersheds, particularly at the base of the watershed. Dissolved minerals are typically associated with naturally occurring processes. However, land use activities may result in increased concentrations of these parameters. Of interest is the decrease in Diazinon detections above the WQO in the 2003 and 2004 data; this constituent was frequently found above the WQO in the 2002 data.

The 2005 Padre Dam data provides some additional information for the water quality assessment of the San Diego River WMA. This program provided measurement of TDS which was not measured in the SWAMP program. This constituent was the one most frequently found in concentrations above the WQO at all six sites sampled, followed by dissolved oxygen which was low during the summer months at all sites except Forrester Creek. Low dissolved oxygen was also observed at the San Diego River SWAMP station in May 2004.

ES.6 Program Review

During the 2001-01 permit issuance, the Copermittees were required to review historical data and develop future recommendations. This was developed in the "San Diego Region Previous Storm Water Monitoring and Future Recommendations Report" (MEC, 2001). This report put forth monitoring objectives for the 2001-01 permit term. The overall goal of monitoring expressed in the report was to "understand conditions of receiving waters within each watershed, identify water quality problems within each watershed, and take actions to correct those problems so that beneficial uses are not degraded or impaired." The design of the program included core monitoring, regional monitoring, and special studies.

The intent of the monitoring design was to identify watersheds with water quality problems using the information collected during wet weather events at the base of the watershed, benthic community information, and information collected in the lagoons and embayments. This "prioritization" of watersheds was intended to provide a mechanism to focus special studies and upstream investigations into identification of the contributing sources to the water quality problems, as well as to provide additional characterization of those watersheds.

The program design that was implemented in the 2001-2002 permit year was intended to provide:

- Information relating to chemical, physical, and biological impacts to receiving waters resulting from urban runoff,
- Indication of the overall health and long-term trends in water quality in the receiving waters.

To date these two over-arching goals have been met by the monitoring design, however, additional questions resulting from the collected data have yet to be answered. Such questions include "What are the dry weather (ambient) concentrations of the urban runoff constituents?" and "How do the constituents of concern vary throughout the watershed?"

Monitoring conducted under Order 2001-01 has provided a significant advancement in understanding water quality conditions throughout San Diego County's watersheds that was not the focus of the prior

Permit. The current data from the monitoring program provides a strong foundation to form the basis of existing knowledge about water quality that was not available for all watershed management areas prior to 2001-2002. Using this information, the Copermittees can refine their monitoring program to better address specific management questions and yield more baseline information against which improvements in water quality can be measured. Copermittees presented their recommended approach toward program evolution in the Report of Waste Discharge presented in 2005.

Based on the review of the information obtained from the existing monitoring program and historical monitoring data, recommendations are presented in the next subsections for the next iteration of the monitoring program to move the San Diego Region forward to continuing to understand urban runoff and its impacts.

ES.7 Recommendations

The recommended actions from the triad assessments are summarized in Section 14.3. Based on the triad assessment results, toxicity identification evaluations (TIEs) are recommended only for Chollas Creek. However, the TIE investigation performed during the 2005-2006 monitoring season in Chollas Creek, for toxicity to *Hyalella azteca*, concluded that synthetic pyrethroids were the causative agent of toxicity. Detections of several synthetic pyrethroid compounds were recorded in every storm event monitored in Chollas Creek during the 2005-2006 monitoring season. Only confirmatory TIEs are recommended to verify that toxicity to *Hyalella azteca* is not attributable to other compounds. As a result of the TIE findings, synthetic pyrethroids should be added to all stations where toxicity to *Hyalella azteca* is observed. This recommendation was presented to the Copermittees in September 2006 during the preparation for the monitoring program for the current 2006-2007 monitoring year. The Copermittees agreed to this recommendation and synthetic pyrethroids have been added to the constituent list for Agua Hedionda Lagoon, Tecolote Creek, and Chollas Creek.

All watersheds should continue water quality monitoring to gather long-term trend information. Under the new permit, additional upstream monitoring stations will provide increased spatial coverage and provide a linkage with the jurisdictional IC/ID program and complement the TMDL efforts.

It is recommended that the Ambient Bay and Lagoon Monitoring program utilize the ambient approach that will be taken during the Bight 08 monitoring to gather additional ambient information regarding embayments and lagoons in the region while leveraging the monitoring breadth and scope that will occur in the entire Bight to provide a larger scale perspective of conditions.