

ES.1 Introduction

This document presents the results of the 2004-2005 municipal urban runoff monitoring conducted by Weston Solutions, Inc. (formerly MEC Analytical Systems, Inc.-Weston and referred to as Weston) 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 2004 and Spring 2005.
- ◆ 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 2004-2005 wet-weather monitoring season at each mass loading station with the exception of the Santa Margarita River which was not sampled by Navy personnel due to equipment loss.

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 Constituents

Storm water samples were analyzed for conventional chemical constituents, 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 constituent(s) of concern (COC) were measured from 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 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 27 different stream monitoring reaches were assessed in San Diego County in the surveys of October 2004 and May 2005. 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 granted 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 2004. 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 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 COC that were above criteria and persistently occurred within the watershed. 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 using the interim guidance and a matrix of findings was 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 2004-2005 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 for Agua Hedionda Creek, Tecolote Creek, and Chollas Creek 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 2004-2005 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 WMA

The Santa Margarita River watershed is the second largest in the San Diego hydrologic region. The primary land use within the contributing runoff area is undeveloped (64%). The Santa Margarita River watershed management area has one mass loading station established in 2001 to characterize storm water runoff within the watershed. Sample collection is coordinated by the US Navy in Camp Pendleton for security reasons.

Storm Water Monitoring

The Navy did not collect samples during 2004-2005 at the Santa Margarita River location due to equipment loss in excessive flooding during the first storm event of the 2004-2005 monitoring season. The Navy indicated they would not sample the remainder of the 2004-2005 monitoring season.

Stream Bioassessment

Stream bioassessment monitoring in the Santa Margarita River WMA included two lower watershed urban affected sites in Santa Margarita River proper, as well as two reference sites in the upper tributaries.

All of the sites had mostly undisturbed conditions, and the Index of Biotic Integrity (IBI) quality ratings ranged from Poor to Good in the 2004-2005 surveys. As in previous surveys, the Santa Margarita River monitoring sites were among the highest rated of the urban affected sites in San Diego County, although the IBI scores in May 2005 were lower than usual. Biological metric values and water quality measures indicated that this watershed is one of the least impacted in San Diego County.

Ambient Bay and Lagoon Monitoring

Sediments in Santa Margarita River Estuary and Oceanside Harbor were monitored as part of the 2004 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.

The results of the chemistry assessment indicated that six metals, including arsenic, chromium, copper, lead, nickel, and zinc, were found in Santa Margarita River Estuary sediments. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. No metal exceeded its respective ERL in Santa Margarita River Estuary, the mean ERM-Q for Santa Margarita River Estuary was the lowest of any of the 12 embayments assessed in the ABLM Program and was well below the threshold of 0.10. Sediments with mean ERM-Q values below this threshold have a low probability of producing adverse biological

effects (Long et al. 1998). There were no PAHs, PCBs, or pesticides found above the detection limit in the Santa Margarita River Estuary. In Oceanside Harbor, seven metals, including arsenic, chromium, copper, lead, nickel, selenium and zinc, were detected in the sediments. Two metals (copper and zinc) exceeded the ERL in Oceanside Harbor. The mean ERM-Q for Oceanside Harbor was above 0.10. There were no PAHs, PCBs, or pesticides found above the detection limit in Oceanside Harbor. Sediment toxicity was not significantly different from that of the control sample at both locations. Benthic community indices suggested that biotic community in the Estuary sediments were similar to other embayments in the County and was dominated by a gammarid amphipod and polychaete worms. For the Santa Margarita River Estuary the relative ranks were one for chemistry, two for toxicity, and five for benthic community structure. The relative ranks for Oceanside Harbor were ten for chemistry, six for toxicity, and two for benthic community. The relative quality for both Santa Margarita River Estuary and Oceanside Harbor increased from the 2003 ABLM monitoring year.

WMA Assessment

The ability to apply the triad decision matrix was limited due to the lack of data from the Santa Margarita River MLS during the 2004-2005 monitoring season. 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 TDS and nitrate were identified as low frequency of occurrence COC. There was no evidence of persistent toxicity and no indications of benthic alteration found in the Santa Margarita River.

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

The WMA assessment findings agreed with the BLTEA rating priorities for the Santa Margarita River WMA, which found sediments to be a high priority (A rating) constituent. The BLTEA ratings indicated a B rating for nutrients, bacteria, gross pollutants and benthic alteration.

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 contributing runoff area is representative of the entire watershed which is approximately 29% open space and 25% agricultural.

Storm Water Monitoring Summary

Total dissolved solids continue to be the primary water quality concern in the watershed for wet weather events. Concentrations of other constituents, including BOD, pH, Diazinon, and fecal coliform have exceeded WQO occasionally. There is an increasing trend in indicator bacteria concentrations. The San Luis Rey River has not been identified as a TIE candidate site based upon the Triad Decision Matrix.

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. The high specific conductivity readings in October 2004, and the high silt deposits in May 2005 at Benet Road indicate that water quality may also have been a factor. The reference site in Doane Creek, while not ecologically

representative of the other sites in the program, provided interesting and valuable data for the region and was rated Very Good during both surveys.

Ambient Bay and Lagoon Monitoring Program

Sediments in San Luis Rey River Estuary were monitored as part of the 2004 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 metals, including arsenic, chromium, copper, lead, nickel, and zinc, were found in the Estuary sediments. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Concentrations of metals were low and only one (nickel) exceeded the ERL value. The mean ERM quotient was 0.122. This value exceeded the ERM-Q threshold of 0.10. There were no PAHs, PCBs, or pesticides found above the detection limit in San Luis Rey River Estuary. Sediment toxicity was not significantly different from that of the control sample. Benthic community indices suggested that the biotic community in the Estuary ranked low compared to other embayments in San Diego County. For San Luis Rey River Estuary, the relative ranks were five for chemistry, four for toxicity, and eight for benthic community structure. Based on the 2004 ABLM monitoring program, the relative quality of San Luis Rey River Estuary decreased compared to the 2003 rankings.

WMA Assessment

For the San Luis Rey River WMA, TDS was the only high frequency of occurrence COC followed by turbidity, nitrate, ammonia, and all three bacterial indicators 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. While elevated TDS levels may be affecting diversity, there may be other constituents not measured that are impacting the benthic invertebrate community.

Only total dissolved solids was identified as having a high frequency of occurrence. However, TDS is not considered in the triad decision making process since the water quality objectives for this parameter as defined in the Basin Plan are established for municipal drinking water and do not necessarily reflect impacts on the ecology of the watersheds. Therefore, based on the triad decision matrix, there was 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, the LTEA findings suggest that sediments and bacteria are also high priority (A rated) constituents followed by benthic alteration which was given a B rating. 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. 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%).

Storm Water Monitoring Summary

Both the Escondido Creek sub-watershed and the Agua Hedionda sub-watershed have similar water quality concerns. Bacteria, total dissolved solids, total suspended solids, and turbidity have consistently exceeded water quality objectives. Last year, the watersheds also had exceedances of BOD and COD. In Agua Hedionda Creek, increasing trends were observed for fecal coliform, TSS, turbidity, COD, TKN, total and dissolved phosphorus and total lead.

Since no toxicity at Agua Hedionda Creek was observed in *Ceriodaphnia* toxicity tests during the 2004-2005 storm season, TIE testing was not performed. The absence of toxicity in the Escondido Creek storm water samples excluded the need for TIE testing.

Stream Bioassessment

The Carlsbad WMA included 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 during both surveys, with the exception of Escondido Creek in Elfin Forest, which was rated Poor in the October 2004 survey. A substantial amount of sedimentation occurred due to the heavy winter rains between the October and May surveys in Escondido Creek. The Agua Hedionda Creek sites both had marginal in-stream habitat conditions, which may have limited macroinvertebrate colonization.

Ambient Bay and Lagoon Monitoring Program

There are four coastal embayments in the Carlsbad WMA that were monitored in the ABLM Program: Buena Vista Lagoon, Agua Hedionda Lagoon, Batiquitos Lagoon, and San Elijo Lagoon. Buena Vista Lagoon is unique in comparison to all other embayments assessed in the ABLM Program. Because this Lagoon is closed to the ocean, it receives no tidal exchange, has no salt water influence, and functions more as a freshwater lake or wetland than a coastal estuary. In Phase I, a stratified random approach was used at all four sites to identify the three sites where COC were most likely to be found (i.e., those with the highest TOC and smallest grains size).

Sites in the Buena Vista Lagoon 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 analyzed were found above the reporting limit, including arsenic, cadmium, chromium, copper, lead, nickel, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Concentrations of all the metals were below their respective ERLs except for copper and zinc. The mean ERM quotient was 0.204. This value exceeded the threshold of 0.10. The mean ERM-Q for Buena Vista Lagoon was the third highest among the embayments assessed in the ABLM Program. There were no PAHs, PCBs, or pesticides found above the detection limit in Buena Vista Lagoon. Sediment toxicity to *E. estuarius* was not significantly different from that of the control sample. Buena Vista Lagoon had the lowest abundance and number of species than any other embayment assessed. The low rankings are likely due to the influence of fresh water and lack of tidal flushing in the Lagoon rather than a greater than average contaminant loading. For Buena Vista Lagoon, the relative ranks were nine for chemistry, one for

toxicity, and nine for benthic community structure. The relative quality of Buena Vista Lagoon increased compared with the 2003 ranking.

Sediments in Agua Hedionda Lagoon 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 (arsenic, chromium, copper, lead, nickel, and zinc) were found in Agua Hedionda Lagoon at concentrations above the detection limit. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Concentrations were slightly higher than those found in other embayments, but only arsenic exceeded the respective ERL. The mean ERM-Q for Agua Hedionda Lagoon was 0.122 which just exceeds the threshold value of 0.10. The mean ERM-Q for Agua Hedionda Lagoon was the fifth highest among the embayments assessed in the ABLM Program. There were no PAHs, PCBs, or pesticides found above the detection limit in Agua Hedionda Lagoon. Percent survival of *E. estuarius* exposed to Agua Hedionda Lagoon sediments was 85%, which was not significantly different from that of the control. Benthic community indices suggested that the biotic community in the Lagoon sediments was intermediate compared to other embayments in San Diego County. The infaunal community was dominated by the sea slug *Acteocina inculta*, which accounted for 37.2 % of the taxa collected. For Agua Hedionda Lagoon, the relative ranks were five for chemistry, seven for toxicity, and six for benthic community structure. Agua Hedionda Lagoon experienced an increase in relative quality compared with last year's ranking.

Sediments in Batiquitos Lagoon 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 were found in Batiquitos Lagoon, including arsenic, chromium, copper, lead, nickel, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Concentrations of metals were low and only arsenic exceeded the ERL. The mean ERM-Q for Batiquitos Lagoon based on these constituents was 0.124, which exceeded the threshold of 0.10. There were no PAHs, PCBs, or pesticides found above the detection limit in Batiquitos Lagoon. The percent survival of test organisms exposed to sediments from Batiquitos Lagoon was 67% and was significantly different than that of the control, suggesting the presence of toxic elements in the Lagoon. However, analyses of benthic community indices suggested that the biotic community in Batiquitos Lagoon ranked high compared to the other embayments. Three taxa dominated the infaunal community in Batiquitos Lagoon: the barley snail, *Barleeia sp*, the herbivorous amphipod, *Ampithoe longimana*, and the sea slug, *Acteocina inculta*. For Batiquitos Lagoon, the relative ranks were 6 for chemistry, 10 for toxicity, and 2 for benthic community structure. The relative quality in Batiquitos Lagoon increased in 2004 compared with the 2003 ranking.

Sediments in San Elijo Lagoon 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 found in the Lagoon sediments, including arsenic, cadmium, chromium, copper, lead, nickel, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. None of the metals detected exceeded its respective ERL value. The mean ERM-Q for San Elijo Lagoon was 0.076, which did not exceed the threshold value of 0.10 and therefore does not suggest the potential for increased toxicity. There were no PAHs, PCBs, or pesticides found above the detection limit in San Elijo Lagoon. Percent survival of *E. estuarius* exposed to San Elijo Lagoon sediments was 88%, but was not statistically different from that of the control. Benthic community indices suggested that the biotic community in the Lagoon sediments

ranked low compared to other embayments in San Diego County. This was primarily due to the lack of organisms found at Site 3L-2, which is located in the inner-most part of the Lagoon and receives minimal tidal flushing. The infaunal community was dominated by polychaete worms and amphipods. For San Elijo Lagoon, the relative ranks were two for chemistry, five for toxicity, and seven for benthic community structure. The relative quality in San Elijo Lagoon increased compared with the 2003 ABLM ranking.

Third Party Data

Third party data was collected from 10 locations in 2002 within the Carlsbad watershed under the Surface Water Ambient Monitoring Program (SWAMP) and was provided by the San Diego Regional Water Quality Control Board. Sampling sites were located on Loma Alta Creek, Buena Vista Creek, Buena Creek, Agua Hedionda Creek, San Marcos Creek, Encinitas Creek, Cottonwood Creek, and Escondido Creek. Data collected from Agua Hedionda Creek and Escondido Creek were compared to the mass loading station and dry weather data results to provide qualitative assessments with current wet and dry weather results. The remaining stations within the watershed were too spatially disconnected from the MLS to correlate the data with any of the wet and dry weather monitoring results, however, exceedances were noted.

The station located on Agua Hedionda Creek upstream of the MLS had consistent water quality objective exceedances for sulfate, manganese and toxicity. Comparing the third party data with wet weather MLS data and dry weather data collected upstream of the MLS, the only common exceedances were for toxicity to *Ceriodaphnia* and *Hyaella*.

Two sampling locations were located on Escondido Creek: one station was located upstream of the MLS while the second location was located in the same vicinity as the MLS. There were water quality objective exceedances for pH, sulfate, manganese, Diazinon, and toxicity at both stations. Comparing the third party data with wet weather MLS data and dry weather data collected upstream of the MLS, the only common exceedances were for Diazinon and *Ceriodaphnia* survival and reproduction.

Exceedances observed at the other seven stations within the Carlsbad watershed were similar to exceedances in Agua Hedionda Creek and Escondido Creek. Sulfate, manganese, and toxicity consistently exceeded objectives at all sites. Other parameters, including pH, nitrate and nitrite as N, and Diazinon exceeded objectives sporadically.

WMA Assessment

For Agua Hedionda Creek, TSS, turbidity, fecal coliform, and enterococcus were identified as high frequency of occurrence COC, TDS and diazinon were identified as medium frequency of occurrence COC, and pH, COD, ammonia, and total coliform were identified as low frequency of occurrence COC.

For Escondido Creek, TDS, turbidity, total coliform, and fecal coliform were identified as high frequency of occurrence COC, enterococcus was identified as a medium frequency of occurrence COC, and TSS and nitrate were identified as low frequency of occurrence COC.

Based on the triad matrix for Agua Hedionda and Escondido Creeks, there was evidence of persistent water quality objective exceedances, no evidence of persistent toxicity, and indications of benthic alteration.

The WMA assessment findings agreed with the BLTEA rating priorities, which found sediments and bacteria to be high priority (A rating) constituents followed by nutrients and benthic alteration which were given a B rating.

ES.4.4 San Dieguito River Watershed Management Area

The San Dieguito River MLS run-off 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%).

Storm Water Monitoring Summary

Elevated levels of TDS during wet weather continues to be the primary water quality concern in the watershed. Concentrations of other constituents, particularly fecal coliform bacteria, exceeded WQO occasionally. There were three dry weather monitoring sites located upstream of the mass loading station, but the data suggested that there was no clear link between dry and wet weather constituents. This mass loading station has not been identified as a TIE candidate site based upon the Triad Decision Matrix.

Stream Bioassessment

The San Dieguito River WMA was sampled at two sites, Green Valley Creek at West Bernardo Drive, and San Dieguito River below Lake Hodges in October 2004 and May 2005. The macroinvertebrate community of Green Valley Creek had an Index of Biotic Integrity rating of Poor and Very Poor for the October and May surveys, respectively. San Dieguito River was rated Very Poor in October and Poor in May. At the San Dieguito River site, nine individuals of the sensitive caddisfly, *Oxyethira*, were collected.

Ambient Bay and Lagoon Monitoring

Sediments in San Dieguito Lagoon were monitored as part of the 2004 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 metals (arsenic, cadmium, chromium, copper, lead, nickel, and zinc), which were common to all the embayments assessed, were found in the Lagoon sediments. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Only cadmium exceeded the ERL value. The mean ERM-Q for San Dieguito Lagoon was 0.088 which is below the threshold of 0.10 and suggests a low probability of producing adverse biological effects (Long et al. 1998). There were no PAHs, PCBs, or pesticides found above the detection limit in San Dieguito Lagoon. However, percent survival of test organisms exposed to San Dieguito Lagoon sediments was 66%, which is significantly different from that of the control, indicating that the sediments were toxic to the test organisms. The polychaete, *Capitella capitata*, dominated the benthic community in the Lagoon, accounting for 42.5 % of all the animals collected. For San Dieguito Lagoon, the relative ranks were 3 for chemistry, 10 for toxicity, and 4 for benthic community structure. The relative quality decreased in 2004 compared with the 2003 ranking.

WMA Assessment

For the San Dieguito River, only TDS was identified as a high frequency of occurrence COC, fecal coliform was identified as a medium frequency of occurrence COC, and turbidity, total coliform, and enterococcus were identified as low frequency of occurrence COC. The in-stream benthic community appears to be limited by unknown factors, and while elevated TDS levels may be affecting diversity, there may be other constituents not measured that are impacting the benthic community.

Only total dissolved solids was identified as having a high frequency of occurrence. However, TDS is not considered in the triad decision making process since the water quality objectives for this parameter as defined in the Basin Plan are established for municipal drinking water and do not necessarily reflect impacts on the ecology of the watersheds. Therefore, based on the triad decision matrix, there was 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, the BLTEA ratings found sediments as a high priority (A) rating followed by gross pollutants, bacteria, benthic alteration, and toxicity which were given a B rating.

ES.4.5 Los Peñasquitos Creek Watershed Management Area

The Los Peñasquitos Creek run-off area accounts for approximately 60% of the Los Peñasquitos watershed management area. The major land uses within the contributing runoff area are parks (29%), residential (28%), and undeveloped (24%).

Storm Water Monitoring Summary

Elevated levels of TDS during wet weather continues to be the primary water quality concern in the watershed. Elevated levels of other constituents, particularly fecal coliform bacteria, occur occasionally. There is a significant decreasing trend in Diazinon concentrations. There has been no toxicity associated with storm water in any of the 12 storms assessed since 2001. The only COC that was common between wet and dry weather monitoring was turbidity. This mass loading station has not been identified as a TIE candidate site based upon the Triad Decision Matrix.

Stream Bioassessment

The Los Peñasquitos WMA was sampled 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 of 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.

Ambient Bay and Lagoon Monitoring

Sediments in Los Peñasquitos Lagoon were monitored as part of the 2004 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 found in the Lagoon sediments, including arsenic, chromium, copper, lead, nickel, selenium, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Only arsenic exceeded the ERL value. The mean ERM-Q for Los Peñasquitos Lagoon was 0.111, which was slightly above the threshold value of 0.10 and suggests a small potential for increased toxicity. There were no PAHs, PCBs, or pesticides found above the detection limit in Los Peñasquitos Lagoon during the 2004 program. Percent survival of test organisms exposed to Los Peñasquitos Lagoon sediments was 96% and was not statistically different than that of the control. Benthic community indices suggested that the biotic community in the Lagoon sediments was intermediate in comparison to other embayments in San Diego County. The infaunal community was dominated by the crustacean, *Grandidierella japonica* and Phoronids. For Los Peñasquitos Lagoon, the relative ranks were four for chemistry, three for toxicity, and six for benthic community structure. The relative quality of the Lagoon increased in 2004 compared with last year's ranking.

Third Party Data

Third party data was collected from three locations in 2002 within Los Peñasquitos watershed under the Surface Water Ambient Monitoring Program (SWAMP) and was provided by the San Diego Regional Water Quality Control Board. Sampling sites were located on Los Peñasquitos Creek, Soledad Canyon Creek, and Poway Creek. Data collected from Los Peñasquitos Creek were compared to the mass loading station and dry weather data results to provide qualitative assessments with current wet and dry weather results. The other two stations within the watershed were too spatially disconnected from the MLS to correlate the data with any of the wet and dry weather monitoring results, however, exceedances were noted.

The station located on Los Peñasquitos Creek in the same vicinity as the mass loading station had water quality objective exceedances for turbidity, pH, sulfate, Diazinon, methyl parathion, and toxicity. Comparing the third party data with wet weather MLS data and dry weather data collected upstream of the MLS, the only common exceedances were for turbidity during wet and dry weather and Diazinon during wet weather, however these exceedances were not persistent.

Exceedances observed at the other two stations within Los Peñasquitos watershed were similar to exceedances that were found in Los Peñasquitos Creek. Sulfate, manganese and toxicity consistently exceeded objectives at all sites.

WMA Assessment

For the Los Peñasquitos Creek WMA, only TDS was identified as a high frequency of occurrence COC, fecal coliform was identified as a medium frequency of occurrence COC, and turbidity, ammonia, orthophosphate, total coliform, and enterococcus were identified as low frequency of occurrence COC. Third party data collected in 2002 under SWAMP indicated that sulfate, manganese, and toxicity had exceedances of the water quality objective throughout Los Peñasquitos watershed. The in-stream benthic community appears to be limited by unknown factors, and while high TDS levels may be enough of a stress to insects, other constituents not monitored in the Los Peñasquitos Creek MLS watershed may also be affecting the benthic invertebrate community.

Only total dissolved solids was identified as having a high frequency of occurrence. However, TDS is not considered in the triad decision making process since the water quality objectives for this parameter as

defined in the Basin Plan are established for municipal drinking water and do not necessarily reflect impacts on the ecology of the watersheds. Therefore, based on the triad decision matrix, there was 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, the BLTEA ratings found sediments and bacteria to be the highest priority (A rated) constituents for the Los Peñasquitos WMA followed by benthic alteration which was given a B rating.

ES.4.6 Mission Bay Watershed Management Area

The Mission Bay watershed management area includes three hydrologic areas: Scripps, Miramar, and Tecolote. 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 watershed management area, the primary land uses within the contributing runoff area are residential (43%) and transportation (21%).

Storm Water Monitoring Summary

Four parameters appear to frequently exceed the water quality objectives in storm water runoff at the Tecolote Creek MLS: fecal coliform bacteria, TSS, turbidity, and Diazinon. Concentrations of MBAS, BOD, ammonia as N, Diazinon, and two metals (total cadmium and total lead) have shown statistically significant decreasing trends, while increasing trends have been observed for total phosphorus and enterococcus. The constituents that had exceedances during both dry and wet weather monitoring in 2004-2005 include total phosphorus and turbidity. There has been toxicity associated with storm water, but it appears to be related to specific storm events rather than a persistent pattern. This mass loading station has not been identified as a TIE candidate site based upon the Triad Decision Matrix.

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 both sites had Index of Biotic Integrity ratings of Poor in October and Very Poor in May, with substantial seasonal variation in the total IBI scores. Seasonal community dynamics showed similar patterns at both sites, with percent collector filterers plus collector gatherers (represented at both sites by *Simulium*, Chironomids, and Ostracods) and macroinvertebrate density much higher in May, and with percent predators, taxa richness, and overall IBI score higher in October.

Ambient Bay and Lagoon Monitoring

Sediments in Mission Bay were monitored as part of the 2003 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 found in Mission Bay sediments, including arsenic, chromium, copper, lead, nickel, selenium, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for

comparison purposes only and are not water or sediment quality objectives. Of the metals detected, arsenic, copper, lead, and zinc exceeded their respective ERL values, but all concentrations were well below their respective ERMs. There were no PAHs, PCBs, or pesticides found above the detection limit in Mission Bay during the 2004 program. The mean ERM-Q for Mission Bay was the highest of any embayment assessed in the ABLM Program (0.299). In contrast to the sediment chemistry results, the percent survival of test organisms exposed to Mission Bay sediments was not significantly different from that of the control, suggesting that the sediments were not significantly toxic to the test organisms. Benthic community indices suggested that the biotic community in Mission Bay had the lowest combined index score of all the embayments assessed in the ABLM Program. The infaunal community was dominated by the barley snail, *Barleeia* sp., and the polychaetes, *Exogone lourei*, and *Aphelocheata* sp. For Mission Bay, the relative ranks were 11 for chemistry, 8 for toxicity, and 1 for benthic community structure. Mission Bay experienced a decrease in relative quality compared with last year's ranking.

Third Party Data

Third party data was collected from two locations in 2002 within the Mission Bay watershed under the Surface Water Ambient Monitoring Program (SWAMP) and was provided by the San Diego Regional Water Quality Control Board. The sampling sites were located on Tecolote Creek near the mass loading station and on Rose Canyon Creek. Data collected from Tecolote Creek were compared to the mass loading station and dry weather data results to provide qualitative assessments with current wet and dry weather results. The Rose Canyon Creek station was too spatially disconnected from the MLS to correlate the data with any of the wet and dry weather monitoring results, however, exceedances were noted.

There were consistent water quality objective exceedances for sulfate, manganese, and toxicity at the Tecolote Creek station. Comparing the third party data with wet weather MLS data and dry weather data collected upstream of the MLS, the only common exceedance was for toxicity during wet weather. Exceedances observed at Rose Canyon Creek included sulfate, manganese, turbidity, pH, Diazinon, and toxicity.

WMA Assessment

For the Mission Bay WMA, turbidity, and all three bacterial indicators were identified as high frequency of occurrence COC, TSS and Diazinon were identified as medium frequency of occurrence COC, and ph, COD, and orthophosphate were identified as low frequency of occurrence COC. Third party data collected in 2002 under SWAMP indicated that sulfate, manganese, and toxicity had exceedances of water quality objectives at the Tecolote Creek monitoring station. There was no evidence of persistent toxicity associated with samples collected from the Tecolote Creek MLS. However, the in-stream benthic community was ranked as poor and very poor, suggesting evidence of benthic alteration. Physical habitat disturbance may play a role in the limited benthic community. Insecticides such as Diazinon, which had a medium frequency of occurrence in the watershed, may also be a limiting factor. Synergistic effects and unknown contaminants in the Mission Bay watershed may also be harming the benthic invertebrate community but more study is needed.

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

In addition to the WMA assessment findings, the BLTEA ratings found heavy metals and bacteria were the highest priority (A rated) constituents for the Mission Bay WMA followed by sediments, nutrients, and bacteria which were given B ratings. The heavy metals priority rating found in the BLTEA 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 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%).

Storm Water Monitoring Summary

Turbidity and bacterial indicators appear to be the most consistent, primary water quality concerns within the watershed. A significant downward trend in Diazinon concentrations has been observed. The exceedances that were common between the wet and dry weather monitoring program were fecal coliform and turbidity. This mass loading station has not been identified as a TIE candidate site based upon the Triad Decision Matrix.

Stream Bioassessment

The San Diego River WMA was sampled at two monitoring sites on San Diego River, one in Mission Trails Regional Park, and one near Morena Blvd. in Mission Valley. The Mission Trails site had an Index of Biotic Integrity rating of Poor in October and Very Poor in May, and the Mission Valley site had an IBI rating of Very Poor for both surveys. The Mission Valley site was one of the lowest rated sites in the San Diego County Storm water program for both the October and May surveys, but increased substantially from the previous years surveys.

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.

Third Party Data

Third party data was provided by Padre Dam Municipal Water District (Padre Dam). Monthly monitoring results collected from January 2004 through December 2004 at six locations upstream from the MLS were evaluated and compared to wet weather and dry weather sample results. Parameter groups that were included in the Padre Dam data include nutrients, conventionals, and microbiology. The sample results from Padre Dam represent a snapshot of the water quality conditions upstream of the MLS throughout the year. For parameters on the 303(d) list for the lower San Diego River, results from Padre Dam exceeded the Basin Plan WQO for TDS in 52 of 72 samples; turbidity exceeded the WQO in 8 of 72 samples; dissolved oxygen exceeded the WQO in 33 of 72 samples, fecal coliform exceeded the WQO in 17 of 72 samples, and E.coli exceeded the WQO in 20 out of 72 samples. Parameters that exceeded water quality objectives in Padre Dam data, dry weather data, and wet weather MLS data include TDS, turbidity, fecal coliform, and total coliform.

WMA Assessment

For the San Diego River WMA, turbidity and all three bacterial indicators 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. As noted in Section 10.2.3, the TDS water quality objective may not accurately reflect the natural conditions of the San Diego River WMA. Dissolved oxygen in samples collected by Padre Dam exceeded the Basin Plan water quality objective 46% of the time. Although ammonia and orthophosphate in dry weather data may indicate localized issues within the WMA, the evaluation and combination of Padre Dam data in the assessment process suggests that on a regional scale these constituents do not frequently exceed water quality objectives. The occurrence of these constituents may be a result of numerous activities or sources. The stream habitat quality was rated Poor in Mission Trails, a large open recreation space, and Very Poor in Mission Valley, a highly urbanized residential and commercial corridor. The Very Poor rating in Mission Valley may be a result of physical disturbances to habitat, insecticides or other COC that are not analyzed for in this program, or algal growth observed and measured as chlorophyll within the stream.

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

In addition to the WMA assessment findings, the BLTEA ratings found sediments, bacteria, and benthic alteration were the highest priority (A rated) constituents for the San Diego River WMA followed by pesticides which was given a B rating.

ES.4.8 San Diego Bay Watershed Management Area

The San Diego Bay watershed management area 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.

Storm Water Monitoring Summary

Water quality concerns within Chollas Creek are typical of heavily residential and commercial areas with frequent water quality exceedances of turbidity, TSS, bacterial indicators, total and dissolved copper, and total zinc. Turbidity, fecal coliform, ammonia, and copper (total during wet weather and dissolved during dry weather) were the only constituents that exceeded during wet weather monitoring and the 2004 dry weather monitoring efforts. Sweetwater watershed has nearly 50% open space and a lower percentage of residential (30%) and commercial (10%) than Chollas Creek. Aside from bacterial indicators, TDS, and turbidity, Sweetwater River does not have other persistent exceedances of water quality objectives. Fecal coliform was the only constituent identified as a high frequency COC during wet weather and only total and fecal coliform concentrations exceeded objectives during the 2004 dry weather monitoring efforts.

Chollas Creek and Sweetwater River were identified as potential TIE candidate sites based on toxicity to *Hyalella* and *Selenastrum*, respectively. Since the toxicity was not consistent among events and was relatively slight, a standard TIE would not likely determine the cause.

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. Chollas Creek had Index of Biotic Integrity ratings of Poor and Very Poor, and the Sweetwater River sites were rated Very Poor for both sites and for both surveys. The Sweetwater River sites had in-stream physical characteristics that provided little stable habitat for macroinvertebrate colonization, which may have negatively affected the IBI scores.

Ambient Bay and Lagoon Monitoring Program

Sediments in the Sweetwater River Estuary were monitored as part of the 2004 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 of the nine metals assessed were found in Sweetwater River sediments, including arsenic, chromium, copper, lead, nickel, and zinc. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. None of the metals detected exceeded their respective ERL or ERM values. The mean ERM-Q for Sweetwater River Estuary was 0.140, the fourth highest of any embayment assessed in the ABLM Program. There were no PAHs, PCBs, or pesticides found above the detection limit in Sweetwater River Estuary during the 2004 program. Percent survival of *E. estuarius* exposed to Sweetwater River Estuary sediments was 79% and was not different from that of the control. The benthic community structure had a low combined index score. The infaunal community was dominated by a genus of barley snail, polychaete worms, and mussels. For Sweetwater River Estuary, the relative ranks were eight for chemistry, nine for toxicity, and three for benthic community structure. The relative quality in Sweetwater River Estuary increased in 2004 compared with the 2003 ranking.

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

WMA Assessment

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. Turbidity, all three indicator bacteria, Diazinon, total and dissolved copper, and total zinc were identified as high frequency of occurrence COC. Medium frequency of occurrence COC were identified for COD and TSS, followed by BOD, MBAS, ammonia, orthophosphate, and total lead which 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. The benthic community impacts and stream habitat impairments may be a result of elevated COC or physical alterations to the riparian corridor.

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, enterococcus, and Diazinon, which were identified as low frequency of occurrence COC. The bioassessment monitoring identified Sweetwater River as having a Very Poor IBI score and was the lowest rated site in the county in the October Survey.

Based on the triad decision matrix for Sweetwater River, there was no evidence of persistent water quality objective exceedances, there was evidence of persistent toxicity, and evidence of benthic alteration.

The BLTEA ratings for the overall San Diego Bay WMA found that sediment was rated as the highest priority constituent (A) followed by pesticides, bacteria, and benthic alterations which were given B ratings. All other constituents were given either a C or D rating. The BLTEA findings are similar to the WMA assessments for both Chollas Creek and Sweetwater River. Turbidity, bacteria, and Diazinon had a high frequency of occurrence in Chollas Creek, while bacteria had a high frequency of occurrence in Sweetwater River. There was evidence of benthic alteration in both sub-watersheds.

ES.4.9 Tijuana River Watershed Management Area

The Tijuana River watershed management area 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.

Storm Water Monitoring Summary

Constituents most prevalent in Tijuana River that pose the greatest concern are typical of conditions found with untreated wastewater. All three bacterial indicators, BOD, COD, TSS, turbidity, and nutrients (un-ionized ammonia as N and total phosphorus) consistently exceeded water quality objectives. In addition, pesticides are also prevalent in elevated concentrations. Diazinon, in particular, has exceeded water quality objectives in 11 of the last 12 storms and has been identified as the likely cause of toxicity in the Tijuana River. Tijuana River was identified as a TIE candidate site based on the Triad Decision Matrix and TIE testing was conducted on the February 11 and 18, 2005 samples. These investigations were inconclusive due to the loss of toxicity in the unmanipulated sample at the time of testing. Heavy particulate load within the sample may have ameliorated the toxic effects of the sample by binding to the contaminants. Non-polar organic compounds were identified in the 2002-2003 and 2003-2004 TIE testing. Diazinon was the suspect contaminant in these testing periods as determined by methanol fractionation procedures.

Stream Bioassessment

Stream bioassessment monitoring in the Tijuana River WMA included two lower urban affected sites, one in Campo Creek and one on the Tijuana River at Dairy Mart Road, and one reference site on Wilson Creek. The Campo Creek site is upstream of any influence from the City of Tijuana and surrounding communities and is not representative of the lower reaches of the Tijuana River directly affected by runoff from these communities. The Index of Biotic Integrity rating for Campo Creek was Very Poor for

both surveys, but there were several organisms collected that were otherwise found only at reference sites. The Tijuana River site had an IBI rating of Poor in May (the site was not sampled in October due to dry conditions) and the IBI rating for the reference site was Fair.

Ambient Bay and Lagoon Monitoring

Sediments in the Tijuana River Estuary were monitored as part of the 2004 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 (arsenic, cadmium, chromium, copper, lead, nickel, and zinc) common to all embayments were also found in the Tijuana River Estuary sediments. Sediment chemistry data were compared to the ERL and the ERM data. These values (ERL and ERM) are for comparison purposes only and are not water or sediment quality objectives. Of the metals detected, concentrations were low and none exceeded their respective ERLs. In addition, there were no PAHs, PCBs, or pesticides found in the Estuary above the detection limit. The mean ERM-Q for the Tijuana River Estuary was 0.128 which exceeds the ERM-Q threshold of 0.10. Percent survival of *E. estuarius* exposed to Tijuana River Estuary sediments was 97% and was not significantly different from that of the control, suggesting that the sediments were not toxic to the test organisms. Benthic community indices suggested that the biotic community in Tijuana River Estuary was intermediate compared to the other embayments assessed. The infaunal community was co-dominated by three taxa: a polychaete worm, a genus of clam that was unique to the Tijuana River Estuary, and a gammarid amphipod. For the Tijuana River Estuary, the relative ranks were seven for chemistry, two for toxicity, and six for benthic community structure. The relative quality in the Tijuana River Estuary decreased in 2004 compared with the 2003 ranking.

WMA Assessment

For the Tijuana River WMA, TSS, turbidity, all three bacterial indicators, and Diazinon were identified as high frequency of occurrence COC, followed by BOD, COD, ammonia, and total phosphorus which were identified as medium frequency of occurrence COC, and MBAS, dissolved phosphorus, Chlorpyrifos, 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, and nutrients (un-ionized ammonia as N and total phosphorus) are indicative of wastewater discharges. Pesticides have also had persistent exceedances of water quality objectives in the watershed. Stream bioassessment monitoring rated the Tijuana River site as Poor, but the investigators in this study feel that this rating is much higher than the actual benthic community quality suggests. The two other bioassessment sites are upstream of any influence from the City of Tijuana and surrounding communities and are not representative of the lower reaches of the Tijuana River directly affected by runoff from these communities.

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 BLTEA rating priorities 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 Tijuana River WMA did not have any high priority (A) ratings for the overall WMA. The highest rated constituents were sediments, nutrients, gross pollutants, bacteria, and benthic alteration which were all given a B rating.

ES.5 Regional Assessments

ES.5.1 Cross Watershed Comparison

Comparisons between watersheds were performed using several different statistical tools, including scatterplot analysis, regression analysis, analysis of variance (ANOVA), multivariate cluster analysis, and multiple regression.

Summary of Statistical Analyses

The single event and annual mean concentrations for key constituents and toxicity at 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 four years of monitoring. This MLS has also had the most consistent toxicity results with toxic reactions for all tests except those for *Selenastrum*. Notable patterns seen at other MLS include lower concentrations of Diazinon than observed in earlier years; decreasing trends for total lead, total cadmium, ammonia, and BOD at Tecolote Creek; increasing turbidity and nitrite in Chollas Creek, and increasing TSS, COD, turbidity, TKN, phosphorus, lead and fecal coliform at Agua Hedionda Creek.

On a regional basis, TSS annual mean concentrations have exceeded the WQO in 7 of the 11 MLS over the last four years indicating that TSS, which is an indicator of sediment loading, is a regional water quality issue. Across watersheds, 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.

Cluster analysis showed the differences between 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 four years.

Relationships between toxicity and COC based on the four years of data showed strong relationships for increasing toxicity with higher amounts of Diazinon, TSS, and dissolved nickel. 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 a spreadsheet model. The static pollutant loadings model consists of a Microsoft Excel™ spreadsheet that calculates annual pollutant loads expressed in pounds per year. The loadings and EMCs were estimated based upon land use types within the mass loading station watersheds, associated EMC values representative of each land use, and volume of runoff from the watershed. The spreadsheet was used to estimate annual runoff pollution loads and EMCs for the following constituents: nutrients (dissolved phosphorus and total Kjeldahl nitrogen); selected heavy metals (lead, copper, zinc, and cadmium); oxygen demand (BOD₅ and COD); and total suspended solids (TSS).

Estimated chemical oxygen demand matched measured concentrations for most mass loading stations. However, measured COD values were much higher than estimated values at Chollas Creek, Agua Hedionda Creek, the San Diego River, and the Tijuana River during storm events, which may be indicative of potential sewage spill or overflow. Other monitoring stations had lower variability and concentrations closer to the modeled value.

Dissolved phosphorus had measured EMC values that were higher than the modeled values. Measured values of dissolved phosphorus during all three events at the Tijuana River and Agua Hedionda Creek were well above the estimated concentrations.

Estimated total suspended solid concentrations were very close to values measured during monitored storm events for many of the mass loading stations. The Tijuana River and Agua Hedionda Creek mass loading stations had a high degree of variability in TSS measurements between storms and all measured values were above estimated concentrations calculated from the model. Other stations had results that were often relatively low as estimated by the model.

The model predicts slightly higher concentrations of total copper from drainage areas that are highly urbanized. Most measured values were close to the predicted ones. However, the Chollas Creek mass loading station had a measured copper concentration during the October 17, 2004 storm that was several times higher than the estimated concentration.

The primary factor influencing water quality in the static model is land use while the primary factor in calculation of the mass load emanating from each hydrologic unit is contributing area. A secondary, but significant factor for mass loading is annual precipitation.

While the EMC model appears to estimate chemical oxygen demand, total Kjeldahl nitrogen, and dissolved phosphorus well, the potential for improvements in the model exists in estimates for metals. The model predicts higher EMCs for metals during wet weather compared to the actual measurements.

Observations based on the model 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.

ES.5.3 Dry Weather Data Analysis Results

The data used in this assessment was collected from May 1 through September 30, 2004. Among individual watersheds and jurisdictions, the number of sites monitored and the sampling frequency varied. Several reasons that account for this variability between watersheds are the number of jurisdictions implementing the program, the number of sites monitored by each individual jurisdiction, and the number of sub-watersheds. In each of the monitored watersheds, the number of exceedances also varied, resulting in a range of total exceedances per watershed from 2 for the Tijuana River area to as many as 133 for Carlsbad. During the 2004 monitoring period, 485 samples exceeded established dry weather action levels. This sample volume has increased significantly since the 2003 monitoring period, when 373 samples exceeded.

The parameter which most frequently exceeded was total coliform, which accounted for 114 (23.5%) of all exceedances. Turbidity and enterococcus were the next highest, with respective contributions of 15.9% and 12.6%. Other parameters which each individually contributed 10-5% of the exceedances were ammonia, nitrate, orthophosphate, and fecal coliform (in descending order). The remaining parameters contributed to less than 5% of the total exceedances combined (conductivity, pH, dissolved copper, MBAS, Diazinon, oil and grease, dissolved cadmium, and Chlorpyrifos). There were no exceedances of dissolved lead or zinc.

Comparison of current data to that collected in 2002 and 2003 reveals several clear trends in the frequency of various contaminant exceedances based on major land use categories. In comparing residential, commercial, industrial, and agricultural land uses, it is apparent that total coliform has frequently exceeded water quality objectives during the past three years of monitoring. Specifically for the residential and commercial categories, total coliform has been the first ranked COC during all three years.

Also notable are the frequent exceedances for fecal coliform, enterococcus, and turbidity. Though it did not appear as a priority COC for any of the land uses in 2004, fecal coliform ranked second in 2003 for residential and commercial, and third for residential (2002), industrial (2002 and 2003), and agriculture (2003). Enterococcus was also consistently high, with rankings of first for commercial in 2002, second for industrial (2003 and 2004) and residential (2002), and third for residential (2003 and 2004) and commercial (2004). Turbidity was the second most frequently exceeded parameter for all the land uses in 2004. In addition, it was ranked second in 2003 for industrial and agricultural land uses.

Comparison of the 2003 and 2004 dry weather data by land use reveals some minor change in the COC found in the major land use categories. The potential benefits of annually updating the list of COC by land use category are:

- the ability to assess the effectiveness of structural BMPs
- the ability to select non-structural BMPs (outreach)
- customizing inspections

- predicting water quality impacts
- determining overall changes in the prevalence of COC

The Municipal Separate Storm Sewer System (MS4) conveyance type at each dry weather sampling location was logged by each jurisdiction. Based on the 8 conveyance types, sites were categorized by construction material as either natural or manmade. Representing the data in this way allows for the identification of the most prevalent pollutants by type of MS4 conveyance system. The natural conveyance systems had notable exceedances for total coliform, turbidity, and nitrates, with proportions of 10%, 18%, and 20%, respectively. About half of the sampling sites for natural conveyances were associated with agricultural or rural residential land uses which may account for the higher frequencies for nitrate; the higher turbidity is likely due to the potential for erosion in earthen waterways. The manmade conveyance systems had exceedances at 10% or more stations of seven parameters. Ammonia, nitrate, and orthophosphate exceeded at 10-20% of the sites, while turbidity exceeded at approximately 27% of the sites. The fecal coliform WQO was exceeded at 13% of the sites, whereas total coliform exceeded the WQO at 42% of the sites and 23% of sites had exceedances of enterococcus. The two parameters that consistently exceeded throughout all conveyance types were total coliform and turbidity.

The potential benefits of annually updating the list of COC by MS4 conveyance type are:

- selecting BMPs for each type based on pollutants found
- selecting cleaning procedures or methods to target pollutants by MS4 type
- using land use and conveyance type COC data to minimize water quality impacts from new development
- prioritizing cleaning frequency of MS4 based on COC in the sub-watershed and/or 303(d) listings

ES.5.4 Rapid Stream Bioassessment Results

A total of 27 different stream monitoring reaches were assessed in San Diego County in the surveys of October 2004, and May 2005. Four of these sites were considered to represent reference conditions. A total of 49 different monitoring reaches have been sampled since May 2001.

Taxonomic identification of samples collected October 2004 produced 110 taxa from a total of 18,460 individuals. The May 2005 samples produced 91 taxa from 21,534 individuals.

The most abundant organisms in October 2004 in the study region were the black fly, *Simulium*; Chironomid midges; the amphipod, *Hyaella*; Ostracods (seed shrimp), and Oligochaetes (earthworms). The most abundant organisms in May 2005 in the study region were the black fly, *Simulium*; the mayfly, *Baetis*; Chironomid midges; Oligochaetes, and the mayfly, *Fallceon quilleri*. 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 San Dieguito River-Del Dios Highway and Santa Margarita River-Willow Glen Road.

The Index of Biotic Integrity ratings of the monitoring sites ranged from Very Good to Very Poor in October 2004 and May 2005. IBI scores for the reference sites were always higher than the scores for the urban influenced sites. The May 2005 survey produced consistently lower IBI scores across the entire region than in the October 2004 survey. Comparison of IBI scores with the in-stream physical habitat quality of the monitoring reaches indicated a poor correlation between habitat quality and benthic macroinvertebrate community quality.

Of all of the watersheds in San Diego County, the Santa Margarita River Watershed was the least impacted. The remaining watersheds have substantially greater amounts of urbanization, and the IBI results generally indicate that greater water quality impacts occur in the lower portions of the watersheds, as the impacts of urban runoff become cumulative.

After 4½ years of bioassessment surveys, long-term trend analysis is becoming possible. The most significant observation is that the macroinvertebrate community quality has not shown any trend towards degradation or improvement. IBI scores for most of the San Diego sites were similar between May 2001 to May 2005. Individual seasons or years have produced varying conditions for the macroinvertebrates, and many of the monitoring sites have shown a parallel response to the variability of the conditions.

ES.5.5 Ambient Bay and Lagoon Monitoring

In the summer of 2004 sediments in the twelve major coastal embayments in San Diego County were monitored to assess the potential for adverse effects from the watershed and to compare sediment quality among the embayments. In Phase I, a stratified random approach was used to identify the three sites in each embayment where COCs were most likely to be found (i.e., those with the highest TOC and smallest grains size). Buena Vista Lagoon had a much higher percentage of TOC and fine grained sediments than the other embayments. In contrast, sediments in the Santa Margarita River Estuary contained a much lower TOC content and percentage of fine-grained particles than the other embayments. This pattern was also seen in the 2003 ABLM sampling.

In Phase II of the assessment, the three sites identified in Phase I for each embayment were sampled and analyzed for chemistry, toxicity, and benthic community structure. For the chemistry assessment, composite sediment samples from each embayment were analyzed for metals, PCBs, PAHs, and pesticides. PCBs, PAHs, and pesticides were not detected in any of the embayments. A suite of six metals was found in all 12 embayments: arsenic, chromium, copper, lead, nickel, and zinc. In general, concentrations of metals were low in all embayments and there were no metals that exceeded their ERM thresholds. However, several metals exceeded ERL values, including copper (exceeded the ERL at three sites), arsenic (exceeded the ERL at four sites), zinc (exceeded the ERL at three sites), and lead (exceeded the ERL at one site). The mean ERM-Q value, which represents the cumulative impact from all COCs for which ERMs are available, was greatest at Mission Bay and Oceanside Harbor and lowest at the Santa Margarita River Estuary and San Elijo Lagoon.

For the toxicity assessment, the percent survival of a marine amphipod exposed to sediments from each of the embayments was compared to that of a control. Percent survival was not significantly different from that of the control for ten embayments: the Santa Margarita River Estuary, Oceanside Harbor, the San Luis Rey River Estuary, Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon, Los Peñasquitos, Mission Bay, Sweetwater River Estuary, and the Tijuana River Estuary. The two remaining embayments where percent survival was significantly different from that of the control were Batiquitos Lagoon and San Dieguito Lagoon.

For the benthic community assessment, animals collected from the sediment at three sites in each embayment were identified to the lowest possible taxonomic level. Several indices of benthic community structure were then calculated, including abundance, richness, diversity, evenness, and dominance. For each embayment the scores from these indices were ranked and the summed ranks were used to compare the benthic communities among the 12 embayments. Based on this overall ranking, the

embayments with the best relative benthic communities were Mission Bay, Sweetwater River Estuary, Batiquitos Lagoon, Oceanside Harbor, the Santa Margarita River Estuary, and San Dieguito Lagoon. Those with the worst relative benthic communities were Buena Vista Lagoon, Agua Hedionda Lagoon, Los Peñasquitos Lagoon, the Tijuana River Estuary, the San Luis Rey River Estuary, and San Elijo Lagoon.

The experimental design for the ABLM Program was based on a presumed positive correlation between COC, TOC content, and grain size, where higher COC concentrations are expected in areas with higher TOC and smaller grain size. The results of the ABLM Program indicate a strong, positive relationship between mean ERM-Qs, TOC content, and percentage of fine-grained sediments. These results help validate the approach utilized in the ABLM Program. However, the relationships between sediment chemistry, toxicity, and benthic community structure were weak. This is likely due to the dynamic nature of coastal estuaries and a limited number of samples and analyses. Results from samples collected in subsequent years of the ABLM Program may help to strengthen these relationships.

ES.5.6 Coastal Outfall Data

The data used in this assessment was collected from April 1, 2004 through March 31, 2005 by the Copermitttees.

Coastal Outfall Data Analysis Results for San Diego County

During the 2004-05 coastal outfall monitoring period, 35 stations were monitored from San Diego County beaches with paired samples (one from the shore and one from the storm drain) and were analyzed for bacterial indicators. The data evaluated for this monitoring period indicate that there are occasional bacterial exceedances in the receiving water and storm drain outfall sampling locations and in the coastal outfall program receiving water sampling stations.

Coastal Lagoon Outfall Data Analysis Results for San Diego County

During the 2004-05 coastal lagoon outfall monitoring period, 25 stations were monitored from San Diego County lagoon outfalls and/or receiving waters and were analyzed for bacterial indicators. In some cases, paired samples (one from the storm drain and one from the shore) were collected. During dry weather eight outfalls had exceedances of at least one bacterial indicator in both the storm drain and receiving water samples. There were no exceedances in any of the samples collected during wet weather.

ES.5.7 Third Party Regional Data

The Padre Dam Water Quality Monitoring Program for 2004 was comprised of six stations, including three located on the San Diego River, two on tributary creeks (Forrester Creek and Sycamore Creek), and one station on one of the Mission Ponds. Water samples are collected for 13 analytical measurements and 8 field measurements. Sediment samples were also collected at these sites. Exceedances were noted for dissolved oxygen, turbidity, *E. coli*, fecal coliform, and TDS. The most notable result was the 91.7% exceedance rate (11 exceedances out of 12 samples) for TDS in Forrester Creek. In addition, all six stations exceeded the WQO for fecal coliform in the month of December, and five stations also exceeded the WQO for *E. coli*.

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). 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?”

Since the 2001-2002 monitoring year (the first year of monitoring under Order 2001-01) significant information has been gathered about each watershed management area in San Diego County under the monitoring program and associated assessments. This information forms 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. As the Copermittees enter into a new permit cycle in 2006-2007, it presents an opportune time to reassess the existing monitoring program together with the management questions to define the future monitoring program approach for the next permit cycle.

ES.7 Recommendations

The recommended actions from the triad assessments are summarized in Section 14. All watersheds should continue water quality monitoring to gather long-term trend information and upstream sources of contaminants should be investigated. In addition, TIEs in Chollas Creek and Sweetwater River should be conducted. Additional recommendations for 2005-2006 are to conduct a qualitative assessment of streambank erosion around mass loading and stream bioassessment stations, as well as to monitor for organochlorine and organophosphate pesticides, PAHs, PCBs, and synthetic pyrethroids at the Ambient Bay and Lagoon sampling locations.

The recommended program for 2007-2010 will advance the understanding of conditions in San Diego County watersheds. It is a holistic program that uses both a weight-of-evidence plus a compliance approach. The program is designed to better address the five Stormwater Monitoring Coalition (SMC) key management questions and provide an integration with the jurisdictional dry weather IC/ID program. Through segmenting the watersheds and adding new stations it will provide additional watershed information relative to magnitude and extent, as well as provide increased spatial coverage to focus management efforts. Linkage with the jurisdictional dry weather IC/ID program and watershed segmentation will provide a better mechanism to identify potential sources. Further, the recommended program provides an integration of program elements, including wet and dry weather monitoring, upstream watershed assessments, bioassessment monitoring, triad assessment, and ABLM monitoring, while resulting in little loss of the ability to detect trends. The program will strive to encourage pollution prevention, storm water educational outreach, and source control measures. Moreover, the

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recommended program provides a more comprehensive view of the watersheds with the addition of dry weather monitoring to complete the loading picture and provide increased information value for future TMDLs.