# Conclusions and Recommendations

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# Conclusions and Recommendations

## 14.1 Conclusions

The current monitoring program has allowed the region to gain an understanding of wet weather conditions at the base of watersheds throughout the County. In addition, this Urban Runoff Monitoring Report provides insight into the biological and ambient conditions of the watersheds of San Diego County. Watershed water quality monitoring is performed by the Copermittees during wet weather rain events, dry weather field screening and IC/ID investigations are performed, and limited third party data is gathered. These water quality data results are incorporated with annual stream bioassessment and three years of Ambient Bay and Lagoon Monitoring data to provide a holistic approach to assessing each watershed and the region. Watershed assessments are performed following the Watershed Data Assessment Framework (Weston, 2004) and the Baseline Long-Term Effectiveness Assessment methodology (WESTON, MOE, & LWA, 2005). It has provided both long-term trend analyses at historic stations, and the foundation for long-term trends throughout the County.

### 14.1.1 Watershed Water Quality Monitoring Conclusions

#### 14.1.1.1 Wet Weather Monitoring Conclusions

Watersheds were compared by examining key constituents across watersheds and through time to determine similarities among the areas. Key constituents were defined as having either been rated as a potential concern based on the frequency and magnitude of concentrations above the applicable water quality objective (WQO) and/or being an indicator of water quality within a constituent group (e.g., total phosphorus is an indicator constituent in the nutrient group).

A comparison of the spatial distribution of the highlighted values for the 2005-2006 wet season indicates the following by constituent group:

- Bacteria – Bacterial concentrations were elevated throughout the region for all three of the bacterial indicators. Fecal coliform concentrations were above the WQO in 29 of the 30 samples collected during the season. The highest concentrations were observed at the Tijuana River MLS, which can be expected given the reported discharges of untreated sewage to the river.

- Total Dissolved Solids (TDS) – TDS concentrations were observed above the WQO at the MLS during all storm events sampled in the San Luis Rey, Carlsbad, and San Dieguito WMAs and at the Sweetwater River MLS. Concentrations fluctuated in the Peñasquitos, Mission Bay, San Diego River WMAs. In contrast, concentrations of TDS in all wet weather samples were below the WQO at the Chollas Creek and Tijuana River MLS. Higher TDS concentrations may indicate greater contributions from higher dissolved mineral salts from groundwater/base flow.

- Total Suspended Solids (TSS) - Comparing TSS concentrations regionally, concentrations were consistently above WQOs in samples collected from Agua Hedionda Creek, Chollas Creek, and the Tijuana River. TSS concentrations were below the WQO during all three storm events at San Luis Rey, San Diego, and Sweetwater Rivers and occasionally (one storm event) in most of the other watersheds. High concentrations of TSS indicate potential sedimentation issues. The intensity and duration of storm events can affect on TSS concentrations. Similar results were observed for turbidity concentrations.

- Nutrients – Total phosphorus, Nitrate, and Nitrite – Total phosphorus concentrations were above WQO during one of the three wet weather events at the Tijuana River, and close to the WQO during the other two events. Nitrate and nitrite concentrations were not observed above the WQO during 2005-2006 storm events.

- Pesticides – Diazinon was measured at concentrations above the WQO only at the Tijuana River MLS. Malathion was found in concentration above the WQO during one storm event in Agua Hedionda Creek, Chollas Creek, and the Tijuana River. The emergence of synthetic pyrethroids at the Chollas Creek MLS indicates the shift in pesticide usage as a result of the recent ban on Diazinon.

- Total Metals – Copper and Zinc – Copper concentrations were above the WQO during all three storm events in Chollas Creek and one event in Santa Margarita River, Tecolote Creek, and Tijuana River. Similar observations were reported for zinc concentrations, except at Santa Margarita River. For the 2005-2006 wet season, water quality issues regarding total metals were limited to these MLS.

- Dissolved Metals – Copper and zinc concentrations were above the WQO during one storm event in Chollas Creek. Nickel and selenium were just above the WQO during the one monitored storm event in Santa Margarita River. For the 2005-2006 wet season, these were the only dissolved metals exceeding WQOs during wet weather monitoring.

- Toxicity – Toxicity was observed as in previous years at the Tijuana River MLS. Toxicity was also observed for *Hyalella azteca* in Chollas Creek and Agua Hedionda and for *Selenastrum* in the San Dieguito River WMA.

The results for the 2005-2006 monitoring period were combined with the previous years' results, and were statistically compared to further identify spatial and temporal differences, commonalities, and trends between watersheds. Shown in Table 14-1 are the persistent wet weather constituents of concern and the observed statistical trends.

**Table 14-1. Mass Loading Station Persistent Wet Weather Constituents and Trends.**

| Mass Loading Station | Persistent Wet Weather Constituents of Concern | Significant Trends Observed |
|---|---|---|
| Santa Margarita | Fecal Coliform<br>Turbidity | No observed trends |
| San Luis Rey | Total Dissolved Solids<br>Fecal Coliform | Increasing nitrate, dissolved phosphorus, total and fecal coliform |
| Agua Hedionda Creek | Total Suspended Solids<br>Turbidity<br>Total Coliform<br>Fecal Coliform<br>Enterococci | Increasing total suspended solids, turbidity, fecal coliform, chemical oxygen demand, nitrate, and total lead |
| Escondido Creek | Total Dissolved Solids<br>Turbidity<br>Total Coliform<br>Fecal Coliform<br>Enterococci | Increasing total coliform and nitrate<br><br>Decreasing Diazinon and toxicity to chronic *Ceriodaphnia* endpoint |
| San Dieguito River | Total Dissolved Solids | Increasing total phosphorus, dissolved phosphorus, and total arsenic |
| Peñasquitos Creek | Total Dissolved Solids | Decreasing Diazinon and pH |
| Tecolote Creek | Turbidity<br>Total Coliform<br>Fecal Coliform<br>Enterococci | Increasing enterococci<br><br>Decreasing MBAS, ammonia, Diazinon, and total lead |
| San Diego River | Turbidity<br>Total Coliform<br>Fecal Coliform | Decreasing Diazinon |
| Chollas Creek | Turbidity<br>Total Coliform<br>Fecal Coliform<br>Enterococci<br>Diazinon<br>Total Copper<br>Total Lead<br>Total Zinc | Increasing nitrite and total coliform and survival for acute and chronic toxicity endpoints for *Ceriodaphnia dubia*<br><br>Decreasing total lead |
| Sweetwater River | Fecal Coliform | Increasing pH, total phosphorus, dissolved phosphorus, and total arsenic<br><br>Decreasing Diazinon |
| Tijuana River | Total Coliform<br>Fecal Coliform<br>Enterococci<br>Total Suspended Solids<br>Turbidity<br>Diazinon | Increasing total suspended solids, enterococci, total coliform, and the acute survival toxicity endpoint for *Ceriodaphnia dubia*.<br><br>Decreasing total phosphorus and dissolved nickel |

Additional notable trends based on regression analysis and listed in Table 14-1 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. While trends for total arsenic show increasing concentrations, it should be noted the highest concentrations of total arsenic at these sites are still below WQO.

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 of the study years. Larger and greater intensity storm events will mobilize a greater amount of sediment which 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 identified 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 have consistently lower concentrations of 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 constituents 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.

#### 14.1.1.2 Dry Weather Monitoring Conclusions

During 2005, out of 9,103 analytical tests conducted, 687 samples had test results above the dry weather action levels. The constituent of greatest concern for all land uses and conveyance types, and the constituent with the highest rate of exceedance for 2005, was total coliform. Agricultural land use 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.

#### 14.1.1.3 Third Party Data Conclusions

Data collected under the Surface Water Ambient Monitoring Program (SWAMP) from 2002-2004 show persistent problems with sulfate and manganese in most of the watersheds, and 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 was that Diazinon concentrations were not observed above the WQO in the 2003 and 2004 data; but 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 measurements of TDS, which was not measured in the SWAMP program or dry weather 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.

### 14.1.2 Stream Bioassessment Conclusions

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), and *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 watershed sites located in the lower watersheds 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 between May 2006 and 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.

### 14.1.3 Ambient Bay and Lagoon Program Conclusions

Overall, the lagoon sediment health across San Diego County is fair based on the metrics assessed. 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.

### 14.1.4 Watershed Assessment Conclusions

#### 14.1.4.1 Santa Margarita River Watershed Management Area

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%). 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 the 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.

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 by 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).

The stream habitat quality had mostly undisturbed conditions, and the Index of Biotic Integrity quality ratings ranged from poor to good which indicated that there was no evidence of benthic alteration. Biological metric values and water quality measures indicated that this watershed is one of the least impacted in San Diego County.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, the Santa Margarita River Estuary scored good for toxicology, poor for biology and good for chemistry. Oceanside Harbor scored fair for toxicology, biology and chemistry.

In addition to the WMA assessment findings, the water quality priority ratings identified 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.

#### 14.1.4.2 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. 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. A review of the scatterplots and trends shows statistically significant increasing trends for nitrate, dissolved phosphorus, and total and fecal coliform. Fecal coliform is the only constituent with an increasing trend to also be observed above WQO.

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.

The San Luis Rey River bioassessment sites had Index of Biotic Ratings of Very Poor for both sites and both surveys. While high TDS levels may be affecting diversity, there may be other constituents that are currently not measured that are impacting the benthic invertebrate community. The in-stream physical habitat of these sites was marginal, which could limit macroinvertebrate colonization, but it may be noted that these sites are quite similar to the Santa Margarita site on Camp Pendleton, which had 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.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, the San Luis Rey River Estuary scored good for toxicology, fair for biology and good for chemistry.

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.

#### 14.1.4.3 Carlsbad Watershed Management Area

The Carlsbad Watershed is the third most densely populated watershed in the San Diego region. Land use within the Carlsbad WMA is approximately 36% residential, 32% vacant/undeveloped, and 10% agricultural. 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 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 the increasing trend for nitrate is well below WQO. Total lead and dissolved arsenic were shown to have significantly increasing trends, which may indicate a future problem.

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%). 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 the increasing trend for nitrate is well below WQO. Diazinon and toxicity to the *Ceriodaphnia* chronic endpoint both show significant decreasing trends.

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.

Bioassessment monitoring in the Carlsbad WMA was conducted 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 three sites, with the exception being 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.

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. Based on the Ambient Bay and Lagoon Monitoring Program for 2005, Buena Vista Lagoon scored good for toxicology, poor for biology, and poor for chemistry. Agua Hedionda Lagoon scored fair for toxicology, fair/good for biology, and fair for chemistry. Batiquitos Lagoon scored fair for toxicology, biology and chemistry. San Elijo Lagoon scored fair for toxicology, fair/poor for biology, and good for chemistry.

The WMA assessment findings agreed with the water quality priority rating priorities, 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.

#### *14.1.4.4 San Dieguito River Watershed Management Area*

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%). Total dissolved solids (TDS) and elevated levels of bacterial indicators, specifically fecal coliform, appear to be the primary water quality concerns within the watershed. TDS was the only high frequency of occurrence 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.

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 in 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 is roughly one order of magnitude higher than the predicted TDS load 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.

Bioassessment monitoring at San Dieguito River WMA was conducted 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.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, the San Dieguito Lagoon scored good for toxicology, poor for biology and fair for chemistry.

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.

### 14.1.4.5 Los Peñasquitos Creek Watershed Management Area

The Los Peñasquitos Creek runoff 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%).

For the Los Peñasquitos Creek WMA, 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 enterococcus were all identified as low frequency of occurrence COC. A review of the scatterplots and trends shows a statistically significant decreasing trend for both pH and Diazinon.

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) included 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.

Stream bioassessment monitoring was conducted 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 upper range of Very Poor or lower 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. 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.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, Los Peñasquitos Lagoon scored good for toxicology, poor/fair for biology and good for chemistry.

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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.

#### 14.1.4.6 Mission Bay Watershed Management Area

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%). 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. A review of the scatterplots and trends indicate significant downward trends for surfactants, ammonia, Diazinon, and total lead concentrations. A significant increasing trend for enterococci was also observed.

Third party data under the SWAMP program in 2002 was collected 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 water quality objective (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.

Two stream bioassessment monitoring sites were sampled in the Mission Bay WMA. 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.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, Mission Bay scored good for toxicology, biology and chemistry.

In addition to the WMA assessment findings, the water quality priority ratings found 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 a high frequency constituent of concern.

#### 14.1.4.7 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%). 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. A review of the scatterplots and trends shows only a statistically significant decreasing trend for Diazinon. As noted in Section 10.2.6, the TDS water quality objective may not accurately reflect the natural conditions of the San Diego River WMA and is likely due to the increase in imported water and the influence of groundwater. Dissolved oxygen in samples collected by Padre Dam exceeded the Basin Plan water quality objective 33% of the time.

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.

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 ratings. 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.

Bioassessment monitoring in the San Diego River WMA occurred 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.

ABLM monitoring is not performed in the San Diego River WMA.

In addition to the WMA assessment findings, the water quality priority ratings found 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 which means the constituents were low priorities or lacked sufficient data to support a higher priority rating.

#### *14.1.4.8 San Diego Bay Watershed Management Area*

The Chollas sub-watershed within the Pueblo San Diego Watershed drains a very densely populated, urban area. Land use within the contributing runoff area is highly urbanized which includes 48% residential and 28% transportation. 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.

Since the EPA has banned the retail sale of Diazinon and Chlorpyrifos, and with the increased public outreach and education regarding the handling of pesticides in general, a decreasing trend for these compounds should continue. Diazinon was previously identified as a high frequency COC, but is now only a low frequency COC. Diazinon has not been detected at the Chollas Creek MLS over the past two monitoring seasons. Continued monitoring of the organophosphate compounds should show an overall decrease in the number of WQO exceedances and concentrations over time with the expectation that residual public supply and use will eventually be exhausted. However, the pesticide manufacturer's shift to synthetic pyrethroids does warrant concern and monitoring is recommended for these constituents.

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. A total of six synthetic pyrethroids and one synergistic compound were detected in Chollas Creek 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 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. The increasing trend in the acute and survival endpoints 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), which would be highly 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.

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. A review of the scatterplots and trends for the Sweetwater River MLS data shows statistically significant increasing trends for pH, total phosphorus, dissolved phosphorus, and total arsenic. Statistically significant decreasing trends are evident for diazinon.

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 water quality objective (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.

Stream bioassessment monitoring occurred at three monitoring sites 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.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, test organisms exposed to the sediments in the Sweetwater River Estuary displayed a toxic response. Evaluation of the metals data found bioavailable metals in the Sweetwater River Estuary sediment are likely responsible for the observed toxicity. The Sweetwater Estuary scored fair for toxicology, fair/good for biology and fair for chemistry.

For the San Diego Bay WMA, there were no high priority (A) ratings based on the water quality priority ratings. The categories 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 found 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.

#### *14.1.4.9 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. 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*. A review of the scatterplots and trends shows statistically significant increasing trends for TSS, enterococcus, 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.

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 indicated by the actual benthic community quality.

Based on the Ambient Bay and Lagoon Monitoring Program for 2005, test organisms did not display a toxic response to the Estuary sediment collected. The Tijuana River Estuary scored good for toxicology, fair for biology and good for chemistry.

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.

## 14.2 Program Review

During the 2001-01 permit issue process, 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 presented 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?"

In 2004, the Storm Water Monitoring Coalition (SMC) developed a Model Storm Water Monitoring Guidance Document. San Diego Region Copermittees had representatives who participated in the development of the guidance document. The SMC developed the guidance by framing five management questions which urban runoff monitoring should consider. The SMC acknowledged that these questions may not all be of equal import to jurisdictions, but rather can assist jurisdictions and jurisdictional groups in refining their monitoring programs. The five questions are:

1. What are the water quality conditions in the watershed?
2. Are water quality conditions in the watershed getting better or worse?
3. Are beneficial uses being impacted?
4. What is the relative contribution of urban runoff to the conditions in the watershed?
5. What are the sources to urban runoff that contribute to water quality conditions?

Up to this monitoring year, 2005-2006, the Copermittee monitoring program has set the stage for answering these questions with gathering basic status and trend information. The program was initially designed to be adaptive through time and focus efforts toward identifying water quality problems in watersheds. Once watersheds with problems were identified, the adaptive part of the program is intended to move monitoring and assessment upstream in those priority watersheds to fully answer the management questions (MEC, 2001).

Under Order 2001-01, Copermittee monitoring program's ability to fully answer the five management questions is limited by the present prescriptive requirements of the NPDES permit. Currently the watershed data assessment uses the wet weather monitoring data at the mass loading stations, the benthic community assessments within the watersheds, dry weather information, limited third party data, and the Clean Water Act 303(d) listing to provide a management tool to stakeholders.

The following describes the degree to which the monitoring program presented in this report addresses each question:

**Question 1: What are the water quality conditions in the watershed?** This question is partially addressed through the current NPDES program, but a comprehensive watershed assessment is not provided by the current program. The current monitoring program evaluates wet weather discharges at the base of the watershed for toxicity effect to freshwater organisms and chemical, bacterial, and general physical parameters. Monitoring conducted through 2005-2006 provides bacterial monitoring at coastal outfalls, benthic community assessment at several locations within the watershed, and chemistry at limited locations within the watershed's MS4 system. While these data are evaluated to provide an indication of potential water quality problems within the watershed, these disparate monitoring groups were not strategically designed to answer question 1 but are designed to meet permit requirements.

**Question 2: Are water quality conditions in the watershed getting better or worse?** This question is partially addressed in the following ways:

- Long-term trend assessment at the mass loading stations can provide an indication of improvements in the watershed.
- Long-term trend assessment of the quality of the benthic community within the watershed.

**Question 3: Are beneficial uses being impacted?** This question is only addressed through comparison to water quality objectives. For example, bacterial counts exceeding water quality objectives indicate an impact to recreational beneficial use.

**Question 4: What is the relative contribution of urban runoff to the conditions in the watershed?** To answer the question of "relative" contribution requires knowledge of baseline conditions or a reference (non-urbanized) area for comparison. This question is not directly addressed in the current program; however, the current program does provide comparison between watersheds. This comparison of watersheds together with an assessment of different land use characteristics and an evaluation of concentrations of constituents of concern, occurrence and magnitude of toxic effects, and benthic community health yields an understanding of the impacts related to urbanization and various land uses.

**Question 5: What are the sources to urban runoff that contribute to water quality conditions?** There are a variety of approaches to answer this question. The current program provides a mechanism to understand potential sources in urbanized watersheds. For example, Diazinon in urban watersheds comes from residential, commercial, or agricultural pest control. Where further source characterization and identification is required, a more focused study would be needed to answer the question.

As outlined above, the monitoring conducted under Order 2001-01 partially addresses these questions, however the program was initially designed to be adaptive through time and focus efforts toward identifying water quality problems in watersheds. Once watersheds with problems were identified, the adaptive part of the program is intended to move monitoring and assessment upstream in those priority watersheds to provide additional information for management actions (MEC, 2001). This adaptive philosophy is the same philosophy presented in the Model Monitoring Document. The SMC did not intend that permit monitoring would comprehensively address all five questions, nor was the intent that the stepwise approach as presented in the Model Monitoring Document would be followed in a linear, stepwise fashion, but rather that monitoring would be conducted based upon a prioritization of needs (SMC, 2004).

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.

## 14.3 Recommendations

### 14.3.1 2006-2007 Recommendations

The recommended actions from the triad assessments are summarized in Table 14-2 and include continuing water quality monitoring in all watersheds to gather long-term trend information, investigating upstream sources of contaminants, and conducting confirmatory TIEs in Chollas Creek.

Since the EPA has banned the retail sale of Diazinon and Chlorpyrifos, and with the increased public outreach and education regarding the handling of pesticides in general, a decreasing trend for the organophosphate pesticide compounds is evident and should continue. Continued monitoring of the organophosphate compounds should show an overall decrease in the number of WQO exceedances and concentrations over time with the expectation that residual public supply and use will eventually be exhausted. However, the pesticide manufacturer's shift to synthetic pyrethroids does warrant concern and monitoring should be considered for these analytes. Based on the findings of the TIE investigation performed in Chollas Creek and the detections of several pyrethroid compounds in every storm event monitored in Chollas Creek, this compound class 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.

**Table 14-2. Recommended actions from the triad assessment.**

| Watershed | Chemistry | Toxicity | Benthic Alteration | Possible Conclusion(s) | Possible Actions or Decisions |
|---|---|---|---|---|---|
| Santa Margarita | Persistent exceedances of water quality objectives (high frequency COC identified) | No persistent evidence of toxicity | No Indications of alteration | Limited dataset makes conclusions difficult.<br>Test organisms not sensitive to problem pollutants.<br>Contaminants are not bioavailable. | 1) Continue monitoring to gather long-term trend information.<br>2) Continue monitoring for toxic and benthic impacts. Consider whether different or additional test organisms should be evaluated.<br>3) Initiate upstream source identification as a low priority.<br>4) TIE would not provide useful information with no evidence of toxicity. |
| San Luis Rey | No persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) No action necessary based on toxic chemicals<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance. |
| Agua Hedionda | Persistent exceedances of water quality objectives (high frequency COC identified) | No persistent evidence of toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) Evaluate upstream source identification as a high priority.<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance.<br>5) TIE would not provide useful information with no evidence of toxicity. |
| Escondido Creek | Persistent exceedances of water quality objectives (high frequency COC identified) | No persistent evidence of toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) Evaluate upstream source identification as a high priority.<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance.<br>5) TIE would not provide useful information with no evidence of toxicity. |
| San Dieguito River | No persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) No action necessary based on toxic chemicals.<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance. |
| Los Peñasquitos | No persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) No action necessary based on toxic chemicals<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance. |

**Table 14-2. Recommended actions from the triad assessment.**

| Watershed | Chemistry | Toxicity | Benthic Alteration | Possible Conclusion(s) | Possible Actions or Decisions |
|---|---|---|---|---|---|
| Mission Bay | Persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Benthic impact due to habitat disturbance, not toxicity.<br>Test organisms not sensitive to problem pollutants. | 1) Continue monitoring to gather long-term trend information.<br>2) Evaluate upstream source identification as a high priority.<br>3) Consider whether different test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance.<br>5) TIE would not provide useful information with no evidence of toxicity. |
| San Diego River | Persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Test organisms not sensitive to problem pollutants.<br>Benthic impact due to habitat disturbance, not toxicity. | 1) Continue monitoring to gather long-term trend information.<br>2) Evaluate upstream source identification as a high priority.<br>3) Consider whether different or additional test organisms should be evaluated.<br>4) Consider potential role of physical habitat disturbance.<br>5) TIE would not provide useful information with no evidence of toxicity. |
| Chollas Creek | Persistent exceedances of water quality objectives | Evidence of persistent toxicity | Indications of alteration | Evidence of current pollution-induced degradation | 1) Perform confirmatory TIE to verify contaminant(s) of concern based on TIE metric.<br>2) Continue monitoring to gather long-term trend information. |
| Sweetwater River | No persistent exceedances of water quality objectives | No evidence of persistent toxicity | Indications of alteration | Alteration may be due to physical impacts, not toxic contamination<br>Test organisms not sensitive to problem pollutants<br>Synergistic effects of multiple chemicals at low levels causing toxicity | 1) No action necessary based on toxic chemicals.<br>2) Consider whether different or additional test organisms should be evaluated.<br>3) Consider potential role of physical habitat disturbance. |
| Tijuana River | Persistent exceedances of water quality objectives | Evidence of persistent toxicity | Indications of benthic alteration | Connections of water quality degradation and toxicity to benthic condition difficult due to spatial disparity. | 1) Continue monitoring to gather long-term trend information.<br>2) Evaluate upstream source identification as a high priority. |

### *14.3.2 Recommendations*

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.