11.0 WATER QUALITY MONITORING SUMMARY AND ANALYSES

11.1 Introduction

The goal of environmental monitoring is to support the management process. In 2002 and 2003, the Program completed development of the *San Diego Region Receiving Waters Monitoring and Reporting Program* and the *San Diego Region Dry-Weather Monitoring Program* for wet and dry weather, respectively.

> "monitoring is most useful when it results in more effective management decisions, specifically management decisions that protect or rehabilitate the environment."
> (NAS, 1991[1])

The *San Diego Region Receiving Waters Monitoring and Reporting Program* is comprised of four program elements. They are briefly described below.

- Urban Stream Bioassessment uses a "triad" of indicators (bioassessment, chemistry, toxicity) to describe impacts on stream communities and the relationship of any impacts to runoff, based on comparisons with reference locations on a year-to-year time frame.

- Long-term Mass Loading using measurements of key pollutants to assess loads over a time frame of years to decades to compared with past and present levels.

- Coastal Stormdrain Outfall Monitoring uses a suite of bacterial indicators at high priority drain outfalls to track compliance with regulatory standards and any improvements due to BMP implementation.

- Ambient Coastal Receiving Waters Monitoring uses measurements of runoff plume characteristics and extent, as well as measures of a suite of physical, chemical, and biological indicators to improve understanding of the impacts of runoff plumes on near-shore ecosystems.

The *San Diego Region Dry-Weather Monitoring Program* comprises a single program element. This element is:

- Dry Weather Reconnaissance consists of gathering data from both random and targeted sites, to define region-wide background dry weather conditions to serve as a basis for identifying candidate sites for further focused source identification work.

Compared to prior monitoring efforts (pre NPDES, First and Second Permit Term Programs), the Third Permit Term monitoring program is characterized by a broader range of locations and a wider array of methods for measuring impacts. For example, the receiving waters monitoring program more completely examines storm drains that

[1] Managing Troubled Waters, National Academy of Sciences, 1991

discharge directly to the coast and pose a potential health risk to swimmers and bathers. Also, there is investigation component to assess the effects of stormwater plumes on the nearshore marine environment. Inland, the monitoring program includes bioassessment studies and consistent use of toxicity testing. Combined with the established measurement of chemical parameters, this "triad" approach describes impacts more fully, more accurately identifies their sources, and more effectively identifies follow-up studies and BMPs.

This section will summarize the progress toward implementation of the Receiving Waters and Dry-weather Monitoring Programs during the Third Term Permit, the findings, and the proposal for future monitoring.

11.2 Accomplishments

11.2.1 Implementation of the Receiving Waters Monitoring Program

On August 13, 2002, a Receiving Water Monitoring Program was submitted to and subsequently approved by the San Diego Regional Water Quality Control Board. Relative to the monitoring program for the second term permit (99-04 Plan) the new program included many new monitoring locations and several new methods for evaluating the impacts of urban runoff including urban stream bioassessment and toxicity testing.

The initial phase of implementation involved:

- Procurement of specialized automatic sampling equipment for the collection of composite samples for pesticide analyses and toxicity testing.
- Establishment of price agreements for consultant services to conduct urban stream bioassessments and toxicity testing.
- Establishment of a Memorandum of Understanding (MOU) with the Orange County Health Care Agency's Public Health Laboratory to conduct bacteriological analyses of samples collected from coastal stormdrains and the surfzone receiving waters.

Subsequently the following monitoring was initiated:

- Urban Stream Bioassessment (USB) monitoring – The program includes semi-annual assessment each spring and fall at 12 urban channels and 3 reference sites. The fall 2002 monitoring began in November with assessments of physical habitat, benthic macroinvertebrate (BMI) taxonomy, and water chemistry at each site. Toxicity testing at bioassessment sites began in the spring of 2003.
- Composite sampling for water chemistry and toxicity of stormwater runoff at Mass Emissions sites began in December 2002.
- Sampling of stormdrain discharges for water chemistry and toxicity began at Ambient Coastal Receiving Waters (ACRW) sites in December 2002.
- Weekly sampling of Coastal Stormdrain Outfalls (CSDO) and their respective surfzone receiving waters began in January 2003.

Urban Stream Bioassessment

The urban stream bioassessment component of the water quality monitoring program is intended to assess the condition of biological communities in freshwater creeks and streams. This is accomplished through a triad of indicators monitored at 15 sites (12 urban channels and 3 reference locations) throughout the San Diego region of the County in the spring (usually May) and fall (usually October) of each year. The triad includes measures of the status of the benthic invertebrate community, aquatic chemistry, and aquatic toxicity.

Data on the species composition of the biological community is converted to an Index of Biotic Integrity (IBI) score and a similar score is computed for the physical habitat. A wide range of physical and chemical water quality measurements are made at each site including basic water quality indictors (temperature, specific conductance, pH, and dissolved oxygen concentration) and concentrations of urban pollutants such as pesticides and metals. Values for five dissolved metals are compared for guidance purposes, to acute toxicity criteria (adjusted for water hardness) established in the California Toxics Rule (CTR). The numbers and percentages of CTR exceedances are tabulated. Aqueous toxicity tests using three freshwater test organisms is conducted on samples from each site to provide a measure of the potential toxicity due to different categories of pollutants.

The analysis and evaluation of this triad of data types focuses on describing spatial patterns and temporal trends in community condition and in relating these to the aquatic concentrations of pollutants as well as to various aspects of physical habitat.

Data from all three years of monitoring demonstrates an overall pattern of lower IBIs in urbanized portions of watersheds, although this is not apparently related to aquatic chemistry or toxicity. **Figures 11.1** and **11.2** show the qualitative ratings of the average seasonal scores of the four metrics (CTR exceedances, aquatic toxicity, physical habitat score, and IBI score) used to assess stream health at each monitoring site. The color scheme for the figures is shown in the table below.

Qualitative Rating	Color	Average of All Data Collected between 2002 - 2005			
		Chemistry	Toxicity	PHAB Score	IBI Score*
Poor	Red	76-100% exceed CTR	67-100% effect@	0-50	0-26
Fair	Yellow	41-75% exceed CTR	34-66% effect	51-100	26-40
Good	Blue	15-40% exceed CTR	6-33% effect	101-150	41-55
Very Good	Green	0-14% exceed CTR	0-5% effect	151-200	56-70
Insuff. Data	White				

* The qualitative rating scale for IBI scores was established by the CA DF&G. A score of 0-13 is considered Very Poor.
@ In undiluted samples, effect relative to control sample = mortality in Ceriodaphnia and Hyallella survival tests, or inhibition of growth in Selenastrum growth test.

Figures 11.1 and **11.2** show that there is no readily apparent relationship across the region between the relative conditions of the biological community on the one hand and levels of toxicity and pollutants on the other.

In general, there is a clear biological pattern associated with the gradient of high to low IBI scores. A cluster analysis (**Figure 11.3**) shows that reference sites group together (i.e., have similar biological communities), characterized by species with relatively restricted habitat ranges. In contrast, sites with lower IBI scores have tolerant species with much wider habitat ranges. The presence of more tolerant species at sites with low IBI scores is a common finding in environmental studies in a wide range of marine, estuarine, and freshwater habitats. The cluster analysis also demonstrates a clear and persistent seasonal difference in biological community structure between spring and fall surveys. While there is some variability over time in the IBI and physical habitat scores at each site, the overall patterns described above are relatively persistent.

The spatial overview of the monitoring results (**Figures 11.1** and **11.2**) strongly suggests that there is no consistent relationship between the patterns in the biological stream communities and aquatic chemistry and toxicity. This conclusion is strongly supported by the very low incidence of both CTR exceedances and toxicity. In addition, a comparison of the station groupings in the cluster analysis in **Figure 11.3** to the actual levels of pollutants and of toxicity showed that there was no relationship between the biological pattern and measures of contamination and/or toxicity.

In contrast, there is a much stronger relationship between patterns in the biological community and various aspects of physical habitat. Overall, there is a positive relationship between IBI scores and physical habitat scores (**Figure 11.4**), although there is some noise around this relationship. This stems from the fact that not all the components of the physical habitat score are equally correlated with biological condition (**Figures 11.5a** and **11.5b**). For example, low values for Instream Cover and Vegetation Protection are highly associated with poor community condition but intermediate values of these habitat components do not seem to be strongly correlated with community condition. On the other hand, Sediment Deposition is highly correlated with community condition only at high and low extremes, but not for intermediate values. In contrast to both these types of correlation, Channel Alteration is correlated with community condition at all levels of this component.

There is a need to further investigate the nature of the relationship between biological community patterns and physical habitat condition. This analysis should take advantage of the fact that both IBI and physical habitat scores are made up of multiple components that reflect different aspects of biological communities and physical habitat. It is likely that different IBI components, which reflect the status of different types of organisms, respond to different features of the physical habitat. The management benefit of such an analysis would be an improved ability to focus on those habitat features that matter the most to biological condition. This could lead to new stream or riparian zone management policies and procedures.

There are some apparent anomalies to the overall pattern just described, i.e., that biological condition is primarily determined by physical habitat characteristics. These situations may be appropriate for special studies that could identify site-specific contamination problems and/or provide additional insights into the relationship between physical habitat and biological condition. For example, station Christianitos Creek at Christianitos Road (station CC-CR) has IBI scores in the fair range but physical habitat scores more typical of sites with IBI scores in the poor to very poor range. However, CC-CR has high values for Riparian Vegetation Zone, Vegetation Protection, and Channel Alteration. Of these three, Riparian Vegetation Zone and Channel Alteration are very highly correlated with biological pattern in both the spring and the fall (**Figure 11.5**), and the high values for these components might explain this anomaly.

In contrast, reference station San Juan Creek at Cold Spring (REF-CS) has high physical habitat scores but anomalously low IBI scores. There is no readily apparent explanation for this in the physical habitat data, which suggests there may be some sort of pollution problem that was not detected by the monitoring program. Finally station WC-WCT also has high physical habitat scores but low IBI scores. This is a unique station in that it is within a wilderness area surrounded by pockets of residential areas. A special study will be conducted to determine if intermittent discharges of toxicants from the urban areas are impacting instream fauna.

Long-term Mass Loading

The long-term mass loading component of the monitoring program is intended to evaluate changes in pollutant loadings over a number of permit terms. This is accomplished through wet weather monitoring at six locations. Three storms are monitored at each location and for each storm the water chemistry is monitored with a series of 3 to 4 composite samples collectively spanning approximately 96-hours. This time period provides for comparison of the data to 96-hour guidance criteria for chronic aquatic toxicity from the California Toxics Rule (CTR). The concentrations of dissolved heavy metals in the composite samples are also compared to acute toxicity criteria from the CTR for guidance. The concentrations of organophosphate pesticides are compared to literature values of LC_{50}s for toxicity testing organisms.

Monitoring of at least three storms per site is attempted each year. Continuous water level records from streamgages at each site are used to determine stormwater discharge rates. The streamgages on Aliso Creek, Trabuco Creek, and San Juan Creek have produced acceptable records to calculate stormwater loads. The streamgage on Laguna Canyon Wash has experienced many operational problems and new monitoring equipment was installed during the 2005-06 monitoring year to overcome these problems. The Segunda Deshecha Channel was under construction during the first two years of the program during which time the streamgage was decommissioned. The high-flow stage-discharge relationships for this site and for the Prima Deshecha Channel have not been adequately defined to calculate accurate stormwater loads. When adequate channel ratings are established the flowrates and loads can be calculated for all prior years where accurate water level records are available.

Coastal Stormdrain Outfall Monitoring

The coastal stormdrain outfall component of the water quality monitoring program is intended to identify those sections of coastline where nearshore receiving waters most consistently exceed state AB411 standards for bacterial indicators, as well as the stormdrains that appear to be contributing the most to these exceedances. Three bacterial indicators (fecal coliforms, total coliforms, Enterococcus) are monitored weekly at 29 stormdrains along the coastline.

At each sampling event, concentrations of bacterial indicators are measured in the discharge of each stormdrain, as well as in the surfzone 25 yards upcoast and downcoast of the stormdrain. The flow from each drain is also estimated and categorized as high, medium, or low. Analyses of these data included calculation of an exceedance rate for each drain and linear regression of indicator concentrations in each drain's discharge against indicator concentrations in the nearby surfzone. The goal of these analyses was to identify the subset of drains that appeared most closely linked to a high rate of exceedance of the AB411 standards.

Coastal Stormdrain Outfall Monitoring was initiated during the final week of January 2003 and, except during periods of constant stormwater runoff, weekly monitoring at each site since that time. When the discharge from a stormdrain is diverted to the local sewage treatment plant, the stormdrain is not sampled. While diverted, only sampling of the downcoast location in the surfzone is conducted. Monitoring data are available through the Orange County Health Care Agency's website at ocbeachinfo.com.

The three years of monitoring data show that exceedances in the receiving water (i.e., the surfzone) tend to occur at the same subset of stations over time, although the rate of exceedances is higher during the winter than during the summer AB411 season (**Figures 11.6** and **11.7**. The five stations with exceedance rates of approximately 10% or higher are: POCHE, DSB-4, DSB-5, SJC1, and SCM1, which are concentrated along one section of the coast. There has been no observable discharge from DSB-4 during the three years of CSDO dry-weather monitoring. The exceedances of the AB-411 standards were most likely caused by the discharges of the other drains in the area (DSB-5 and SJC1). The highest exceedance rate during the AB411 season is 0.288 at station SCM1 and yearround 0.493 at station DSB5 (**Table 11.1**).

The exceedance rates alone do not necessarily indicate a problematic drain because the elevated bacterial indicator levels could stem from sources other than the nearby drain. Establishing a link between a particular drain and the receiving water exceedances depends on the relationship between indicator levels in the drain's discharge and in the receiving water. For example, the combination of elevated indicators in the receiving water with low levels in a drain's discharge would suggest that the exceedances could be due to longshore transport from another location. Conversely, elevated indicator levels in a drain's discharge combined with persistently low surfzone levels would suggest mixing and dilution by nearshore currents.

Linear regressions were performed for each indicator / drain combination and the results used to rank drains in terms of the strength of their relationship to receiving water conditions. The approximated yearly volume of flow from each drain was then used to qualitatively identify those drains with the highest loading of bacteria to the receiving water. Taken together, these evaluations resulted in the identification of five drains with a combination of high loadings of bacterial indicators and a statistically significant relationship between indicator levels in the drain and the surfzone:

- Aliso Creek (ACM-1)
- Salt Creek (SCM-1)
- Doheny Beach – North Creek Mouth (DSB-5)
- San Juan Creek (SJC1)
- Poche Beach (POCHE).

Table 11.2 summarizes conditions at these drains. Note that this list of drains is similar to, but not identical to, the list of drains with the highest exceedance rates.

These five stormdrains present opportunities for further upstream source identification studies to determine whether persistent receiving water contamination is due to sources near their mouths, to sources higher up in their respective drainage areas, and/or to longshore ocean currents transporting contamination from other nearby drains or creek mouths.

The following projects have been initiated in response to analysis of data from shoreline microbiology monitoring conducted for the Third Term Permit, the South Orange County Water Association (SOCWA) NPDES permit, and the Orange County Health Care Agency beach water quality program.

- The County has funded a $200,000 microbial source tracking study in the Prima Deshecha Channel watershed. The report will be submitted by the consultant, Weston Solutions, Inc. to the County at the end of August 2006.
- The City of Dana Point has funded the construction, operation and maintenance of the ozone disinfection system for the dry-weather discharges from the Salt Creek Channel. Recent data from the surfzone has shown that the bacterial indicator concentrations are now consistently meeting the AB-411 standards.
- The City of Dana Point has procured grant funding and will provide matching funds for an epidemiological study by SCCWRP on the health effects of ocean water contact near the mouths of the Doheny Beach drains and San Juan Creek.

Ambient Coastal Receiving Water Monitoring

The ambient coastal receiving water component of the water quality monitoring program is intended to assess the impact of urban runoff to ecologically sensitive coastal areas by analyzing the water chemistry, aqueous toxicity, and magnitude of plumes of stormwater discharges to these areas. With this information the Permittees would then prioritize these sites for further study in terms of their relative degree of potential threat to water quality and ecological resources. Monitoring at these 17 sites focuses primarily on aquatic chemistry and aquatic toxicity during both dry and wet (storm) weather conditions. Aerial photographs of stormwater plumes provide a basis for estimating the relative magnitudes of the impact zones.

Values for five metals are compared to acute toxicity criteria established in the California Toxics Rule (CTR) for guidance and the numbers and percentages of CTR exceedances tabulated. Toxicity tests with marine test organisms provide a measure of the potential toxicity due to different categories of pollutants. Because of the relatively high incidence of toxicity at some stations, the observed level of toxicity (in toxic units) was compared to the predicted toxicity expected from the observed aquatic chemistry results. Predicted toxicity was estimated by first calculating the average LC_{50} for key chemicals from literature values. This average value was then used to calculate the amount of toxicity (in toxic units) to expect from the concentrations of these chemicals in aquatic chemistry samples. Summing the estimated toxicity from all chemicals resulted in an estimate of the toxicity that theoretically should be present.

For the coastal areas Ambient Coastal Receiving Waters monitoring was designed as an adaptive program whereby the initial monitoring would consist of sampling the discharges from selected coastal stormdrains for water chemistry and toxicity. The data from these samplings would be supplemented by aerial photographs of stormwater plumes in order to determine the drain which showed the greatest impact on its receiving waters. The receiving water for this drain would be selected for an offshore assessment of water quality and toxicity during the fifth year of the program. Water quality and toxicity monitoring of the stormdrains was initiated during a stormwater runoff event in December 2002 and has continued for three years. Aerial photography of stormwater plumes was carried out once in 2004 and once in 2005. Because of limited visibility due to cloud cover the plume photography for the first storm was conducted nearly two days after rainfall had ceased. For the second storm, the altitude of the flight was decreased to a level below the cloud cover which enabled photography at a time closer to the end of the storm.

Table 11.3 summarizes the frequency and pattern of exceedances of the acute saltwater CTR criteria at the ambient coastal receiving water stations during the period from 2002 – 2005. It should be noted that this analysis involved comparison of the freshwater discharges from these stormdrains to saltwater criteria. For each site, the potential impact to the receiving water assumes no dilution of the stormdrain discharge.

The data from this analysis show that exceedances are predominantly due to copper, with a lesser number due to nickel and zinc. The frequency of exceedance of the acute saltwater CTR criterion for copper remained fairly consistent during dry-weather sampling. The percentage of exceedances of the CTR criteria for stormwater samples in the third year appeared to drop dramatically from the prior two years. This observation may be the result of the higher than normal annual rainfall during year, as shown below:

			Exceeded Cu Criterion #(%)		
Permit year	**Total Samples**	**Stormwater Samples**	**Dry Weather**	**Stormwater**	**Rainfall (inches)**
1	32	6	14(54%)	4(67%)	14.57
2	39	5	14(41%)	4(80%)	8.41
3	59	39	10(50%)	15(38%)	28.44

Table 11.3 shows that the Doheny Beach stations most frequently exceed CTR values for multiple metals.

The toxicity results from these stations present another perspective on water quality conditions. **Table 11.4** summarizes the average degree of toxicity, averaged over all toxicity tests, at each station over the 2002-05 period. **Figures 11.8** and **11.9** visually present the regional pattern of toxicity, showing that toxicity is primarily concentrated at a subset of the stations, as are the CTR exceedances. The Doheny Beach stations (DSB -1, DSB-3, DSB-4, DSB-5) have consistently high average toxicities; these are generally the same stations with the highest frequencies of CTR exceedances. In addition, several other stations, distributed across a number of watersheds, had high average levels of toxicity. In general, the same stations exhibited elevated toxicity in both dry and wet weather.

There is a general correspondence between the overall patterns of CTR exceedances and toxicity, as exhibited by the Doheny Beach stations. However, other stations with elevated toxicity (e.g., LB-3) do not have higher than average numbers of CTR exceedances. Based on their combined patterns of CTR exceedances and toxicity, the following stations would be the highest priority for special studies to investigate the sources of contamination and/or toxicity:

- Doheny Beach (DSB-1, DSB-3, DSB-4, DSB-5)
- LB-4
- Salt Creek (SCM-1).

Stations DSB-5 and SCM-1 were also two of the five coastal stormdrain stations with persistent exceedances of AB411 standards for indicator bacteria. The differential sensitivity of toxicity test organisms can help provide a starting point for such source identification studies. Urchins and abalone are more sensitive to dissolved metals, while mysids are most sensitive to ammonia and organic compounds, particularly pesticides. Further guidance can be obtained from a comparison of the observed toxicity to that predicted from laboratory studies, as illustrated in **Figure 11.10**. An examination of this comparison for all the toxicity tests from this program component shows that predicted toxicity from zinc is often higher than the observed toxicity, strongly suggesting that zinc may not be as bio-available as other pollutants.

Much of the toxicity in the sea urchin fertilization test can be explained by elevated levels of dissolved metals, particularly copper. The predicted toxicity (from comparison of water chemistry to literature values of LC_{50}s) was higher than the observed toxicity.

This was due primarily to high concentrations of dissolved zinc, suggesting that zinc may be bound to organic ligands and is not completely bio-available.

The observed toxicity in the mysid survival tests is harder to explain because ammonia is very low and organophosphate pesticides were almost never found in the water samples (mysids are especially sensitive to Chlorpyrifos). The predicted toxicity was typically equal to or less than observed, which suggests that there are unknown toxicants affecting the system. Phase I TIEs have been conducted on a limited basis and have thus far proven inconclusive. For most of these TIEs the initial toxicity was only observed in the undiluted sample of the multiple dilution test. The baseline test of the TIE produced no response. The toxicity testing laboratory has hypothesized that the toxicant that caused the initial toxicity was most likely a volatile compound that dissipated over time.

Dana Point Harbor

The Ambient Coastal Receiving Water (ACRW) monitoring program also includes Dana Point Harbor. The monitoring of Dana Point Harbor was initiated in June of 2003 and consists of sampling for water chemistry and aqueous toxicity. Semiannual dry-weather analyses of sediment chemistry, sediment toxicity, and benthic infaunal analyses were added during the 2003-04 monitoring year.

As an enclosed embayment with several stormdrain inputs, Dana Point Harbor is a focus of particular attention within the region. **Figure 11.11** shows that average BRI (Benthic Response Index) scores for station DAPTDC (Dana Cove) were within the reference range, while BRI scores for all other stations fell within Response Level 2, indicating a change in species composition of between 25% and 50% compared to reference. DAPTDC also had relatively low levels of pollutants in the sediments and the lowest level of sediment toxicity (**Figure 11.12**). The bottom at this site consists mostly of rock and large gravel, with very little of the fine sediment which is typically associated with associated with elevated levels of particle-bound pollutants.

The overview presented in **Figure 11.12** shows that, with the exception of station DAPTDC, sediment monitoring data for Dana Point Harbor show a moderate level of impact to the benthic community and a moderate to substantial level of toxicity. The sediment chemistry picture is less clear because data are only available from two samplings (Spring and Fall 2005).

Impacts to the benthic community can stem from both toxicity due to chemical contamination and from physical disturbance. **Figure 11.13** shows that the relationship between BRI score and toxicity, while statistically significant, is not strong. Much of the relationship is driven by the handful of samples with the lowest BRI scores, which are all from station DAPTDC, which is somewhat anomalous. Since the sampling location for DAPTDC does not have a typical muddy bottom its benthic infaunal community is depauperate. Without this station, the regression would not be statistically significant. This finding is similar to results being generated as part of the technical work for the

State Water Resources Control Board's Sediment Quality Objectives project. Using data from embayments throughout California, this project has found that relationships among sediment chemistry, sediment toxicity, and benthic community changes are highly variable. Significant relationships can typically only be documented with large numbers of samples.

The cumulative frequency distribution of sediment toxicity from embayments in the Southern California Bight (**Figure 11.14**), based on data from the Bight '03 regional survey, provides a larger regional context to the toxicity results from Dana Point Harbor. The median mortality in sediment toxicity tests in the Bight '03 data is about 20%, which is lower than the average toxicity of all tests from Dana Point Harbor. **Figure 11.13** shows that the bulk of toxicity results fall between about 20% and 45% mortality relative to test controls.

Region-Wide CTR Exceedance Patterns

The CTR is a convenient benchmark for assessing region-wide patterns. For the purposes of this analysis it is not being used for compliance purposes but merely for guidance as to where the levels of constituents of concern may be persistently elevated.

Aquatic chemistry samples from several components of the water quality monitoring program (urban stream bioassessment, long-term mass loading, ambient coastal receiving water monitoring) were evaluated with respect to criteria for dissolved metals established in the CTR. While such CTR criteria are available for only a portion of the constituents measured in the program's samples, the combination of CTR exceedances from all available program components provides an overview of contamination patterns across the region. In addition to tabulating the number of exceedances at each station, the overall percentage of exceedances at each station (out of all samples collected at each station) was used to place stations into one of four categories representing relative frequency of exceedances.

Table 11.5 summarizes exceedances of acute CTR criteria for dissolved metals at all water quality monitoring stations in the San Diego region with more than one sampling event. For purposes of this assessment, all program components (bioassessment, mass loading, ambient coastal) were combined into one dataset, in order to better represent the spatial pattern of exceedances across the region.

Exceedances overall are predominantly due to copper, with a much smaller percentage due to nickel and zinc. Exceedances of the CTR for cadmium, lead, and silver were extremely rare and thus not included in **Table 11.5**. Most exceedances occur at a subset of the stations along the coast. There is year-to-year variability within this larger pattern, although this appears to be somewhat related to the amount of annual rainfall. **Figures 11.15** and **11.16** visually summarize these regional patterns, using the data presented in **Table 11.5**.

Within these larger patterns, the CTR exceedance data help identify locations where targeted special studies to identify upstream sources should be implemented. These are stations with more than a handful of samples where both the exceedance rate and/or the number of pollutants showing exceedances are among the highest:

- ACJ01
- SCM-1
- PDCM01
- SDCM02
- SJNL01
- DSB-5

Stations DSB-5 and SCM-1 were also two of the five coastal stormdrain stations with persistent exceedances of AB411 standards for indicator bacteria. It should be noted that stations ACJ01 and SJNL01 are a significant distance upstream of their respective coastal receiving waters and that their respective Ambient Coastal Receiving Waters monitoring locations ACM1 and SJC1 show much less of an impact with respect to the acute saltwater criteria from the CTR. These findings suggest that sampling of a mass emissions site and its corresponding ACRW discharge point be monitored concurrently during storms to more accurately evaluate the potential impacts of urban runoff.

Region-wide Toxicity Patterns

Aquatic toxicity test results from several components of the water quality monitoring program (urban stream bioassessment, long-term mass loading, ambient coastal receiving water monitoring) were combined to present a picture of how toxicity is distributed throughout the region. The average mortality rate of test organisms at each station was used to place each station into one of four categories representing relative intensity of toxicity. **Figures 11.17** and **11.18** show the distribution of relative toxicity across the region. In both dry and wet weather, toxicity is concentrated along the coast, although toxicity is detected somewhat further inland during wet weather.

11.2.2 Implementation of the Dry-weather Monitoring Program

The proposal for the Dry-weather Monitoring Program to detect illegal discharges and illicit connections (ID/ICs) to the stormdrain system was submitted to and subsequently approved by the Regional Board in February 2003. Monitoring was initiated in May 2003 and has continued each dry-weather season (May 1 – September 30).

The program includes monitoring 3 times annually at approximately 30 randomly selected stormdrains (random sites) to determine regional mean concentrations of constituents of concern. Each Permittee selected several stormdrains (targeted sites) within their respective jurisdiction, which were suspected to contain ID/ICs. These targeted sites were sampled monthly (5 times annually) for the same constituents. Triggers for source investigations were established using two statistical methods:

- If on consecutive sampling dates, the value of a monitored constituent exceeds the upper bound (lower bound for dissolved oxygen) of the tolerance interval around the estimated 90th percentile of random site data for that constituent, or
- The value of a monitored constituent exceeds the control limits for that constituent at that site. The control limits are set at 3.9 standard deviations above (below for dissolved oxygen) the mean for that site.

The Permittees are provided an updated spreadsheet of the monitoring data on a monthly basis throughout the dry-weather season. The tolerance intervals are updated periodically as more data are compiled. Extreme values of physical properties or chemical constituents measured in the field triggers immediate notification of the authorized inspector(s) of the city or cities which have jurisdiction within the watershed of the offending stormdrain. In many instances (e.g. high surfactant or TSS discharges) the responsible party has been identified quickly by the authorized inspector.

11.2.3 Establishment of a New Water Quality Database

In 2004, a new computer program was developed for managing NPDES monitoring data. The intent of this program which has been called Labtrack, is to provide a single repository for all current NPDES data, to reduce the number of systematic errors in monitoring and laboratory analyses, and to increase the efficiency in processing invoices for the payment of analytical services. Some of the features of Labtrack include the ability to:

- Produce customized periodic data summaries
- Print labels for sampling containers
- Print and maintain chain-of-custody documentation
- Check laboratory results against quality assurance criteria
- Check invoice pricing against price agreements
- Integrate discharge rate information from Hydstra (hydrologic database) to calculate load information for Performance Evaluation Assessment (PEA) and TMDL reports

11.2.4 Participation in Regional Monitoring Programs

Since 1997, the Permittees have been an active participant in the Regional Monitoring Program for the Southern California Bight. A Permittee representative has served on the steering committees for the 1998 Regional Assessment (Bight 98) and the 2003 Assessment (Bight 03). A representative has also served on several of the monitoring subcommittees on Bight 03.

The Permittees have also provided representation to the southern California Stormwater Monitoring Coalition. A Permittee representative was instrumental in the development of the Model Stormwater Monitoring Program guidance document which has incorporated many of the same methods used in this program. A Permittee representative is currently on the working group with SCCWRP and the California

Department of Fish and Game to improve the California Stream Bioassessment Procedure.

The Permittees are is also participating in the Regional Harbor Monitoring Program (RHMP), which was designed and implemented in response to a 13267 letter from the San Diego Regional Water Quality Control Board. The RHMP is intended to help answer fundamental questions about the status of and trends in beneficial uses in the coastal harbors along this region of the coast. Dana Point Harbor, in southern Orange County, is included in the RHMP.

The RHMP uses a stratified random design modeled on the Bight Program approach and intended to ensure that the RHMP data are compatible with data from the periodic Bight Program. While the Bight Program uses a single stratum for harbors, the RHMP has identified mutliple strata within harbors in order to provide for more detailed assessments of conditions. These strata are based on both structural (e.g., depth) and use (e.g., industrial, marina) features of harbors. Within each stratum, a broad range of indicators are sampled, including water quality, sediment quality and characteristics, toxicity, and fish tissue contamination. The RHMP is being implemented in two phases. The first phase focuses on using a more limited sampling protocol to validate design assumptions and gather the information needed for full implementation in the second, permanent, phase. The first phase will include 3 years of data collection and evaluation to validate design assumptions and sampling protocols. The first year of data collection was completed in 2005.

The knowledge gained from participation in these regional programs has enabled the Permittees to improve the monitoring program in many ways. The newly established price agreements for analytical services for the stormwater program required that the vendor had participated in the rigorous laboratory inter-calibration exercises for the Bight Regional Monitoring Program. These exercises, coordinated by SCCWRP, ensured that the accuracy and precision by each of the participating laboratories were maintained at a high standard.

11.2.5 <u>Involvement in Research Level Investigations</u>

The Permittees also contributed monitoring equipment and funding to UCI to conduct bacteriological investigations in the Santa Ana River and Huntington Beach surfzone. As a result of the study findings, the dry-weather discharges of several channels which drain to that area have been diverted to the Orange County Sanitation District. Since the diversions have been implemented there has been an improvement in scores for the surfzone in that area on Heal the Bay's Beach Water Quality Report Card.

On behalf of the Aliso Creek Watershed Permittees, the County worked with UC Irvine researchers Dr. Sunny Jiang and Dr. Betty Olson to investigate sources of bacteria in the J03P02 sub-watershed of Sulphur Creek. The UCI researchers used three Microbial Source Tracking (MST) methods to identify the sources of bacteria from samples collected in the sub-watershed from May through August 2002. These MST methods included: (1) analysis for human enteric viruses, (2) analysis for genetic biomarkers indicative of human, cow, pig/cat, rabbit, and bird sources, and (3) Antibiotic Resistance Analysis (ARA). The analysis of samples for biomarkers of human and animal sources showed no samples with biomarkers of human origin, and showed that all or almost all samples had biomarkers of bird, rabbit, and cow origin. Findings from the human virus and ARA studies suggest that sewage was an unlikely source of fecal coliform in the drainage system, and that bacteria from wild animal feces were the dominant source of *Enterococci* in the watershed. Further details can be found in the eighth quarterly progress report for the Aliso Creek Directive, dated April 30, 2003, and ninth quarterly progress report, dated July 31, 2003.

11.3 Assessment

The monitoring results described in the preceding section have led to conclusions about patterns of impact and the potential sources of these impacts. These conclusions, summarized below, provide the basis for the summary recommendations in **Section 11.4.**

The current Urban Bioassessment monitoring program in South Orange County utilizes the triad approach from the SMC's model stormwater monitoring program. The results from the first three years of monitoring have shown that there is a clear pattern of lower IBIs in the more urbanized portions of watersheds, and this pattern appears to primarily reflect habitat degradation rather than aquatic toxicity due to chemical contamination. This is a typical result of bioassessment monitoring programs elsewhere in the country. These findings suggest further investigation of the relationship between the physical habitat and biological communities.

The current method of triad monitoring consists of a synoptic evaluation of the chemistry, toxicity, and bioassessment (physical habitat assessment and IBI score). IBI score may not be reflective of the water chemistry or toxicity testing results if the water quality is not consistent. If intermittent discharges of toxicants affect the study area they may not be measured during the synoptic sampling. If low IBI scores cannot be attributed to physical habitat degradation a more comprehensive water quality study should be conducted.

The Mass Emission monitoring program evaluates long-term trends in pollutant loading. Although the current mass emissions monitoring program has not yet generated enough data over time to fully accomplish this goal, it has identified two channels (Prima and Segunda Deshecha) with stormwater discharges that have shown persistent toxicity to marine test organisms.

The Coastal Stormdrain Outfall monitoring program provides a weekly indicator of the impacts to the coastal zone from bacteria in urban runoff. The program has enabled the Permittees to identify surfzone areas near the outlets of stormdrains that have shown the highest frequency of exceeding AB411 single-sample ocean water sports contact standards.

The first four years of the Ambient Coastal Receiving Waters program involved monitoring the chemistry and aquatic toxicity of dry weather and stormwater discharges to ecologically sensitive areas along the southern Orange County coastline. During two storms aerial photographs were taken of the stormwater plumes to estimate the spatial extent of the impact of urban runoff. While the impacts of urban runoff to the coastline were monitored indirectly, it did enable the Permittees to identify the stormdrains that had the highest concentrations of urban pollutants and showed the greatest potential for toxic effects to nearshore areas. In Dana Point Harbor the impacts to the receiving waters were monitored directly. Monitoring was conducted in the harbor near the outlets of the stormdrains with measurements of water chemistry and aqueous toxicity, sediment chemistry, sediment toxicity, and benthic infaunal analyses.

11.4 Summary

The data analysis results form the basis for the following recommendations for further investigations and modifications to the monitoring design itself. The proposed further studies are focused on improving our understanding of the sources and causes of the observed impacts. The suggested modifications to the program are intended to improve the cost effectiveness of the program by focusing on those areas where impacts are most persistent or where substantial knowledge gaps remain.

11.4.1 Receiving Water Monitoring Program

Urban Stream Bioassessment

The past three years of bioassessment data suggest that physical habitat rather than water chemistry has a greater influence on IBI scores. The Permittees will conduct statistical analyses of the relationship between the components of the IBI and physical habitat (PHAB) scores to provide more detailed insight into the specific aspects of physical habitat most important to maintaining biological communities. If the specific aspect(s) of physical habitat causing the impairment can be identified, the Permittees will investigate BMPs and/or management measures to improve the physical habitat and reduce the impairment. The Permittees will also continue to participate in the SMC's working group to improve the current DF&G California Stream Bioassessment Procedure.

There are two sites (REF-CS and WC-WCT) that exhibited higher than system-wide average physical habitat scores but low IBI scores. These sites will be the focus of targeted special studies which would include:

- Reconnaissance of the immediate upstream watershed to locate all natural and manmade inputs to the channel. The discharges from these inputs will be field screened (using Dry-weather Reconnaissance tools) to identify candidates for more comprehensive monitoring.
- Sampling for intermittent discharges of low concentrations of toxicants (e.g. pesticides and dissolved metals) which may be affecting the intolerant species at the bioassessment locations. Using automatic sampling equipment, 24-hour composite samples will be collected at the bioassessment site, one day each week for the four weeks prior to bioassessment monitoring. the composite samples will be analyzed for nutrients, trace metals, pesticides (organophosphates, carbamates, pyrethroids), and water toxicity (Ceriodaphnia and Hyallella survival in undiluted samples).

Mass Emissions Monitoring

Two of the sites (PDCM01 and SDCM02) showed persistent toxicity in the mysid survival/growth tests. The OP pesticide data could not account for this toxicity. During the upcoming storm season the suite of pesticide analyses will be expanded to include carbamates and pyrethroids.

More high-flow instantaneous discharge measurements will be made at the streamgaging locations operated by the Permittees in order to improve the accuracy of the channel stage-discharge relationships (ratings). Equipment utilizing state-of-the-art acoustic Doppler current profiling technology has been recently purchased to enable rapid measurements of discharge rates.

Coastal Stormdrain Outfall Monitoring

Three years of monitoring data show that there is a small subset of coastal drains that display persistent exceedances of AB411 standards and for which there is a statistically significant relationship between bacterial indicator levels in the drain discharge and the surfzone.

The consistency of this overall pattern supports a recommendation to consider reducing monitoring effort at those stormdrains that rarely if ever have exceedances and reprogramming that effort toward more intensive investigations of the problematic drains. The actual amount of any such reduction would be determined only after an evaluation of the statistical consequences of a reduction in monitoring frequency and in consultation with the Permittees and Regional Board staff.

Ambient Coastal Receiving Water Monitoring

The ACRW monitoring results highlight the following questions and/or issues that will be addressed either through targeted special studies or modifications of the scope of on-going monitoring.

Source Identification and Determining Causes of Toxicity

Examination of the water chemistry results provided insight into the causes of toxicity in the sea urchin fertilization tests. The toxicity in the mysid /survival growth tests however could not be explained either with water chemistry or phase I TIEs. To aid in identifying the unknown causes of toxicity in the mysid tests, the water chemistry analyses of the stormdrain discharges will be expanded to include carbamate and pyrethroid pesticides. If found, the concentrations of these pesticides will be compared to their respective literature values for the LC_{50} in the mysid survival test. If a carbamate and/or pyrethroid pesticide is consistently found and their LC_{50}s for the mysid survival test have not been determined, the program would propose that the SMC conduct toxicity tests to determine those LC_{50}s.

There is a subset of six stations that provide targets for special studies to identify upstream sources of contamination and toxicity, based on the number of pollutants showing exceedances to CTR criteria, the high percentage of the time these exceedances occurred, and the level of toxicity observed. These sites include the Doheny Beach stormdrains (DSB-1, DSB-3, DSB-4, and DSB-5), a 48-inch stormdrain south of Main Beach in Laguna Beach (LB-4), and Salt Creek Mouth (SCM1).

A start on these efforts was made during the 2005-06 monitoring year, when the discharge from the DSB-5 stormdrain (North Beach Creek) was monitored extensively during a storm in March 2006. An automatic sampler was used to collect samples representative of the first flush and a 24-hour period after the first flush. In addition to the usual stormwater analyses for nutrients, metals, OP pesticides, and aquatic toxicity the Permittees also analyzed these samples for dissolved organic carbon, pyrethroid pesticides, organochlorine pesticides, PCBs, polynuclear aromatic hydrocarbons, and oil and grease. The results of this monitoring will be presented in the 2005-06 PEA report and will be used as guidance for special investigations of the drains described in the preceding paragraph.

Measuring Direct Impacts to the ACRWs

The toxicity testing results and the aerial photographs of stormwater plumes were used to select two coastal receiving waters (off of North Beach Creek and Salt Creek) for nearshore monitoring during a significant stormwater runoff event in the upcoming year.

The discharge from North Beach Creek in Doheny has shown significant amounts of metals and toxicity during both dry weather and stormwater runoff conditions. The spatial extent of the stormwater plume from this drain appears to be limited to the jetty immediately west of the mouth of the creek.

The discharge from Salt Creek has also shown significant amounts of toxicity in the mysid survival/growth tests. Although the watershed area and consequently the stormwater discharge volume are much smaller than those of San Juan or Aliso Creeks, the impact of Salt Creek on the nearshore habitat may be greater.

Because the Permittees do not currently possess an ocean-worthy vessel for offshore monitoring during storm conditions, a price agreement with a consultant will be established to perform the monitoring off the mouth of Salt Creek. The monitoring will be consistent with those used in the assessment of stormwater plumes conducted as part of the Bight '03 Regional Monitoring Program. Monitoring of the physical characteristics of the plume and sample collection will be conducted by the consultant. Sample analyses will be performed by the Permittees' analytical services and toxicity testing providers. The localized monitoring of the impacts from North Beach Creek near the Dana Point Harbor jetty will be conducted by Permittee staff.

Dana Point Harbor

The monitoring data indicate that at least one area is significantly impacted by urban runoff. To determine the type of contaminant causing the high toxicity in the benthic sediment near the outlet of East Basin stormdrain (DAPTEB), a sediment TIE will be conducted. In addition to the routine analyses for sediment chemistry these samples will also be analyzed for polynuclear aromatic hydrocarbons, mercury, and tributyl tin. If the cause of the toxicity is identified, a source identification study will be initiated in the watershed of the Golden Lantern stormdrain.

11.4.2 Database Improvements

A module will be created for the Labtrack database which will enable the Permittees to produce data files consistent with the SMC's Standardized Data Transfer Format (SDTF). The SDTF is a Microsoft Access based format that will allow data transfer between Southern California Stormwater agencies.

Table 11.1: Proportion of All Samples Exceeding AB411 Standards Near Coastal Stormdrains

Entire Year			AB411 Season		
Rank	Station	Avg Hits[1]	Rank	Station	Avg Hits
1	BLULGN	0.000	1	RIVERA	0.000
1	HEISLR	0.000	1	SCCS17	0.000
1	LADERA	0.000	1	SCCS52	0.000
1	PEARL	0.000	1	TRFCYN	0.000
1	TRFCYN	0.000	1	VICTRA	0.000
2	BLUBRD	0.003	1	WEST	0.000
3	DUMOND	0.004	1	BLUBRD	0.000
3	SCCS52	0.004	1	BLULGN	0.000
4	WEST	0.007	1	DUMOND	0.000
5	MARIPO	0.008	1	HEISLR	0.000
5	SCCS17	0.008	1	LADERA	0.000
6	LINDAL	0.016	1	LINDAL	0.000
6	RIVERA	0.016	1	MAINBC	0.000
7	CSBBR1	0.020	1	MARIPO	0.000
8	EMRLD	0.021	1	PEARL	0.000
9	ELMORO	0.022	2	PICO	0.015
10	PIER	0.023	2	ACM1	0.015
11	CLEO	0.041	2	CLEO	0.015
12	PICO	0.042	2	ELMORO	0.015
13	MAINBC	0.043	2	EMRLD	0.015
14	CSBMP1	0.050	3	PIER	0.023
15	DSB1	0.057	3	CSBBR1	0.023
15	VICTRA	0.057	4	CSBMP1	0.061
16	ACM1	0.062	5	DSB1	0.068
17	POCHE	0.081	6	POCHE	0.121
18	DSB4	0.133	7	DSB4	0.136
19	SCM1	0.238	8	DSB5	0.188
20	SJC1	0.455	9	SJC1	0.242
21	DSB5	0.493	10	SCM1	0.288

[1] At each site, one (upcoast) or two samples (upcoast and downcoast) are collected from the surfzone. For each sample three tests for pathogen indicator bacteria (total coliform, fecal coliform, and Enterococcus) are conducted. Hits represent the ratio of the number of exceedances of the AB-411 standards to the total number of tests conducted.

Table 11.2: Conditions at Drains of Highest Concern.

	Exceedances (proportion)		Regression (p value)		Mouth	Flow [1]	Watershed (lower reach)
Drain	Year	AB411	Year	AB411			
Aliso Creek ACM1	.06	.07	.0001 All	.04 ENT .49 FC .17 TC	Occasionally barricaded by berm	Flows ~90% of time 2nd highest flow	Partly rural, wilderness park
Salt Creek SCM1	.24	.29	.001 ENT .16 FC .40 TC	.04 ENT .26 FC .03 TC	Large stagnant scour pond always present on beach, with many birds Flows from pond to surfzone	Flows ~90% of time 3rd highest flow	Underground last 3 – 400 yds Aboveground through golf course and residential area
Doheny Beach – North Beach Creek Mouth DSB5	.49	.19	.0001 ENT .002 FC .0001 TC	.0001 ENT .01 FC .0002 TC	Long stagnant section at bottom end Stagnant portion of harbor at drain discharge	Low gradient 5th highest flow, much lower than other 4 drains Substantial flow only during storms Diverted during summer	Drains parking lot and state park with wildlife near mouth
San Juan Creek SJC1	.45	.24	.29 ENT 1 FC 1 TC	1 All	Occasionally barricaded by berm in summer Stagnant lagoon that drains to surfzone under sand	Flows most of year Highest flow	Residential area Bird refuge at bottom with 1 – 2000 birds
Poche Beach POCHE	.08	.12	.0001 ENT .0006 FC .001 FC	.005 ENT .02 FC .01 TC	Large stagnant scour pond that regularly flows to surfzone	Flows ~80% of time 4th highest flow	Entirely residential

[1] Flow ranks are relative and refer only to this group of five drains.

Table 11.3: Summary of Exceedances of Acute Saltwater CTR Criteria at Ambient Coastal Receiving Water Stations, 2002-2005

			Cd		Cr		Cu		Pb		Ni		Zn	
	Acute CTR Criterion		42 µg/L		100 µg/L		4.8 µg/L		210 µg/L		74 µg/L		90 µg/L	
	# Samples		Exceeded CTR Criterion											
Station	Storm	Dry	Storm	Dry	Storm	Dry	Storm	Dry	Storm	Dry	Storm	Dry	Storm	Dry
AB-1		1						1						
ACM-1	3	9						1						
DAPTDC	3	5					1	2						
DAPTEB	3	5					1	4						
DAPTLB	3	3						1						
DAPTLR	3	4						1						
DAPTWB	3	5					1	5						
DSB-1	4	1					3				2	1	1	
DSB-3	2	1					2	1			1		1	
DSB-4		1						1						
DSB-5	3	4	2	2			1	3			2	3	2	3
LB-1	1	2					1	1						1
LB-2	2	3					2	4					1	
LB-3	3	5					2	1						
LB-4	3	5					2	5						1
NI-1	1	2					1	2			1	1		
SCM-1	5	10					3	7						
SJC-1	6	8												
Totals	48	74	2	2			20	40			6	5	5	5

Table 11.4: Overall Average Level of Toxicity at Ambient Coastal Receiving Water Stations, 2002 – 2005

Station	Watershed	Weather	# Samples	Average Effect[1]
ACM-1	Aliso Creek	Dry	8	31.25
ACM-1	Aliso Creek	Storm	3	66.67
DAPTDC	Dana Point Coastal Streams	Dry	3	16.67
DAPTEB	Dana Point Coastal Streams	Dry	6	16.67
DAPTLB	Dana Point Coastal Streams	Dry	2	0.00
DAPTLR	Dana Point Coastal Streams	Dry	3	16.67
DAPTWB	Dana Point Coastal Streams	Dry	6	8.33
DAPTDC	Dana Point Coastal Streams	Storm	2	0.00
DAPTEB	Dana Point Coastal Streams	Storm	2	0.00
DAPTLB	Dana Point Coastal Streams	Storm	4	25.00
DAPTLR	Dana Point Coastal Streams	Storm	2	0.00
DAPTWB	Dana Point Coastal Streams	Storm	2	0.00
DSB-1	San Juan Creek	Dry	3	83.33
DSB-3	San Juan Creek	Dry	2	75.00
DSB-4	San Juan Creek	Dry	1	50.00
DSB-5	San Juan Creek	Dry	5	90.00
DSB-1	San Juan Creek	Storm	2	75.00
DSB-3	San Juan Creek	Storm	1	100.00
DSB-5	San Juan Creek	Storm	1	100.00
LB-2	Laguna Coastal Streams	Dry	3	50.00
LB-3	Laguna Coastal Streams	Dry	4	25.00
LB-4	Laguna Coastal Streams	Dry	3	66.67
LB-2	Laguna Coastal Streams	Storm	3	50.00
LB-3	Laguna Coastal Streams	Storm	4	62.50
LB-4	Laguna Coastal Streams	Storm	1	0.00
NI-1	Dana Point Coastal Streams	Dry	2	75.00
SCM-1	Dana Point Coastal Streams	Dry	8	43.75
SCM-1	Dana Point Coastal Streams	Storm	5	80.00
SJC-1	San Juan Creek	Dry	6	30.95
SJC-1	San Juan Creek	Storm	4	50.00

[1] Average effect is calculated as the percentage of samples in which the effect in the undiluted sample of a multiple dilution test exceeded 25%. Effect = percent mortality in the mysid survival/growth test and percentage of failed fertilization in the sea urchin test. All toxicity testing results are relative to results from control samples conducted concurrently with the environmental samples.

Table 11.5: Summary of Exceedances of Acute CTR Criteria Across the Region

					% Samples Exceeding CTR Criteria		
Weather	CTR Type	Station	Watershed	# Samples	Cu	Ni	Zn
Dry	FW*	ACJ01	Aliso Creek	3	0	0	0
Dry	FW	ACM1	Aliso Creek	7	0	0	0
Dry	FW	AC-PPD	Aliso Creek	4	0	0	0
Dry	FW	EC-MD	Aliso Creek	2	0	0	0
Dry	SW	ACM1	Aliso Creek	7	14	0	0
Storm	FW	ACJ01	Aliso Creek	55	0	0	0
Storm	FW	ACM1	Aliso Creek	3	0	0	0
Storm	SW	ACJ01	Aliso Creek	55	75	0	0
Storm	SW	ACM1	Aliso Creek	3	0	0	0
Dry	FW	SCM1	Dana Point Coastal Streams	7	14	0	0
Dry	FW	SC-MB	Dana Point Coastal Streams	3	0	0	0
Dry	SW	DAPTDC	Dana Point Coastal Streams	3	67	0	0
Dry	SW	DAPTEB	Dana Point Coastal Streams	3	100	0	0
Dry	SW	DAPTLB	Dana Point Coastal Streams	2	100	0	0
Dry	SW	DAPTLR	Dana Point Coastal Streams	3	33	0	0
Dry	SW	DAPTWB	Dana Point Coastal Streams	3	100	0	0
Dry	SW	SCM1	Dana Point Coastal Streams	7	57	0	14
Storm	FW	SCM1	Dana Point Coastal Streams	5	0	0	0
Storm	SW	SCM1	Dana Point Coastal Streams	5	80	0	0
Dry	FW	LC-133	Laguna Coastal Streams	3	0	0	0
Dry	SW	LB-2	Laguna Coastal Streams	3	67	0	0
Dry	SW	LB-3	Laguna Coastal Streams	4	0	0	0
Dry	SW	LB-4	Laguna Coastal Streams	3	100	0	0
Storm	FW	LCWI02	Laguna Coastal Streams	35	3	0	3
Storm	SW	LB-1	Laguna Coastal Streams	2	100	0	50
Storm	SW	LB-2	Laguna Coastal Streams	3	100	0	33
Storm	SW	LB-3	Laguna Coastal Streams	5	60	0	0
Storm	SW	LB-4	Laguna Coastal Streams	2	100	0	50
Storm	SW	LCWI02	Laguna Coastal Streams	35	71	0	9

					% Samples Exceeding CTR Criteria		
Weather	CTR Type	Station	Watershed	# Samples	Cu	Ni	Zn
Dry	FW	PDCM01	San Clemente Coastal Streams	2	0	0	0
Dry	FW	SDCM02	San Clemente Coastal Streams	4	0	0	0
Dry	SW	PDCM01	San Clemente Coastal Streams	2	100	100	0
Dry	SW	SDCM02	San Clemente Coastal Streams	4	50	0	0
Storm	FW	PDCM01	San Clemente Coastal Streams	48	0	0	0
Storm	FW	SDCM02	San Clemente Coastal Streams	36	3	0	0
Storm	SW	PDCM01	San Clemente Coastal Streams	48	96	63	15
Storm	SW	SDCM02	San Clemente Coastal Streams	36	89	22	8
Dry	FW	REF-BC	San Juan Creek	2	0	0	0
Dry	FW	REF-CS	San Juan Creek	3	0	0	0
Dry	FW	REF-TCAS	San Juan Creek	2	0	0	0
Dry	FW	SJC1	San Juan Creek	7	0	0	0
Dry	FW	SJC-74	San Juan Creek	2	0	0	0
Dry	FW	SJC-CC	San Juan Creek	3	0	0	0
Dry	FW	TC-AP	San Juan Creek	2	0	0	0
Dry	FW	TC-DO	San Juan Creek	2	0	0	0
Dry	SW	DSB5	San Juan Creek	3	67	33	33
Dry	SW	SJC1	San Juan Creek	5	0	0	20
Storm	FW	SJC1	San Juan Creek	5	0	0	0
Storm	FW	SJNL01	San Juan Creek	47	0	0	0
Storm	FW	TC-DO	San Juan Creek	35	0	0	0
Storm	SW	DSB1	San Juan Creek	3	100	33	0
Storm	SW	SJC1	San Juan Creek	5	20	0	0
Storm	SW	SJNL01	San Juan Creek	47	53	0	0
Dry	FW	CC-CR	San Mateo Creek	2	0	0	0

*Freshwater CTR criteria are a function of the water hardness

Date: August 8, 2006

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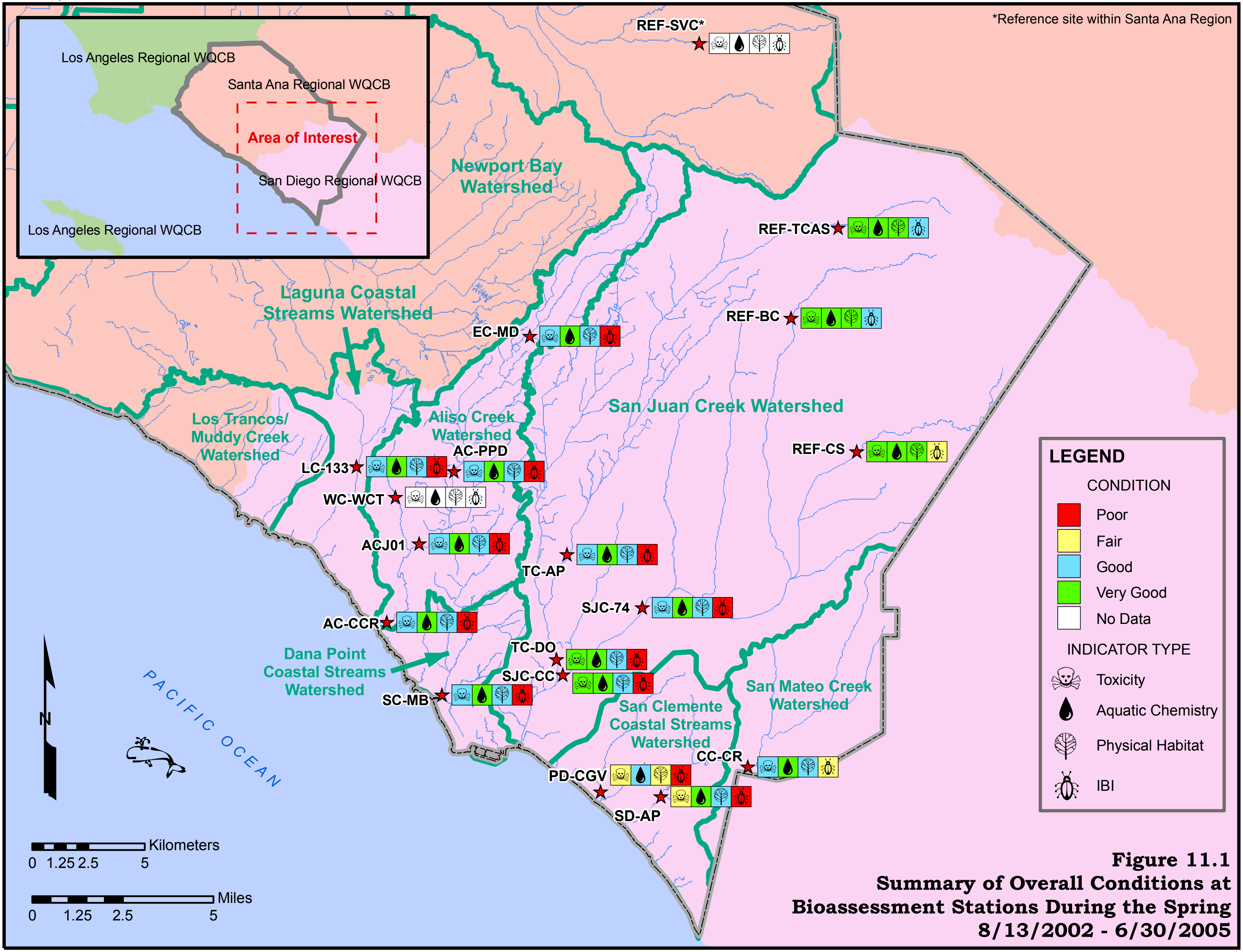


Figure 11.1
Summary of Overall Conditions at Bioassessment Stations During the Spring
8/13/2002 - 6/30/2005

Date: August 8, 2006

s:\GIS\mxds\SDR_Fall_Bioassessment_Map2.mxd

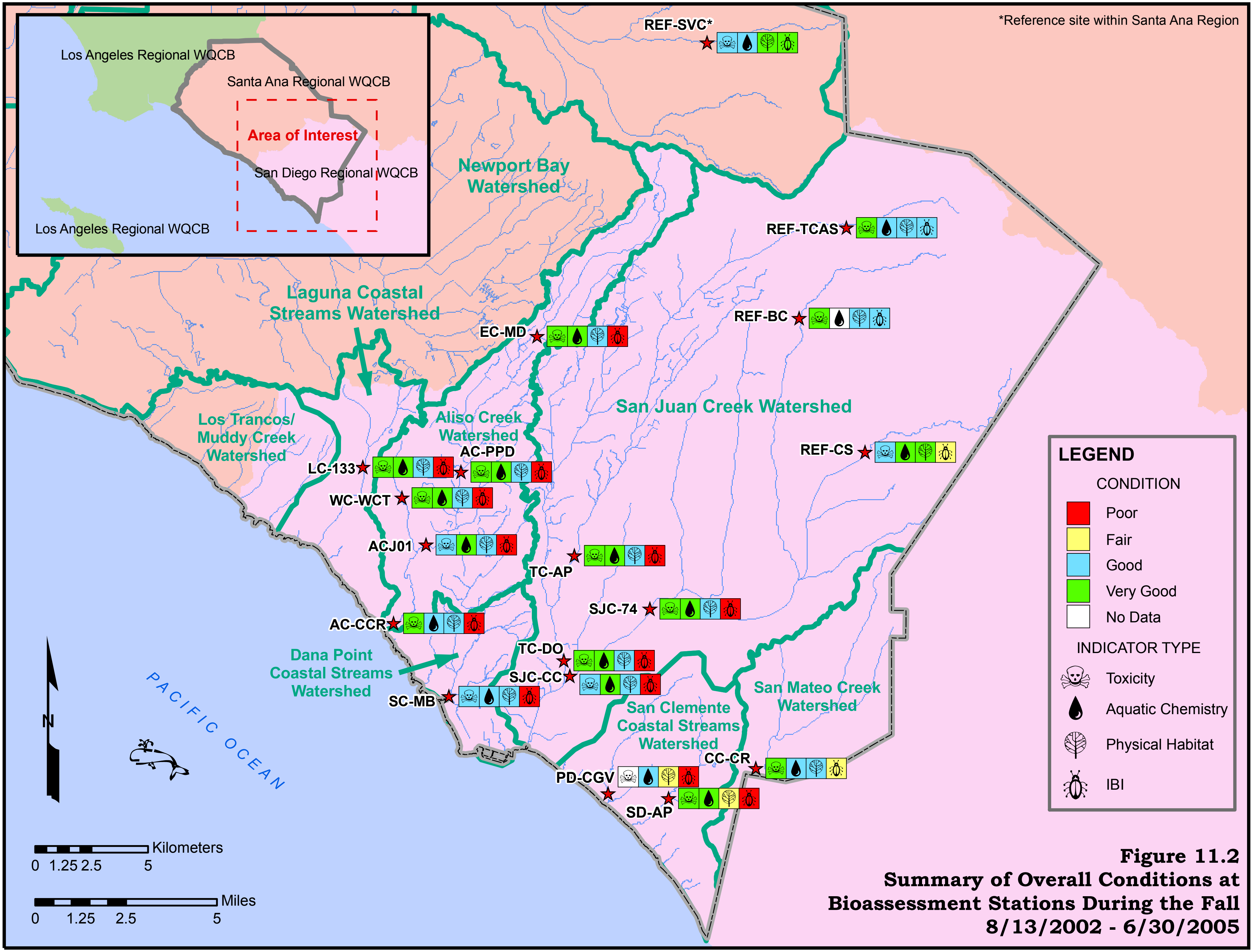


Figure 11.2
Summary of Overall Conditions at Bioassessment Stations During the Fall
8/13/2002 - 6/30/2005

Figure 11.3: Two-way Coincidence Table of Stations and Species for all Bioassessment Surveys. Reference Stations are Positioned at the Left and More Impacted Stations to the Right

Bioassessment - 2002-2005 - All Data

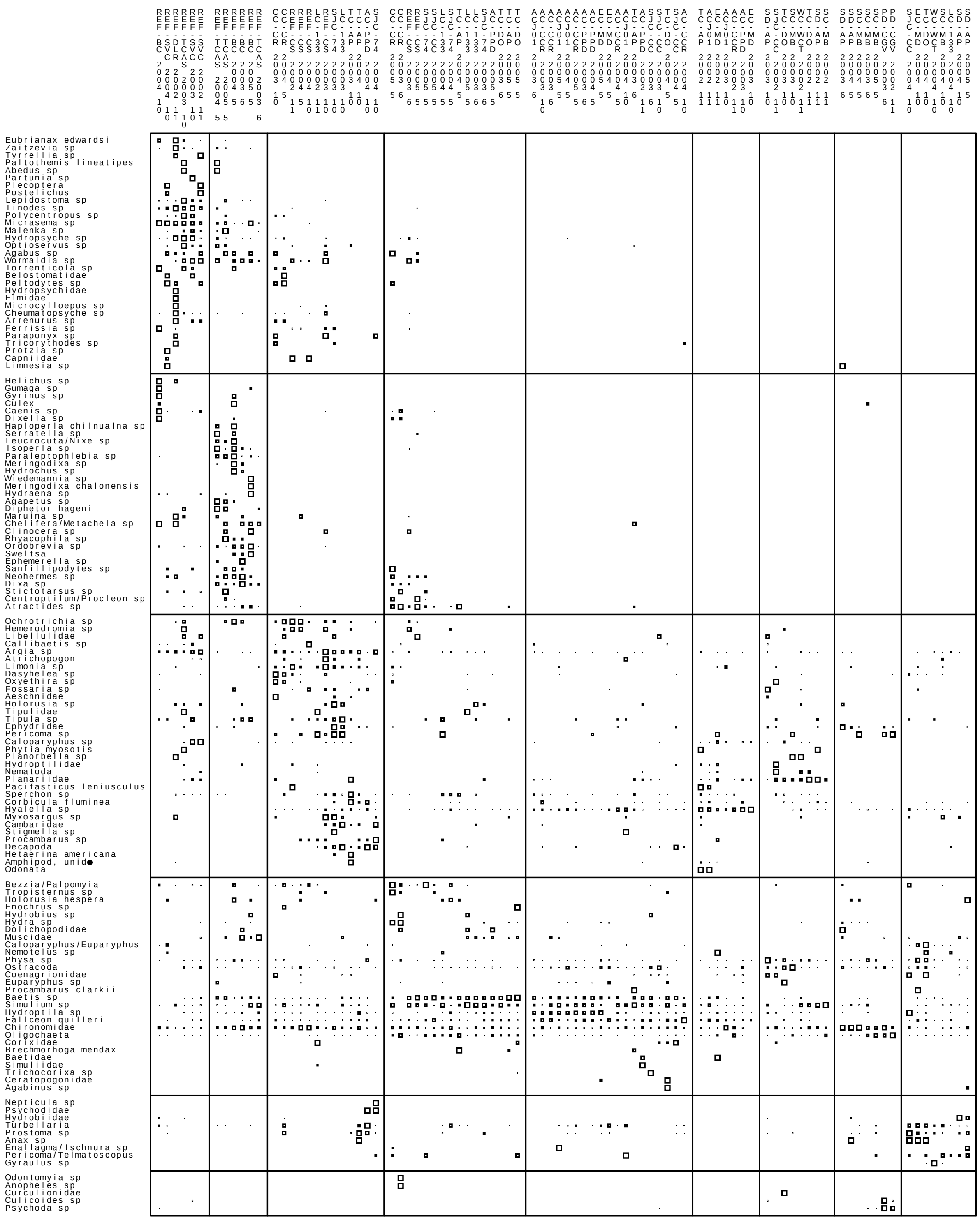


Figure 11.4: Overall Relationship Between IBI Scores and Physical Habitat Scores for all Bioassessment Surveys.

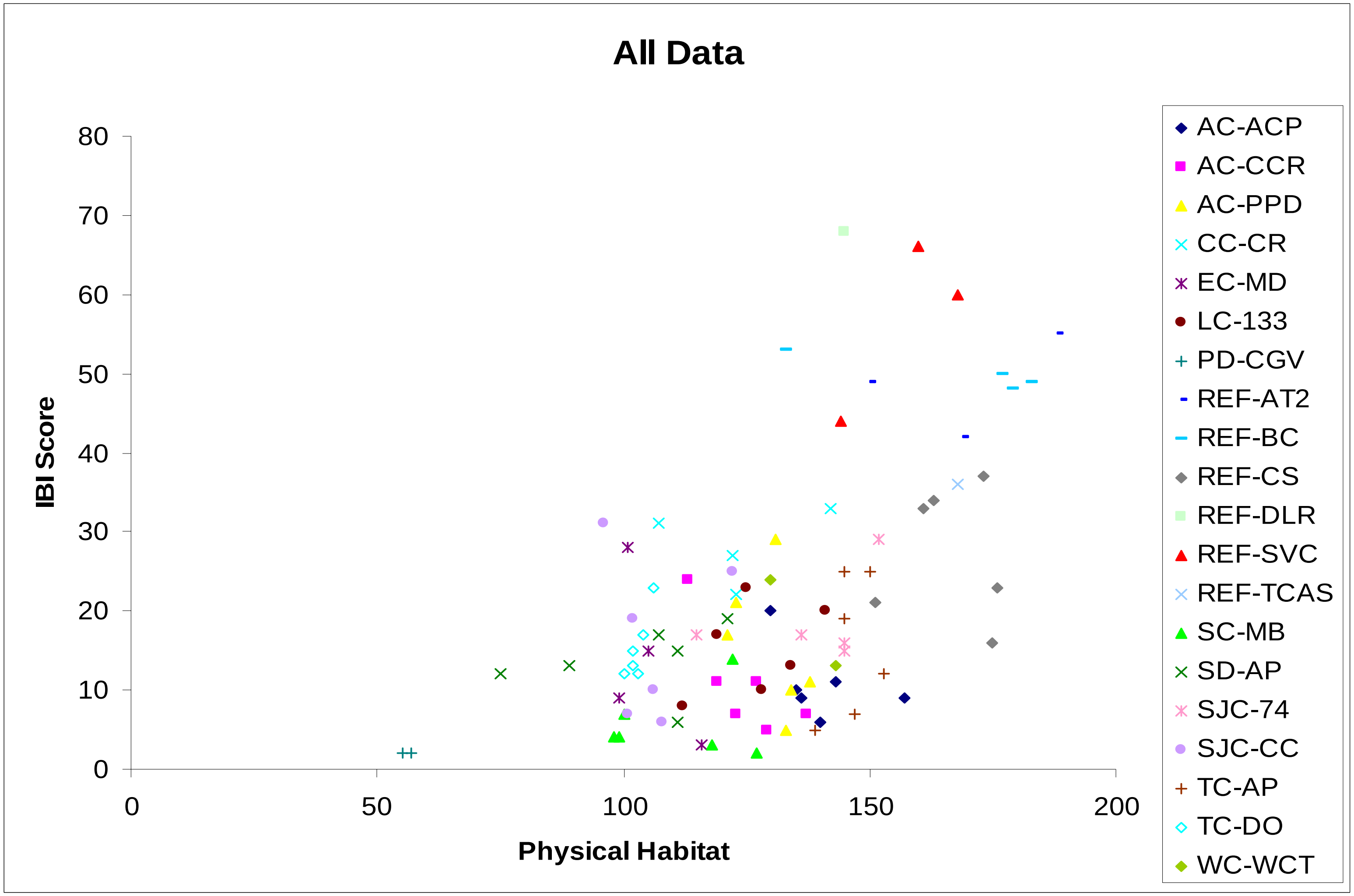
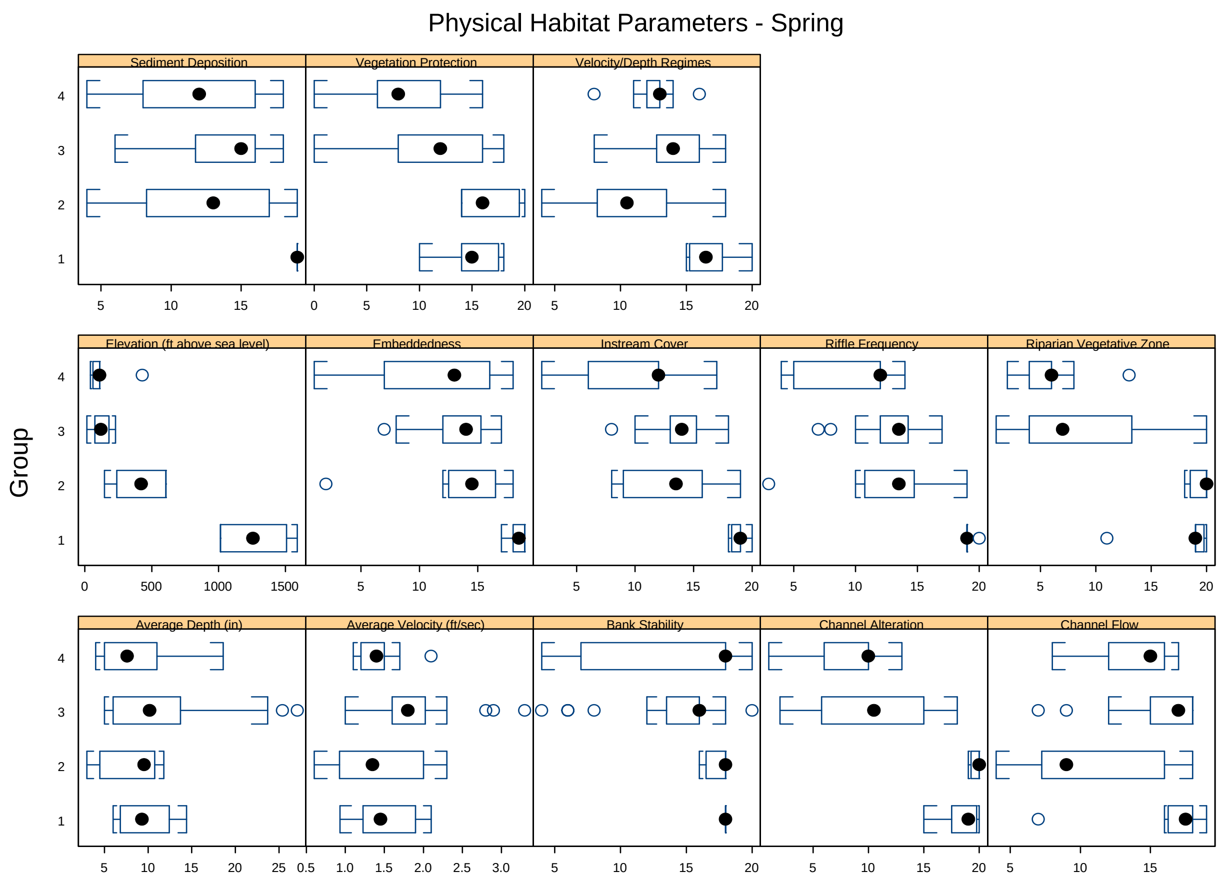
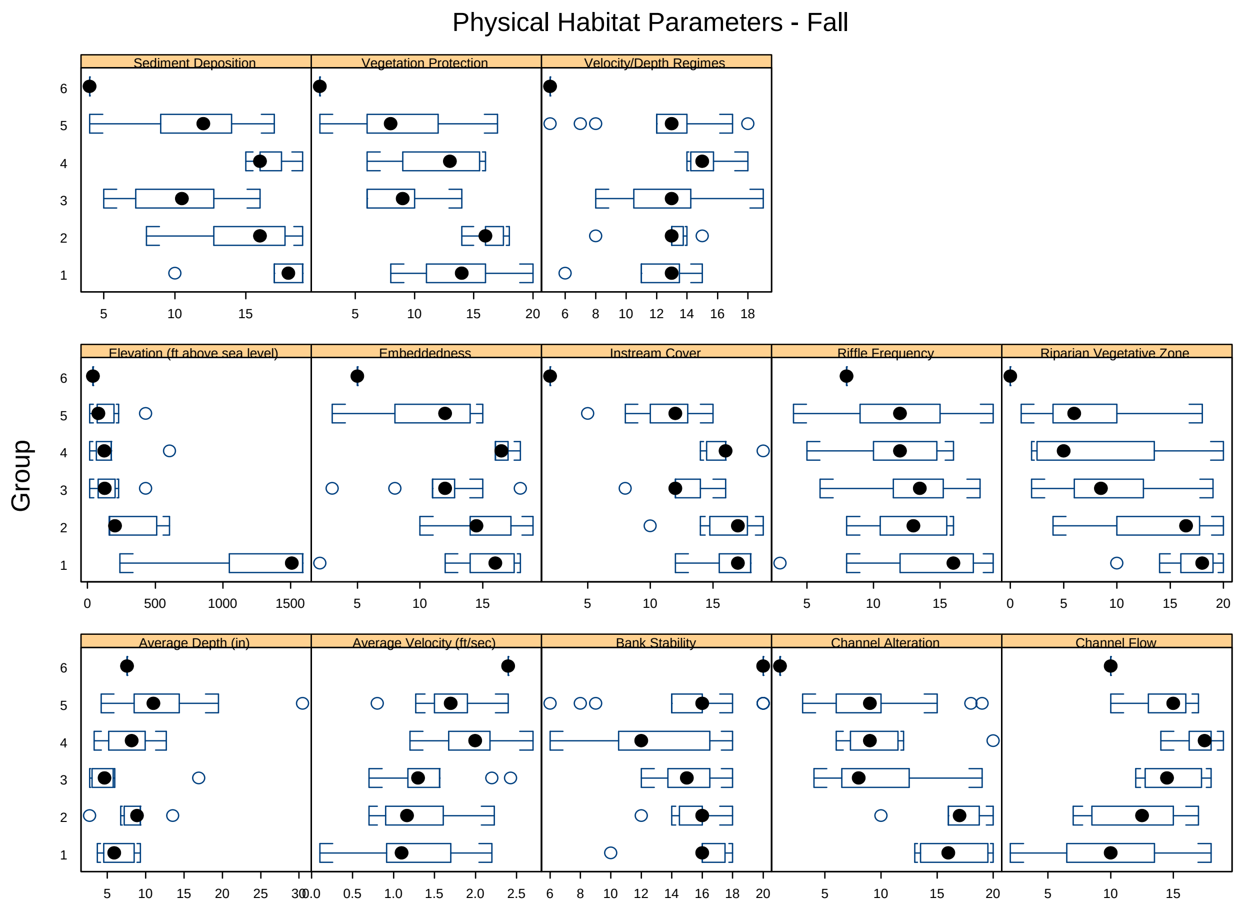


Figure 11.5a: Box and Whisker Plots of Related Physical Habitat Parameters for Spring Bioassessment Surveys. "Group" Refers to Station Groups in the Cluster Analysis, with Group 1 the Reference Sites and Groups 2 – 4 the Increasingly More Impacted Sites[1]



[1] The four site groups were defined in a separate cluster analysis of all spring samples, not shown here.

Figure 11.5b: Box and Whisker Plots of Related Physical Habitat Parameters for Fall Bioassessment Surveys. "Group" Refers to Station Groups in the Cluster Analysis, with Group 1 the Reference Sites and Groups 2 – 6 the Increasingly More Impacted Sites[1]



[1] The six site groups were defined in a separate cluster analysis of all fall samples, not shown here.

Date: August 7, 2006

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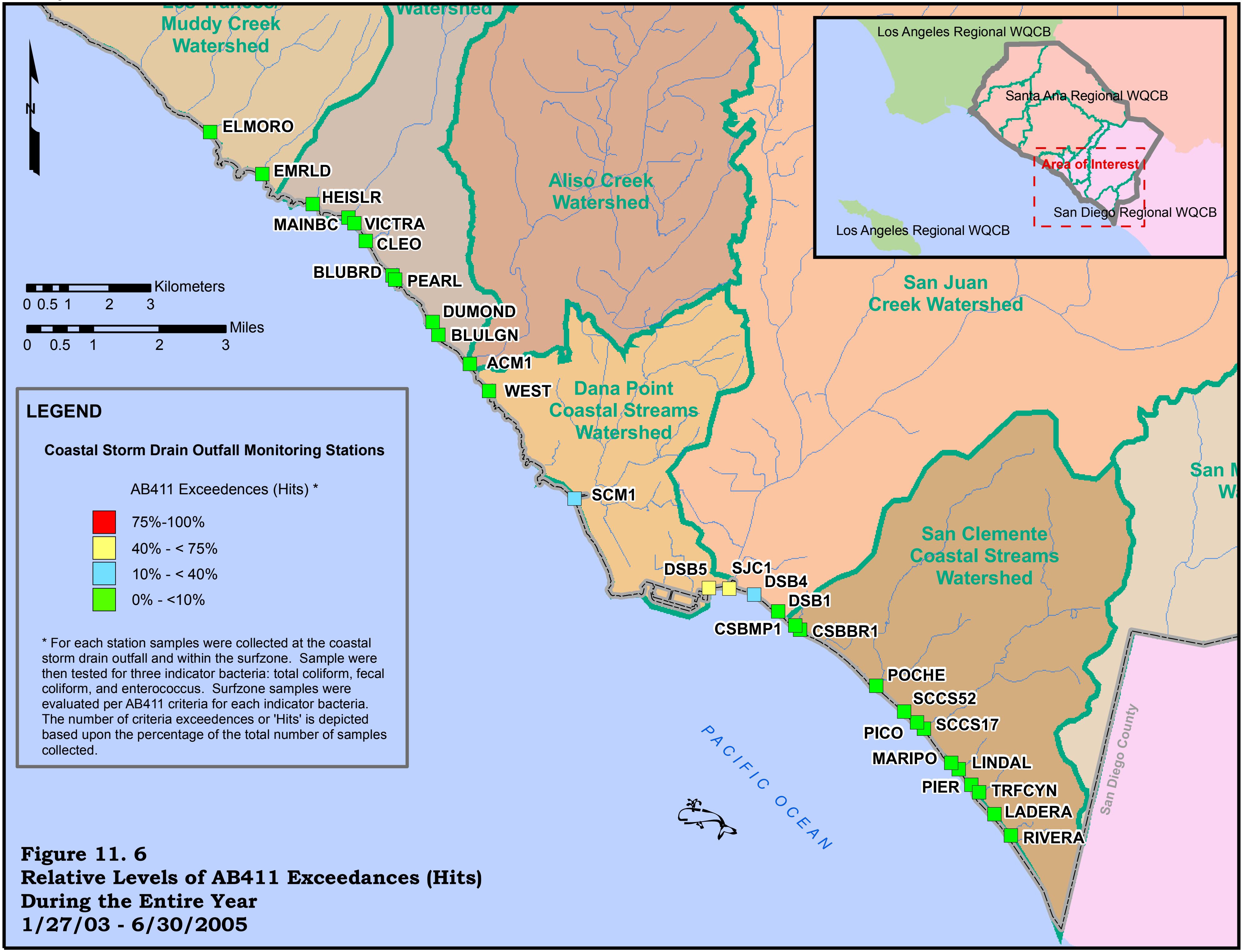


Figure 11. 6
Relative Levels of AB411 Exceedances (Hits)
During the Entire Year
1/27/03 - 6/30/2005

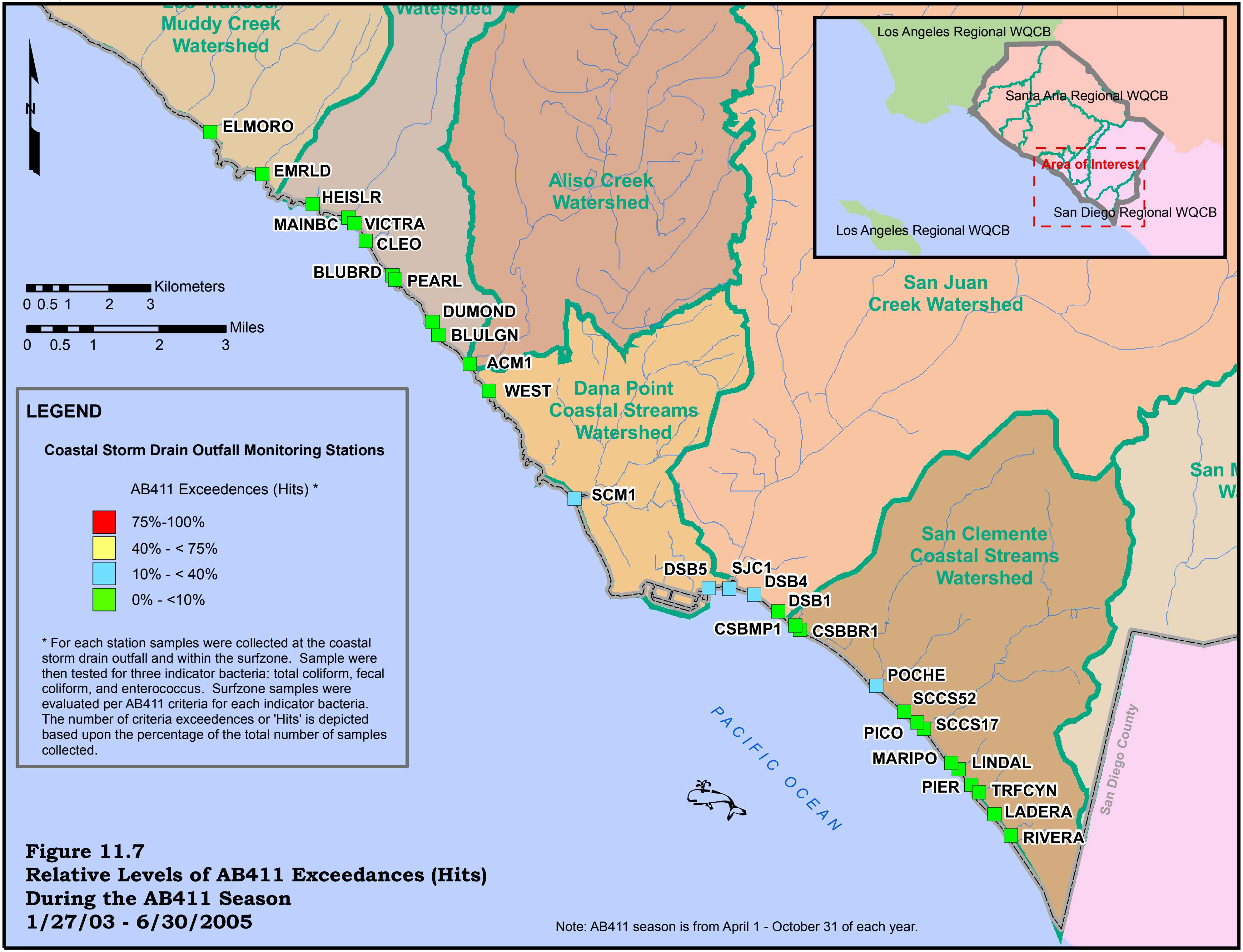
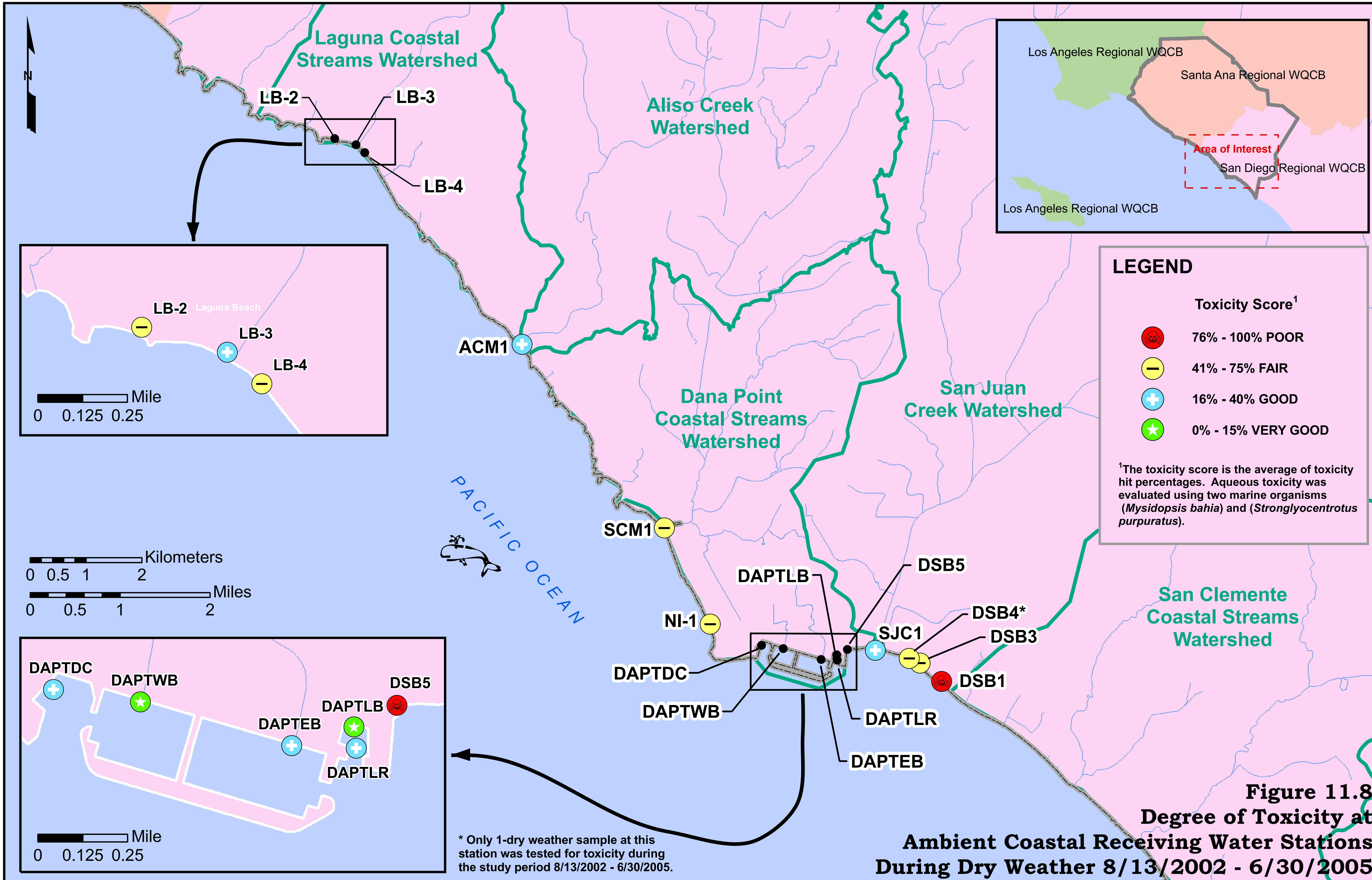


Figure 11.7
Relative Levels of AB411 Exceedances (Hits)
During the AB411 Season
1/27/03 - 6/30/2005



* Only 1-dry weather sample at this station was tested for toxicity during the study period 8/13/2002 - 6/30/2005.

Figure 11.8
Degree of Toxicity at Ambient Coastal Receiving Water Stations During Dry Weather 8/13/2002 - 6/30/2005

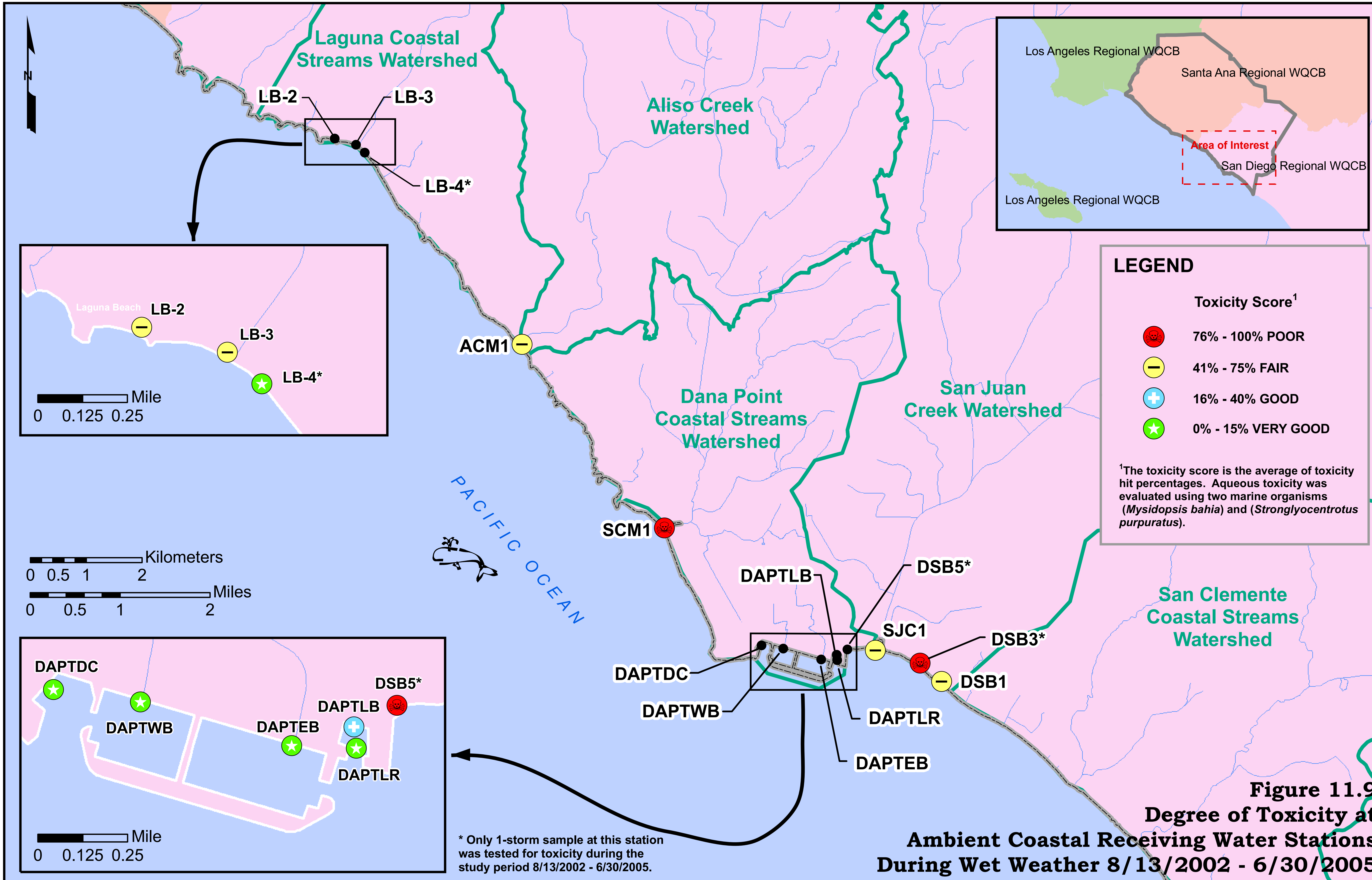
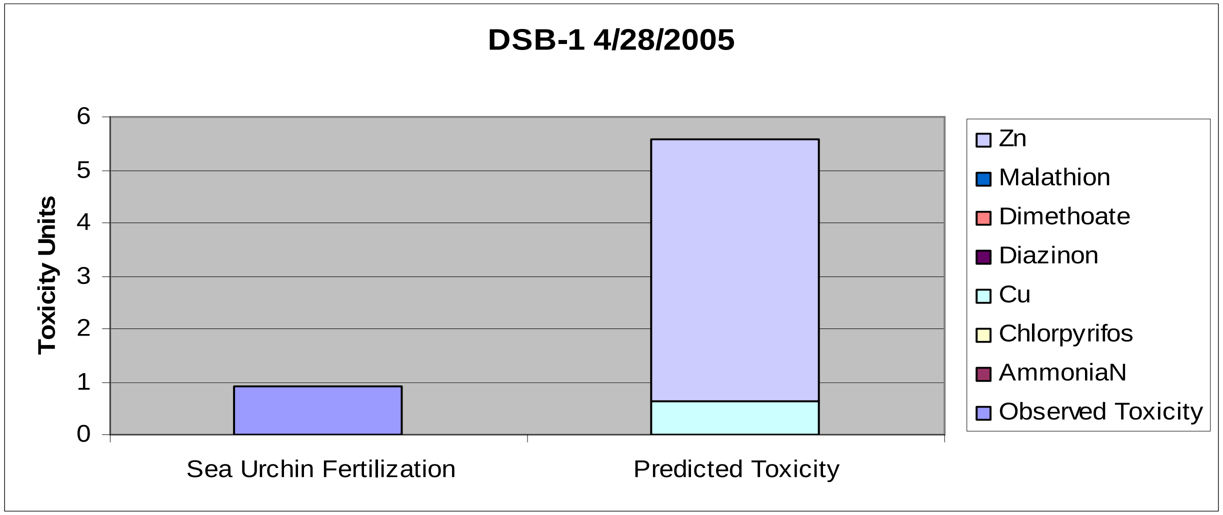


Figure 11.9
Degree of Toxicity at Ambient Coastal Receiving Water Stations During Wet Weather 8/13/2002 - 6/30/2005

Figure C-11.10: Example Comparison of Observed to Predicted Toxicity



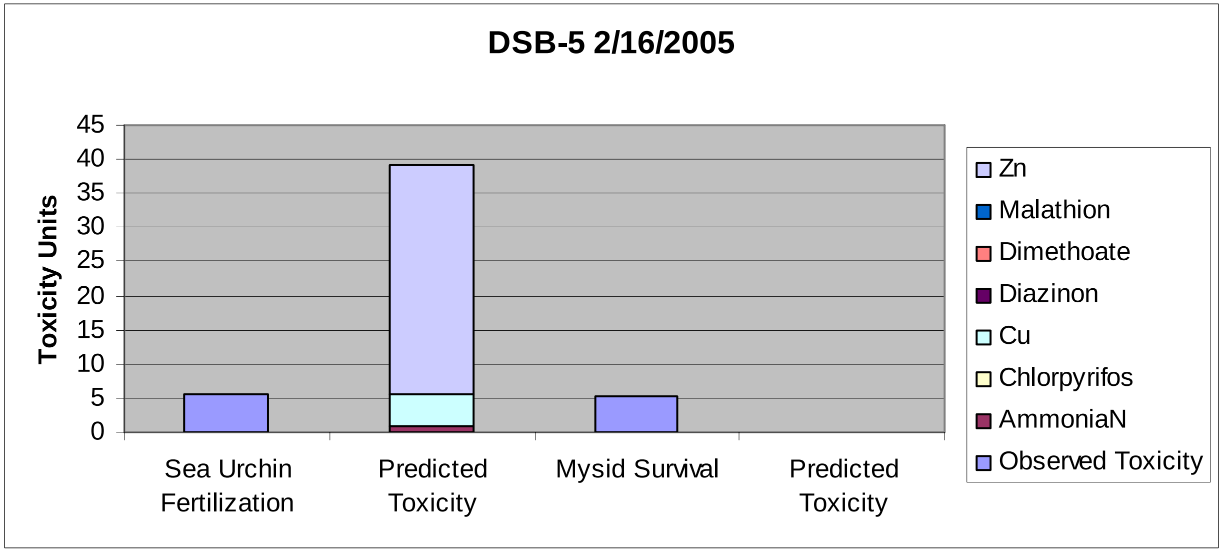
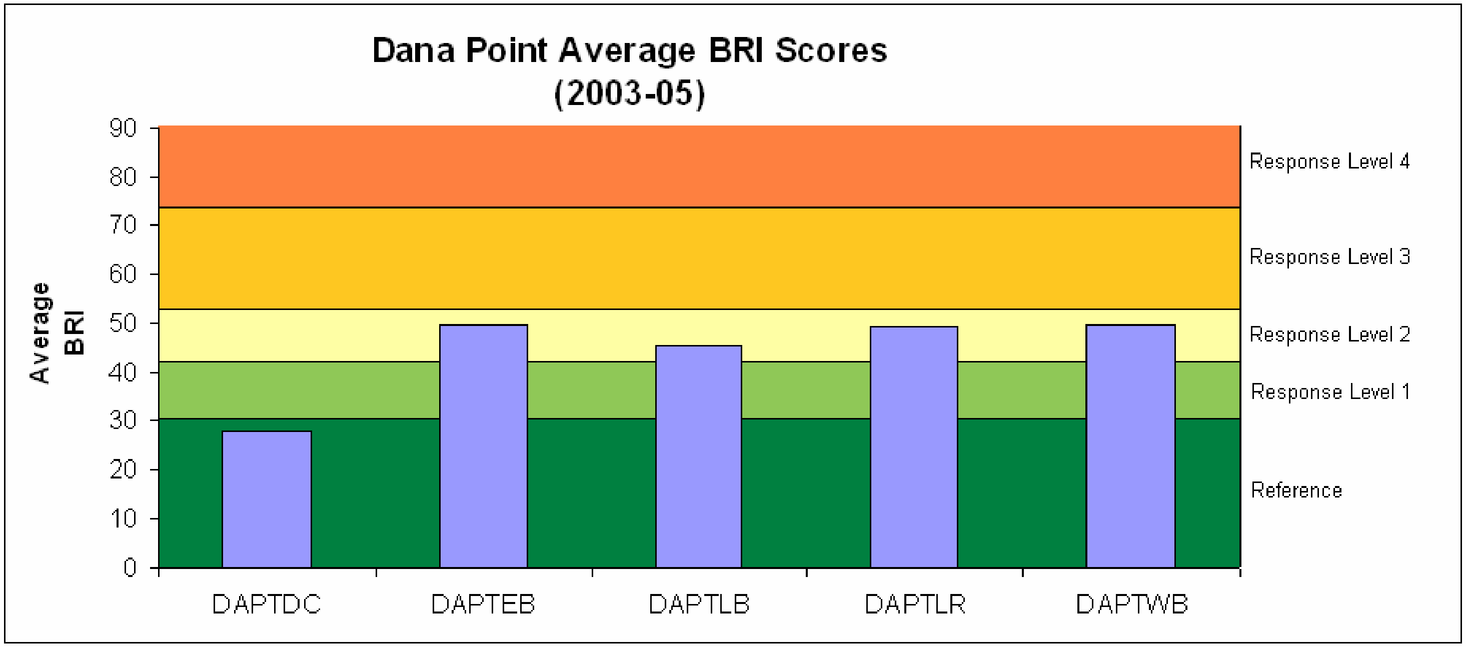


Figure 11.11: Average BRI Scores in Dana Point Harbor Over All Sampling Periods



BRI Threshold	Level	Definition
<31	Reference	
31-42	Response Level 1	>5% of reference species lost
42-53	Response Level 2	>25% of reference species lost
53-73	Response Level 3	>50% of reference species lost
>73	Response Level 4	>80% of reference species lost

Date: August 7, 2006

s:\GIS\mxds\Dana_Point_Harbor_Sediment.mxd

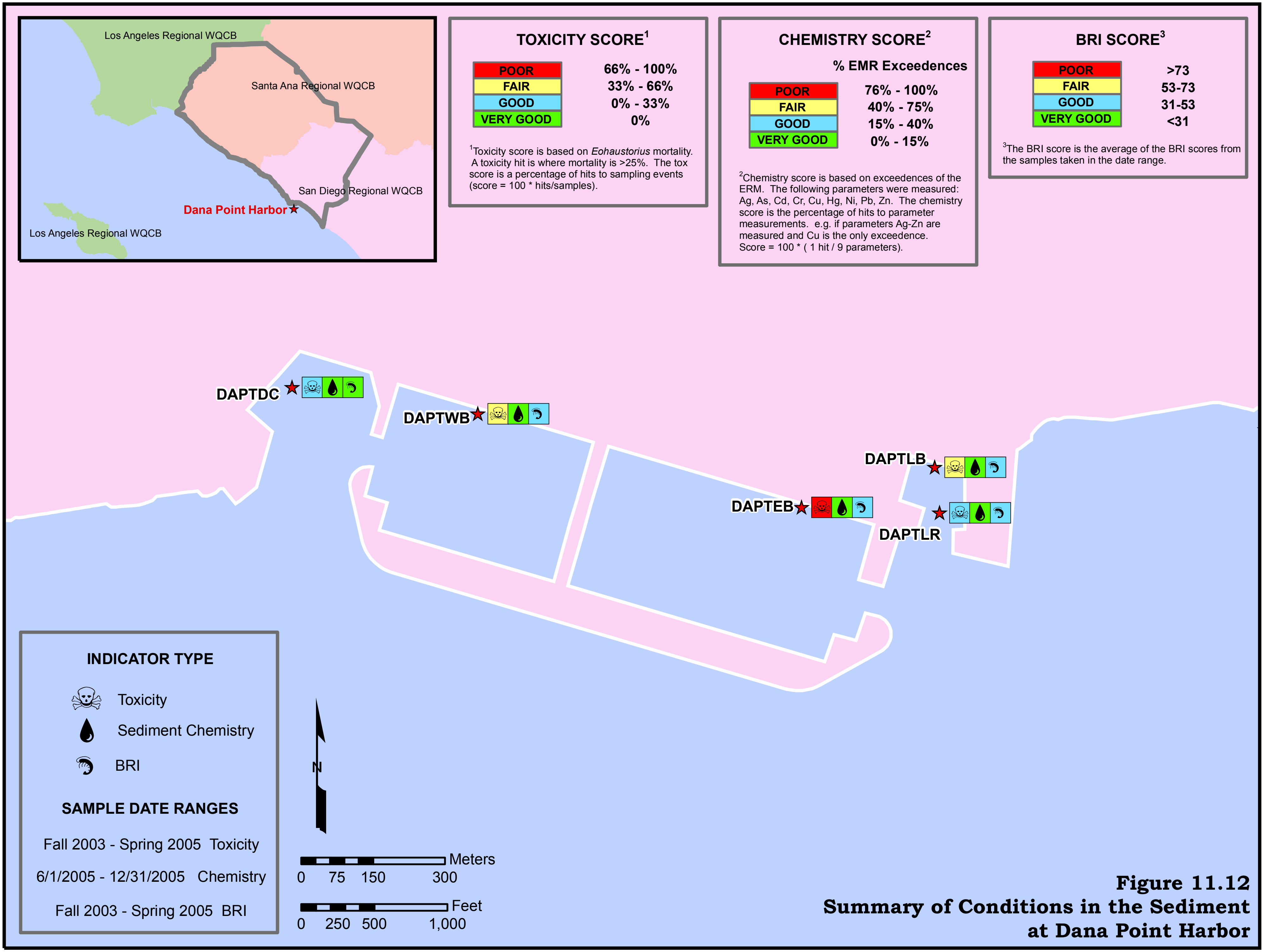


Figure 11.12
Summary of Conditions in the Sediment at Dana Point Harbor

Figure 11.13: Linear Regression of BRI Score against Toxicity to Eohaustorius

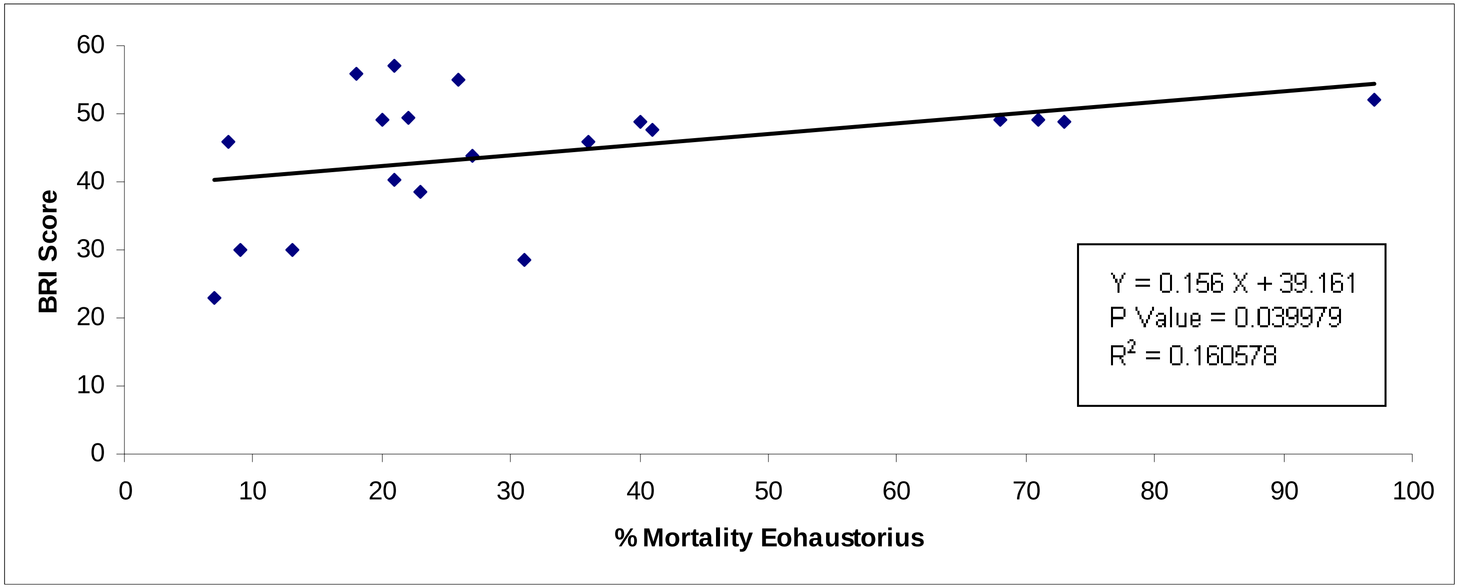
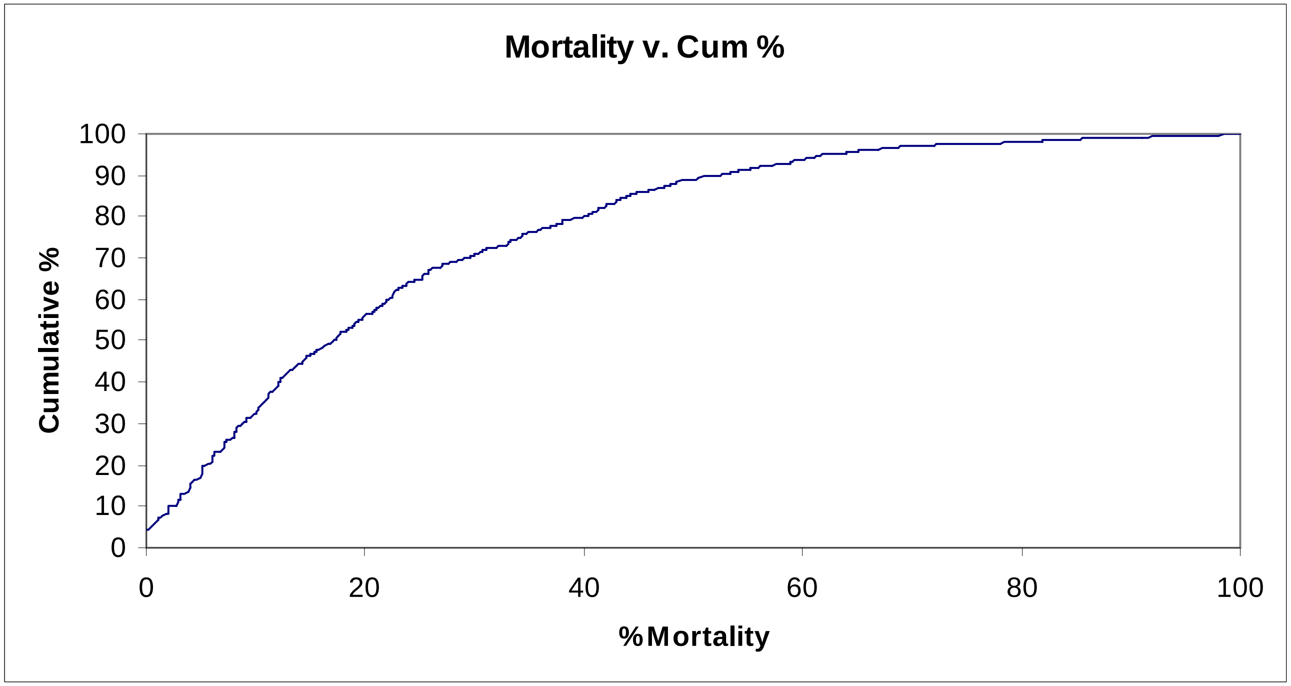


Figure 11.14: Cumulative Frequency Distribution Curve of Sediment Toxicity From the Bight '03 Survey of Conditions in Embayments Throughout Southern California



Date: August 7, 2006

s:\GIS\mxds\SDR_DW_CTR_Map_Large_Font.mxd

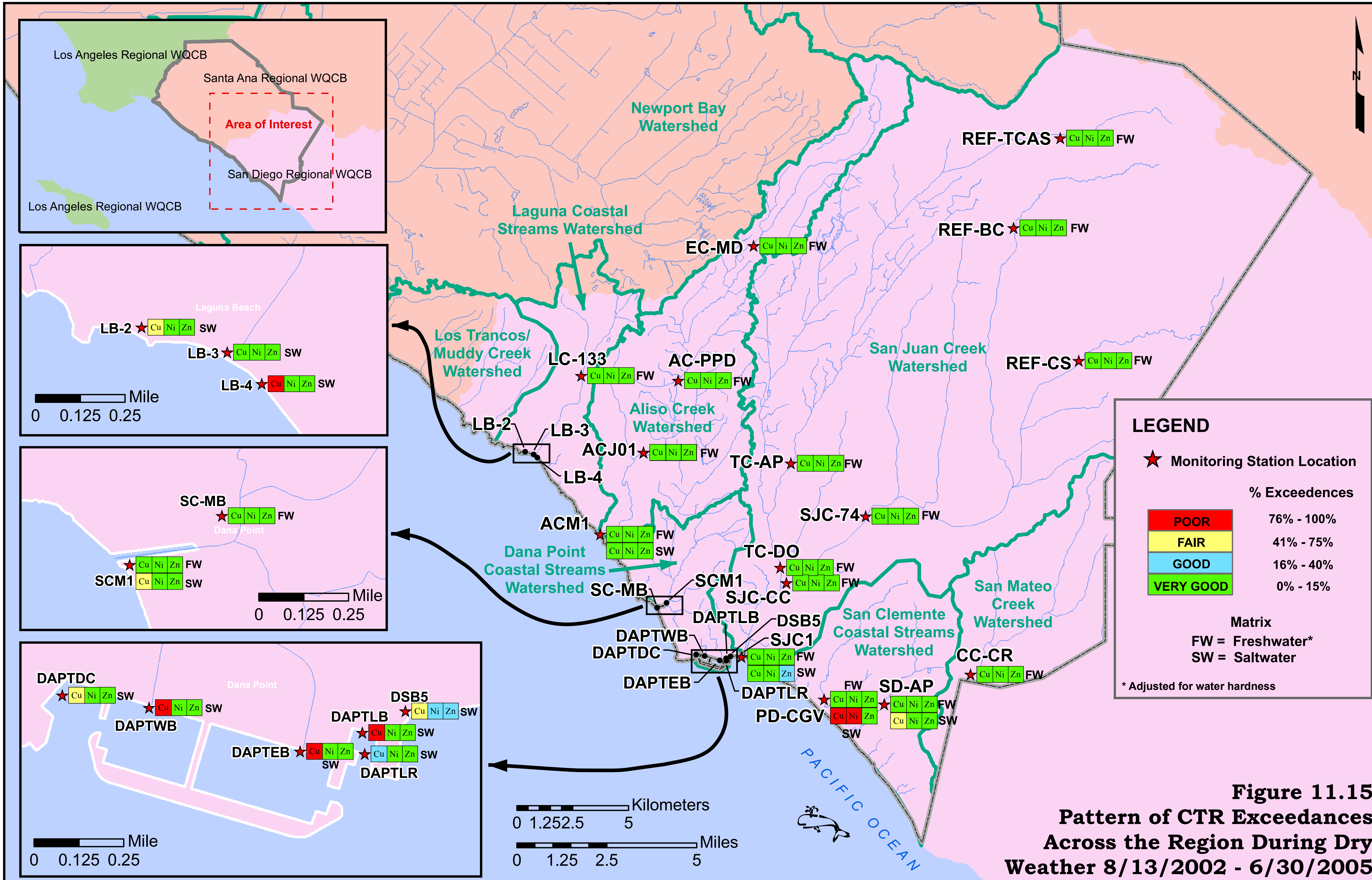


Figure 11.15
Pattern of CTR Exceedances Across the Region During Dry Weather 8/13/2002 - 6/30/2005

Date: August 7, 2006

s:\GIS\mxds\SDR_STORM_CTR_Map_Large_Font.mxd

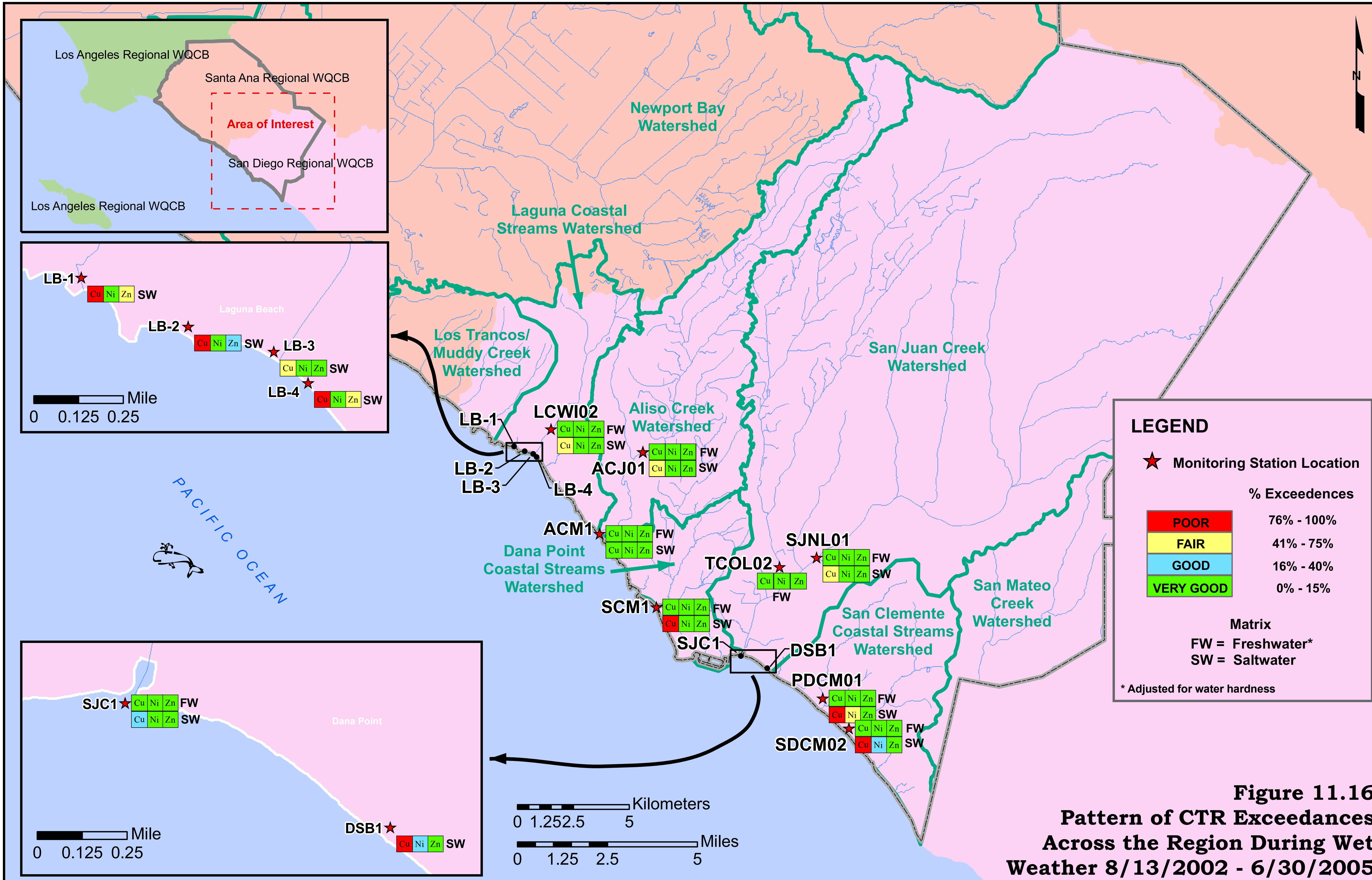


Figure 11.16
Pattern of CTR Exceedances Across the Region During Wet Weather 8/13/2002 - 6/30/2005

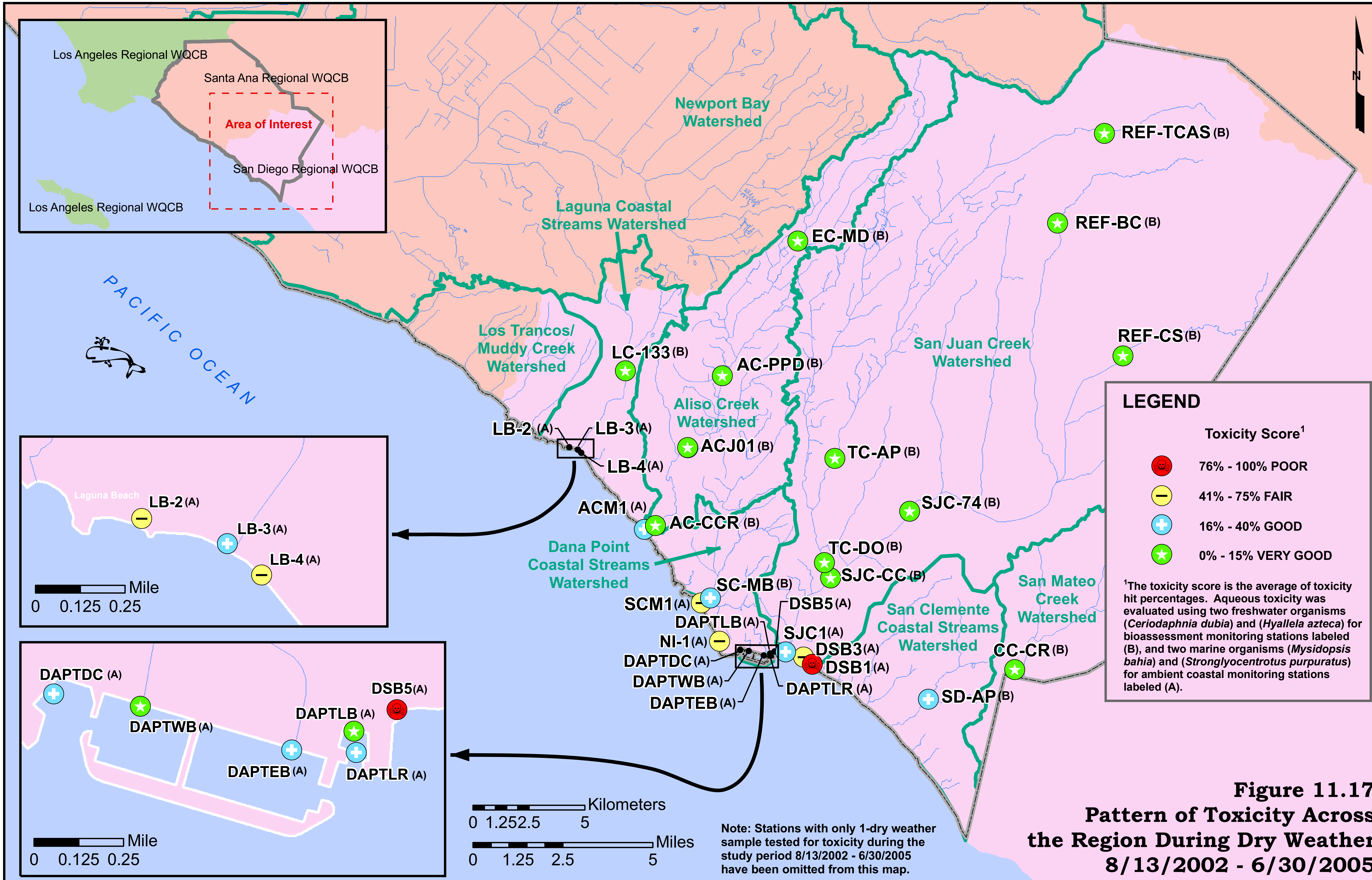


Figure 11.17
Pattern of Toxicity Across the Region During Dry Weather 8/13/2002 - 6/30/2005

Date: August 7, 2006

s:\GIS\mxds\SDR_Storm_Toxicity_Map_Large_Font.mxd

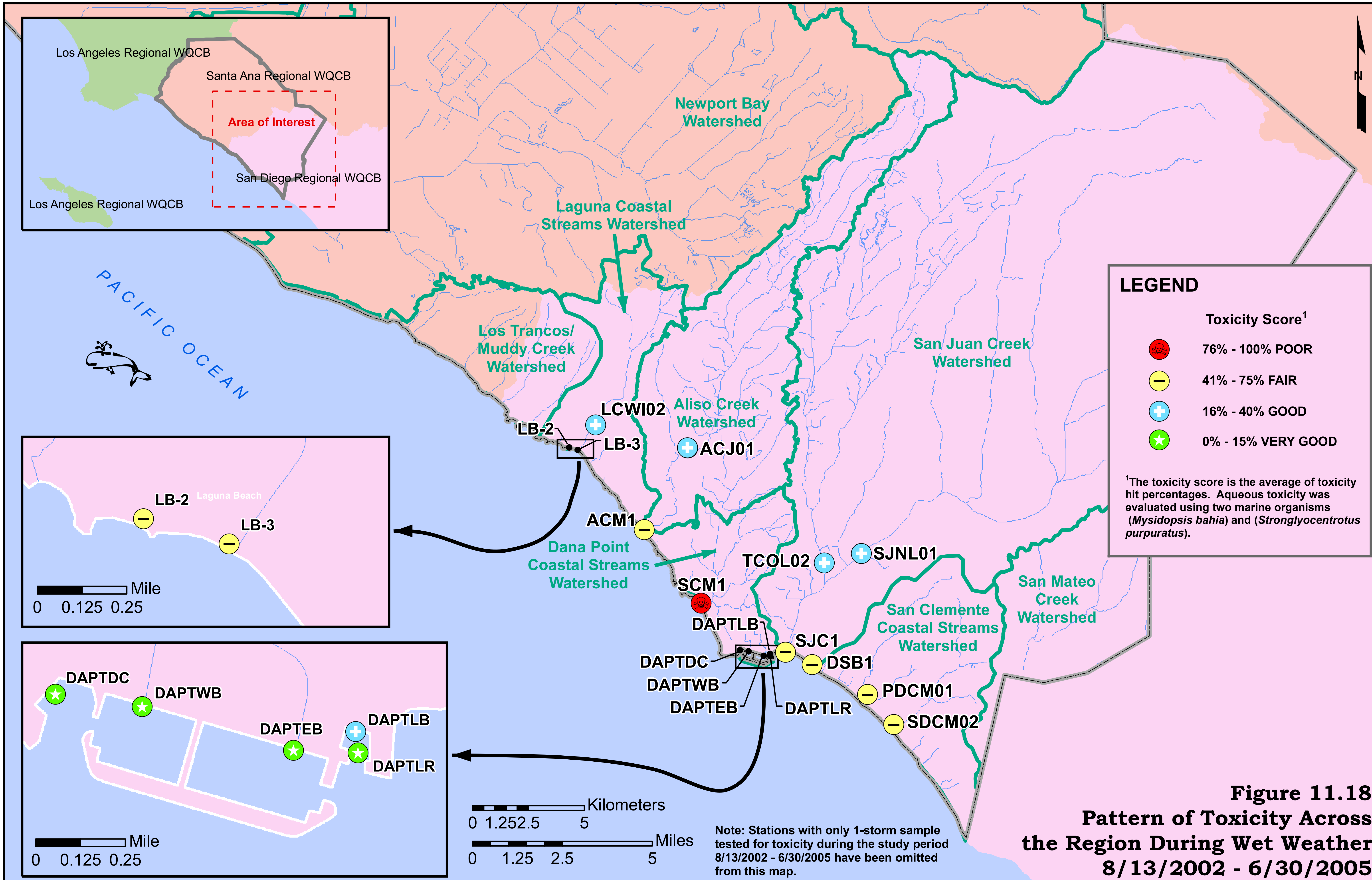


Figure 11.18
Pattern of Toxicity Across the Region During Wet Weather 8/13/2002 - 6/30/2005