Exhibit 11.III

Santa Ana Region

Water Quality Monitoring Program

February 2003

Exhibit 11.III

Santa Ana Region Monitoring and Reporting Program

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EXECUTIVE SUMMARY

This report fulfills the requirements of NPDES Permit No. CAS618030, Order No. R8-2002-0010, from the Santa Ana Regional Water Quality Control Board to the Orange County Stormwater Program Permittees for a monitoring and reporting program to be implemented beginning in 2003. This report documents that the monitoring program fulfills all the requirements of the permit. It describes program elements focused on:

- Long-term mass emissions monitoring
- Estuary / wetlands monitoring
- Bacteriological / pathogen monitoring
- Urban stream bioassessment monitoring
- Reconnaissance (dry-weather) monitoring
- Land use correlations monitoring
- Nutrient TMDL monitoring.

This sequence of program elements mirrors that laid out in the permit, with the exception that Item III.2.C. Water Column Toxicity Monitoring, is incorporated into the long-term mass emissions element. This is because Item III.2.C in the permit is defined to occur on the mass emissions samples.

The design of each element follows a structure defined in both the Publicly Owned Treatment Works (POTW) and stormwater model monitoring programs developed through the Southern California Coastal Water Research Project (SCCWRP) and the Stormwater Monitoring Coalition (SMC) that splits monitoring efforts into:

- Core monitoring of routine measurements
- Regional monitoring related to periodic regional assessments (as in the Bight ’03 study) and the development of regionally coordinated approaches and methods for stormwater monitoring and management
- Special studies that focus on answering specific questions and / or following up on potential problems identified by the results of core and / or regional monitoring.

In addition to these specific program elements, the Permittees’ Santa Ana Region monitoring and reporting program (Program) is also in direct compliance with Items III.3.A and II.3.B of the permit. The monitoring program not also uses EPA approved methods, but is actively participating in a laboratory intercalibration study being managed by SCCWRP that will set common performance standards for stormwater chemical analyses across the region. The Orange County Stormwater Program is also an active participant in the ongoing SMC’s model stormwater monitoring program project. The goal of this project is to identify a core set of key management questions and then develop common monitoring approaches to these that would provide a framework for monitoring program design throughout Southern California. As part of that project, the Program has provided data that are being used to characterize the variability of various types of stormwater data, in order to develop more rigorous monitoring design guidance.

Overall, the Permittees' water quality monitoring program is characterized by the extensive use of adaptive features such as explicit triggers for follow-on studies that focus on particular potential problems in greater depth. For example, toxicity identification evaluations (TIEs) will be triggered where toxicity impacts cross certain thresholds and upstream source identification studies will be triggered where routine chemical and / or toxicity monitoring data cross other defined thresholds.

The monitoring program described here also builds, to the greatest extent possible, on knowledge gained from past monitoring efforts throughout the county, and in other counties as well. The specific elements of this program thus represent a significant evolutionary step in terms of how management questions will be addressed through monitoring. Finally, certain aspects of the monitoring program are expected to evolve, particularly as more specific guidance becomes available from the SMC model stormwater monitoring project.

11.III - 1.0 INTRODUCTION

11.III - 1.1 Introduction

The Permittees' Monitoring and Reporting Program under Order No R8-2002-0010, NPDES Permit No. CAS618030, consists of seven main elements:

- Long-term mass emissions monitoring
- Estuary / wetlands monitoring
- Bacteriological / pathogen monitoring
- Urban stream bioassessment monitoring
- Dry weather reconnaissance
- Land use correlations
- Nutrient TMDL monitoring.

Each of these addresses a different aspect of characterizing urban stormwater runoff and its impact on the environment. The dry weather reconnaissance, long-term mass loading, estuary / wetlands, and nutrient TMDL monitoring elements build on previous efforts in the First and Second Term Permit periods, while the urban stream bioassessment, bacteriological / pathogen, and land use correlations element are relatively new efforts. The following sections describe the Permittees' overall approach to implementing these elements, relate them to the permit objectives, and describe their measurement and data analysis designs.

It is important to recognize that the Permittees' overall Stormwater Management Program includes a wide range of elements that involve activities such as public education, inspections, and a variety of best management practices (BMPs). The Monitoring and Reporting Program described in this section will provide important feedback on the ultimate effects of such actions on receiving water quality. Combined with special studies and focused BMP evaluations, the Monitoring and Reporting Program will enhance the Program's ability to continually adapt its management approach as knowledge improves.

11.III - 1.2 Report Overview

This report describes the Orange County Stormwater Program's overall approach to the design and implementation of receiving water monitoring (Section 2.1) and then explicitly states the Program's objectives (Section 2.2). Section 3 and its subsections detail each of the monitoring program's components in turn. For each component, the report states the underlying objective and then describes its core monitoring, regional monitoring, and special studies elements.

11.III - 1.3 Permit and Monitoring Background

11.III - 1.3.1 Permit history

In response to the First Term Permits (1990-1995), the Permittees developed and implemented a water quality monitoring program to aid in the detection and control of illicit connections and illegal discharges to the municipal storm drain systems and to meet other program performance objectives. The monitoring program estimated pollutant loads in urban stormwater runoff, tracked compliance with water quality objectives, searched for sources of pollutants, and addressed impacts on areas of special concern.

In response to the Second Term Permits (1996-2002), the Permittees conducted a two-year re-evaluation and revision of the water quality monitoring program. The purpose of this review was to (1) re-focus the efforts to determine the role, if any, of urban stormwater discharges to the impairment of beneficial uses and (2) to provide technical information to support an effective urban stormwater management program to reduce the beneficial use impairments associated with urban stormwater.

The Pemittees also initiated several water quality planning efforts, conducted additional water quality evaluations in response to technical requests from the Regional Boards, and participated in various regional research and monitoring programs. The combination of these efforts will aid the Permittees in determining the extent and degree of the relationship between urban stormwater runoff and impairment of beneficial uses within the aquatic resources of Orange County.

With the Third Term Permits (2002-2006), this evolution has continued with the third-term permit monitoring program described below. It expands further on previous efforts to identify pollutant sources, measure impacts, and gauge effectiveness of stormwater control efforts.

11.III - 1.3.2 Past monitoring programs and findings

Past monitoring programs have helped to characterize spatial and temporal patterns of contamination in creeks, channels, and coastal bays and estuaries, as well as laying the groundwork for long-term tracking of trends. In addition, monitoring data have helped to increase understanding of the dynamics and patterns of stormwater pollution, thereby contributing to improved monitoring and management strategies. Specific representative findings include the following:

- The first flush of a storm typically has higher concentrations of trace metals and greater organic-based turbidity than any other part of a storm. The first flush of the first storm of the season typically has the highest levels of the year.
- The concentration of total and dissolved metals is greater in storm runoff than in dry weather runoff.

- Water hardness appears to be the dominant factor in the assessment of compliance with CTR standards for dissolved metals. Stormwater in a concrete-lined channel is more likely to have a lower hardness than in an earthen channel. Stormwater in a concrete-lined channel will therefore exceed CTR standards for dissolved metals more often than stormwater in an earthern channel, assuming similar land uses in the respective watersheds.
- The Program is currently meeting the nutrient TMDL targets for San Diego Creek.
- The nutrient load to Upper Newport Bay is seasonal, with the largest dry-weather load occurring during April and May.
- The spring peak in nutrient load is correlated with peak algae blooms in Peters Canyon Wash and San Diego Creek.
- Groundwater seepage into the stormdrain system appears to be a significant source of nitrate in the San Diego Creek watershed.
- Benthic sediments collected from the harbors and bays typically have higher concentrations of trace metals than sediments collected from channels. Harbor and bay sediments also tend to have greater concentrations of silts and clays.
- Reconnaissance monitoring of the Construction Circle Drain in Irvine showed that many businesses in that drainage area were violating the County’s water pollution ordinance.

11.III - 2.0 PROGRAM OVERVIEW

11.III - 2.1 Approach to Monitoring Design and Implementation

The Permittees' approach to the development of the Monitoring and Reporting Program is based on several widely recognized and fundamental principles of monitoring design. Monitoring should be:

- Focused on specific, answerable questions that are relevant to management concerns
- Based on the most current scientific and technological understanding
- Cost effective and statistically efficient
- Designed with adaptive feedback mechanisms that allow for appropriate adjustments to the program.

Continually assessing the seven main monitoring program elements against these principles ensures that the program, and the information it produces, remain relevant and effective. In order to help accomplish this, the Permittees have considered each program element in terms of three kinds of monitoring activities, each with different implications for implementation and for the analysis and evaluation of resulting data:

- <u>Core monitoring</u> – routine, ongoing measurements, analyzed with well-defined methods, that address clearly defined questions related to small-scale or site-specific problems and processes
- <u>Regional monitoring</u> – periodic, collaborative, and larger-scale surveys, e.g., the Bight Study carried out through SCCWRP, that use standardized sampling methods to collect a wide range of data across the entire region in both impacted and reference areas. Regional data can be analyzed with a variety of descriptive, hypothesis testing, and pattern analysis methods, as well as with indices designed to place sites on regional pollution or disturbance gradients.
- <u>Special studies</u> – tightly focused and relatively short-term studies, e.g., those carried out through the SMC, often using exploratory data analysis methods, to investigate new measurement methods, improve basic understanding, characterize problems, or provide one-time measurements of important parameters or processes.

These basic principles, along with the three-part framework, have been accepted by the SMC as a template for the design of a regional model stormwater monitoring program. They will help ensure that the various aspects of each program element utilize appropriate methods for sampling, data analysis, standardization, and flexibility. It will do by helping to adapt the design of specific monitoring studies (e.g., whether a long-term trend monitoring or a shorter-term experimental approach is used, the selection of parameters, the number and location of sites) to the particular questions being asked and/or problems being addressed. **Figure 11.III - 1** illustrates how these three monitoring categories were used in organizing more detailed designs for each program element.

Figure 11.III – 1.0 provides an overall depiction of the role of monitoring information in the Program's decision making. A key aspect of this framework is the set of feedbacks that use information developed during the design and implementation of the monitoring program to refine not only technical study strategies but also more fundamental management expectations and goals.

These feedbacks occur in large part through the Program's existing reporting process and management structure, including the Public Education component. These provide ample opportunities to disseminate information about patterns of pollution and discuss their implications for the Program's objectives.

11.III - 2.2 Objectives and Program Overview

The objectives of the Monitoring and Reporting Program, as stated in the Third Term Permit, are to:

1. Develop and support an effective municipal urban runoff and non-point source control program
2. Define water quality status, trends, and pollutants of concern associated with urban storm water and non-storm water discharges and their impact on the beneficial uses of the receiving waters
3. Characterize pollutants associated with urban storm water and non-storm water discharges and to assess the influence of urban land uses on water quality and the beneficial uses of receiving waters
4. Identify significant water quality problems related to urban storm water and nonstorm water discharges
5. Identify other sources of pollutants in storm water and non-storm water runoff to the maximum extent possible (e.g., atmospheric deposition, contaminated sediments, other non-point sources, etc.)
6. Identify and prohibit illicit discharges
7. Identify those waters, which without additional action to control pollution from urban storm water discharges, cannot reasonably be expected to attain or maintain applicable water quality standards required to sustain the beneficial uses in the Basin Plan (TMDL monitoring)
8. Evaluate the effectiveness of existing municipal storm water quality management programs, including an estimate of pollutant reductions achieved by the structural and nonstructural BMPs implemented by the permittees
9. Evaluate costs and benefits of proposed municipal storm water quality control programs to the stakeholders, including the public.

The monitoring program described in the following section (see **Table 11.III - 2** for summary overview) meets these objectives (with the proviso that evaluating the overall effectiveness and cost-benefit relationships of municipal stormwater programs, including specific BMPs, requires further effort beyond the scope of the water quality monitoring program outlined in the Permit and detailed in the following section). **Figure 11.III - 3** illustrates the direct relationship between the specific permit objectives and the seven monitoring program elements.

The Monitoring and Reporting Program continues and expands the previous monitoring program's emphasis on assessing impacts on aquatic resources, documenting long-term trends in water quality, targeting problematic discharge sites for more focused investigations, and adding additional monitoring elements. **Figure 11.III - 3** briefly summarizes the specific objectives of the four program elements in terms of management goals, monitoring strategies, and other aspects of monitoring program design currently being used as a design framework in the SMC's Model Stormwater Monitoring project. **Figure 11.III - 4** results in the following more detailed objectives for each program element:

Long-term mass emissions monitoring:	Using measurements of key pollutants, loads, as well as exceedances of relevant standards, shall decline over a time frame of years to decades, as compared with past and present levels.
Estuary / wetlands monitoring:	Using measurements of key pollutants, loads, and biological community parameters, describe impacts on estuarine and wetlands ecosystems and the relationship of any impacts to runoff, based on theoretical and empirical expectations about the structure and function of healthy communities.
Bacteriological / pathogen monitoring:	Using measurements of a suite of bacterial indicators, identify spatial and temporal patterns of elevated level in order to prioritize problem areas.
Urban stream bioassessment monitoring:	Using a "triad" of indicators (bioassessment, chemistry, toxicity), describe impacts on stream communities and the relationship of any impacts to runoff, based on comparisons with reference locations and a regional IBI on a year-to-year timeframe.
Dry weather reconnaissance:	Using measurements of key pollutants, identify potential illegal discharges and illicit connections, based on comparison with historical data and available estimates of background levels.
Land use correlations:	Using an experimental, "before-after," design, identify changes in runoff associated with the urbanization of previously agricultural land.
Nutrient TMDL monitoring:	Using measurements of nutrients, track progress of nutrient control measures over time, based on comparison with TMDL targets.

The monitoring program will reflect the Program's continued evolution toward watershed management and toward addressing a more complex set of questions that integrate multiple Program elements. For example, the inclusion of an adaptive toxicity testing component in the mass emissions program element provides the ability to more fully characterize toxicity and then track its upstream source(s) on a watershed scale. As another example, the reconnaissance program (focused on identifying illegal discharges and illicit connections) will make use of the growing databases of commercial and industrial facilities resulting from the cities' ongoing inventories of such facilities. Further, the inclusion of bioassessment and estuary / wetlands components enables the Program to investigate the relationship of important biological endpoints to chemical contamination and physical changes in habitat. Overall, the monitoring program described in the following sections has expanded its focus on identifying the sources of problems, while continuing important historical data collection on trends at key sites.

Finally, the receiving water quality monitoring program responds explicitly to Section 3.3.1, Item 2, of the DAMP, which states that water quality problems will be identified through a countywide monitoring program and other assessments.

11.III - 3.0 MONITORING AND REPORTING PROGRAM ELEMENTS

Figure 11.III - 2 summarizes the monitoring program elements that have been designed to address the objectives described above. Each element is then described in fuller detail in the following sections. Data processing and analysis methods are as described in the most recent Annual Status Report, unless otherwise noted.

11.III - 3.1 Long-Term Mass Emissions Monitoring

The goal of the long-term mass emissions component of the program is to:

- Estimate the total mass emissions from the MS4
- Assess trends in mass emissions over time
- Determine if the MS4 is contributing to exceedances of water quality objectives or beneficial uses, by comparing results to the California Toxics Rule (CTR), Basin Plan, and / or other relevant standards.

These objectives will be addressed with a trend monitoring design that focuses on sites at or near the bottoms of key watersheds, and includes sampling in both wet and dry weather for toxicity as well as for a broad range of pollutants. The trend monitoring is supplemented by toxicity testing, and by special studies for TIEs (Toxicity Identification Evaluations) and upstream source identification, where called for.

In addition to meeting the basic permit objectives, these data will also be useful in helping to assess the effectiveness, in a general sense, of urban runoff management programs. More specifically, they will be helpful in measuring the performance of existing site-specific TMDLs (e.g, Newport Bay) and in generating the requirements for new TMDLs (e.g., Huntington Harbour). While the design described below makes every effort to achieve efficiencies by coordinating the TMDL and NPDES monitoring activities, there are differences in the underlying information needs for these two programs that sometimes limit the degree of coordination that can be achieved. Linkages between the NPDES and TMDL programs include:

- Mass emissions stations in the Newport Bay watershed will act as “trigger” sites in an adaptive monitoring approach that may initiate further sampling at upstream Toxics TMDL stations
- Mass emissions stations in the Newport Bay watershed are part of the sampling networks for the Toxics and Nutrient TMDLs, and data for multiple programs can often be gathered during the same sampling event
- The needs of the Toxics TMDL require that the fathead minnow (Pimephales promelas) be added to the suite of freshwater toxicity test organisms as a screening test during the first year of the permit.

However, sampling frequencies differ across the NPDES and TMDL programs, which limits the degree to which sampling efficiencies can be achieved.

The inclusion of toxicity testing in this element will not only help identify where biological impacts may be occurring, but will also improve the ability to assess potential impacts on coastal receiving waters (in coordination with the Bight '03 study). Where called for, toxicity tests at higher dilutions and TIEs, carried out as special studies, will provide additional information for further upstream source identification and / or source control efforts. With the agreement of the Board, this adaptive toxicity testing component will be substituted for the permit requirement for priority pollutant scans.

Figure 11.III - 2 shows the flow of information, and the relationships, among the NPDES mass emissions and TMDL monitoring programs.

11.III - 3.1.1 Core monitoring

The core monitoring aspects of this program element include chemical and toxicity monitoring, for both aqueous and sediment samples, collected in both wet and dry seasons. This element is based on a trends monitoring design. However, mass emissions data may also be used in combination with data from other program elements to improve understanding of patterns in urban runoff and their potential relationship to other aspects of the environment.

Mass emissions monitoring is targeted at important inputs to Huntington Harbor and Newport Bay, as well as at key coastal sites, and areas of north Orange County where surface flows have not yet been well characterized (**Figure 11.III - 3**).

11.III - 3.1.1.1 Monitored parameters

The parameters to be sampled will depend on the season (3 storm events, 3 dry weather samples per year) and on whether the sample is an aqueous or a sediment sample, as illustrated below:

Parameter	Wet Season Storms	Dry Season Aqueous	Dry Season Sediment
■ Nutrients			
o nitrate plus nitrite	X	X	
o total ammonia	X	X	
o total Kjeldahl nitrogen (TKN)	X	X	
o total phosphate	X	X	
o orthophosphate	X	X	
■ Dissolved organic carbon (DOC)	X		
■ Total organic carbon (TOC)			X
■ Total suspended solids (TSS)	X	X	
■ Volatile suspended solids	X	X	
■ Turbidity	X	X	
■ pH	X	X	
■ Oil and grease		X	
■ Temperature	X	X	

■ Dissolved oxygen	X	X	
■ Electrical conductivity	X	X	
■ Hardness	X	X	
■ Particle size			X
■ Total and dissolved heavy metals			
o cadmium	X	X	X
o chromium	X	X	X
o copper	X	X	X
o lead	X	X	X
o silver	X	X	X
o mercury[1]	X	X	X
o selenium[1]	X	X	X
o zinc	X	X	X
■ Organophosphate pesticides			
o diazinon	X	X	
o chlorpyrifos	X	X	
o malathion	X	X	
o dimethoate	X	X	
■ Bacterial indicators			
o total coliform	X	X	
o fecal coliform	X	X	
o Enterococcus	X	X	
■ Toxicity	X[2]	X[3]	
■ Herbicides[4] (e.g. Roundup)	X		
■ Others[5]			

[1]To be sampled only at the five stations that are also part of the Toxics TMDL program
[2] During two storms per year with Ceriodaphnia, sea urchin fertilization, mysid survival and growth; fathead minnow to be used in addition during the first year at the five stations that are also part of the Toxics TMDL in the Newport Bay watershed
[3] Two times during dry weather with freshwater test organisms; fathead minnow to used in addition to Ceriodaphnia, Selenastrum, and Hyallela azteca during the first year at the five stations that are also part of the Toxics TMDL in the Newport Bay watershed
[4] To be determined
[5] Constituents, determined on a case by case basis, known to have contributed to the impairment of local receiving waters

11.III - 3.1.1.2 Monitoring sites and analyses

Monitoring will be conducted at the mass loading sites shown on **Figure 11.III - 3**. Samples will be collected for three storm events per season, with three to four samples collected per storm event, and three times during the dry season. The sites target:

- Coyote Creek (in north Orange County)
- Fullerton Creek (in north Orange County)
- Carbon Creek (in north Orange County)
- Santa Ana Delhi Channel (Newport Bay watershed) *
- Peters Canyon Wash (Newport Bay watershed) *

- San Diego Creek at Campus (Newport Bay watershed) *
- Central Irvine Channel (Newport Bay watershed)
- San Diego Creek at Harvard (Newport Bay watershed) *
- Costa Mesa Channel (Newport Bay watershed) *
- Bolsa Chica Channel (Huntington Harbour) *
- East Garden Grove-Wintersburg Channel (Bolsa Bay) *.

Sites in the above list followed by an asterisk (*) are ones for which the Program has historical data that will be useful in providing a context for tracking trends into the future.

Sampling on the three northern County creeks will be phased in over a three-year period, to reflect the somewhat lower priority given this area in Section 3 of the DAMP. The sampling schedule will be:

- Year 1: Time-weighted composite samples from three storm events per year and 24-hr composite samples from three dry-weather periods per year
- Year 2: Continue automatic sampling of three storms and three dry-weather periods; install stream gauges and define the rating curves for each site
- Year 3: install automatic samplers and move to routing mass emissions monitoring on alternate years
- Year 5: continue monitoring in alternate years.

Analytical methods will remain as in the current 99-04 plan. Sampling equipment and methods will be modified to enable determinations of aqueous concentrations of organic compounds (diazinon, chlorpyrifos, malathion, dimethoate, DOC) and aquatic toxicity. Calculation of both loads and event mean concentrations will be performed as in the previous program.

Loads and event mean concentrations will be analyzed for historical patterns and trends, both at individual sites and across the north County region as a whole. These analyses will use statistical techniques such as plotting and regression analysis (for identifying trends), and cluster analysis (for identifying patterns among sites). In addition, composite samples, grab samples, and event mean concentrations will be compared to relevant standards, including:

- California Toxics Rule (CTR) levels
- Basin Plan objectives.

11.III - 3.1.1.3 Toxicity tests

With the concurrence of staff at the Santa Ana Regional Water Quality Control Board, the toxicity testing approach described in the permit has been modified. The approach in the permit specifies that toxicity testing be performed using one freshwater (Ceriodaphnia) and one marine (sea urchin fertilization) test organism to evaluate both stormwater and non-stormwater discharges from the channels. The requirement has been modified as follows:

- Stormwater
  - Ceriodaphnia
  - Sea urchin fertilization
  - Mysid survival and growth
  - Fathead minnow (Newport Bay watershed only)

- Non-stormwater (i.e., dry weather)
  - Ceriodaphnia
  - Selanastrum
  - Hyalella azteca
  - Fathead minnow (Newport Bay watershed only).

This combination of test organisms was selected to provide adequate coverage of the major classes of pollutants known as sources of toxicity (e.g., metals, organophosphate pesticides). This will provide more insight into the probable sources of toxicity, because it is well known that test organisms differ in their relative sensitivity to different pollutants. Two marine test organisms were included for stormwater testing because the major potential impact of these flows is on the estuarine and nearshore marine environment. In addition, using some of the same test organisms for both stormwater and receiving water (i.e., bays and estuaries) testing will allow for drawing tighter conclusions about the relative contribution of different inputs to the observed toxicity in the receiving waters.

Stations in the Newport Bay watershed, that are also part of the Toxics TMDL, will include the fathead minnow in the freshwater tests. Since the fathead minnow is more sensitive to pyrethroid pesticides than are Ceriodaphnia and Hyallela azteca, this will address concerns about this pesticide in the Toxics TMDL. Fathead minnow will be used as a screening test during the first year of the permit. It will continue to be used only if it shows a toxic response.

These test organisms correspond as closely as possible to those being used in the San Diego region on the County. Commonality of approach provides important benefits, including:

- Enhancing the comparability of results among programs and between Regions
- A broader assessment of potential impacts on saline receiving waters, i.e., Bolsa Bay, Talbert Marsh, Huntington Harbour.
- Decreasing the likelihood that sampling error will result in the wrong test being performed
- Improving efficiency and reducing costs
- Providing additional information on dry-weather freshwater toxicity in the Santa Ana Region with the addition of Selanastrum.
- Providing feedback, as the result of the addition of Selanastrum (which is sensitive to nutrients), that can be used in the Nutrient TMDL program for San Diego Creek and Upper Newport Bay.

All wet weather toxicity tests will be performed at 100%, 50%, 25%, 12.5%, and 6.25% concentrations, and dry weather tests at 100% and 50% concentrations, based on past findings of much higher toxicity in wet weather. (All fathead minnow tests will be performed at 100% concentration only.) A finding of substantial toxicity at the 100% and 50% concentrations will trigger a set of adaptive special studies involving additional tests at higher dilutions and TIEs (see **Figure 11.III - 4** and Sections 3.1.3.1 and 3.1.3.2.

11.III - 3.1.2 Regional monitoring

As described above, the mass emissions stations in the Newport Bay watershed are also an integral part of regional monitoring programs for the Nutrient and Toxics TMDLs. In addition, mass emissions stations on channels that drain into Huntington Harbour and Bolsa Chica Bay will provide information useful in developing future TMDLs in that area.

In addition, the Bight '03 study will have an estuarine component that will measure chemical contamination in benthic sediments and in the water column, as well as in the tissue of benthic and pelagic fish. This component will also estimate pollutant loads to estuaries from surrounding watersheds. The mass emissions stations may provide useful information about pollutant loads, depending on which estuaries Bight '03 samples (the Bight '03 planning process is not yet complete).

11.III - 3.1.3 Special studies

In addition to the core monitoring, there are four additional special studies aspects of this program element (see **Tables 2-1** and **2-2**):

- Toxicity tests at higher dilutions
- Toxicity identification evaluations (TIE)
- Upstream source identification studies
- Design of a model stormwater monitoring program.

Figure 11.III - 4 shows the interrelationship of the first three of these special study components.

11.III - 3.1.3.1 Toxicity tests at higher dilutions

If the core monitoring toxicity tests show substantial toxicity (defined as a 100% effect) at the 100% and 50% concentrations within the first hour, this will trigger additional toxicity tests at higher dilutions (up to seven dilutions for wet weather and five dilutions for dry weather) (see **Figure 11.III - 3.3**). The purpose of these additional tests is to better characterize the degree of toxicity. This information, in turn, will be useful in designing any subsequent TIEs and/or upstream source ID studies.

11.III - 3.1.3.2 Toxicity Identification Evaluation (TIE)

Where toxicity tests show **persistent** toxicity, the program will prioritize available resources to carry out toxicity identification evaluations (TIEs) to identify sources of toxicity and thereby provide information needed for more focused source identification and control. Because there are no widely accepted standards within stormwater monitoring for using toxicity test results to prompt toxicity identification evaluations (TIEs), the following rules of thumb have been used. These rules of thumb were developed in the ongoing SMC project to develop a model stormwater monitoring program for southern California. **Persistent** is interpreted to mean the occurrence of substantial toxicity in at least half the monitoring events conducted through a particular season. The instances of persistent toxicity will then be ranked in terms of their degree of toxic effect (as compared to controls) and allocate available TIE resources to these sites in rank order. The SMC model monitoring project is developing a quantitative metric that includes the persistence and magnitude of toxicity, as well as the percentage of the suite of organisms that shows a toxic response to any one sample. This metric will be adopted for use in the program as soon as it is developed and accepted by the SMC project. The relative ranking of sites on this metric will then be used to identify a set of monitoring sites for potential TIE studies in the following year (as described in the following paragraph). Prioritizing sites for TIEs based on a year’s worth of data reflects the fact that toxicity in stormwater runoff is often sporadic and serve to focus TIEs on those instances where the likelihood of identifying the source(s) of toxicity is the highest.

In general, where there is persistent and substantial evidence of toxicity in Year A, TIE’s should be conducted in Year B (the following year). (However, the list of sites may be prioritized to fit within budget and logistical constraints.) In such cases, the Program will prepare to conduct both toxicity tests and toxicity identification evaluations (TIEs) in parallel in Year B. Toxicity tests will be started and, if their results confirm the Year A conclusions (i.e., 50% or greater effect at the highest concentration), toxicity identification evaluations (TIEs) will be run immediately, using water collected from the same storm. (Based on past monitoring results, the first storms in the wet season will be the most toxic.) Where the Year B toxicity tests do not confirm the Year A results, the water collected for the toxicity identification evaluations (TIEs) will simply be discarded. This approach runs the risk of incurring extra costs in those cases where the toxicity identification evaluations (TIEs) are not run. However, it may be possible to balance such extra costs by focusing the toxicity tests on the specific organisms that demonstrated toxicity in Year A. Depending on the results of the toxicity identification evaluations (TIEs), a variety of management actions, from further source identification to specific best management practices (BMPs) and source control actions, could be implemented. Again, because there are no commonly accepted standards for using toxicity identification evaluation (TIE) results to trigger management actions, the Program will work with SCCWRP and the SMC’s model monitoring program project during Year 1 of the Program to further the development of such standards.

11.III - 3.1.3.3 Upstream source identification studies

Upstream source identification studies will be an integral part of this and other Program components.

The design of any upstream source identification studies will depend on the nature of the clues provided by the higher dilution toxicity tests and the TIEs. If the results of these are specific enough to “fingerprinting” a particular kind of activity / source, then upstream clusters of these could be identified either through map-based Yellow Page searches or with the results of municipal inventories of commercial and industrial facilities. This information could be combined with historical reports of spills or other violations to narrow the search to a smaller number of likely sources.

An alternative approach is to work upstream from the monitoring site at which the toxicity was originally found, testing both for toxicity and the presence of the identified toxic compounds at major branch points and / or inputs. While this approach is straightforward in its design, it may be difficult to implement because of the often sporadic nature of stormwater flows. Thus, identifying the source(s) of toxicity will most likely require a combination of both approaches and the source identification studies may of necessity extend over more than one monitoring year.

11.III - 3.1.3.4 Model stormwater monitoring design

The Orange County Stormwater Program is participating in the SMC project to develop a model stormwater monitoring design for the southern California region. The model design is being developed by a technical committee with representatives of the three Regional Boards (Los Angeles, Santa Ana, and San Diego) and the major municipal stormwater programs in southern California. It will involve developing regionally consistent higher-level management questions, detailed objectives, and monitoring approaches. While not intended to be overly rigid, the model program is meant to provide a common framework or starting point for fleshing out the details of individual monitoring programs. Thus, the model monitoring project will result in specific guidance for the design of the mass emissions program element (and for a range of other program elements), as well as the criteria for prompting TIEs discussed in the preceding paragraph.

11.III - 3.2 Estuary / Wetlands Monitoring

The goal of the estuary / wetlands component of the program is to determine the effects of stormwater and non-stormwater runoff associated with the increased urbanization in the watersheds of these systems. This objective will be addressed with an assessment monitoring approach that identifies relationships between runoff inputs, levels of key pollutants, and measurements of the integrity of biological communities.

These data will be useful in assessing the effectiveness of urban runoff management programs. More specifically, they will improve understanding of the ecological health of, and stresses on, these important coastal zone ecosystems. This understanding will be helpful in developing, adjusting, and tracking the performance of site-specific TMDLs and other management strategies. Coordination of the design and implementation of this element with the Bight '03 study will help place the northern Orange County monitoring results in a broader regional context by comparing conditions in the County to conditions elsewhere in southern California. Where called for, toxicity identification evaluations (TIEs) carried out as special studies will provide additional information for further source identification and / or source control efforts.

11.III - 3.2.1 Core monitoring

The core monitoring aspects of this program element include chemical and toxicity monitoring, in both aqueous and sediment samples, from key estuaries / wetlands as well as the channels that input to them. This element is based on an assessment monitoring design that searches for relationships among important biological and chemical endpoints and a range of inputs and processes.

11.III - 3.2.1.1 Monitored parameters

The parameters to be sampled in the input channels will be the same as those sampled in the mass emissions component of the Program (see section 3.1.1.1). The parameters to be sampled in the estuaries / wetlands themselves will depend on the season, on whether the sample is an aqueous or a sediment sample, and on the location of the monitoring site, as illustrated below:

Parameter	Wet Season Storms	Dry Season Aqueous	Dry Season Sediment[1]
■ Nutrients			
o nitrate plus nitrite	X	X	
o total ammonia	X	X	
o total Kjeldahl nitrogen (TKN)	X	X	
o total phosphate	X	X	
o orthophosphate	X	X	
■ Dissolved organic carbon (DOC)	X		
■ Total organic carbon (TOC)			X
■ Total suspended solids (TSS)	X	X	
■ Volatile suspended solids	X	X	
■ Turbidity	X	X	
■ pH	X	X	
■ Oil and grease	X	X	
■ Temperature	X	X	
■ Dissolved oxygen	X	X	
■ Electrical conductivity	X	X	
■ Hardness	X	X	
■ Particle size			X
■ Total and dissolved heavy metals			
o Cadmium	X	X	X
o Chromium	X	X	X

o Copper	X	X	X
o Lead	X	X	X
o Zinc	X	X	X
■ Organophosphate pesticides			
o Diazinon	X	X	
o Chlorpyrifos	X	X	
o Malathion			
o Dimethoate			
■ Bacterial indicators			
o total coliform	X	X	
o fecal coliform	X	X	
o Enterococcus	X	X	
■ Toxicity	X[2]	X[3]	X
■ Benthic infauna [4]			X

[1] In estuaries
[2] Aqueous, during two storms per year with the standard marine test organisms sea urchin fertilization, sea urchin embryo development, mysid survival and growth, at 5 dilutions
[3] Aqueous, once during dry weather with the standard marine test organisms, at 2 dilutions
[4] Once per year

The Program will combine its own monitoring data (e.g., benthic infauna) with data being collected by other parties in order to assess a broader suite of biological indicators. **Figure 11.III - 5** summarizes the key ongoing monitoring efforts in the four water bodies to be monitored.

11.III - 3.2.1.2 Monitoring sites and analyses

Monitoring will be conducted at the sites shown on **Figure 11.III - 5**. These include a combination of channel and estuary / wetland sites, with both types of sites sampled during both wet and dry weather.

There will be six channel stations, including:

- Talbert Channel
- San Diego Creek at Campus Drive
- Santa Ana Delhi Channel
- Costa Mesa Channel
- East Garden Grove-Wintersburg Channel
- Bolsa Chica Channel.

Samples will be collected at the channel stations during two storm events per season, with three to four composite samples collected during each storm. Two 24-composite samples will be collected from these channels during the dry season.

All the channel sites, with the exception of Talbert Channel, are also mass emissions sites. The availability of mass emissions data for these channels will assist in identifying potential relationships between patterns and trends in the estuaries/wetlands and the inputs of key pollutants.

There will be 12 estuary / wetland sites, including:

- UNBJAM (Upper Newport Bay-Unit Basin 1) (Toxics & Nutrient TMDLs)
- UNBSDC (Upper Newport Bay-Unit Basin 2) (Toxics & Nutrient TMDLs)
- UNBCHB (Upper Newport Bay-PCH Bridge) (Toxics & Nutrient TMDLs)
- UNBNSB (Upper Newport Bay-North Star Beach) (Toxics & Nutrient TMDLs)
- LNBHIR (Lower Newport Bay-Harbor Island Reach) (Toxics & Nutrient TMDLs)
- LNBRIN (Lower Newport Bay-Rhine Channel) (Toxics TMDL)
- HUNBCC (Huntington Harbour-near Bolsa Chica Channel mouth)
- HUNWAR (Huntington Harbour-Warner Avenue Bridge)
- HUNCRB (Huntington Harbour-Christiana Bay)
- TGDC05 (Bolsa Bay-d/s E. Garden Grove Wintersburg Channel tidegates)
- BBOLR (Bolsa Bay-off observation pier)
- Talbert Marsh.

Some sites are situated near the mouths of channels that represent major inputs of runoff, and there is a minimum of one site in each estuary that is free of direct runoff influences from the channels (**Figure 11.III - 5**). Comparisons between these two types of sites will help identify runoff impacts. The estuary / wetland sites in Huntington Harbour, Bolsa Bay, and Talbert Marsh will be sampled during two storm events per season, with three samples collected per storm event, and twice during the dry season, once prior to the beginning of the storm season (October) and once after the end (May). Sites in Upper Newport Bay have a somewhat different sampling regime because of nutrient TMDL Regional Monitoring Program (RMP) requirements. These four sites will be monitored monthly throughout the year, in addition to the two storms. However, toxicity tests in Upper Newport Bay will be conducted at only two of the four sites (UNBJAM and UNBSDC). See Section 3.1.2 for a description of chemical sampling and laboratory analytical methods.

The data analysis approaches used in the program element will reflect the basic conceptual model used to develop the monitoring design (**Figure 11.III - 6**). This model is a generic source – transport – fate/effects model that assumes that pollutants enter the estuary / wetland from channels, move through the system with the flow of water and sediment, and potentially cause impacts on sensitive habitats and/or species. While it is understood that certain pollutants can accumulate in the sediment, precise knowledge about residence times, chemical transformations, and biological uptake in this and other ecosystem compartments is not available. The data analysis approach will therefore be based primarily on two related approaches:

- A search for evidence of impacts in endpoints such as chemical concentrations in sediment, benthic infaunal community parameters, and sediment toxicity
- A search for patterns of relationship between these endpoints and measures of the input of pollutants from channels.

Evidence of impacts can be derived from comparison of current data with historical data (where available), with similar sites in other areas of southern California, or with commonly accepted reference standards (e.g., for toxicity and benthic infauna). Patterns of relationship between endpoints and measures of pollutant input can be derived from correlation analyses and multivariate pattern analyses. Where long-term historical data are available (e.g., Upper Newport Bay, Bolsa Bay Ecological Reserve) trend analyses, along with information about land use changes, may provide additional insight.

11.III - 3.2.1.4 Toxicity testing

See the discussion of toxicity in the mass emissions section (section 3.1.1.4).

11.III - 3.2.2 Regional monitoring

The availability of a southern California Benthic Response Index (BRI) for enclosed bays and estuaries will make it possible to place benthic infauna monitoring results in a broader regional context. Combined with information on sediment chemistry and channel inputs, this will assist in drawing more reliable conclusions from the Orange County monitoring results.

In addition, the Bight ’03 study contains an estuaries component, targeted at locations on the mainland that are saline in the summer, have soft-sediment bottoms, contain sub-tidal habitat, and have minimal vessel traffic. Upper Newport Bay and Bolsa Bay meet these criteria, but the set of sampling locations has not yet been finalized. This component will measure chemical contamination in sediments and in the water column, as well as in the tissue of benthic and pelagic fish. In addition, this component will estimate pollutant loads to estuaries from surrounding watersheds. While there is overlap between the Bight ’03 and the Program’s parameter list (particularly for sediment and water column measurements), the two efforts will complement each other in useful ways. Bight ‘03’s measures of tissue contamination will provide an additional indicator for documenting the effects of pollutant inputs. Comparisons between patterns of benthic infauna (County’s Program) and tissue contamination in fish (Bight ’03) may provide insight into the fate and effects of pollutants and the processes that control them.

11.III - 3.2.3 Special studies

Where toxicity tests show substantial toxicity, the program will carry out toxicity testing at higher dilutions, followed by toxicity identification evaluations (TIEs) to identify sources of toxicity (see discussion in the mass emissions section (Sections 3.1.3.1 and 3.1.3.2) for more detail). In addition, upstream source identification studies may be implemented where monitoring data indicate that impacts may be caused by inputs of one or more particular pollutants from a specific channel (see Section 3.1.3.3 for more detail). Finally, further special studies (yet to be defined) may be required to investigate specific patterns or relationships suggested by the monitoring data, for example, between sediment chemistry and observed changes in the benthic infauna community.

There is some concern that pollutants in stormwater may enter wetland upland areas through two mechanisms. First, pollutants with a specific gravity less than 1.0 float on the surface of the water and may collect along the land / water interface. Second, periodic flooding during storm events may bring stormwater-borne contaminants to upland areas. This concern will be addressed with a scoping study of upland sediment contamination. A transect of four stations, beginning just below the low tide line and traversing inland, will be sampled during dry weather on Shellmaker Island in Upper Newport Bay, and in Bolsa Bay. These sites will be chosen to minimize other sources of human impact and thus help isolate any contamination signal from stormwater. The suite of parameters to be measured will be determined in consultation with Regional Board staff. The results of this study may then provide a basis for additional special studies and/or monitoring.

11.III - 3.3 Bacteriological / Pathogen Monitoring

The goal of the bacteriological / pathogen component of the program is to determine the impacts of stormwater and non-stormwater runoff on the loss of beneficial uses to receiving waters. This objective will be addressed with a design that:

- Compares ambient indicator levels to relevant standards at sites along the coastline and on a number of inland channels during dry weather
- Evaluates the impacts of coastal stormdrains on the surfzone.

The design of the coastal stormdrain portion of this program component is based on an adaptive approach. In this approach, the basic coastal stormdrain design described below will be carried out in Years 1 and 2 of the permit. Beginning in Year 3, additional drains will be evaluated with shorter-term studies. The design of these shorter-term studies will be based on results obtained in Years 1 and 2. In addition, persistently high levels of indicator bacteria in the drains themselves will trigger upstream source identification studies to be carried out by the relevant city. Over time, these monitoring data will help to establish correlations between indicator levels in the surfzone, indicator levels in the stormdrains themselves, and upstream sources, and to identify and resolve upstream sources of elevated levels.

<u>11.III - 3.3.1 Core monitoring</u>

Core monitoring will include coastal stormdrains in representative areas along the Orange County coastline.

11.III - 3.3.1.1 Monitored parameters

Monitoring will focus on total coliforms, fecal coliforms, and *Enterococcus*. The County Health Care Agency Public Health Laboratory will perform the necessary laboratory work, using the membrane filtration method and negotiations are currently underway between the Program and the Health Care Agency Environmental Health Division to establish a cooperative approach to performing the field sampling, especially for the coastal sites.

11.III - 3.3.1.2 Monitoring sites and analyses

Designation of the set of coastal sites will require a more formal reconnaissance and site-selection process conducted in coordination with HCA and the County Sanitation Districts of Orange County (CSDOC), which both currently monitor a number of sites at bathing beaches. The reconnaissance will be necessary because the sites currently being monitored were not necessarily selected with reference to the locations of coastal storm drains and because not all of the coastal drains have been identified and mapped. Therefore, the available drains, identified through a reconnaissance effort, will be subset according to a hierarchy of criteria and different monitoring approaches applied to each (**Figure 11.III - 8**).

The rationale for each of the sorting criteria in **Figure 11.III - 8** is as follows:

- Drains with equivalent circular diameters greater than 39 inches or smaller drains whose dry-weather flow is greater than 100,000 gallons per day are more likely to be a source of significant contamination problems and this was the size threshold used in the recent Aliso Creek Directive studies and the Coastal Stormdrain Outfall Monitoring for the Permit in San Diego Region.
- Drains posted by the Health Care Agency are more likely to discharge to areas of public access where there may be a potential for human health risk
- Drains that outlet to the coast but whose flow does not reach the surfzone, even at high tide, are not likely to be affecting indicator levels in the surfzone and will not be monitored during the dry season (May-September); however, increased flows characteristic of the wet season have the potential for sometimes reaching the surfzone and warrant monitoring during this season
- Drains that are larger than 39 inches or have dry-weather flows of greater than 100,000 gallons per day, are posted by the Health Care Agency, and whose flow reaches the surfzone are high priorities for monitoring and will be monitored weekly throughout the year, in the drain itself and in the surfzone 25 yards upcoast and downcoast of the drain / surfzone interface.

The set of drains meeting the criteria described above will be identified through a field reconnaissance to be carried out in cooperation with the County Health Care Agency (HCA) and the County Sanitation Districts of Orange County (CSDOC).

Analyses of these surfzone data for core monitoring purposes will focus primarily on calculating the weekly levels of indicator bacteria and direct comparison of monitored levels to the Ocean Water Contact Standard (AB-411 standard -see Section 3.3.3.1 for more detail). Exceedances will be reported to the County Health Care Agency, which posts bacterial indicator monitoring data on the Agency's website and emails a data spreadsheet to all local jurisdictions. The Health Care Agency also routinely reviews these data and notifies cities when problems occur. Analyses of the inland data for core monitoring purposes will focus primarily on direct comparison to the Basin Plan's REC-1 and REC-2 standards.

<u>11.III - 3.3.2 Regional monitoring</u>

The regional monitoring aspect of this program element involves participation in the Bight '03 stormwater plume tracking and monitoring study, which will use a combination of remote sensing and in-situ measurements to characterize wet season stormwater plumes from the Santa Ana, San Gabriel, and Los Angeles Rivers. In addition to offshore plume measurements, additional bacteriology samples will be collected in the surfzone and at the beach, inshore of the plumes, in order to determine if such plumes have an effect on indicator levels along the shoreline.

<u>11.III - 3.3.3 Special studies</u>

In addition to the core monitoring, there are four additional special studies aspects of this program element (see **Tables 11.III - 1** and **11.III - 2**):

- Inland channels and/ or creeks
- Reprioritization and source identification
- Correlations between stormdrain and surfzone indicator levels
- Assessment and/or application of improved indicators.

11.III - 3.3.3.1 Inland channels and/or creeks

The permit specifies that six inland channels and/or creeks that are currently impaired for pathogens shall be monitored. The following sites have been selected, based on consultation with the County Health Care Agency (HCA) (**Figure 11.III - 7**):

- Buck Gully
- Los Trancos Creek
- San Diego Creek at Campus Drive
- Waterfall Creek on the Newport Coast
- El Moro Creek
- Santa Ana Delhi Channel.

The creeks were selected based on their contamination and their likelihood of containing flowing water. Monitoring at these locations will be coordinated with the monitoring currently being conducted by HCA, in order to increase the frequency of monitoring data and thus possibly provide a more accurate picture of contamination patterns at these locations. Data from this effort will be evaluated with statistical power analysis to determine whether the increased frequency does indeed improve the ability to resolve patterns and differences among drains. The design of this element of the program will then be reevaluated in consultation with the Board.

11.III - 3.3.3.2 Reprioritization and source identification

Special studies aspects of this program element include analyses needed to prioritize the drains for further study, based on the first two years of monitoring data. These analyses will include both the patterns of indicator levels (e.g., loads, frequency of exceedance, average amount of exceedance), receiving water characteristics (e.g., well flushed open coast, poorly flushed, semi-enclosed), and measures of body contact recreational water use to develop a qualitative site-specific risk measure. Prioritization criteria will be developed in collaboration with SCCWRP and the SMC and will be useful in providing a meaningful context for the raw data on levels, loads, and exceedances.

Prioritization criteria will then be used to identify the worst drains for additional ID/IC (Illegal Discharges and Illicit Connections) monitoring and for reconnaissance source identification studies to be carried out by the Permittees (see Section 3.1.3.3 for more detail on source identification methods). The results of such monitoring and source identification in turn could lead to further source identification efforts and/or management actions such as best management practice (BMP) implementation. In addition, the prioritization process could lead to reductions in monitoring effort on drains that are shown not to be a problem. The SMC model stormwater monitoring project is currently developing a quantitative trigger for initiating source identification work based on the results of monitoring of discharges to coastal and inland receiving waters. This trigger will be applied when it has been approved by the SMC model monitoring committee.

The Program will also identify a priority list of additional drains for assessment and monitoring activities in Years 3 – 5 of the permit period.

11.III - 3.3.3.3 Correlations between stormdrain and surfzone indicator levels

Another goal of the special studies analyses is to improve our understanding of the correlations between levels of indicator bacteria in the surfzone and levels in the stormdrains themselves. This will be accomplished through correlational analyses of data from the stormdrains and data collected in the surfzone. These analyses will also include data from the Bight '03 water plume tracking study that may provide insight into the relationship between indicator levels in offshore stormwater plumes and in the surfzone and at the beach (see Section 3.3.2).

11.III - 3.3.3.4 Improved indicators

In addition, the Program will participate, through the SMC, in developing rapid bacteriological indicators that will provide managers with near-real-time measures of human health risk and microbiological source identification methods that will narrow the source(s) of contamination to specific human and non-human categories.

Although they are widely used, there are well-known shortcomings that limit the effectiveness of current bacteriological indicators, both for measuring human health risk and for identifying the sources of pathogen contamination. Two projects being managed by SCCWRP are currently underway that begin to address these shortcomings. The first, development of rapid bacteriological indicators, is focused on producing easily used field tests that would provide a reliable measure of bacteriological contamination within a few hours at most. The second, validation and comparison of alternative methods to identify the upstream sources of bacteriological contamination, will select those methods (primarily genetics-based) that provide the most dependable means of identifying and distinguishing among such sources. The Orange County Stormwater Program will participate in these and related projects as needed and appropriate. For example, the Bight '03 study may include a bacterial source tracking component utilizing one or more genetic methods.

11.III - 3.4 Urban Stream Bioassessment Monitoring

The goal of the urban stream bioassessment element of the program is to describe impacts on stream communities due to stormwater runoff and to track trends in such impacts over time. The combination of core monitoring aspects described below provides the urban bioassessment program element with the ability to use a "triad" approach to assessment that includes routinely collected biological and physical data, along with direct measures of toxicity. In addition, special studies aspects provide the ability to identify pollutant and disturbance sources more accurately, improving the knowledge base for implementing best management practices (BMPs).

This is illustrated in **Figure 11.III - 9** that shows how bioassessment, chemical monitoring, and toxicity testing combine to create an overall assessment of condition. In addition, each portion of the "triad" can lea d, as appropriate, to targeted source identification studies that, in turn, can suggest specific best management practices (BMPs). The effectiveness of these best management practices (BMPs) can then be evaluated, in part, through future monitoring efforts conducted by each portion of the "triad." However, establishing a causal linkage between best management practices (BMPs) and receiving water conditions also requires information from focused studies of the effectiveness of individual best management practices (BMPs), such as those currently being conducted by the County.

11.III - 3.4.1 Core monitoring

Core monitoring aspects of this program element include bioassessment, chemical monitoring, and toxicity testing at all sites (see **Figure 11.III - 2** for more detail). This will permit assessment of conditions based on a "triad" of complementary indicator groups that provide different kinds of insight into the action of runoff-related stressors. The inclusion of toxicity testing as an aspect of core monitoring exceeds the specific permit requirements. However, it is included because of its potential to enhance information from the other two legs of the "triad" (**Figure 11.III - 9**) and provide additional guidance to source identification studies.

11.III - 3.4.1.1 Monitored parameters

In addition to the habitat and biological community parameters typical of bioassessment approaches, this element will include routine monitoring of:

- Nutrients
  - nitrate plus nitrite
  - total ammonia
  - total Kjeldahl nitrogen (TKN)
  - total phosphate
  - orthophosphate
- Total suspended solids (TSS)
- Volatile suspended solids
- Turbidity
- pH
- Oil and grease (if sheen is present)
- Temperature
- Dissolved oxygen
- Electrical conductivity
- Hardness
- Total and dissolved heavy metals
  - cadmium
  - chromium
  - copper
  - lead
  - silver
  - zinc
- Organophosphate pesticides
  - diazinon
  - chlorpyrifos
  - malathion
  - dimethoate
- Toxicity testing with the standard freshwater test organisms *Selenastrum*, *Hyallela azteca*, and *Ceriodaphnia* (with the addition of fathead minnow in the Newport Bay watershed).

11.III - 3.4.1.2 Monitoring sites and analyses

The bioassessment program will include up to 12 monitoring stations, determined in coordination with the Regional Board and SCCWRP (**Figure 11.III - 10**). While explicit site-selection criteria have not yet been established, it is likely they will include some or all of the following:

- Be located within a range of watersheds throughout the north County
- Be representative of urban stream conditions within these watersheds (e.g., Santa Ana River, Santiago Creek, San Diego Creek, Peters Canyon Wash)
- Be listed in the Basin Plan as containing freshwater aquatic habitat
- Meet the physical criteria of the California Stream Bioassessment Procedure
- Be coincident with, or in close proximity to, a long-term mass loading monitoring site.

To the extent feasible, as many as possible of the monitoring sites will be in channels that contain mass loading sites (see Section 3.1.2). Although the bioassessment sites will most probably be upstream of the mass loading sites (which are situated as close to the mouths of their respective watersheds as possible) the availability of loading data may help in interpreting bioassessment results from these watersheds. Sampling at the 12 sites will be conducted twice annually, in May and October, to coincide with the end and the beginning of the rainy season. Sites will be selected to ensure that adequate flow is present at these times of years in all but drought conditions.

Data from each site will be used to establish a basis for longer-term trend monitoring of site-specific conditions. In addition, correlation and other appropriate statistical analyses will be used to search for site-specific relationships between chemical measurements, toxicity results, and bioassessment results. These site-specific relationships will be compared across sites in order to gain an understanding of the differences between reference and more urbanized sites, as well as of any gradient of changes that might be associated with various degrees of pollution and/or habitat disturbance. On a regional basis, data from each site will be compared to an appropriate Index of Biological Integrity (IBI) when this becomes available (see Section 3.4.3.3).

There are no formal and widely accepted frameworks for interpreting data from the Triad approach in the context of stormwater management. The framework developed by the San Diego County Stormwater Program (**Figure 11.III - 6**) will be used, which provides a decision framework for implementing specific follow-up analyses depending on particular combinations of Triad results.

11.III - 3.4.2 Regional monitoring

The two aspects of this component that are relevant to regional monitoring, the development of a model stormwater monitoring program and the development of a regional Index of Biotic Integrity (IBI) are discussed in the following section on special studies.

11.III - 3.4.3 Special studies

In addition to the core monitoring, there are five additional special studies aspects of this program element (see **Figure 11.III - 1**):

- Toxicity tests at higher dilutions
- Toxicity identification evaluations (TIE)
- Upstream source identification
- Design of a model stormwater monitoring program
- Development of an urban stream Index of Biotic Integrity (IBI).

Two of these, toxicity testing and toxicity identification evaluations (TIEs), will characterize impacts in more depth, while the index of biotic integrity (IBI) will provide a more standardized framework for interpreting bioassessment monitoring results.

11.III - 3.4.2.1 Toxicity tests at higher dilutions

See Section 11.III - 3.1.3.1 above for a discussion of how additional tests will be implemented.

11.III - 3.4.3.2 Toxicity identification Evaluations (TIEs)

See Section 11.III - 3.1.3.2 above for a discussion of the Program's approach to TIEs.

11.III - 3.4.3.3 Upstream source identification

See Section 11.III - 3.1.3.3 above for a discussion of the Program's approach to upstream source identification.

11.III - 3.4.3.4 Model stormwater monitoring design

See Section 11.III - 3.1.3.4 above for a description of the program's participation in the SMC's model stormwater monitoring design project. This project may result in regionally consistent approaches to bioassessment monitoring, the use of the "triad" approach, and the application of TIEs.

11.III - 3.4.3.5 Urban stream Index of Biotic Integrity

The Stormwater Program will also participate in the SMC's planned effort, in cooperation with the California Department of Fish and Game to develop an urban stream Index of Biotic Integrity (IBI) that is consistent across the entire southern California region. This may result in a single IBI or a set of related IBIs that are appropriate for various subsets of the southern California region.

11.III - 3.5 Reconnaissance Monitoring

The goal of the reconnaissance component of the program is to identify and eliminate illegal discharges and illicit connections (ID/ICs). This will be accomplished through a monitoring design that targets specific, individual sites for which there is some prior evidence (e.g., history of spills or contamination events, surrounding landuses) that suggests the presence of ID/ICs.

11.III - 3.5.1 Core Monitoring

Core monitoring aspects of this program element will consist primarily of monitoring at 30 or more targeted sites selected for their potential to provide information about ID/ICs. In addition, ten randomly selected sites will be monitored during the first year. The data from these random sites will be used to determine if monitoring data from the San Diego region of the County can provide a basis of comparison for determining which targeted sites warrant further source identification studies to be carried out by the relevant city.

11.III - 3.5.1.1 Monitored parameters

Monitored parameters will include:

- Ammonia (f)
- nitrate (f)
- soluble phosphorus (f)
- Total suspended solids (TSS)
- pH (f)
- Oil and grease (if sheen is present) or total petroleum hydrocarbons
- Temperature (f)
- Dissolved oxygen (f)
- Electrical conductivity (f)
- Hardness (f)
- Dissolved heavy metals
  - cadmium
  - hexavalent chromium (f)
  - total chromium
  - copper (f&)
  - lead
  - nickel
  - zinc
- Organophosphate pesticides
  - diazinon
  - chlorpyrifos
  - malathion
  - dimethoate
- Bacterial indicators
  - total coliform
  - fecal coliform
  - Enterococcus
- MBAS (f)
- Phenols (f).

(f) field determination
(f&) field determination and laboratory analysis

11.III - 3.5.1.2 Monitoring sites and analyses

The locations of the sites recommended by the individual cities are listed in **Figure 11.III - 7** and shown on **Figure 11.III - 11**. These sites were all chosen based on their elevated potential to contain pollution from ID/ICs. This potential was subjectively evaluated on the basis of past history of spills, local land uses, the configuration of the drainage network, and the proximity of concentrations of specific types of commercial and/or industrial activities. Sampling and analytical methods will be the similar to those used in the San Diego region of the County (see Attachment 1, Section 3.2.1.2).

An important issue in this design is establishing the criteria to be used to trigger follow-up source identification studies by individual cities. In principle, only those sites that contain significantly higher than average levels of pollutants, or that exhibit unusual increases of pollutant levels over time, should be targeted, so that resources can be prioritized to deal with the worst problems first.

The County's reconnaissance program in the San Diego region of the County accomplishes this by comparing monitoring data from all reconnaissance sites to the average regional background, established with data from a set of 30 randomly selected sites (see Attachment 1, Section 3.2.1.1). Statistical methods (i.e., tolerance intervals, control charts) are then used to determine which sites contain pollutant levels that are well above the average background (see Attachment 2).

If the description of the average regional background from the San Diego portion of the County could be applied to the Santa Ana portion of the County, this would improve consistency across the County and achieve potential cost savings. However, the Santa Ana portion of the County has larger concentrations of commercial and industrial activity, and thus the background calculated from sites in the southern portion of the County might not be applicable to the northern County. The applicability of the south County background will be assessed with ten randomly selected sites (**Table 11.III - 8**, **Figure 11.III - 11**) in the north County (selected from the list of major County drains that discharge to open channels). If statistical tests show that the data from the north County are equivalent to the background data from the south County (**Figure 11.III - 12**), the south County background estimates will be used, and the procedures described in Attachment 2 (Section 3.3) to select the subset of reconnaissance sites for follow-up source identification studies.

If statistical tests show that data from the ten randomly selected north County sites are not equivalent to those from the south County, a combination of three approaches will be used to select monitoring sites for follow-up source identification efforts (see Attachment 1 (Section 3.3) for additional detail). These are intended primarily to help provide the basis for determining which sites are candidates for follow-up source identification studies to be carried out by the Permittees. These include:

- Comparison of each site's data values with relevant guidance levels, which will help answer the question: What are the characteristics of urban dry weather runoff at specific locations that may present higher risk?
- Calculation of a site-specific control chart for each individual targeted site (see Attachment 2 for more detail), which will help answer the question: Which sites exhibit substantial changes in their characteristics over time that could be indicative of worsening or improving conditions?
- The application of professional judgment to assess the results of the preceding two statistical analyses.

When the County has identified a site that meets the criteria for follow-up studies, it will notify the appropriate City representative that follow-up ID/IC efforts should be initiated. However, if the monitoring program finds extreme conditions that represent a clear and immediate risk to human health or receiving water quality, or that provide unambiguous evidence of a substantial upstream problem, then this routine procedure will be bypassed and the relevant inspector for that City notified immediately. In both kinds of instances, if the monitored site is near a jurisdictional boundary and the upstream drainage network for the site extends into a neighboring jurisdiction, both the jurisdiction containing the site as well as the jurisdiction containing the upstream portion of the drainage network will be notified.

The County plans to deliver monitoring data to the cities as soon as it is received from the contract laboratory and processed through a set of quality control checks. In most cases, this will be accomplished within 45 days of the sampling data. In addition, the County will carry out the procedure described in Appendix 1, Section 3.3 after each sampling event and notify the relevant city of any sites that require follow-up ID/IC investigations within 21 days of receipt of the data from the laboratory.

Each year's monitoring results will be used to assess the need for continued monitoring at each targeted site. The list of targeted sites will be reevaluated to determine whether an individual site requires further monitoring by the County or whether monitoring can be shifted to another targeted site that has yet to be monitored. Monitoring will be discontinued at a particular site when:

- Multiple sampling events find no evidence of elevated values compared to the regional tolerance interval
- An ID/IC effort, led by the relevant Permittee, is underway and does not require further County monitoring data from the targeted site
- An ID/IC effort has found the source of elevated values.

In such cases, the Program will identify additional priority sites and shift monitoring effort to those.

<u>11.III - 3.5.2 Regional monitoring</u>

See Section 3.1.3.4 above for a description of the program's participation in the SMC's model stormwater monitoring design project. This project may result in regionally consistent approaches to reconnaissance monitoring and to the development of consistent criteria for triggering follow-up ID/IC investigations.

<u>11.III - 3.5.3 Special studies</u>

Follow-up ID/IC source investigation studies may be triggered in specific instances by the core reconnaissance monitoring data. However, with the exception of Seal Beach, which contains large amounts of unincorporated County land, these will be conducted by the individual Permittees. In the case of Seal Beach, any needed studies will follow the approach described above in Section 3.1.3.3.

11.III - 3.6 Land Use Correlations

The goal of the land use correlations component of the program is to determine the effects of changes in land use on the quality of receiving waters, in particular, the impacts of increasing development and the conversion of agricultural land on the sediment loading of Upper Newport Bay.

This goal will be addressed with an experimental design that uses a series of comparisons to help isolate the impacts of specific kinds of land use changes.

<u>11.III - 3.6.1 Core monitoring</u>

Core monitoring aspects of this program element will consist primarily of the implementation of an experimental design that will measure several key parameters in runoff both before and after conversion of agricultural land to urban land uses. The monitoring design is intended to answer the question:

> What is the reduction in sediment load (and associated pollutants) in runoff associated with the conversion of agricultural land to urban land uses?

The monitoring design will include flat farmland at a minimum and may also include hillside agricultural sites if appropriate and representative ones can be found. Two replicate sites will be monitored in each condition (i.e., flat, hillside) and monitoring will take place both before and after land conversion has occurred. Replicate sites within each condition are required in order to estimate the variability in converted sites of a similar type. Repeated monitoring events in both before and after conditions are required in order to estimate the background temporal variability against which changes due to land use conversion will be compared (**Figure 11.III - 13**).

The ability to implement this design will depend on the timing of land use conversions in these two areas and the speed at which they progress. Specific decisions about the size and location of monitoring sites will depend on development plans, as will the number and timing of monitoring events in the before and after conditions. [Note: reconnaissance of potential sites will be taking place at the end of June.]

11.III - 3.6.1.1 Monitored parameters

Monitored parameters will be the same as those monitored in the mass emissions element of the program (Section 3.1.1.1).

11.III - 3.6.1.2 Monitoring sites and analyses

The locations of study areas and monitoring sites within these will be determined in consultation with the Regional Board and relevant developers, depending on the schedule of planned land conversions. Potential study areas include the old Tustin helicopter base, a planned development north of Brea, and a planned development in Villa Park.

Data analyses will involve standard ANOVA (analysis of variance) approaches to assessing differences between land use type and between before and after conditions.

11.III - 3.6.2 Regional monitoring

If possible, study areas will be chosen to complement other monitoring being carried out for (or planned for) the Sediment, Nutrient, and Toxics TMDLs.

11.III - 3.6.3 Special studies

The monitoring results may suggest additional questions that may warrant special studies to investigate patterns of pollution during certain conditions, the relationship between soil and runoff characteristics, the different effects of alternative development scenarios, and the application of different sets of BMPs.

11.III - 3.7 Nutrient TMDL Monitoring

The permit specifies that the Permittees shall continue to participate in the Regional Monitoring Program for the San Diego Creek Nutrient TMDL. This monitoring program is most recently described in the Regional Board's staff report, "A Regional Nutrient Monitoring Program for the Newport Bay Watershed – RWQCB Staff Report." This is included as Appendix A in Appendix T of the County Stormwater Program's 2001 Annual Status Report.

In addition, the permit states that strategies must be revised and / or developed to evaluate the impacts of stormwater or non-stormwater runoff on all impairments with the Newport Bay watershed and other 303(d) listed waterbodies. The components of the receiving water program described in the preceding sections meet this objective. 303(d) listing is dynamic, as the permit recognizes, as is the state of our knowledge about the patterns and sources of impacts due to urban runoff. The receiving water program explicitly recognizes this dynamism by including adaptive elements and special studies throughout the program.

11.III - 3.8 Relationship to the Bight '03 Study

There are several instances in which the Program's participation in the Bight '03 study will complement the NPDES permit monitoring. For example, the Bight '03 stormwater plume tracking and characterization study will provide a broader context for interpreting data from the coastal stormdrain monitoring element, and the Bight '03 coastal ecology monitoring will do likewise for the Program's wetlands and estuaries monitoring element. In addition, the Program is cooperating with UCI researchers on a project in the Santa Ana River to improve our understanding of the ecology of bacterial indicators.

The Program is making a direct financial contribution to both these efforts and therefore proposes to offset these costs during the first year of the permit by foregoing the monitoring of one storm event in the Huntington Harbour / Bolsa Bay estuary. The cost offset from not sampling the two channel stations and the five estuary sites in this estuary would be $56,100. This one-time cost offset will help ensure that the Program's overall monitoring effort, including its participation in Bight '03 and the Santa Ana River study, remains cost neutral.

11.III - 4.0 SUMMARY

This report fulfills the requirements of the Monitoring and Reporting Program defined in Permit CAS618030, Order No. R8-2002-0010, from the Santa Ana Regional Water Quality Control Board to the Orange County Stormwater Program Permittees. It describes the design of the new Third Term Permit monitoring plan to be implemented beginning July 2003. There are three distinct aspects of the Program that deserve emphasis.

11.III - 4.1 Program Philosophy

In terms of the overall philosophy underlying the monitoring program, the program will continue to improve its ability to assess compliance, document impacts, identify the sources of these impacts, and evaluate the effectiveness of best management practices (BMPs) and other management actions taken by the Permittees to reduce impacts (**Figure 11.III - 14**). This means the Program should continue to improve its ability to:

- Assess compliance
- Describe the ultimate impact of stormwater runoff on ecosystems (e.g., by including bioassessment in routine monitoring)
- Target additional kinds of impact (e.g., on estuarine and wetland ecosystems)
- Work with the Permittees to identify and evaluate effective methods for reducing pollutants and other stormwater-related sources of impact.

This will require the continued development of new monitoring tools and approaches.

11.III - 4.2 Program Structure

In terms of the basic structure of the monitoring program, the program will formally adopt the three-part structure being considered by the SMC – core monitoring, regional monitoring, and special studies. As **Figure 11.III - 1** shows, this is an effective way to organize the range of monitoring activities needed to fully address the objectives described in **Figure 11.III - 4**.

It also provides a means of avoiding the constraints on spatial pattern and temporal trend analyses stemming from shifts in methods, management and monitoring questions, and sampling designs. By providing mechanisms to address several different types of questions, it allows for core monitoring stations, spread throughout the northern region of the County, to be sampled with consistent methods over a period of many years. Such stable core monitoring elements reduce variance from extraneous sources, thereby enhancing the Program's ability to perform trend analyses and spatially extensive analyses without hampering the capacity to conduct a full range of shorter-term special studies.

This three-part structure also highlights the Program's growing involvement in regional monitoring and its opportunity to cost effectively develop new monitoring techniques, standardize approaches, and carry out monitoring efforts that are beyond the Program's capacity when acting alone.

11.III - 4.3 Specific Program Elements

In terms of the specific elements of the monitoring program, the program will adopt the elements summarized in Section 3.0 for the ensuing five-year permit period, including:

- Long-term mass emissions monitoring
- Estuary / wetlands monitoring
- Bacteriological / pathogen monitoring
- Urban stream bioassessment monitoring
- Dry weather reconnaissance
- Land use correlations
- Nutrient TMDL monitoring.

This new program is notable for the addition of routine bioassessment and toxicity testing, the provision for toxicity identification evaluations (TIEs), as well as for expanded estuary and wetlands assessment. In addition, these elements involve several interactions with the SMC's efforts to improve and standardize methods. They also include two specific interactions with the upcoming regional Bight '03 study:

- Participation in the assessment of conditions in estuaries, which will provide a regional background for the evaluation of local conditions in Newport Bay, Talbert Marsh, Huntington Harbour, and Bolsa Bay
- Participation in the coastal plumes study, which will provide data to complement the Program's studies of bacterial contamination in coastal storm drains.

Table 11.III - 1 Distribution of Monitoring Types Across Program Elements

Program Element	Core Monitoring	Regional Monitoring	Special Studies
Mass Loading	Chemical and flow monitoring Toxicity testing with marine or freshwater organisms	Share stations with Nutrient and Toxics TMDLs Participation in the SMC regional model monitoring design	Toxicity tests at higher dilutions TIEs Upstream source identification Participation in the SMC regional model monitoring design
Estuary Wetlands	Chemical, biological, toxicity monitoring	Application of regional BRI to benthic infauna results Participation in Bight '03 estuaries assessment Participation in the SMC regional model monitoring design	Toxicity tests at higher dilutions TIEs Upstream source identification Upland contamination Other studies suggested by monitoring results
Bacterial / Pathogen	Bacterial indicators in inland channels Adaptive design for coastal stormdrains	Participation in Bight '03 stormwater plume tracking study Participation in the SMC regional model monitoring design	Reprioritization of design and source tracking Stormdrain / surfzone correlations Assessment of improved indicators
Bioassessment	Bioassessment monitoring with DFG methods Chemical monitoring Toxicity testing with freshwater organisms	Application of regional IBI (when available) Participation in the SMC regional model monitoring design	Toxicity tests at higher dilutions TIEs Upstream source identification Participation in the SMC regional model monitoring design Participation in SMC development of regional IBI
Reconnaissance	Monitoring at targeted sites to identify potential IC/Ids	Participation in the SMC regional model monitoring design	Upstream source identification (Seal Beach only)
Land-use	Monitor water and sediment quality before and after land use changes		Other studies suggested by monitoring results
Nutrient TMDL	Monitor compliance with regional TMDL targets	Monitor compliance with regional TMDL targets	Develop and implement new and/or additional studies as 303(d) information is updated

Table 11.III - 2 Summary Monitoring Program Overview

Program Element	Targeted Areas	# Sites	Frequency/Yr	Monitoring Parameters	Additional Studies
Mass Emissions	Huntington Harbour/Anaheim Bay Coastline between Huntington Harbor and Newport Bay Upper / Lower Newport Bay North Orange County	12	3 storm events 3 dry weather Phase in 3 N. County sites over 3 yrs	Nutrients, OP pesticides, metals, bacti, dissolved organic carbon (DOC), toxicity (2 storms/2 dry weather), herbicides	Toxicity tests at higher dilutions TIEs Upstream source ID
Estuary / Wetlands	Estuaries (Talbert Marsh, Upper Newport Bay, Huntington Harbour/Bolsa Bay) Related channels (Talbert Channel, San Diego Creek, Santa Ana Delhi Channel, Costa Mesa Channel, East Garden Grove Wintersburg Channel)	12 6	2 storm events 2 dry weather UNB monthly UNB toxicity only at UNBJAM, UNBSDC See Mass Emissions	Nutrients, OP pesticides, metals, bacti, DOC, aqueous toxicity, sediment toxicity, TOC & particle size (sed), benthic infaunal analysis	Toxicity tests at higher dilutions TIEs Upstream source ID Bight '03 link Upland contamination (scoping)
Bacteriological	Inland creeks/channels Coastal drains not monitored by HCA or OCSD	6 TBD	Weekly in dry weather	Total coliform, fecal coliform, Enterococcus	Reprioritization Upstream source ID Drain/surfzone correlations Assess improved indicators
Urban Stream Bioassessmnet	To be determined with RB8 and SCCWRP assistance	11	(dry-weather May and October)	Bioassessment, nutrients, metals, OP pesticides, toxicity testing	Additional chemistry Toxicity tests at higher dilutions TIEs Upstream source ID
Reconnaissance	Commercial/industrial, new development	30	5 dry weather	DO, pH, EC, T, OP pesticides, dissolved metals, O&G or TPH, MBAS, bacteria, TSS	Source ID (by cities)
Land Use Correlations	Newport Bay watershed	2 areas ? sites / area	? storm events ? dry weather	Same as mass emissions	TBD

Program Element	Targeted Areas	# Sites	Frequency/Yr	Monitoring Parameters	Additional Studies
Nutrient TMDL	Newport Bay watershed Upper Newport Bay	9 channel 5 UNB 9 UNB	Biweekly Monthly 9/yr	Nutrients Nutrients Algal biomass	TBD

Table 11.III – 3 Relationship of Permit Objectives to Monitoring Program Elements

Permit Objectives	Long-term Mass Loading	Estuary / Wetlands	Bacterial / Pathogen	Urban Stream Bioassessment	Recon-naissance	Land-use Correlations	Nutrient TMDL
1. Effective runoff & source control program							
2. Define status, trends, & impacts	X	X	X	X	X	X	X
3. ID pollutants & assess land-use effects	X	X	X		X	X	
4. ID significant problems	X	X	X	X	X	X	X
5. ID other sources of pollutants							
6. ID & prohibit illegal discharges					X		
7. ID sensitive waters		X		X			
8. Evaluate municipal programs	X	X	X	X	X	X	X
9. Evaluate costs & benefits of municipal programs							

Table 11.III – 4 Specific Monitoring Objectives of the Program Elements

	Long-term Mass Loading	**Estuary / Wetlands**	**Bacterial / Pathogen**	**Urban Stream Bioassessment**	**Reconnaissance**	**Land-use Correlations**	**Nutrient TMDL**
Management goal(s)	Steady improvement	Describe impacts	Prioritize problem areas	Describe conditions / impacts Describe relationship to runoff	Identify potential IC/IDs	Describe consequences of change	
Monitoring strategy	Measure actual targets at individual sites	Assessment	Measure suite of indicators across the region	Measure suite of indicators	Measure suite of pollutants at specific sites	Before-after experimental design	
Certainty / precision	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Reference condition	Historical data	Historical data Ecological theory Empirical expectations	Standards Internal comparisons	Reference watersheds Regional IBI	Historical data Regional background	Before condition	
Spatial scale	Site specific	Individual system	Site-specific Regional	Site specific Regional	Site-specific	Site-specific Regional	
Temporal scale	Years to decades	Annual to years	Weekly to seasonal	Year-to-year	Seasonal to years	Years	

Table 11.III – 5 Ongoing Monitoring Efforts in Wetlands and Estuaries *

Agency	*Talbert Marsh*	Upper Newport Bay	Bolsa Bay / Bolsa Chica Marsh	Huntington Harbour
Audubon		bird counts (monthly)		
Coastal Res. Mgmt.		vegetation surveys for Salt Marsh Bird's Beak		
Cal. State Univ. LA		Water and sediment		
County of Orange		Micro algae	Chemistry	
County of Orange		Sediment		
Dept. Fish & Game		Least Tern nesting sites (summer)		
Dept. Fish & Game		Marine Life Inventory (monthly)		
OC Water District		Light Footed Clapper Rail surveys		

* Table lists longer-term efforts ongoing in these locations. Studies of one or two year's duration are not included.

Table 11.III – 6 Decision Framework for Interpreting Triad Results

Chemistry	Toxicity	Benthic Alteration	Possible Conclusion(s)	Possible Actions or Decisions
Exceedance of water quality objectives	Evidence of toxicity *	Indications of alteration	Strong evidence of pollution-induced degradation	Use TIE to identify contaminants of concern
No persistent exceedances of water quality objectives	No evid-ence of toxicity	No indications of alteration	No evidence of pollution-induced degradation	No action necessary
Exceedance of water quality objectives	No evid-ence of toxicity	No indications of alteration	Contaminants are not bio-available	1. TIE would not provide useful information if there is no evidence of toxicity 2. Continue monitoring and attempt to identify source(s) of chemical(s) exceeding water quality objectives
No persistent exceedances of water quality objectives	Evidence of toxicity *	No indications of alteration	Unmeasured contaminant(s) or conditions have the potential to cause degradation	1. Recheck chemical analyses; verify toxicity test results 2. Consider additional advanced chemical analyses 3. Use TIE to identify contaminants of concern
No persistent exceedances of water quality objectives	No evid-ence of toxicity	Indications of alteration	Alteration is probably not due to toxic contamination	No action necessary due to toxic chemicals (action be necessary for other reasons, e.g., physical habitat changes)
Exceedance of water quality objectives	Evidence of toxicity *	No indications of alteration	Toxic contaminants are bio-available, but in-situ effects are not demonstrable	1. Determine if chemical and toxicity tests indicate persistent degradation 2. Recheck results from benthic analyses, consider additional data analyses 3. If recheck indicates benthic alteration, perform TIE to identify contaminant(s) of concern 4. If recheck shows no effect, use TIE to identify contaminant(s) of concern
No persistent exceedances of water quality objectives	Evidence of toxicity *	Indications of alteration	Unmeasured toxic contaminants are causing degradation	1. Recheck chemical analyses and consider additional advanced analyses 2. Use TIE to identify contaminants of concern

Chemistry	Toxicity	Benthic Alteration	Possible Conclusion(s)	Possible Actions or Decisions
Exceedance of water quality objectives	No evid- ence of toxicity	Indications of alteration	Inconclusive	1. TIE would not provide useful information if there is no evidence of toxicity 2. Continue monitoring and attempt to identify source(s) of chemical(s) exceeding water quality objectives

* Toxicity defined as in Section 3.1.3

Table 11.III – 7 Dry-Weather Targeted Reconnaissance Sites

Jurisdiction	Map No.	Targeted Sites
Anaheim	1	Large drain discharging to Santa Ana River just north of Chapman Avenue: South East Anaheim Channel E12
	2	Box culvert discharging to Carbon Creek near La Palma Avenue and Citron Street
	3	Outlet into Anaheim Barber Channel on S. side of Ball Road between Hampstead Street and Gilbuck Drive
Brea	4	Randolph Channel at south end of Randolph Avenue and Imperial Highway, south of Imperial
Buena Park	5	Drain and open channel at end of Dodd Circle, off of Stage Road, drains to Coyote Creek
	6	Catch basin on Arturo and Regio, drains to Coyote Creek
Costa Mesa	7	Just S. of 15th and Newport Blvd, looks closed, needs recon
	8	Irvine Ave. and 17th St. (share w/Newport Beach), G02P02 at G02
	9	19th St. and Dover (share w/Newport Beach) G02P01
Cypress	10	Currently being located
Fountain Valley	11	Fountain Valley Ch (D05) at Euclid and Southpark
Fullerton	12	*Carbon Creek Channel at St. College and Orangethorpe*
	13	Discharge of Kimberly Creek Channel (A03S05) into Fullerton Creek Channel (A03) just W. of Raymond, between Lemon and Raymond
Garden Grove	14	Discharge of 72" drain that comes into C02S01 from south, Knott and C02S01
	15	Discharge of 39" drain into C02S01, just east of Hardee Way and west of Western, and south of Katella
	16	Discharge of 54" drain into channel at Knott and Belgrave
Huntington Beach	17	Murdy Channel at C05 and SE corner of Murdy Park; W of Gothard. Drains a mixed use industrial area.
	18	Slater Pump Station, right before the C05 channel, past the W end of Slater Ave and SW of the end of Glenstone
	19	Discharge of 69" drain that discharges into C02 channel at Bolsa Ave.
Irvine	20	Construction Circle Drain (F06P06) at F06
	21	Como Channel (F06S03) at Culver Blvd. Discharge of pump station.
La Habra	22	A01P10 at A01, E of Euclid and S of La Habra Blvd.
	23	30" pipe under railroad tracks just west of Lambert and Palm
La Palma		Nothing suitable
Laguna Hills	24	F23 at Moulton Parkway
Laguna Woods	25	Catch basin at NW side of intersection of Moulton and El Toro
	26	Catch basin at NE side of intersection of Moulton and El Toro
Lake Forest	27	Upper end of F19, end of 72" inch pipe discharging into F19, N of intersection of Dimension and Lake Forest Dr. Pipe is W of Lake Forest Dr.
	28	Intersection of F19P11 and F19S02, just S of intersection of Dimension Dr. and Commercentre Drive
Los Alamitos	29	Fenley Pump Station at W end of Fenley Drive at A01, S of Ball
Newport Beach	8	G02P02 at G02, Irvine Ave. and 17th St. (share w/Costa Mesa)
	9	G02P01, 19th St. and Dover (share w/Costa Mesa)
Orange	30	*Pipe discharge at E07 and Katella*
	31	Discharge into Collins Channel (E07S03) of 48" drain between Blueridge Ave. and Glassell St.
Placentia	32	Sao Paolo and Rose, S of Yorba Linda and Rose
Santa Ana	33	Currently being located

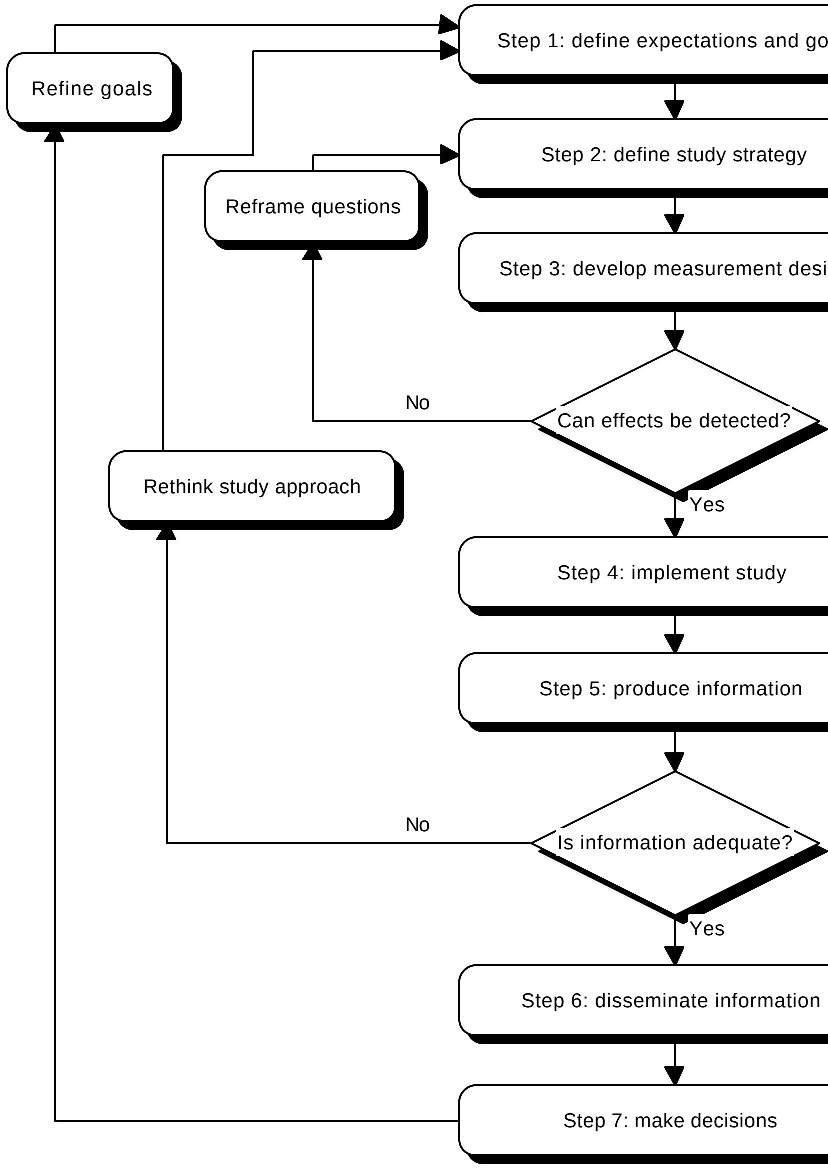
Jurisdiction	Map No.	Targeted Sites
Seal Beach	34	(2) 6x3 boxes discharging into San Gabriel River at 1st St. and extension of Electric Ave northwestward.
	35	Discharge of 24”drain into San Gabriel River at end of Marina Dr.
Stanton	36	SW corner of Beach Blvd. and Pacific
Tustin	37	F07P01 at F07
	38	F10P01 at F10
Villa Park	39	48” drain that discharges onto Estates near Canyon Dr.
Westminster	40	Map sent
Yorba Linda	41	Currently being located

[1] Site locations use County drainage facility numeric designations wherever possible. Location descriptions may be refined further before Program description is finalized.

Table 11.III – 8 Dry-Weather Random Reconnaissance Sites

Map No.	Random Sites
42	B00P01, Lincoln Stormdrain, end of Lincoln at Coyote Creek
43	F13P12, Rockhurst and Newport Blvd.
44	F08P10, Main and MacArthur
45	F05P07, Canada Stormdrain, end of Whatney W of Rockfield
46	C04P12, Taft Stormdrain, Taft and Trask
47	F09P03, off the end of Cartwright
48	B02P04, La Palma W of Valley View
49	F23P04, Veeh Stormdrain, Ridgeroute and Peralta
50	F08P01, Von Karnann at 405 Fwy
51	F07P04, Red Hill at Old Irvine

Figure 11.III – 1 Role of Monitoring in the Program's Decision Making



Adapted from NRC, 1990. Managing Troubled Waters.

Figure 11.III – 2 Relationship of Mass Emissions Monitoring to Other Management Efforts

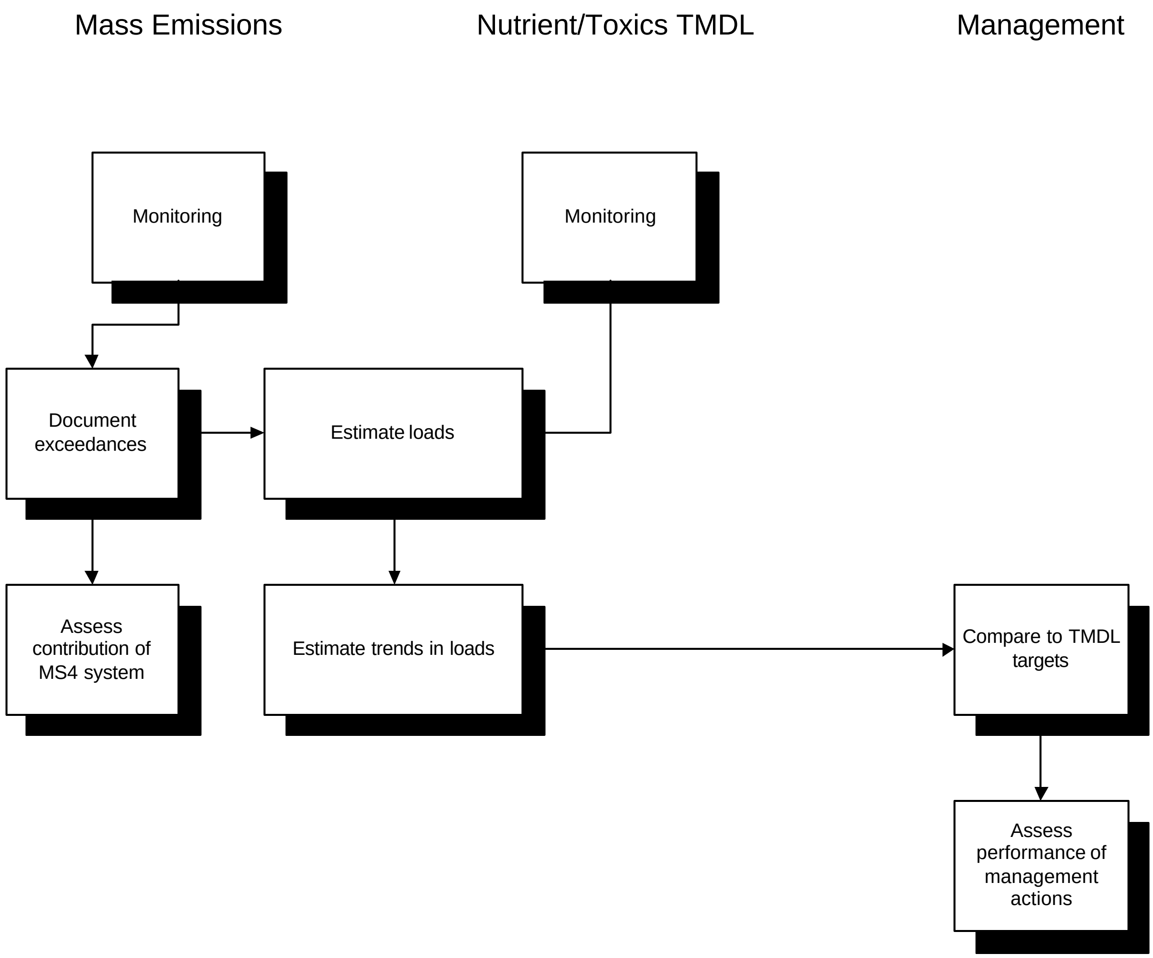


Figure 11.III – 3 Mass Emissions Monitoring Sites

Figure 11.III – 4 Adaptive Toxicity Testing Protocol

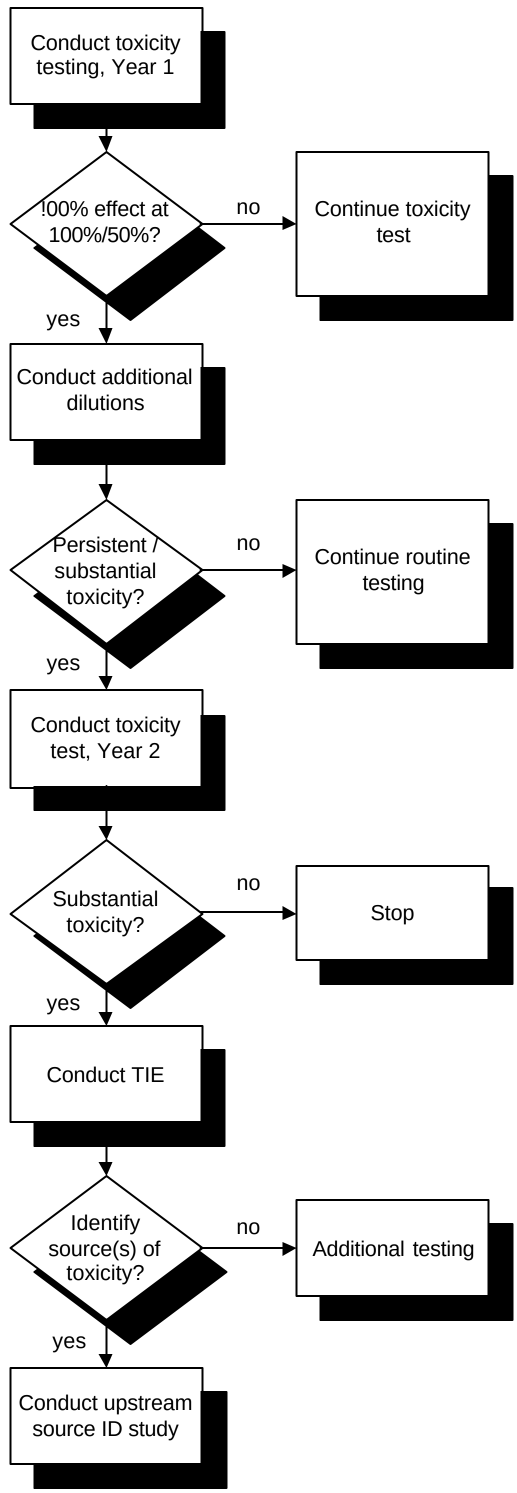


Figure 11.III – 5 Estuary / Wetlands Monitoring Sites

Figure 11.III – 6 Conceptual Model Underlying Estuary / Wetlands Assessment

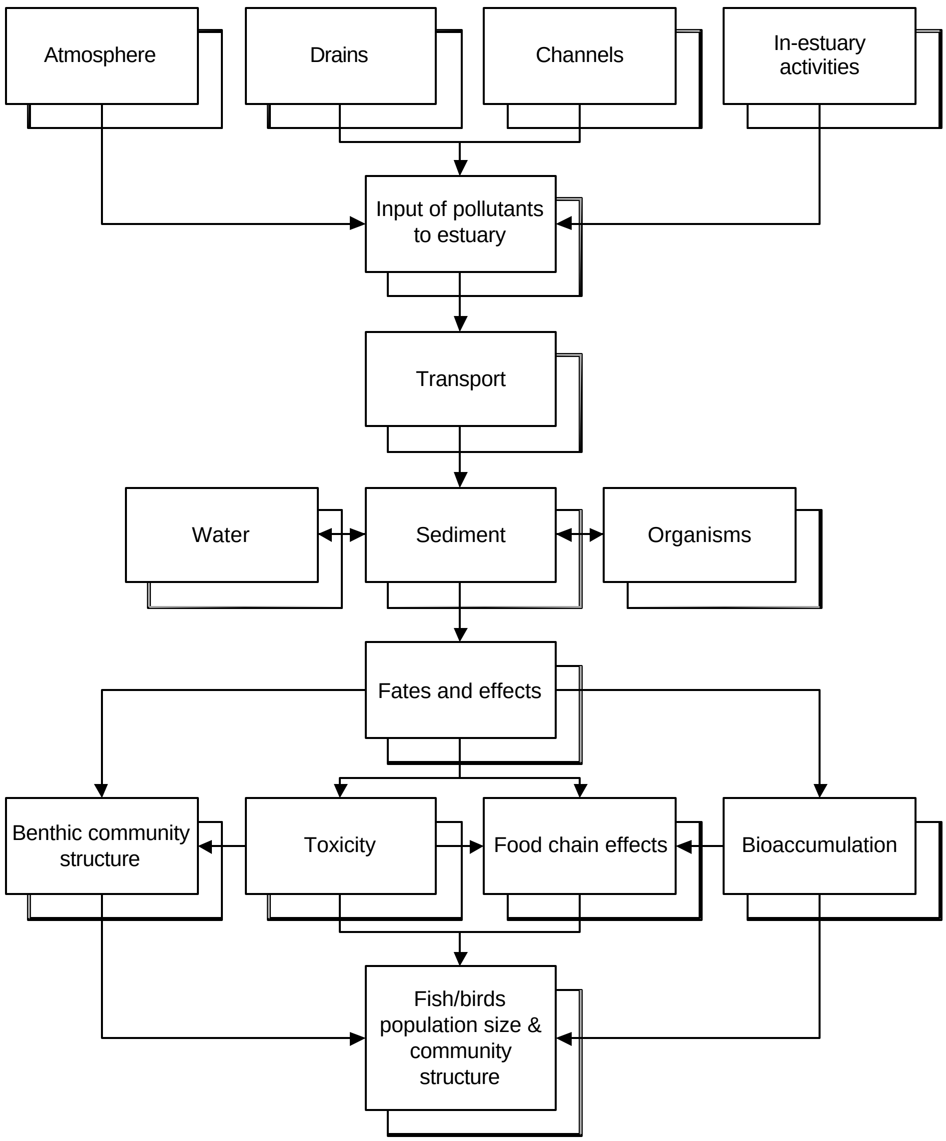


Figure 11.III – 7 Bacteriology / Pathogen Monitoring Sites

Figure 11.III – 8 Coastal Storm Drain Site Selection Process

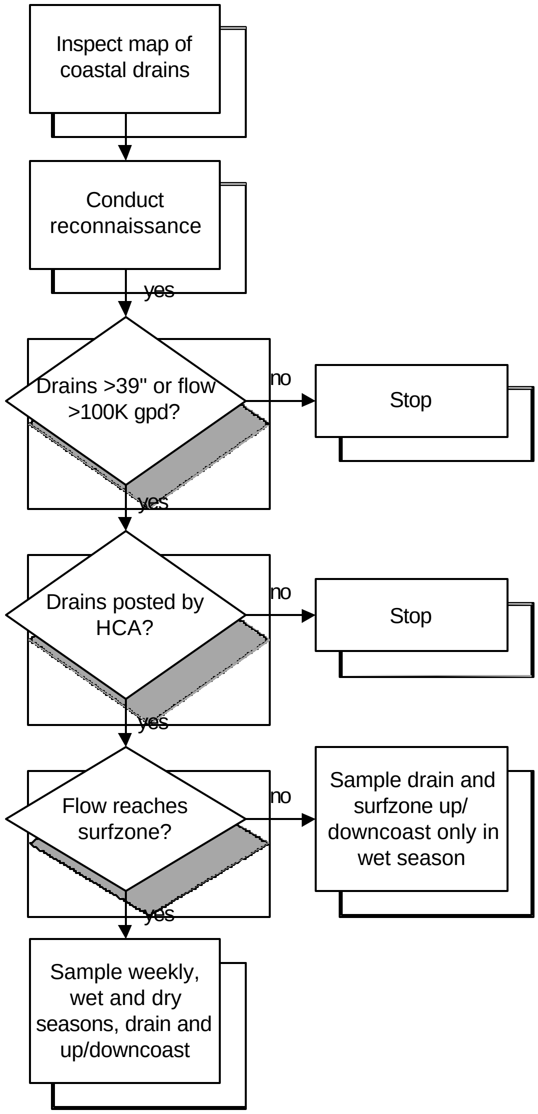


Figure 11.III – 9 Structure of the "Triad" Approach to Urban Stream Bioassessment

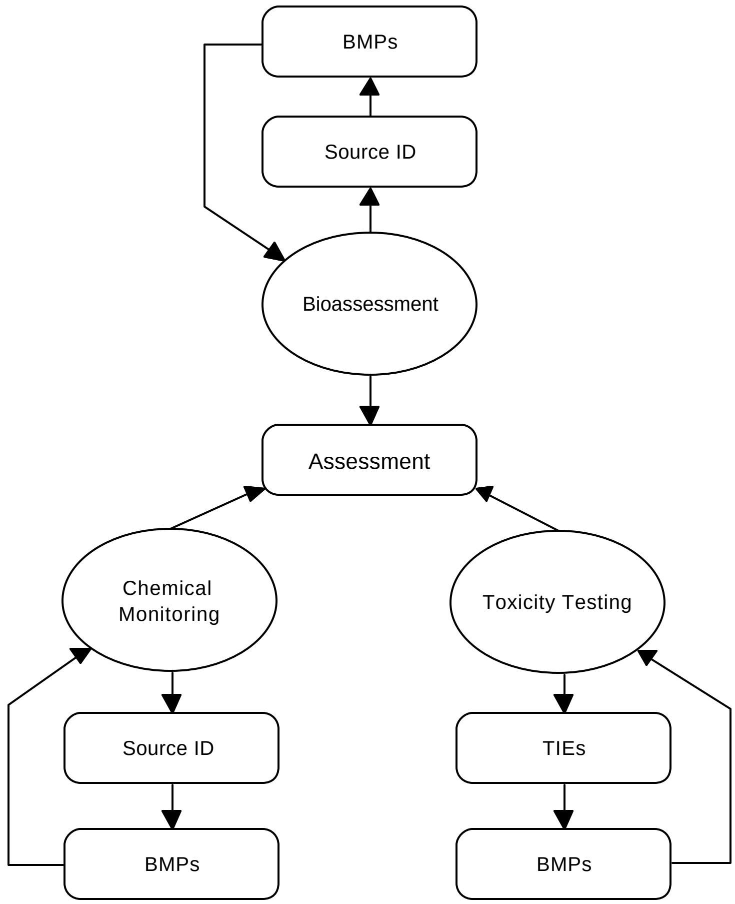


Figure 11.III – 10 Bioassessment Monitoring Sites

Map of Bioassessment monitoring sites will be added after a reconnaissance effort has been undertaken in cooperation with the Santa Ana Regional Board and SCCWRP.

Figure 11.III – 11 Reconnaissance Monitoring Sites (see Tables 3-3 and 3-4 for descriptions of site locations)

Figure 11.III – 12 Process for Determining Basis of Comparison for Reconnaissance Sites

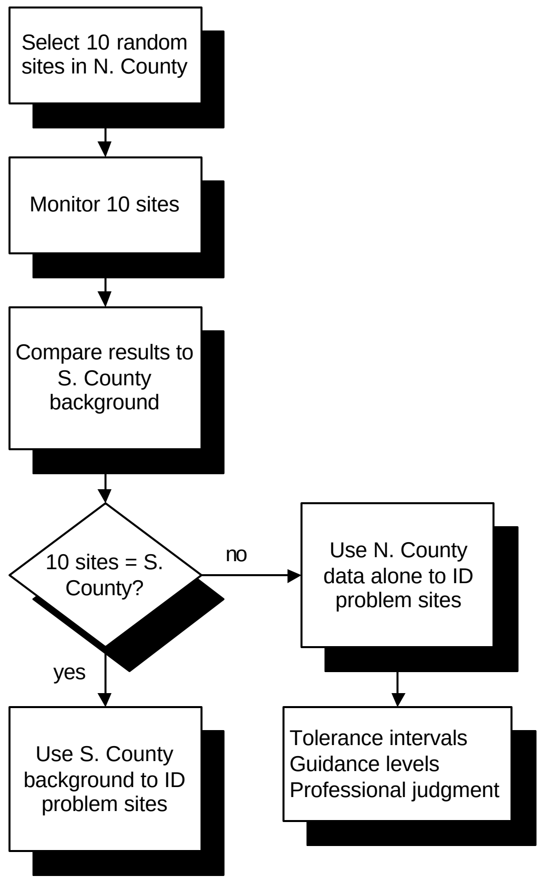
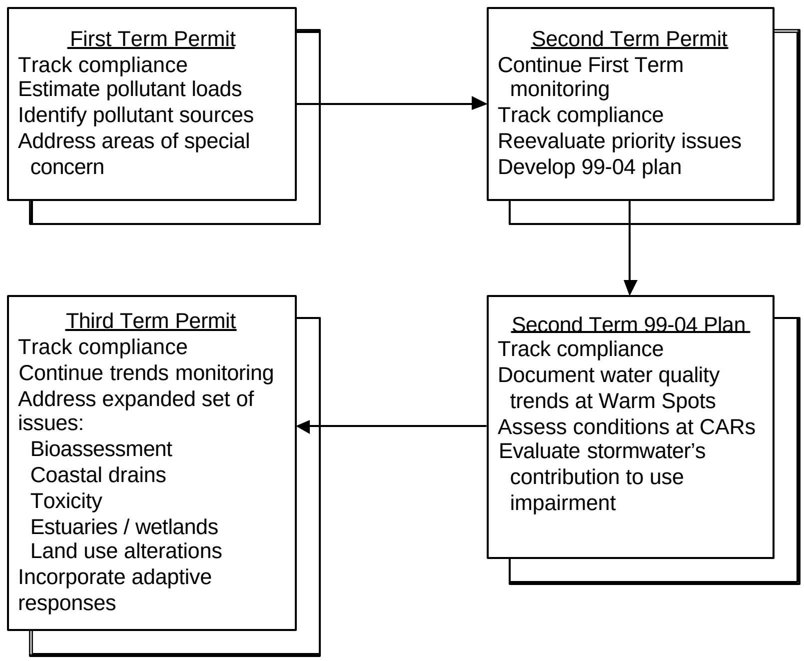


Figure 11.III – 13 Monitoring Design for Land Use Correlations

	Flat fields	Hillside orchards
Before conversion	Monitoring event B1 * Monitoring event B2 • •	Monitoring event B1 Monitoring event B2 • •
After conversion	Monitoring event A1 * Monitoring event A2 • •	Monitoring event A1 Monitoring event A2 • •

* "B" refers to the Before condition, and "A" to the After condition.

Figure 11.III - 14 Receiving Waters Monitoring Program Evolution



"Warm spots" refer to sites with pollutant levels that are elevated relative to the long-term County average
"CARs" refers to critical aquatic resources, sites with greater beneficial use potential