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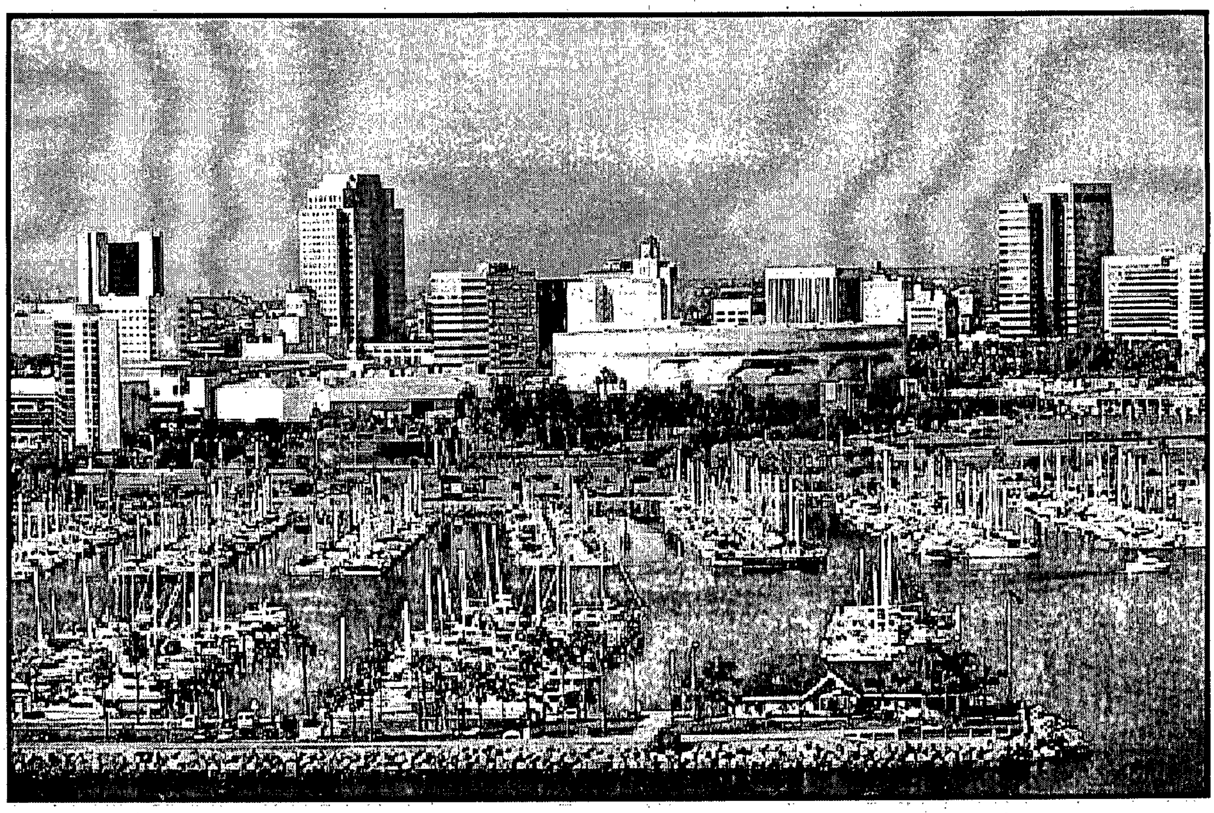
City of Long Beach Storm Water Monitoring Report 2001-2002

NPDES Permit No.
CAS004003 (CI 8052)

JULY 2002



Submitted By

City
Of
Long
Beach

Prepared By

Kinnetic Laboratories, Inc.
and
Southern California Coastal
Water Research Project

CITY OF LONG BEACH
STORM WATER MONITORING REPORT 2001-2002

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ACRONYMNS AND ABBREVIATIONS LIST

ASTM - American Society for Testing and Materials
BHC - Benzene hexachloride
BMP - Best Management Practice
BOD- Biological Oxygen Demand
CCC – Criterion Continuous Concentration
CD - Compact Disk
CFU - Colony Forming Units
CMC – Criterion Maximum Concentration
COD - Chemical Oxygen Demand
CTR - California Toxics Rule
CV - Coefficient of Variance
2,4 D - 2,4-dichlorophenoxy
2,4 DB - (2,4-dichlorophenoxy) butanoic acid
DDD - dichloro (p-chlorophenyl)ethane
DDE - dichloro (p-chlorophenyl)ethylene
DDT - dichlorodiphenyl trichloroethane
DF - dilution factor
DI - Deionized
DL - Detection Limit (considered the same as RL)
DO - Dissolved Oxygen
EC_{50} - Concentration causing effects to 50% of the test population
EDTA - ethylene diamine triacetic acid
EMC- Event mean concentration
GIS - Geographic Information System
IC25 - Concentration causing 25% inhibition in growth or reproduction
IC50 - Concentration causing 50% inhibition in growth or reproduction
ICP-MS - Inductively Coupled Plasma-Mass Spectrometry
ID - Identifier
ID - Insufficient Data
KLASS - Kinnetic Laboratories Automated Sampling System
KLI - Kinnetic Laboratories, Inc.
LC_{50} - Bioassay concentration that produces 50% lethality
LDPE - Low Density Polyethylene
LOEC - Lowest Observed Effect Concentration
LPC - Limiting Permissible Concentration
MBAS - methylene-blue-active substances
MCPA - 2-methyl-4-chloro-phenoxy acetic acid
MCPP - 2-(4-chloro-2-methylphenoxy) propanoic acid
ML – Minimum level as defined in State Implementation Plan
MPN- Most Probable Number
MS4 - Multiple Separate Storm Sewer System
MTBE- Methyl Tertiary Butyl Ether
NCDC-National Climate Data Center
NPDES –National Pollutant Discharge Elimination System
NOEC - No observed effect concentration
NTS - Not to Scale
NTU - nephelometric turbidity units
NURP- Nationwide Urban Runoff Program

PAH - Polynuclear Aromatic Hydrocarbons
PCB - Polychlorinated bi-phenyls
PDF - Portable Document Format
ppb - Parts per Billion
Q - Flow
QA/QC - Quality Assurance/Quality Control
RBF- RBF Consultants
RMP - Regional Monitoring Program
RL- Reporting Limit (considered the same as DL)
RPD- Relative Percent Difference
SAP - Sampling and Analysis Plan
SCCWRP - Southern California Coastal Water Research Project
sf- Square Feet
SIP – State Implementation Plan
SM- Standard Methods for the Examination of Water and Wastewater
SOP - Standard Operating Procedure
SRM - Standard Reference Material
STS - sodium tetradecyl sulfate
SV - Semi-Volatile Compound
2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid
2, 4, 5-T - 2,4,5-trichlorophenoxy
TBD - To Be Determined
TDS – Total Dissolved Solids
TIE – Toxicity Identification Evaluation
TKN- Total Kjeldahl Nitrogen
TOC - Total Organic Carbons
2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid
TPH - total petroleum hydrocarbons
TRPH - Total Recoverable Petroleum Hydrocarbons
TSI - ToxScan, Inc.
TSS –Total Suspended Solids
TTLC - Total Threshold Limit Concentration
TU - Toxicity Unit
TUc – Chronic Toxicity Unit
USEPA - U.S. Environmental Protection Agency
WQO - Water Quality Objective
WQS - Water Quality Standard

CITY OF LONG BEACH
STORMWATER MONITORING REPORT 2001/2002

NPDES Permit No. CAS004003 (CI 8052)

1.0 EXECUTIVE SUMMARY

1.1 Background and Purpose

The City of Long Beach is required to conduct a water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4). The water quality monitoring program beginning in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052).

The monitoring program calls for monitoring mass emissions and toxicity at three representative mass emission sites during the first wet season and four sites for subsequent wet seasons. Four wet weather storm events were to be monitored annually. Monitoring of one receiving water site (Alamitos Bay) was also required for each of these four wet weather storm events. In addition, dry weather inspections and the collection and analysis of dry weather discharges were required at each of these monitoring sites over two different 24-hour periods during each dry season. Water samples collected at the monitoring sites during each time period were to be analyzed for all parameters specified in the permit and tested for toxicity. Additionally, the program called for monitoring the receiving water body site (Alamitos Bay) for bacteria and toxicity to provide water quality information during both the wet and dry seasons, and on the effectiveness of a dry-weather diversion.

Monitoring sites specified in the permit are as follows:

- Basin 14: Dominguez Gap Pump Station Monitoring Site
- Basin 20: Bouton Creek Monitoring Site
- Basin 23: Belmont Pump Station Monitoring Site
- Basin 27: Los Cerritos Channel Monitoring Site (Second Year)
- Alamitos Bay Receiving Water Monitoring Site

During the first 1999/2000 wet weather season, start-up delays associated with permitting for placement of stormwater monitoring equipment in the Los Angeles County Flood Control District facilities prevented the wet weather monitoring from being carried out. Instead, a special research study on Parking Lot Runoff was carried out with the permission of the Regional Water Quality Control Board staff. In addition, the required dry weather monitoring was carried out for this first year. The first annual report (Kinnetic Laboratories, Inc., 2000) covered the first season dry-weather monitoring events performed in June of 2000 as well as one additional receiving water sampling in April 2000. The second annual report (Kinnetic Laboratories, Inc., 2001) covered a full season of wet season and dry season monitoring. This report also presented and interpreted the data obtained by the program up to that point in time. In addition to the dry weather sampling, four wet weather events were monitored at each of the monitoring sites, with the exception of the Dominguez Gap Pump Station where rainfall was insufficient, causing a discharge for only three events.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the third year, 2001/2002. Kinnetic Laboratories, Inc. conducted this monitoring program as Prime Contractor to the City of Long Beach. Analytical laboratory services were provided by

ToxScan, Inc. supplemented by other participating laboratories as necessary. Toxicity studies, including Toxicity Identification Evaluations (TIEs) were also conducted by ToxScan, Inc. Interpretation of the toxicity and TIE data was performed by the Southern California Coastal Water Research Project (SCCWRP) as a subcontractor to Kinnetic Laboratories. In the previous year, SCCWRP staff had performed the marine toxicity tests but, due to laboratory loads, these tests were performed by ToxScan this year.

1.2 Summary of Results

Rainfall and Sampling Events

All monitoring stations were fully operational at the start of the 2001/2002 wet weather season and precipitation and discharge were continuously monitored throughout the season. Record low rainfall occurred during this 2001/2002 wet season. Furthermore, most of this rain occurred before January. These factors limited the number of successful stormwater monitoring events captured during the year in spite of numerous false event attempts. Precipitation during the 2001/2002 water year was 84% below normal in Long Beach, amounting to only 1.99 inches of rain recorded by the National Weather Service climate station at Long Beach Airport, compared to a normal year of 12.27 inches and 13.32 inches last year.

Importantly, however, the first two storm events of the 2001/2002 season were captured at three of the stations (Belmont Pump Station, Los Cerritos Creek, and Bouton Creek), though rainfall was insufficient to cause a discharge at the Dominguez Gap Pump Station. Both were relatively small events characterized by brief, intense periods of scattered shower activity. Total rainfall during each event at the three stations ranged between 0.23 to 0.39 inches which did represent a significant percentage of the total rainfall for the season.

Dry weather inspections/monitoring events were obtained in August, 2001 and in May 2002 for the three mass-emission sites, Dominguez Gap Pump Station, Bouton Creek, and the Belmont Pump Station, as well as for Alamitos Bay. Again, the Dominguez Pump Station inflow was dry during these inspections. An additional dry weather event will be carried out at all of these sites later this summer (August, 2002).

The results of the City of Long Beach's stormwater monitoring program may be briefly summarized as follows based upon the data for the monitored events available at this time for the program.

Chemical and Bacterial Results

- Currently, numerical standards do not exist for stormwater discharges. However, water quality criteria or objectives may provide reference points for assessing the relative importance of various stormwater contaminants, though specific receiving water studies are necessary to quantify the presence and magnitude of any actual water quality impacts.

- For reference only, provisional water quality benchmarks are developed and presented herein based upon work in the Central Valley Regional Water Quality Control Board (Marshack, 2000) and draft benchmarks under development as part of Project Clean Water in San Diego County.

- Event Mean Concentrations (EMCs) calculated for contaminants in Long Beach stormwater discharges were compared with the water quality benchmarks appropriate to the designated beneficial uses of the Long Beach receiving waters.

- Oil and grease (O&G) exceeded by 2 to 2.5 times benchmark values based upon USEPA's Stormwater Multisector General Permit for Industrial Activities (O&G; 15, mg/l) for the Belmont Pump Station and the Los Cerritos Channel.

- Total suspended solids (TSS) in the Long Beach wet weather discharges exceeded by 5 to 10 times the draft benchmarks (TSS; 60-100 mg/l) based upon the median EMC from the National Urban Runoff Program (USEPA, 1983b).

- Concentrations of bacteria (total coliform, fecal coliform, and enterococcus) in the Long Beach stormwater discharges were high compared to benchmark values based upon receiving water criteria, as is common for all urban runoff. Mean EMCs for fecal coliform were highest at the Belmont Pump Station where stormwater is discharged directly to Alamitos Bay. Mean values in the Long Beach stormwater discharges are three orders of magnitude greater than the benchmark values. Other studies have shown however that such exceedances are not limited to urban stormwater sources but are also measured from undeveloped surrounding land.

- For the Alamitos Bay receiving water, samples from this study for all three years and from the City of Long Beach Department of Health and Human Services monitoring data were compared with historical rainfall records from the Long Beach Airport. Microbiological data from the City's stormwater program demonstrate relatively low levels of total coliform, fecal coliform, and fecal streptococcus during all dry weather periods. Based upon dry weather data obtained before a dry season interceptor was instatalled in Basin 24 as compared to dry season data after that time, it is not apparent that the interceptor has had any discernable impact on the bacterial concentrations in Alamitos Bay during the extended dry weather during the summer of 2000. Tests conducted during wet weather periods resulted in levels of each bacterial component that were one to two orders of magnitude higher than during summer dry weather periods.

- Benchmark values used for trace metals were mostly based upon Criteria Maximum Concentrations (CMC) values form the California Toxics Rule (USEPA, 2000). Only two metals were found to exceed benchmark values in the Long Beach stormwater discharges, and in both cases, only the estuarine/marine benchmarks were exceeded. The mean EMC for copper at the Belmont Pump Station was approximately three times the benchmark value for discharges to enclosed bays and estuaries. Mean copper EMCs for discharges to inland surface waters were below the benchmark value of 13 ug/l. The mean EMC for dissolved zinc at the Belmont Pump Station was 98 ug/l, slightly exceeding the enclosed bay and estuary benchmark value of 90 ug/l. Mean EMCs for dissolved zinc at both Bouton Creek and Los Cerritos were 78-84 ug./, which was approximately 2/3 of the inland surface water benchmark.

- Benchmark values for organic compounds for both saltwater and freshwater were based upon recent assessments conducted by the California Department of Fish and Game (Seipmann and Finlayson, 2002). Diazinon benchmarks are routinely exceeded in discharges from the Belmont Pump, Bouton Creek, and the Los Cerritos Channel. Mean EMCs for the two monitoring sites that discharge to inland surface waters were roughly four to five times higher than the proposed benchmark, while discharges from the Belmont Pump station was an order of magnitude greater than the marine/estuarine benchmark. Chlorpyrifos, another organophosphate pesticide, was found in significant concentration in water from the second storm event in the Los Cerritos Channel, approximately one order of magnitude greater than the recently updated California Department of Fish and Game benchmark. Other organic compounds are rarely detected in the stormwater samples, and when detected, are often very near reporting limits. Glyphosate, which was detected in runoff the previous year was not detected in runoff from any of the sites during the 2001/2002 season. Low levels of two organochlorine pesticides DDT and aldrin were present in a few samples during the past monitoring year. Phthalate compounds are common in the stormwater samples but are present at relatively low levels. The highest concentration reported for a phthalate compound (bis(2)ethylhexylphthalate) this season was 10 ug/l. Both diazinon and chlorpyrifos are undergoing changes in registration due to the high toxicities as well as persistent occurrences in runoff, and their uses may be curtailed or phased out.

- Noteworthy findings from the dry weather sampling are as follows:
  - Chemical results generally did not tend to vary greatly between sites or sampling dates, and with a few exceptions, contaminant concentrations were consistent with previous results and no parameters stood out as particularly high.
  - Diazinon was the only organic contaminant routinely detected in the dry weather discharges this year due to lower detection limits. The herbicide 2, 4-D, was absent from all sites in the fall survey but was present in all samples from the May survey. Several phthalate compounds were detected in the August 2001 surveys but were below detection limits in the May 2002 surveys.
  - Dry weather discharges were typically low in suspended solids and total metals, but dissolved metals were more consistent with the expected dissolved/total ratios than those measured during wet weather events. Dissolved metals occurred at levels similar to those measured during the winter storm events. Increased hardness during the dry weather conditions tends to mitigate potential toxicity.
  - Elevated pH levels are common in excess of 9.0 probably due to high benthic algal production resulting in low levels of CO_2 and concurrent high levels of dissolved oxygen and lower alkalinity.
  - Bouton Creek dry weather discharge shows higher specific conductivities, COD, chloride, and TDS as saltwater continues to drain form the algal turf well after low tide, along with low dry weather flows.
  - Dry level flows continue to show moderately high levels of bacteria including total and fecal coliform as well as enterococci, with total and fecal coliform above benchmark levels. The effects of these flows are not typically evident in receiving water as demonstrated both by concurrent measurements form Alamitos Bay and surveys conducted by the City's Department of Health as discussed in this report.
  - Discharges to and from the Dominguez Gap Pump Station continue to be dry during the dry weather season.

Toxicity Results

- Toxicity was detected for each of the three stations sampled this year for each of the two wet weather storm events, which was consistent with the results from last year's monitoring. The toxicity measured was greater this year, possibly because these were the first flush storms of the year, in contrast to the later storms monitored last year. The frequency and magnitude of stormwater toxicity from the Long Beach stations is similar to stormwater samples from other southern California watersheds, with Chollas Creek (San Diego) and Ballona Creek (Santa Monica) most similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds relative to the Los Angeles River and San Gabriel River.

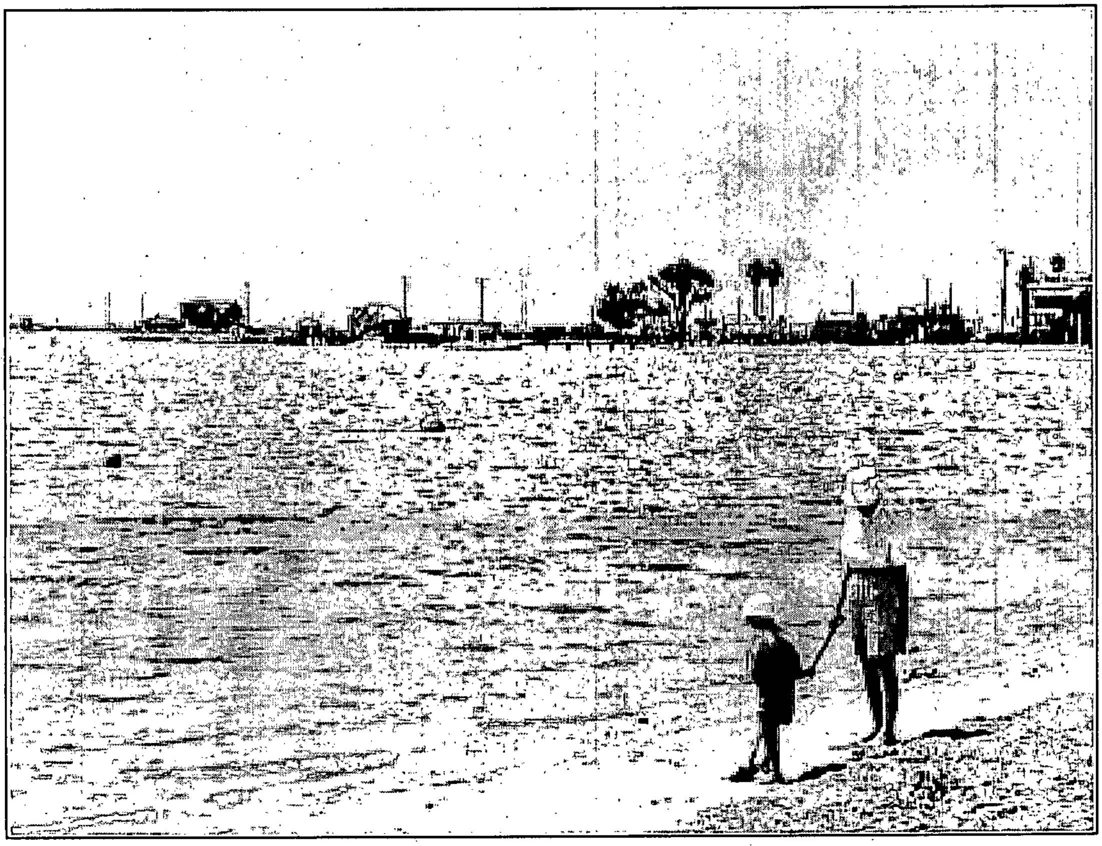
- Consistent with last year's results, toxicity was measured in all of the dry weather samples, but was again less than that measured in the wet weather samples. These results are indicative of significant differences in the composition of stormwater and dry weather discharge form the City of Long Beach.

- No significant toxicity was present in any of the Alamitos Bay receiving water samples as was true last year. These results are consistent with three dry weather samples collected from the same site in 2000. Salinity measurements indicated that the wet weather receiving water samples contained about 2 % or less fresh water. The lack of toxicity in the Alamitos Bay samples is consistent with the results of the wet weather discharge samples, which usually had NOEC values greater than 5-10%.

- The modified TIE trigger criteria instituted this year facilitated a successful TIE testing program, with 12 wet weather and 2 dry weather TIEs attempted that yielded useful information on 10 samples. The results of this year were consistent within each species and similar to the data obtained from the previous year.

- All TIEs conducted using the water flea indicated that organophosphate pesticides were the most likely category of toxic constituents.

- The two-year toxicity data also implicated dissolved metals, particularly zinc and copper as causes of stormwater toxicity. These conclusions are supported by the TIE results, by correlations of toxicity with chemical constituents, and by calculations of predicted toxicity based upon measured zinc and copper concentrations in the stormwater.



2.0 INTRODUCTION

The City of Long Beach received an NPDES Permit issued by the California Regional Water Quality Control Board, Los Angeles Region on 30 June 1999 (Order No 99-060, NPDES No. CAS004003, (CI 8052)). This order defines Waste Discharge Requirements for Municipal Stormwater and Urban Runoff discharges within the City of Long Beach. Specifically, the permit regulates discharges of stormwater and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems, into receiving waters of the Los Angeles Basin.

The Regional Board modified the permit by letter on October 24, 2001 based upon review of the second year report and concurrent modifications being negotiated on the Los Angeles County stormwater permit. Permit modifications consisted of three primary elements. The first modification was an adjustment to the list of constituents and the required reporting limits for consistency with Minimum Levels (MLs) listed in the State's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (2000). The second change addressed the requirements for triggering TIEs and a reduction in toxicity testing requirements for the mysid, *Americamysis.* TIE triggers were changed to enhance opportunities for defining toxicity that might be related to first flush or other early season events. The final change was a requirement to compare stormwater quality data to water quality criteria applicable to specific beneficial uses in each receiving water body.

The City of Long Beach serves a population of about 462,000 people in an area of approximately 50 square miles. The discharges from the MS4 system consist of surface runoff (non-stormwater and stormwater) from various land uses in the hydrologic drainage basins within the City. Approximately 44% of the land area discharges to the Los Angeles River, 7% to the San Gabriel River, and the remaining 49% drains directly to Long Beach Harbor and San Pedro Bay (City of Long Beach Municipal Stormwater Permit, 1999). The quality and quantity of these discharges vary considerably and are affected by the hydrology, geology, and land use characteristics of the watersheds; seasonal weather patterns; and frequency and duration of storm events. Impairments or threatened impairments of beneficial uses of water bodies in Long Beach include Alamitos Bay, Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont shore Beach, Bluff Park Beach, and Long Beach Shore.

The NPDES permit requires the City of Long Beach to prepare, maintain, and update if necessary a monitoring plan. The specified monitoring plan requires the City to monitor three discharge sites (Year 1) and four discharge sites (Years 2 through 5) draining representative urban watersheds (mass emission sites) during the first two years of the monitoring program. Flow, chemical analysis of water quality, and toxicity are to be monitored at each of these sites for four representative storm events each year. During the dry season, inspections and monitoring of these same discharge sites are to be carried out, with the same water quality characterization and toxicity tests to be run. In addition, one receiving water body (Alamitos Bay) is to be monitored for bacteria and toxicity during both the wet and the dry seasons and the effect of a dry weather diversion documented. In years three through five of the permit period, the City was also expected to participate in a "fair share" study of receiving waters in the Los Angeles River and San Gabriel River watersheds. The Regional Board has verbally indicated that this effort is being eliminated or delayed.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the third year, 2001/2002.

3.0 STUDY AREA DESCRIPTION

The four sites for mass emissions monitoring were originally selected by the City of Long Beach with the assistance of the Southern California Coastal Water Research Project (SCCWRP), with input from the environmental community, the Los Angeles County Deparment of Public Works and with the approval of the Regional Water Quality Control Board. These sites were then specified in the NPDES permit after an analysis of the drainage basins and receiving waters. They were selected to be representative of the stormwater discharges from the City's storm drain system, as well as to be practical sites to carry out stormwater and dry weather monitoring. An additional site in Alamitos Bay was also selected as representative of receiving waters and for evaluation of the effectiveness of a dry weather diversion.

3.1 Regional Setting

3.1.1 Geography

The City of Long Beach is located in the center and southern part of the Los Angeles Basin (Figure 3.1) and is part of the highly urbanized Los Angeles region. In addition to residential and other uses, the City also encompasses heavy industrial and commercial areas and includes a major port facility, one of the largest in the United States. The City's waterfront is protected from the open Pacific Ocean by the extensive rock dikes encircling the outer harbor area of the Port of Los Angeles/Port of Long Beach complex. The waterfront includes port facilities along with a downtown commercial/residential area that includes small boat marinas, recreational areas, and convention facilities. Topography within the City boundaries can be generally characterized as low relief, with Signal Hill being the most prominent topographic feature (Figure 3.2).

3.1.2 Major Watersheds

Major water bodies receiving stormwater discharges from the City of Long Beach include the Los Angeles River located near the western boundary of the City, the San Gabriel River located near the eastern boundary, and the outer Harbor of the Los Angeles/Long Beach area. The City of Long Beach has fifteen pump stations that discharge into the Los Angeles River, and one pump station that discharges into the San Gabriel River. Receiving water sub-areas of importance include the extensive Alamitos Bay, heavily developed for marina and recreational uses, and the inner harbor areas of the City, heavily developed as port facilities. Other receiving water sub-areas include the Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont shore Beach, Bluff Park Beach, and Long Beach Shore. The drainage from the City is characterized by major creeks or storm channels, usually diked and/or concrete lined such as the Los Cerritos Channel that originates in Long Beach, flows near the eastern City boundary, and discharges into the Marine Stadium and then into Alamitos Bay. Other such regional drains include:

- Coyote Creek, which passes through a small portion of Long Beach before it discharges to the San Gabriel River;
- Heather Channel and Los Cerritos Line E that both enter Long Beach from the City of Lakewood and discharge into the Los Cerritos Channel; and the
- Artesia-Norwalk Drain that enters Long Beach from Hawaiian Gardens and discharges into Coyote Creek.

The City of Long Beach is divided into 30 watersheds as shown in Figure 3.3. Data presently in the City of Long Beach GIS database on total areas and specific land use categories for each basin are given in

Table 3.1 (City of Long Beach 2001). Specific watersheds selected by the City of Long Beach for this present stormwater monitoring program are described in more detail in the following section.

3.1.3 Annual Rainfall and Climate

The City of Long Beach is located in the semi-arid Southern California coastal area and receives significant rainfall on a seasonal basis. The rain season generally extends from October through April, with the heavier rains more likely in the months of November through March (see Figure 5.1 for average rainfall by month and seasonal total rainfall as measured at the Long Beach Airport). Total average annual rainfall at the Long Beach Airport is 12 inches per year.

The City lies in the Los Angeles Plain, which is south of the Santa Monica and San Gabriel Mountains and west of the San Jose and the Puente Hills. The Los Angeles River is the largest stream on the plain and it drains the San Fernando Valley and much of the San Gabriel Mountains. Most of the streams are dry during the summer and there are no lakes or ponds, other than temporary ponding behind dunes (Miles & Goudy, 1998). The climate is mild, with a 30-year average temperature of 23.4 °C (74.1°F) at the Long Beach Daugherty Airport (NCDC, 2000).

3.1.4 Population and Land Use Characteristics

The population of the City of Long Beach totaled 461,522 residents during the year 2000 (U.S. Census Bureau, 2000). The total population of the County of Los Angeles, in which it resides, was 9,519,338. The independent city of Signal Hill, located on a promontory, is surrounded by the City of Long Beach. Signal Hill's population numbered 9,333 in the year 2000 and it contributes runoff to drainage basins 6, 7, 8, 9 and 18.

The City of Long Beach has a total area of 26,616 acres. Of that total 16,926 acres (64%) are classified as residential, 4,784 acres (18%) as commercial, 2,269 acres (8.5%) as industrial, 1,846 (7%) as institutional, and 786 acres (3%) as open space (City of Long Beach, 1999). The drainage basins sampled for the stormwater monitoring study follow this general pattern of land use.

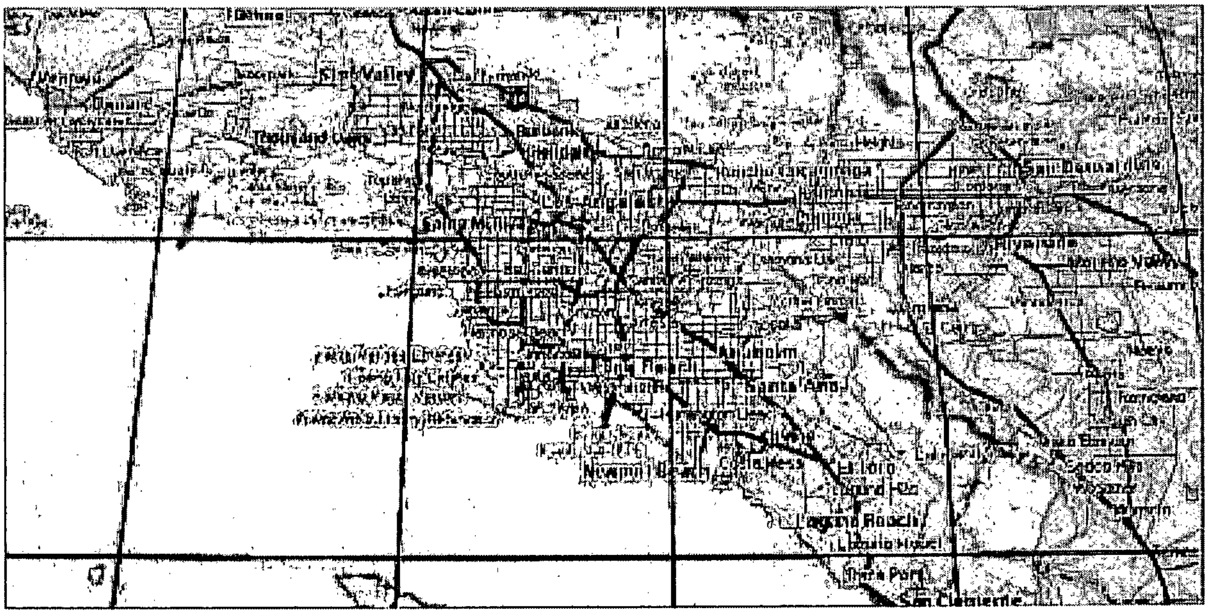


Figure 3.1. Los Angeles Basin. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

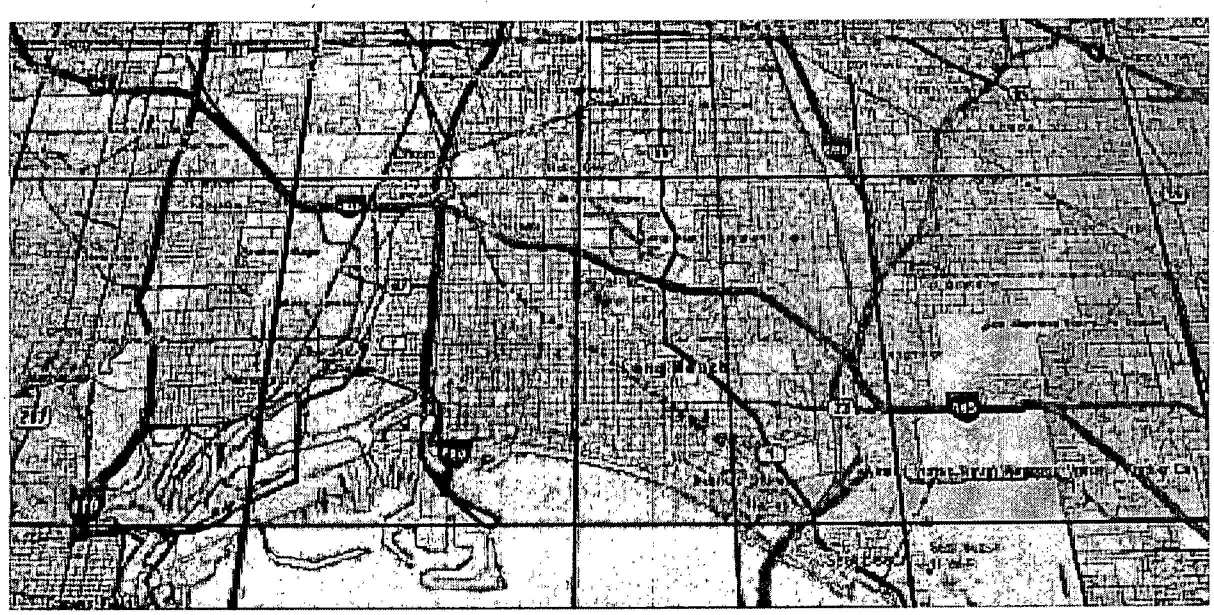


Figure 3.2. City of Long Beach. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

Major Drainage Basins and Monitoring Sites

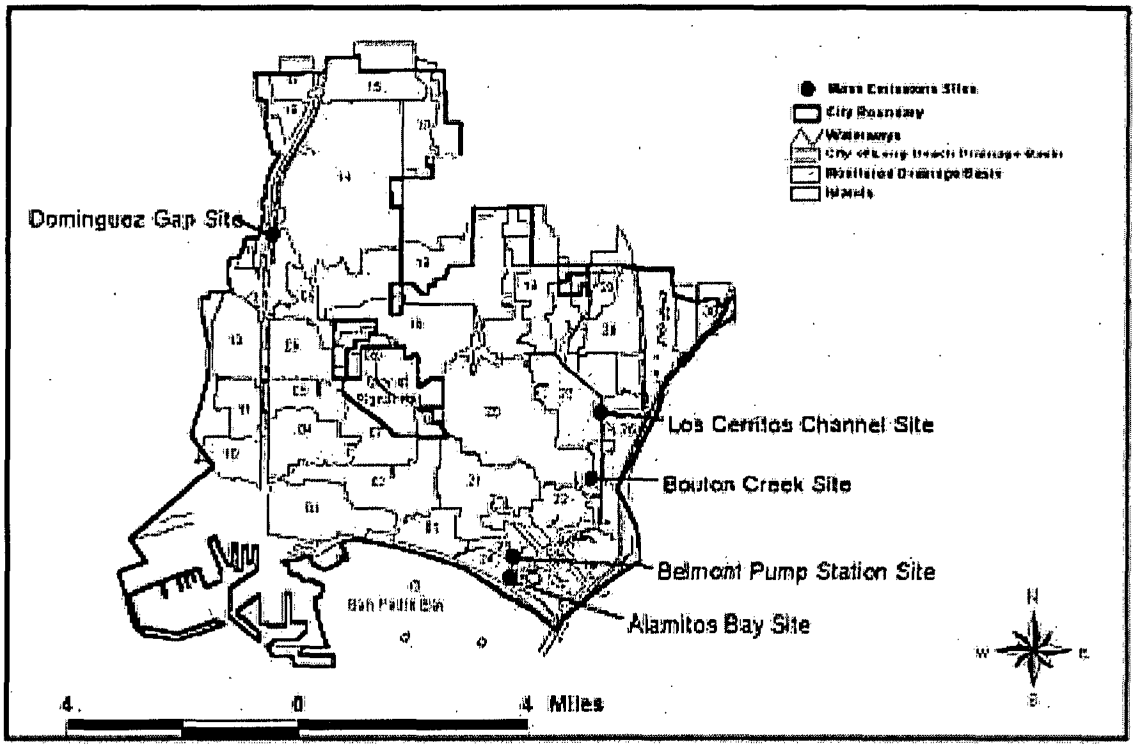


Figure 3.3. City of Long Beach Major Drainage Basins (Source: City of Long Beach, Department of Technology Services) and City of Long Beach Stormwater Monitoring Sites.

Table 3.1. **Total Areas and Land Use for City of Long Beach Watersheds.**

Drainage Basin	Drainage Pattern	Sub-basins	Total Acres	Residential Acres	Commercial Acres	Industrial Acres	Institutional Acres	Open Space Acres
1	N to S	4	456	393	44	0	7	12
2	E to W	1	1,276	905	287	22	59	3
3	E to W	3	1,083	367	642	7	58	9
4	E to W	2	810	426	176	140	56	12
5	E to W	1	546	434	97	0	13	2
6	S & SE	1	695	475	125	0	73	17
7	to center	1	1,029	858	89	11	53	18
8	E to W	1	248	163	27	58	0	0
9	SW & NW	1	399	295	91	0	12	1
10	S & E	3	416	16	49	351	0	0
11	S & E	1	424	338	64	3	18	1
12	S & E	1	719	556	98	9	41	15
13	S & E	1	84	0	7	77	0	0
14	S & W	2	3,374	2,445	392	148	273	116
15	S & W	1	958	569	167	197	25	0
16	N to S	1	194	113	61	8	5	7
17	S & E	1	317	244	68	0	5	0
18	E	1	1,814	804	262	729	19	0
19	E	20	3,898	2,475	610	439	228	146
20	S & E	1	2,259	1,215	412	70	492	70
21	S & E	3	1,172	773	125	0	55	219
22	variable	9	520	38	428	0	54	0
23	S	1	213	110	85	0	14	4
24	SE & NW	1	281	188	30	0	0	63
25	W & E	2	90	70	9	0	4	7
26	S & W	3	355	304	22	0	29	0
27	E & S	9	1,083	825	109	0	143	6
28	S & E	1	630	386	179	0	65	0
29	S	8	727	633	10	0	26	58
30	SW(6) & SE(1)	7	546	508	19	0	19	0
		Total Acres	26,616	16,926	4,784	2,269	1,846	786

4.0 MONITORING PROGRAM

4.1. Monitoring Program Objectives

The stated long-term objectives of the stormwater monitoring program (Part 3, II, A(1-6)) are as follows:

1. Estimate annual mass emissions of pollutants discharged to surface waters through the MS4;
2. Evaluate water column and sediment toxicity in receiving waters;
3. Evaluate impact of stormwater/urban runoff on biological species in receiving waters;
4. Determine and prioritize pollutants of concern in stormwater;
5. Identify pollutant sources on the basis of flow sampling, facility inspections, and ICID investigations; and
6. Evaluate BMP effectiveness.

The emphasis during the first two years of monitoring efforts has been directed towards characterizing the chemical and toxicological characteristics of discharges from the city's MS4 during both storm events and dry weather periods to develop the data needed to address the first five objectives listed above. In addition, a start on BMP investigations through the special Parking Lot Study was implemented during the first full year of monitoring. Specific objectives of this year's work included the following:

1. Obtain monitoring data from four (4) storm events for each mass emission station during the 2001/2002 storm season along with corresponding receiving water sampling at the Alamitos Bay receiving water station.
2. Carry out dry weather inspections and obtain samples of dry weather flow at each of the four mass emission stations and the receiving water station. Perform this dry weather work twice during the dry season that extends from May through October.
3. Perform chemical analyses for the specified suite of analytes at the appropriate detection limits for all stormwater samples collected.
4. Perform toxicity testing of the stormwater samples collected, and Toxicity Identification Evaluations (TIEs) if warranted by the toxicity results at a given site.
5. Report the above results and evaluate the monitoring data with respect to receiving water quality criteria.

4.2 Monitoring Site Descriptions

4.2.1 Basin 14: Dominguez Gap Monitoring Site

A sampling station located at the Dominguez Gap Pump Station is intended to monitor Basin 14 that covers 3,374 acres. Land use in this basin is 72% residential, 12% commercial, 8% institutional, 4% industrial, and 4% open space (Figure 4.1). The basin is located in the northwestern portion of Long Beach just east of the Los Angeles River and is bounded on the north, south, east, and west by Artesia Boulevard, Roosevelt Road, the railroad, and the Los Angeles River respectively (City of Long Beach, 2001). The location of the Dominguez Gap Pump Station is shown in Figure 4.2 with the coordinates given in Table 4.1. Photographs of the site are shown in Figure 4.3.

Normally in the summer, the retention basin located adjacent to the pump station would be dry according to the Flood Maintenance Division of the Los Angeles County of Public Works. However, current practice is to have the pumps locked off for the summer with water diverted into the retention basin from the Los Angeles River to recharge the groundwater aquifer and to study the feasibility of a wetland habitat in the area. During winter storms, the retention basin fills from stormwater discharge, which then infiltrates into the groundwater. During intense rains, when the retention basin fills to a specified level, the pump station pumps the water over the levee and discharges it into the Los Angeles River.

The stormwater monitoring equipment is located within the Dominguez Gap Pump Station. The automatic sampler utilized a peristaltic pump to collect water from the pump station's sump. The sampler was activated at the same set point (sump elevation) that activated the main discharge pumps, thus obtaining water samples during discharge to the Los Angeles River. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged was obtained by integrating this data over the period of time each pump discharged.

4.2.2 Basin 20: Bouton Creek Monitoring Site

This site collects water from Basin 20 covering 2,259 acres. Basin 20 is 54% residential, 22% institutional, 18% commercial, 3% industrial, and 3% open space (Figure 4.4). This basin is located in the east central portion of the City and is bounded on the north, south, east, and west by Spring Street, 8th Avenue, the Los Cerritos Channel and Redondo Avenue, respectively. The sampling station is located a short way upstream from the point of discharge into Los Cerritos Channel, along side of the Alamitos Maintenance Yard of the Los Angeles County Public Works Department. The location of the sampling station is shown in Figure 4.5 and Table 4.1. Photographs of the site are shown in Figure 4.6.

At the sampling station, Bouton Creek is a 35 ft wide, 8.5 ft deep open concrete box channel. The elevation of the channel bed is approximately one inch lower at the side than the center. About a quarter of a mile to the southeast, Bouton Creek flows into Los Cerritos Channel. Based on numerous observations of conductivity at various tides, this site has saltwater influence at tide levels above three feet. The automatic sampling equipment was therefore configured and programmed to measure discharge flow and to obtain flow composited samples of the freshwater discharge down the creek, avoiding the tidal contributions by using real-time conductivity sensors. A velocity sensor was mounted on the invert of the box channel near the center of flow. Two conductivity sensors were mounted on the wall of the channel near the bottom and 2 feet above the bottom. A third conductivity sensor and the sample intake were mounted on a floating arm that kept them near the surface. In practice, the horizontal boundary between brackish tidal water and fresh stormwater was found to be fairly sharp, allowing good separation for sampling and volume measurements of the stormwater discharge.

4.2.3 Basin 23: Belmont Pump Station Monitoring Site

This site collects water from Basin 23 that covers 213 acres. Land use in the basin is 52% residential, 40% commercial, 0% industrial, 6% institutional, and 2% open space (Figure 4.7). This basin is located in the southeastern portion of the City and is bounded on the north, south, east, and west by Colorado Street, Division Street, Ultimo Avenue and Belmont Avenue respectively. The Belmont Pump Station is located at 222 Claremont Avenue as shown in Figure 4.8 with coordinates given in Table 4.1. Photographs of this site are shown in Figure 4.9.

Water enters the forebay of the facility via a nine-foot diameter underground storm pipe. A trash rack catches debris before water drops four feet into the sump area. A single sump pump typically comes on and discharges about two feet of water from the sump area every evening at around 2300 hours. Four main pumps are available to remove water during storm events. Water from these pumps is discharged into Alamitos Bay.

The stormwater monitoring equipment was located outside the pump station but on the grounds of the pump station inside a steel utility box. The sensors and sampling hose were installed inside the pump station sump adjacent to the large discharge pumps. The automatic sampler utilized a peristaltic pump to sample from the sump. The sampler was activated at the same set point (sump elevation) that activated the discharge pumps, thus obtaining water samples during the discharge to Alamitos Bay. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged (obtained by integrating this data over the period of time each pump discharged).

4.2.4 Basin 27: Los Cerritos Channel Monitoring Site

Basin 27 is 1,083 acres and land use is 76% residential, 10% commercial, 13% institutional, and 1% open space (Figure 4.10). It is located in the east central portion of Long Beach and is bound on the north, south, east, and west by Spring Street, Rendina Street, the San Gabriel River, and Bellflower Boulevard, respectively.

The drainage pattern is to the east and south on the west side of the Los Cerritos Channel and to the west and south on the east side. There are eight major storm drain systems with a total of three major storm drain lines contributing runoff. All eight major systems discharge into the Los Cerritos Channel.

The stormwater monitoring station was installed in a steel utility box located on the west side of the channel south of Stearns Street. The site location and coordinates are shown in Figure 4.11 and in Table 4.1. Photographs of the site are shown in Figure 4.12. Flow sensors and sampling tubing was installed on the bottom of the large concrete lined channel. This sampling site is above tidewater on Los Cerritos Channel. Flow rates based upon flow velocity and channel dimensions are used to control the composite sampler, and to calculate total flow at the end of the storm event.

4.2.5 Alamitos Bay Receiving Water Monitoring Site

Alamitos Bay, located along the southeastern shoreline of Long Beach, is an extensive inshore estuarine area opening to the waters of the Outer Harbor. It supports extensive marina and recreational uses as well as residential/commercial uses in nearby areas. It also receives stormwater runoff from the Los Cerritos Channel and local drainage basins.

The Bayshore Aquatic Park on the southwestern shore of Alamitos Bay was selected and designated in the permit to be the receiving water site for this stormwater monitoring study. This site is downstream of the monitoring sites for Basins 20 and 23 but also receives stormwater from other basins as well. The monitoring site selected was at the end of a floating wharf located approximately 41 meters 188 degrees true north of the Alamitos Bay Pump Station outfall (Figure 3.3, Table 4.1). The end of the outfall pipe to Alamitos Bay is elevated above the surface of the water of the Bay. Grab samples were taken at the end of the dock during an in-coming tide for bacteria and toxicity only.

The Alamitos Bay Pump Station discharges stormwater from Basin 24 (Figure 4.13). Basin 24 consists of 281 acres located along the south shore of Alamitos Bay and westward along the shore of the Outer Harbor. Land use in Basin 24 consists of 67% residential, 11% commercial, and 22% open space with no industrial or institutional land use (Figure 4.13). The site location and coordinates are shown in Figure 4.14 and in Table 4.1. Photographs of the site are shown in Figure 4.15. A dry-weather storm drain diversion project was constructed in the fall of 1999 for Basin 24. This diversion was activated May 1, 2000 to divert dry weather flows to the sanitary system. The results from monitoring this site were also intended to help in the assessment of the effectiveness of this dry weather diversion.

4.3 Monitoring Station Design and Configuration

Each of the four land use stations monitored in Long Beach were equipped with a Kinnetic Laboratories Automatic Sampling System (KLASS). Figure 4.16 illustrates the configuration of a typical KLASS. This system consists of several commercially available components that Kinnetic Laboratories has integrated and programmed into an efficient flow-based stormwater compositing sampler. The receiving water site was not equipped with a KLASS.

The integral components of this system consist of an acoustic Doppler flow meter or a pressure transducer, a data logger/controller module, cellular or landline telecommunications equipment, a rain gauge, and a peristaltic sampler. The system installed at Bouton Creek also incorporated several conductivity cells for distinguishing tidal flow from fresh water runoff.

The equipment was installed with intakes and sensors securely mounted, tubing and wires in conduits, and all above ground instruments protected within a security enclosure. Section 4.2 described how the equipment was placed at each station.

All materials used in the collection and handling of stormwater samples met strict criteria in order to prevent any form of contamination of the sample. These materials must allow both inorganic and organic trace toxicant analyses from the same sampler and composite bottle. Only the highest grade of borosilicate glass is suitable for both trace metal and organic analyses from the same composite sample bottle. Sample hoses were Teflon®.

All bottles and hoses were cleaned according to EPA-approved protocols consistent with approved methodology for analysis of stormwater samples (USEPA, 1983a). These bottles and hoses were then evaluated through a blanking process to verify that the hoses and composite bottles were contamination-free and appropriately cleaned for analyses of both inorganic and organic constituents.

4.4 Field Monitoring Procedures

4.4.1 Wet Weather Monitoring

4.4.1.1 Composite Sample Collection

A priority objective of the storm monitoring is to maximize the percent storm capture of the composite sample, while ensuring that the composite bottle collects enough water to support all the required analyses. This study required volumes of up to 70 liters of sample from each of the four land use sites to meet these analytical needs.

All aspects of the sampling events were continuously tracked from an office command and control center (Storm Control) located at our Santa Cruz laboratory. The status of each station is monitored through telecommunication links to each site. Station data were downloaded, and the stations were controlled and reprogrammed remotely. Weather information, including Doppler displays of rainfall for each area being monitored were also available on screen at the Storm Control center. In addition, Storm Control is in contact by cellular phone with the field crews.

When a storm is likely, all stations are made ready to sample. This preparation included entering the correct volume of runoff required for each sample aliquot ("Volume to Sample"), setting the automatic sampler and the data logger to sampling mode, pre-icing the composite sample bottle, and performing a general equipment inspection. A brief physical inspection of the equipment was made (if possible) to make certain that there were no obvious problems such as broken conduit, a kinked hose, or debris.

Once a storm event ended, the stations were shut down either on site or remotely by Storm Control. The station was left ready for the next storm event in case there was insufficient time for a maintenance visit between storms. Data were retrieved remotely via telecommunications from the data logger on a daily basis throughout the wet weather season.

All water samples were kept chilled (4°C) and were transferred to the analytical laboratories within holding times. Prior to sample shipping, sub-sampling from the composite container into sample containers was accomplished using protocol cleaned Teflon and silicone sub-sampling hoses and a peristaltic pump. Using a large magnetic stirrer, all composite water was first mixed together thoroughly and then continuously mixed while the sub-sampling took place. All sub-sampling took place at a staging area near Long Beach. Documentation accompanying samples to the laboratories included Chain of Custody forms, and Analysis Request forms (complete with detection limits).

4.4.1.2 Grab Sampling

During each storm event, grab samples for oil and grease, total recoverable petroleum hydrocarbons (TRPH), total and fecal coliform, enterococcus, and methyl tertiary butyl ether (MTBE) were collected. The timing of grab sampling efforts was often driven by the short holding times for the bacterial analyses. The ability to deliver samples to the microbiological laboratory within the 6-hour holding time was always a major consideration.

Except at the pump stations, all grab samples were taken near the center of flow as possible or at least in an area of sufficient velocity to ensure good mixing. At the Dominguez Gap sampling site, grabs were taken from the sump. At the Belmont pump station, grabs were taken at the point of discharge for the pumps. Some sites required the use of a pole to obtain the samples. Poles used were fitted with special bottle holders to secure the sampling containers. Care was taken not to overfill the sample containers as some of the containers contained preservative. For the MTBE samples, care was taken to assure that no air bubbles were trapped in the sample vial.

4.4.2 Dry Weather Sampling

The Citiy's NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site.

Inspections at each site included whether water was present and whether this water was flowing or just ponded. At sites that were found not to have flowing water, inspections were done in the upstream drains to verify that flow was not occurring into the site. This situation was encountered again this year at the Dominguez Gap Pump station where remnants of water were still ponded in the basin in front of the pump station, but the storm drain discharges into this basin were dry.

When flowing water was present at one of these mass emission sites, then water quality measurements, flow estimates, and water samples were taken along with observations of site conditions. Flowing water was present and all measurements were taken at Bouton Creek, the Belmont Pump Station, and at Los

Cerritos Channel. Temperature and conductivity were measured with an Orion Model 140 meter, pH with an Orion Model 250 meter, and oxygen was measured with an Orion Model 840 meter.

Water samples were collected at the Belmont Pump Station and the Los Cerritos Channel Station by use of an automatic peristaltic pump sampler that collected aliquots every half hour for a 24-hour period. For the Bouton Creek Station where tidal influences are present, a similar sample was collected over a 2-4 hour period of low tide in order to sample just the fresh water discharge down the creek. Additional grab samples were taken just after the time-composited samples for MTBE, TPH, and bacteria. All samples were chilled to 4 ^{0}C and transported to the appropriate laboratory for analysis.

4.5 Laboratory Analyses

The water quality constituents selected for this program were established based upon the requirements of the City of Long Beach NPDES permit for stormwater discharges. Analytical methods are based upon approved USEPA methodology. Substantial changes were made to the analytical suite and certain detection limits based upon extensive discussions with Regional Board staff. The most significant changes were elimination of many of the herbicides, carbamate and urea pesticides that were below reporting limits in both this and the Los Angeles County monitoring efforts. Other significant changes included reduction of reporting limits for metals, organophosphates, chlorinated pesticides and semivolatile organic compounds. The following sections detail laboratory methods for chemical and biological testing.

4.5.1 Analytical Suite and Methods

Conventional, bacteriological, and chemical constituents selected for inclusion in this stormwater quality program are presented in Table 4.2. Analytical method numbers, holding times, and reporting limits are also indicated for each analysis.

4.5.1.1 Laboratory QA/QC

Quality Assurance/ Quality Control (QA/QC) activities associated with laboratory analyses are detailed in Appendix A.

The laboratory QA/QC activities provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness. Analytical quality assurance for this program included the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, USEPA methods and written SOPs.
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates and SRMs.
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks included the use of internal standards, method blanks, matrix spike/spike duplicates, duplicates, laboratory control spikes and Standard Reference Materials (SRMs).

Data validation was performed in accordance with the National Functional Guidelines for Organic Data Review (EPA540/R-94/012), Inorganic Data Review (EPA540/R-94/013), and Guidance on the Documentation and Evaluation of Trace Metals Data Collected for the Clean Water Act Compliance Monitoring (EPA/821/B/95/002).

4.5.2 Toxicity Testing Procedures

Upon receipt in the laboratory, stormwater discharge and receiving water samples were stored at 4 °C, in the dark until used in toxicity testing. Toxicity testing commenced within 72 hours of sample collection for most samples. The relative toxicity of each discharge sample was evaluated using three chronic test methods: the water flea (*Ceriodaphnia dubia*) reproduction and survival test (freshwater), the purple sea urchin (*Strongylocentrotus purpuratus*) fertilization test (marine), and the mysid (*Americamysis bahia*) growth and survival test (marine). Each of the methods is recommended by the USEPA for the measurement of effluent and receiving water toxicity. Samples of marine receiving water from Alamitos Bay were tested with the two marine species only. Water samples were diluted with laboratory water to produce a concentration series using procedures specific to each test method.

4.5.2.1 Water Flea Reproduction and Survival Test

Toxicity tests using the water flea, *Ceriodaphnia dubia*, were conducted in accordance with methods recommended by USEPA (1994a). The test procedure consisted of exposing 10 *C. dubia* neonates (less than 24 hours old) to the samples for six days. One animal was placed in each of 10 individual polystyrene cups containing approximately 20 mL of test solution. The test temperature was 25 ± 1 °C and the photoperiod was 16 hours light: 8 hours dark. Daily water changes were accomplished by transferring each individual to a fresh cup of test solution; water quality measurements and observations of survival and reproduction (number of offspring) were made at this time also. Prior to transfer, each cup was inoculated with food (100 µL of a 3:1 mixture of *Selenastrum* culture, density approximately 3.5 x 10^8 cells/mL, and *Ceriodaphnia* chow).

The test organisms were obtained from in-house cultures that were established from broodstock obtained from USEPA (Duluth, MN). The laboratory water used for cultures, controls, and preparation of sample dilutions was synthetic moderately hard freshwater, prepared with deionized water and reagent chemicals. Test samples were poured through a 60 µm Nitex screen in order to remove indigenous organisms prior to preparation of the test concentrations. Serial dilutions of the test sample were prepared, resulting in test concentrations of 100, 50, 25, 12, and 6 %.

The quality assurance program for this test consisted of three components. First, a control sample (laboratory water) was included in all tests in order to document the health of the test organisms. Second, a reference toxicant test consisting of a concentration series of potassium chloride (KCl) was conducted with each batch of samples to evaluate test sensitivity and precision. Third, the results were compared to established performance criteria for control survival, reproduction, reference toxicant sensitivity, sample storage, and test conditions. Any deviations from the performance criteria were noted in the laboratory records and prompted corrective action, ranging from a repeat of the test to adjustment of laboratory equipment.

4.5.2.2 Mysid Growth and Survival Test

Samples of wet weather discharge and receiving water were assessed for chronic toxicity using the marine mysid, *Americamysis bahia* (formerly named *Mysidopsis bahia*). Test procedures followed the guidelines established by USEPA (1994b). The procedure consisted of a seven-day exposure of juvenile (7 day old) mysids to the samples. Eight replicate test chambers (250 mL beakers), each containing five mysids, were tested for each concentration. The beakers contained 150 mL of test solution, which was changed daily. The test temperature was 26 ± 1 °C and the photoperiod was 16 hours light: 8 hours dark. Water quality and mysid survival measurements were recorded during each water change. Mysids were fed a standardized amount of newly hatched brine shrimp twice daily. At the end of the test, the surviving animals were dried and weighed to the nearest 0.001 mg to determine effects on growth.

The discharge water samples were adjusted to a salinity of 30 g/kg before testing. This was accomplished by adding a sea salt mixture (TropicMarin™) to the samples. The addition of sea salts was carried out the day before a test was initiated. The receiving water samples from Alamitos Bay had salinities greater than 30 g/kg and were tested without adjustment of the salinity. The salinity-adjusted samples were then diluted with seawater to produce test concentrations of 100, 50, 25, 12, and 6%. The test organisms were lab-reared *A. bahia* that were purchased from a commercial supplier. For most of the tests, the animals were received the day before the test started and were acclimated to the test temperature and salinity overnight.

Negative control (1.0 µm and activated carbon filtered natural seawater from ToxScan's Marine Bioassay facility at Long Marine Laboratory in Santa Cruz was diluted to 30 g/kg with deionized water) and sea salt control samples (deionized water mixed with sea salts) were included in each test series for quality control purposes. In addition, a reference toxicant test was included with each batch of test samples. Each reference toxicant test consisted of a concentration series of copper chloride with eight replicates tested per concentration. The median lethal concentration (LC50) was calculated from the data and compared to control limits based upon the cumulative mean and two standard deviations from recent experiments. Control and water quality data were also compared to established performance objectives; any deviations from these were noted and corrected, if possible.

4.5.2.3 Sea Urchin Fertilization Test

All discharge and receiving water samples of stormwater were also evaluated for toxicity using the purple sea urchin fertilization test (USEPA 1995b). This test measures toxic effects on sea urchin sperm, which are expressed as a reduction in their ability to fertilize eggs. The test consisted of a 20-minute exposure of sperm to the samples. Eggs were then added and given 20 minutes for fertilization to occur. The eggs were then preserved and examined later with a microscope to assess the percentage of successful fertilization. Toxic effects are expressed as a reduction in fertilization percentage. Purple sea urchins (*Strongylocentrotus purpuratus*) used in the tests were supplied by U.C. Davis – Granite Canyon. The tests were conducted in glass shell vials containing 10 mL of solution at a temperature of 15 ± 1 °C. Five replicates were tested at each sample concentration.

All samples were adjusted to a salinity of 33.5 g/kg for the fertilization test. Previous experience has determined that many sea salt mixes are toxic to sea urchin sperm. Therefore, the salinity for the urchin test was adjusted by the addition of hypersaline brine. The brine was prepared by freezing and partially thawing seawater. Since the addition of brine dilutes the sample, the highest stormwater concentration that could be tested for the sperm cell test was 50%. The adjusted samples were diluted with seawater to produce test concentrations of 50, 25, 12, 6, and 3%.

Seawater control (1.0 µm filtered natural seawater from ToxScan's Long Marine Laboratory facility) and brine control samples (50% deionized water and 50% brine) were included in each test series for quality control purposes. Water quality parameters (temperature, dissolved oxygen, pH, ammonia, and salinity) were measured on the test samples to ensure that the experimental conditions were within desired ranges and did not create unintended stress on the test organisms. In addition, a reference toxicant test was included with each stormwater test series in order to document intralaboratory variability. Each reference toxicant test consisted of a concentration series of copper sulfate with four replicates tested per concentration. The median effective concentration (EC50) was estimated from the data and compared to control limits based upon the cumulative mean and two standard deviations of recent experiments.

4.5.2.4 Toxicity Identification Evaluations (TIEs)

Phase I TIEs were conducted on selected runoff samples from stations that exhibited substantial ($\geq$ 2 TU_{ec}) toxicity, in order to determine the characteristics of the toxicants present. Each sample was subjected to treatments designed to selectively remove or neutralize classes of compounds (e.g., metals, nonpolar organics) and thus the toxicity that may be associated with them. Treated samples were then tested to determine the change in toxicity using the sea urchin fertilization test.

Four or five treatments were applied to each sample. These treatments were: particle removal, trace metal chelation, nonpolar organic extraction, organophosphate (OP) deactivation (except urchins) and chemical reduction. With the exception of the organics extraction, each treatment was applied independently on a salinity-adjusted sample. A control sample (lab dilution water) was included with each type of treatment to verify that the manipulation itself was not causing toxicity. If the TIE was not conducted concurrently with the initial testing of a sample, then a reduced set of concentrations of untreated sample was tested at the time of the TIE to determine the baseline toxicity and control for changes in toxicity due to sample storage.

Ethylene diamine tetraacetic acid (EDTA), a chelator of metals, was added to a concentration of 60 mg/L to the marine test samples. EDTA additions to the *Ceriodaphnia* samples were based upon sample hardness (USEPA 1991). Sodium thiosulfate (STS), a treatment that reduces oxidants such as chlorine and also decreases the toxicity of some metals was added to a concentration of 50 mg/L to separate portions of each marine sample. STS additions to the *Ceriodaphnia* samples were at 500, 250 and 125 mg/L. The EDTA and sodium thiosulfate treatments were given at least one hour to interact with the sample prior to the start of toxicity testing. Pipernyl butoxide, which inhibits activation of OP pesticides was added to a concentration of 100 mg/L for mysids and at three concentrations (125, 250 and 500 mg/L) for *Ceriodaphnia.*

Samples were centrifuged for 30 min at 3000 X g to remove particle-borne contaminants and tested for toxicity. A portion of the centrifuged sample was also passed through a 360 mg Sep-Pak™ C-18 solid phase extraction column in order to remove nonpolar organic compounds. C-18 columns have also been found to remove some metals from aqueous solutions.

4.5.2.5 Statistical Analysis

The toxicity test results were normalized to the control response in order to facilitate comparisons of toxicity between experiments. Normalization was accomplished by expressing the test responses as a percentage of the control value. Four statistical parameters (NOEC, LOEC, median effect, and TUc) were calculated to describe the magnitude of stormwater toxicity. The NOEC (highest test concentration not producing a statistically significant reduction in fertilization or survival) and LOEC (lowest test concentration producing a statistically significant reduction in fertilization or survival) were calculated by comparing the response at each concentration to the dilution water control. Various statistical tests were used to make this comparison, depending upon the characteristics of the data. Water flea survival and reproduction data were usually tested against the control using Fisher's Exact and Steel's Many-One Rank test, respectively. Sea urchin fertilization and mysid survival data were evaluated for significant differences using Dunnett's multiple comparison test, provided that the data met criteria for homogeneity of variance and normal distribution. Data that did not meet these criteria were analyzed by the non-parametric Steel's Many-One Rank or Wilcoxon's tests.

Measures of median effect for each test were calculated as the LC50 (concentration producing a 50% reduction in survival) for mysid and water flea survival, the EC50 (concentration effective on 50% of eggs) for sea urchin fertilization, or the IC50 (concentration inhibitory to 50% of individuals) for water flea reproduction and IC25 for mysid growth. The LC50 or EC50 was calculated using either probit analysis or the trimmed Spearman-Karber method. The IC25 and IC50 were calculated using linear interpolation analysis. All procedures for calculation of median effects followed USEPA guidelines.

The toxicity results were also expressed as chronic Toxic Units (TUc). This statistic was calculated as: 100/NOEC. Increased values of toxic units indicate relatively greater toxicity, whereas greater toxicity for the NOEC, LOEC, and median effect statistics is indicated by a lower value.

Comparisons of chemical or physical parameters with toxicity results were made using the non-parametric Spearman rank order correlation.

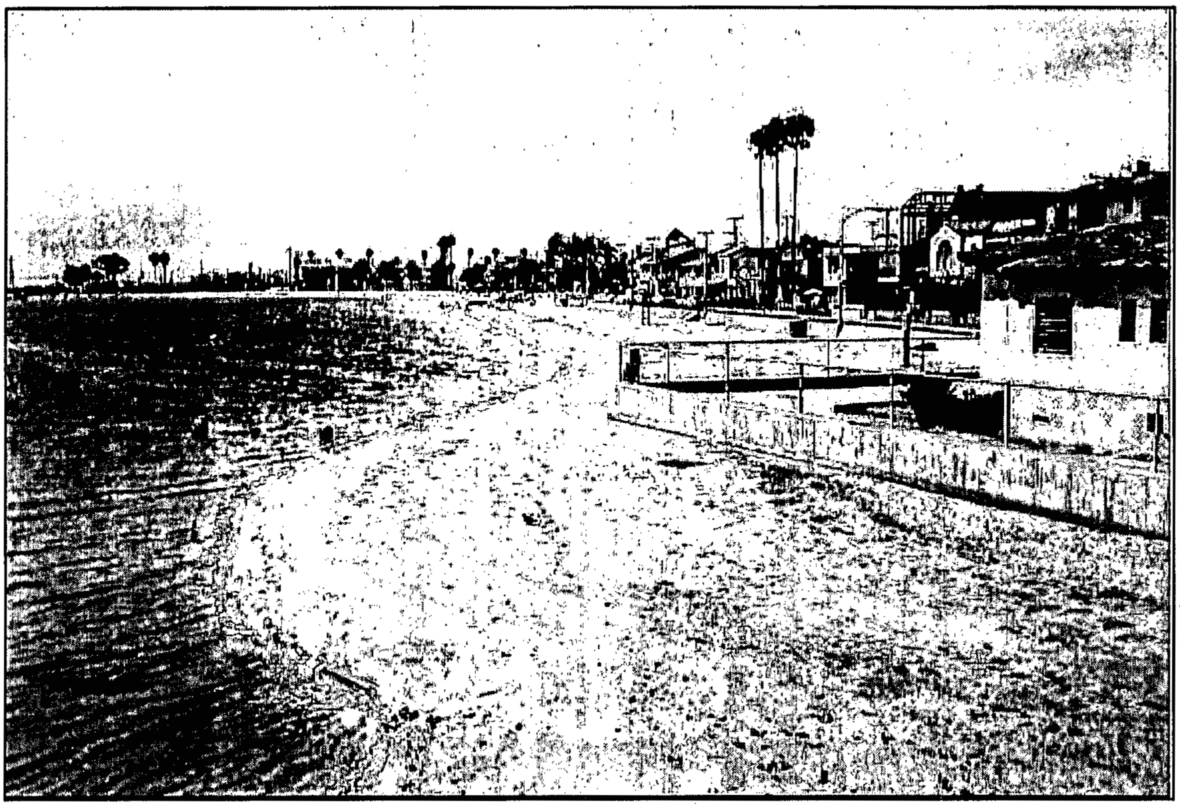


Table 4.1 Location Coordinates of Monitoring Stations for the City of Long Beach Stormwater Monitoring Program.

Station Name	State Plane Coordinates: Zone 5		North American Datum (NAD) 83	
	Northing (ft)	Easting (ft)	Latitude	Longitude
Belmont Pump	1734834.9	6522091.2	33° 45' 36.6"N	118° 07' 48.7"W
Bouton Creek	1741960.5	6529305.2	33° 46' 44.3"N	118° 06' 23.4"W
Los Cerritos Channel	1747935.9	6530153.2	33° 47' 43.3"N	118° 06'13.4"W
Dominguez Gap	1764025.0	6500042.5	33° 50' 22.1"N	118° 12' 10.5"W
Alamitos Bay (Floating Dock)	1732942.2	6521892.8	33° 45' 15.0"N	118° 07' 52.0"W
Alamitos Bay (Dry-Weather Outfall)	1732807.4	6521874.4	33° 45' 13.7"N	118° 07' 54.2"W

Table 4.2. Analytical Methods, Holding Times, and Reporting Limits.

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
CONVENTIONAL PARAMETERS			
Oil and Grease (mg/L)	1664	28 days	5.0
Total Phenols (mg/L)	420.1	28 days	0.1
Cyanide (µg/L)	335.2	14 days	0.005
pH (units)	150.1	ASAP	0 – 14
Dissolved Phosphorus (mg/L)	365.3	48 hours	0.05
Total Phosphorus (mg/L)	365.3	28 days	0.05
Turbidity (NTU)	180.1	48 hours	0.1
Total Suspended Solids (mg/L)	160.2	7 days	1.0
Total Dissolved Solids (mg/L)	160.1	7 days	1.0
Volatile Suspended Solids (mg/L)	160.4	7 days	2.0
Total Organic Carbon (mg/L)	415.1	28 days	1.0
Total Recoverable Petroleum Hydrocarbon (mg/L)	1664	28 days	5.0
Biochemical Oxygen Demand (mg/L)	405.1	48 hours	2.0
Chemical Oxygen Demand (mg/L)	410.1	28 days	10
Total Ammonia-Nitrogen (mg/L)	350.2	28 days	0.1
Total Kjeldahl Nitrogen (mg/L)	351.3	28 days	0.1
Nitrite Nitrogen (mg/L)	300.0	48 hours	0.1
Nitrate Nitrogen (mg/L)	300.0	48 hours	0.1
Alkalinity, as CaCO3 (mg/L)	310.1	48 hours	2.0
Specific Conductance (umhos/cm)	120.1	48 hours	1.0
Total Hardness (mg/L)	130.2	180 days	2.0
MBAS (mg/L)	425.1	48 hours	0.5
Chloride (mg/L)	300.0	48 hours	2.0
Fluoride (mg/L)	300.0	48 hours	0.1
Methyl tertiary butyl ether (MTBE) (µg/L)	8020A	14 days	1.0
BACTERIA (MPN/100ml)			
Total Coliform	SM 9221B	6 hours	<20
Fecal Coliform	SM 9221B	6 hours	<20
Enterococcus	SM 9230C	6 hours	<20
TOTAL AND DISSOLVED METALS (µg/L)[1]			
Aluminum	200.8	180 days	100
Antimony	200.8	180 days	0.5
Arsenic	200.8	180 days	1.0
Beryllium	200.8	180 days	0.5
Cadmium	200.8	180 days	0.25
Chromium	200.8	180 days	0.5
Copper	200.8	180 days	0.5
Hexavalent Chromium (total)	SM 3500D	24 hours	5.0
Iron	236.1	180 days	100
Lead	200.8	180 days	0.5
Mercury	245.1	28 days	0.5
Nickel	200.8	180 days	1.0
Selenium	200.8	180 days	1.0
Silver	200.8	180 days	0.25
Thallium	200.8	180 days	1.0
Zinc	200.8	180 days	1.0

1. Samples to be analyzed for dissolved metals are to be filtered within 48 hours.

Table 4.2. **Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
CHLORINATED PESTICIDES (µg/L)			
Aldrin	8081A	7 days	0.005
alpha-BHC	8081A	7 days	0.01
beta-BHC	8081A	7 days	0.005
delta-BHC	8081A	7 days	0.005
gamma-BHC (lindane)	8081A	7 days	0.02
alpha-Chlordane	8081A	7 days	0.1
gamma-Chlordane	8081A	7 days	0.1
4,4'-DDD	8081A	7 days	0.05
4,4'-DDE	8081A	7 days	0.05
4,4'-DDT	8081A	7 days	0.01
Dieldrin	8081A	7 days	0.01
Endosulfan I	8081A	7 days	0.02
Endosulfan II	8081A	7 days	0.01
Endosulfan sulfate	8081A	7 days	0.05
Endrin	8081A	7 days	0.01
Endrin Aldehyde	8081A	7 days	0.01
Heptachlor	8081A	7 days	0.01
Heptachlor Epoxide	8081A	7 days	0.01
Toxaphene	8081A	7 days	0.5
Total PCBs	8081A	7 days	1.0
AROCLORS (µg/L)			
Aroclor-1016	8081A	7 days	0.5
Aroclor-1221	8081A	7 days	0.5
Aroclor-1232	8081A	7 days	0.5
Aroclor-1242	8081A	7 days	0.5
Aroclor-1248	8081A	7 days	0.5
Aroclor-1254	8081A	7 days	0.5
Aroclor-1260	8081A	7 days	0.5
ORGANOPHOSPHATE PESTICIDES (µg/L)			
Diazinon	8141A	7 days	0.01
Chlorpyrifos (Dursban)	8141A	7 days	0.5
Malathion	8141A	7 days	1.0
Prometryn	8141A	7 days	2.0
Atrazine	8141A	7 days	2.0
Simazine	8141A	7 days	2.0
Cyanazine	8141A	7 days	2.0
HERBICIDES (µg/L)			
2,4-D	8151A	7 days	1.0
2,4,5-TP-Silvex	8151A	7 days	5.0
Glyphosate	547	7 days	5.0

Table 4.2. **Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)			
Acenaphthene	625	7 days	1.0
Acenaphthylene	625	7 days	2.0
Anthracene	625	7 days	2.0
Benzidine	625	7 days	5.0
Benzo(a)anthracene	625	7 days	5.0
Benzo(b)fluoranthene	625	7 days	10
Benzo(k)fluoranthene	625	7 days	2.0
Benzo(g,h,i)perylene	625	7 days	5.0
Benzo(a)pyrene	625	7 days	2.0
Benzyl butyl phthalate	625	7 days	10
Bis(2-chloroethyl)ether	625	7 days	1.0
Bis(2-chloroethoxy)methane	625	7 days	5.0
Bis(2-ethylhexyl)phthalate	625	7 days	5.0
Bis(2-chlorisopropyl)ether	625	7 days	2.0
4-Bromophenyl phenyl ether	625	7 days	5.0
2-Chloroethyl vinyl ether	625	7 days	1.0
2-Chloronaphthalene	625	7 days	5.0
4-Chlorophenyl phenyl ether	625	7 days	5.0
Chrysene	625	7 days	5.0
Dibenz(a,h)anthracene	625	7 days	0.1
1,3-Dichlorobenzene	625	7 days	1.0
1,2-Dichlorobenzene	625	7 days	1.0
1,4-Dichlorobenzene	625	7 days	1.0
3,3-Dichlorobenzidine	625	7 days	5.0
Diethylphthalate	625	7 days	2.0
Dimethylphthalate	625	7 days	2.0
Di-n-Butyl phthalate	625	7 days	10
2,4-Dinitrotoluene	625	7 days	5.0
2,6-Dinitrotoluene	625	7 days	5.0
4,6 Dinitro-2-methylphenol	625	7 days	5.0
1,2-Diphenylhydrazine	625	7 days	1.0
Di-n-Octyl phthalate	625	7 days	10
Fluoranthene	625	7 days	0.05
Fluorene	625	7 days	0.1
Hexachlorobenzene	625	7 days	1.0
Hexachlorobutadiene	625	7 days	1.0
Hexachloro-cyclopentadiene	625	7 days	5.0
Hexachloroethane	625	7 days	1.0
Indeno[1,2,3-cd]pyrene	625	7 days	0.05
Isophorone	625	7 days	1.0
Naphthalene	625	7 days	0.2
Nitrobenzene	625	7 days	1.0
N-Nitroso-dimethyl amine	625	7 days	5.0
N-Nitroso-diphenyl amine	625	7 days	1.0
N-Nitroso-di-n-propyl amine	625	7 days	5.0

Table 4.2. Analytical Methods, Holding Times, and Reporting Limits. (continued)

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L) (continued)			
Phenanthrene	625	7 days	0.05
Pyrene	625	7 days	0.05
1,2,4-Trichlorobenzene	625	7 days	1.0
4-Chloro-3-methylphenol	625	7 days	1.0
2-Chlorophenol	625	7 days	2.0
2,4-Dichlorophenol	625	7 days	1.0
2,4-Dimethylphenol	625	7 days	2.0
2,4-Dinitrophenol	625	7 days	5.0
2-Nitrophenol	625	7 days	10
4-Nitrophenol	625	7 days	5.0
Pentachlorophenol	625	7 days	2.0
Phenol	625	7 days	1.0
2,4,6-Trichlorophenol	625	7 days	10

SM = Method number from *Standard Methods for the Examination of Water and Wastewater* (APHA 1995).
1. Samples must be filtered within 48 hours.

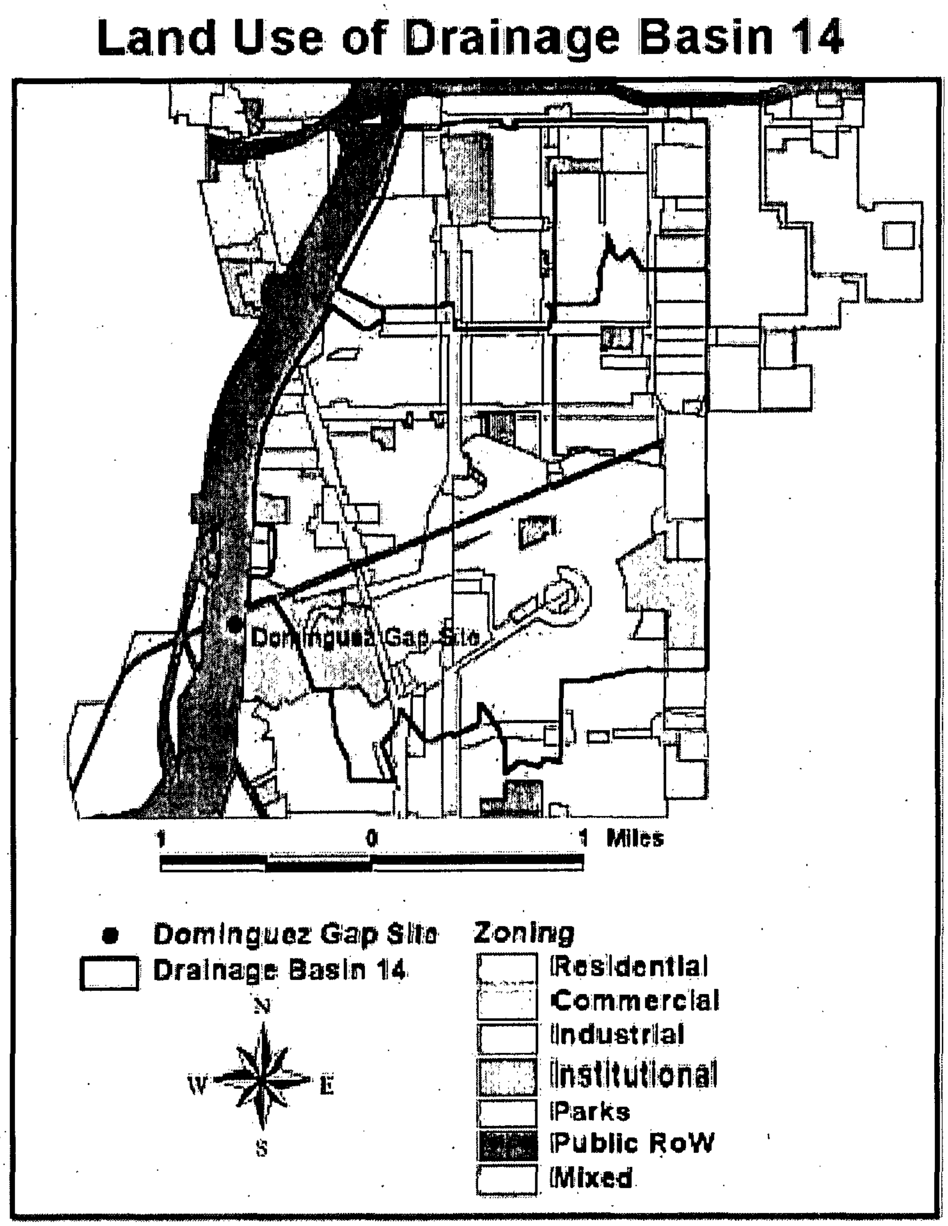


Figure 4.1. Land Use of Drainage Basin #14, which Drains to the Dominguez Gap Mass Emissions Site (Source: City of Long Beach Department of Technology Services, last update 12/20/00).

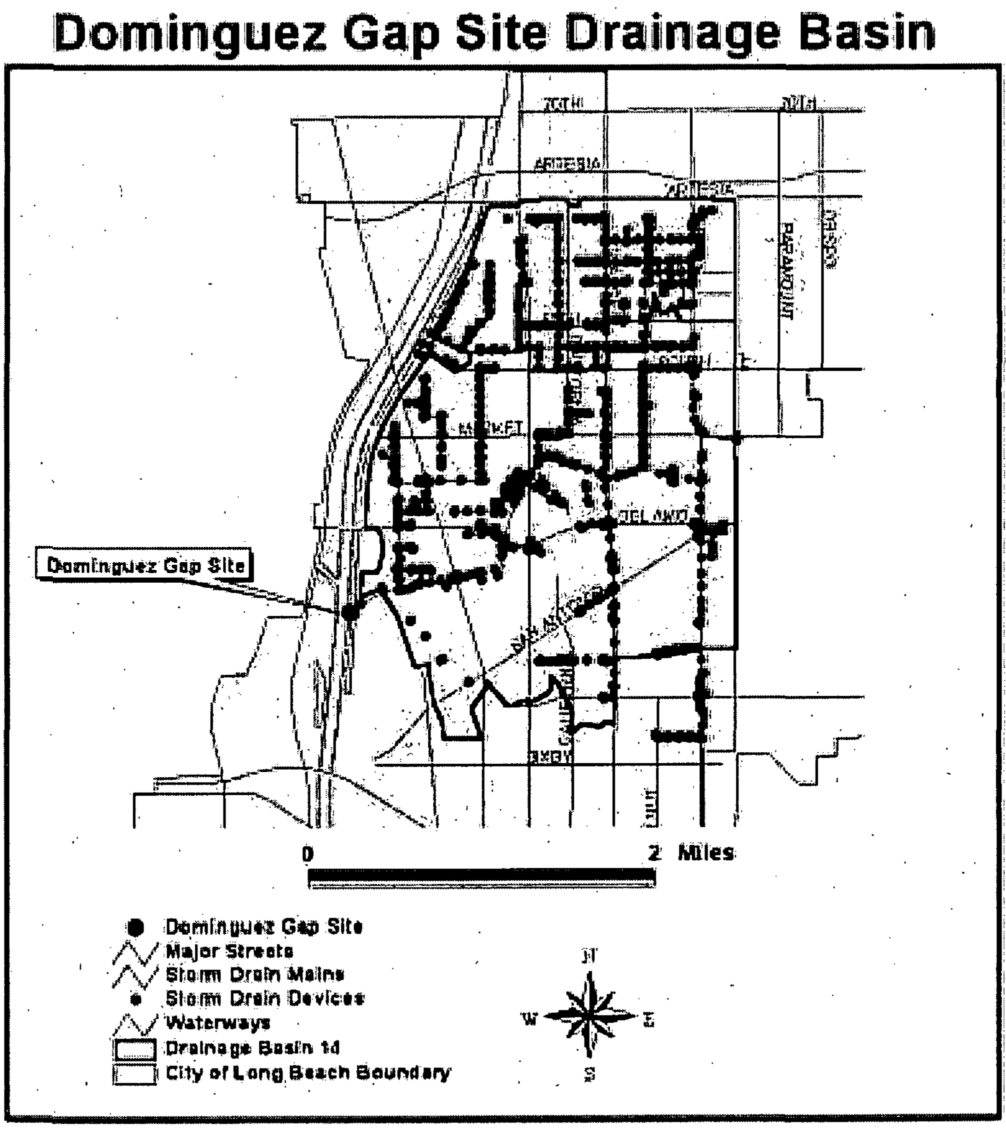
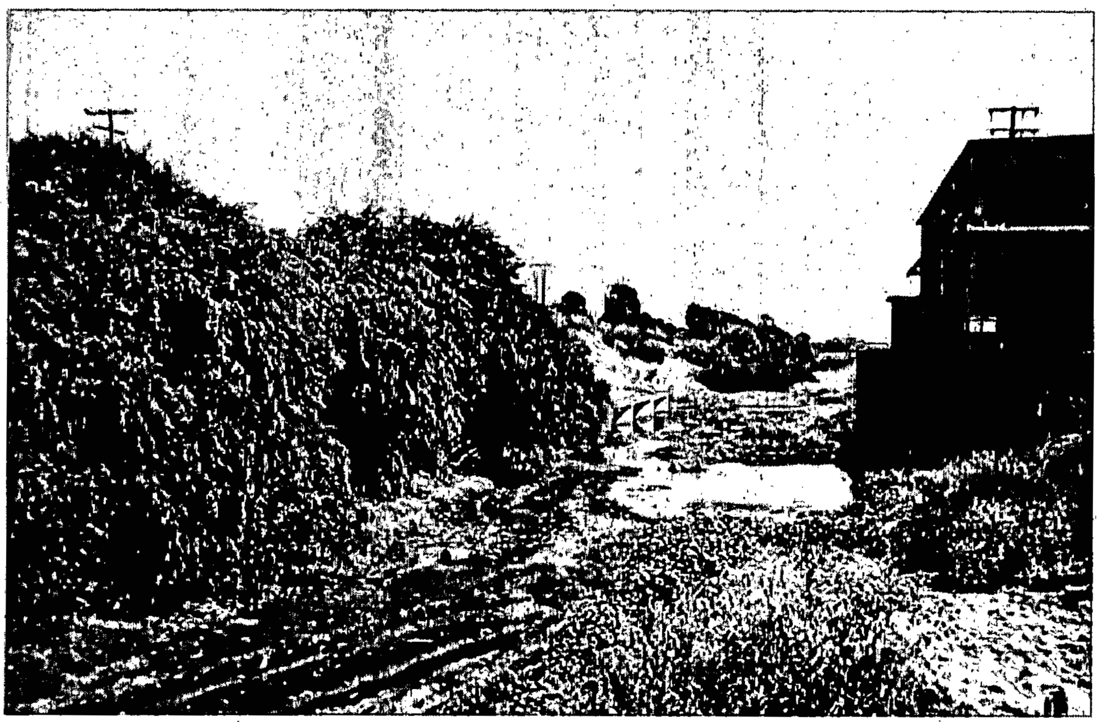


Figure 4.2. **Dominguez Gap Mass Emissions Site and the City of Long Beach Drainage Basin #14 (Source: City of Long Beach, Department of Technology Services, last updated 1/9/00).**



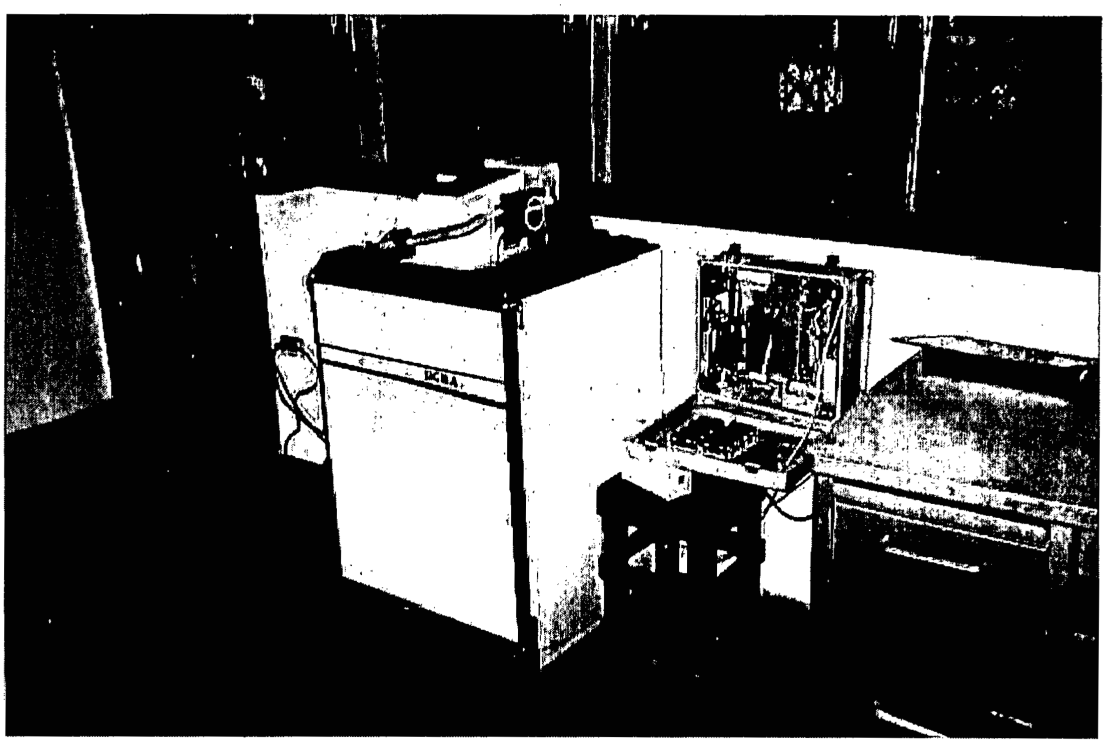


Figure 4.3 **Dominguez Gap Pump Station Monitoring Site – Forebay and Monitoring Equipment**

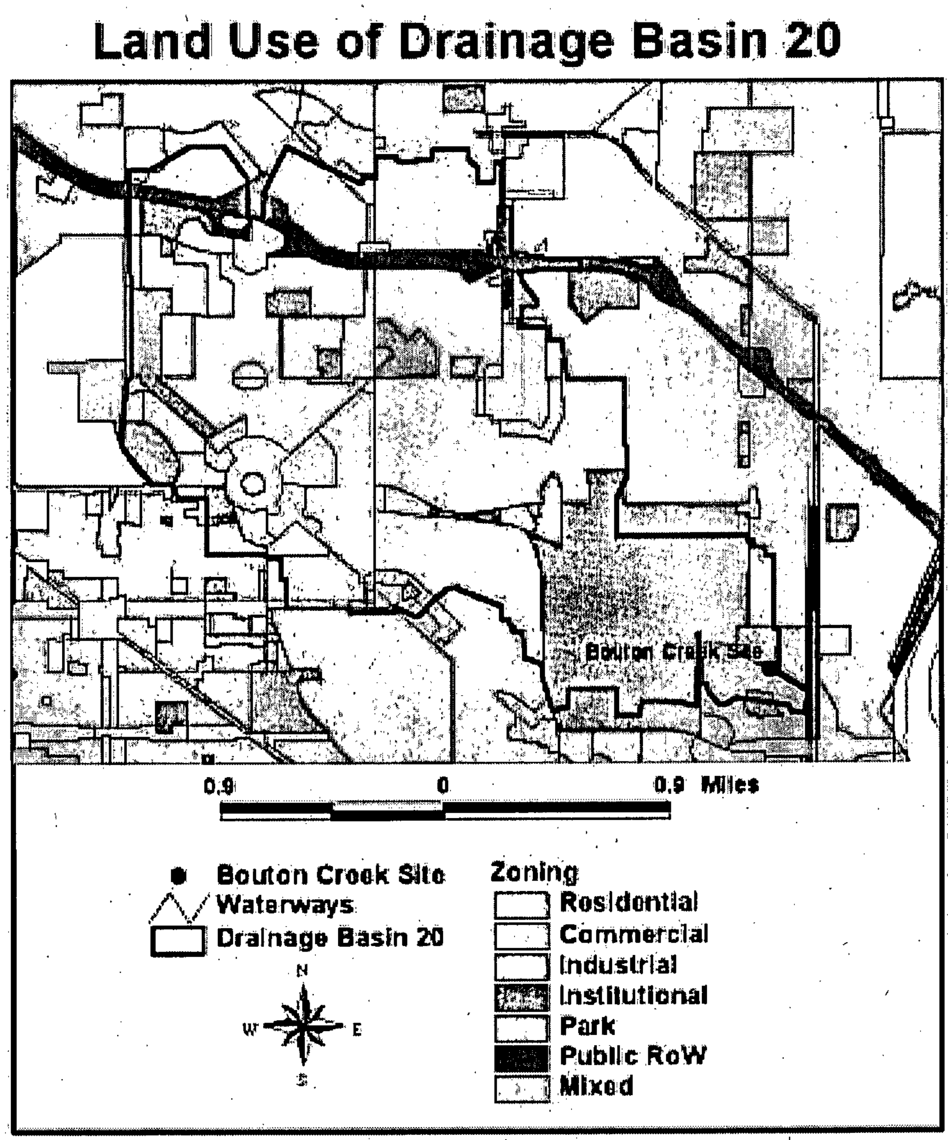


Figure 4.4. **Land Use of Drainage Basin #20, which drains to the Bouton Creek Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00).**

Bouton Creek Site Drainage Basin

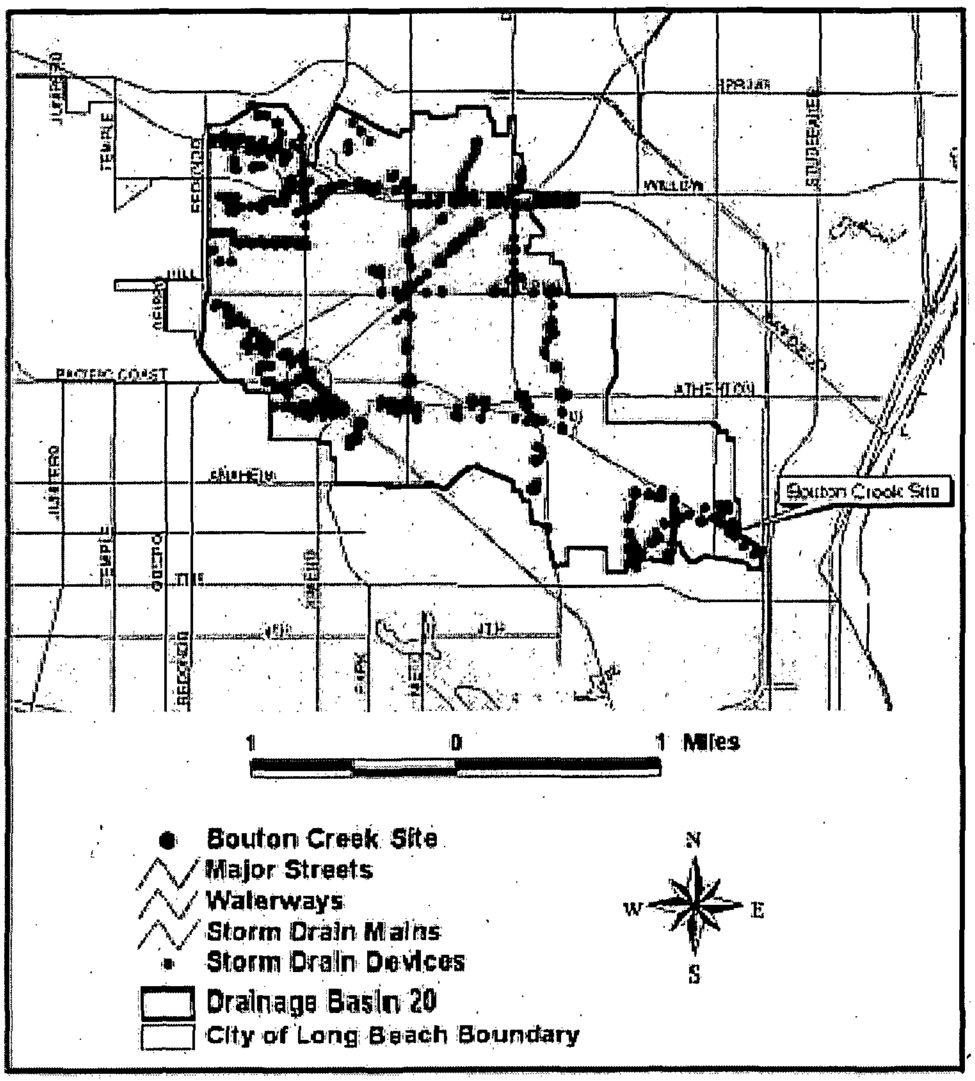


Figure 4.5. **Bouton Creek Mass Emissions Site and City of Long Beach Drainage Basin #20. (Source: City of Long Beach, Department of Technology Services, last updated 1/9/00).**

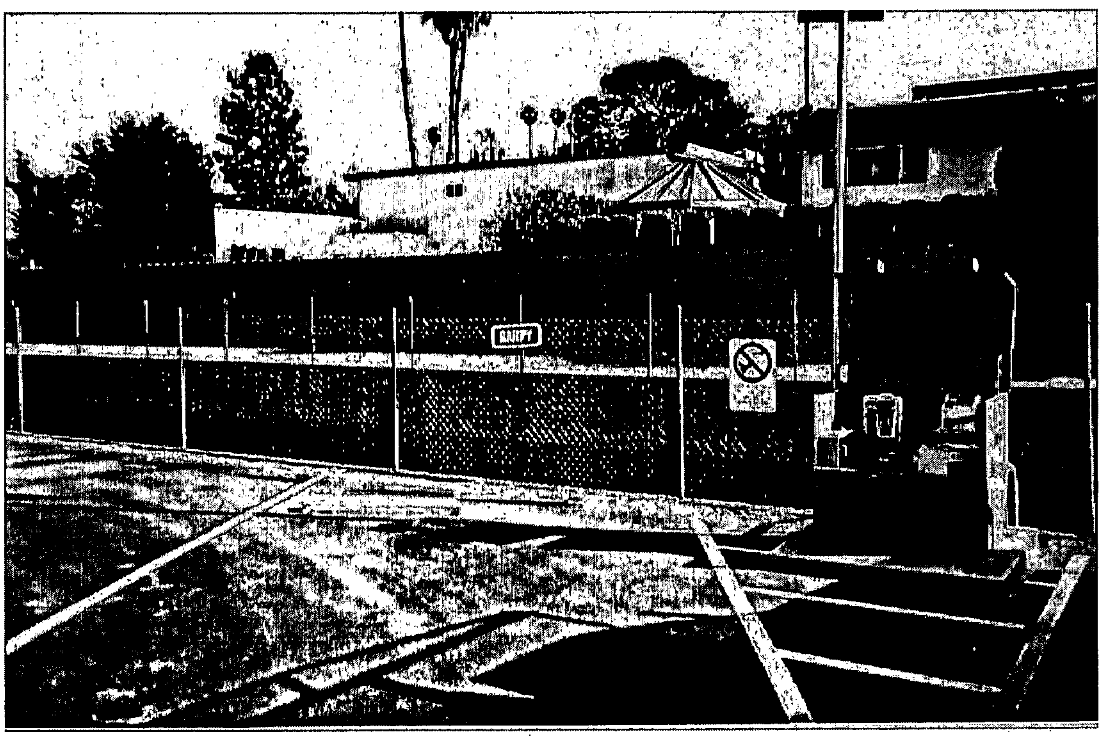


Figure 4.6 Bouton Creek Monitoring Site – Channel and Monitoring Equipment

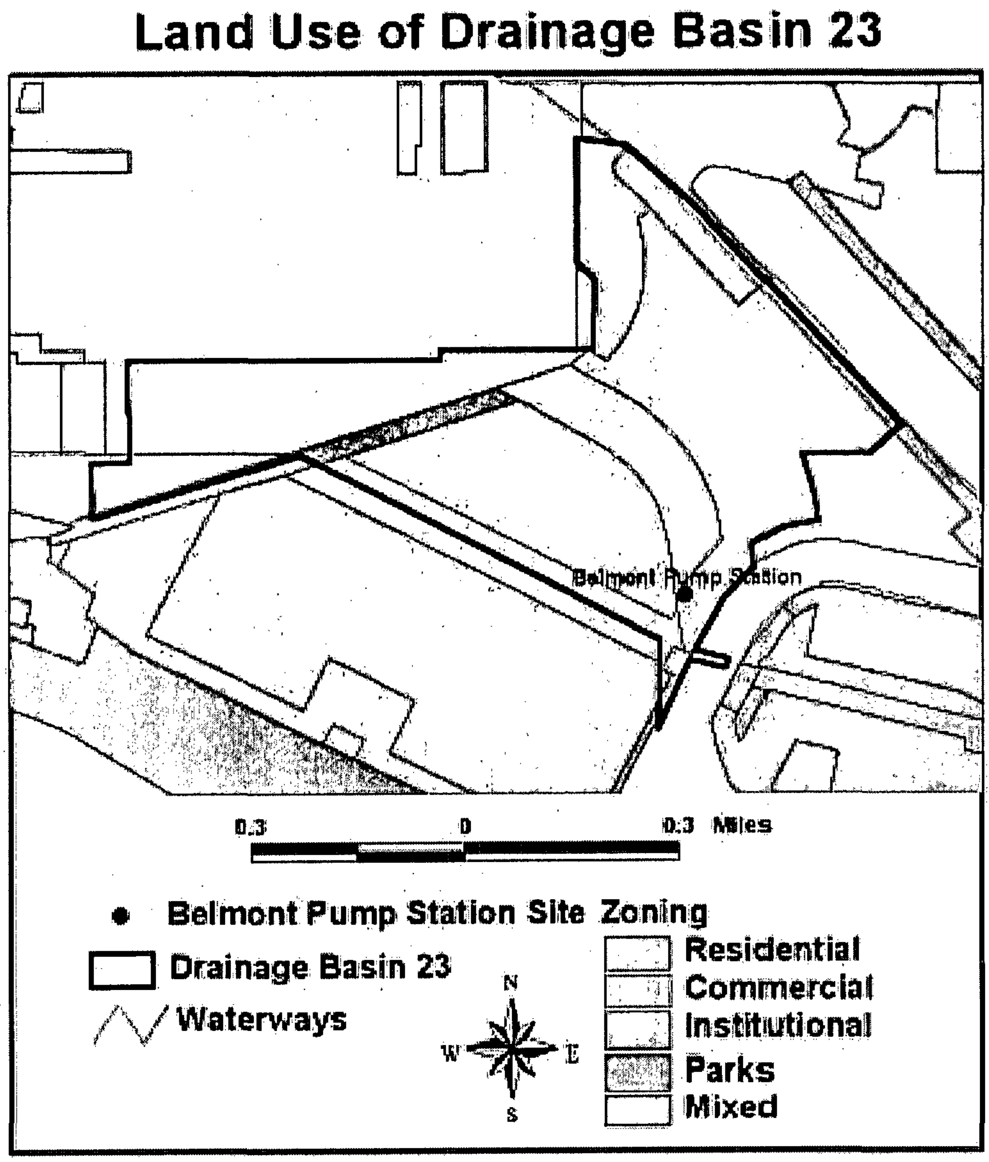


Figure 4.7. **Land Use of Drainage Basin #23, which Drains to the Belmont Pump Station Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00)**

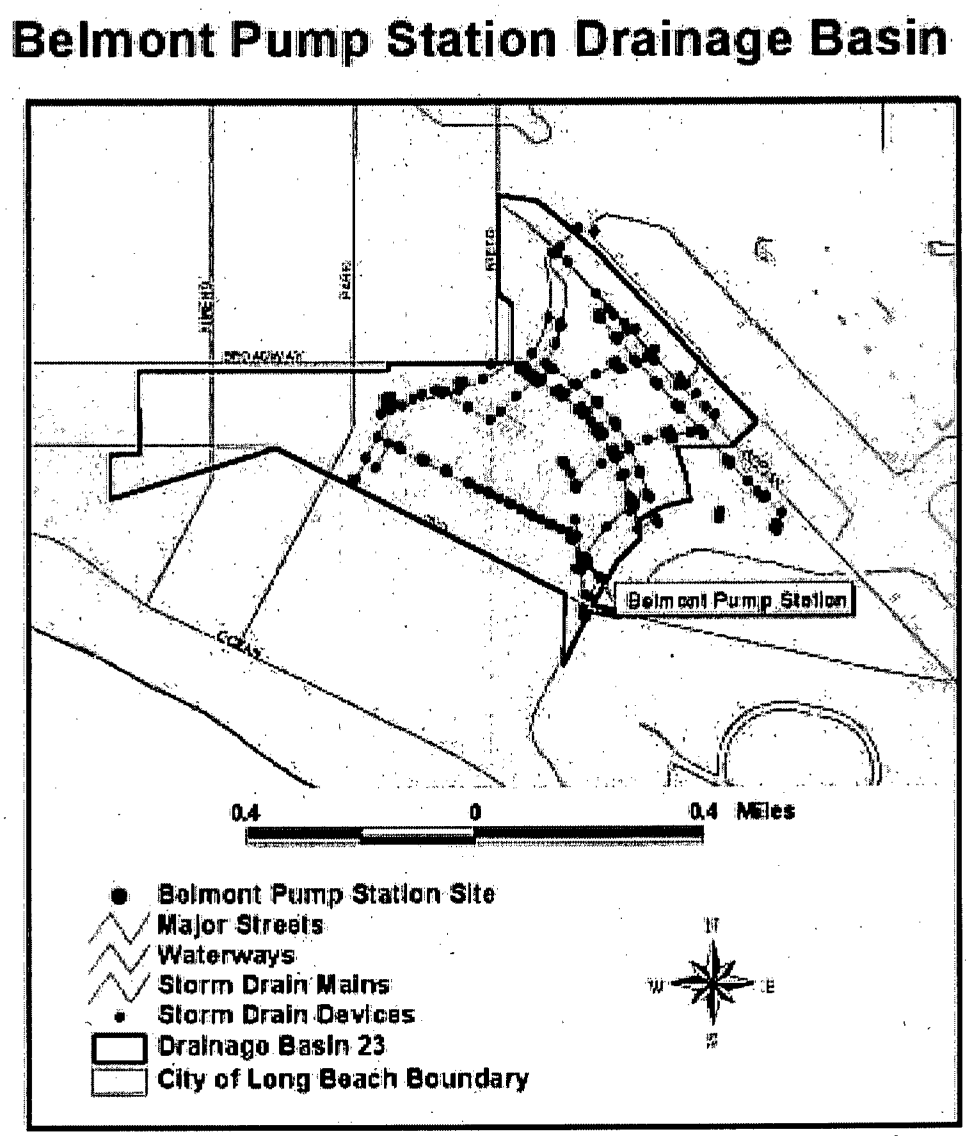
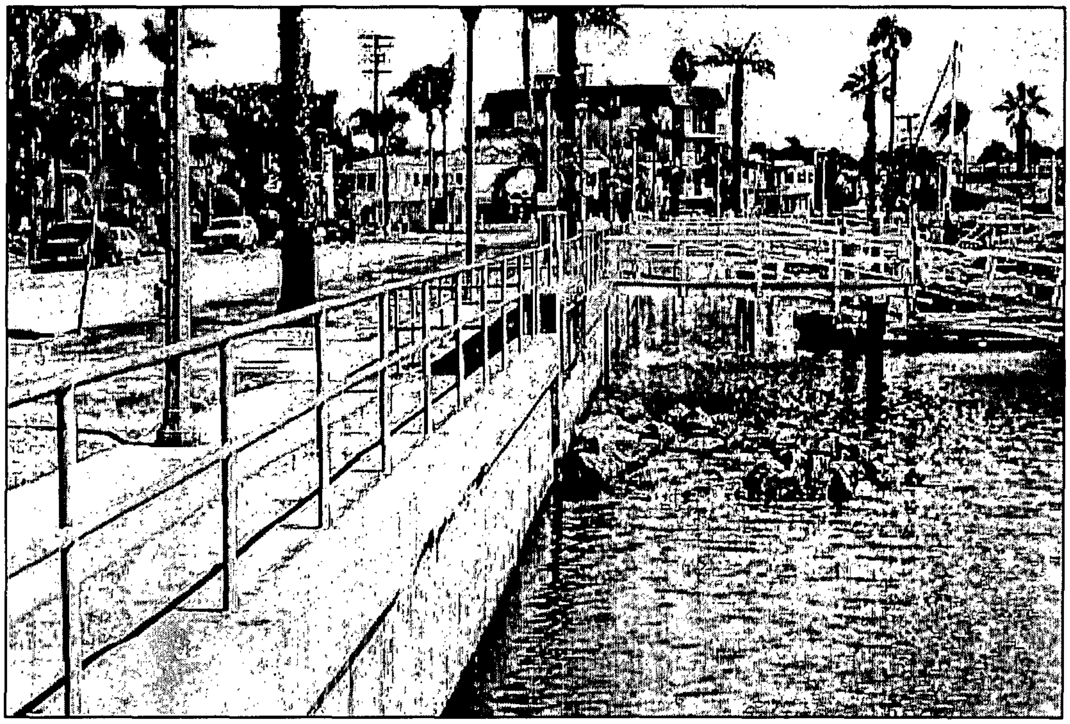


Figure 4.8. **Belmont Pump Station Mass Emissions Site and City of Long Beach Drainage Basin #23 (Source: City of Long Beach, Department of Technology Services, last updated 1/9/00).**



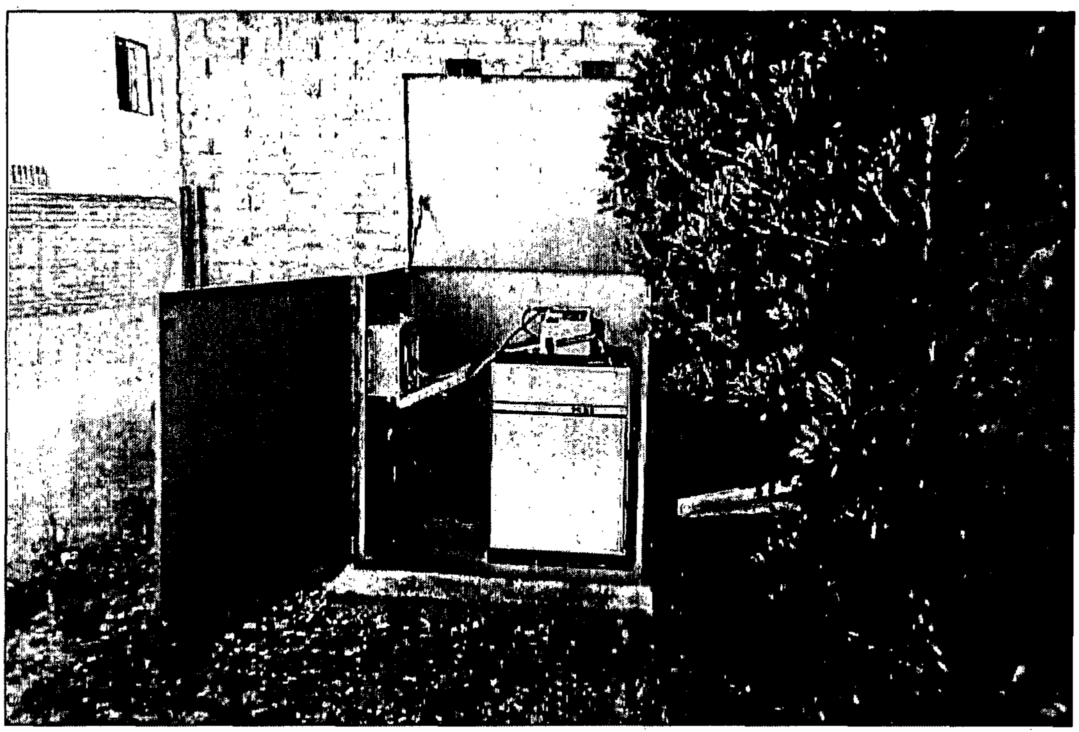


Figure 4.9 Belmont Pump Station Monitoring Site – Pump Station Outfall and Monitoring Equipment

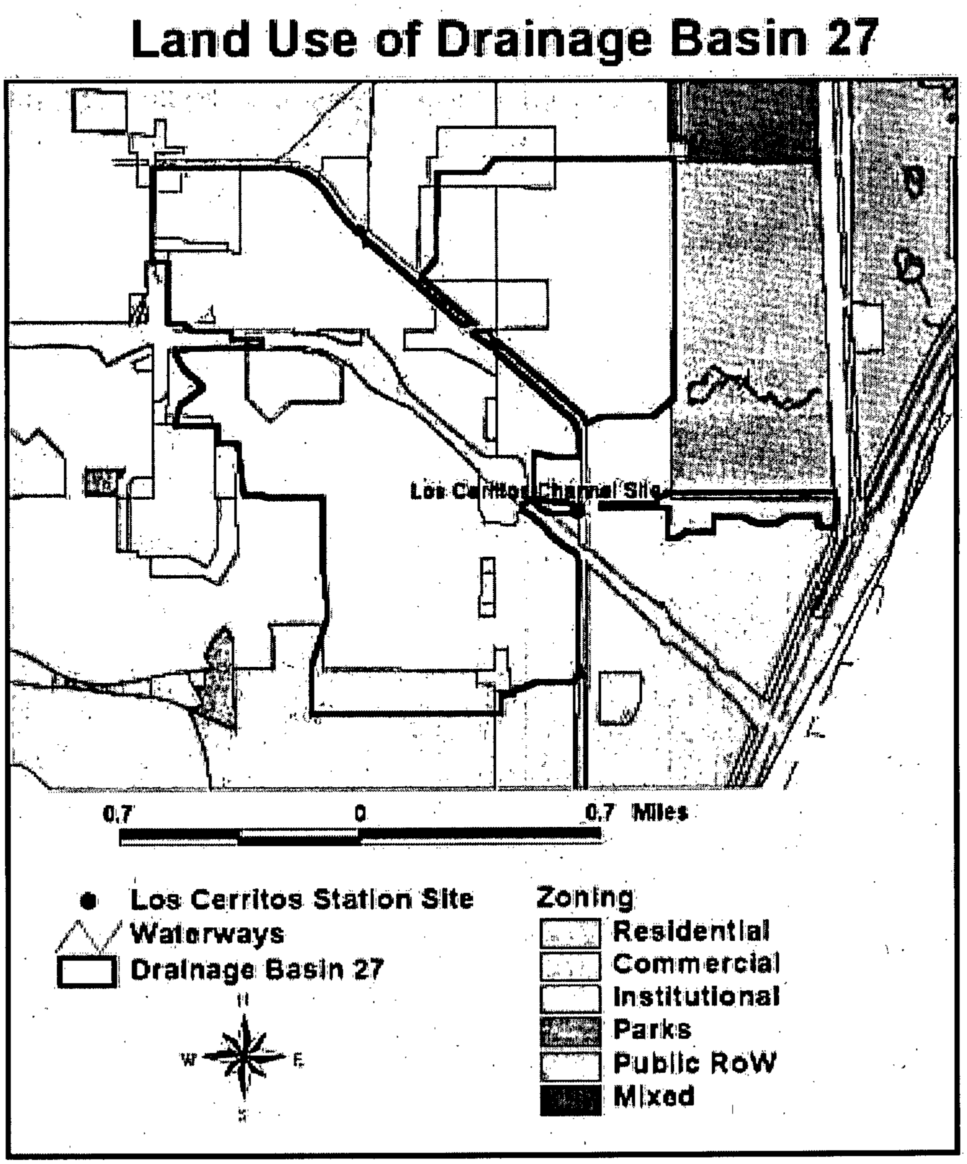


Figure 4.10. Land Use of Drainage Basin #27, which Drains to the Los Cerritos Channel Monitoring Site (Source: City of Long Beach, Department of Technology Services, last update 12/20/00).

Los Cerritos Channel Site
Drainage Basin

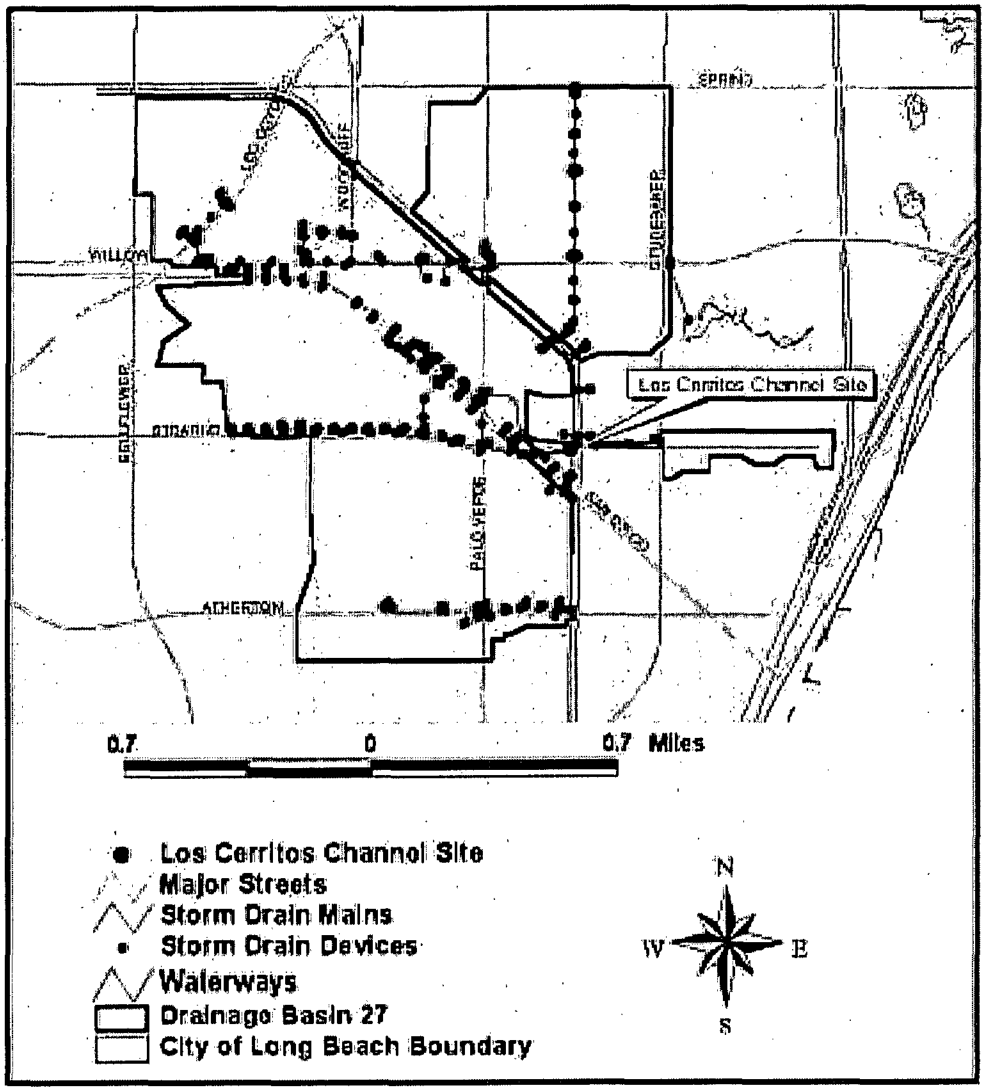


Figure 4.11. **Los Cerritos Channel Mass Emissions Site and City of Long Beach Drainage Basin #27 (Source: City of Long Beach, Department of Technology Services, last updated 1/9/00).**

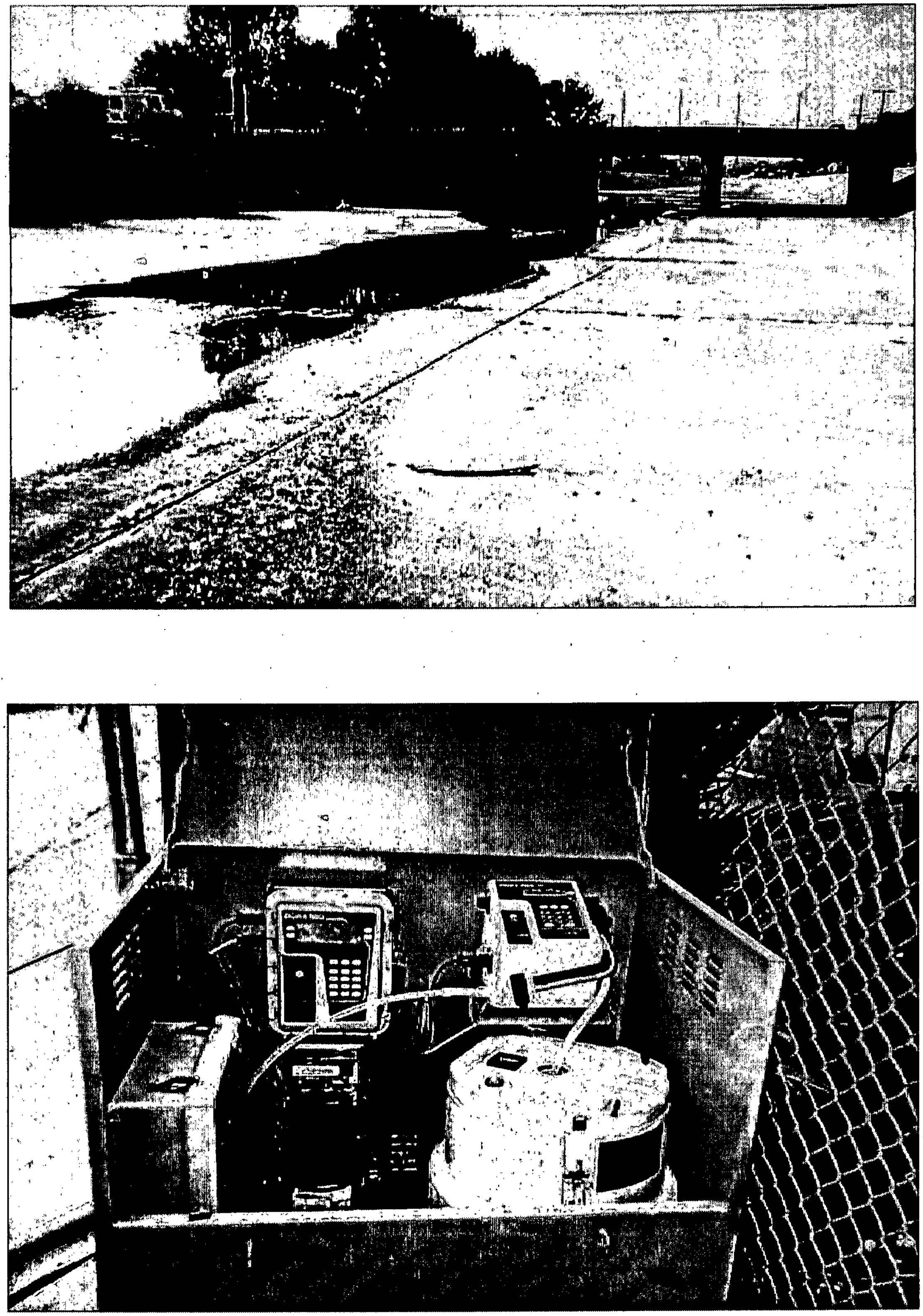


Figure 4.12 Los Cerritos Channel Monitoring Site – Channel and Monitoring Equipment

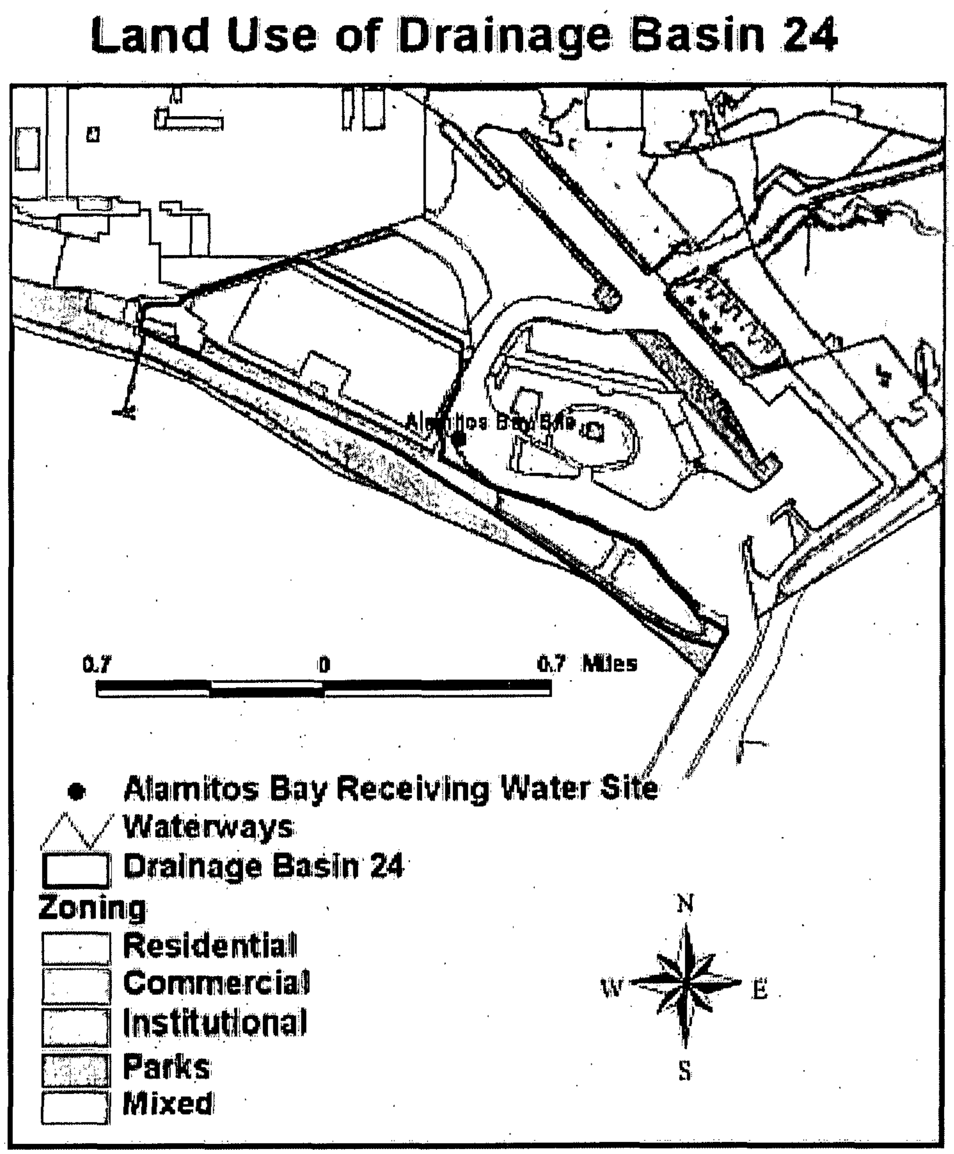


Figure 4.13. Land Use of Drainage Basin #24 which Drains to Alamitos Bay (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00).

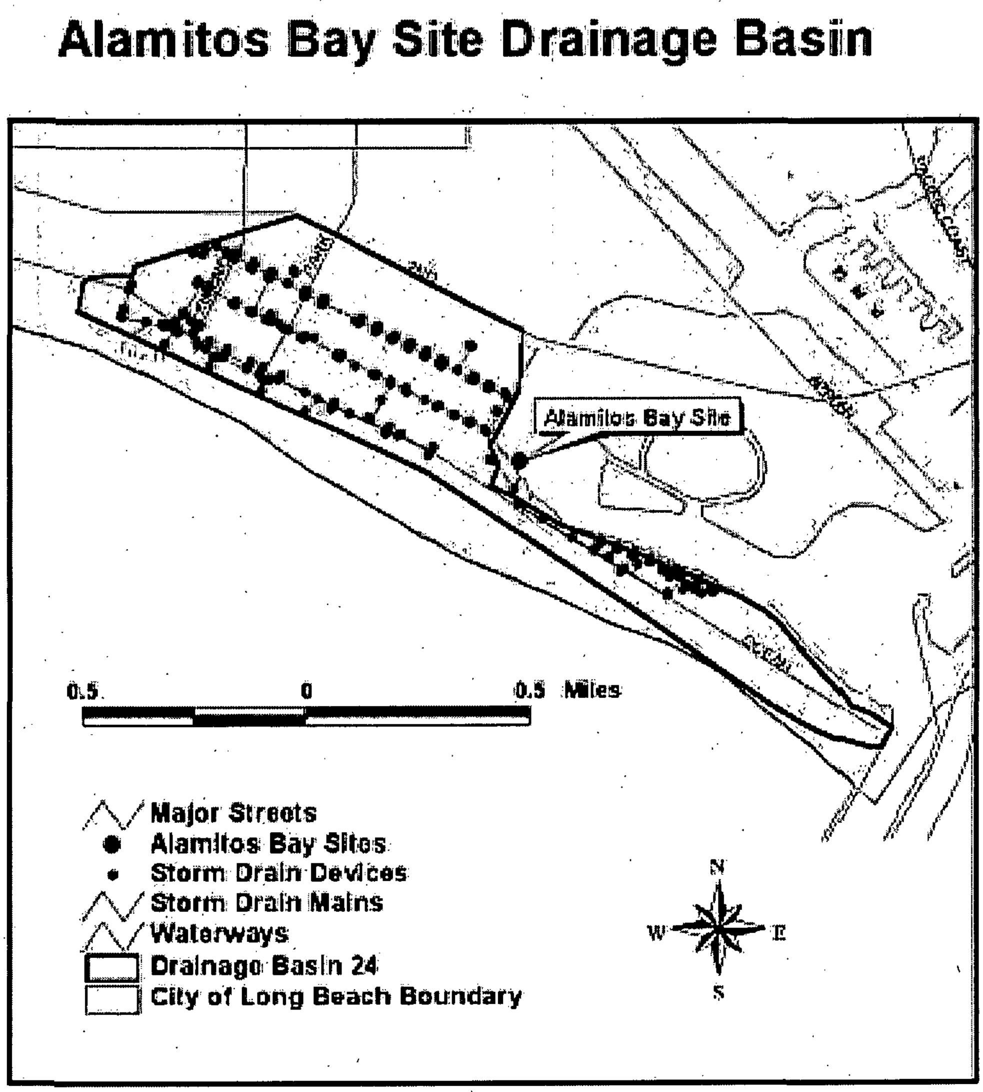


Figure 4.14. **Alamitos Bay Receiving Water Site and City of Long Beach Drainage Basin #24 (Source: City of Long Beach, Department of Technology Services, last updated 1/9/00).**

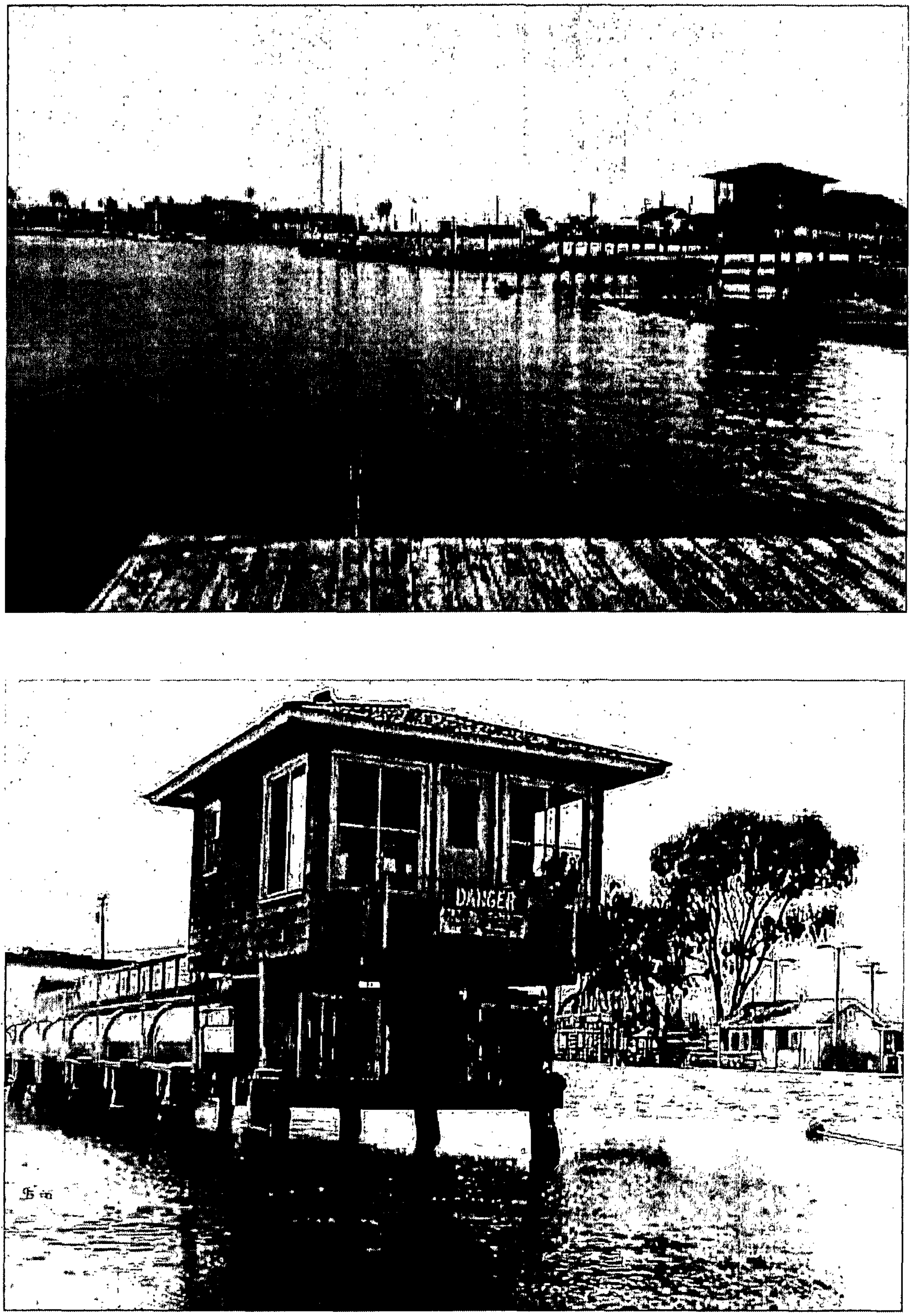
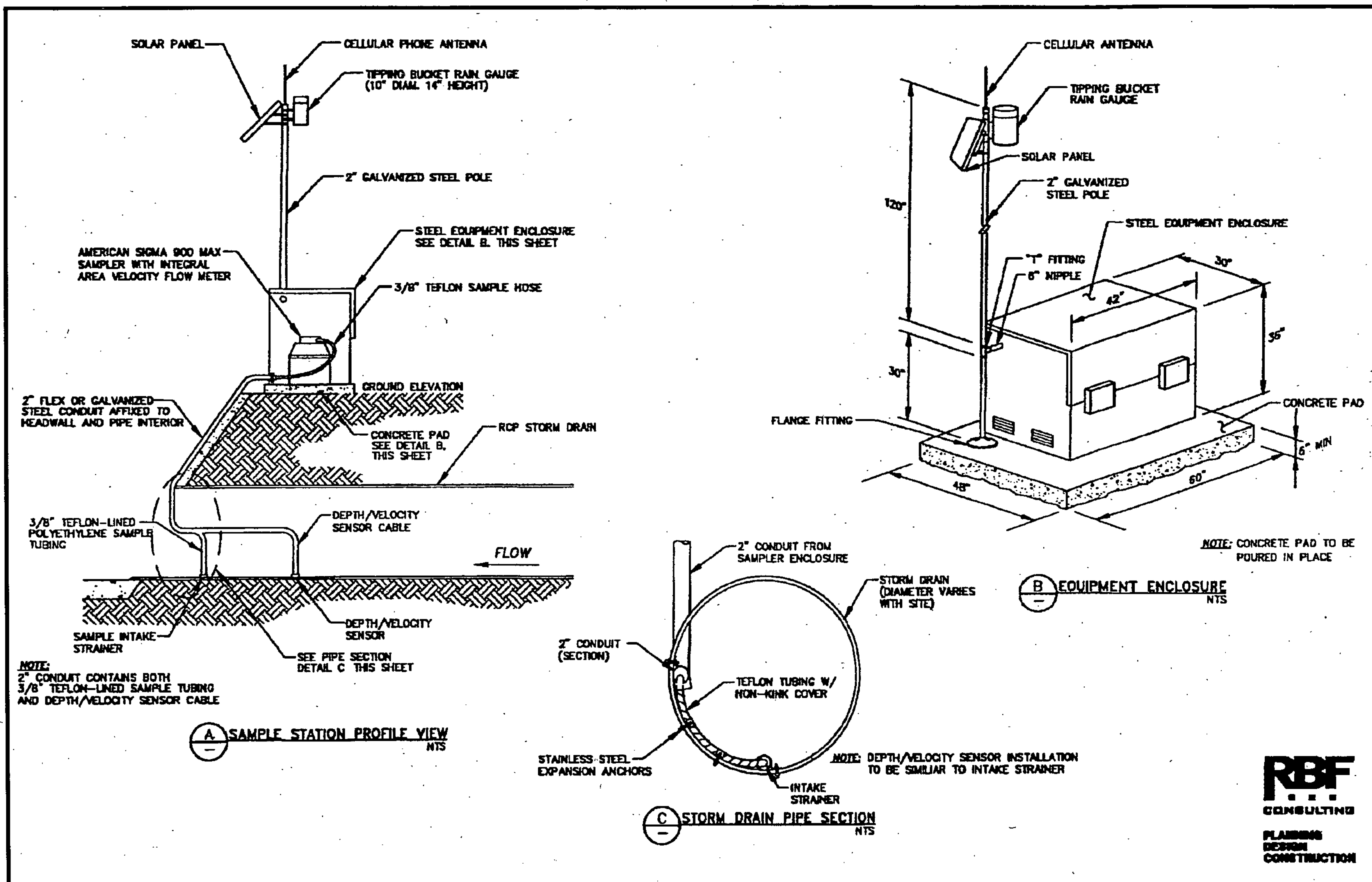


Figure 4.15 Alamitos Bay Receiving Water Monitoring Site – Sampling Site and Closeup of Outfall

Figure 4.16. Typical KLASS Stormwater Monitoring Station.



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5.0 HYDROLOGY

All Long Beach monitoring stations were fully operational at the start of the 2001/2002 wet weather season. Precipitation and discharge were continuously monitored throughout the season. The first two major storm events of the season were captured at three of the stations including the Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Neither event was sufficient to produce a discharge at the Dominguez Gap Pump Station. Due to the rapid capture of these two events, a decision was made to delay further sampling until later in the season to assure adequate temporal coverage. This decision was also intended to allow for a greater probability of getting conditions that would produce runoff at the Dominguez Gap Pump Station. Unexpected drought conditions throughout the early months of 2002 prevented collection of further stormwater runoff inspite of numerous false-event attempts.

5.1 Precipitation during the 2001/2002 Storm Season

Precipitation during the 2001/2002 water year was far below normal in Long Beach according to the National Weather Service climate station at Long Beach Airport (Figure 5.1). During the prior season, a total of 13.32 inches of rain was recorded at the Long Beach Airport from October, 2000 and April, 2001. This season, only 1.99 inches of rainfall was recorded at the airport during this time period. This level of rainfall was only 16 percent of historical average seasonal rainfall. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches.

Rainfall was relatively uniform at each of the monitoring stations with seasonal totals ranging from 2.99 inches at the Dominguez Pump Station to 3.86 inches at the Los Cerritos stormwater monitoring site.

5.1.1 Monthly Precipitation

January and February are characteristically the wettest months of the storm season (Figure 5.1) in Long Beach. Normal rainfall during these two months averages nearly six inches and typically represents half of the season's total precipitation. During January and February 2002, total rainfall was only 0.32 inches, accounting for only 16 percent of total rainfall for the season. Between 70 and 80 percent of the wet season rainfall occurred in November and December of 2001.

5.1.2 Precipitation during Monitored Events

Precipitation during each storm event was characterized by total rainfall, duration of rainfall, maximum intensity, days since last rainfall, and the magnitude of the event immediately preceding the monitored storm event (antecedent rainfall). Precipitation characteristics for each event are summarized in Table 5.1. Cumulative descriptive statistics for each monitoring station are presented in Table 5.3. Cumulative rainfall and intensity are summarized graphically for each monitored event at each station in Figures 5.2 through 5.7.

The two events monitored during the 2001/2002 wet weather season were the first and second events of the year. Both were relatively small events characterized by brief, intense periods of scattered shower activity. Total rainfall for the first event ranged from 0.23 to 0.39 inches. The second event yielded 0.33 to 0.39 inches of rain. The majority of rain fell during very short time periods as indicated by intensities of approximately one inch per hour occurring during each storm. Rainfall characteristics were, however, quite variable among sites. Rainfall at the Bouton Creek site was characterized by light rainfall during extended time periods during both events.

5.2 Stormwater Runoff during Monitored Events

Monitoring was designed to isolate rainfall events and the runoff created by those events. Table 5.2 summarizes flow characteristics among monitored events at each station. Table 5.3 provides descriptive statistics for all monitored events since initiation of the monitoring program. This information complements Event Mean Concentration (EMC) statistics for each monitored analyte at these sites. Figures 5.2 through 5.7 graphically depict flow during each monitored event at each station in response to rainfall. These figures also show how the aliquoting of each composite sample was conducted.

Runoff duration at the Belmont Pump Station was very brief during both events. Discharges from the pump station lasted between 15 and 45 minutes. Runoff duration at the two other sites with larger drainages occurred over extended time periods ranging from roughly 10 to 17 hours. Flow duration was typically greatest at Bouton Creek due to tidal effects. During incoming tides, low flows are backed up and held back by the tide. As the tide recedes, stormwater is detected at the station and sampling continues. This effect was most notable during the first event (Figure 5.3).

The percent storm captures (percentage of the total storm event volume effectively represented by the flow-weighted composite sample) were less than optimal in several cases. The intensity of rainfall combined with conservative sampling rates caused bottles to fill rapidly before crews could get to the sites to change bottles and settings. In all cases the rising limb of the hydrograph and periods of high flow were well represented by the samples.

Table 5.1. Rainfall for Monitored Events during the 2001/2002 Wet-Weather Season

Site/Event	Start Rain		End Rain		Duration Rain (hrs:mins)	Total Rain (inches)	Max Intensity (Inches/hr)	Antecedent Rain (days)	Antecedent Rain (inches)
	Date	Time	Date	Time					
EVENT 1									
Belmont Pump Station	11/12/01	17:50	11/12/01	19:00	1:10:00	0.23	0.6	1.24	0.03
Bouton Creek	11/12/01	18:00	11/13/01	9:40	15:40:00	0.28	0.12	1.17	0.02
Los Cerritos Creek	11/12/01	17:55	11/13/01	0:00	6:05:00	0.39	1.2	8.2	0.03
Dominguez Gap Pump Station	NA								
EVENT 2									
Belmont Pump Station	11/24/01	13:45	11/24/01	16:35	2:50:00	0.33	0.96	11.8	0.23
Bouton Creek	11/24/01	13:15	11/25/01	5:40	16:25:00	0.36	0.12	10.7	0.28
Los Cerritos Creek	11/24/01	13:25	11/24/01	16:40	3:15:00	0.39	0.96	11.6	0.39
Dominguez Gap Pump Station	NA								

NA = Not Available, no events occurred at the Dominguez Gap Pump Station

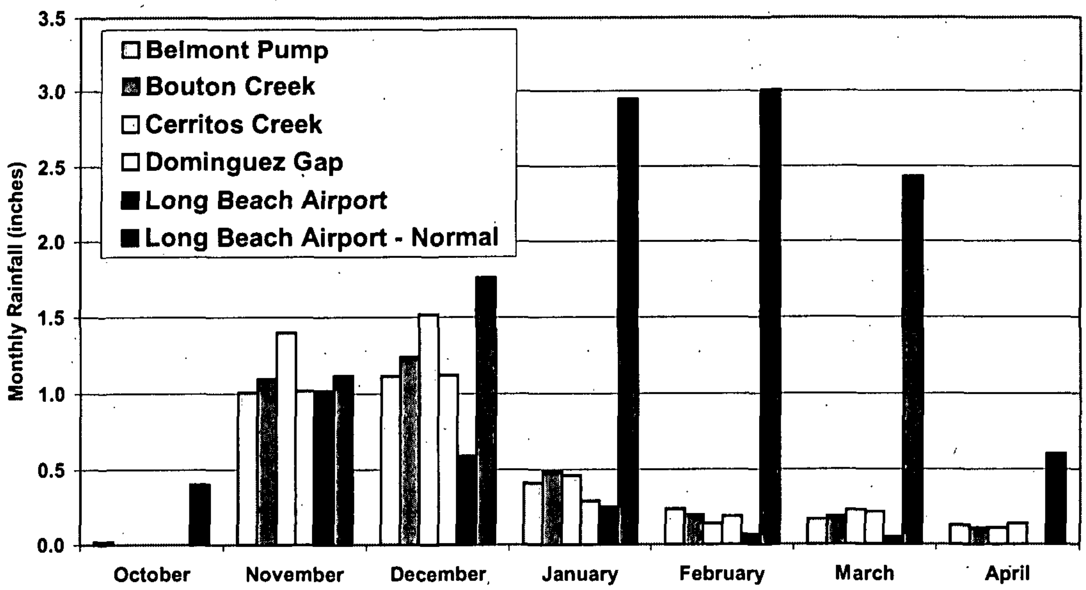
Table 5.2. Flow for Monitored Events during the 2001/2002 Wet-Weather Season

Site/Event	Start Flow		End Flow		Duration Flow (hrs:mins)	Total Flow (kilo-cubic feet)	No. of Sample Aliquots Collected	Peak Flow (cfs)	% Capture	Peak Capture
	Date	Time	Date	Time						
EVENT 1										
Belmont Pump Station	11/12/01	18:35	11/12/01	18:50	0:15	42.6	3	66	100	Y
Bouton Creek	11/12/01	18:35	11/13/01	11:40	17:05	608	28	162.5	60.2	Y
Los Cerritos Creek	11/12/01	17:55	11/13/01	3:35	9:40	2857	46	487.6	51.7	N
Dominguez Gap Pump Station										
EVENT 2										
Belmont Pump Station	11/24/01	14:50	11/24/01	15:35	0:45	90.1	6	66	93.4	Y
Bouton Creek	11/24/01	13:25	11/25/01	3:30	14:05	1066	51	161.2	79.5	Y
Los Cerritos Creek	11/24/01	14:05	11/25/01	1:00	10:55	7072	95	1378	90.3	Y
Dominguez Gap Pump Station										

Table 5.3. Cumulative Descriptive Statistics for Rainfall and Flow Data for All Monitored Events (2000-2002)

Site / Parameter	n	Min	Max	Mean	Standard Deviation	1st Quartile	Median	3rd Quartile
BELMONT PUMP ST.								
Duration Flow (days)	6	0.01	1.8	0.5	0.7	0.0	0.1	0.6
Total Storm Vol. (kcf)	6	43	331	112	109	55	79	90
Duration Rain (days)	7	0.05	1.17	0.41	0.43	0.11	0.15	0.64
Total Rain (in)	7	0.23	0.93	0.46	0.27	0.26	0.33	0.60
Max Intensity (in/hr)	7	0.24	1.20	0.65	0.37	0.36	0.60	0.90
Antecedent Dry (days)	7	1.1	28.0	9.6	9.7	1.5	9.4	12.8
Antecedent Rain (in)	7	0.03	2.39	0.56	0.84	0.14	0.23	0.49
BOUTON CREEK								
Duration Flow (days)	6	0.6	2.7	1.4	0.8	0.8	1.3	1.8
Total Storm Vol. (kcf)	6	608	2755	1252	818	695	962	1453
Duration Rain (days)	6	0.6	2.5	1.2	0.8	0.6	0.7	1.7
Total Rain (in)	6	0.28	0.89	0.50	0.25	0.35	0.37	0.65
Max Intensity (in/hr)	6	0.12	1.20	0.46	0.40	0.18	0.42	0.48
Antecedent Dry (days)	5	1.2	28.0	12.6	9.9	8.7	10.7	14.3
Antecedent Rain (in)	5	0.02	3.05	0.86	1.25	0.22	0.28	0.74
LOS CERRITOS CHANNEL								
Duration Flow (days)	6	0.4	0.7	0.5	0.1	0.4	0.5	0.6
Total Storm Vol. (kcf)	7	1582	7072	3557	1884	2303	2857	4391
Duration Rain (days)	6	0.1	0.5	0.3	0.2	0.2	0.3	0.5
Total Rain (in)	7	0.19	0.60	0.35	0.13	0.27	0.33	0.39
Max Intensity (in/hr)	7	0.36	1.20	0.70	0.31	0.48	0.60	0.90
Antecedent Dry (days)	7	1.8	28.0	11.6	8.7	5.9	11.6	13.9
Antecedent Rain (in)	7	0.03	0.60	0.24	0.21	0.11	0.13	0.36
DOMINGUEZ GAP PUMP ST.								
Duration Flow (days)	3	0.1	1.7	0.7	0.9	0.2	0.3	1.0
Total Storm Vol. (kcf)	3	812	7528	3903	3390	2091	3370	5449
Duration Rain (days)	4	0.7	2.9	1.6	1.1	0.8	1.4	2.2
Total Rain (in)	4	0.39	2.68	1.43	1.14	0.51	1.33	2.25
Max Intensity (in/hr)	4	0.24	0.84	0.45	0.27	0.33	0.36	0.48
Antecedent Dry (days)	4	1.8	13.9	7.5	5.2	4.4	7.1	10.2
Antecedent Rain (in)	4	0.27	3.50	1.66	1.59	0.36	1.44	2.74

Figure 5.1 **Monthly Rainfall Totals for the 2001/2002 Wet Weather Season and Normal Rainfall at Long Beach Daugherty Air Field.**



	Belmont Pump	Bouton Creek	Los Cerritos Creek	Dominguez Gap	Long Beach Airport	Long Beach Airport-Normal
October	0.02	0.00	0.00	0.00	0.00	0.40
November	1.01	1.10	1.40	1.02	1.02	1.12
December	1.12	1.24	1.52	1.13	0.59	1.76
January	0.41	0.49	0.46	0.29	0.25	2.95
February	0.24	0.20	0.14	0.19	0.07	3.01
March	0.17	0.19	0.23	0.22	0.05	2.43
April	0.13	0.11	0.11	0.14	0.00	0.60
Season Totals	**3.10**	**3.33**	**3.86**	**2.99**	**1.98**	**12.27**

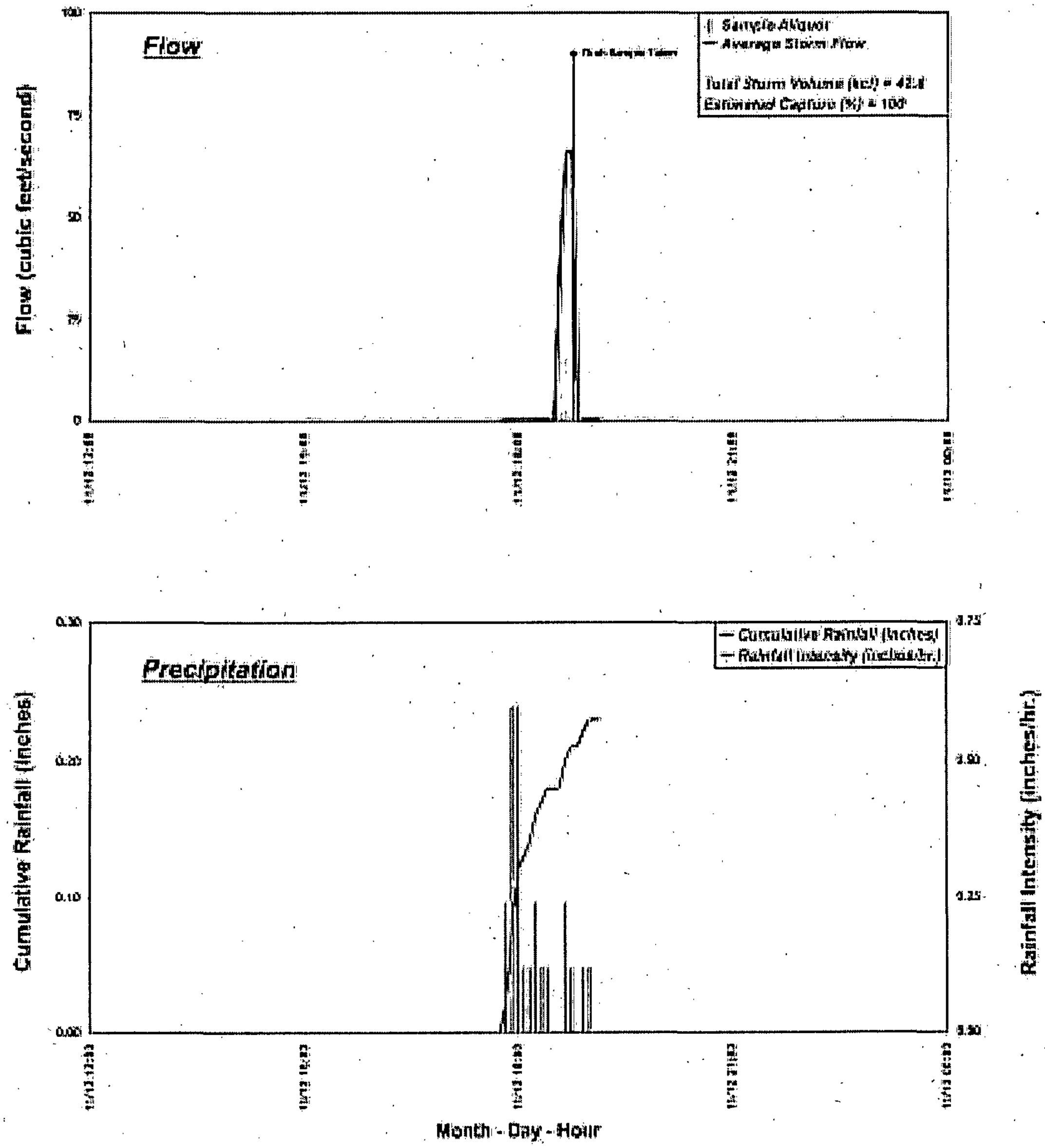


Figure 5.2. Belmont Pump Station – Event 1 (12 November, 2001)

Figure 5.3. Bouton Creek – Event 1 (12-13 November, 2001)

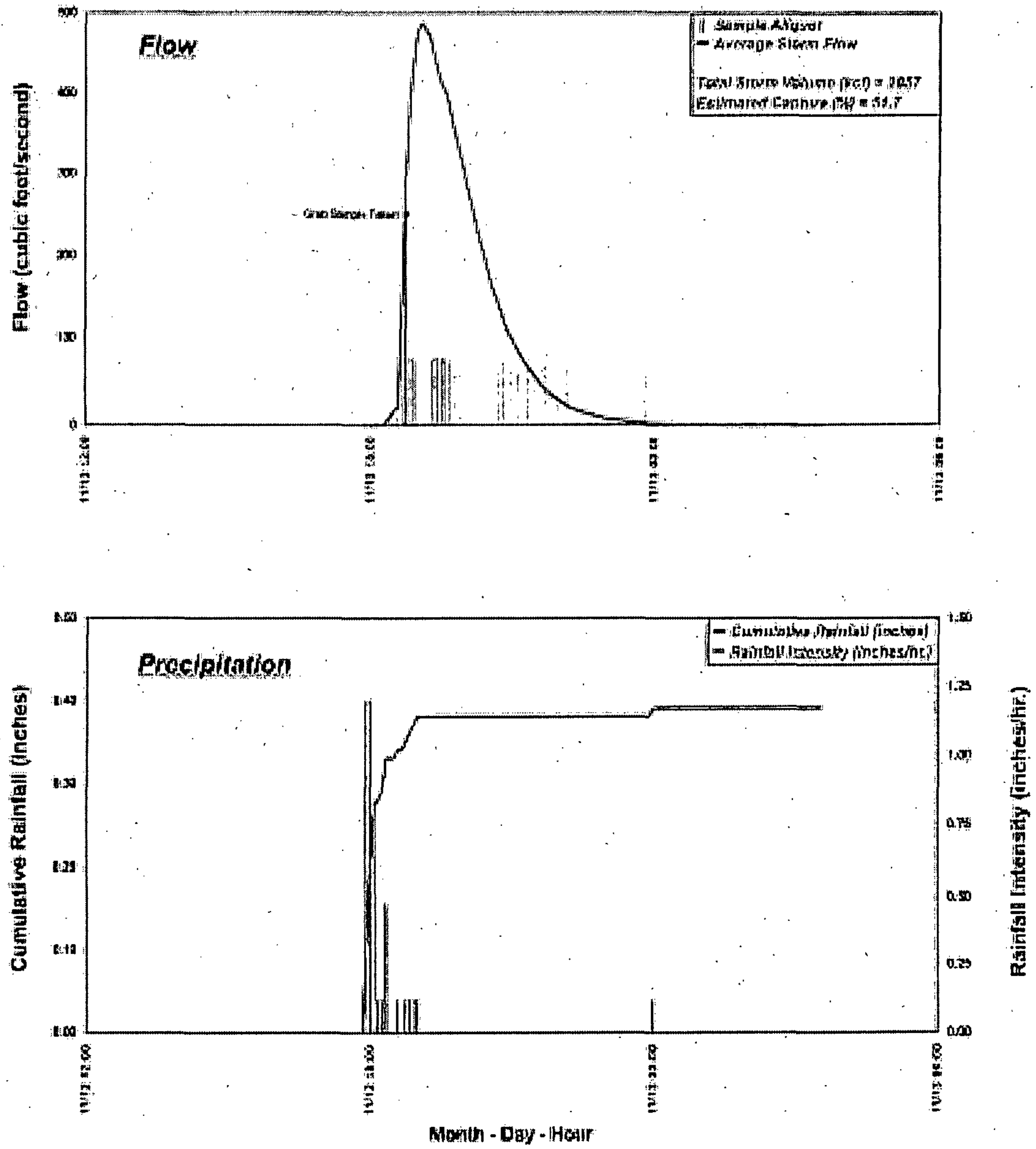


Figure 5.4. **Los Cerritos Channel –Event 1 (12 November, 2001)**

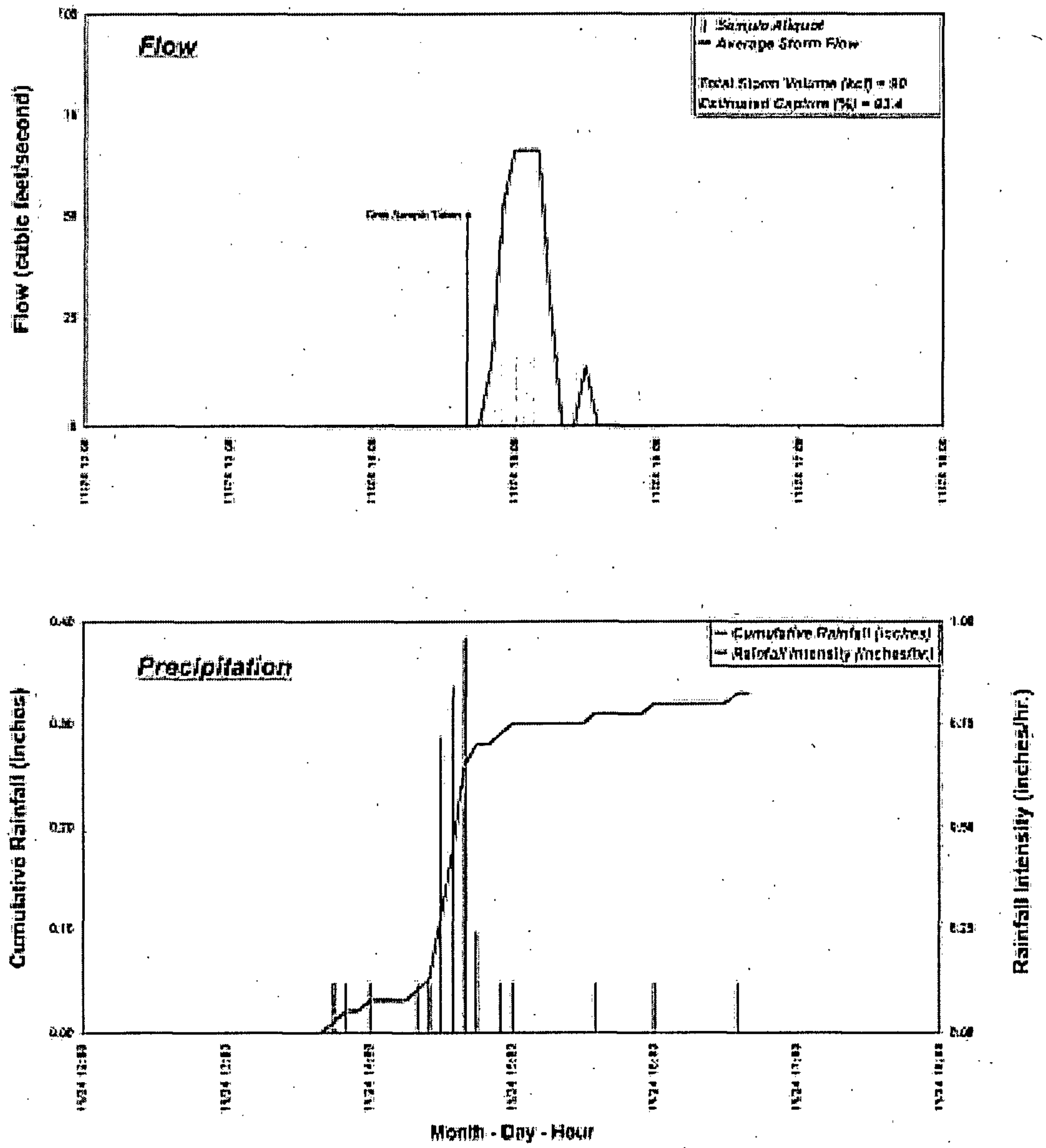


Figure 5.5. Belmont Pump Station – Event 2 (24 November, 2001)

Figure 5.6. Bouton Creek – Event 2 (24-25 November, 2001)

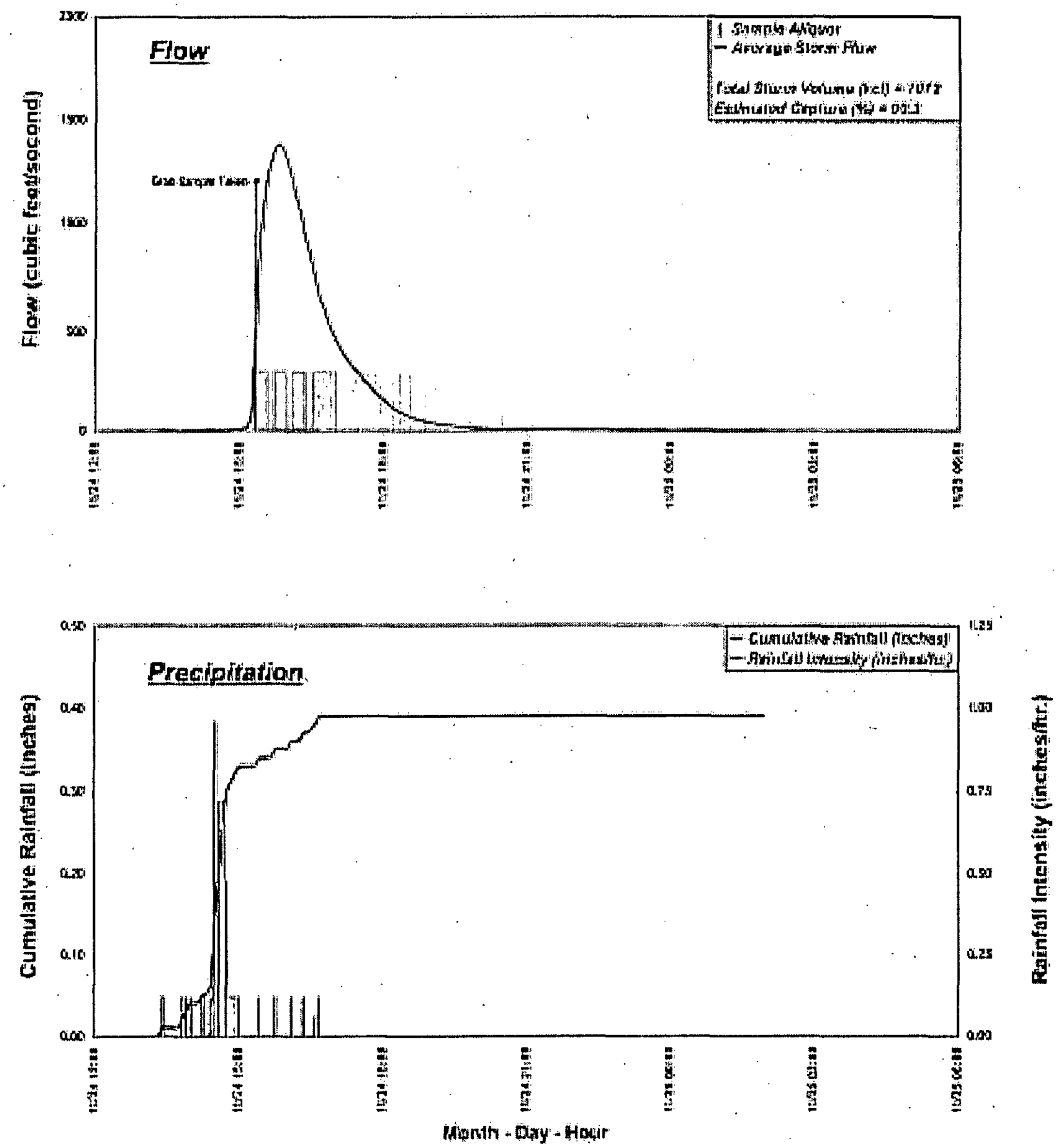


Figure 5.7. Los Cerritos Channel – Event 2 (24 November, 2001)

6.0 CHEMISTRY RESULTS

6.1 Wet Weather Chemistry Results

Due to drought conditions in the study area, only two events were successfully sampled at each of three sites. However, these events represented seasonal first flush at the monitoring sites. These seasonal first flush events were not captured during the previous year as the instrumentation was not in place until January of that year. No discharges occurred from the Dominguez Gap pump station during this entire year. The events that were monitored at each site, successfully sampled, and sent to the laboratories for analysis are summarized in Table 6.1.

For each of these monitored events, all chemical constituents summarized in Table 4.2 above were analyzed in the resulting samples for all stations. Receiving waters were also sampled during these two wet weather events. Samples were analyzed for toxicity and bacteria.

Composite samples collected during these storm events were also tested for toxicity with three species, the water flea (freshwater crustacean), mysid (marine crustacean), and sea urchin (marine).

The results of the chemical analysis of these composite and grab stormwater samples are summarized in Table 6.2. Bacterial results for the Alamitos Bay receiving water site are summarized in Table 6.4. Toxicity results for the composite samples and the receiving water samples from these monitored events are given in Section 7 below.

6.2 Dry Weather Sampling Results

The City's NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site. During the 1999/2000 year, the two dry weather inspections/sampling events were done in late June so that the results could be reported in the annual report due 15 July 2000. For the second year, the first of these dry weather inspections/samplings was done at all sites in June 2001 and the results are reported in this annual report. However, it was decided that it would be better to do the second sampling event later in the summer such that dry weather surveys bracketed the storm season. This event was conducted on 16 August 2001 and the results are reported as an addendum that is included as Appendix F of this annual report. Data from the August 2001 (Dry Weather Event 5) survey are included in the data tables for comparison purposes. The dry weather events monitored during the 1999/2000, 2000/2001 and 2001/2002 seasons are summarized in Table 6.3. Events 5 and 6 conducted during the past monitoring season are shaded. Microbiological data from Alamitos Bay are summarized in Table 6.4. Field water quality measurements associated with the 2001/2002 dry weather surveys are summarized in Tables 6.5. The results of chemical analysis of the both the August 2001 and May 2002 dry weather surveys are presented in Table 6.6.

6.2.1 Basin 14: Dominguez Gap Monitoring Site

An inspection for dry weather flow was conducted at the Dominguez Gap Pump Station on 7 May 2002. No dry weather flow was observed. The basin in front of the pump house had standing water in it but field crews were unable to reach the water to measure the depth. The source of this ponded water was not determined due to the lack of current flow from any source. The concrete lined channel that extends east from, and discharges into, the basin had small, isolated pools of standing water, but there was no flow. The construction activity that took place on the railroad bridge just north of the pump house is completed. The earth dam that was placed across the basin just north of the pump house to provide convenient vehicle access to the eastside of the swale has been removed. There was no flow from the north part of the basin observed. It is apparent that water from the Los Angeles River was not being diverted into the swale for ground water recharge as was observed in 2001.

6.2.2 Basin 20: Bouton Creek Monitoring Site

Bouton Creek was sampled on 14 May 2002 from 6:00 a.m. to 8:00 a.m. This time corresponded to a period of low tide when the flow in the creek was not impeded by seawater backing into the creek. The tide levels at this time were between negative 0.21 and plus 1.0 feet in the Long Beach area. This assured that the flow was fresh water flowing downstream in the creek and that that saline tidal water did not commingle with the dry weather discharge of fresh water.

Every 20 minutes during the two-hour period, a 2.86-liter aliquot of water was pumped from the creek using the automatic sampler installed at the site. An aliquot was deposited into each of four 20-liter borosilicate glass bottles. At the conclusion of the sampling, grab samples for MTBE, TPH and bacteria were collected. All samples were chilled to 4° C, and transported to the appropriate laboratory for analysis. Conductivity and pH measurements were also taken at this time and these field measurements are summarized in Table 6.5.

6.2.3 Basin 23: Belmont Pump Station Monitoring Site

Time weighted composite sampling was conducted over a 24 hour period starting on 8 May 2002 and ending on 9 May 2002. Samples were collected from the sump using the automated sampler installed outside of the pump house. Samples were collected into three 20-liter bottles. Every half-hour for the 24 hours, an aliquot of approximately 1.25 liters of water was pumped from the sump into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite. Upon completion of the 24-hour sampling, on 9 May 2002, at 7:15 a.m., grab samples for MTBE, TPH and bacteria were manually collected from the sump. All samples were chilled to 4° C and transported to the appropriate laboratory for analysis.

6.2.4 Basin 27: Los Cerritos Channel Monitoring Site

Time weighted sampling was conducted over a 24-hour period of the water flowing through the channel. Sampling was started on 8 May 2002 and completed on 9 May 2002. Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. The dry weather flow is a narrow stream approximately 22 feet wide and 1.5 inches deep located in the middle of the channel. To reach the water, the sampling hose that is used for sampling stormwater was extended an additional 33 feet. Samples were collected into three 20-liter bottles. Every half-hour for 24 hours, an aliquot of approximately 1.25 liters of water was pumped into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite sample. After completion of the 24-hour sampling, on May 9 at 4:55 a.m., grab samples were manually collected for MTBE, TPH and bacteria. All samples were chilled to 4° C and transported to the appropriate laboratory for analysis.

6.2.5 Basin 23: Alamitos Bay Receiving Water Monitoring Site

Samples of water were collected at the Alamitos Bay Receiving Water Site occupied during the wet season in the vicinity of the pump station outfall from Basin 24. The samples were collected from the end of the swimming dock just north of the outfall. Sampling was done on the morning of May 9, 2002 at 5:10 a.m. The outfall has a low-flow diverter that prevents dry weather flow from being discharged into the Bay. Samples for toxicity testing were collected in 1-gallon amber glass bottles by dipping them approximately one foot below the surface. In addition, grab-samples for bacteria were also collected from the same site. All samples were cooled to 4° C and transported to the appropriate laboratories for analysis. Results of the bacterial analyses for these dry weather samples are summarized in Table 6.4.

Table 6.1. Monitored Storm Events, 2001/2002

Station	Event 1 12 Nov '01	Event 2 24 Nov '01
Bouton Creek	X	X
Belmont Pump	X	X
Los Cerritos Channel	X	X
Dominguez Gap	NF	NF

NF = No Flow as the Pump Station did not discharge to the Los Angeles River.

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 1 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
CONVENTIONALS											
BOD5 (mg/L)	**24**	**22**	**22J**	**31**	**19J**	**49**	-	**16J**	**23J**	-	-
COD (mg/L)	**94**	**110**	**68**	**120**	**68**	**95**	-	**48**	**46**	-	-
TOC (mg/L)	**49J**	**57**	**22**	**52J**	**32**	**58J**	-	**21**	**22**	-	-
EC (umhos/cm)	**460**	**470**	**150**	**710**	**180**	**180**	-	**96**	**95**	-	-
Hardness (mg/L)	**100**	**92**	**37**	**100**	**46**	**68**	-	**27**	**39**	-	-
Alkalinity (mg/L)	**71**	**78**	**21**	**33**	**22**	**120**	-	**17**	**17**	-	-
pH (units)	**7.8**	**7.4**	**7.2**	**7.3**	**7.3**	**7.4**	-	**7.4**	**7.4**	-	-
Cyanide (ug/L)	5U	5U	5U	5U	5U	5U	-	5U	5U	-	-
Chloride (mg/L)	**72J**	**63J**	**20J**	**170J**	**26J**	**52J**	-	**6.7J**	**6.2J**	-	-
Fluoride (mg/L)	**0.86J**	**0.90J**	**0.32J**	**1.3J**	**0.41J**	**0.66J**	-	**0.30J**	**0.28J**	-	-
TKN (mg/L)	**8.1**	**8.9**	**3.4**	**9.2**	**4.2**	**21**	-	**4.4**	**3.1**	-	-
Ammonia-N (mg/L)	**1.1**	**1.1**	**0.73**	**1.2**	**0.88**	**1.5**	-	**0.69**	**0.67**	-	-
Nitrite N (mg/L)	0.2U	0.2U	0.2U	0.2U	0.2U	0.2U	-	0.2U	0.2U	-	-
Nitrate N (mg/L)	**2.9**	**2.9**	**1.5**	**3.0**	**1.6**	**2.5**	-	**1.2**	**1.2**	-	-
Total Nitrogen	**11.1**	**11.9**	**5**	**12.3**	**5.9**	**23.6**	-	**5.7**	**4.4**	-	-
Total P (mg/L)	**2.10**	**2.20**	**0.990**	**1.70**	**0.800**	**6.20**	-	**1.40**	**0.710**	-	-
Diss. P (mg/L)	**0.510**	**0.490**	**0.590**	**0.380**	**0.380**	**0.470**	-	**0.320**	**0.310**	-	-
MBAS (mg/L)	**0.20**	**0.24**	**0.14**	**0.18**	**0.17**	**0.16**	-	**0.18**	**0.16**	-	-
MTBE (ug/L)	0.5U	0.5U	1.0U	0.5U	1.0U	0.5U	-	1.0U	1.0U	-	-
Tot. Phenols (mg/L)	0.1UJ	0.1UJ	0.1U	0.1UJ	0.1U	0.1UJ	-	0.1U	0.1U	-	-
Oil&Grease (mg/L)	**7.4**	-	5.0U	5.0U	5.0U	**7.4**	**29**	5.0U	5.0U	-	-
TRPH (mg/L)	5U	**10**	5U	5U	5U	5U	-	5U	5U	-	-
TSS (mg/L)	**620**	**580**	**220**	**380**	**200**	**1700**	-	**200**	**250**	-	-
TDS (mg/L)	**280**	**300**	**120**	**470**	**150**	**140**	-	**56**	**88**	-	-
Turbidity (NTU)	**230**	**210**	**92**	**120**	**76**	**290**	-	**78**	**70**	-	-
TVS (mg/L)	R'	R'	R'	R'	R'	R'	-	R'	R'	-	-
BACTERIA (mpn/100ml)											
Fecal Coliform	**50000J**	-	**>160000J**	**50000J**	**>160000J**	**50000J**	**30000J**	**50000J**	**90000J**	**3000J**	**800J**
Fecal Enterococci	**13600**	-	**10160**	**8420**	**18480**	**13210**	**11020**	**7520**	**10240**	**820**	**720**
Total Coliform	**>160000J**	-	**>160000J**	**>160000J**	**>160000J**	**>160000J**	**>160000J**	**>160000J**	**>160000J**	**3000J**	**1300J**

Bolded values indicate results that were greater than the reporting detection limit.
R' Indicates data were not valid. Data were rejected.
\- Analyte not tested
FD Field Duplicate

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 2 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
TOTAL METALS (ug/L)											
Aluminum	**4200**	**4000**	**1600**	**2600**	**1400**	**4800**		**1400**	**1400**	-	
Antimony	**2.3**	**2.6**	**1.6J**	**4.4**	**5.4J**	**5.1**		**2.2J**	**2.9J**	-	-
Arsenic	**4.8**	**4.7**	**3.0**	**3.4**	**2.5**	**9.7**	-	**2.9**	**3.1**	-	-
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	-	0.50U	0.50U	-	-
Cadmium	**2.80**	**2.70**	**1.30**	**1.80**	**1.30**	**5.50**	-	**1.60**	**1.70**	-	-
Chromium	**12**	**15**	**3.1**	**9.6**	**3.5**	**25**	-	**2.8**	**3.1**	-	-
Hex Chromium	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U		0.02U	0.02U	-	-
Copper	**120**	**120**	**53**	**83**	**41**	**90**	-	**36**	**40**	-	-
Iron	**5000**	**5500**	**360J**	**3100**	**1700J**	**11000**	-	**1900J**	**1900J**	-	-
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	-	0.20U	0.20U	-	-
Nickel	**25**	**23**	**9.9**	**16**	**9.3**	**28**	-	**8.8**	**9.0**	-	-
Lead	**150**	**190**	**59**	**88**	**45**	**370**	-	**43**	**46**	-	-
Selenium	1.0U	1.0U	1.0U	**1.2**	**1.8**	1.0U	-	1.0U	**2.0**	-	-
Silver	0.25U	0.25U	0.25U	0.76	0.25U	0.25U	-	0.25U	0.25U	-	-
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Zinc	**830**	**820**	**720**	**710**	**760**	**1500**	-	**770**	**780**	-	-
DISSOLVED METALS (ug/L)											
Aluminum	**53**	**46**	**25**	**48**	**64**	**210**	-	**110**	**110**	-	-
Antimony	**2.5**	**2.2**	**1.3**	**1.7**	**1.3**	**2.1**	-	**1.0**	**0.98**	-	-
Arsenic	**1.9**	**1.8**	**1.2**	**1.3**	**1.1**	**1.9**	-	**1.2**	**1.1**	-	-
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	-	0.50U	0.50U	-	-
Cadmium	**0.28**	**0.28**	0.25U	0.25U	0.25U	0.25U	-	0.25U	0.25U	-	-
Chromium	**1.0**	**0.91**	0.50U	1.2U	**0.69**	**1.3**	-	**0.79**	**0.71**	-	-
Copper	**9.5**	**9.3**	**6.8**	**10**	**10**	**7.4**	-	**7.9**	**7.4**	-	-
Iron	50U	50U	**360**	50U	**300**	**94**	-	**110**	**160**	-	-
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	-	0.20U	0.20U	-	-
Nickel	**8.7**	**8.5**	**3.7**	**6.4**	**4.1**	**6.3**	-	3.3U	3.0U	-	-
Lead	**2.7**	**2.5**	**1.7**	**3.6**	**2.7**	**3.1**	-	**1.7**	**1.6**	-	-
Selenium	1.0U	1.0U	1.0U	1.0U	**1.4**	1.0U	-	1.0U	1.0U	-	-
Silver	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	-	0.25U	0.25U	-	-
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Zinc	**49**	**48**	**44**	**91**	**72**	**48**	-	**78**	**65**	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested.

FD *Field Duplicate*

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 3 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
CHLORINATED PESTICIDES (ug/L)											
4,4'-DDD	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
4,4'-DDE	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
4,4'-DDT	0.01U	0.01U	**0.04**	0.01U	**0.05**	0.01U	-	0.01U	0.01U	-	-
Aldrin	0.005U	0.005U	**0.066**	0.005U	**0.042**	0.005U	-	**0.071**	**0.079**	-	-
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.07	0.05U	-	0.05U	0.05U	-	-
alpha-Chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
alpha-Endosulfan	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
beta-Endosulfan	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Endosulfan Sulfate	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Endrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
Endrin Aldehyde	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
gamma-BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
gamma-Chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
Heptachlor	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	-	0.012	0.011	-	-
Heptachlor Epoxide	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
Total PCBs	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Toxaphene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
AROCLORS (ug/L)											
Arochlor 1016	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1221	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1232	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1242	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1248	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1254	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1260	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
ORGANOPHOSPHATE PESTICIDES (ug/L)											
Atrazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Dursban(chlorpyrifos)	**0.13**	**0.07**	0.05U	**0.17**	0.05U	0.05U	-	**0.28**	**0.31**	-	-
Cyanazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Diazinon	**3.0**	**2.4**	**0.92**	**0.43**	**0.42**	0.01U	-	**0.41**	**0.35**	-	-
Malathion	**1.1**	**1.3**	**1.4**	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Prometryn	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Simazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested.

FD Field Duplicate

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 4 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
HERBICIDES (ug/L)											
2,4,5-TP (Silvex)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
2,4-D	4UJ	4UJ	1UJ	4UJ	1UJ	4UJ	-	1UJ	1UJ	-	-
Glyphosate	5U	5U	5UJ	5U	5UJ	5U	-	5UJ	5UJ	-	-
SEMIVOLATILES (ug/L)											
1,2,4-Trichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,2-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,2-Diphenylhydrazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,3-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,4-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,4,6-Trichlorophenol	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,4-Dichlorophenol	2U	2U	2U	2U	2U	2U	-	2U	2U	-	-
2,4-Dimethylphenol	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
2,4-Dinitrophenol	5.0U	5.0U	5.0U	5.0U	**5.2**	5.0U	-	**5.5**	**7.1**	-	-
2,4-Dinitrotoluene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,6-Dinitrotoluene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2-Chloroethylvinyl ether	-	-	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2-Chlorophenol	2U	2U	2U	2U	2U	2U	-	2U	2U	-	-
2-Nitrophenol	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
3,3'-Dichlorobenzidine	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
4,6 Dinitro-2-methylphenol	2U	2U	5U	2U	5U	2U	-	5U	5U	-	-
4-Bromophenyl Phenyl Ether	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Chloro-3-methylphenol	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Chlorophenyl Phenyl Ether	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Nitrophenol	**1.5**	**1.8**	5.0U	**1.9**	**6.6**	1.0U	-	**5.9**	**6.3**	-	-
Acenaphthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Acenaphthylene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Anthracene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzidine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(a)Anthracene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(a)Pyrene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested.

Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 5 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12-Nov-'01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
SEMI-VOLATILES (ug/L)											
Benzo(b)Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(ghi)Perylene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Benzo(k)Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Bis(2-chloroethoxy)Methane	2U	2U	10U	2U	10U	2U	-	10U	10U	-	-
Bis(2-chloroethyl)Ether	1U	1U	10U	1U	10U	1U	-	10U	10U	-	-
Bis(2-chloroisopropyl)Ether	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Bis(2-Ethylhexyl)Phthalate	1.0U	1.0U	**8.0**	1.0U	**10**	1.0U	-	**8.8**	**9.4**	-	-
Butylbenzyl Phthalate	1.0U	1.0U	**1.1**	1.0U	**1.7**	1.0U	-	**1.2**	**1.6**	-	-
Chrysene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Dibenzo(a,h)Anthracene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Dieldrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	**0.13**	0.01U	-	-
Diethyl Phthalate	1U	1U	4U	1U	4U	1U	-	4U	4U	-	-
Dimethyl Phthalate	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Di-n-Butyl Phthalate	**2.4**	**1.6**	4.0U	1.3UJ	4.0U	**2.3**	-	4.0U	4.0U	-	-
Di-n-Octyl Phthalate	1.0U	1.0U	**1.7**	**1.1**	**4.5**	1.0U	-	**4.4**	**4.5**	-	-
Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Fluorene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Hexachlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Hexachlorobutadiene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Hexachlorocyclopentadiene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Hexachloroethane	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Indeno(1,2,3-c,d)Pyrene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Isophorone	1U	1U	5U	1U	5U	1U	-	5U	5U	-	-
Naphthalene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Nitrobenzene	1U	1U	5U	1U	5U	1U	-	5U	5U	-	-
N-Nitrosodimethylamine	-	-	-	-	-	-	-	-	-	-	-
N-Nitrosodi-n-Propylamine	5U	5U	10U	5U	10U	5U	-	10U	10U	-	-
N-Nitrosodiphenylamine	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Pentachlorophenol	1.0U	**1.5**	**8.3**	1.0U	5.0U	1.0U	-	5.0U	5.0U	-	-
Phenanthrene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Pyrene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Phenol	1U	1U	2.0U	1U	2.0U	**5.7**	-	2.0U	2.0U	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested.

Table 6.3. Monitored Dry Weather Events, 1999-2002

Station	Event 1 10 Apr. '00	Event 2 21 Jun. '00	Event 3 29 Jun. '00	Event 4 5 Jun.'01	Event 5 16 Aug 01	Event 6 9,14 May 02
Bouton Creek		X	X	X	X	X
Belmont Pump		X	X	X	X	X
Los Cerritos Channel				X	X	X
Dominguez Gap		X[1]	X[1]	X[1]	X[1]	X[1]
Alamitos Bay	X	X	X	X	X	X

1 Intake to basin was observed to be dry. Therefore, no samples were collected.
Shading indicates 2001/2002 Dry Weather Surveys included in this report. Data from Event 5 reported in earlier letter report that is included as Appendix F. Summary data from this event are included in the data tables.

Table 6.4. Dry and Wet Weather Bacteria Results for Alamitos Bay Receiving Waters (2001/2002)

Date	16 Aug '01[2]	12 Nov '01[1]	24 Nov '01[1]	9 May '02[2]
Total Coliform	11	3000J	1300J	240
Fecal Coliform	4	3000J	800J	7
Fecal Enterococci	1.0U[3]	820	720	10

1. Wet weather sampling event. Data also included in Table 6.3 for comparison with stormwater monitoring sites.
2. Dry weather sampling event.
3. Fecal Streptococci was measured during the 16 Aug 2001 survey. Analytical requirements were changed to enterococci for all subsequent events.

Table 6.5. Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, Dry Weather Season (2001/2002).

	Bouton Creek		Belmont Pump		Los Cerritos	
Date	8/16/01	5/14/02	8/16/01	5/9/02	8/16/01	5/9/02
Time	02:00	07:30	06:40	07:20	05:35	05:00
Temperature (^{0}C)	20.8	17.0	21.8	16.1	19.9	13.9
pH	8.15	8.41	8.45	8.39	8.17	8.72
Conductivity (mmho/cm)	7.17	9.57	2.63	2.21	0.84	0.66
Flow (cfs)	1.48[1]	0.15[3]	0..086[4]	1.82[4]	3.55[1]	2.75[1]
Dissolved Oxygen (mg/L)	2.27[2]	9	5.17	11	2.77	9

1. Flow was determined by measuring the depth and width of the water channel, as well as the velocity of a floating object in the water.
2. Value based on 100% saturation conditions, measured temperature and salinity values.
3. The flow rate was determined with the KLASS flow meter installed at the station.
4. The flow rate was determined by observing changes in water level in the sump area over a 24-hour period.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 1 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
CONVENTIONALS										
Biochemical Oxygen Demand (mg/L)	5.0U	**27J**	**26J**	**21J**	-	-	10U	**18**	10U	10U
Chemical Oxygen Demand (mg/L)	**180**	**210**	**100**	**760**	-	-	**220**	**100**	**440**	**390**
Total Organic Carbon (mg/L)	11U	13U	15U	12U	-	-	**8**	**24**	**18**	**20**
Specific Conductance (umhos/cm)	**2800**	**840**	**7800**	**7700**	-	-	**2700**	**650**	**12000**	**12000**
Total Hardness (mg/L)	**350**	**170**	**890**	**910**	-	-	**330**	**130**	**1300**	**1300**
Alkalinity, as CaCO3 (mg/L)	**440**	**150**	**140**	**140**	-	-	**380**	**120**	**170**	**170**
pH (units)	**8.4**	**8.6**	**7.8**	**8.0**	-	-	8.41	9.66	7.71	7.72
Cyanide (ug/L)	5.0U	5.0U	5.0U	5.0U	-	-	5UJ	5UJ	5UJ	5UJ
Chloride (mg/L)	**560**	**120**	**2500**	**2700**	-	-	**570**	**83**	**4200**	**4000**
Fluoride (mg/L)	**1.6**	**0.69**	**0.9**	**0.91**	-	-	**1.7**	**0.76**	**1.7**	**1.4**
Total Kjeldahl Nitrogen (mg/L)	**0.90**	**1.8**	**4.1**	**1.8**	-	-	**0.89J**	**1.8J**	**1.5**	**1.7**
Total Ammonia-Nitrogen (mg/L)	**0.13**	**0.58**	**0.11**	**0.23**	-	-	**0.11**	**0.15**	0.1U	0.1U
Nitrite Nitrogen (mg/L)	0.2U	0.2U	0.2U	0.2U	-	-	0.2U	0.1U	1U	1U
Nitrate Nitrogen (mg/L)	**1.3**	**0.068**	0.01U	0.01U	-	-	**1.2**	0.1U	1U	1U
Total Nitrogen	**2.3**	**2.0**	**4.2**	**1.9**	-	-	**2.19**	**2**	**2.6**	**2.8**
Total Phosphorus (mg/L)	**0.86**	**0.12**	**0.36**	**0.11**	-	-	**0.86**	**0.17**	**0.11**	**0.13**
Dissolved Phosphorus (mg/L)	**0.87**	**0.046**	**0.025**	**0.029**	-	-	**0.96**	**0.046**	**0.031**	**0.031**
MBAS (mg/L)	**0.046**	**0.054**	**0.064**	**0.040**	-	-	**0.037**	0.02U	**0.037**	**0.033**
MTBE (ug/L)	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U	-	-	0.1UJ	0.1UJ	0.1UJ	0.1UJ
Oil & Grease (mg/L)	5.0U	-	5.0U	5.0U	-	-	5U	5U	5U	5U
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	-	-	5U	5U	5U	5U
Total Suspended Solids (mg/L)	1.0U	**58**	**10**	**10**	-	-	**2**	**2**	1U	1U
Total Dissolved Solids (mg/L)	**1800**	**600**	**5100**	**5100**	-	-	**1600**	**430**	**7400**	**7400**
Turbidity (NTU)	**11**	**36**	**10**	**9.2**	-	-	**1.8**	**4.9**	**2.5**	**2.6**
Total Volatile Solids (mg/L)	1.0U	1.0U	1.0U	1.0U	-	-	R[1]	R[1]	R[1]	R[1]
BACTERIA (mpn/100ml)										
Fecal Coliform	**2,300**	**2300**	**230**	**2300**	**4**	**7**	**2400**	**1100**	**170**	**300**
Fecal Enterococci	-	-	-	-	-	**10**	**1760**	**910**	**1720**	**910**
Total Coliform	**8,000**	**30,000**	**3,000**	**2300**	**11**	**240**	**90000**	**3000**	**17000**	**5000**

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
- Analyte not tested
FD Field Duplicate

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 2 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
TOTAL METALS (ug/L)										
Aluminum	**140**	**97**	**84**	**88**	-	-	**31**	**25**	**39**	**29**
Antimony	-	-	-	-	-	-	**0.6**	**3.7**	**1.1**	**1**
Arsenic	3.9U	1.2U	1.8U	1.6U	-	-	**3.3**	**7**	0.5U	0.5U
Beryllium	0.50U	0.50U	0.50U	0.50U	-	-	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	**0.57**	0.25U	0.25U	-	-	0.25U	**0.36**	0.25U	0.25U
Chromium	**2.5**	**1.5**	**2.4**	**2.4**	-	-	**51**	**15**	**41**	**36**
Hexavalent Chromium	**4.91J**	**6.20**	**4.91J**	**5.43**	-	-	0.02U	0.02U	0.02U	0.02U
Copper	4.8U	**17**	**15**	**16**	-	-	**5.4**	**22**	**11**	**10**
Iron	**330**	**320**	**220**	**220**	-	-	**100J**	50UJ	**310J**	**280J**
Mercury	0.20U	**3.5**	0.20U	0.20U	-	-	0.2U	0.2U	0.2U	0.2U
Nickel	**5.6**	**7.5**	**5.0**	**5.2**	-	-	**2.6**	**3.5**	**6.3**	**5.6**
Lead	**0.99**	**3.5**	**3**	**3.5**	-	-	**0.68**	**0.78**	**1.7**	**1.6**
Selenium	-	-	-	-	-	-	**2.5**	**2.2**	**4.7**	**2.7**
Silver	-	-	-	-	-	-	0.25U	**0.62**	**0.56**	0.25U
Thallium	-	-	-	-	-	-	1U	1U	1U	1U
Zinc	**13**	**43**	**21**	**23**	-	-	**19**	**17**	**41**	**39**
DISSOLVED METALS (ug/L)										
Aluminum	**140**	**88**	**80**	**75**	-	-	25U	25U	25U	25U
Antimony	-	-	-	-	-	-	0.5U	**1.2**	**0.7**	**0.7**
Arsenic	3.9U	1.1U	1.5U	1.6U	-	-	**2.3**	**4.7**	0.5U	0.5U
Beryllium	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	0.5	0.25U	0.25U	-	-	0.25U	0.25U	0.25U	0.25U
Chromium	**2.4**	**1.3**	**2.4**	**2.1**	-	-	**39**	**8.8**	**22**	**22**
Copper	**4.8**	**16**	**15**	**14**	-	-	**3.8**	**16**	**6.7**	**6.7**
Iron	**50**	**40**	**60**	**70**	-	-	**110**	50U	**210**	**220**
Mercury	0.2U	0.2U	0.2U	0.2U	-	-	0.2U	0.2U	0.2U	0.2U
Nickel	**5.4**	**7.2**	**4.9**	**5.1**	-	-	**1.6**	**2.5**	**3.9**	**3.8**
Lead	**0.97**	**3.2**	**2.9**	**3**	-	-	0.5U	0.5U	0.5U	0.5U
Selenium	-	-	-	-	-	-	**1.9**	**1.1**	**4.2**	1U
Silver	-	-	-	-	-	-	0.25U	0.25U	0.25U	0.25U
Thallium	-	-	-	-	-	-	1U	1U	1U	1U
Zinc	**13**	**39**	**21**	**20**	-	-	**12**	**9.3**	**23**	**26**

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Analyte not tested
FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 3 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
CHLORINATED PESTICIDES (ug/L)										
4,4'-DDD	0.5U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
4,4'-DDE	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
4,4'-DDT	0.05U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Aldrin	0.005U	0.005U	0.005U	0.005U	-	-	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
alpha-Chlordane	0.5U	0.5U	0.5U	0.5U	-	-	0.1U	0.1U	0.1U	0.1U
alpha-Endosulfan	0.05U	0.05U	0.05U	0.05U	-	-	0.02U	0.02U	0.02U	0.02U
beta-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
delta-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.005U	0.005U	**0.019**	**0.021**
Endosulfan Sulfate	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
Endrin	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Endrin Aldehyde	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
gamma-BHC (lindane)	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
gamma-Chlordane	0.5U	0.5U	0.5U	0.5U	-	-	0.02U	0.02U	0.02U	0.02U
Heptachlor	0.01U	0.01U	0.01U	0.01U	-	-	0.1U	0.1U	0.1U	0.1U
Heptachlor Epoxide	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Total PCBs	1.0U	1.0U	1.0U	1.0U	-	-	0.01U	0.01U	0.01U	0.01U
Toxaphene	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
AROCLORS (ug/L)										
Arochlor 1016	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1221	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1232	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1242	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1248	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1254	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1260	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Atrazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Dursban (chlorpyrifos)	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
Cyanazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Diazinon	**0.22**	**0.096**	**0.15**	**0.15**	-	-	**0.12**	**0.32**	**0.33**	**0.34**
Malathion	0.1U	0.1U	0.1U	0.1U	-	-	1U	1U	1U	1U
Prometryn	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Simazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 4 of 5)

ANALYTE	Belmont Pump 16 Aug '01	Los Cerritos Channel 16 Aug '01	Bouton Creek 16 Aug '01	Bouton Creek FD 16 Aug '01	Alamitos Bay 16 Aug '01	Alamitos Bay 9 May '02	Belmont Pump 9 May '02	Los Cerritos Channel 9 May '02	Bouton Creek 14 May '02	Bouton Creek FD 14 May '02
HERBICIDES (ug/L)										
2,4,5-TP (Silvex)	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
2,4-D	1U	1U	1U	1.0U	-	-	**1.2**	**5.5**	**3**	**3**
Glyphosate	5U	5U	5U	5.0U	-	-	5UJ	5UJ	5UJ	5UJ
SEMI-VOLATILES (ug/L)										
1,2,4-Trichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,2-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,2-Diphenylhydrazine	3.0U	3.0U	0.5U	3.0U	-	-	1U	1U	1U	1U
1,3-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,4-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2,4,6-Trichlorophenol	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
2,4-Dichlorophenol	2.0U	2.0U	2.0U	2.0U	-	-	2U	2U	2U	2U
2,4-Dimethylphenol	2.0U	2.0U	2.0U	2.0U	-	-	1U	1U	1U	1U
2,4-Dinitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	5U	5U	5U	5U
2,4-Dinitrotoluene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2,6-Dinitrotoluene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2-Chloroethylvinyl ether	-	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	-	-	-	-	-	-	1U	1U	1U	1U
2-Chlorophenol	2.0U	2.0U	2.0U	2.0U	-	-	2U	2U	2U	2U
2-Nitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
3,3'-Dichlorobenzidine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
4,6 Dinitro-2-methylphenol	3.0U	3.0U	3.0U	3.0U	-	-	2U	2U	2U	2U
4-Bromophenyl Phenyl Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
4-Chloro-3-methylphenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
4-Chlorophenyl Phenyl Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
4-Nitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Acenaphthene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Acenaphthylene	0.2U	0.2U	0.2U	0.2U	-	-	1U	1U	1U	1U
Anthracene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Benzidine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Benzo(a)Anthracene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(a)Pyrene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(b)Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(ghi)Perylene	-	-	-	-	-	-	1U	1U	1U	1U
Benzo(k)Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Analyte not tested
FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 5 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
SEMIVOLATILES (ug/L)										
Bis(2-chloroethoxy)Methane	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Bis(2-chloroethyl)Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Bis(2-chloroisopropyl)Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Bis(2-Ethylhexyl)Phthalate	**3.1**	**15.8**	**8.9**	**10.7**	-	-	1U	1U	1U	1U
Butylbenzyl Phthalate	-	-	-	-	-	-	1U	1U	1U	1U
Chrysene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Dibenzo(a,h)Anthracene	-	-	-	-	-	-	0.1U	0.1U	0.2U	0.2U
Dieldrin	0.01U	0.01U	0.01U	0.01U	-	-	1U	1U	1U	1U
Diethyl Phthalate	0.5U	**0.8**	**0.9**	0.5U	-	-	1U	1U	1U	1U
Dimethyl Phthalate	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Di-n-Butyl Phthalate	3.0U	**6.0**	3.0U	**3.1**	-	-	1U	1U	1U	1U
Di-n-Octyl Phthalate	3.0U	3.0U	**3.8**	**3.1**	-	-	0.05U	0.05U	0.05U	0.05U
Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	0.1U	0.1U	0.1U	0.1U
Fluorene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Hexachlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Hexachlorobutadiene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Hexachlorocyclopentadiene	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Hexachloroethane	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Indeno(1,2,3-c,d)Pyrene	1.0U	1.0U	1.0U	1.0U	-	-	0.05U	0.05U	0.2U	0.2U
Isophorone	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Naphthalene	0.5U	0.5U	0.5U	0.5U	-	-	0.2U	0.2U	0.2U	0.2U
Nitrobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
N-Nitrosodimethylamine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
N-Nitrosodi-n-Propylamine	1.0U	1.0U	1.0U	1.0U	-	-	5U	5U	5U	5U
N-Nitrosodiphenylamine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Pentachlorophenol	2.0U	3.0U	2.0U	2.0U	-	-	1U	1U	1U	1U
Phenanthrene	0.5U	0.5U	0.5U	0.5U	-	-	0.05U	0.05U	0.05U	0.05U
Pyrene	0.5U	0.5U	0.5U	0.5U	-	-	0.1U	0.1U	0.1U	0.1U
Phenol	1.0U	1.0U	1.0U	1.0U	-	-	0.05U	0.05U	0.05U	0.05U

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Analyte not tested
FD Field Duplicate.

7.0 TOXICITY RESULTS

Toxicity tests were conducted on subsamples of the composites collected for chemical analysis. Wet weather samples were collected from two storm events: November 12-13, 2001 and November 24, 2001. Dry weather sampling occurred on May 9, 2002, with a resampling of one station on May 24, 2002.

7.1 Wet Weather Discharge

7.1.1 Belmont Pump

Composite samples were collected from the Belmont pump station during separate storm events and were tested with three species, the water flea (freshwater crustacean), mysid (marine crustacean), and sea urchin (marine echinoderm). The first sample collected from this station this year was on November 12, 2001. This sample caused toxic effects to all three test species (Table 7.1), with the fertilization test being the most sensitive (Figure 7.1). Both the water flea survival and reproduction endpoints showed the presence of toxicity (Table 7.1), with the survival endpoint slightly more sensitive (Figure 7.1). Mysid survival, but not growth, was adversely affected by the sample.

The second sample was collected on November 24, 2001 and produced toxic responses in all three species. Again, the sea urchin fertilization test was the most sensitive indicator of toxicity with a 27.1% sample calculated to cause a 50% reduction in fertilization (Table 7.1). Significant reductions in water flea survival and reproduction were found at the 12% and 25% concentrations. Mysid survival and growth was significantly reduced at the 100% concentration. Water flea survival showed a greater degree of response than did the reproduction endpoint (Figure 7.1).

7.1.2. Bouton Creek

The first sample from the Bouton Creek station was collected on November 13, 2001. Toxicity to this sample was detected by all three test species (Table 7.2). Sea urchin egg fertilization was again the most sensitive test method, with 32 TUc (Figure 7.2).

The second Bouton Creek sample was collected on November 24, 2001 and caused a toxic response to both sea urchins and water fleas (Table 7.2 and Figure 7.2). The mysid test was not applied to this sample, in accordance with a modification to the monitoring plan approved by the LA Regional Water Quality Control Board.

7.1.3. Los Cerritos Channel

The first sample from the Los Cerritos Channel station was collected on November 12, 2001. This sample caused a toxic response to all three test species (Table 7.3 and Figure 7.3). The second Los Cerritos Channel sample was collected on November 24, 2001 and elicited a toxic response from the water flea survival and reproduction and sea urchin fertilization tests. The NOEC for the sea urchin test was 3% (Table 7.3) and much lower than the NOEC for the water flea test, indicating that the stormwater sample was approximately four times more toxic to the sea urchin than to the water flea. The mysid test was not used to test the second sample.

7.2. Receiving Water

Two grab samples of receiving water from Alamitos Bay were collected during storm events on November 12 and 24, 2001 (Table 7.4). Each sample was tested for toxicity to mysids and sea urchins. Since these samples were saline, the water flea test was not conducted. None of the samples caused toxic effects to mysid survival, mysid growth or sea urchin fertilization.

7.3 Toxicity Identification Evaluations (TIEs) of Stormwater

The trigger for performing a TIE was modified prior to the 2001/2002 wet season. A TIE was initiated when a LC50 of ≤100% (equivalent to ≥1 acute TU) was obtained for the water flea or mysid test, or an EC50 of ≤50% (≥2 acute TU) was obtained for the sea urchin fertilization test. This TIE trigger was exceeded 12 times among the tests conducted on the two wet weather samples (Table 7.5). Each of the three species had at least one exceedance of the TIE trigger.

For the first wet weather sampling event, TIEs were initiated on samples from all three sites for the water flea test, on the Belmont pump station sample for the mysid test, and on the Bouton Creek sample for the sea urchin test. A reduction in toxicity relative to the initial test result was obtained for both TIEs of the Bouton Creek sample, resulting in a baseline toxicity of less than 2 TU, which prompted termination of these TIEs. The TIE trigger was exceeded in all tests conducted with samples from the second storm event monitored (November 24, 2001). The TIE of the Bouton Creek sample with the water flea was again terminated due to a loss of toxicity in the baseline test results.

7.3.1 Belmont Pump Station

The results of the TIEs on samples from the Belmont pump station are summarized in Figure 7.4. Extraction of the November 12 sample using a C-18 column was highly effective in reducing toxicity in both the water flea and mysid tests. PBO treatment also eliminated the toxicity to the water flea. Increased toxicity was present in the blanks for the PBO, EDTA, and STS treatments used with the mysid test, and in the STS treatment with the water flea. The increase in toxicity of the Belmont pump sample obtained for these treatments (Figure 7.4) is an artifact of this toxicity and confounds the interpretation of this portion of the results. The consistent effectiveness of the C-18 treatment and elimination of toxicity obtained with the PBO treatment in the water flea tests suggest that a nonpolar organic, probably an organophosphate (OP) pesticide is a likely toxicant of concern in this sample.

Three TIEs were conducted on the November 24 Belmont Pump sample and the results yielded three distinct patterns of response. The water flea test results were similar to those obtained with the November 12 sample; toxicity was eliminated with the C-18 and PBO treatments, which suggested OP pesticide toxicity. The mysid TIE also indicated the presence of a nonpolar organic toxicant, but toxicity was increased following addition of PBO. This result suggests that the mysids were not responding to the toxic effects of OP pesticides. The addition of EDTA in the TIE using the sea urchin test eliminated all toxicity (Figure 7.4), indicating that a divalent metal was the likely toxicant to this species.

7.3.2. Bouton Creek Station

One TIE on stormwater from Bouton Creek was conducted; the November 24 sample was tested using the sea urchin fertilization test (Table 7.5). The TIE results obtained for this sample were similar to the results of the Belmont Pump tests using the sea urchin test, addition of EDTA eliminated the toxicity of the sample. Addition of STS, centrifugation, and extraction using a C-18 column did not have a substantial impact on the toxicity of this sample.

7.3.3 Los Cerritos Channel Station

TIEs were conducted on both stormwater samples from the Los Cerritos Channel. The November 12 and 24 samples were tested using the water flea and the results were similar to those obtained for the Belmont Pump station (Figure 7.6). Extraction using C-18 and addition of PBO eliminated the toxicity of both of the Los Cerritos Channel samples, again indicating the presence of OP pesticide toxicity. An indication of other types of toxicants was also present in these samples, however. EDTA was partially effective in reducing toxicity in the November 12 sample (suggesting metal toxicants) and centrifugation of the November 24 sample eliminated the toxicity, which indicated that the toxicants were associated with particles.

7.4 Dry Weather Discharge

Toxicity tests were conducted on samples from one sampling event on May 9, 2002. The Bouton Creek sample contained 13 g/kg salinity, which was more than the tolerance limit of the water flea. Bouton Creek was resampled on May 14 and a sample with an acceptable salinity of 7 g/kg was obtained and used for toxicity testing.

7.4.1 Belmont Pump Station

The Belmont Pump sample was not toxic to the water flea (Table 7.6). A significant amount of toxicity was detected with the sea urchin fertilization test, however. The Belmont Pump sample contained 4 TUc when assessed using the sea urchin test.

7.4.2 Bouton Creek

The Bouton Creek sample contained significant toxicity to the water flea (Table 7.6). Survival was significantly reduced at the 50% exposure concentration, and water flea reproduction was significantly inhibited by exposure to 12% of the Bouton Creek sample.

7.4.3 Los Cerritos Channel

The Los Cerritos dry weather sample was not toxic to the water flea. However, this sample produced significant toxicity to sea urchin sperm (Figure 7.7 and Table 7.6).

7.4.4 Alamitos Bay Receiving Water

The Alamitos Bay dry weather surface water sample did not contain any detectable toxicity (Table 7.7). This sample was evaluated for toxicity using only the sea urchin fertilization test.

7.4.5 Dry Weather Toxicity Identification Evaluations

Sea urchin TIEs were initiated on dry weather samples from the Belmont Pump and Los Cerritos stations. The Belmont TIE was terminated due to a loss of toxicity in the baseline test. Sufficient baseline toxicity was present in the Los Cerritos sample to complete the TIE, however. The toxicity of the Los Cerritos sample was eliminated by addition of EDTA (Figure 7.7). A partial reduction of toxicity was produced by extraction using C-18 and the remaining treatments did not alter the toxicity of the sample. The pattern of response of the sea urchin sperm to the TIE treatments is consistent with the presence of toxic concentrations of divalent trace metals.

Table 7.1. Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2001/2002 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid tests were conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/12/2001	**Water Flea Survival**	**<6**	**6**	**3.9**	**>16**
11/12/2001	**Water Flea Reproduction**	**6**	**12**	**8.0**	**16**
11/12/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/12/2001	Mysid Growth	nm[f]	nm	na	na
11/12/2001	**Sea Urchin Fertilization**	**3**	**6**	**>50**	**32**
11/24/2001	**Water Flea Survival**	**6**	**12**	**10.2**	**16**
11/24/2001	**Water Flea Reproduction**	**12**	**25**	**15.7**	**8**
11/24/2001	**Mysid Survival**	**≤50**	**≤100**	**na**	**≥2**
11/24/2001	**Mysid Growth**	**≤50**	**≤100**	**na**	**≥2**
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**27.1**	**32**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).

[d] Chronic toxicity units = 100/NOEC.

[e] Not applicable.

[f] Not measured due to lack of survivors.

01-02

Table 7.2. **Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2001/2002 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/13/2001	**Water Flea Survival**	**25**	**50**	**36.1**	**4**
11/13/2001	**Water Flea Reproduction**	**25**	**50**	**42.2**	**4**
11/13/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/13/2001	**Mysid Growth**	**≤50**	**≤100**	**na**	**≥2**
11/13/2001	**Sea Urchin Fertilization**	**3**	**6**	**47.0**	**32**
11/24/2001	**Water Flea Survival**	**50**	**100**	**64.3**	**2**
11/24/2001	**Water Flea Reproduction**	**50**	**100**	**70.1**	**2**
11/24/2001	**Mysid Survival**	**na**	**na**	**na**	**na**
11/24/2001	**Mysid Growth**	**na**	**na**	**na**	**na**
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**38.4**	**32**

a No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
b Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.
c Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).
d Chronic toxicity units = 100/NOEC.
e Not applicable.

100%

75%

36.1% LOEC

50% NOEC

25%

LOE 100 50 NOEC 25

Table 7.3. Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2001/2002 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample) NOEC[a]	LOEC[b]	Median Response[c]	TUc[d]
11/12/2001	**Water Flea Survival**	**12**	**25**	**21.4**	**8**
11/12/2001	**Water Flea Reproduction**	**12**	**25**	**19.9**	**8**
11/12/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/12/2001	**Mysid Growth**	**≤50**	**≤100**	**Na**	**≥2**
11/12/2001	**Sea Urchin Fertilization**	**<3**	**3**	**>50**	**>32**
11/24/2001	**Water Flea Survival**	**12**	**50**	**18.8**	**8**
11/24/2001	**Water Flea Reproduction**	**12**	**50**	**19.3**	**8**
11/24/2001	Mysid Survival	na	na	Na	na
11/24/2001	Mysid Growth	na	na	Na	na
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**26.5**	**32**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).

[d] Chronic toxicity units = 100/NOEC.

[e] Not applicable.

Table 7.4. Toxicity of Receiving Water Samples Collected from Alamitos Bay during the 2001/2002 Storm Season. Water flea tests were not conducted on these samples.

Date	Test	Estimated % Runoff	NOEC[a]	TUc[b]
11/12/2001	Mysid Survival	2	Nontoxic	<1
11/12/2001	Mysid Growth	2	Nontoxic	<1
11/12/2001	Sea Urchin	2	Nontoxic	<1
11/24/2001	Mysid Survival	1	Nontoxic	<1
11/24/2001	Mysid Growth	1	Nontoxic	<1
11/24/2001	Sea Urchin	1	Nontoxic	<1

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Chronic toxicity units = 100/NOEC. These values are estimated since the NOEC was not determined through analysis of a dilution series.

Table 7.5. **Summary of TIE Activities.** Acute Toxic Units for the initial (TU-1) and TIE baseline (TU-B) tests are shown (96 hr exposure time for water flea and mysid tests), along with the TIE-related action taken. TIEs were aborted when the baseline TU value was less than 2.0.

		Water Flea			Mysid			Sea Urchin		
Date	**Test**	**TU-I**	**TUB**	**Action**	**TU-I**	**TU-B**	**Action**	**TU-I**	**TU-B**	**Action**
11/12	Belmont	10.7	12	TIE	>1	3.4	TIE	<2	na	none
11/13	Bouton	1.4	1.2	abort	1	na	none	2.1	1.3	abort
11/12	Los Cerritos	2.8	3.3	TIE	<1	na	none	<2	na	none
11/24	Belmont	9.8	3.5	TIE	>1	1.7	TIE	3.7	4.8	TIE
11/24	Bouton	1.6	<1	abort	na	na	none	2.6	6.1	TIE
11/24	Los Cerritos	5.3	3.3	TIE	na	na		3.8	6.2	TIE

Table 7.6. **Toxicity of Dry Weather Samples from the City of Long Beach.** Test results indicating toxicity are shown in bold type.

Station	Date	Test	Test Response (% sample) NOEC[a]	LOEC[b]	Median Response[c]	TUc[d]
Belmont	5/9/2002	Water Flea Survival	≥100	>100	>100	≤1
Belmont	5/9/2002	Water Flea Reproduction	≥100	>100	>100	≤1
Belmont	**5/9/2002**	**Sea Urchin Fertilization**	**25**	**50**	**47.6**	**4**
Bouton	**5/14/2002**	**Water Flea Survival[e]**	**25**	**50**	**37.5**	**4**
Bouton	**5/14/2002**	**Water Flea Reproduction[e]**	**6**	**12**	**29.6**	**16**
Bouton	5/14/2002	Sea Urchin Fertilization	≥50	>50	>50	≤2
Los Cerritos	5/9/2002	Water Flea Survival	≥100	>100	>100	≤1
Los Cerritos	5/9/2002	Water Flea Reproduction	≥100	>100	>100	≤1
Los Cerritos	**5/9/2002**	**Sea Urchin Fertilization**	**12**	**25**	**31.8**	**8**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.
[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50), or 50% reduction in sea urchin fertilization or mysid growth (EC50).
[d] Chronic Toxicity Units = 100/NOEC.
[e] The conductivity of this sample was believed to exceed the osmotic tolerance of the water flea.

Table 7.7 Toxicity of the Receiving Water Sample Collected from Alamitos Bay during the 2001/2002 Storm Season.

Date	Test	NOEC[a]	TUc[b]
5/9/2002	Sea Urchin	Nontoxic	≤1

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Chronic toxicity units = 100/NOEC. These values are estimated since the NOEC was not determined through analysis of a dilution series.

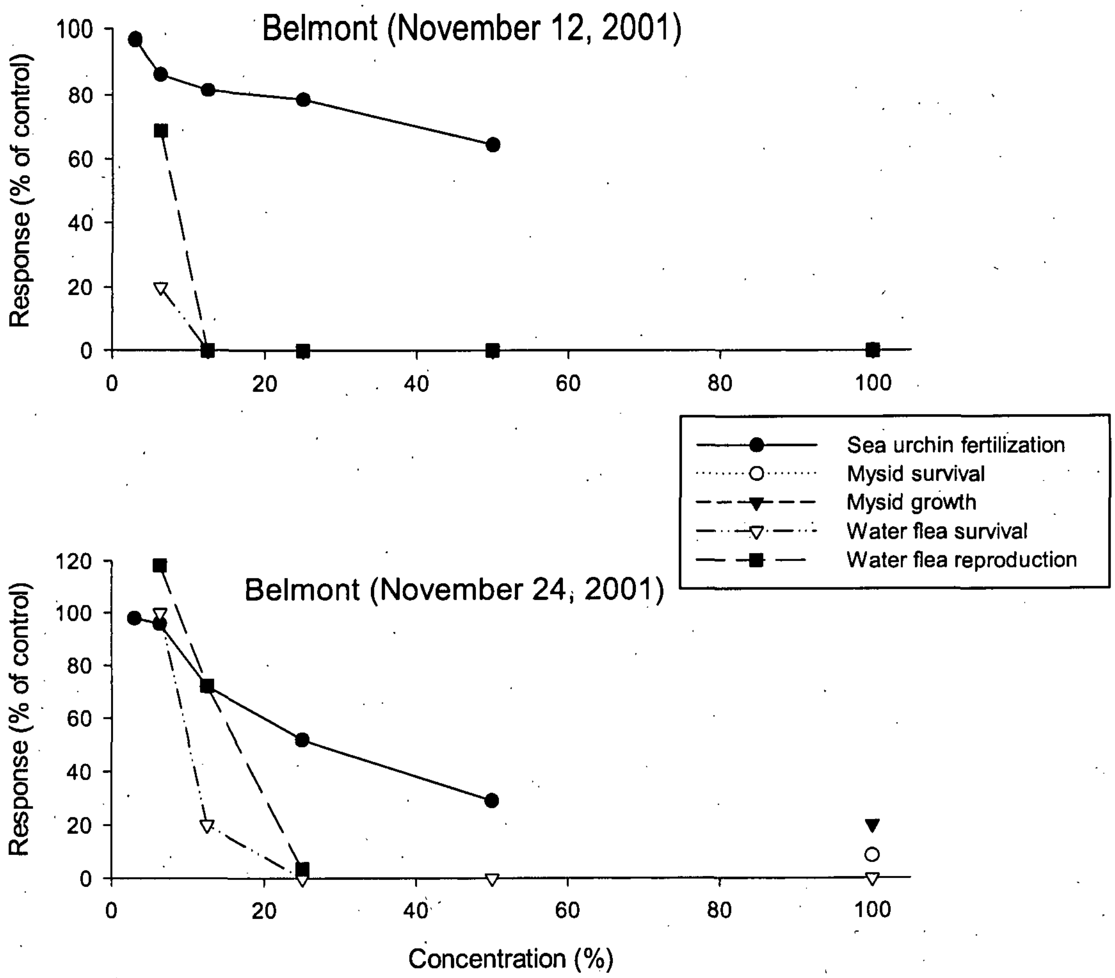


Figure 7.1. **Toxicity Dose Response Plots for Stormwater Samples Collected from the Belmont Pump Station.**

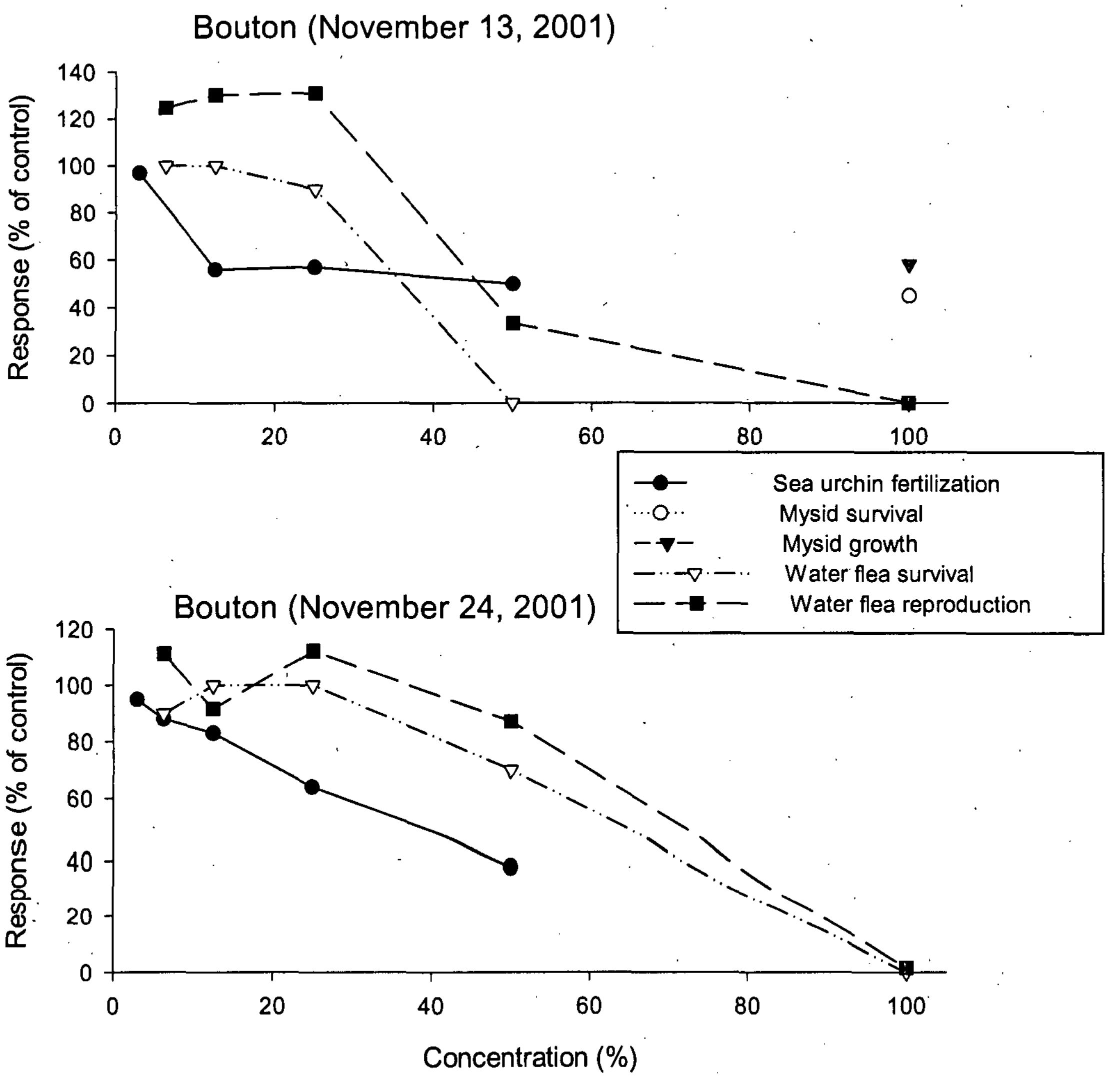
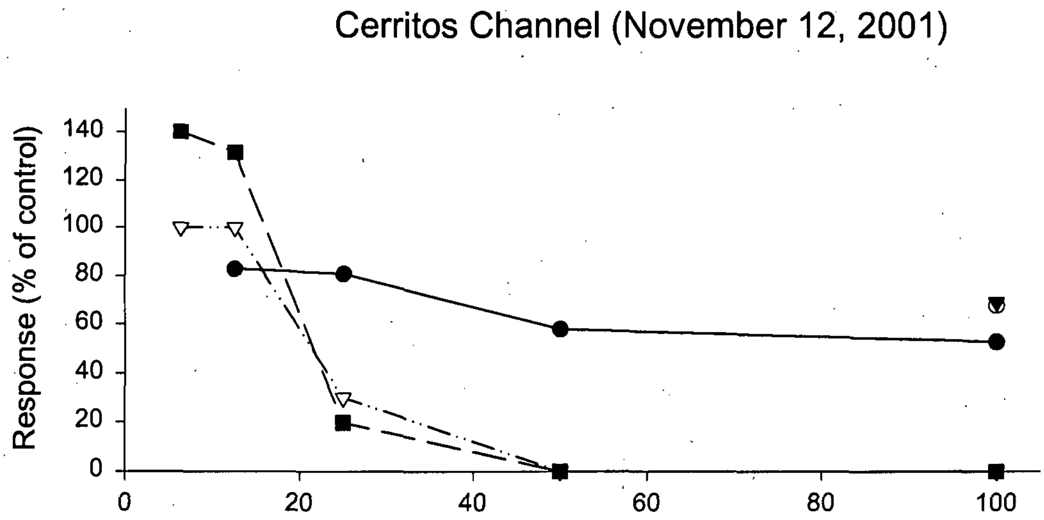


Figure 7.2. Toxicity Dose Response Plots for Stormwater Samples Collected from Bouton Creek.



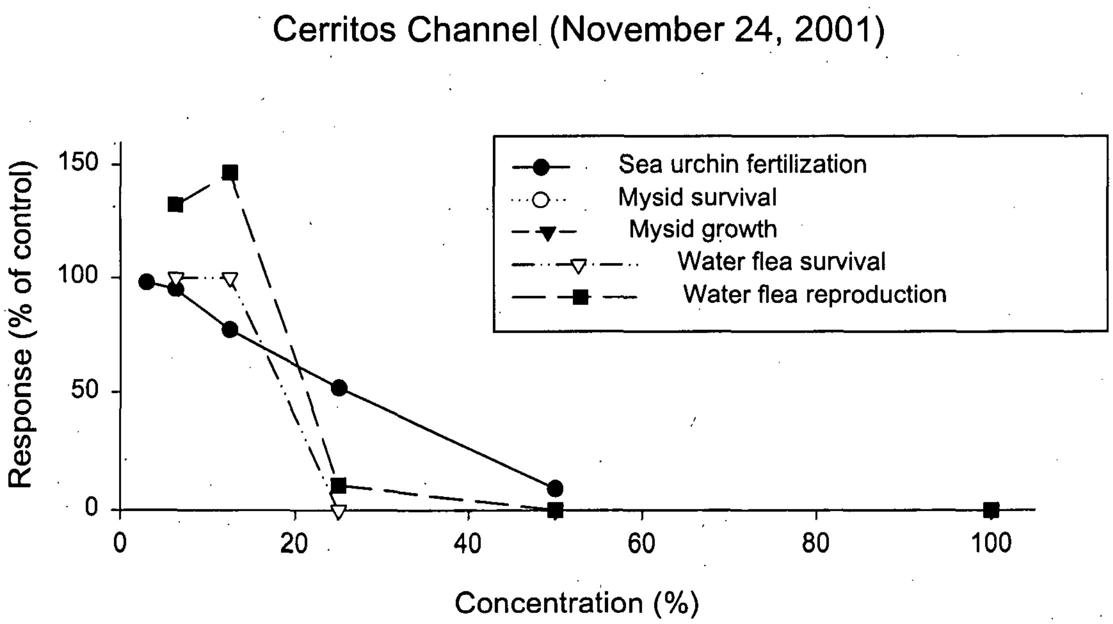


Figure 7.3. **Toxicity Dose Response Plots for Stormwater Samples Collected from the Los Cerritos Channel.**

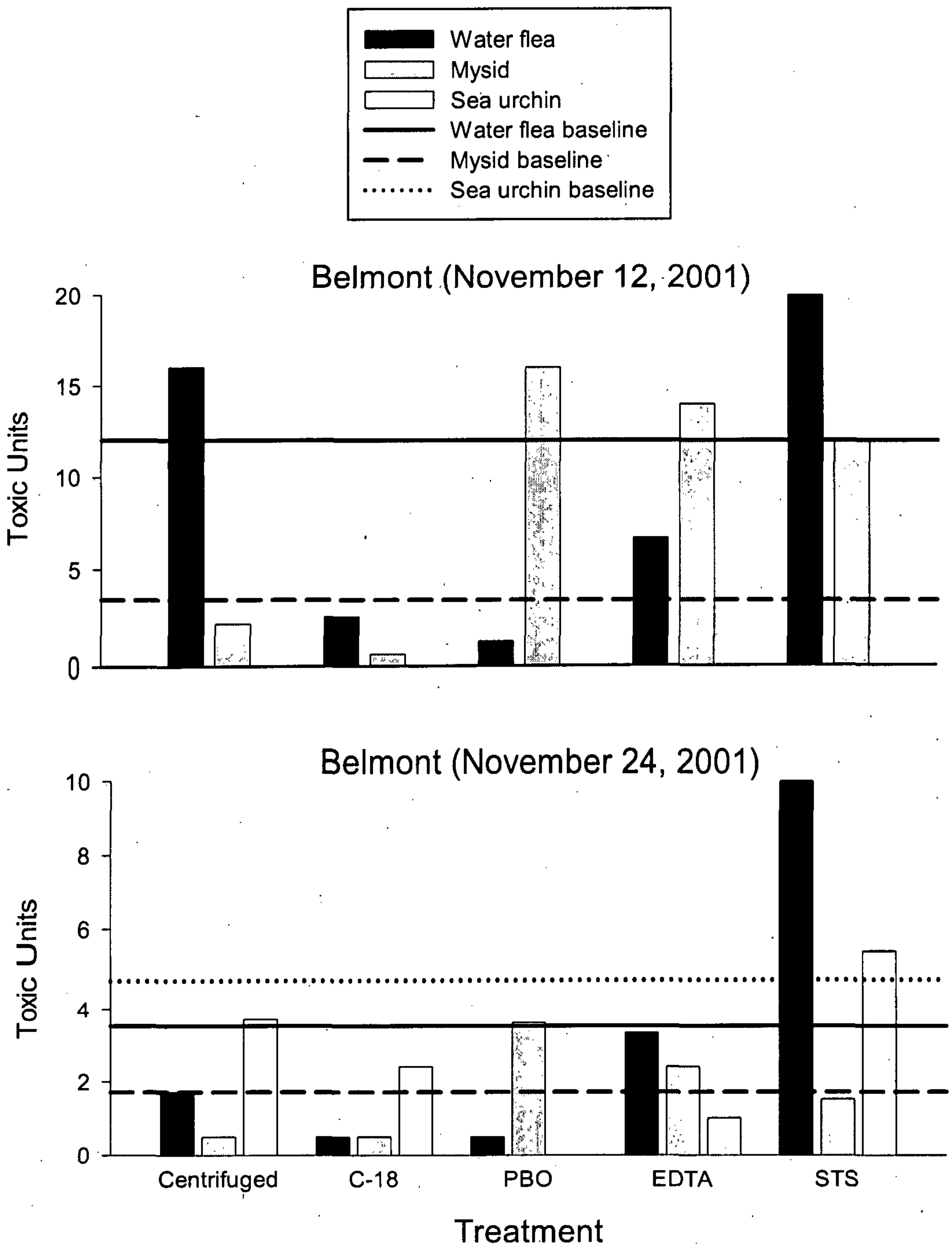


Figure 7.4. **Summary of Phase I TIE Analyses on Stormwater Samples from the Belmont Pump Station.**

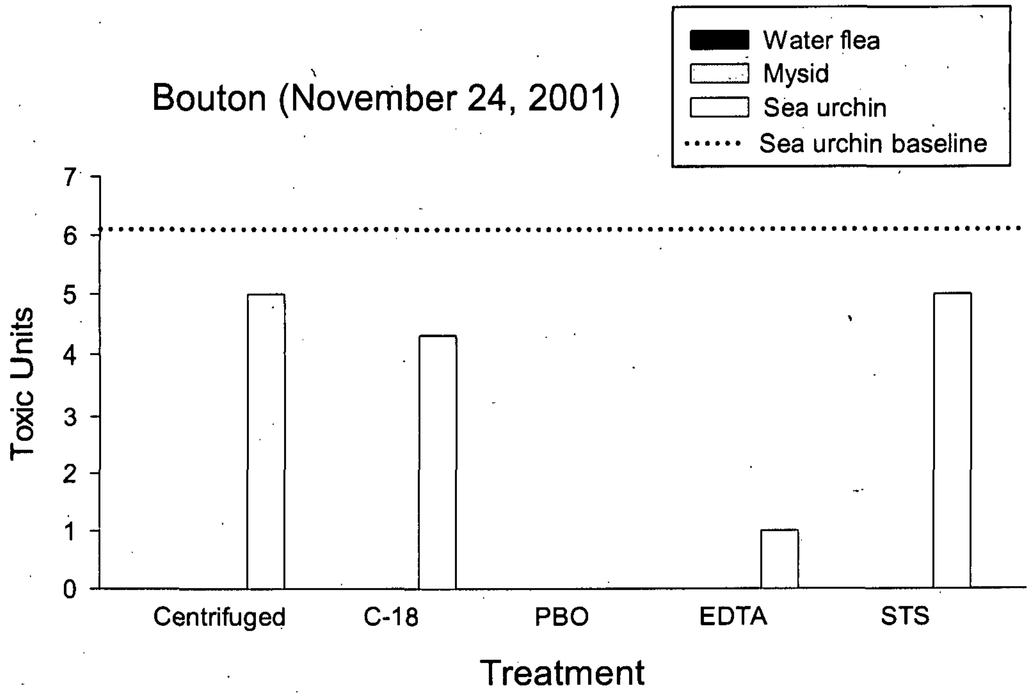


Figure 7.5. **Summary of Phase I TIE Analyses on the November 24 Stormwater Sample from the Bouton Creek Station.**

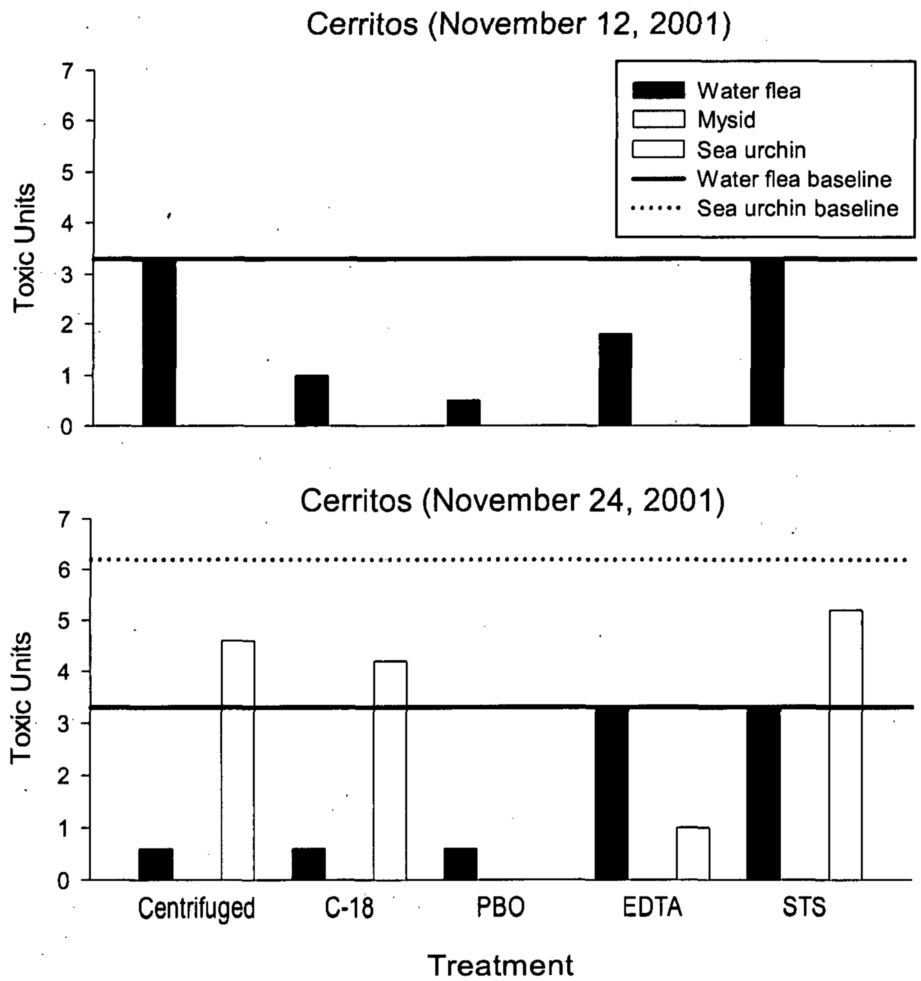


Figure 7.6. **Summary of Phase I TIE Analyses on Stormwater Samples from the Los Cerritos Channel Station.**

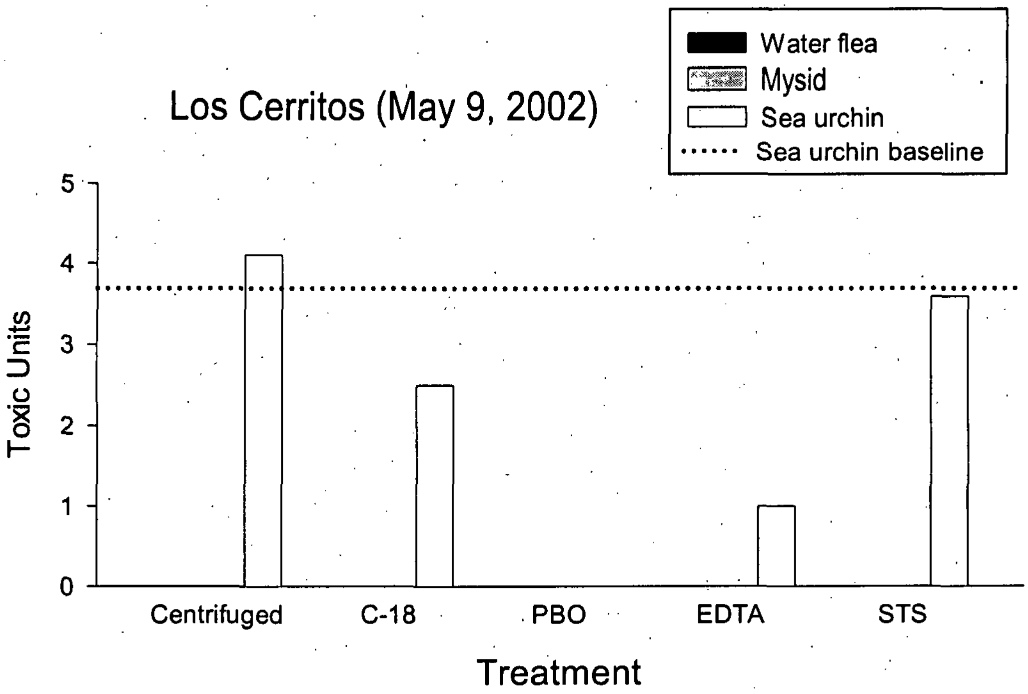


Figure 7.7. Summary of Phase I TIE Analyses on the May 9 Dry Weather Sample from the Los Cerritos Channel Station.

8.0 DISCUSSION

Water quality criteria or objectives may provide valuable reference points for assessing the relative importance of various stormwater contaminants. Selection of appropriate water quality objectives for comparative purposes is dependant upon designated beneficial uses for each receiving water body. Since the designated beneficial uses for each receiving water body are the driving force in selection of the water quality objectives, beneficial uses were first summarized for each water body (Table 8.1).

Based upon beneficial uses, the receiving water bodies generally fell into two groups. Bouton Creek, Los Cerritos Channel, and the Dominguez Gap Pump Station are all located within Hydrological Unit (HU) 405.15. Principal beneficial uses for receiving water bodies at these locations include potential municipal and domestic water supply (MUN), potential or existing water contact recreation (REC1), intermittent or existing non-contact water recreation (REC2), intermittent or existing warm freshwater habitat (WARM), and existing or potential wildlife habitat (WILD). In addition, receiving water bodies associated with the Dominguez Pump Station are designated as existing ground water recharge (GWR) and potential industrial service supply (IND).

The second group includes water bodies receiving discharge from the Belmont Pump Station and Alamitos Bay. These sites are both within HU 405.12. These receiving water bodies are both marine and estuarine in character. Beneficial uses include commercial and sport fishing (COMM), estuarine habitat (EST), industrial service supply (IND), marine habitat (MAR), rare, threatened or endangered species (RARE), contact (REC1) and non-contact recreation (REC2), shellfish harvesting (SHELL), wetland habitat (WET), and wildlife habitat (WILD).

Currently, numerical standards do not exist for stormwater discharges. Table 8.2 provides a summary of various water quality criteria for each measured constituent, proposed benchmarks for use as reference points to interpret stormwater and dry weather discharges, and the 2001/2002 laboratory method detection limits for each constituent. These benchmarks are intended to serve as a tool for interpreting the stormwater quality data and assuring that beneficial uses are not impacted. Exceedances of these receiving water quality benchmarks do not necessarily indicate impairment. Other factors such as dilution, duration and transformation in the receiving waters must also be considered.

Development of the benchmarks was based upon Marshack (2000) and also upon draft benchmarks under development as part of Project Clean Water in San Diego County (San Diego, Project Clean Water 2001). Averaging intervals for the various water quality objectives were important considerations in selection of benchmarks. Appropriate water quality goals for use as benchmarks for discharges from Bouton Creek, Los Cerritos Channel and the Dominguez Gap Pump Station are listed as Inland Surface Water Discharges. Proposed water quality goals for the Belmont Pump Station and Alamitos Bay sites are listed as Enclosed Bay and Estuary Discharges. In using these benchmarks, it is important that the source of the specific criterion is considered. For instance, metals concentrations derived from California Toxics Rule (CTR) freshwater criteria for protection of aquatic life are based upon dissolved concentrations and are often a function of hardness. Values listed are based upon a default hardness of 100 mg/L. In addition, saltwater objectives listed for metals under the CTR are based upon dissolved concentrations while those listed under the California Ocean Plan are based upon total recoverable measurements. The source of each particular benchmark is identified in columns to the right of the proposed benchmark/water quality goals or, in some cases, in footnotes.

8.1 Wet Season Water Quality

Stormwater quality data from the four mass emission sites in Long Beach were grouped to provide an initial characterization of discharges from the City (Table 8.3). Descriptive statistics were based upon detected values and the assumption that all data are log normally distributed. Most stormwater investigations conducted since the initial Nationwide Urban Runoff Program (NURP) (EPA 1983b) studies have found that the majority of constituents in stormwater tend to be log normally distributed. As the City of Long Beach database expands, the distribution of these data will be tested to determine if transformations are necessary for statistical comparisons and methods will be applied to incorporate censored (below detection limit) data where appropriate.

The mean EMCs from the combined data from all Long Beach mass emission sites are developed and presented in Table 3. A simple, tabulated comparison of these mean EMCs is not possible because of the multiple benchmark sources, and intended purposes of these benchmarks. Rather comparisons are made in the text that follows.

Among the conventional pollutants, oil and grease, total suspended solids (TSS), and bacteria were the only constituents that exceeded the proposed stormwater benchmark values. Water samples to be analyzed for oil and grease are taken as grab samples and therefore only provide an instantaneous measurement of the discharges. In addition, oil and grease are typically not well mixed in the stormwater samples. An exception may be samples taken at the Belmont Pump Station during events sampled this year. Grab samples were taken at the discharge point in extremely turbulent water. The proposed benchmark for oil and grease was 15 mg/L based upon the median Stormwater Effluent Limitation Guidelines in USEPA's Stormwater Multi-Sector General Permit for Industrial Activities. Oil and grease was detected above the reporting limit of 5 mg/L in about one third of the samples taken at both the Belmont Pump Station and in the Los Cerritos Channel. When detected, the mean concentration of oil and grease at these two sites was 2 to 2.5 times the benchmark values. Benchmark values for TSS were based upon the 2001 Ocean Plan Instantaneous Maximum of 60 mg/L is applied to enclosed bays and estuaries, and the median EMC of 100 mg/L for TSS from the National Urban Runoff Program (NURP) for inland surface waters. The mean TSS EMC for the Belmont Pump Station Discharge is 602 mg/L or roughly 10 times the proposed benchmark. The mean TSS EMCs for Bouton Creek and the Los Cerritos Channel ranged from 476 to 516 mg/L or roughly five times the benchmark for inland waters. The impacts of excursions above these candidate benchmarks and the appropriateness of the benchmarks are difficult to assess. The proposed benchmark for TSS discharges to inland waters is inherently conservative since we are comparing log-normal means to medians. Use of the NURP median value was simply based upon maintenance of consistency with draft reference values currently being considered for San Diego County.

Concentrations of bacteria in stormwater runoff routinely exceed proposed benchmark levels. Mean EMCs for fecal coliform are highest at the Belmont Pump Station where the stormwater is discharged directly to Alamitos Bay. Mean values are three orders of magnitude greater than the benchmark values that were based upon receiving water limits. Elevation of bacteria in stormwater discharges may not be completely controllable. A number of studies have indicated that high levels of bacteria are present in discharges from areas that are relatively unimpacted by urban activities. Work conducted in San Diego (Kinnetic Laboratories, Inc. 1995a) and in Santa Cruz (Kinnetic Laboratories, Inc. 1995b) demonstrated comparable bacterial concentrations in runoff from both chaparral and highly urbanized catchments.

Benchmark values used for trace metals are mostly based upon Criteria Maximum Concentrations (CMC) from the California Toxics Rule (USEPA 2000). These values are for the dissolved fraction and are often a function of hardness. When criteria were a function of hardness, a default value of 100 mg/L was used for tabulated benchmark values in Table 8.2. The CMC was selected as the appropriate benchmark value since stormwater impacts are generally of short duration. Use of the CMC is also consistent with the San Diego Project Clean Water draft benchmarks. Derivation of beryllium and total chromium benchmark values differed from the other metals. The benchmark value for beryllium in bays and estuaries is based upon the 2001 Ocean Plan. The value of 0.033 µg/L is based upon 30-day average exposures to organisms when consumption may result in cancer risk to humans. This is evaluated analytically by meeting the established minimum level (ML) of 0.5 µg/L. All beryllium measurements were below the laboratory ML of 0.5 µg/L. Total chromium benchmarks are derived from the instantaneous maximum (20 µg/L) from the 2001 Ocean Plan inland and drinking water standards. Both are based upon total recoverable measurements. Mean EMCs for total chromium at each site were below the benchmark at all sites.

Only two metals were found to exceed benchmark values. Mean site EMCs for copper and zinc exceeded benchmark values at some sites. In both cases, only the estuarine/marine benchmarks were exceeded. The mean EMC for copper at the Belmont Pump Station was approximately three times the benchmark value for discharges to enclosed bays and estuaries. Mean copper EMCs for discharges to inland surface waters were below the benchmark value of 13 µg/L. The mean EMC for dissolved zinc at the Belmont Pump Station was 98 µg/L, slightly exceeding the enclosed bay and estuary benchmark value of 90 µg/L. Mean EMCs for dissolved zinc at both Bouton Creek and Los Cerritos were 78-84 µg/L, which was approximately 2/3 of the inland surface water benchmark.

Organic compounds were rarely detected in the stormwater samples. When detected, these compounds were often very near reporting limits. Exceptions included occasional occurrences of bis(2-ethylhexyl) phthalate at levels of up to 35 µg/L during the first monitoring season and up to 10 µg/L this past season. Diazinon was detected at concentrations as high as 3.0 µg/L this season. Diazinon benchmarks are routinely exceeded in discharges from the Belmont Pump, Bouton Creek, and the Los Cerritos Channel. Benchmark values for both saltwater and freshwater were based upon recent assessments conducted by the California Department of Fish and Game (Seipmann and Finlayson 2002). Mean EMCs for the two monitoring sites that discharge to inland surface waters were roughly four to five times higher than the proposed benchmark. Discharge from the Belmont Pump station had a site mean EMC that was an order of magnitude greater than the benchmark. Chlorpyrifos, another organophosphate pesticide, was found in significant concentrations in water from the second storm event in the Los Cerritos Channel. Measured concentrations of chlorpyrifos in this sample were approximately one order of magnitude greater than the recently updated California Department of Fish and Game CMC (Seipmann and Finlayson 2002).

Most other organic compounds are rarely detected or are typically near minimum levels (MLs). Glyphosate, which was detected in runoff the previous year was not detected in runoff from any of the sites during the 2001/2002 season. Low levels of two organochlorine pesticides, DDT and aldrin, were present in a few samples during the 2001/2002 monitoring year.

Both diazinon and chlorpyrifos are undergoing changes in registration due to the high toxicity of diazinon and chlorpyrifos as well as persistent occurances in runoff. EPA and the registrants have agreed to phase out use of diazinon for outdoor residential lawn and garden uses (EPA 2001). The agreement virtually ends sales of diazinon for residential lawn care by 2003. Residential uses of chlorpyrifos (EPA 2000) are also being phased out. Thus, threats to aquatic life posed by these two compounds should be expected to decline over the next ten years. It is expected that household stockpiles of these pesticides will continue to used for several years after these chemicals are no longer available for residential use. It is possible, however, that educational/informational programs may help to reduce these stockpiles and prevent further use.

8.2 Dry Season Water Quality

8.2.1 Chemical Analysis of Dry Weather Samples from Mass Emission Sites

As in the previous year, chemical results generally did not tend to vary greatly between sites or sampling dates (Table 6.6). With a few exceptions, contaminant concentrations were consistent with previous results and no parameters stood out as particularly high. Several phthalate compounds were detected in samples from the August 2001 survey but were below detection limits in the May 2002 surveys. The herbicide, 2,4-D, was absent from all sites in the fall survey but was present in all samples from the May survey. Diazinon was the only organic contaminant routinely detected in the dry weather discharges. This was not true in previous years due to higher detection limits.

Dry weather discharges were typically low in suspended solids and total metals. The relationships between dissolved and total metals were more consistent with expected dissolved/total ratios than those measured during wet weather events. With a few exceptions, dissolved metals occur at levels similar to those measured during the winter storm events (Tables 6.2 and 6.6). The primary difference between the wet and dry weather concentrations of dissolved trace metals is the increased hardness which tends to mitigate potential toxicity.

Elevated pH levels have been common during dry weather sampling efforts (Kinnetic Laboratories, Inc. /SCCWRP 2001). These mostly occur in open channel sites such as Bouton Creek and the Los Cerritos Channel. It is not unusual to see pH levels in excess of 9.0. This past year, a pH of 9.66 was measured in samples taken from Los Cerritos Channel. Occurrences of elevated pH in these channels is likely due to high benthic algal production resulting in low levels of CO_2. Concurrent high levels of dissolved oxygen would tend to further support algal production as the cause of the elevated pH. In addition, alkalinity also tends to be lowest at sites where high pH values were encountered.

Despite efforts to isolate dry weather flows in Bouton Creek, the very low flows and large surface area of the channel tend to result in higher specific conductivities, COD, chloride and TDS. Saltwater continues to drain from the algal turf well after the water level is below the sampling point. In addition dry weather flows are not substantial enough to drive the saltwater out of the channel. Despite these problems, movement of the sampling point to a location further up the channel would result in the loss of potential flow from numerous drains that enter along the channel.

Dry weather flows continue to show moderately high levels of bacteria including total and fecal coliform as well as enterococci (Table 6.6). All total and fecal coliform measurements were above benchmark levels except for one field duplicate for fecal coliform at Bouton Creek. The effects of these discharges, however, are not typically evident in receiving waters as demonstrated both by concurrent measurements from Alamitos Bay and surveys conducted by the City's Department of Health discussed in the following section.

8.2.2 Bacteriological Data from Alamitos Bay

Microbiological contamination in Alamitos Bay has been a major concern during summer months when bathers are utilizing local beaches. Due to these concerns, a low flow diversion for Drainage Basin 24 to prevent dry weather flows from entering the Bay from this Drainage Basin. The low-flow diversion was activated on May 1, 2000. Prior to activation of the diversion, dry weather flows were discharged at the Bayshore Aquatic Park on the southwestern shoreline of Alamitos Bay. This stormwater monitoring program has now sampled total coliform, fecal coliform, fecal streptococcus/enterococcus in Alamitos Bay near the discharge point for Basin 24 once prior to activation of the dry weather intercept and five times during dry weather periods subsequent to activation of the low-flow intercept. Due to the limited temporal and spatial extent microbiological information associated with this program, alternative data sources were investigated to assist in evaluation of the effectiveness of the diversion. Data from the ongoing microbiological monitoring being conducted by the City of Long Beach Department of Health and Human Services was obtained during the previous year. This data set was updated with additional data from June 2001 through June 2002 provide additional post-implementation data.

The City of Long Beach Department of Health and Human Services (Ms. Mae Nikaido) provided updates of microbiological data from monitoring conducted in and near Alamitos Bay since 1997. Historical data exist for total coliform, fecal coliform (or *Escherichia coli)* and enterococcus at five locations. In January 2000, the Department of Health and Human Services switched from using fecal coliform to use of *E. coli* as a surrogate from fecal coliform. In June 2001, the Department abandoned use of *E. coli* and returned to use of fecal coliform. The length of data records varies among the sites but the most complete survey records start in March 1999. The monitoring sites are shown in Figure 8.1 and are listed below starting from sites within Los Cerritos Creek and proceeding towards the entrance of the Bay:

- B27 - Los Cerritos Creek by Golden Sail (Near mouth of Los Cerritos Cr.)
- B28 - Long Beach Rowing Association (Near Los Cerritos Cr. and Marine Station)
- B67 - Bayshore and Second St. Bridge (Near outlet of Belmont site)
- B29 - First and Bayshore (Nearest our Station -end of East First Street and Bayshore Ave.)
- B14 - Bayshore Float (Out close to Mouth, North of spit of E. Bayshore Walk)

The B29 monitoring site is located at the Bayshore Aquatic Park a short distance from the Alamitos Bay receiving water site monitored as part of the City's stormwater program.

Department of Health and Human Services monitoring data were compared with historical rainfall records from the Long Beach Airport. Microbiological data from extended dry weather conditions occurring between late spring and early fall of each year were extracted from the data set and available data are identified in Table 8.4. This summary identifies the dry weather period for each year, the total number of measurements taken during each dry weather period and the percentage of measurements exceeding Ocean Plan and AB411 reference values. The frequency of exceedances of the Ocean Plan reference value refers to single measurements that exceed the standard for 30-day averages. It was used only as a benchmark. None of the data indicated presence of sustained levels that would violate Ocean Plan Standards. For visual inspection of these data, time-series plots are provided for each site for total coliform, fecal coliform and enterococcus (Figures 8.2 through 8.6).

General trends remained similar to those observed in previous years (Kinnetic Laboratories, Inc./SCCWRP, 2001). Concentrations of bacteria are consistently lower at the lower Alamitos Bay sites B27 and B28 in comparison to other sites. Concentrations of fecal coliform most frequently exceed reference levels at the B67 and B29 monitoring sites. Enterococcus bacteria were only tested at the three sites closest to the ocean during the 1999, 2000, and 2001 dry weather seasons. During the 1999 dry weather season, reference levels were most commonly exceeded at the B67 monitoring site. During both the 2000 and 2001 dry weather seasons, excursions above reference levels were most common near the mouth of Alamitos Bay at the B14 monitoring site. Overall, the frequency of dry weather exceedance of the enterococcus standards was lower in 2001 compared to dry weather monitoring conducted in 2000. Fewer single measurements exceeded the 30-day average Ocean Plan limit of 35 mpn/100 ml and none exceeded the AB411 Instantaneous Limits.

Microbiological data from the City's stormwater program demonstrate relatively low levels of total coliform, fecal coliform, and enterococcus during all dry weather periods including the preimplementation survey and each of the five post-implementation dry weather surveys. Tests conducted during wet weather periods resulted in levels of each bacterial component that were one to two orders of magnitude higher that during summer dry weather periods.

As noted in the previous year, monitoring data continue to show no apparent changes in the bacterial concentrations in Alamitos Bay during the summer that can be related to activation of the dry weather interceptor in Basin 24 in May 2000.

8.3 Temporal Trends of Selected Metals and Organic Compounds

Temporal trends were examined for selected trace metals and organic compounds that are often high in storm drain discharges or suspected to be primary sources of toxicity (Figures 8.7 through 8.18). Trace metals include cadmium, copper, nickel, lead, and zinc. Temporal trends of two organophosphate pesticides, chlorpyrifos and diazinon, were also examined. Figures 8.7 through 8.18 include both wet weather and dry weather monitoring data from each of the four sites. Dry weather sampling periods are delineated by the shaded areas. Due to the typically large differences between total lead and dissolved lead concentrations, especially during storm events, a separate graphic is included to examine temporal trends for dissolved lead.

During the 2000/2001 monitoring season, sampling was started well into the storm season. Sampling conducted this year produced the first results from a first flush event. The relatively small first flush event yielded the highest concentrations of total cadmium, copper, nickel, lead and zinc encountered in the first two years of stormwater monitoring. Despite the increases in total metals, concentrations of dissolved metals remained comparable to those reported during other storm events. During dry weather periods, most total metal concentrations tend to be both lower and more comparable to dissolved metal concentrations. Nickel is an exception. Based upon the current database, nickel concentrations during dry weather events have tended to be highly variable. During the summer 2001 dry weather surveys, both dissolved and total nickel concentrations were often as high or higher than concentrations measured during storm events. The occurrence of elevated levels of nickel in dry weather flows appears to have been limited to the summer of 2001, but it is premature to conclude that this was an isolated occurrence.

Temporal trends for diazinon and chlorpyrifos are obscured by higher detection limits utilized during the first year of the program. Diazinon occurs in both wet weather and dry weather flows at relatively high levels. Highest concentrations have been found in discharges from the Belmont Pump station but discharge volumes have typically been low at this site. Chlorpyrifos was not detected during the first year but it is likely that this was due to high reporting limits. Thus far, detectable quantities of chlorpyrifos have been limited to stormwater discharges. As noted earlier, both these pesticides are currently being phased out for common residential uses. This process is expected to result in significant reductions of the mass discharge of these two pesticides in association with both wet and dry season flows.

8.4 Stormwater Toxicity

A total of six wet weather samples were analyzed for toxicity during the monitoring period. Each sample produced similar results in that toxicity was observed in all of the test species. The sea urchin test was the most sensitive toxicity test method. The toxicity of the two wet weather samples analyzed during the monitoring period was substantially greater than that measured during the previous monitoring period (Figure 8.19). The two samples from each of the three locations contained greater toxicity to sea urchins than any Long Beach sample tested previously.

The samples of dry weather discharge collected in May 2002 were toxic, but the magnitude of toxicity was less than most of the stormwater samples analyzed during 2001 (Figure 8.19). These data are consistent with the results of dry weather samples analyzed during the 2000/2001 monitoring period and indicate that there are significant differences in the composition of stormwater and dry weather discharge from the City of Long Beach.

8.4.1 Receiving Water Toxicity

No significant toxicity was present in the two Alamitos Bay receiving water samples collected and tested during wet weather. These results are consistent with the results of wet weather and dry weather bay samples analyzed during the previous monitoring period. Salinity measurements indicated that the wet weather receiving water samples contained less than 5% freshwater. The lack of toxicity in the Alamitos Bay samples is consistent with the results of the wet weather discharge samples, which usually had LOEC values of greater than 5%.

The results of the receiving water sample analyses should not be used to describe water quality throughout Alamitos Bay. Test samples were collected from only one location in the bay and the results may therefore not be representative of other locations in Alamitos Bay, especially those areas located near major stormwater discharges.

8.4.2 Temporal Toxicity Patterns

The small number of storms sampled during the monitoring period (2), and the brief separation in time between them (<2 weeks) does not allow for the evaluation of temporal trends among the data. All samples from these two storms were more toxic than any sample collected during the 2000/2001 monitoring period, however. The samples collected in November 2001 represented the first significant storms of the season, whereas the samples from February-April 2001 were collected after approximately 30% of the season's rainfall had already occurred.

The toxicity data from the 2000/2001 and 2001/2002 monitoring periods suggest that seasonal flushing may be an important factor affecting the variability in stormwater toxicity. In previous studies, it was found that early season storm water runoff from Ballona Creek (Los Angeles County) was more toxic than samples obtained later in the season (Bay *et al.* 1999).

8.4.3 Comparative Sensitivity of Test Species

For five of six samples, the sea urchin fertilization test was the most sensitive toxicity test method. The water flea survival/reproduction test was the most sensitive method for the November 24 sample from Bouton Creek. The relative sensitivity of the mysid toxicity test could not be evaluated for this monitoring period because only the 100% stormwater concentration was tested, which prevented estimation of a precise value for the EC50 or NOEC. Mysid survival and growth in 100% stormwater generally indicated less toxicity than the sea urchin or water flea results for similar sample concentrations, indicating that the mysid test was the least sensitive of the three methods. This same pattern of sensitivity (sea urchin > water flea > mysid) was also observed during the 2000/2001 monitoring program and in a study of urban stormwater toxicity in San Diego (Southern California Coastal Water Research Project 1999).

8.4.4 Relative Toxicity of Stormwater

The frequency and magnitude of stormwater toxicity from the Long Beach stations is similar to stormwater samples from other southern California watersheds (Table 8.5). Results from the Chollas Creek and Ballona Creek studies are probably most similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds, relative to the samples from the L.A. River and San Gabriel River. As with the Long Beach samples, toxicity in other watersheds is variable among storms, and stormwater toxicity is usually detected using the sea urchin fertilization test.

8.4.5 Toxicity Characterization

The TIE testing program for this monitoring period was quite successful. Phase I TIEs were attempted on 12 wet weather and 2 dry weather samples and they yielded useful information for 10 samples. The remaining TIEs were not useful due to the loss of toxicity with time in the laboratory.

The results of the 2001/2002 TIE analyses were consistent within each species and similar to the data obtained from the previous year (Table 8.6). All of the TIEs conducted using the water flea indicated that organophosphate pesticides was the most likely category of toxic constituents. This conclusion is supported by the effectiveness of the C-18 and PBO treatments for reducing toxicity to the water flea. Other monitoring programs in California have obtained similar Phase I TIE results and subsequent studies have verified that OP pesticides are frequently the cause of urban stormwater toxicity to this species.

The sea urchin TIE results consistently identified EDTA as the most effective treatment for removing toxicity. EDTA is effective at chelating divalent metals, such as copper, cadmium and zinc, thus rendering them biologically unavailable. Studies in other watersheds have also found EDTA to be successful at removing toxicity from runoff (Jirik *et al.* 1998, Schiff *et al.* 2001). In these studies, copper and zinc were found to be the specific metals most likely causing toxicity. Solid phase extraction using C-18 was partially effective at removing toxicity to sea urchins from most of the Long Beach samples tested. This treatment is intended to remove non-polar organic contaminants from the sample. However, C-18 treatment has also been shown to remove significant amounts of toxicity associated with copper and zinc from the sample (Schiff *et al.* 2001). Since both solid phase extraction and EDTA were highly effective in these samples, it is likely that divalent metals, rather than organics, caused the observed toxicity. The other possibility is that both metals and non-polar organics are present and acting in a synergistic manner so that the removal of one effectively eliminates most of the toxicity in the sample. Additional tests are necessary to confirm the unlikely presence of such a synergistic effect.

The removal of particles by centrifugation was effective in partially reducing toxicity in only one sample. Previous studies have also found particle removal to be an ineffective method for the removal of toxicity from stormwater (Bay *et al.* 1999). However, particles may contribute to the chemical-associated toxicity of stormwater from the desorption of bound contaminants into the water. A previous study found that urban stormwater particles released toxic quantities of unidentified materials into clean seawater in less than 24 hours (Noblet *et al.* 2001).

Correlation analysis of the toxicity and chemistry data provides an additional test of the association between stormwater toxicity and chemical contamination. Insufficient data were available to conduct correlation analyses using just the data from the 2001/2002 monitoring period. Instead, the data from both years of monitoring were pooled for the correlation analyses, except for tests using diazinon and chlorpyrifos, which were not detected in the first year of monitoring. The correlation analyses confirm the results from the first year of study: that the toxic responses measured in this study are related to the chemical composition of the stormwater samples. The toxic responses of sea urchins or water fleas were significantly correlated with increased concentrations of several stormwater constituents, including dissolved metals, TSS and TOC (Table 8.7). Dissolved zinc was the only constituent that was significantly correlated with toxicity to both species, this metal also showed the strongest correlation with reduced sea urchin fertilization. Increased copper was the only other constituent that was significantly correlated with sea urchin fertilization; these results differed from those obtained using only the first year's monitoring data, which obtained significant correlations with dissolved cadmium and chromium.

A larger number of constituents were significantly correlated with toxicity to the water flea, including TSS, TOC, and dissolved metals including Cd, Cr, Pb, Ni, and Zn (Table 8.7). Increased concentrations of the OP pesticides chlorpyrifos and diazinon had moderate correlations with water flea toxicity ($r=0.54$), but the association was not statistically significant due to the small number of data points available.

The presence of significant correlations between toxicity and selected chemicals supports the TIE results and provides information to help identify key constituents of concern, but the statistical results do not prove that those constituents are the cause of toxicity. The true cause of toxicity may be another (possibly unmeasured) constituent that has a similar pattern of occurrence in the samples. A third method, comparing the measured and predicted toxic units of the samples was used to assess the importance of zinc, copper, and pesticides as a cause of the toxicity of Long Beach stormwater. The predicted toxicity of the sample was calculated from the measured concentrations of the chemical constituents and the corresponding EC50 or LC50. This toxic unit comparison showed that five of six stormwater samples contained sufficient dissolved zinc and copper to account for nearly all of the toxicity measured (Figure 8.20). These results were similar to those obtained for the first year's monitoring data.

Comparison of the measured and predicted toxic units for the water flea tests (Figure 8.21) showed a different pattern from that obtained for the sea urchin tests. The toxicity of two of the five samples containing substantial toxicity could be accounted for by the measured concentrations of diazinon and chlorpyrifos. Zinc was estimated to contribute ≤1 toxic unit and copper contributed even less toxicity to the samples (data not shown). The measured concentrations of op pesticides, zinc and copper accounted for less than 50% of the toxicity of both November 2001 Belmont Pump samples and one Los Cerritos Channel sample, suggesting that additional unmeasured toxicants are present. Alternatively, the undetected poor recovery of chemical analytes or losses during storage may have reduced the measured concentrations of some constituents and resulted in low predicted toxicity values.

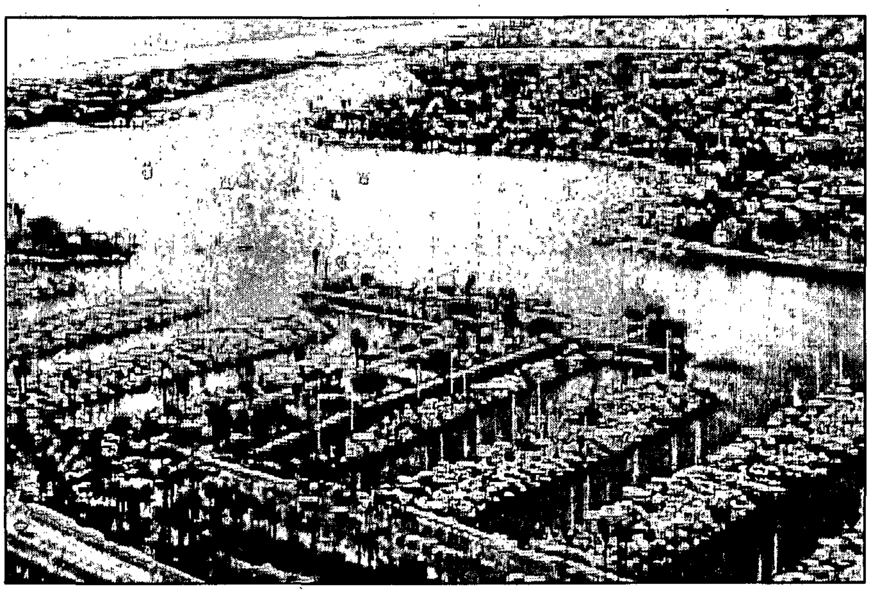


Table 8.1. Summary of Beneficial Uses for Receiving Water Bodies Associated with each Monitoring Location[1]

DISCHARGE LOCATION	HYDRO. UNIT	COMM	EST	GWR	IND	MAR	MUN	NAV	RARE	REC1	REC2	SHELL	WARM	WET	WILD
Bouton Creek	**405.15**						**P**			**P**	**I**		**I**		**E**
Los Cerritos Channel	**405.15**						**P**			**P**	**I**		**I**		**E**
Dominguez Gap Pump Sta.	**405. 15**			**E**	**P**		**P**			**E**	**E**		**E**		**P**
Belmont Pump Sta.	**405.12**	**E**	**E**		**E**	**E**		**E**	**E**	**E**	**E**	**E**		**E**	**E**
Alamitos Bay	**405.12**	**E**	**E**		**E**	**E**		**E**	**E**	**E**	**E**	**E**		**E**	**E**

1. Source: California Regional Water Quality Control Board, Los Angeles Region. 1994. Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. P=Potential, E=Existing, and I=Intermittent

Commercial and Sport Fishing (COMM): Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Estuarine Habitat (EST): Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Ground Water Recharge (GWR): Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Industrial Service Supply (IND): Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Marine Habitat (MAR): Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation, such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Municipal and Domestic Supply (MUN): Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.

Navigation (NAV): Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Rare, Threatened, or Endangered Species (RARE): Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Water Contact Recreation (REC-1): Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2): Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sun bathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Shellfish Harvesting (SHELL): Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Warm Freshwater Habitat (WARM): Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Wetland Habitat (WET): Uses if water that support wetland ecosystems including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Wildlife Habitat (WILD): Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., Mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Table 8.2. Summary of Applicable Water Quality Benchmarks and Receiving Water Quality Criteria (Page 1 of 5)

Analytes	Units	Benchmarks		Water Quality Criteria										Lab. ML
				California Toxics Rule		California Ocean Plan (2)		USEPA Ambient Criteria		USEPA IRIS Reference Dose as a Drinking Water Level (4)	California Drinking Water Standard (5)	USEPA Drinking Water Standard (6)	Basin Plan (7)	
		Enclosed Bay & Estuary Discharge (Saltwater)	Inland Surface Water Discharge (Freshwater)	Saltwater (1A)	Freshwater (1B)	Saltwater Aquatic Life Protection	Consumption of Aquatic Organisms Only	Saltwater Aquatic Life Protection (3A)	Freshwater Aquatic Life Protection (3A)					
BOD5	mg/L	30(4)	30(4)											2
COD	mg/L	120(9)	120(9)											20-900
Total Organic Carbon	mg/L													1
Specific Conductance	umho/cm		900											1
Total Hardness	mg/L													2
Alkalinity	mg/L													2
PH	units	6.0-9.0	6.0-9.0				6.0-9.0	6.0-8.5	6.0-9.0					0-14
Cyanide	mg/L	0.001(1H)	0.022(1H)	0.001(1H)	0.022(1H)	0.004(DM)		1	22	0.14	0.2	0.2	0.2	0.005
Chloride	mg/L		150						860(1)				150	2
Fluoride	mg/L		0.42							4.2	2	4	1.4	0.1
Total Kjeldahl Nitrogen	mg/L													0.1
Total Ammonia – Nitrogen	mg/L	6(IM)	12.1			6(IM)		0.233(1H)	12.1					0.1
Nitrite	mg/L	0.7	0.7							0.7	1	1	1	0.1
Nitrate	mg/L		10							11	10	10	10	0.1
Total Phosphorus	mg/L		0.5							0.00014	0.5	0.5		0.05
Dissolved Phosphorus	mg/L		-							0.00014				0.05
MBAS	mg/L	0.5	0.5								0.5			0.5
MTBE	mg/L	0.013	0.013								0.013			0.001
Total Phenols	µg/L	4,600,000	4,600,000	4,600,000	4,600,000	120(DM)			2560	4200				0.1
Oil & Grease	mg/L	15 (12)	15(12)				75(IM)							5
TPH	mg/L	0.02	0.02											5
Total Suspended Solids	mg/L	60(IM)	100(13)			60(IM)								2
Total Dissolved Solids	mg/L													2
Volatile Suspended Solids	mg/L													2
Turbidity	NTU	225				225								0.1
Fecal Coliform	mpn/100ml	200(30D)	200(30D)				200(30D)						200(30D)	<20
Total Coliform	mpn/100ml	1000,70(30D)	1000(30D)				1000(30D)						70(30D)	<20
Enterococcus	mpn/100ml	35(30D)	104(IM)(14)				35(30D)							<20
Aluminum	µg/L	750(1H)	750(1H)						750(1H)		1000		1000	100
Antimony	µg/L	1200	2.8	4300	4300		1200		1600	2.8	6	6	6	0.5
Arsenic	µg/L	69(1H)	340(1H), 2.1	69(1H)	340(1H)	32(DM)				2.1	50	50	50	1
Beryllium*	µg/L	0.033					0.033		5.3	14	4	4	4	0.5
Cadmium	µg/L	44(1H)	4.6(1H)	44(1H)	4.6(1H)	4(DM)	10(IM)			3.5	5	5	5	0.25
Chromium (total)	µg/L	20(IM)	50			20(IM)					50	100	50	0.5
Copper	µg/L	4.8(1H)	13(1H)	4.8(1H)	13(1H)	12(DM)					1300	1300		0.5
Hex. Chromium	µg/L	1111(1H)	16.3(1H)	1111(1H)	16.3(1H)	8(DM)				21				5

Table 8.2 Summary of Applicable Water Quality Benchmarks and Receiving Water Quality Criteria (Page 2 of 5). (continued)

Analytes	Units	Benchmarks		Water Quality Criteria										Lab. ML
				California Toxics Rule		California Ocean Plan (2)		USEPA Ambient Criteria		USEPA IRIS Reference Dose as a Drinking Water Level (4)	California Drinking Water Standard (5)	USEPA Drinking Water Standard (6)	Basin Plan (7)	
		Enclosed Bay & Estuary Discharge (Saltwater)	Inland Surface Water Discharge (Freshwater)	Saltwater (1A)	Freshwater (1B)	Saltwater Aquatic Life Protection	Consumption of Aquatic Organisms Only	Saltwater Aquatic Life Protection (3A)	Freshwater Aquatic Life Protection (3A)					
Iron	µg/L													100
Lead	µg/L	210(1H)	65(1H)	210(1H)	65(1H)	8(DM)					15	15		0.5
Mercury	µg/L	2.1(1H)	1.6(1H)	2.1(1H)	1.6(1H)	0.16(DM)					2	2	2	0.5
Nickel	µg/L	74(1H)	470(1H)	74(1H)	470(1H)	20(DM)				100	100		100	1
Selenium	µg/L	290(1H)	20(1H)	290(1H)	20(1H)	60(DM)				35	50	50	50	1
Silver	µg/L	1.9(1H)	3.4(1H)	1.9(1H)	3.4(1H)	2.8(DM)				35				0.25
Thallium	µg/L	6.3	6.3	6.3	6.3		2		40	0.6	2	2	2	1
Zinc	µg/L	90(1H)	120(1H)	90(1H)	120(1H)	80(DM)				2100				1
2-Chlorophenol	µg/L	400	400	400	400		10(IM)			35				2
2,4-Dichlorophenol	µg/L	790	790	790	790		10(IM)		365	21				1
2,4-Dimethylphenol	µg/L	2300	2300	2300	2300		300(IM)							2
2,4-Dinitrophenol	µg/L	14,000	14,000	14,000	14,000		4							5
2-Nitrophenol	µg/L	4850	230				300(IM)	4850	230					10
4-Nitrophenol	µg/L	4850	230				300(IM)	4850	230					5
4-Chloro-3-methylphenol	µg/L	10(IM)	30				10(IM)		30					1
Pentachlorophenol	µg/L	13(1H)	19(1H)	13(1H)	19(1H)					6				2
Phenol	µg/L	4,600,000	4,600,000	4,600,000	4,600,000	120(DM)			2560	4200				1
2,4,6-Trichlorophenol	µg/L	6,5	6.5	6.5	6.5		10(IM)							10
Acenaphthene	µg/L	2700	2700	2700	2700			970		420				1
Acenaphthylene*	µg/L	300	300				0.0088	300						2
Anthracene*	µg/L	110,000	110,000	110,000	110,000		0.0088			2100				2
Benzidine*	µg/L	0.00054	0.00054	0.00054	0.00054		0.000069							5
1,2 Benzanthracene*	µg/L	0.049	0.049	0.049	0.049		0.0088					0.1		5
Benzo(a)pyrene*	µg/L	0.049	0.049	0.049	0.049		0.0088				0.2	0.2	0.2	2
Benzo(g,h,i)perylene*	µg/L	0.0088	0.0088				0.0088							5
3,4 Benzofluoranthene*	µg/L						0.0088							10
Benzo(k)fluoranthene*	µg/L	0.049	0.049	0.049	0.049		0.0088							2
Bis(2-Chloroethoxyl)methane	µg/L	4.4					4.4							5
Bis(2-Chloroisopropyl)ether	µg/L	170,000	170,000	170,000	170,000		1200		122	280				2
Bis(2-Chloroethyl) ether*	µg/L	1.4	1.4	1.4	1.4		0.045		122					1
Bis(2-Ethylhexl) phthalate*	µg/L	5.9	5.9	5.9	5.9		3.5							5
4-Bromophenyl phenyl ether	µg/L	360	360						360					5
Butyl benzyl phthalate	µg/L	5200	5200	5200	5200			2,944	940	140				10
2-Chloroethyl vinyl ether	µg/L													1
2-Chloronaphthalene	µg/L	4300	4300					7.5		560				10
4-Chlorophenyl phenyl ether	µg/L													5
Chrysene*	µg/L	0.049	0.049	0.049	0.049		0.0088							5

Table 8.2 Summary of Applicable Water Quality Benchmarks and Receiving Water Quality Criteria (Page 3 of 5). (continued)

Analytes	Units	Benchmarks		Water Quality Criteria										Lab. ML
				California Toxics Rule		California Ocean Plan (2)		USEPA Ambient Criteria		USEPA IRIS Reference Dose as a Drinking Water Level (4)	California Drinking Water Standard (5)	USEPA Drinking Water Standard (6)	Basin Plan (7)	
		Enclosed Bay & Estuary Discharge (Saltwater)	Inland Surface Water Discharge (Freshwater)	Saltwater (1A)	Freshwater (1B)	Saltwater Aquatic Life Protection	Consumption of Aquatic Organisms Only	Saltwater Aquatic Life Protection (3A)	Freshwater Aquatic Life Protection (3A)					
Dibenzo(a,h)-anthracene	µg/L	0.049	0.049	0.049	0.049		0.0088							0.1
1,3-Dichlorobenzene	µg/L	2600	2600	2600	2600		5100	129	763					1
1,4-Dichlorobenzene*	µg/L	2600	2600	2600	2600		18	129	763		5	75	5	1
1,2-Dichlorobenzene	µg/L	17,000	17,000	17,000	17,000		5100	129	763	630	600	600	600	1
3,3-Dichlorobenzidine*	µg/L	0.077	0.077	0.077	0.077		0.0081							5
Diethylphthalate	µg/L	120,000	120,000	120,000	120,000		33,000	2944	940	5600				2
Dimethylphthalate	µg/L	2,900,000	2,900,000	2,900,000	2,900,000		820,000	2944	940					2
di-n-Butyl phthalate	µg/L	12,000	12,000	12,000	12,000		3500	2944	940	700				10
2,4-Dinitrotoluene*	µg/L	9.1	9.1	9.1	9.1		2.6		230	14				5
2,6-Dinitrotoluene	µg/L													5
4,6-Dinitro-2-methylphenol	µg/L	765	765	765	765		220							5
1,2-Diphenylhydrazine*	µg/L	0.54	0.54	0.54	0.54		0.16							1
di-n-Octyl phthalate	µg/L	2944	940					2944	940					10
Fluoranthene	µg/L	370	370	370	370		15	16		280				0.05
Fluorene	µg/L	14,000	14,000	14,000	14,000		0.0088			280				0.1
Hexachlorobenzene*	µg/L	0.00077	0.00077	0.00077	0.00077		0.00021				1	1	1	1
Hexachlorobutadiene*	µg/L	50	50	50	50		14	32	9.3					1
Hexachloro-cyclopentadiene	µg/L	17,000	17,000	17,000	17,000		58	7	5.2	42	50	50	50	5
Hexachloroethane*	µg/L	8.9	8.9	8.9	8.9		2.5		540	0.7				1
Indeno(1,2,3-cd)pyrene*	µg/L	0.049	0.049	0.049	0.049		0.0088							0.05
Isophorone*	µg/L	600	600	600	600		730			170				1
Naphthalene	µg/L	2350	2300					2350	2300	14				0.2
Nitrobenzene	µg/L	1900	1900	1900	1900		4.9			3.5				1
N-Nitroso-dimethyl amine*	µg/L	8.1	8.1	8.1	8.1		7.3							5
N-Nitroso-diphenyl amine*	µg/L	16	16	16	16		2.5							1
N-Nitroso-di-n-propylamine*	µg/L	1.4	1.4	1.4	1.4		0.38							5
Phenanthrene*	µg/L	0.0088	0.0088				0.0088							0.05
Pyrene*	µg/L	10	10	11,000	11,000		0.0088			210				0.05
1,2,4-Trichlorobenzene	µg/L	129	70					129		70	70	70		1
4,4'-DDD*	µg/L	0.00083	0.00083	0.00083	0.00083		0.00017							0.05
4,4'-DDE*	µg/L	0.00059	0.00059	0.00059	0.00059		0.00017							0.05
4,4'-DDT*	µg/L	0.13(IM)	1.1(IM)	0.13(IM)	1.1(IM)		0.00017	0.13(IM)	1.1(IM)	3.5				0.01
Aldrin*	µg/L	1.3(IM)	3(IM)	1.3(IM)	3(IM)		0.000022	1.3	3					0.005
alpha-BHC	µg/L	0.013	0.013	0.013	0.013	0.008(DM)								0.01
alpha-chlordane*	µg/L	0.09(IM)	2.4	0.09(IM)	2.4(IM)		0.000023	0.09	2.4	0.42	0.1	2		0.1
beta-BHC	µg/L	0.046	0.046	0.046	0.046	0.008(DM)								0.005
delta-BHC	µg/L	0.008(DM)	0.008(DM)			0.008(DM)								0.005
gamma-BHC (lindane)	µg/L	0.16(IM)	0.95(1H)	0.16(IM)	0.95(1H)	0.008(DM)		0.16(IM)	0.95(IM)	0.2				0.02
gamma-chlordane*	µg/L	0.09(IM)	2.4	0.09(IM)	2.4(IM)		0.000023	0.09	2.4	0.42	0.1	2		0.1

Table 8.2 Summary of Applicable Water Quality Benchmarks and Receiving Water Quality Criteria (Page 4 of 5). (continued)

Analytes	Units	Benchmarks		Water Quality Criteria										Lab. ML
				California Toxics Rule		California Ocean Plan (2)		USEPA Ambient Criteria		USEPA IRIS Reference Dose as a Drinking Water Level (4)	California Drinking Water Standard (5)	USEPA Drinking Water Standard (6)	Basin Plan (7)	
		Enclosed Bay & Estuary Discharge (Saltwater)	Inland Surface Water Discharge (Freshwater)	Saltwater (1A)	Freshwater (1B)	Saltwater Aquatic Life Protection	Consumption of Aquatic Organisms Only	Saltwater Aquatic Life Protection (3A)	Freshwater Aquatic Life Protection (3A)					
Dieldrin*	µg/L	0.71(IM)	0.24(1H)	0.71(IM)	0.24(1H)		0.00004	0.71(IM)	0.024(1H)					0.01
alpha-Endosulfan	µg/L	0.034(IM)	0.22(IM)	0.034(IM)	0.22(IM)	0.018(DM)		0.034(IM)	0.22(IM)	42				0.02
beta-Endosulfan	µg/L	0.034(IM)	0.22(IM)	0.034(IM)	0.22(IM)	0.018(DM)		0.034(IM)	0.22(IM)	42				0.01
Endosulfan sulfate	µg/L	240	240	240	240	0.018(DM)								0.05
Endrin	µg/L	0.037(IM)	0.086(1H)	0.037(IM)	0.086(1H)	0.004(DM)		0.037(IM)	0.086(1H)	2	2	2	2	0.01
Endrin aldehyde	µg/L	0.0018	0.0018											0.01
Heptachlor*	µg/L	0.053(IM)	0.52(IM)	0.053(IM)	0.52(IM)		0.00005	0.053(IM)	0.52(IM)		0.01	0.4	0.01	0.01
Heptachlor Epoxide*	µg/L	0.053(IM)	0.52(IM)	0.053(IM)	0.52(IM)		0.00002	0.053(IM)	0.52(IM)		0.01	0.2	0.01	0.01
Toxaphene*	µg/L	0.21(1H)	0.73(1H)	0.21(1H)	0.73(1H)		0.00021	0.21(1H)	0.73(1H)		3	3	3	0.5
Aroclor-1016*	µg/L	0.127	0.127				0.000019							0.5
Aroclor-1221*	µg/L	100	100				0.000019							0.5
Aroclor-1232*	µg/L	0.318	0.318				0.000019							0.5
Aroclor-1242*	µg/L	0.20	0.20				0.000019							0.5
Aroclor-1248*	µg/L	2.54	2.54				0.000019							0.5
Aroclor-1254*	µg/L	100	100				0.000019							0.5
Aroclor-1260*	µg/L	0.477	0.477				0.000019							0.5
Chlorpyrifos	µg/L	0.02(10)	0.02(10)					0.0056	0.041	21				0.05
Diazinon	µg/L		0.08(10)											0.01
Prometryn	µg/L													2
Atrazine	µg/L		3.0							25	3	3	3	2
Simazine	µg/L		3.5							3.5	4	4	4	2
Cyanazine	µg/L													2
Malathion	µg/L		0.1					0.1	0.1	140				1
Glyphosate	µg/L		700							700	700	700	700	5
2,4-D	µg/L		70							70	70	70	70	0.02
2,4,5-TP (Silvex)	µg/L		50							53	50	50	50	0.2

Footnotes

Table is based upon the California Regional Water Quality Control Board, Central Region's "Compilation of Water Quality Goals" (Marshack 2000) and draft analytical benchmarks being developed by San Diego's Project Clean Water, Science and Technology, Technical Advisory Committee.

(1) USEPA Recommended Ambient Water Quality Criteria – Acute (Instantaneous Maximum or 1 – Hour Average Maximum) Concentration, Freshwater Aquatic Life Protection.

(1A,1B) Numeric Criteria for Priority Toxic Pollutants for the State of California; California Toxics Rule, USEPA, 60 Federal Register (FR) 31681-31719, May 18, 2000. Values are "30-day Average Concentration for Human Health Protection (consumption of aquatic organisms only for both Saltwater & Freshwater)," unless indicated for (IM) for (Instantaneous Maximum or (1-H) for 1-Hour Average Maximum Concentration for Saltwater or Freshwater Aquatic Life Protection). The Policy for Implementation of Toxic Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California (Phase 1 of the Inland Surface Water Plan and the Enclosed Bays and Estuaries Plan) was adopted by the State Water Resources Control Board on March 2, 2000 and effective on May 18,2000.

(2) Water Quality Control Plan for Ocean Waters of California (California Ocean Plan), California State Water Resources Control Board, adopted on November 16, 2000 and became effective on December 3, 2001. Values are 30-day Average Concentration for Human Health Protection (consumption of aquatic organisms only), unless indicated (IM) for (Instantaneous Maximum Concentration or (DM) for Daily Maximum Concentration).

(3) Secondary Treatment Regulations – 40 CFR 133.

(3A,3B) USEPA National Recommended Ambient Water Quality Criteria – Saltwater or Freshwater Aquatic Life Protection, Ambient Water Quality Criteria, various dates. Values are "Lowest Observed Effect Level (LOEL) concentrations for Chronic (24-Hour or 4 day Average) Concentration, Saltwater and Freshwater Aquatic Life Protection.

(4) USEPA Integrated Risk Information System (IRIS) Reference Dose (RfD) as a Drinking Water Level.

(5) Drinking Water Standards, Maximum Contaminant Levels – California (California Department of Health Services), California Code Regulations (CCR), Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring.

(6) Drinking Water Standards, Maximum Contaminant Levels – Federal (USEPA), 40 Code of Federal Regulations (CFR) Parts 141 and 143.

(7) Los Angeles Regional Water Quality Control Board Basin Plan Water Quality Objectives.

(8) USEPA Recommended Ambient Water Quality Criteria – Human Health Protection (consumption of water and organisms).

(9) Factor of 4 times Biochemical Oxygen Demand (BOD – 5day) concentration – North Carolina benchmark.

(10) Freshwater Final Acute Values (FAV) California Department of Fish and Game, Water Quality Criteria for Diazinon and Chlorpyrifos (April 26, 2002).

(11) USEPA Recommended Ambient Water Quality Criteria – Lowest Observed Effect Level (LOEL) Concentration for Acute Toxicity, Freshwater Aquatic Life Protection.

(12) Median concentration of Stormwater Effluent Limitation Guideline – 40 CFR Part 419.

(13) National Urban Runoff Program (NURP) median concentration.

(14) AB411 Instantaneous Max

* Carcinogen

Table 8.3. Stormwater Monitoring Chemistry Statistics for Each Watershed. (Page 1 of 5)

ANALYTE	Belmont Pump					Bouton Creek					Los Cerritos Channel				
	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV
CONVENTIONALS															
BOD5 (mg/L)	7	71	21	21	0.13	6	100	20	16	0.48	8	100	24	19	0.54
COD (mg/L)	7	100	96	81	0.44	6	100	105	88	0.45	8	100	136	100	0.60
Total Organic Carbon (mg/L)	7	100	49	17	1.35	6	100	37	20	0.93	8	100	29	21	0.63
Conductance (umhos/cm)	7	100	405	299	0.60	6	100	534	306	0.86	8	100	122	105	0.38
Total Hardness (mg/L)	7	100	126	97	0.55	6	100	125	74	0.84	8	100	70	49	0.66
Alkalinity, as CaCO3 (mg/L)	7	100	59	45	0.57	6	100	26	24	0.25	8	100	40	26	0.74
PH (units)	7	100	7.3	7.3	0.05	6	100	7.0	7.0	0.08	8	100	7.2	7.2	0.03
Cyanide (ug/L)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Chloride (mg/L)	7	100	73	48	0.73	6	100	143	66	1.08	8	100	17	9.3	0.94
Fluoride (mg/L)	7	100	0.57	0.30	0.94	6	83	0.68	0.34	1.01	8	75	0.34	0.28	0.49
Total Kjeldahl Nitrogen (mg/L)	7	100	6.2	3.1	1.01	6	100	5.0	2.7	0.93	8	100	7.1	4.0	0.86
Total Ammonia-Nitrogen (mg/L)	7	100	0.92	0.70	0.56	6	100	0.97	0.71	0.60	8	100	0.90	0.78	0.40
Nitrite Nitrogen (mg/L)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Nitrate Nitrogen (mg/L)	7	100	2.7	1.0	1.29	6	100	1.8	0.90	1.01	8	100	1.4	0.95	0.68
Total Phosphorus (mg/L)	7	100	1.4	0.77	0.91	6	100	0.89	0.47	0.95	8	100	1.9	0.99	0.95
Dissolved Phosphorus (mg/L)	7	100	0.40	0.30	0.57	6	100	0.29	0.13	1.09	8	100	0.27	0.19	0.63
MBAS (mg/L)	7	100	0.18	0.13	0.60	6	100	0.23	0.19	0.51	8	100	0.17	0.11	0.73
MTBE (ug/L)	6	0	ID	ID	ID	6	33	1.3	1.3	0.11	8	13	ID	ID	ID
Total Phenols (mg/L)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Oil & Grease (mg/L)	6	33	37	14	1.24	6	0	ID	ID	ID	9	33	22	12	0.89
TRPH (mg/L)	6	17	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Total Suspended Solids (mg/L)	7	100	602	135	1.86	6	100	476	105	1.88	8	100	516	303	0.84
Total Dissolved Solids (mg/L)	7	100	251	191	0.56	6	100	344	199	0.85	8	100	106	90	0.41
Turbidity (NTU)	7	100	167	73	1.14	6	100	88	69	0.53	8	100	183	137	0.58
BACTERIA (mpn/100ml)															
Fecal Coliform	5	80	658,331	24,868	5.05	6	83	32,324	11,518	1.34	9	100	67,000	28,217	1.17
Total Coliform	5	40	259,109	53,478	1.96	6	67	64,167	34,736	0.92	9	56	189,575	120,346	0.76

Table 8.3. Stormwater Monitoring Chemistry Statistics for Each Watershed. (Page 2 of 5)

ANALYTE	Belmont Pump					Bouton Creek					Los Cerritos Channel				
	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV
TOTAL METALS (ug/L)															
Aluminum	7	100	3215	1187	1.31	6	100	1697	934	0.90	8	100	2768	1850	0.70
Arsenic	7	100	3.2	2.5	0.53	6	100	2.6	2.08	0.52	8	88	4.9	4.1	0.45
Beryllium	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Cadmium	7	71	2.1	1.5	0.62	6	67	1.3	1.0	0.49	8	100	2.6	1.9	0.63
Chromium	7	100	8.9	4.6	0.96	6	100	5.3	3.6	0.67	8	100	10	6.0	0.82
Hexavalent Chromium (mg/L)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Copper	7	100	93	57	0.79	6	100	45	28	0.77	8	100	44	38	0.39
Iron	7	100	4251	1213	1.58	6	100	1732	1217	0.65	8	100	5473	2876	0.95
Mercury	7	0	ID	ID	ID	6	33	0.39	0.34	0.36	8	13	ID	ID	ID
Nickel	7	100	21	9.6	1.08	6	100	9.3	6.3	0.69	8	100	13	11	0.45
Lead	7	100	129	49	1.27	6	100	64	26	1.19	8	100	105	57	0.91
Zinc	7	100	731	369	0.99	6	100	592	248	1.18	8	100	842	544	0.74
DISSOLVED METALS (ug/L)															
Aluminum	7	71	109	61	0.89	6	67	103	77	0.59	8	88	182	136	0.58
Arsenic	7	100	1.4	1.3	0.33	6	100	1.1	1.1	0.17	8	88	1.4	1.3	0.21
Beryllium	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Cadmium	7	43	0.29	0.29	0.04	6	ID	ID	ID	ID	8	25	0.54	0.34	0.77
Chromium	7	71	1.3	1.2	0.29	6	33	1.9	1.1	0.82	8	88	1.3	1.2	0.34
Copper	7	100	14	11	0.58	6	100	10	9.3	0.30	8	100	10	8.5	0.42
Iron	7	71	273	105	1.26	6	83	307	145	1.06	8	88	306	169	0.90
Mercury	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Nickel	7	100	6.4	4.0	0.77	6	100	3.9	2.8	0.63	8	100	4.2	3.4	0.50
Lead	7	86	2.1	1.9	0.30	6	100	2.6	2.2	0.46	8	75	1.8	1.6	0.40
Zinc	7	100	98	65	0.71	6	100	84	63	0.57	8	100	78	67	0.41
CHLORINATED PESTICIDES (ug/L)															
4,4'-DDD	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4,4'-DDE	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4,4'-DDT	7	14	ID	ID	ID	6	ID	ID	ID	ID	8	0	ID	ID	ID
Aldrin	7	14	ID	ID	ID	6	ID	ID	ID	ID	8	25	0.08	0.07	0.08
Alpha-BHC	7	14	ID	ID	ID	6	ID	ID	ID	ID	8	13	ID	ID	ID
Alpha-Chlordane	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
beta-BHC	7	0	ID	ID	ID	6	0	ID	ID	ID	8	13	ID	ID	ID
Delta-BHC	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Dieldrin	7	0	ID	ID	ID	6	0	ID	ID	ID	8	13	ID	ID	ID

Table 8.3. Stormwater Monitoring Chemistry Statistics for Each Watershed. (Page 3 of 5)

ANALYTE	Belmont Pump					Bouton Creek					Los Cerritos Channel				
	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV
CHLORINATED PESTICIDES (ug/L) (continued)															
Endosulfan Sulfate	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Endrin	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Endrin Aldehyde	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
gamma-BHC (lindane)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
gamma-Chlordane	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Heptachlor	7	0	ID	ID	ID	6	0	ID	ID	ID	8	25	0.01	0.01	0.06
Heptachlor Epoxide	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Total PCBs	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Toxaphene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
AROCLORS (ug/L)															
Arochlor 1016	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1221	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1232	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1242	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1248	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1254	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Arochlor 1260	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
ORGANOPHOSPHATE PESTICIDES (ug/L)															
Atrazine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Dursban (chlorpyrifos)	7	29	0.12	0.10	0.46	6	ID	ID	ID	ID	8	25	0.30	0.29	0.07
Cyanazine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Diazinon	7	43	2.8	1.9	0.70	6	33	0.43	0.42	0.02	8	38	0.35	0.31	0.36
Malathion	7	43	1.3	1.3	0.12	6	0	ID	ID	ID	8	13	ID	ID	ID
Prometryn	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Simazine	7	0	ID	ID	ID	6	ID	ID	ID	ID	8	13	ID	ID	ID
HERBICIDES (ug/L)															
2,4,5-TP (Silvex)	7	0	ID	ID	ID	6	0	ID	ID	ID	8	13	ID	ID	ID
2,4-D	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Glyphosate	7	29	13	11	0.44	6	ID	ID	ID	ID	8	38	106	24	1.86

Table 8.3. Stormwater Monitoring Chemistry Statistics for Each Watershed. (Page 4 of 5)

ANALYTE	Belmont Pump					Bouton Creek					Los Cerritos Channel				
	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV
SEMIVOLATILE ORGANICS (ug/L)															
1,2,4-Trichlorobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
1,2-Dichlorobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
1,2-Diphenylhydrazine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
1,3-Dichlorobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
1,4-Dichlorobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2,4,6-Trichlorophenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2,4-Dichlorophenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2,4-Dimethylphenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2,4-Dinitrophenol	7	0	ID	ID	ID	6	ID	ID	ID	ID	8	25	6.5	6.3	0.18
2,4-Dinitrotoluene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2,6-Dinitrotoluene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2-Chloronaphthalene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2-Chlorophenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
2-Nitrophenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
3,3'-Dichlorobenzidine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4-Bromophenyl Phenyl Ether	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4-Chloro-3-Methylphenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4-Chlorophenyl Phenyl Ether	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
4-Nitrophenol	7	29	1.7	1.6	0.13	6	33	7.7	3.5	1.08	8	25	6.1	6.1	0.05
Acenaphthene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Anthracene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Benzidine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Benzo(a)Anthracene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Benzo(a)Pyrene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Benzo(b)Fluoranthene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Benzo(k)Fluoranthene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Bis(2-chloroethoxy)Methane	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Bis(2-chloroethyl)Ether	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Bis(2-Ethylhexyl)Phthalate	7	71	13	12	0.29	6	83	32	11	1.40	8	75	23	17	0.57
Chrysene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Dibenzo(a,h)Anthracene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Diethyl Phthalate	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Dimethyl Phthalate	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Di-n-Butyl Phthalate	7	29	2.13	1.96	0.29	6	ID	ID	ID	ID	8	13	ID	ID	ID
Di-n-Octyl Phthalate	7	14	ID	ID	ID	6	33	6.0	2.2	1.30	8	25	4.4	4.4	0.02
Fluoranthene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID

Table 8.3. Stormwater Monitoring Chemistry Statistics for Each Watershed. (Page 5 of 5)

ANALYTE	Belmont Pump					Bouton Creek					Los Cerritos Channel				
	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV	No. of Samples	Percent Detect	Mean	Median	CV
SEMIVOLATILE ORGANICS (ug/L) (continued)															
Fluorene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Hexachlorobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Hexachlorobutadiene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Hexachlorocyclopentadiene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Hexachloroethane	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Indeno(1,2,3-c,d)Pyrene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Isophorone	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Naphthalene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Nitrobenzene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
N-Nitrosodi-n-Propylamine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
N-Nitrosodiphenylamine	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Pentachlorophenol	7	29	15	3.5	1.82	6	0	ID	ID	ID	8	0	ID	ID	ID
Phenanthrene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Pyrene	7	0	ID	ID	ID	6	0	ID	ID	ID	8	0	ID	ID	ID
Phenol	7	0	ID	ID	ID	6	0	ID	ID	ID	8	13	ID	ID	ID

Table 8.4 Number of Measurements of Microbiological Indicator Organisms and Percent of Samples Exceeding Ocean Plan and AB411 Reference Values during Extended Dry Weather Periods from 1997 through 2001.

	May 1-Sep 15, 1997			May 16-Nov 1, 1998			Jun 15-Nov 5,1999			Apr 20-Oct 10, 2000			Apr 24-Nov 12, 2001		
	n[1]	OP (%)[2]	AB411 (%)[3]	n	OP (%)	AB411 (%)	n	OP (%)	AB411 (%)	n	OP (%)	AB411 (%)	n	OP (%)	AB411 (%)
Total Coliform															
B27	4	0	0	6	0	0	5	0	0	6	0	0	5	0	0
B28	5	0	0	6	0	0	5	0	0	6	0	0	7	0	0
B67							22	9	0	24	8	0	29	3	0
B29							22	0	0	25	8	4	30	3	3
B14	9	0	0	11	0	0	21	0	0	22	5	0	30	10	0
Fecal Coliform or E. coli[4]															
B27							5	0	0	6	0	0	5	0	0
B28							5	0	0	6	0	0	7	0	0
B67							22	5	0	26	12	4	29	0	0
B29							22	0	0	25	12	4	30	3	0
B14							21	0	0	25	4	0	30	0	0
Enterococcus															
B27	4	0													
B28	3	0													
B67							24	21	17	27	7	7	29	7	0
B29							20	0	0	26	12	0	30	10	0
B14							22	5	5	25	44	24	30	13	0

1. n=number of measurements during time period
2. OP= Ocean Plan 30-day average
   Total Coliforms: 1000 per 100 ml
   Fecal Coliforms: 200 per 100 ml
   Enterococcus: 35 per 100 ml
3. AB411=Assembly Bill 411 Single Sample Criteria
   Total Coliforms: 10,000 per 100 ml
   Total Coliforms: 1000 per 100 ml if ratio of fecal to total coliforms is greater than 0.1
   Fecal Coliforms: 400 per 100 ml
   Enterococcus: 104 per 100 ml
4. *Escherichia coli* was used as surrogate for fecal coliform from January 2000 through June 12, 2001. Since a correction factor was not available, *E. coli* measurements were compared directly with Fecal Coliform criteria.

Table 8.5. **Summary of Toxicity Characteristics of Stormwater from Various Southern California Watersheds.** Test Types: SF = sea urchin fertilization, MS = mysid survival/growth, DS = daphnid survival/reproduction.

Location	Date	Test Type	Number of Samples	%Toxic	TUc
Long Beach	2001	SF	22	86	≤2-32
Long Beach	2001	MS	20	55	1-16
Long Beach	2001	DS	22	77	1->16
Los Angeles River	1997-99	SF	4	100	4-8
San Gabriel River	1997-99	SF	4	50	≤2-4
Ballona Creek	1996-97	SF	13	85	≤4-32
Chollas Creek	1999-2000	SF	5	100	8-32
Chollas Creek	1999	MS	3	0	1
Chollas Creek	1999	DS	3	67	1-2

Table 8.6. **Summary of TIE Results for Each Sample.** The primary toxicant category indicates the chemical class most strongly indicated by the results. The secondary category indicates the chemical class indicated from partially effective TIE treatments.

Date	Station	Water Flea		Mysid		Sea Urchin	
		Primary Category[a]	Secondary Category[a]	Primary Category	Secondary Category	Primary Category	Secondary Category
2/23/01	Cerritos					METAL	PARTICLE
4/7/01	Belmont					METAL	NPO
4/7/01	Cerritos					METAL	NPO
11/12/01	Belmont	OP	METAL	NPO			
11/13/01	Bouton						
11/12/01	Cerritos	OP	METAL				
11/24/01	Belmont	OP		NPO		METAL	
11/24/01	Bouton					METAL	
11/24/01	Cerritos	OP	PARTICLE			METAL	
5/9/02	Cerritos					METAL	

[a] OP = organophosphate pesticide, METAL = divalent trace metal, NPO = unspecified nonpolar organic, PARTICLE = toxicity associated with particulate fraction of sample.

Table 8.7. Nonparametric Spearman Correlation Coefficients showing the Relationship between Change in Chemical Concentration and Toxic Units for the Sea Urchin and Water Flea Toxicity Tests. Toxic units are based on the EC50 (sea urchin fertilization, water flea reproduction) or LC50 (water flea survival). Values in bold are statistically significant at $p \leq 0.05$ (*) or $p \leq 0.01$ (**). N=22 for all constituents except for chlorpyrifos and diazinon, where n=6.

Constituent		Sea Urchin Fertilization TUa	Water Flea	
			Survival TUa	Reproduction TUa
TSS		-0.18	**0.55****	**0.60****
TDS		-0.18	0.35	0.33
TOC		0.05	**0.79****	**0.79****
Cadmium	Dissolved	0.24	**0.78****	**0.77****
Chromium	Dissolved	0.22	**0.49***	0.42
Copper	Dissolved	**0.46***	0.23	0.08
Lead	Dissolved	0.12	**0.42***	0.36
Nickel	Dissolved	0.22	**0.86****	**0.79****
Zinc	Dissolved	**0.54****	**0.59****	**0.49***
Chlorpyrifos		0.28	0.15	0.15
Diazinon		-0.12	0.54	0.54

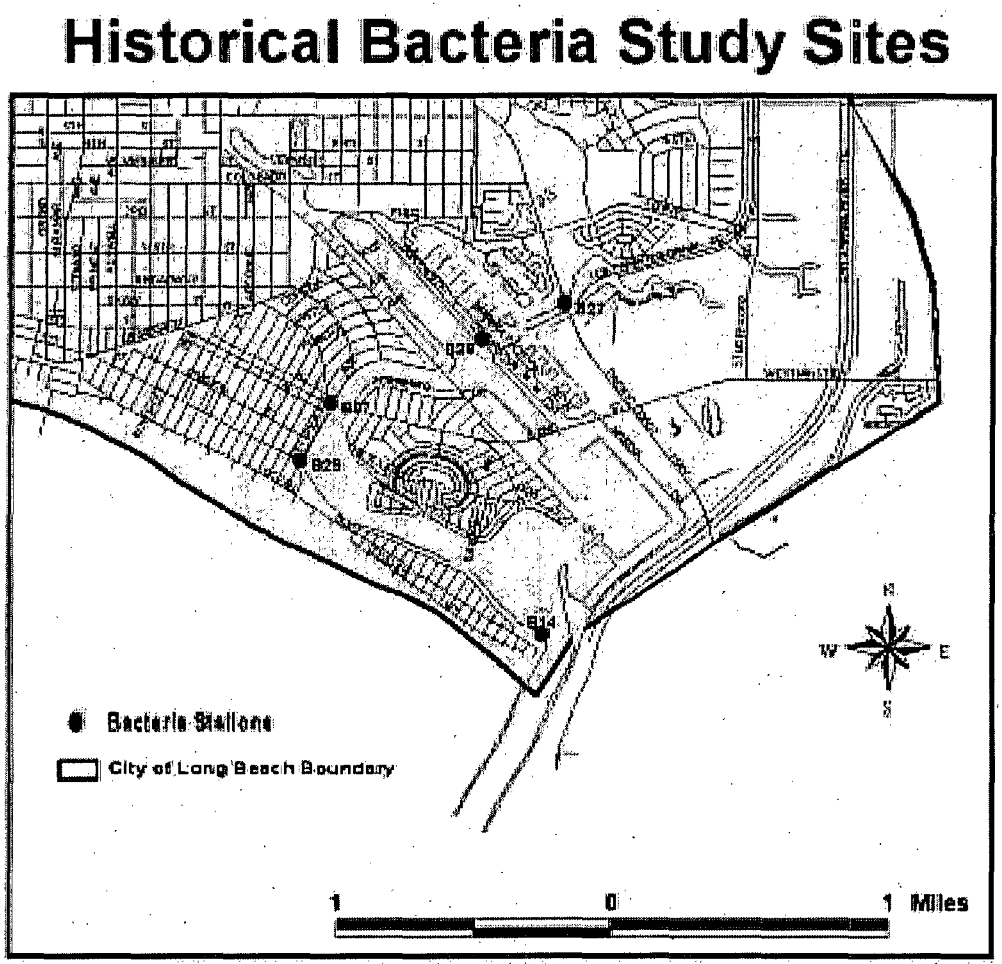


Figure 8.1. **Location of City of Long Beach Department of Health and Human Service's Microbiological Monitoring Sites.**

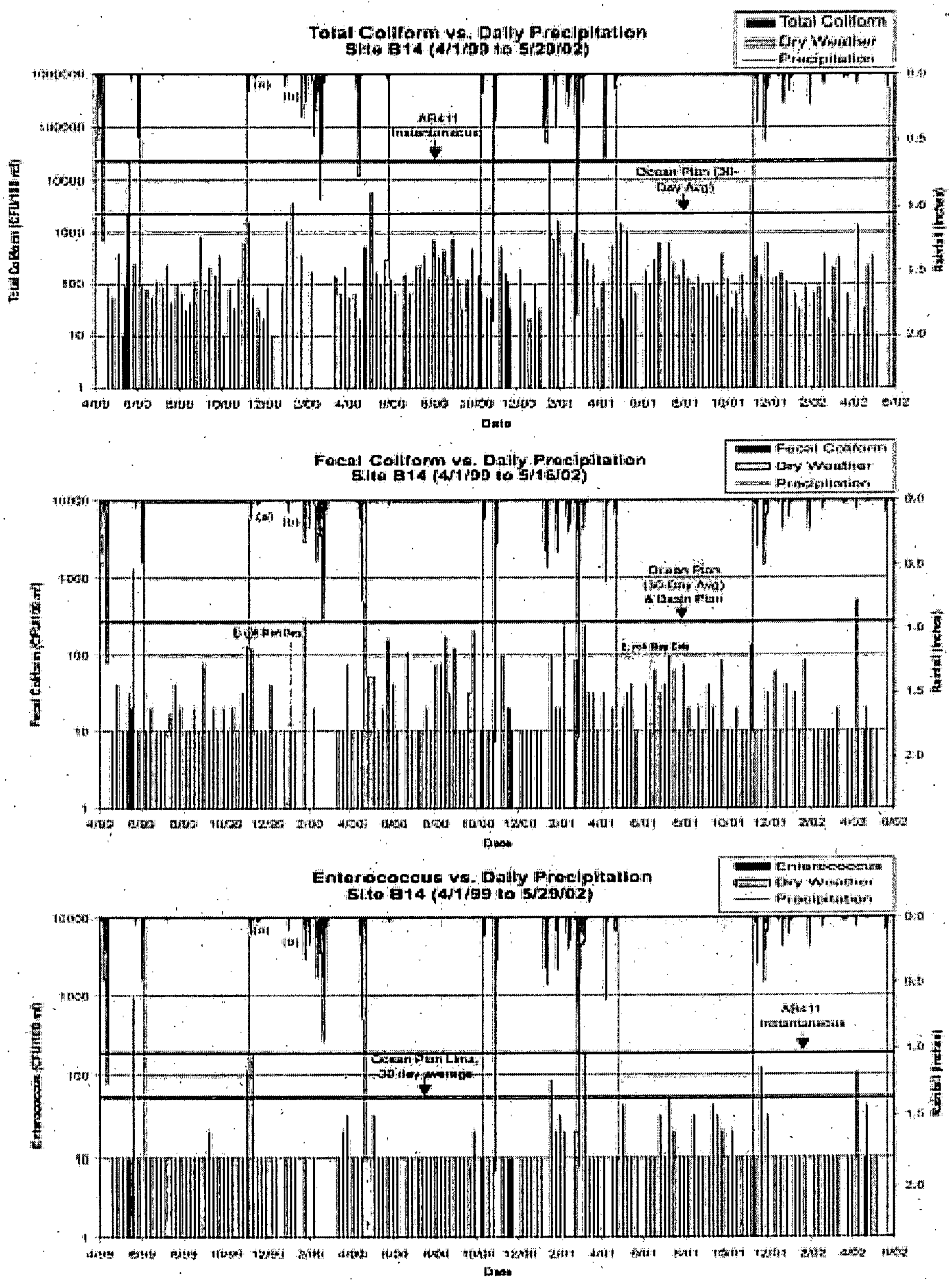


Figure 8.2. Bacterial Time Series for City of Long Beach Alamitos Bay Bacteria Station B14 (Bayshore Float).

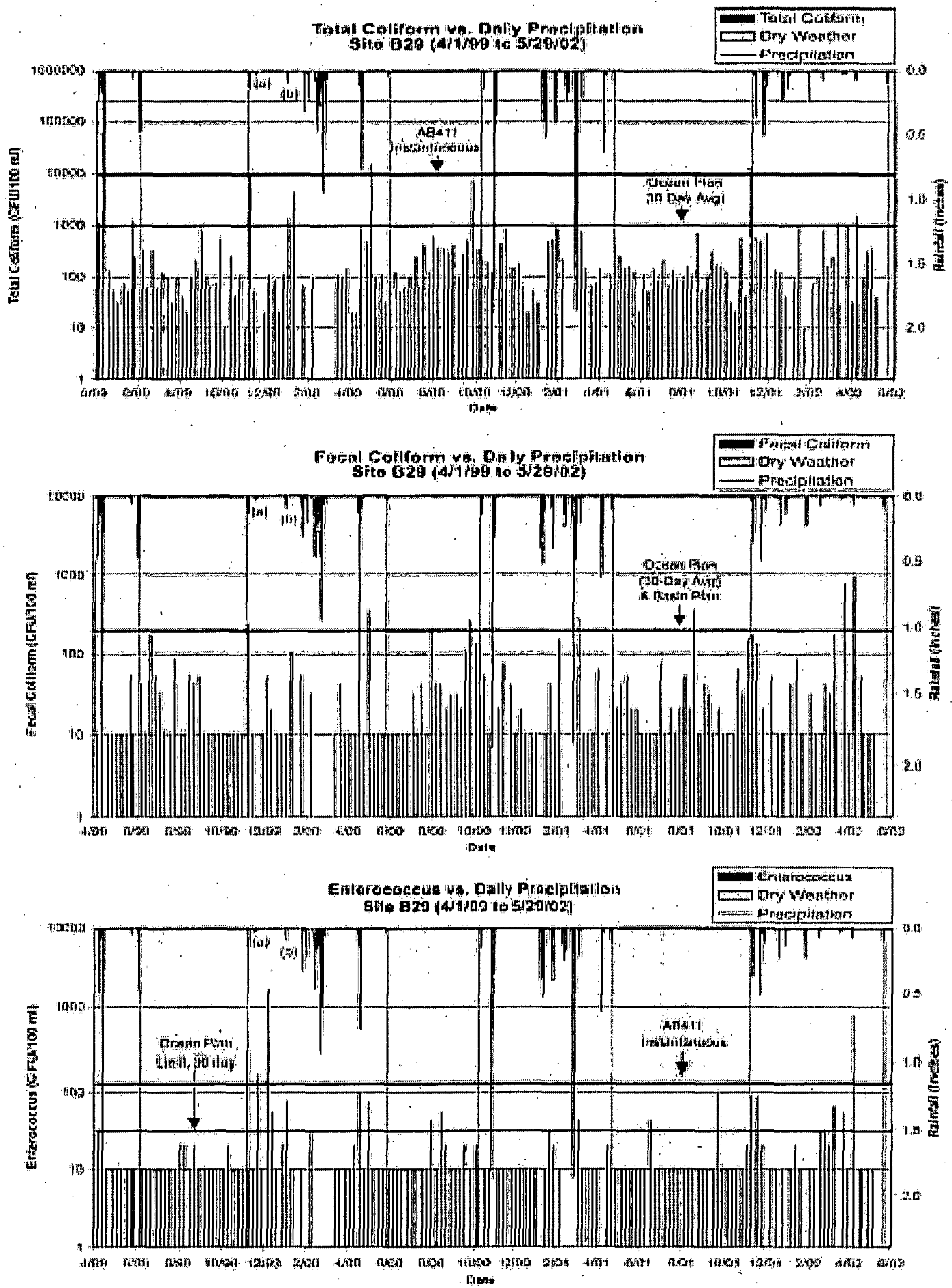


Figure 8.3. **Bacterial Time Series for City of Long Beach Alamitos Bay Bacteria Station B29 (Bayshore and First).**

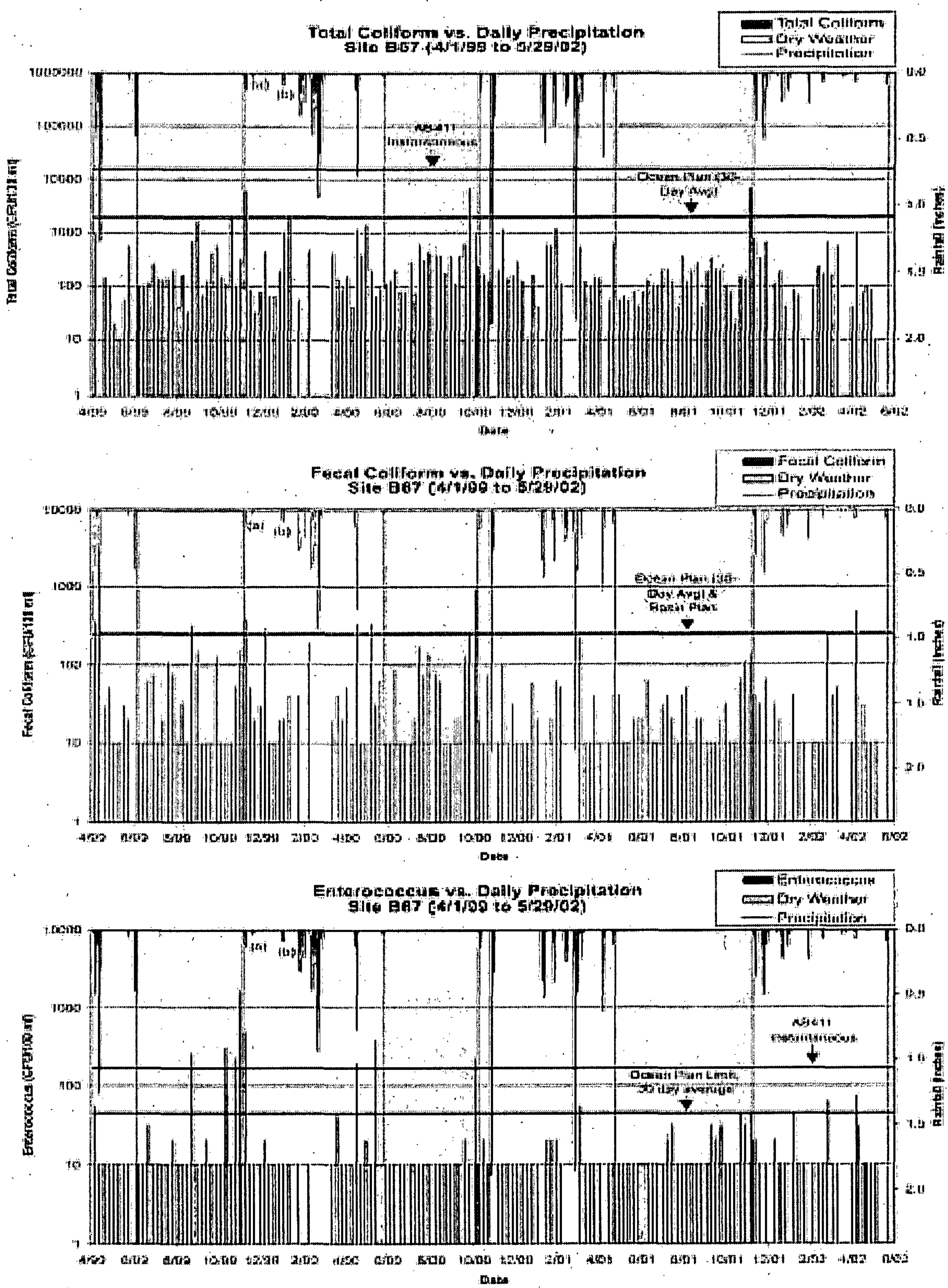


Figure 8.4. **Bacterial Time Series for City of Long Beach Alamitos Bay Bacteria Station B67 (Bayshore and Second Street Bridge).**

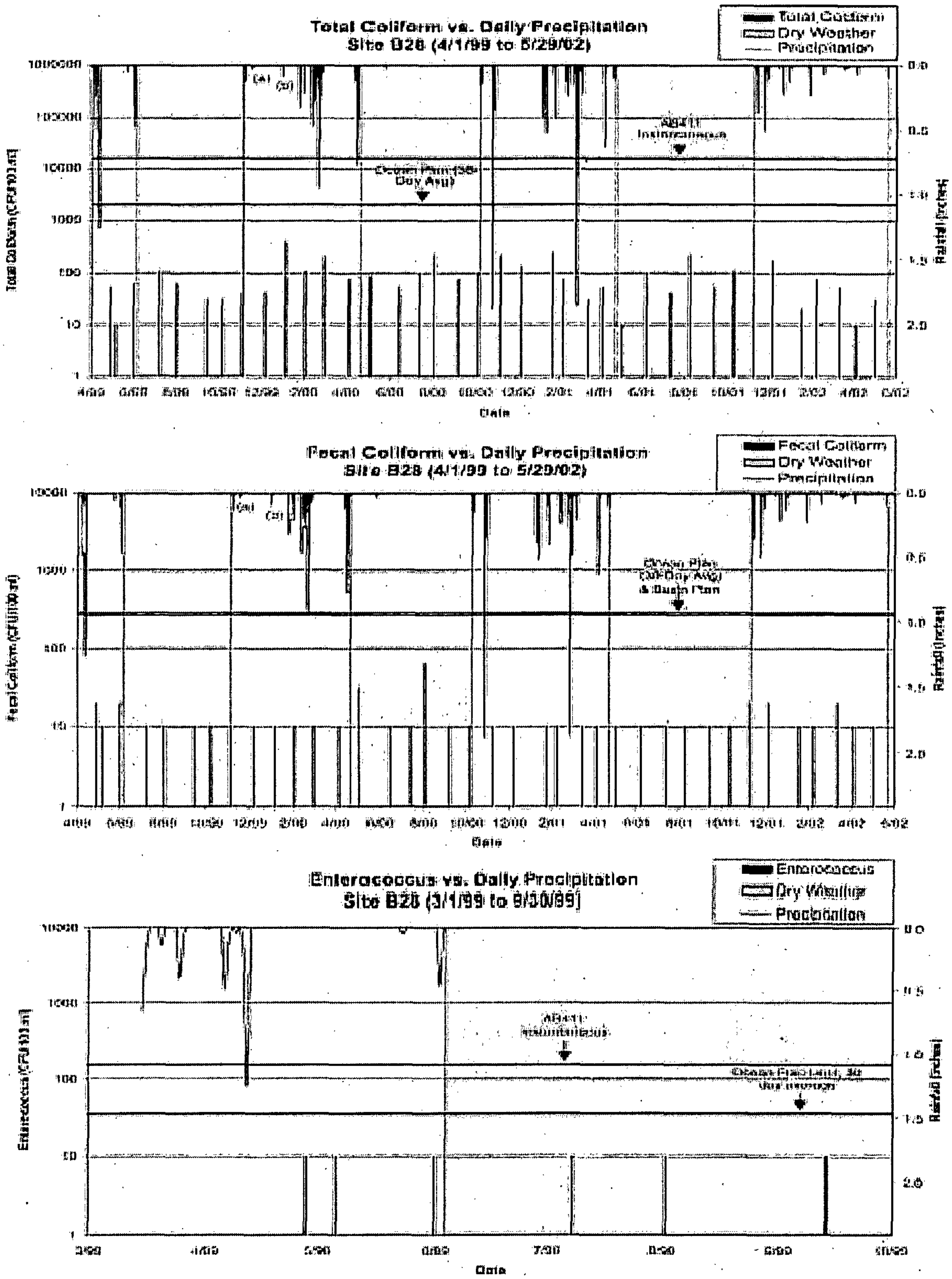


Figure 8.5. **Bacterial Time Series for City of Long Beach Rowing Association Bacteria Station B28 (Los Cerritos Channel and Marine Stadium).**

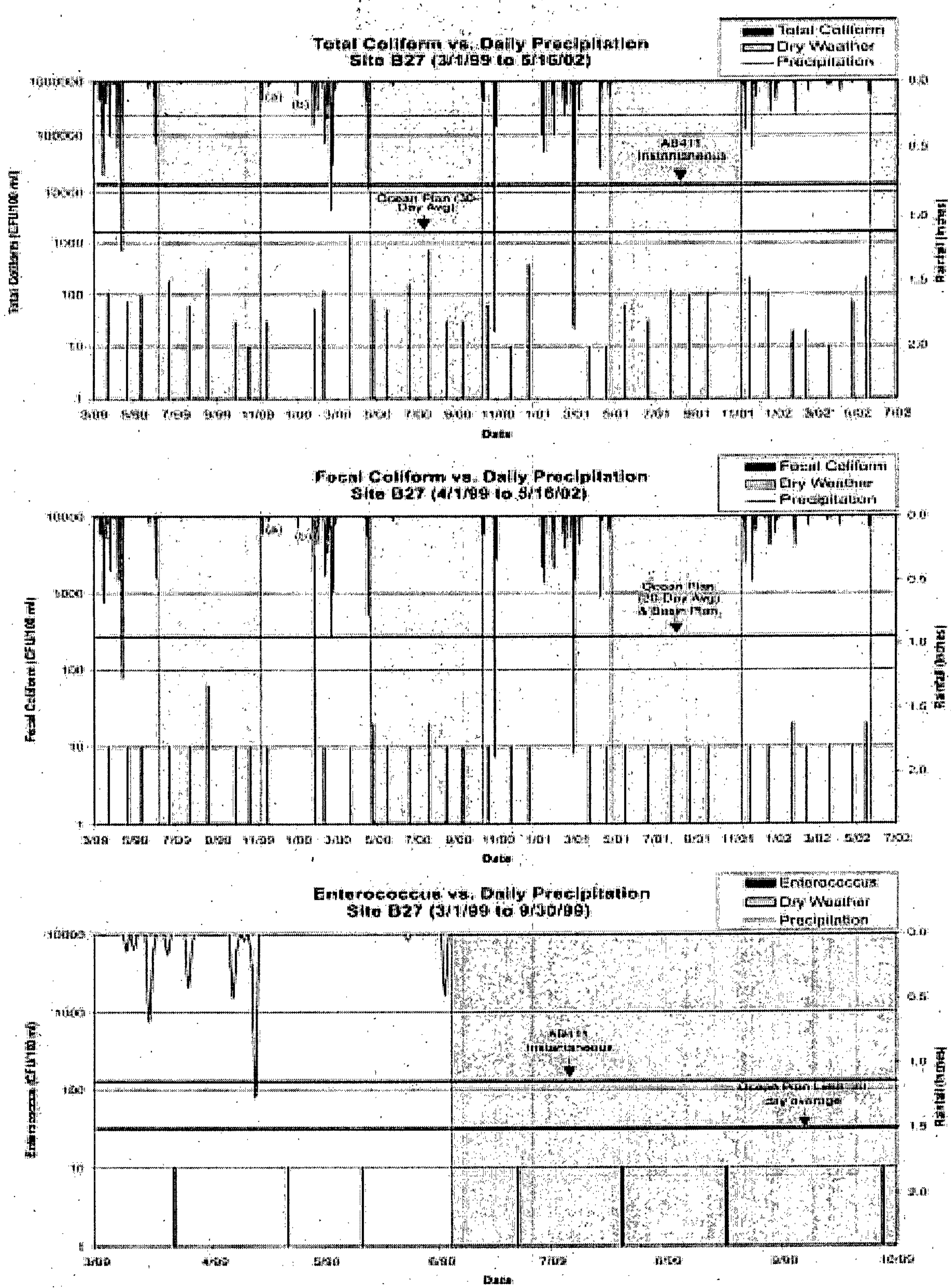
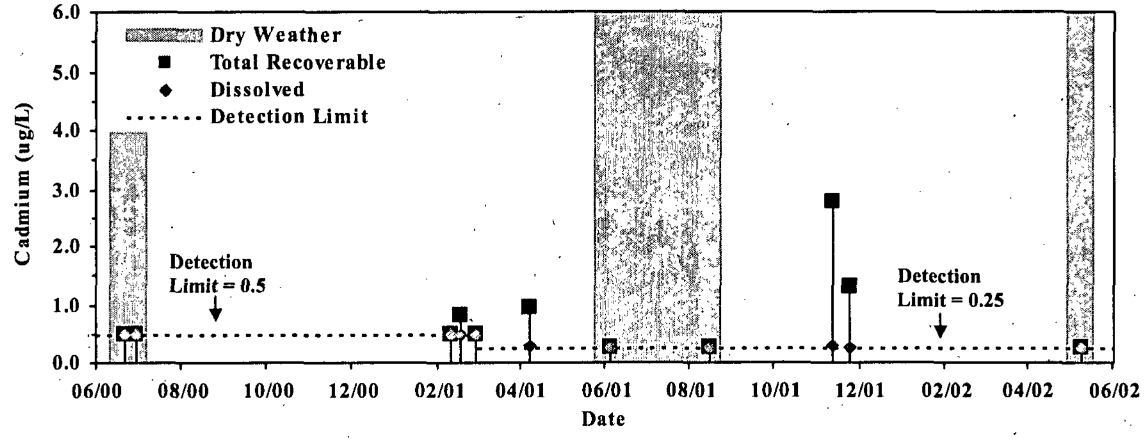
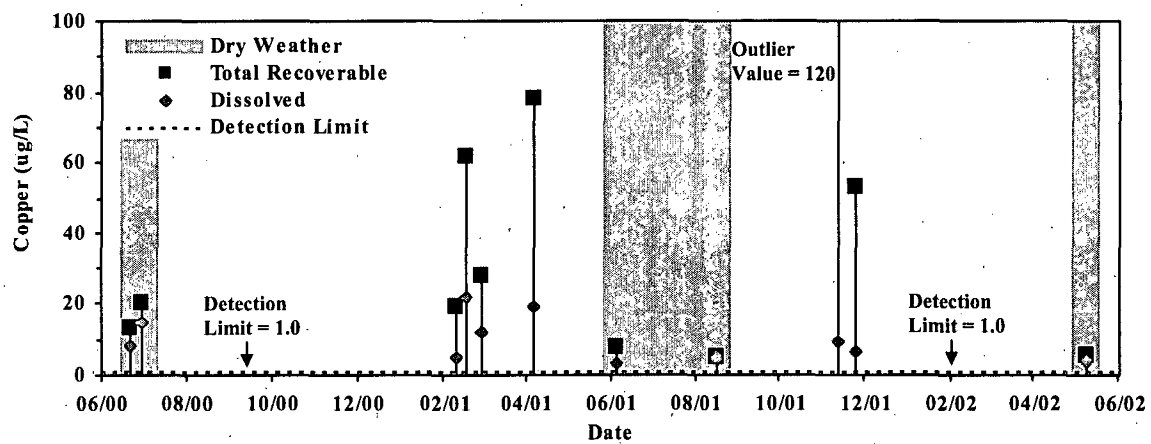


Figure 8.6. Bacterial Time Series for City of Long Beach Los Cerritos Channel Bacteria Station B27 (Los Cerritos Channel and Pacific Coast Highway).



a)



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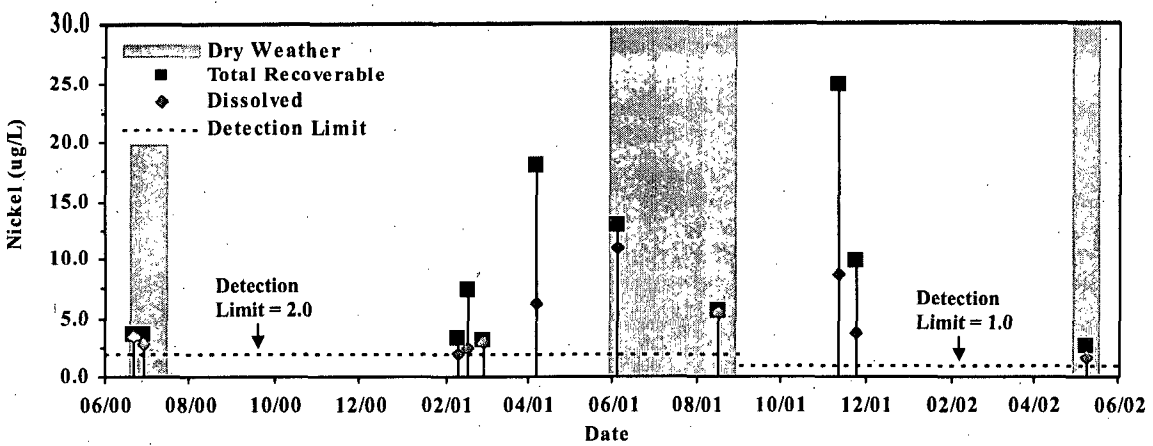
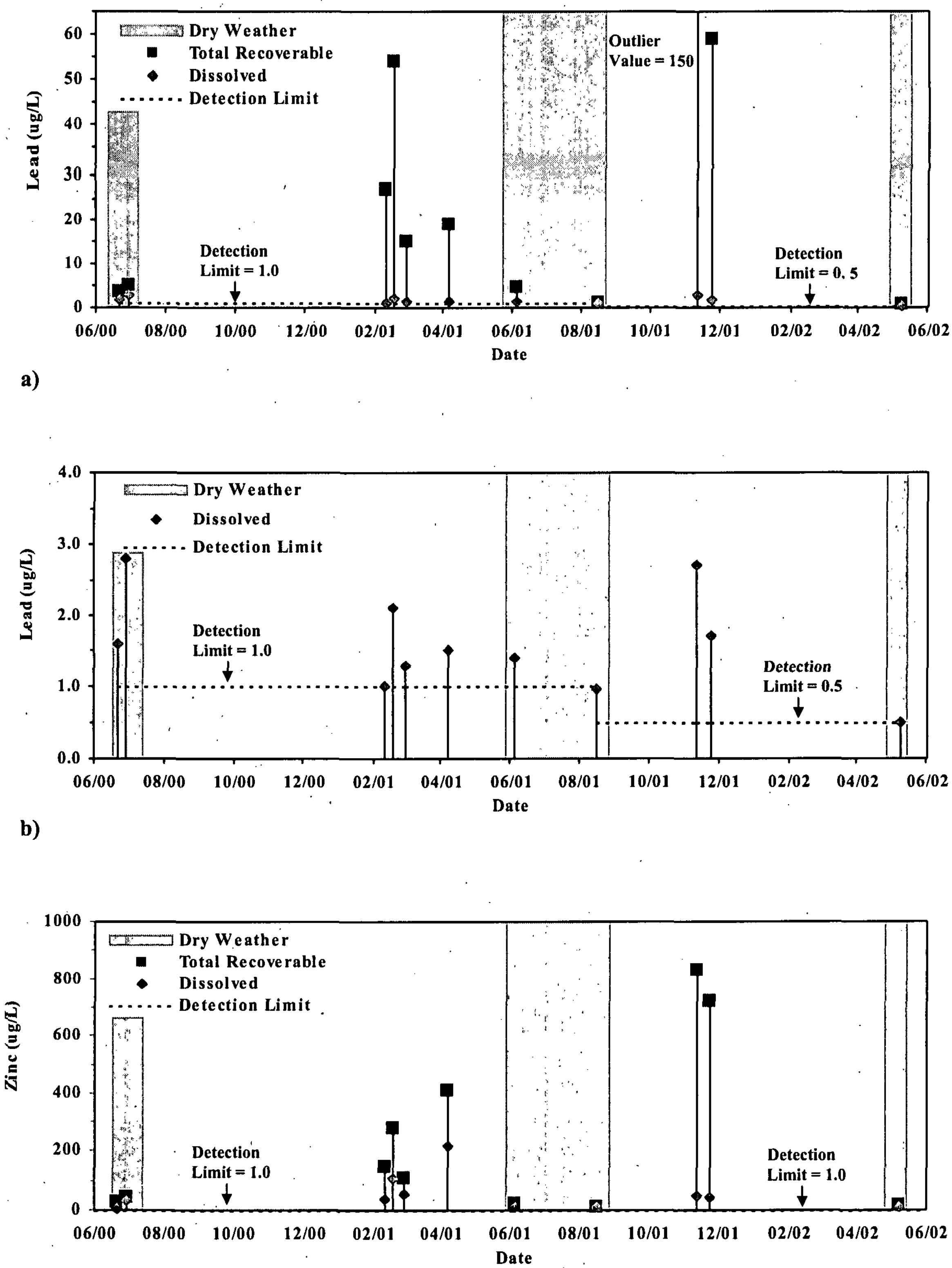


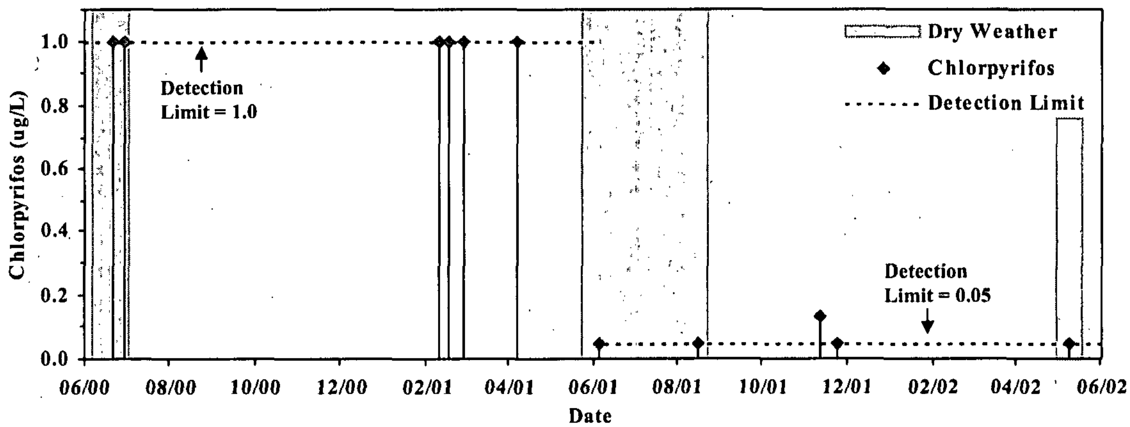
c)

Figure 8.7 Belmont Pump Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



a) b) c)

Figure 8.8 Belmont Pump Chemistry Results: a) Lead (Total and Dissolved); b) Lead (Dissolved); c) Zinc.



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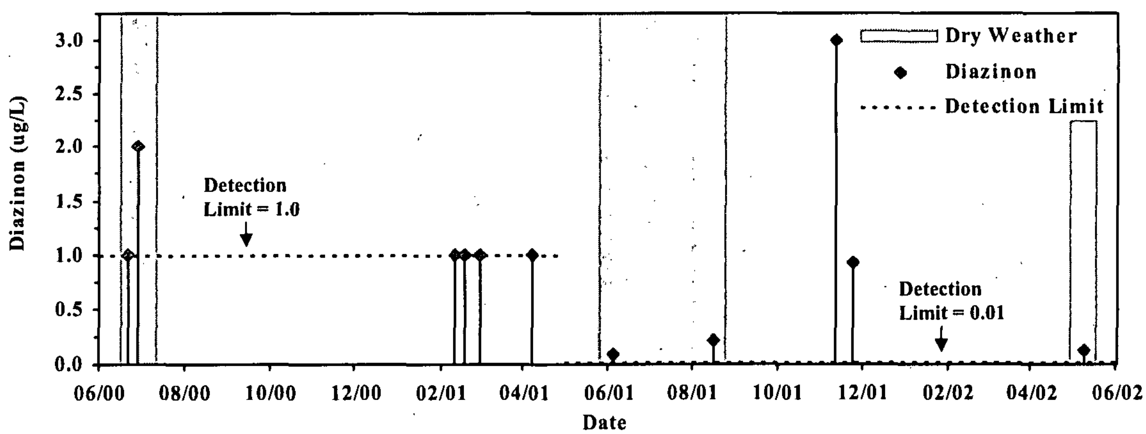


b)

Figure 8.9 Belmont Pump Chemistry Results: a) Chlorpyrifos; b) Diazinon.

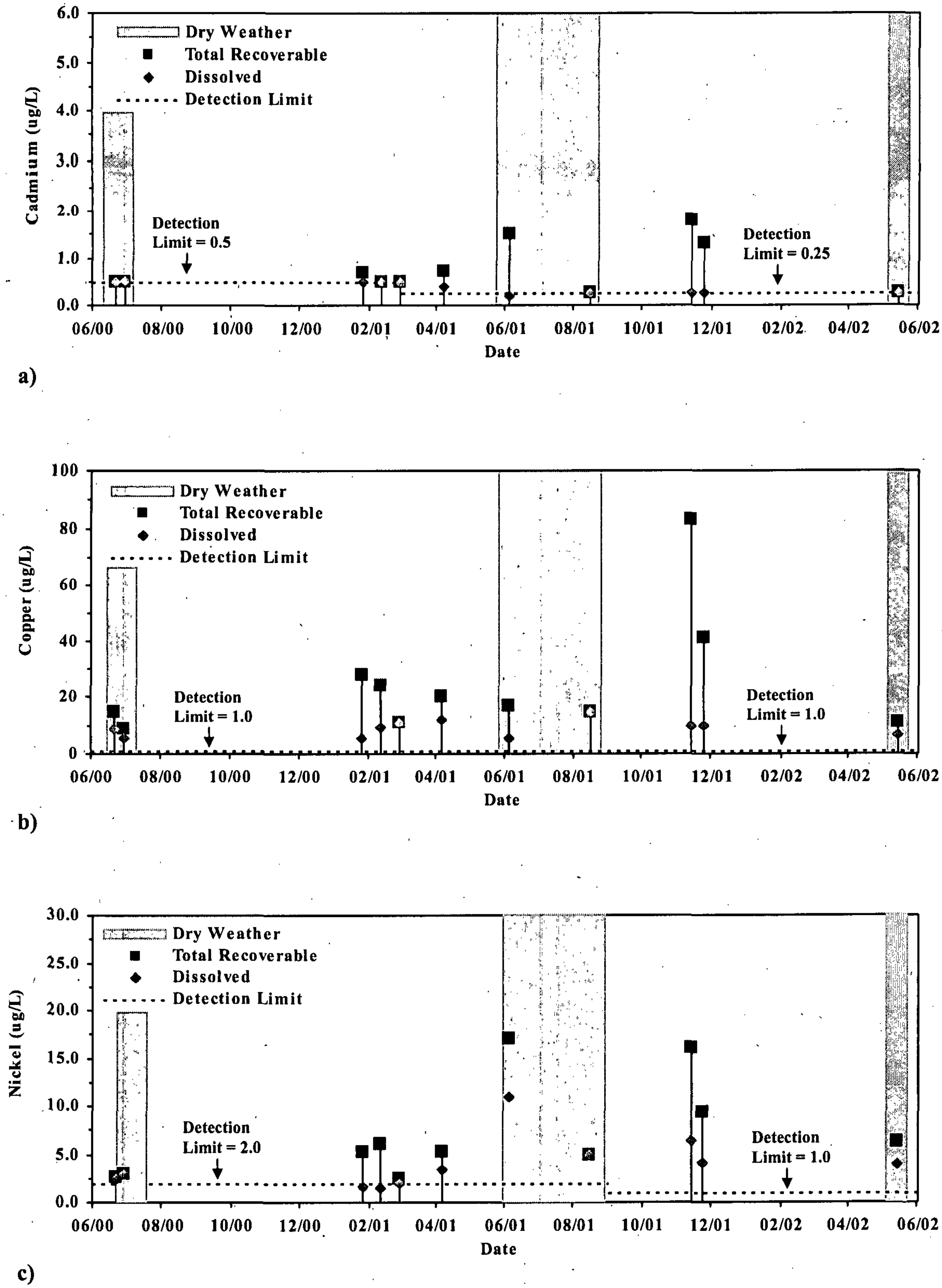


Figure 8.10 Bouton Creek Chemistry Results: a) Cadmium; b) Copper; c) Nickel.

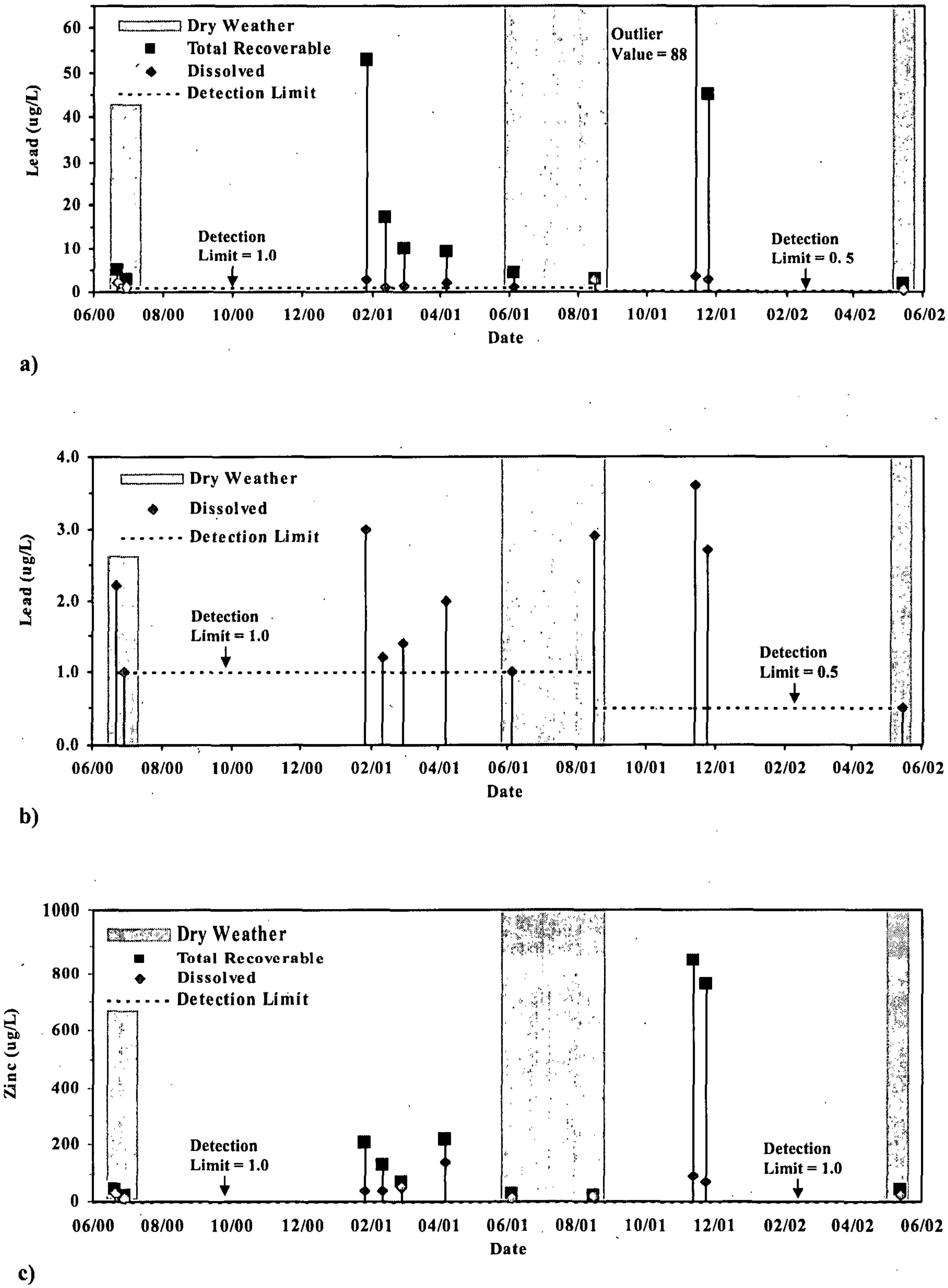
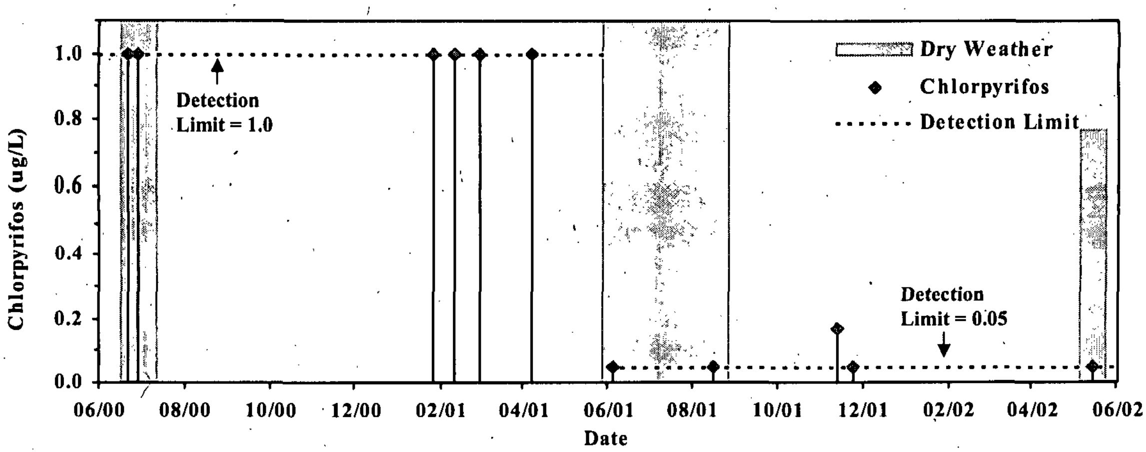


Figure 8.11 **Bouton Creek Chemistry Results: a) Lead (Total and Dissolved); b) Lead (Dissolved); c) Zinc.**



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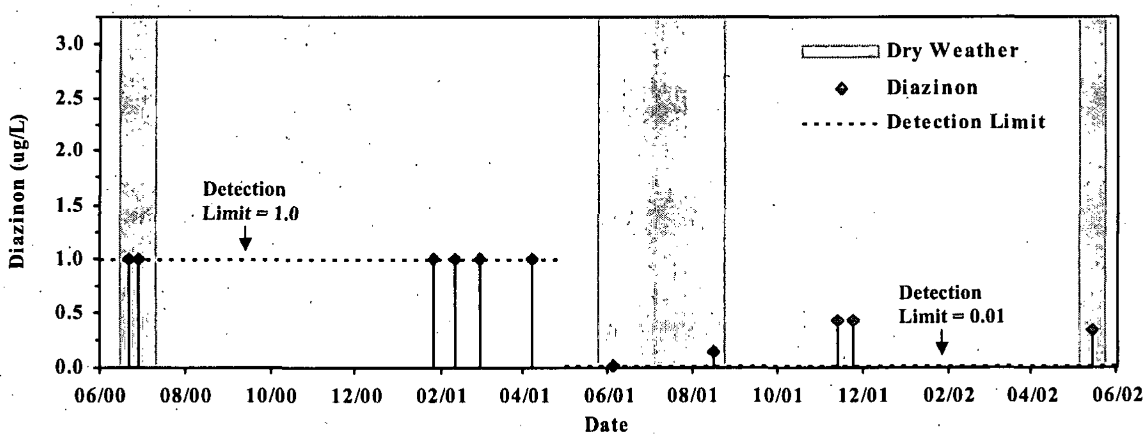


b)

Figure 8.12 Bouton Creek Chemistry Results: a) Chlorpyrifos; b) Diazinon.

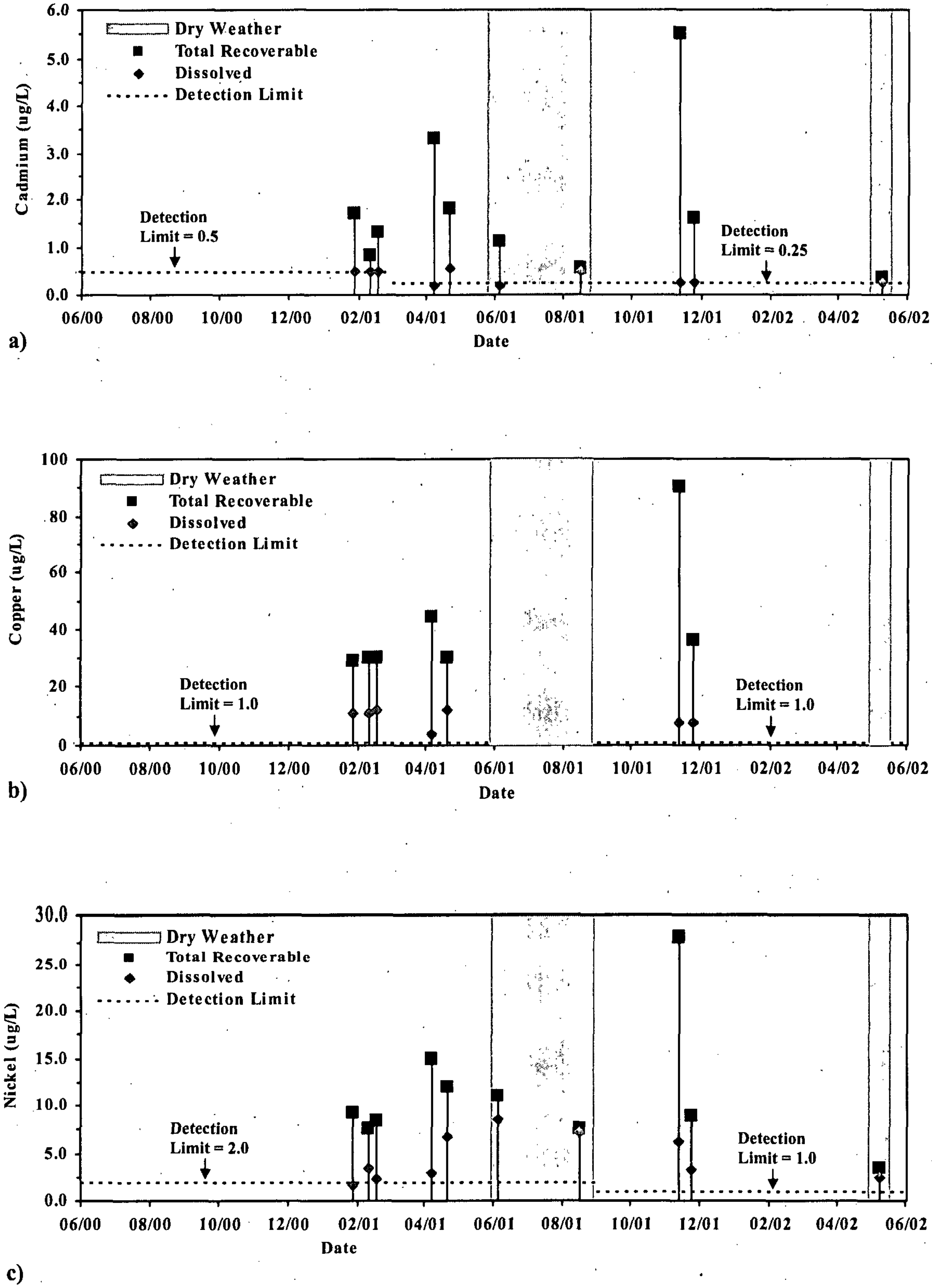
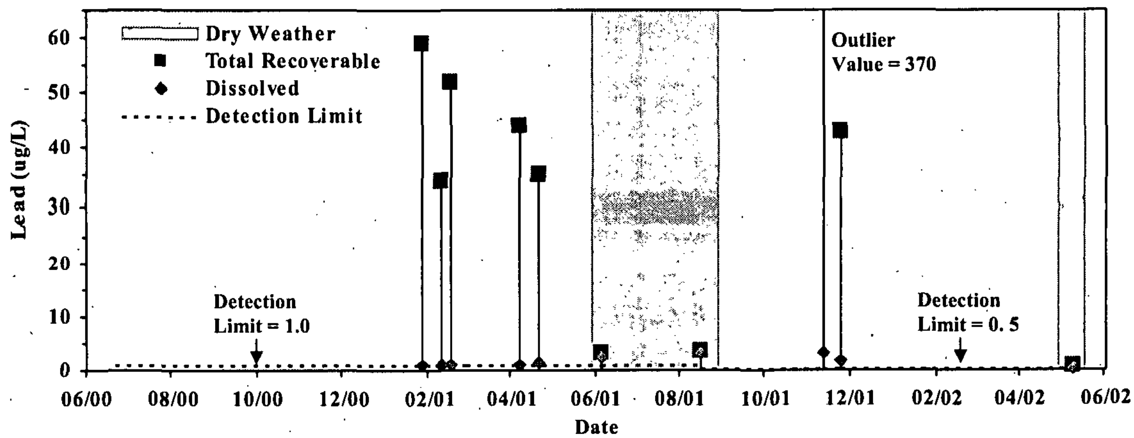


Figure 8.13 Los Cerritos Channel Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



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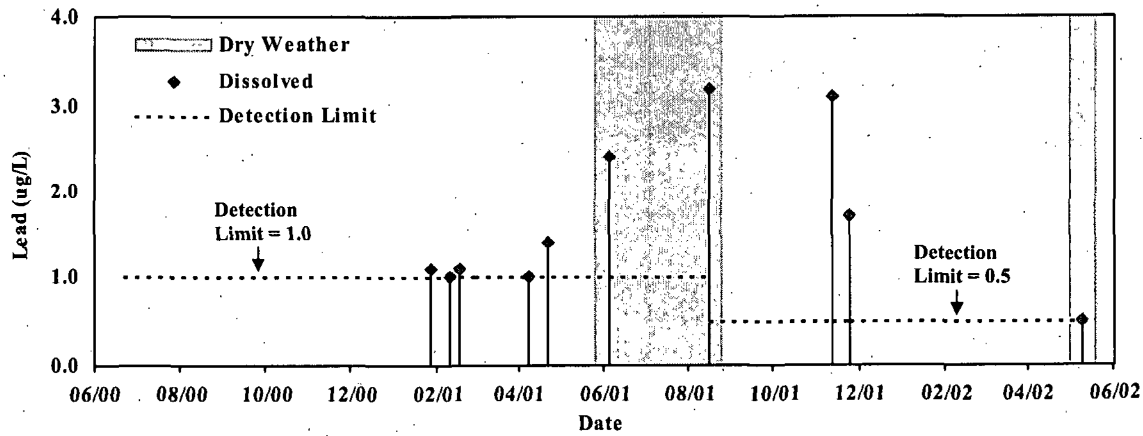

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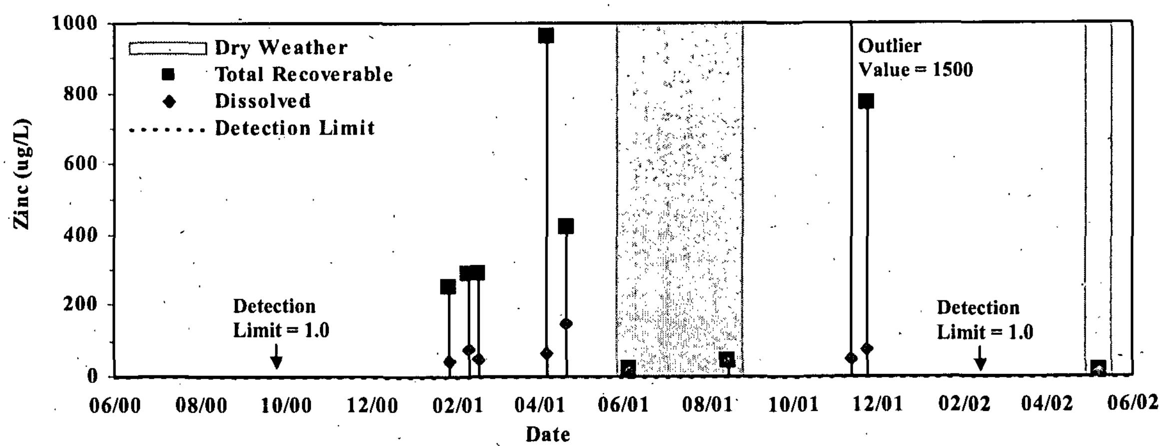

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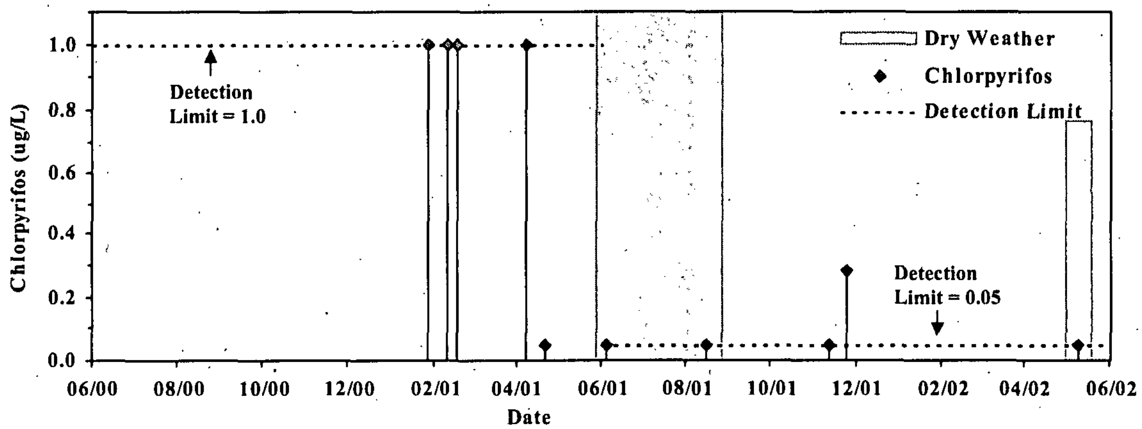
Figure 8.14 Los Cerritos Channel Chemistry Results: a) Lead (Total and Dissolved); b) Lead (Dissolved); c) Zinc.



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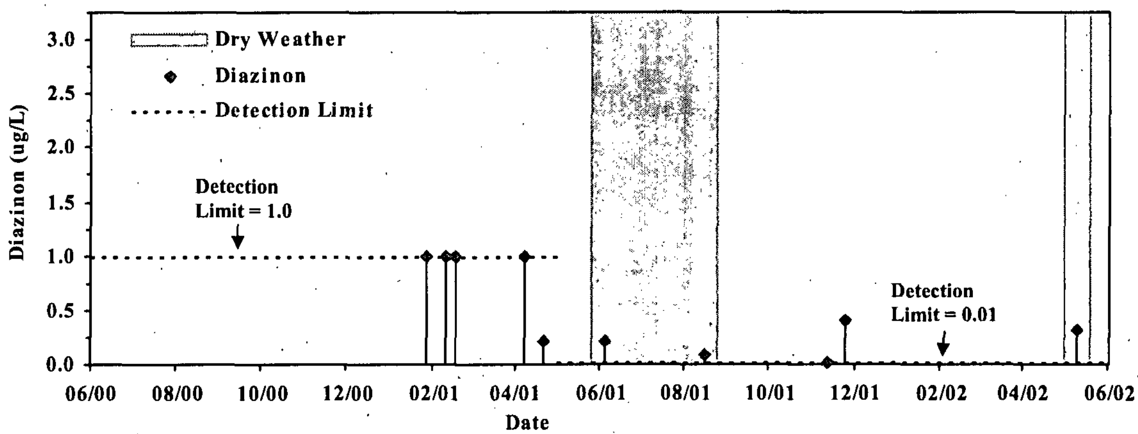


b)

Figure 8.15 Los Cerritos Channel Chemistry Results: a) Chlorpyrifos; b) Diazinon.

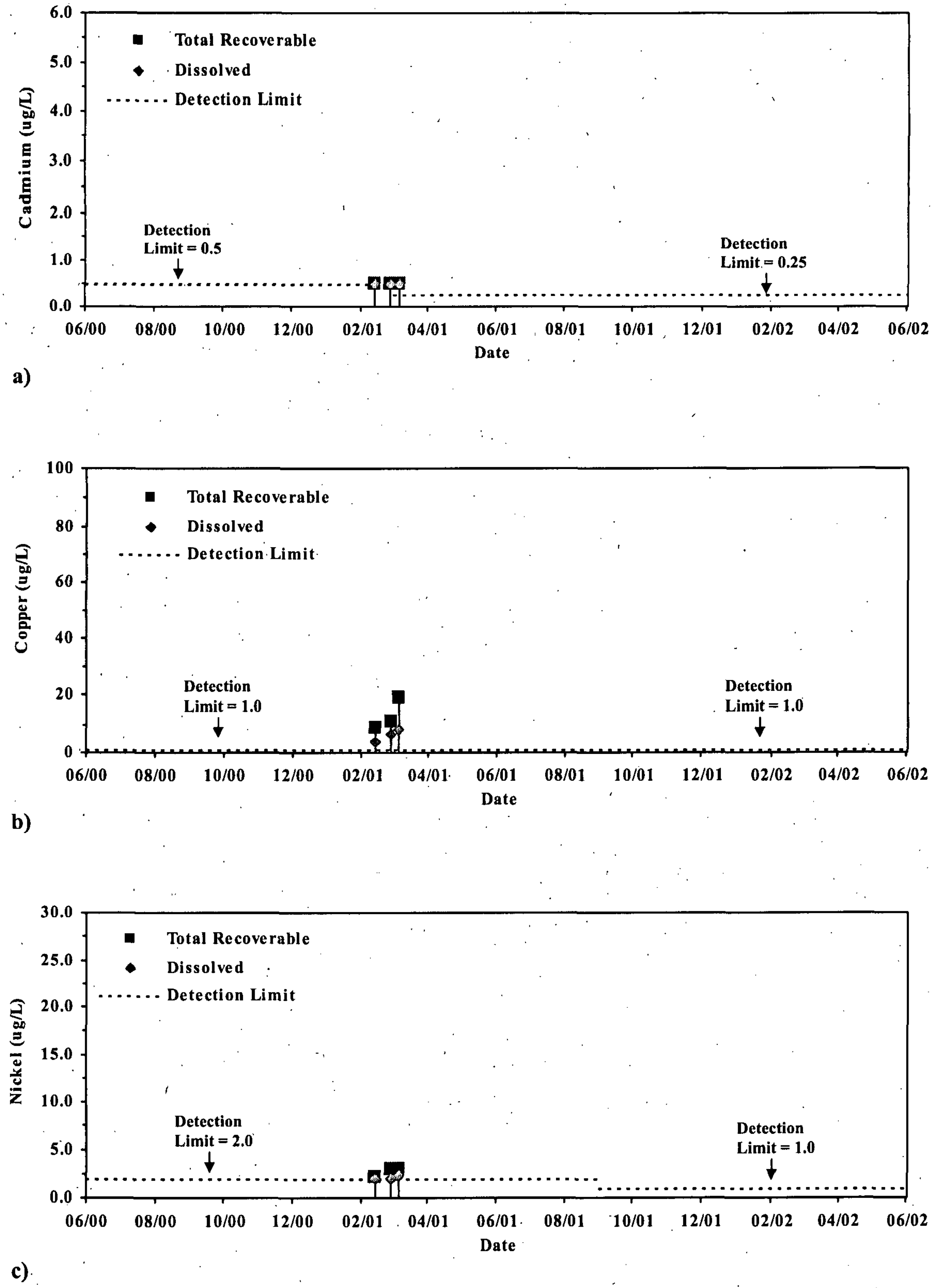
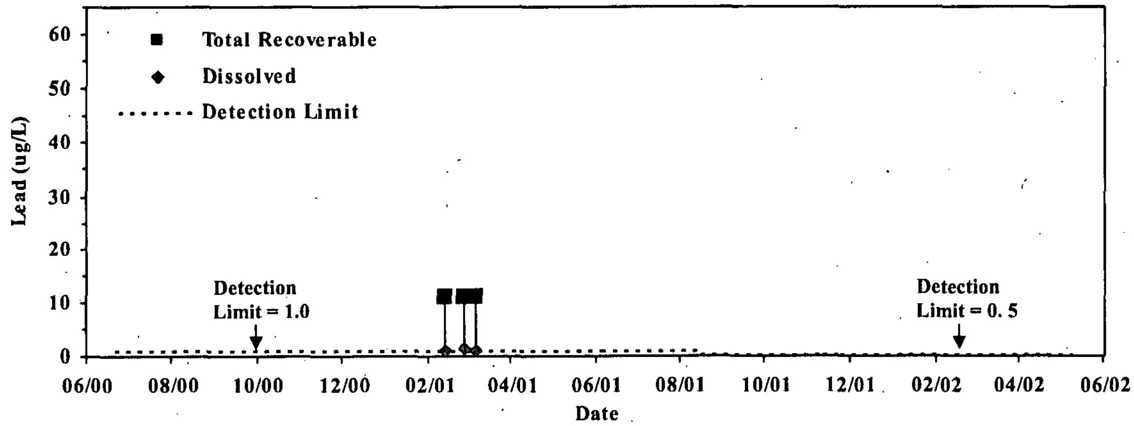
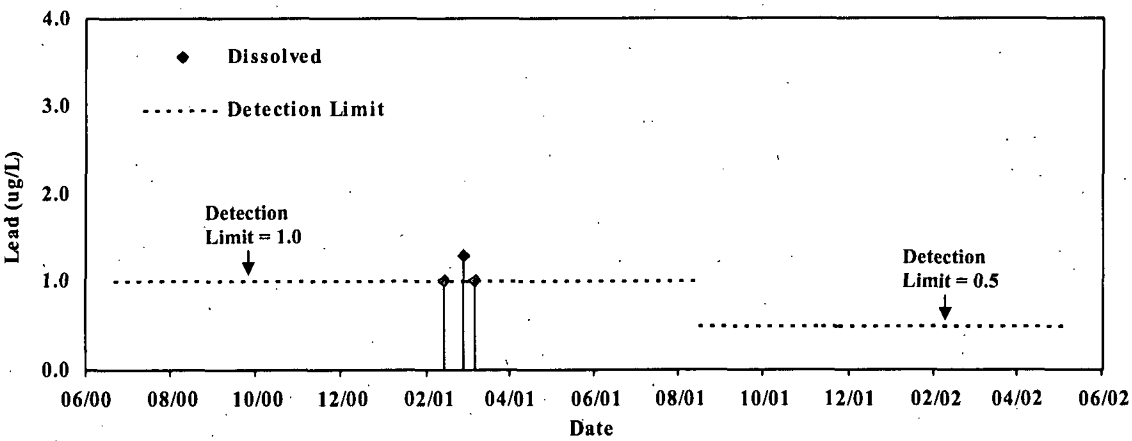


Figure 8.16 Dominguez Pump Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



a)



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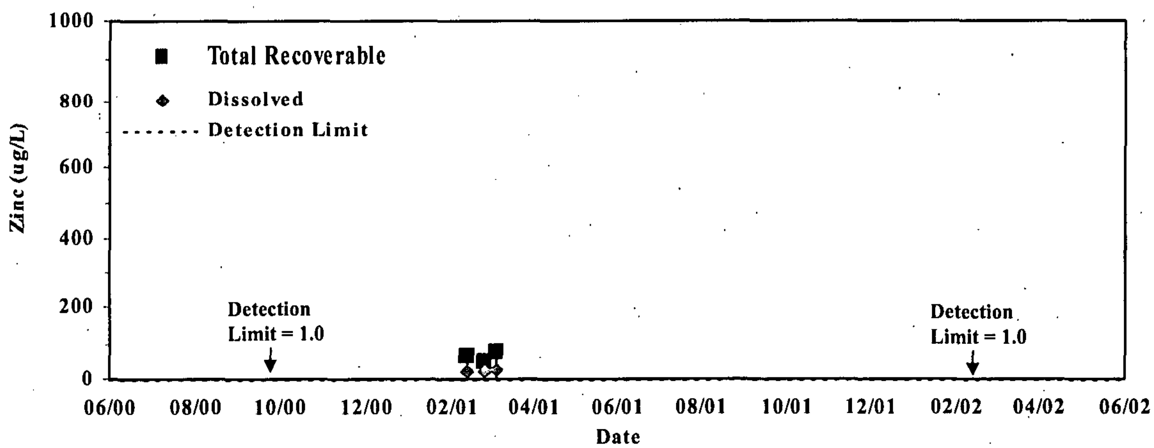
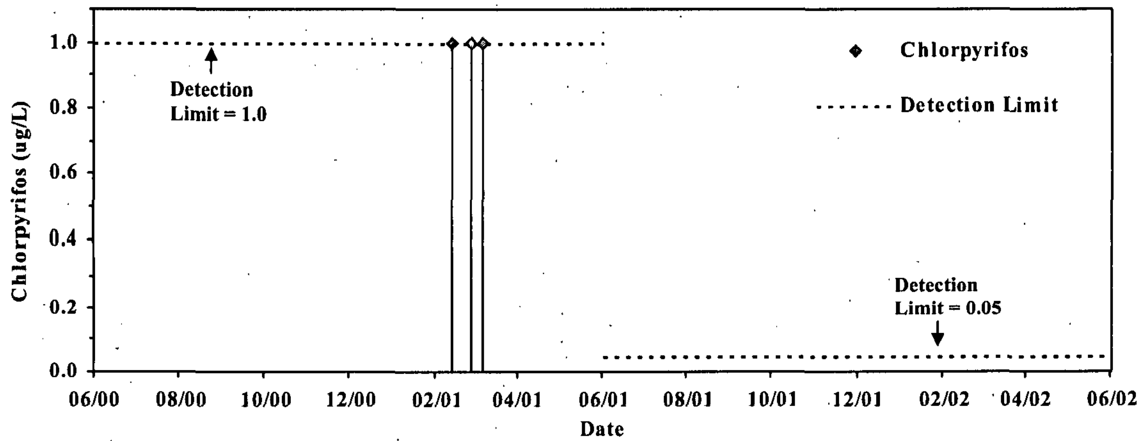
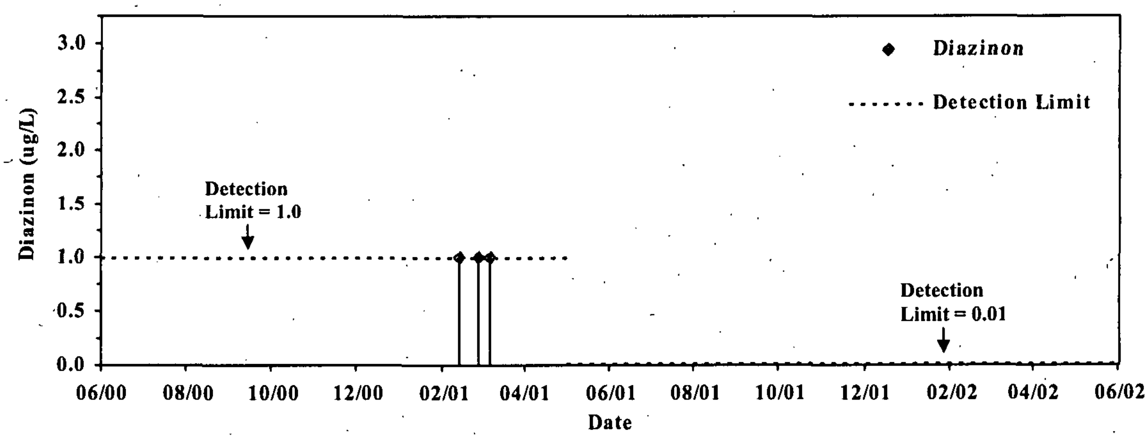


c)

Figure 8.17 **Dominguez Pump Chemistry Results: a) Lead (Total and Dissolved); b) Lead (Dissolved); c) Zinc.**



a)



b)

Figure 8.18 Dominguez Pump Chemistry Results: a) Chlorpyrifos; b) Diazinon.

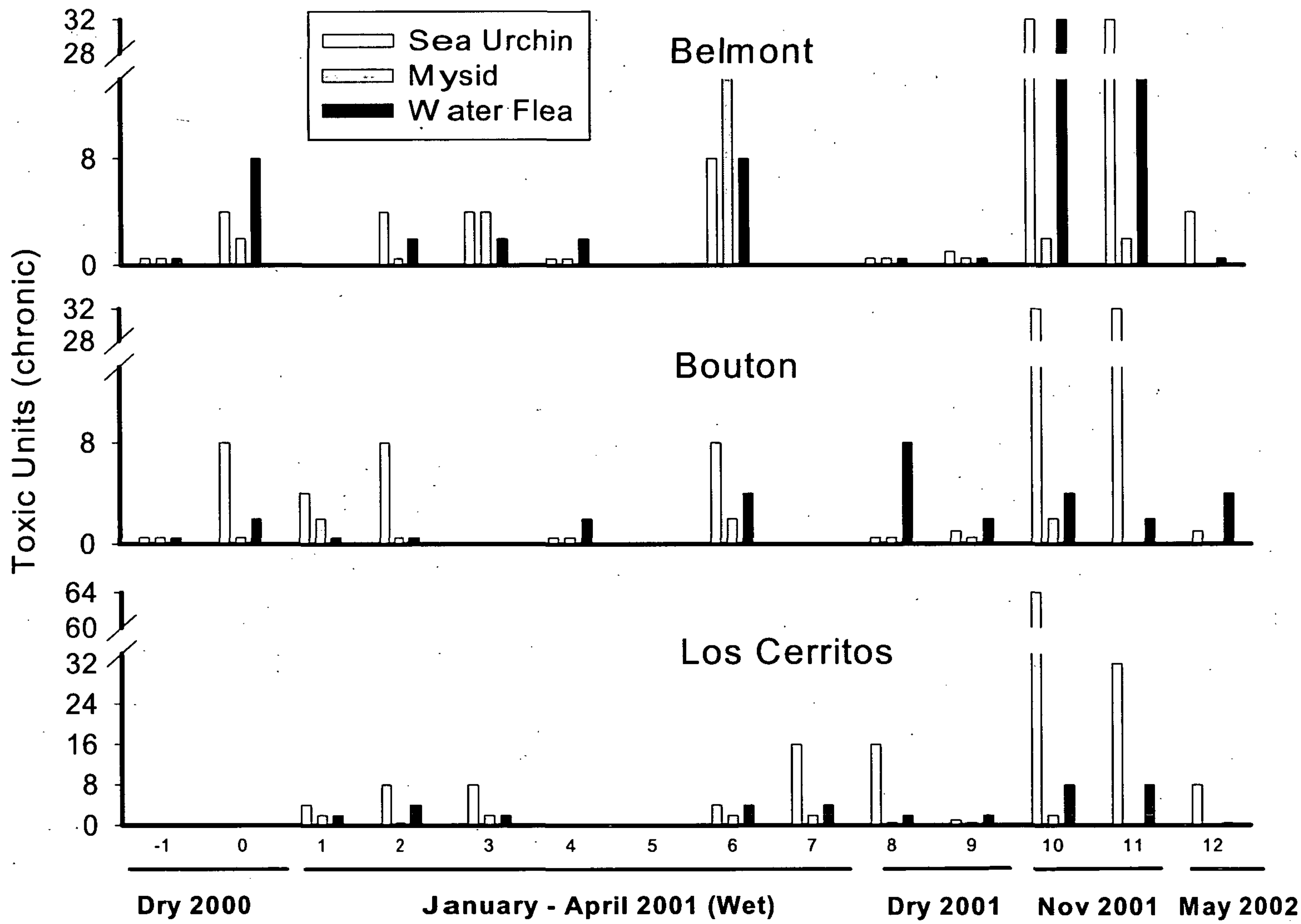


Figure 8.19. Summary of Wet and Dry Weather Toxicity Results for all Long Beach Samples.

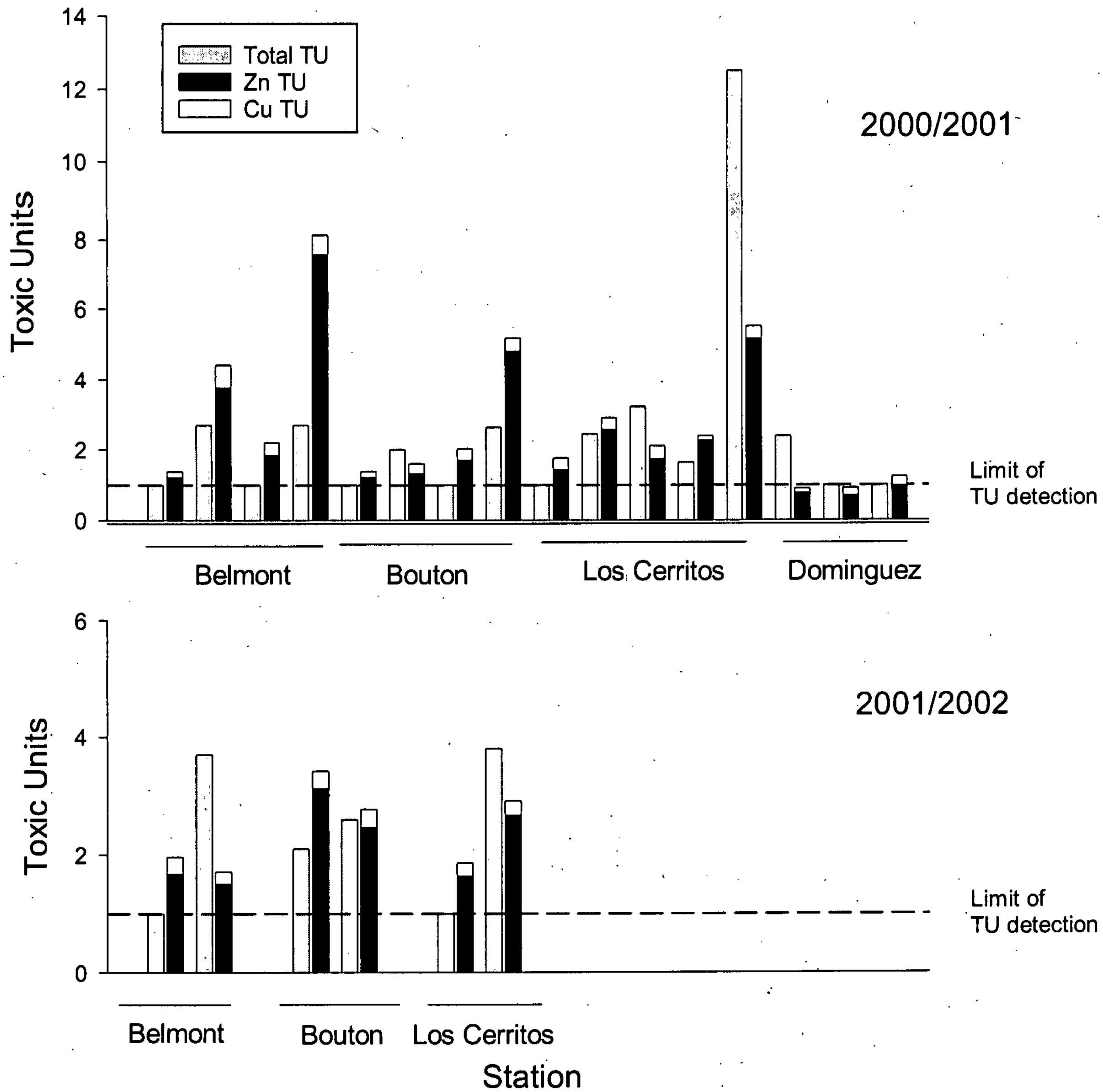


Figure 8.20. Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50 of >100%.

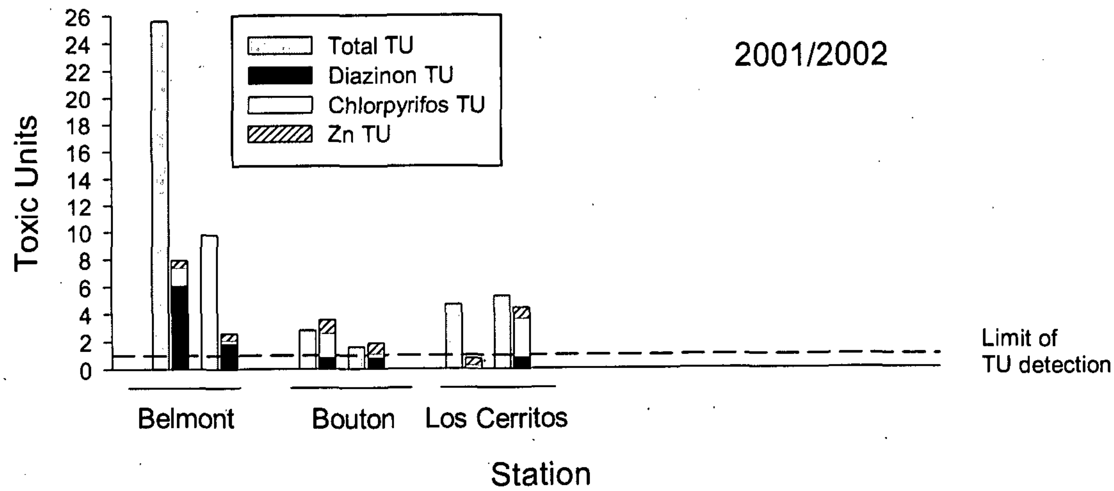


Figure 8.21. Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50 of >100%.

9.0 CONCLUSIONS

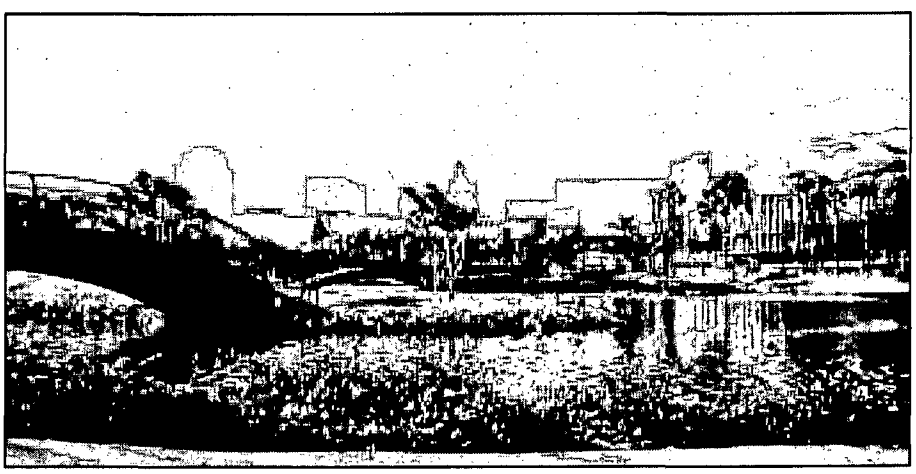
Stormwater and dry weather monitoring has been carried out for the City of Long Beach at four mass emission stations and one receiving water station as specified in the NPDES permit. Twenty-one wet weather station events have been monitored along with twenty dry weather inspections/monitoring efforts. This program involved a coordinated chemical analysis and toxicity testing (marine and freshwater) approach.

Exceedances of provisional benchmark values have been identified for some metals, primarily zinc and copper, and for diazinon and chlorpyrifos (organophosphate pesticides). Stormwater discharges have consistently shown measured toxicity to freshwater and marine test species, but the one receiving water site (lower Alamitos Bay) does not show measured toxicity, consistent with indicated dilution. Bacterial levels in the wet weather discharges are 2 to 3 orders of magnitude above receiving water criteria and dry weather discharges also exceed criteria. Data from Alamitos Bay receiving waters and from the City of Long Beach Department of Health and Human Services show that the Bay bacterial values are elevated during rain events, but are at relatively low values during dry weather periods.

Toxicity Identification Evaluations (TIEs) implicate organophosphate pesticides (diazinon and chlorpyrifos) in causing toxicity to the freshwater water flea. In addition, dissolved metals, primarily zinc and perhaps copper, are implicated in the toxicity to the purple sea urchin (marine).

Proposed storm water monitoring program refinements/recommendations at this point in the program include the following:

- The Dominguez Gap Pump Station discharges infrequently to the Los Angeles River, only during periods of large and intense rains (3 events captured to date). Dry weather flows at this station are non-existent. It is recommended that the monitoring efforts and resources be directed elsewhere in the program.
- Additional TIE work needs to be conducted to verify the preliminary results on the causes of toxicity in Long Beach stormwater and dry weather flows.
- Considerations should be given to further receiving water sampling to measure chemical and toxicity impacts in the receiving waters. Establishing two receiving water stations in upper Alamitos Bay may help to evaluate if receiving water quality criteria are being impacted by stormwater discharges. This may be achieved by relocating the current lower Alamitos Bay receiving water site and redirecting resources currently expended at the Dominquez Gap site to establishment of a second receiving water location in upper Alamitos Bay.



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ToxScan Incorporated

BIOASSAY RESULTS

City of Long Beach Wet Weather Runoff Samples

Chronic Toxicity Tests:

Ceriodaphnia dubia Survival and Reproduction
Americamysis bahia Survival and Growth
Strongylocentrotus purpuratus Fertilization

SAMPLES RECEIVED 14 November 2001

T-19895

Prepared for:
KINNETIC LABORATORIES, INC
Santa Cruz, California

Prepared by:
TOXSCAN, INC.
BIOASSAY DIVISION
Watsonville, California

June 2002

Introduction

ToxScan, Inc. conducted chronic toxicity tests on three wet weather runoff samples collected by Kinnetic Laboratories, Inc. from three locations within the City of Long Beach. The time-and-flow composited samples were collected from stations at Belmont Pump, Bouton Creek and Los Cerritos Channel under KLI Task Number 585.09. In addition, a grab sample of receiving water was collected from Alamitos Bay. Sample ID's are summarized in Table 1.

The toxicity tests were conducted using one freshwater species (*Ceriodaphnia dubia*) and two species of marine organisms. The two marine species tested were *Americamysis (Mysidopsis) bahia* and *Strongylocentrotus purpuratus* which were additionally tested with the receiving water sample from Alamitos Bay. The results of the toxicity tests were used to determine triggering of Toxicity Identification Evaluations (TIE's) with each sample/species combination. Results of TIE's are reported elsewhere.

Methods

Ceriodaphnia dubia Tests

The test methods for *Ceriodaphnia* followed protocols outlined in Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (EPA/600/4-91/002, July 1994)The *Ceriodaphnia dubia* tests were six days in duration, utilizing static-renewal protocols, which require daily replacement of test solutions. The bioassays were performed between 14 and 20 November 2001. The experimental design called for testing laboratory water controls to serve as evidence of laboratory quality assurance and for testing stormwater at 6.25%, 12.5%, 25%, 50% and 100% concentrations. A concurrent reference toxicant test was also performed using potassium chloride as the test chemical.

Laboratory control water was EPA moderately hard (E-pure) with 10% Perrier plus selenium. Test organisms were <24 hr old neonates derived from in-house cultures. Original broodstock was from EPA Duluth and cultured in EPA moderately hard water prepared with E-Pure water. Concentrations of runoff water were prepared daily during the test, using the laboratory control water as dilution water.

Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 20 mL of test solution. Test temperature was 25 ± 1°C and photoperiod was 16:8 L:D. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (200 µL of a 3:1 mixture of *Selenastrum* culture, density approximately 3.0 X 10^7 cells/mL and YCT). Test conditions are summarized in Appendix B, Table B-1.

Americamysis (Mysidopsis) bahia Tests

Test protocols for *Americamysis* are specified in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms (EPA/600/4-91/003, July 1994) The *Americamysis bahia* tests were seven days in duration, utilizing static-renewal protocols that require daily replacement of test solutions. The samples were tested at 100% concentration only. Bioassays were performed between 14 and 21 November 2001. The salinity of the runoff samples was adjusted to 30 ppt with a sea salt mixture (Forty Fathoms Bioassay Laboratory Formula), while the receiving water (Alamitos Bay) sample was tested at its ambient salinity (33 ppt). A concurrent salt control sample and a reference toxicant test were also performed, using copper sulfate as the test chemical.

Laboratory control water was natural seawater from our flow-through laboratory in Santa Cruz. Test organisms were 7-day-old juveniles purchased from Aquatic BioSystems, Fort Collins, CO. Renewal volumes of runoff and receiving waters were prepared daily during the test.

Testing was conducted with a total of 40 individuals per treatment, comprising eight replicate chambers containing five mysids. Test temperature was 26 1C and photoperiod was 16:8 light:dark. Test solutions were renewed daily concurrent with water quality measurements and assessment of survival. Each test container was fed twice daily with a standard amount of newly-hatched brine shrimp. After test termination, surviving animals were dried and weighed to determine growth. Test conditions are summarized in Appendix B, Table B-2.

Strongylocentrotus purpuratus Tests

Methods for the *Strongylocentrotus purpuratus* fertilization test are specified in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136, August, 1995).The *Strongylocentrotus purpuratus* tests were of very short duration (20 minute sperm exposure). Bioassays were performed on 15 November, 2001. Concentrated seawater brine was used to adjust the salinity of runoff samples to 33 ppt, resulting in unavoidable dilution of the test material. The Alamitos Bay sample was tested at 100% concentration only, while the runoff samples were tested at five concentrations (3.1%, 6.25%, 12.5% 25% and 50%). Concurrent brine control and reference toxicant bioassays were also performed, using copper sulfate as the test chemical.

Laboratory control water was natural seawater from our flow-through laboratory system in Santa Cruz. Gravid sea urchins were supplied to us in a cooperative exchange agreement with a University of California at Davis toxicology laboratory. A brine control was prepared from a mixture of 50% brine and 50% deionized water, and tested with each sample set. Concentrations of salinity adjusted runoff water were prepared using laboratory control water as diluent.

Testing was conducted using four replicate test containers per treatment. A pre-test was conducted to determine the minimum sperm:egg ratio necessary to achieve 95% fertilization. An appropriate volume of diluted sperm suspension was pipetted into each test tube containing test treatments. The sperm was allowed to remain in contact with the test solutions for exactly 20 minutes, whereupon a standardized number of eggs was added to each. Exactly 20 minutes were allowed for fertilization to occur, after which time formalin was added to halt fertilization and preserve eggs and embryos. Each test container was examined microscopically to determine the percentage of eggs fertilized. Test conditions are summarized in Appendix B, Table B-3.

RESULTS

Results of all bioassays are summarized in Table 2; and details of data and statistical analyses are contained in Toxis reports in Appendix A.

***CERIODAPHNIA* REPRODUCTION AND SURVIVAL** data are tabulated, and results of statistical analyses are summarized and presented in Appendix A; Toxis reports 19895CD-BP (Belmont Pump), 19895CD-BC (Bouton Creek) and 19895CD-CC (Cerritos Channel).

For the Belmont Pump Station sample Fisher's Exact Test showed significantly decreased survival in all runoff water concentrations. The NOEC was <6.25% and the LOEC was 6.25%. The LC_{50} for survival was 3.9% sample with 95% confidence limits of 3.12% and 5.21%. Reproduction data were not normally distributed, and variance was non-homogeneous. Wilcoxon's test with Bonferroni's adjustment showed significantly decreased reproduction in the 12.5% runoff water concentration. The NOEC was 6.25% and the LOEC was 12.5%. The IC_{50} for reproduction was 7.95% sample.

For the Bouton Creek sample Fisher's Exact Test showed significantly decreased survival in the 100% and 50% runoff water samples. The NOEC for survival was 25% and the LOEC was 50%. The LC_{50} for survival was 36% with 95% confidence limits of 32.1% and 37.5%. Reproduction data were not normally distributed and variance was not homogeneous. Wilcoxon's Test with Bonferroni's adjustment showed significantly decreased reproduction in the 100% and 50% runoff water concentrations. The NOEC for reproduction was 25% and the LOEC was 50%. The IC_{50} for reproduction was 42.2% with 95% confidence limits of 38.7% and 44.8%.

For the Los Cerritos Channel Sample Fisher's Exact Test showed significantly decreased survival in the 100%, 50% and 25% runoff water concentrations. The NOEC for survival was 12.5% and the LOEC was 25%. The LC_{50} for survival was 21.4% with 95% confidence limits of 19.4% and 29.2%. Reproduction data were not normally distributed and variance was not homogeneous. Steel's Test showed significantly decreased reproduction in the 100%, 50% and 25% runoff water concentrations. The NOEC for reproduction was 12.5% and the LOEC was 25%. The IC_{50} for reproduction was 19.9% sample, with 95% confidence limits of 18.8% and 22.0%.

All three tests met all protocol acceptability criteria: laboratory controls produced 100% survival (80% needed to pass) and mean reproduction in control animals was • 15 offspring.

Quality Assurance - Ceriodaphnia

A chronic reference toxicant bioassay was run concurrently with tests of the stormwater samples. The results of the *Ceriodaphnia* reference toxicant test (using KCl as the toxicant) are presented in Appendix A, Toxis® report 19895CD-R.

The LC_{50} for survival was 0.660 g/L KCl (95% confidence limits = 0.58 - 0.75 g/L). The IC_{50} for reproduction was 0.63 g/L KCl, with 95% confidence limits of 0.45 - 0.70 g/L. These results are within laboratory control chart limits for reproduction (0.28 - 0.63 g/L) and for survival (0.28 - 0.70 g/L), suggesting that this group of test organisms demonstrated typical sensitivity.

Environmental monitoring data for the effluent tests and those for the reference toxicant tests are presented in the Toxis® reports in Appendix A.

***AMERICAMYSIS* SURVIVAL AND GROWTH** data are tabulated, and results of statistical analyses are summarized and presented in Appendix A TOXIS reports 19895MY-AB (Alamitos Bay), 19895MY-BP (Belmont Pump), 19895MY-BC (Bouton Creek) and 19895MY-CC(Los Cerritos Channel).

For the Alamitos Bay sample there were no statistically significant reductions in survival or growth in the Alamitos Bay receiving water sample vs. laboratory controls. Survival in the test sample (98%) exceeded survival in the laboratory seawater control (88%) and mean growth in receiving water was slightly greater (• • = 0.37 mg) than in laboratory control water (• = 0.36 mg).

For the Belmont Pump Station sample Wilcoxon's Rank Sum Test with Bonferroni's adjustment showed that the sample produced significantly decreased survival when compared with either laboratory controls or brine controls. The sample produced 0% survival compared to 95% survival in the laboratory seawater control, and 100% survival in the artificial salt control. Because there were no survivors in the sample, the growth endpoint was not calculable.

For the Bouton Creek sample t-tests or Wilcoxon's Rank Sum Test showed that the sample produced significantly decreased survival and growth when compared with either laboratory controls or brine controls. The sample produced 45% survival compared to 95% and 100% survival in the two controls, with average growth of 0.21 mg versus 0.36 - 0.37 mg in the controls.

For the Los Cerritos Channel sample t-tests or Wilcoxon's Rank Sum Test showed that the sample produced significantly decreased survival and growth when compared with either laboratory controls or brine controls. The sample produced 67.5% survival compared to 95% and 100% survival in the two controls, with average growth of 0.25 mg versus 0.36 - 0.37 mg in the controls.

All four tests met test acceptability criteria: survival in laboratory controls was between 95% and 100% (need 80%) and mean weight was between 0.36 and 0.37 mg / mysid (need at least 0.20).

Quality Assurance - *Americamysis*

A chronic reference toxicant bioassay was run concurrently with tests of the runoff samples. The results of the *Americamysis* reference toxicant test (using copper sulfate as the toxicant) are presented in Appendix A, Toxis® report 19895MY-R.

The LC_{50} for survival was 242 ug/L Cu (95% confidence limits = 225 - 259 ug/L). The EC_{50} for growth was 217 ug/L Cu, with 95% confidence limits of 203 - 229 u g/L. These results are within laboratory control chart limits for growth (113 - 344 ug/L) and for survival (121 - 399 ug/L), suggesting that this group of test organisms demonstrated typical sensitivity.

Environmental monitoring data for the effluent tests and those for the reference toxicant tests are presented in the Toxis® reports in Appendix A.

***STRONGYLOCENTROTUS* FERTILIZATION** data are tabulated, and results of statistical analyses are summarized in Appendix A TOXIS reports 19895SP-AB (Alamitos Bay), 19895SP-BP (Belmont Pump), 19895SP-BC (Bouton Creek) and 19895SP-CC(Los Ceritos Channel). One sample (Bouton Creek) produced a discontinuous dose response due to an anomalous response in all four replicates of the 6.25% concentration. This concentration produced virtually no fertilization, whereas all other concentrations produced between 49% and 96% fertilization. All replicates of the 6.25% concentration were excluded from statistical analyses.

For the Alamitos Bay sample the receiving water did not produce significantly reduced fertilization of sea urchin eggs compared to the laboratory seawater control exposures.

For the Belmont Pump sample a modified Dunnett's Test with two controls showed significantly reduced fertilization in the 50%, 25%, 12.5% and 6.25% concentrations. The NOEC was 3.1% sample and the LOEC was 6.25% sample. The EC_{50} was >50% sample.

For the Bouton Creek sample a modified Dunnett's Test with two controls showed significantly reduced fertilization in the 50%, 25% and 12.5% concentrations. The NOEC was 3.1% sample and the LOEC was 12.5% sample. Note that the 6.25% concentration was not included in the statistical calculations (see above). The EC_{50} was 47% sample.

For the Los Cerritos Channel sample the Modified Dunnett's Test with two controls indicated that every concentration of Los Cerritos Channel runoff water produced significantly decreased fertilization of sea urchin eggs. The LOEC was 3.1% and the NOEC was <3.1% sample. The EC_{50} for fertilization was >50%.

All four tests met acceptability criterion of • 70% fertilization in the control exposures.

Quality Assurance - *Strongylocentrotus.*

A reference toxicant bioassay was run concurrently with the tests of the runoff and receiving water samples. The EC_{50} for copper was 31.9 ug/L , which was within the limits of our laboratory control chart. Control chart limits were 0.01 and 45.6 ug/L copper.

Environmental monitoring data for the effluent tests and those for the reference toxicant tests are presented in the Toxis® reports in Appendix A.

SUMMARY AND DISCUSSION

Two marine species and one freshwater species were used to assess toxicity of wet weather runoff water collected from three locations within the City of Long Beach. Additionally, the two marine species were tested with a sample of water collected at the receiving location at Alamitos Bay. Results were as follows:

-The water sample from the Belmont Pump Station produced measurable toxicity to all three test organisms at the maximum concentration tested. TIEs were triggered for *Ceriodaphnia* and *Americamysis*, but not for *Strongylocentrotus.*

-The water sample from Bouton Creek produced measurable toxicity to all three test species. TIEs were triggered for *Ceriodaphnia* and *Strongylocentrotus*. but not to *Americamysis*.

-The water sample from Los Cerritos Channel produced measurable toxicity to all three test species. A TIE was triggered for *Ceriodaphnia*, but not for *Americamysis* or for *Strongylocentrotus.*

-The Alamitos Bay receiving water sample did not show toxicity to either of the two marine species tested.

Bioassays performed with all three species met all quality assurance guidelines and test acceptability criteria, and the data can be viewed with full confidence. Results of TIEs are reported in a separate report.

Table 1. Samples received, City of Long Beach Wet Weather Runoff, 14 November 2001.

Sample Date/ Time	Field Sample ID	Site Name	Lab Sample ID	Toxis ID
11/12/2001; 20:20	LB2-BP-Comp-1	Belmont Pump	T-19895 -01	19895xx-BP
11/13/2001; 11:45	LB2-BC-Comp-1	Bouton Creek	T-19895 -02	19895xx-BC
11/12/2001; 23:50	LB2-CC-Comp-1	Los Cerritos Channel	T-19895 -04	19895xx-CC
11/12/2001; 21:00	LB2-Abay-Grab-1	Alamitos Bay	T-19895 -05	19895xx-AB

"xx": CD = *Ceriodaphnia* MY = *Americamysis* SP = *Strongylocentrotus*

Table 2. Bioassay Results Summary, City of Long Beach Wet Weather Runoff, 14 November 2001.

Test Species	Test Endpoint	Belmont Pump	Bouton Creek	Los Cerritos Channel	Alamitos Bay*
C. dubia- Survival	LC50	3.91%[TIE]	36.1%[TIE]	21.4%[TIE]	na
	NOEC	<6.25%	25%	12.5%	na
Reproduction	IC50	7.95%	42.2%	19.9%	na
	NOEC	6.25%	25%	12.5%	na
*A. bahia**- Survival	• Percent	0.0[TIE]	45.0	67.5	98.0
	Sig < Control?	Yes	Yes	Yes	No
Growth	• mg	nm	0.11	0.25	0.36
	Sig < Control?	nc	Yes	Yes	No
S. purpuratus-Fertilization	EC50	>50%	47%[TIE]	>50%	na
	NOEC	3.1%	3.1%	<3.1%	>100%

[TIE] TIE triggered na = not applicable nm = not measured (no survivors to weigh) nc = not calculable

*Exposures to 100% sample only.

ToxScan Incorporated

BIOASSAY RESULTS

City of Long Beach Dry Weather Runoff Samples

Chronic Toxicity Tests:

Ceriodaphnia dubia Survival and Reproduction
Strongylocentrotus purpuratus Fertilization

SAMPLES RECEIVED:
9 May 2002 and 15 May 2002

T-20307 and **T-20312**

Prepared for:
KINNETIC LABORATORIES, INC
Santa Cruz, California

Prepared by:
TOXSCAN, INC.
BIOASSAY DIVISION
Watsonville, California

June 2002

Introduction

ToxScan, Inc. conducted chronic toxicity tests on three wet weather runoff samples collected by Kinnetic Laboratories, Inc. from three locations within the City of Long Beach. The time-and-flow composited samples were collected from stations at Belmont Pump, Bouton Creek and Los Cerritos Channel under KLI Task Number 585.06. In addition, a grab sample of receiving water was collected from Alamitos Bay. Sample ID's are summarized in Table 1.

The toxicity tests were conducted using one freshwater species (*Ceriodaphnia dubia*) and one species of marine organism (*Strongylocentrotus purpuratus*) that was additionally tested with the receiving water sample from Alamitos Bay. The mysid *Americamysis bahia* was not tested with these samples. The results of the toxicity tests were used to determine triggering of Toxicity Identification Evaluations (TIE's) with each sample/species combination. Results of TIE's are reported elsewhere.

The initial sample collected on 9 May 2002 (ToxScan ID T-20307-03) from the Bouton Creek station was moderately saline (13.1‰). This level of salinity is more than 4X the published acute LC50 for *Ceriodaphnia dubia*. Therefore, the station was resampled on 14 May 2002 (ToxScan ID T-20312-01) under more favorable tide conditions. This sample was slightly saline (7.3‰) but useable in the *Ceriodaphnia* bioassay (see Discussion).

Methods

Ceriodaphnia dubia Tests

The test methods for *Ceriodaphnia* followed protocols outlined in Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (EPA/600/4-91/002, July 1994). The *Ceriodaphnia dubia* tests were six days in duration, utilizing static-renewal protocols, which require daily replacement of test solutions. The bioassays were performed between 10 and 16 May 2002 (T-20307) and 15 and 21 May (T-20312). The experimental design called for testing laboratory water controls to serve as evidence of laboratory quality assurance and for testing stormwater at 6.25%, 12.5%, 25%, 50% and 100% concentrations. A concurrent reference toxicant test was also performed using potassium chloride as the test chemical.

Laboratory control water was EPA moderately hard (E-pure) with 10% Perrier plus selenium. Test organisms were <24 hr old neonates derived from in-house cultures. Original broodstock was from EPA Duluth and cultured in EPA moderately hard water prepared with E-Pure water. Concentrations of runoff water were prepared daily during the test, using the laboratory control water as dilution water.

Testing was conducted with 10 individuals per treatment, each in individual plastic cups containing 20 mL of test solution. Test temperature was 25 ± 1°C and photoperiod was 16:8 L:D. Test solutions were renewed daily, concurrent with transfers, water quality measurements and assessment of survival and reproduction. At each daily transfer, new media were inoculated with food (200 µL of a 3:1 mixture of *Selenastrum* culture, density approximately 3.0 X 10^7 cells/mL and YCT). Test conditions are summarized in Appendix B, Table B-1.

Strongylocentrotus purpuratus Tests

Methods for the *Strongylocentrotus purpuratus* fertilization test are specified in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to West Coast Marine and Estuarine Organisms (EPA/600/R-95/136, August, 1995).The *Strongylocentrotus purpuratus* tests are of very short duration (20 minute sperm exposure). Bioassays were performed on 10 May, 2002 (T-20307) and 16 May (T-20312). Concentrated seawater brine was used to adjust the salinity of runoff samples to 33 ppt, resulting in unavoidable dilution of the test material. The Alamitos Bay sample was tested at 100% concentration only, while the runoff samples were tested at five concentrations (3.1%, 6.25%, 12.5% 25% and 50%). Concurrent brine control and reference toxicant (CuSO4) bioassays were also performed.

Laboratory control water was natural seawater from our flow-through laboratory system in Santa Cruz. Gravid sea urchins were supplied to us in a cooperative exchange agreement with a University of California at Davis toxicology laboratory. A brine control was prepared from a mixture of 50% brine and 50% deionized water, and tested with each sample set. Concentrations of salinity adjusted sample waters were prepared using laboratory control water as diluent.

Testing was conducted using four replicate test containers per treatment. A pre-test was conducted to determine the minimum sperm:egg ratio necessary to achieve 95% fertilization. An appropriate volume of diluted sperm suspension was pipetted into each test tube containing test treatments. The sperm was allowed to remain in contact with the test solutions for exactly 20 minutes, whereupon a standardized number of eggs was added to each. Exactly 20 minutes were allowed for fertilization to occur, after which time formalin was added to halt fertilization and preserve eggs and embryos. Each test container was examined microscopically to determine the percentage of eggs fertilized. Test conditions are summarized in Appendix B, Table B-2.

RESULTS

Results of all bioassays are summarized in Table 2; and details of data and statistical analyses are contained in Toxis reports in Appendix A.

***CERIODAPHNIA* REPRODUCTION AND SURVIVAL** data are tabulated, and results of statistical analyses are summarized and presented in Appendix A; Toxis reports 20307CD-BP (Belmont Pump), 20312CD-BC (Bouton Creek) and 20307CD-CC (Cerritos Channel).

For the Belmont Pump Station sample Fisher's Exact Test showed no significantly decreased survival in all runoff water concentrations. The NOEC was >100% and the LOEC was >100%. The LC_{50} for survival was >100% sample. Reproduction data were not normally distributed, and variance was non-homogeneous. Wilcoxon's test with Bonferroni's adjustment showed no significantly decreased reproduction in the any of the runoff water concentrations. The NOEC was >100% and the LOEC was >100%. The IC_{50} for reproduction was also >100% sample.

For the Bouton Creek sample Fisher's Exact Test showed significantly decreased survival in the 100% and 50% runoff water samples. The NOEC for survival was 25% and the LOEC was 50%. The LC_{50} for survival was 37.5% with 95% confidence limits not calculable. Reproduction data were normally distributed but variance was not homogeneous. Wilcoxon's Test with Bonferroni's adjustment showed significantly decreased reproduction in the 100%, 50%, 25% and 12.5% runoff water concentrations. The NOEC for reproduction was 6.25% and the LOEC was 12.5%. The IC_{50} for reproduction was 29.6% with 95% confidence limits of 12.0% and 33.6%.

For the Los Cerritos Channel Sample Fisher's Exact Test showed no significantly decreased survival in any of the runoff water concentrations. The NOEC for survival was >100%% and the LOEC was >100%. The LC_{50} for survival was >100%% with 95% confidence limits not calculable. Reproduction data were normally distributed but variance was not homogeneous. Steel's Test showed no significantly decreased reproduction in any of the runoff water concentrations. The NOEC for reproduction was >100% and the LOEC was >100%. The IC_{50} for reproduction was also >100% sample.

Both tests met all protocol acceptability criteria: laboratory controls produced 100% survival (80% needed to pass) and mean reproduction in control animals was • 15 offspring.

Quality Assurance - Ceriodaphnia

Chronic reference toxicant bioassays were run concurrently with tests of each stormwater sample. The results of the *Ceriodaphnia* reference toxicant tests (using KCl as the toxicant) are presented in Appendix A, Toxis® report 20307CD-R.

The LC_{50} for survival was 0.44 g/L KCl (95% confidence limits = 0.36 - 0.53 g/L). The IC_{50} for reproduction was 0.42 g/L KCl, with 95% confidence limits not calculable. These results are within laboratory control chart limits for reproduction (0.29 - 0.63 g/L) and for survival (0.35 - 0.71 g/L), suggesting that this group of test organisms demonstrated typical sensitivity.

Environmental monitoring data for the effluent tests and those for the reference toxicant tests are presented in the Toxis® reports in Appendix A.

S*TRONGYLOCENTROTUS* FERTILIZATION data are tabulated, and results of statistical analyses are summarized in Appendix A TOXIS reports 20307SP-AB (Alamitos Bay), 20307SP-BP (Belmont Pump), 20307SP-BC (Bouton Creek) and 20307SP-CC (Los Cerritos Channel).

For the Alamitos Bay sample the receiving water did not produce significantly reduced fertilization of sea urchin eggs compared to the laboratory seawater control exposures.

For the Belmont Pump sample a modified Dunnett's Test with two controls showed significantly reduced fertilization in the 50% concentration only. The NOEC was 25% sample and the LOEC was 50% sample. The EC_{50} was 47.3% sample.

For the Bouton Creek sample a modified Dunnett's Test with two controls showed no significantly reduced fertilization in any of the concentrations. The NOEC was 100% sample and the LOEC was >100% sample. The EC_{50} was >50% sample.

For the Los Cerritos Channel sample the Modified Dunnett's Test with two controls indicated that the 50% and 25% concentrations of Los Cerritos Channel runoff water produced significantly decreased fertilization of sea urchin eggs. The NOEC was 12.5% and the LOEC was 25% sample. The EC_{50} for fertilization was 31.8%.

All four tests met acceptability criterion of • 70% fertilization in the control exposures.

Quality Assurance - *Strongylocentrotus.*

A reference toxicant bioassay was run concurrently with each test of the runoff and receiving water sample (T-20307 and T-20312). The IC_{25} for copper was 12.2 and 36.1 ug/L, which was within the limits of our laboratory control chart (0.03 and 55.9 ug/L copper).

Environmental monitoring data for the effluent tests and those for the reference toxicant tests are presented in the Toxis® reports in Appendix A.

SUMMARY AND DISCUSSION

One marine species and one freshwater species were used to assess toxicity of wet weather runoff water collected from three locations within the City of Long Beach. Additionally, the marine species was tested with a sample of water collected at the receiving location at Alamitos Bay. Results were as follows:

-The water sample from the Belmont Pump Station produced measurable toxicity at the maximum concentration tested. A TIE was triggered for *Strongylocentrotus.*

-The water sample from Bouton Creek produced measurable toxicity to *Ceriodaphnia* survival and reproduction. However, a TIE was not triggered because approximately 2.8 TU (based on 48 hr LC50s; USEPA 1991) of the observed 3.4TU toxicity was attributable to the high salinity of the sample.

-The water sample from Los Cerritos Channel produced measurable toxicity to *Strongylocentrotus* at the two highest concentrations. A TIE was triggered for *Strongylocentrotus.*

-The Alamitos Bay receiving water sample did not show toxicity to *Strongylocentrotus.*

Bioassays performed with all three species met all quality assurance guidelines and test acceptability criteria, and the data can be viewed with confidence.

The following adjustments were made during bioassay testing to maintain acceptable water quality parameters:

-For *Ceriodaphnia*:: Bouton Creek 100% sample was received at 7.2‰ salinity, equivalent to approximately 2.8TU. Sample toxicity was evaluated for TIE induction by subtracting the calculated salinity-caused toxicity from the observed sample toxicity. Los Cerritos Channel 100% sample required daily pH adjustment of the renewal waters, from pH 10.0 to pH • 9, using 0.12N HCl.

-For *Strongylocentrotus*:Reference toxicant control chart C.V. was >50% during these tests.

TIE results are presented in a separate report.

<u>Reference</u>

USEPA. 1991. Methods for aquatic toxicity identification evaluations: Phase I toxicity characterization procedures (2nd Edition). U.S. Environmental Protection Agency, Environmental Research Laboratory-Duluth Technical Report EPA/600/6-91/003, Duluth, MN.

Table 1. Samples received 10 and 15 May 2002, City of Long Beach Dry Weather Runoff,

Sample Date/ Time	Field Sample ID	Site Name	Lab Sample ID	Toxis ID
5/9/2002 05:10	LB2-Abay-Grab-3	Alamitos Bay	T-20307 -01	20307xx-AB
5/9/2002 05:45	LB2-BP-Comp-3	Belmont Pump	T-20307-02	20307xx-BP
5/9/2002 04:20	LB2-BC-Comp-3	Bouton Creek	T-20307-03	20307xx-BC
5/9/2002 06:15	LB2-CC-Comp-3	Los Cerritos Channel	T-20307-05	20307xx-CC
5/14/2002 08:00	LB2-BC-Comp-3	Bouton Creek	T-20312-01	20312xx-BC

"xx": CD = *Ceriodaphnia* SP = *Strongylocentrotus*

Table 2. Bioassay Results Summary, City of Long Beach Wet Weather Runoff, 5 and 10 May 2002.

Test Species	Test Endpoint	Belmont Pump	Bouton Creek**	Los Cerritos Channel	Alamitos Bay*
C. dubia- Survival	LC50	>100	37.5	>100	na
	NOEC	>100	25	>100	na
Reproduction	IC50	>100	29.6	>100	na
	NOEC	>100	6.25	>100	na
S. purpuratus-Fertilization	EC50	47.6 TIE	>50	31.8 TIE	na
	NOEC	25	>50	12.5	>100

TIE TIE triggered na = not applicable

*Exposures to 100% sample only. **T-20312 resample; see text.

City of Long Beach
Dry Weather Addendum

NPDES Permit No. CAS004003 (CI 8052)

AUGUST 2001

Prepared By

Kinnetic Laboratories, Inc.

and

Southern California Coastal
Water Research Project

Submitted By

City
Of
Long
Beach

1.0 INTRODUCTION

The City of Long Beach received an NPDES Permit issued by the California Regional Water Quality Control Board, Los Angeles Region on 30 June 1999 (Order No 99-060, NPDES No. CAS004003, (CI 8052)). This order defines Waste Discharge Requirements for Municipal Storm Water and Urban Runoff discharges within the City of Long Beach. Specifically, the permit regulates discharges of storm water and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems, into receiving waters of the Los Angeles Basin.

The NPDES permit requires the City of Long Beach to prepare, maintain, and update if necessary a monitoring plan. The specified monitoring plan requires the City to monitor three (Year 1) and four (Year 2) discharge sites draining representative urban watersheds (mass emission sites) during the first two years of the monitoring program. Flow, chemical analysis of water quality, and toxicity are to be monitored at each of these sites for four representative storm events each year. During the dry season, inspections and monitoring of these same discharge sites are to be carried out twice, with the same water quality characterization and toxicity tests to be run. In addition, one receiving water body (Alamitos Bay) is to be monitored for bacteria and toxicity during both the wet and the dry seasons and the effect of a dry weather diversion documented.

At the time the Year 2 report was submitted, the second dry weather sampling event was not completed. The purpose of this present report is to transmit the results of the City of Long Beach's final dry weather event for the second year, 2000-2001.

2.0 DRY WEATHER FIELD SAMPLING PROCEDURES

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site. Data from the first dry weather survey was reported in the City of Long Beach's Annual NPDES Monitoring Report. The second survey was conducted on August 16, 2001.

Inspections at each site included whether water was present and whether this water was flowing or just ponded. At sites that were found not to have flowing water, inspections were done in the upstream drains to verify that flow was not occurring into the site. As in previous surveys, no dry weather discharges were evident at the Dominguez Gap Pump. Dry weather monitoring was therefore conducted at three mass emission sites and in Alamitos Bay (Table 1).

Table 1 Station Coordinates for Dry Weather Monitoring Stations.

	State Plane Coordinates: Zone 5		North American Datum (NAD) 83	
Station Name	**Northing (ft)**	**Easting (ft)**	**Latitude**	**Longitude**
Belmont Pump	1734834.9	6522091.2	33° 45' 36.6"N	118° 07' 48.7"W
Bouton Creek	1741960.5	6529305.2	33° 46' 44.3"N	118° 06' 23.4"W
Cerritos Channel	1747935.9	6530153.2	33° 47' 43.3"N	118° 06' 13.4"W
Alamitos Bay (Floating Dock)	1732942.2	6521892.8	33° 45' 15.0"N	118° 07' 52.0"W

When flowing water was present at one of these mass emission sites, then water quality measurements, flow estimates, and water samples were taken along with observations of site conditions. Flowing water was present and all measurements were taken at Bouton Creek, the Belmont Pump Station, and at Los Cerritos Channel. Temperature and conductivity were measured with an Orion Model 140 meter, pH with an Orion Model 250 meter, oxygen was measured with an Orion Model 840 meter.

Water samples were collected at the Belmont Pump Station and the Los Cerritos Channel Station by use of an automatic peristaltic pump sampler that collected aliquots every half hour for a 24-hour period. For the Bouton Creek Station where tidal influences are present, a similar sample was also collected over a 24-hour period where the tide was sufficiently low to sample just the fresh water discharge down the creek. Additional grab samples were taken just after the time-composited samples for MTBE, TPH, and bacteria. All samples were chilled to 4 ^{0}C and transported to the appropriate laboratory for analysis.

3.0 LABORATORY ANALYSIS

The water quality constituents selected for this program were established based upon the requirements of the City of Long Beach NPDES permit for storm water discharges. Analytical methods are based upon approved USEPA methodology. The following sections detail laboratory methods for chemical and biological testing.

3.1 Analytical Suite and Methods

Conventional, bacteriological, and chemical constituents selected for inclusion in this storm water quality program are presented in Table 4.2 of the Annual Report. Analytical method numbers, holding times, and reporting limits are also indicated for each analysis.

3.2 Laboratory QA/QC

Quality Assurance/ Quality Control (QA/QC) activities associated with laboratory analyses are detailed in Appendix A. Appendix A was modified to incorporate QA/QC review for the entire 2000-2001 data set.

The laboratory QA/QC activities provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness. Analytical quality assurance for this program included the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, USEPA methods and written SOPs.
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates and SRMs.
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks included the use of internal standards, method blanks, matrix spike/spike duplicates, duplicates, laboratory control spikes and Standard Reference Materials (SRMs).

Data validation was performed in accordance with the National Functional Guidelines for Organic Data Review (EPA540/R-94/012), Inorganic Data Review (EPA540/R-94/013), and Guidance on the Documentation and Evaluation of Trace Metals Data Collected for the Clean Water Act Compliance Monitoring (EPA/821/B/95/002).

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site. During the 1999-2000 year, the two dry weather inspections/sampling events were done in late June so that the results could be reported in the annual report due 15 July 2000. For the present year, the first of these dry weather inspections/samplings was done at all sites in June 2001 and the results are reported in this annual report. However, it was decided that it would be better to do the second sampling event later in the summer, and the results from this second event will be reported as an addendum to this annual report.

4.0 Water Quality Results

4.1 Basin 14: Dominguez Gap Monitoring Site

An inspection for dry weather flow was conducted at the Dominguez Gap Pump Station on 14 August 2001. No dry weather flow was observed. The basin in front of the pump house had approximately 1/8 inches of standing water in it. The source of this ponded water was not determined due to the lack of flow from any source. The concrete lined channel that extends east from, and discharges into, the basin had small, isolated pools of standing water, but there was no flow.

4.2 Basin 20: Bouton Creek Monitoring Site

Bouton Creek was sampled on 16 August from 0200 to 0515. This time corresponded to a period of low tide when the flow in the creek was not impeded by seawater backing into the creek. The tide levels at this time were between negative 0.05 and plus 1.0 feet in the Long Beach area. This assured that the flow was fresh water flowing downstream in the creek and that that saline tidal water did not commingle with the dry weather discharge of fresh water.

Every 30 minutes during the sampling period 2.25-liter aliquots of water were pumped from the creek using the automatic sampler installed at the site. An aliquot was deposited into each of five 20-liter borosilicate glass bottles. At the conclusion of the sampling, grab samples for MTBE, TPH, and bacteria were collected. All samples were chilled to 4° C, and transported to the appropriate laboratory for analysis. Conductivity and pH measurements were also taken at this time and these field measurements are summarized in Table 2. Results of the chemical analysis of this dry weather sample are summarized in Table 3.

4.3 Basin 23: Belmont Pump Station Monitoring Site

Time weighted composite sampling was conducted over a 24-hour period starting on 15 August 2001 at 0635 and ending on 16 August 2001 at 0535. Samples were collected from the sump using the automated sampler installed outside of the pump house. Samples were collected into four 20-liter bottles. Every half-hour for the 24 hours, an aliquot of approximately 1.67 liters of water was pumped from the sump into a 20-liter bottle. The bottles were changed every six hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the four bottles of water were combined into a composite, Grab samples for MTBE, TPH, and bacteria were manually collected from the sump upon completion of the 24-hour sampling on 16 August 2001 at 0640. All samples were chilled to 4° C and transported to the appropriate laboratory for analysis. The field measurements are summarized in Table 2. Results of the chemical analysis of this dry weather sample are summarized in Table 3.

4.4 Basin 27: Los Cerritos Channel Monitoring Site

Time weighted sampling was conducted over a 24-hour period of the water flowing through the channel. Sampling was started on 15 August at 0610 and completed on 16 August 2001 at 0510. Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. The dry weather flow is a narrow stream approximately 21 feet wide and 2 inches located in the middle of the channel. To reach the water, the sampling hose that is used for sampling storm water was extended an additional 33 feet. Every half-hour for 24 hours, an aliquot of approximately 1.67 liters of water was pumped into a 20-liter bottle. The bottles were change every six hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the four bottles of water were combined into a composite sample. After completion of the 24-hour sampling, on 16 August, grab samples were manually collected for MTBE, TPH, and bacteria. All samples were chilled to 4° C, and transported to the appropriate laboratory for analysis. The field measurements are summarized in Table 2. Results of the chemical analysis of this dry weather sample are summarized in Table 3.

4.5 Basin 23: Alamitos Bay Receiving Water Monitoring Site

Samples of water were collected at the Alamitos Bay Receiving Water Site occupied during the wet season in the vicinity of the pump station outfall from Basin 24. The samples were collected from the end of the swimming dock just north of the outfall. Sampling was done on the morning of June 5, 2001 at 9:15 a.m.. The outfall has a low-flow diverter that prevents dry weather flow from being discharged into the Bay. Samples for toxicity testing were collected in 1-gallon cubitainers by dipping them approximately one foot below the surface. In addition, grab-samples for bacteria and chemical analyses were also collected from the same site. All samples were cooled to 4° C and transported to the appropriate laboratories for analysis. Results of the bacterial analyses for these dry weather samples are summarized in Table 4.

Table 2. Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, August 2001.

	Bouton Creek	Belmont Pump	Los Cerritos
Date	**8/16/01**	**8/16/01**	**8/16/01**
Time	**0515**	**0640**	**0630**
Temperature (°C)	20.8	21.6	19.9
pH	8.15	8.14	8.17
Conductivity (mS/cm)	4.17	2.66	0.84
Flow (cfs)	0.?	0.086	3.6
Dissolved Oxygen (mg/L)	2.27	5.17	2.77

1 Flow was determined by measuring the depth and width of the water channel, as well as the velocity of a floating object in the water.

Table 3. Summary of Chemical Analyses of Dry Weather Monitoring, August 2001.

ANALYTE	BELMONT PUMP Aug 2001	BOUTON CREEK Aug 2001	LOS CERRITOS CHANNEL Aug 2001
CONVENTIONALS			
Oil and Grease (mg/L)	5.0U	5.0U	5.0U
Total Phenols	0.1U	0.1U	0.1U
Cyanide (µg/L)	5.0U	5.0U	5.0U
pH (units)	8.4	7.8	8.6
Dissolved Phosphorous (mg/L)	0.87	0.025	0.046
Total Phosphorous (mg/L)	0.86	0.36	0.12
Turbidity (NTU)	11	10	36
Total Suspended Solids (mg/L)	1.0U	10	58
Total Dissolved Solids (mg/L)	1800	5100	600
Volatile Suspended Solids (mg/L)	1.0U	1.0U	1.0U
Total Organic Carbon (mg/L)	11U	15U	13U
Total Recoverable Petroleum Hydrocarbon (mg/L)	5.0U	5.0U	5.0U
Biochemical Oxygen Demand (mg/L)	5.0U	26J	27J
Chemical Oxygen Demand (mg/L)	180	100	210
Total Ammonia-Nitrogen (mg/L)	0.13	0.11	0.58
Total Kjeldahl Nitrogen (mg/L)	0.90	4.1	1.8
Nitrite (mg/L)	0.2U	0.2U	0.2U
Nitrate (mg/L)	1.3	0.01U	0.068
Alkalinity (mg/L)	440	140	150
Specific Conductance (umhos/cm)	2800	7800	840
Total Hardness (mg/L)	350	890	170
MBAS (mg/L)	0.046	0.064	0.054
Chloride (mg/L)	560	2500	120
Fluoride (mg/L)	1.6	0.9	0.69
Sulfate (mg/L)	200	490	150
Methyl tertiary butyl ether (MTBE)	1.0U	1.0U	1.0U
BACTERIA (mpn/100 mL)			
Total Coliform	8,000	3,000	30,000
Fecal Coliform	2,300	230	2300
Fecal Streptococcus	2,980	1,810	4,880
TOTAL METALS (µg/L)			
Aluminum	140	84	97
Arsenic	3.9U	1.8U	1.2U
Beryllium	0.50U	0.50U	0.50U
Cadmium	0.25U	0.25U	0.57
Chromium	2.5	2.4	1.5
Copper	4.8U	15	17
Hexavalent Chromium	4.91JR	4.91JR	6.20R
Iron	330	220	320
Lead	0.99	3	3.5
Mercury	0.20U	0.20U	0.20U
Nickel	5.6	5.0	7.5
Zinc	13	21	43

Table 3. Summary of Chemical Analyses of Dry Weather Monitoring, August 2001. (continued)

	BELMONT PUMP	BOUTON CREEK	LOS CERRITOS CHANNEL
ANALYTE	**Aug 2001**	**Aug 2001**	**Aug 2001**
DISSOLVED METALS (µg/L)			
Aluminum	140	80	88
Arsenic	3.9U	1.5U	1.1U
Beryllium	0.5U	0.5U	0.5U
Cadmium	0.25U	0.25U	0.5
Chromium	2.4	2.4	1.3
Copper	4.8	15	16
Iron	50	60	40
Lead	0.97	2.9	3.2
Mercury	0.2U	0.2U	0.2U
Nickel	5.4	4.9	7.2
Zinc	13	21	39
CHLORINATED PESTICIDES (µg/L)			
Aldrin	0.005U	0.005U	0.005U
Alpha-BHC	0.05U	0.05U	0.05U
beta-BHC	0.05U	0.05U	0.05U
Delta-BHC	0.05U	0.05U	0.05U
gamma-BHC (lindane)	0.05U	0.05U	0.05U
Alpha-Chlordane	0.5U	0.5U	0.5U
gamma-Chlordane	0.5U	0.5U	0.5U
4,4'-DDD	0.05U	0.05U	0.05U
4,4'-DDE	0.05U	0.05U	0.05U
4,4'-DDT	0.01U	0.01U	0.01U
Dieldrin	0.01U	0.01U	0.01U
Endosulfan I	0.05U	0.05U	0.05U
Endosulfan II	0.05U	0.05U	0.05U
Endosulfan sulfate	0.05U	0.05U	0.05U
Endrin	0.01U	0.01U	0.01U
Endrin Aldehyde	0.01U	0.01U	0.01U
Endrin Ketone	0.1U	0.1U	0.1U
Heptachlor	0.01U	0.01U	0.01U
Heptachlor Epoxide	0.01U	0.01U	0.01U
Methoxychlor	0.5U	0.5U	0.5U
Toxaphene	0.5U	0.5U	0.5U
Total PCBs	1.0U	1.0U	1.0U

Table 3. **Summary of Chemical Analyses of Dry Weather Monitoring, August 2001. (continued)**

	BELMONT PUMP	BOUTON CREEK	LOS CERRITOS CHANNEL
ANALYTE	Aug 2001	Aug 2001	Aug 2001
CARBAMATE & UREA PESTCIDES (µg/L)			
Oxamyl	10U	10U	10U
Methoamyl	10U	10U	10U
Fenuron	4U	4U	4U
Monuron	4U	4U	4U
Propoxur	10U	10U	10U
Carbofuran	10U	10U	10U
Carbaryl	10U	10U	10U
Flumeturon	4U	4U	4U
Diuron	4U	4U	4U
Propham	10U	10U	10U
Siduron	10U	10U	10U
Methiocarb	10U	10U	10U
Linuron	4U	4U	4U
Swep	4U	4U	4U
Chlorprophan	10U	10U	10U
Brabane	10U	10U	10U
Neburon	4U	4U	4U
AROCLORS (µg/L)			
Aroclor-1016	1.0U	1.0U	1.0U
Aroclor-1221	1.0U	1.0U	1.0U
Aroclor-1232	1.0U	1.0U	1.0U
Aroclor-1242	1.0U	1.0U	1.0U
Aroclor-1248	1.0U	1.0U	1.0U
Aroclor-1254	1.0U	1.0U	1.0U
Aroclor-1260	1.0U	1.0U	1.0U
ORGANOPHOSPHATE PESTICIDES (µg/L)			
Diazinon	0.22	0.15	0.096
Dursban (chlorpyrifos)	0.05U	0.05U	0.05U
Malathion	0.1U	0.1U	0.1U
Prometryn	1.0U	1.0U	1.0U
Atrazine	1.0U	1.0U	1.0U
Simazine	1.0U	1.0U	1.0U
Cyanazine	1.0U	1.0U	1.0U
HERBICIDES (µg/L)			
Dalapon	2U	2U	2U
Dicamba	0.5U	0.5U	0.5U
MCPP	250U	250U	250U
MCPA	250U	250U	250U
Dichlorprop	1U	1U	1U
2,4-D	1U	1U	1U
2,4,5-TP-Silvex	0.5U	0.5U	0.5U
2,4,5-T	0.5U	0.5U	0.5U
2,4,5-DB	1U	1U	1U
Dinoseb	0.5U	0.5U	0.5U
Bentazon	1U	1U	1U
Glyphosate	5U	5U	5U

Table 3. Summary of Chemical Analyses of Dry Weather Monitoring, August 2001. (continued)

	BELMONT PUMP	BOUTON CREEK	LOS CERRITOS CHANNEL
ANALYTE	**Aug 2001**	**Aug 2001**	**Aug 2001**
SEMI-VOLATILES (µg/L)			
Acenaphthene	0.5U	0.5U	0.5U
Acenaphthylene	0.2U	0.2U	0.2U
Acetophenone	3.0U	3.0U	3.0U
Aniline	3.0U	3.0U	3.0U
Anthracene	0.5U	0.5U	0.5U
4-Aminobiphenyl	3.0U	3.0U	3.0U
Benzidine	3.0U	3.0U	3.0U
Benzo(a)anthracene	1.0U	1.0U	1.0U
Benzo(b)fluoranthene	1.0U	1.0U	1.0U
Benzo(k)fluoranthene	1.0U	1.0U	1.0U
Benzo(a)pyrene	1.0U	1.0U	1.0U
Benzyl butyl phthalate	3.0U	3.0U	3.0U
Bis(2-chloroethyl)ether	1.0U	1.0U	1.0U
Bis(2-chloroethoxy)methane	1.0U	1.0U	1.0U
Bis(2-ethylhexyl)phthalate	3.1	8.9	15.8
Bis(2-chlorisopropyl)ether	1.0U	1.0U	1.0U
4-Bromophenyl phenyl ether	1.0U	1.0U	1.0U
4-Chloroaniline	1.0U	1.0U	1.0U
1-Chloronaphthalene	1.0U	1.0U	1.0U
2-Chloronaphthalene	1.0U	1.0U	1.0U
4-Chlorophenyl phenyl ether	1.0U	1.0U	1.0U
Chrysene	1.0U	1.0U	1.0U
p-Dimethylaminoazobenzene	3.0U	3.0U	3.0U
7,12-Dimethylbenz(a)-anthracene	1.0U	1.0U	1.0U
a-,a-Dimethylphenethylamine	3.0U	3.0U	3.0U
Dibenz(a,j)acridine	3.0U	3.0U	3.0U
Dibenz(a,h)anthracene	1.0U	1.0U	1.0U
1,4-Dichlorobenzene	0.5U	0.5U	0.5U
1,3-Dichlorobenzene	0.5U	0.5U	0.5U
1,2-Dichlorobenzene	0.5U	0.5U	0.5U
3,3-Dichlorobenzidine	3.0U	3.0U	3.0U
Diethyl phthalate	0.5U	0.9	0.8
Dimethyl phthalate	0.5U	0.5U	0.5U
Di-n-butylphthalate	3.0U	3.0U	6.0
2,4-Dinitrotoluene	0.5U	0.5U	0.5U
2,6-Dinitrotoluene	0.5U	0.5U	0.5U
Diphenylamine	3.0U	3.0U	3.0U
1,2-Diphenylhydrazine	3.0U	3.0U	3.0U
Di-n-octylphthalate	3.0U	3.8	3.0U
Ethyl methanesulfonate	3.0U	3.0U	3.0U
Endrin Ketone	1.0U	1.0U	1.0U
Fluoranthene	1.0U	1.0U	1.0U
Fluorene	1.0U	1.0U	1.0U
Hexachlorobenzene	0.5U	0.5U	0.5U
Hexachlorobutadiene	1.0U	1.0U	1.0U
Hexachlorocyclopentadiene	3.0U	3.0U	3.0U

Table 3. Summary of Chemical Analyses of Dry Weather Monitoring, August 2001. (continued)

ANALYTE	BELMONT PUMP Aug 2001	BOUTON CREEK Aug 2001	LOS CERRITOS CHANNEL Aug 2001
SEMI-VOLATILES (µg/L) (continued)			
Hexachloroethane	1.0U	1.0U	1.0U
Indeno[1,2,3-cd]pyrene	1.0U	1.0U	1.0U
Isophorone	0.5U	0.5U	0.5U
3-Methylcholanthrene	3.0U	3.0U	3.0U
Methyl methanesulfonate	3.0U	3.0U	3.0U
Napthalene	0.5U	0.5U	0.5U
1-Naphthylamine	3.0U	3.0U	3.0U
2-Naphthylamine	3.0U	3.0U	3.0U
2-Nitroaniline	3.0U	3.0U	3.0U
3-Nitroaniline	3.0U	3.0U	3.0U
4-Nitroaniline	3.0U	3.0U	3.0U
Nitrobenzene	0.5U	0.5U	0.5U
N-Nitrosodimethylamine	3.0U	3.0U	3.0U
N-Nitrosodiphenylamine	3.0U	3.0U	3.0U
N-Nitroso-di-n-propylamine	1.0U	1.0U	1.0U
N-Nitrosopiperidine	3.0U	3.0U	3.0U
Pentachlorobenzene	3.0U	3.0U	3.0U
Phenacitin	3.0U	3.0U	3.0U
Phenanthrene	0.5U	0.5U	0.5U
2-Picoline	3.0U	3.0U	3.0U
Pronamide	5.0U	5.0U	5.0U
Pyrene	0.5U	0.5U	0.5U
1,2,4,5-Tetrachlorobenzene	3.0U	3.0U	3.0U
1,2,4-Trichlorobenzene	0.5U	0.5U	0.5U
Benzoic Acid	5.0U	5.0U	5.0U
Benzyl Alcohol	5.0U	5.0U	5.0U
4-Chloro-3-methylphenol	3.0U	3.0U	3.0U
2-Chlorophenol	2.0U	2.0U	2.0U
2,4-Dichlorophenol	2.0U	2.0U	2.0U
2,6-Dichlorophenol	2.0U	2.0U	2.0U
2,4-Dimethylphenol	2.0U	2.0U	2.0U
2,4-Dinitrophenol	3.0U	3.0U	3.0U
2-Methyl-4,6-dinitrophenol	3.0U	3.0U	3.0U
2-Methylphenol	3.0U	3.0U	3.0U
4-Methylphenol	3.0U	3.0U	3.0U
2-Nitrophenol	3.0U	3.0U	3.0U
4-Nitrophenol	3.0U	3.0U	3.0U
Pentachlorophenol	2.0U	2.0U	2.0U
Phenol	1.0U	1.0U	1.0U
2,3,4,6-Tetrachlorophenol	1.0U	1.0U	1.0U
2,4,5-Trichlorophenol	1.0U	1.0U	1.0U
2,4,6-Trichlorophenol	1.0U	1.0U	1.0U

"R" Qualifier denotes rejection of associated data based upon QAQC review

"U" Qualifier denotes analyte not detected above the level of the associated value.

The associated value is either the sample quantitation limit or the sample reporting limit.

Table 4. Concentration of Bacteria in Alamitos Bay, 16 August 2001

BACTERIA (mpn/100 mL)	
Total Coliform	11
Fecal Coliform	4
Fecal Streptococcus	1.0U

5.0 TOXICITY RESULTS

The second set of dry weather samples for the 2000-2001 Monitoring Program were taken on August 16, 2001. Toxicity tests were performed within 48 hours of collection. Three species were tested: water flea (*Ceriodaphnia dubia*, freshwater crustacean), mysid (*Americamysis bahia*, marine crustacean), and sea urchin (*Strongylocentrotus purpuratus*, marine echinoderm).

5.1 Belmont Pump Station

No toxicity was found in any of the three tests performed (Table 5). Slight mortality was observed in both the mysid and water flea tests. However, mysid survival was greater than 90% in all concentrations and mysid weight showed no downward trend. Water flea survival for the 100% treatment was 80%. A decrease in reproduction was also observed. Neither result was significantly different from the controls. In the sea urchin test, sample fertilization values exceeded those of the controls.

5.2 Bouton Creek

Toxicity was observed in the 100% treatment of the water flea test, which had zero survival (Table 1). Reproduction was also significantly reduced in the 50% treatment. All treatments in the mysid test had $\geq$ 95% survival and no reduction in weight was observed. Sea urchin fertilization for all treatments was $\geq$ 98%.

5.3 Cerritos Channel

Water flea survival was significantly reduced in the 100% treatment (Table 5). The 100% and 50% treatments caused a significant reduction in water flea reproduction. No toxicity was observed in mysid survival or weight. Sea urchin fertilization for the 50% treatment was 99%, indicating no toxicity.

5.4 Alamitos Bay Receiving Water

The receiving water sample was tested at 100% using the mysid and sea urchin tests. Neither test showed toxicity (Table 6). Mysid survival was 95%; mysid weight was greater than the control. The sea urchin test had 98% fertilization.

5.5 Laboratory Quality Assurance/Quality Control Assessment

All of the tests met critical test acceptability criteria and the results were judged to be valid. Minor deviations in test procedure occurred in all tests but did not have a significant effect on the results. The QA/QC results are summarized below.

The water flea tests met protocol acceptability criteria. The reference toxicant fell within control chart limits.

The mysid tests all met acceptability criteria for survival (>80%) and weight ($\geq$0.20 mg/mysid). The EC50 for the reference toxicant was within control chart limits. The temperature fell within a degree below the recommended range (25-27°C) in all of the stations. This was not seen to have an effect on the results of the test, as there was no toxicity at any station.

The sea urchin fertilization tests produced very low fertilization in the controls as well as high variability throughout the test. We retested the samples the following day and received results that passed test acceptability criteria. These samples were tested after the 36-hour holding time. The EC50 for the reference toxicant (5.5 μg/L) fell below control chart limits (11.2-68.4 μg/L Cu). This could indicate a sensitive batch of animals, possibly due to their being out of spawning season, or a change in water chemistry affecting metal bioavailability. All of the brine controls had poor fertilization (<70%), though none were found to be significantly different from the seawater controls. This did not seem to have an effect on test results since no toxicity was observed. Water quality data from S522 (Bouton Creek) were recorded but then misplaced. All other water quality data were recorded and indicated that all test exposure conditions were within normal limits.

6.0 DISCUSSION

The results from the August 16, 2001 dry weather sampling continue to indicate variability in the water quality and toxicity of dry weather runoff from each station. Water quality results agree with previous surveys conducted in 2000. Belmont did not produce toxicity in any species. This data, combined with two other non-toxic events, may indicate that the toxicity observed in the 6/29/00 sample is uncommon. Bouton showed toxicity in *Ceriodaphnia*, but the sample had a conductivity that exceeded the tolerance of the water flea. High conductivity is also believed to be the cause for toxicity in 6/6/01 samples. The Los Cerritos sample produced moderate toxicity in the water flea. The sample from 6/6/01 also produced toxicity but in the sea urchin instead of the water flea. This may be due to different constituents in the runoff and the varying sensitivities of the test organisms to said constituents. No toxicity was observed in the Alamitos receiving water sample. These data agree with all previous Alamitos results.

APPENDIX A

SUMMARY OF TOXICITY TEST RESULTS

Project: Long Beach Stormwater
Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: MB53
Test Ended: 8/24/01

Test Method: Mysid survival and growth
Species: *Americamysis bahia*
Supervising Technician: Jeff Brown

Laboratory: SCCWRP

		% Survival				Weight (mg/mysid)			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
LBSW08170102	Seawater Control 30 ppt.	100	0.0	8		0.281	0.051	8	
LBSB08170102	Salt Blank 30 ppt.	93	14.9	8		0.317	0.034	8	
LBRO08160104	Cerritos Channel 12.5%	100	0.0	8		0.300	0.032	8	
LBRO08160104	Cerritos Channel 25%	98	7.1	8		0.315	0.041	8	
LBRO08160104	Cerritos Channel 50%	98	7.1	8		0.333	0.043	8	
LBRO08160104	Cerritos Channel 100%	95	9.3	8		0.360	0.032	8	

Survival:
NOEC: ≥ 100% LC50: > 100%
Weight:
NOEC: ≥ 100% IC25: > 100%

The test met acceptability criteria for control survival (>80%) and average weight of controls (0.20 mg/mysid) and reference toxicant EC50 was within control chart limits.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Salinity (g/kg)	Temp (°C)	Ammonia (mg/L)
Cerritos					
Min:	7.8	3.5	29.2	24.2	0.3
Max:	8.3	6.6	31.5	26.6	2.0
Test					
Min:	7.7	3.0	29.2	24.2	0.0
Max:	8.4	7.1	33.6	27.2	2.0

Project: Long Beach Stormwater
Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: MB53
Test Ended: 8/24/01

Test Method: Mysid survival and growth
Species: *Americamysis bahia*
Supervising Technician: Jeff Brown

Laboratory: SCCWRP

		% Survival				Weight (mg/mysid)			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
LBSW08170102	Seawater Control 30 ppt.	100	0.0	8		0.2805	0.051	8	
LBSB08170102	Salt Blank 30 ppt.	93	14.9	8		0.3170	0.034	8	
LBRO08160105	Belmont Pump 12.5%	100	0.0	8		0.2855	0.052	8	
LBRO08160105	Belmont Pump 25%	95	14.1	8		0.3230	0.033	8	
LBRO08160105	Belmont Pump 50%	93	10.4	8		0.3163	0.071	8	
LBRO08160105	Belmont Pump 100%	93	10.4	8		0.3075	0.029	8	

Survival:
NOEC: ≥ 100%   LC50: > 100%
Weight:
NOEC: ≥ 100%   IC25: > 100%

The test met acceptability criteria for control survival (>80%) and average weight of controls (0.20 mg/mysid) and reference toxicant EC50 was within control chart limits.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Salinity (g/kg)	Temp (°C)	Ammonia (mg/L)
Belmont					
Min:	7.9	3.7	29.2	24.2	0.1
Max:	8.4	7.1	31.1	26.4	0.8
Test					
Min:	7.7	3.0	29.2	24.2	0.0
Max:	8.4	7.1	33.6	27.2	2.0

Project: Long Beach Stormwater
Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: MB53
Test Ended: 8/24/01

Test Method: Mysid survival and growth
Species: *Americamysis bahia*
Supervising Technician: Jeff Brown

Laboratory: SCCWRP

		% Survival				Weight (mg/mysid)			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
LBSW08170102	Seawater Control 30 ppt.	100	0.0	8		0.2805	0.051	8	
LBSB08170102	Salt Blank 30 ppt.	93	14.9	8		0.3170	0.034	8	
LBRO08160105	Bouton Creek 12.5%	98	7.1	8		0.3424	0.032	8	
LBRO08160106	Bouton Creek 25%	95	9.3	8		0.3171	0.033	8	
LBRO08160105	Bouton Creek 50%	98	7.1	8		0.3226	0.034	8	
LBRO08160106	Bouton Creek 100%	95	9.3	8		0.3356	0.040	8	
LBRW08160102	Alamitos Bay 100%	95	9.3	8		0.3280	0.037	8	

Survival:
NOEC: ≥ 100% LC50: > 100%
Weight:
NOEC: ≥ 100% IC25: > 100%

The test met acceptability criteria for control survival (>80%) and average weight of controls (0.20 mg/mysid) and reference toxicant EC50 was within control chart limits.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Salinity (g/kg)	Temp (°C)	Ammonia (mg/L)
Bouton					
Min:	7.8	3.0	29.5	24.2	0.2
Max:	8.2	7.0	30.6	26.7	1.1
Test					
Min:	7.7	3.0	29.2	24.2	0.0
Max:	8.4	7.1	33.6	27.2	2.0

Project: Long Beach Stormwater
Sample Description: Copper Reference Toxicant

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: MB54
Test Ended: 8/24/01

Test Method: Mysid survival and growth
Species: *Americamysis bahia*
Supervising Technician: Jeff Brown

Laboratory: SCCWRP

		% Survival				Weight (mg/mysid)			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
LBSW08170101	30 ppt Seawater Control	95	9.3	8		0.2558	0.044	8	
LBRF08170101	100 ug/l Cu	88	21.2	8		0.3030	0.038	8	
LBRF08170102	200 ug/l Cu	88	10.4	8		0.2338	0.041	8	
LBRF08170103	250 ug/l Cu	55	20.7	8	*	0.2035	0.029	8	
LBRF08170104	300 ug/l Cu	35	14.1	8	*	0.1873	0.057	8	*
LBRF08170105	350 ug/l Cu	25	17.7	8	*	0.1640	0.046	7	*

Survival:
NOEC: 200 ug/L LC50: 271 ug/L
Weight:
NOEC: 250 ug/L IC25: 240 ug/L

The test met acceptability criteria for control survival (>80%) and average weight of controls (0.20 mg/mysid) and reference toxicant EC50 was within control chart limits (185.2 µg/L to 330.0 µg/L).

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Salinity (g/kg)	Temp (°C)	Ammonia (mg/L)
Ref Tox					
Min:	7.6	4.0	28.0	24.1	0.0
Max:	8.1	7.3	31.1	26.8	0.6

Project: Long Beach Stormwater
Sample Description: Belmont Pump Dry Weather and Alamitos Bay Receiving Water Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/18/01

Experiment Number: S551
Test Ended: 8/18/01

Test Method: Purple Sea Urchin Fertilization
Species: *Strongylocentrotus purpuratus*
Supervising Technician: Darrin Greenstein

Laboratory: SCCWRP

		% Fertilization			
Sample Code	Sample	Mean	SD	N	Sig Diff
LBSW08180101	Seawater Control	88	8.5	5	
LBBK08180101	Brine Control 50%	60	8.5	5	
LBRO08160101	Belmont Pump 3%	-	-	0	
LBRO08160101	Belmont Pump 6.3%	-	-	0	
LBRO08160101	Belmont Pump 12.5%	-	-	0	
LBRO08160101	Belmont Pump 25%	95	2.5	5	
LBRO08160101	Belmont Pump 50%	92	5.3	5	
LBRW08160101	Alamitos Bay 100%	98	1.9	5	

NOEC: ≥ 50%
EC50: > 50%

The test met acceptability criteria for control fertilization (>70%). The reference toxicant EC50 fell below control chart limits (11.2 µg/L to 68.4 µg/L).

Sample characteristics (range among treatments during test):

Sample		pH	Salinity (g/kg)	Temp (°C)
Belmont				
	Min:	8.01	33.4	14.6
	Max:	8.28	34.2	14.6

Project: Long Beach Stormwater
Sample Description: Bouton Creek Dry Weather Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/18/01

Experiment Number: S552
Test Ended: 8/18/01

Test Method: Purple Sea Urchin Fertilization
Species: *Strongylocentrotus purpuratus*
Supervising Technician: Darrin Greenstein

Laboratory: SCCWRP

		% Fertilization			
Sample Code	Sample	Mean	SD	N	Sig Diff
LBSW08180104	Seawater Control	78	19.8	5	
LBBK08180102	Brine Control 50%	27	20.6	5	
LBRO08160102	Bouton Creek 3%	-	-	0	
LBRO08160102	Bouton Creek 6.3%	-	-	0	
LBRO08160102	Bouton Creek 12.5%	-	-	0	
LBRO08160102	Bouton Creek 25%	99	0.4	5	
LBRO08160102	Bouton Creek 50%	98	0.8	5	

NOEC: $\geq$ 50%
EC50: > 50%

The test met acceptability criteria for control fertilization (>70%). The reference toxicant EC50 fell below control chart limits (11.2 µg/L to 68.4 µg/L).

Sample characteristics (range among treatments during test)*:

Sample		pH	Salinity (g/kg)	Temp (°C)
Bouton				
	Min:			14.6
	Max:			14.6

*Several water quality measurements for this experiment have been misplaced and are therefore not present in this table.

Project: Long Beach Stormwater
Sample Description: Cerritos Channel Dry Weather Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/18/01

Experiment Number: S553
Test Ended: 8/18/01

Test Method: Purple Sea Urchin Fertilization
Species: *Strongylocentrotus purpuratus*
Supervising Technician: Darrin Greenstein

Laboratory: SCCWRP

		% Fertilization			
Sample Code	Sample	Mean	SD	N	Sig Diff
LBSW08180103	Seawater Control	88	12.1	5	
LBBK08180103	Brine Control 25%	-	-	0	
LBBK08180103	Brine Control 50%	49	9.1	5	
LBRO08160103	Cerritos Channel 3.0%	-	-	0	
LBRO08160103	Cerritos Channel 6.3%	-	-	0	
LBRO08160103	Cerritos Channel 12.5%	-	-	0	
LBRO08160103	Cerritos Channel 25%	99	0.4	5	
LBRO08160103	Cerritos Channel 50%	99	1.0	5	

NOEC: ≥ 50%
EC50: > 50%

The test met acceptability criteria for control fertilization (>70%). The reference toxicant EC50 fell below control chart limits (11.2 µg/L to 68.4 µg/L).

Sample characteristics (range among treatments during test):

Sample		pH	Salinity (g/kg)	Temp (°C)
Cerritos				
	Min:	8.06	33.7	14.6
	Max:	8.23	33.9	14.6

Project: Long Beach Stormwater
Sample Description: Copper Ref Tox

Sample Collected: 8/16/01
Test Initiated: 8/18/01

Experiment Number: S554
Test Ended: 8/18/01

Test Method: Purple Sea Urchin Fertilization
Species: *Strongylocentrotus purpuratus*
Supervising Technician: Darrin Greenstein

Laboratory: SCCWRP

		% Fertilization			
Sample Code	Sample	Mean	SD	N	Sig Diff
LBSW08180102	Seawater Control	76	20.8	5	
LBRT08180101	9.5 ug/l Cu	34	17.0	5	
LBRT08180102	13.9 ug/l Cu	12	9.6	5	*
LBRT08180103	20.4 ug/l Cu	8	4.6	5	*
LBRT08180104	30.0 ug/l Cu	1	1.3	5	*
LBRT08180105	44.0 ug/l Cu	0	0.4	5	*
LBRT08180106	65.0 ug/l Cu	0	0.4	5	*

Test met acceptability criteria for control fertilization (>70%). The EC50 for the reference toxicant fell below control chart limits (11.2 μg/L to 68.4 μg/L).

NOEC: 9.5 μg/L Cu
EC50: 5.5 μg/L Cu

Sample characteristics (range among treatments during test):

Sample		pH	Salinity (g/kg)	Temp (°C)
Copper Ref				
	Min:	8.04	33.4	14.6
	Max:	8.07	33.8	14.6

Project: Long Beach Stormwater

Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01

Experiment Number: 19661CD-A1

Test Initiated: 8/17/01

Test Ended: 8/24/01

Test Method: Water flea survival and reproduction

Species: *Ceriodaphnia dubia*

Laboratory: ToxScan, Inc.

		% Survival				Young/Individual			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
	Freshwater Control	100	0.0	10		30.7	9.2	10	
LBBPCerODW2	Belmont Pump 6.25%	100	0.0	10		41.4	9.0	10	
LBBPCerODW2	Belmont Pump 12.5%	100	0.0	10		42.1	8.1	10	
LBBPCerODW2	Belmont Pump 25%	100	0.0	10		43.2	9.7	10	
LBBPCerODW2	Belmont Pump 50%	100	0.0	10		34.5	7.2	10	
LBBPCerODW2	Belmont Pump 100%	80	0.4	10		25.0	4.5	10	

Survival:

NOEC: ≥ 100% LC50: >100%

Reproduction:

NOEC: ≥ 100% IC50: >100%

Test met protocol acceptability criteria (>80% survival in controls and mean control reproduction >15 offspring). Results are within laboratory control chart limits for both survival and reproduction.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Conductivity (umho/cm)	Hardness (mg/L)	Temp (°C)
Belmont					
Min:	7.80	7.6	285	72	23.9
Max:	8.80	8.4	3063	432	25.9

Project: Long Beach Stormwater
Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: 19661CD-A2
Test Ended: 8/24/01

Test Method: Water flea survival and reproduction
Species: *Ceriodaphnia dubia*

Laboratory: ToxScan, Inc.

		% Survival				Young/Individual			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
	Freshwater Control	100	0.0	10		20.9	8.3	10	
LBBCCerODW2	Bouton Creek 6.25%	80	0.4	10		21.3	12.6	10	
LBBCCerODW2	Bouton Creek 12.5%	80	0.4	10		23.1	13.4	10	
LBBCCerODW2	Bouton Creek 25%	80	0.4	10		19.1	11.3	10	
LBBCCerODW2	Bouton Creek 50%	70	0.5	10		4.3	4.9	9	*
LBBCCerODW2	Bouton Creek 100%	0	0.0	10	*				

Survival:
NOEC: 50% LC50: 61%
Reproduction:
NOEC: 25% IC50: 38.9%

Test met all protocol acceptability criteria (>80% survival in controls and mean control reproduction >15 offspring). Results are within laboratory control chart limits for both survival and reproduction.

Sample Characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Conductivity (umho/cm)	Hardness (mg/L)	Temp (°C)
Bouton					
Min:	7.70	7.4	285	88	23.9
Max:	8.20	8.2	8360	952	25.9

Project: Long Beach Stormwater

Sample Description: Dry Weather Runoff Samples Collected 8/16/01

Sample Collected: 8/16/01
Test Initiated: 8/17/01

Experiment Number: 19661CD-A3
Test Ended: 8/24/01

Test Method: Water flea survival and reproduction
Species: *Ceriodaphnia dubia*

Laboratory: ToxScan, Inc.

		% Survival				Young/Individual			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
	Freshwater Control	100	0.0	10		27.5	6.1	10	
LBCCCerODW2	Cerritos Channel 6.25%	100	0.0	10		32.2	7.4	9	
LBCCCerODW2	Cerritos Channel 12.5%	90	0.3	10		31.4	9.3	10	
LBCCCerODW2	Cerritos Channel 25%	100	0.0	10		26.1	7.4	10	
LBCCCerODW2	Cerritos Channel 50%	80	0.4	10		0.8	1.5	8	*
LBCCCerODW2	Cerritos Channel 100%	0	0.0	10	*	0.0	0.0	10	*

Survival:
NOEC: 50% LC50: 64.8%
Reproduction:
NOEC: 25% IC50: 35.8%

Test met all protocol acceptability criteria (>80% survival in controls and mean control reproduction >15 offspring). Results are within laboratory control chart limits for both survival and reproduction.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Conductivity (umho/cm)	Hardness (mg/L)	Temp (°C)
Cerritos					
Min:	7.90	7.5	291	88	23.9
Max:	8.50	8.1	923	165	25.1

Project: Long Beach Stormwater
Sample Description: KCl Reference Toxicant

Sample Collected: 8/16/01
Experiment Number: 19661CD-R
Test Initiated: 8/15/01
Test Ended: 8/22/01

Test Method: Water flea survival and reproduction
Species: *Ceriodaphnia dubia*
Laboratory: ToxScan, Inc.

		% Survival				Young/Individual			
Sample Code	Sample	Mean	SD	N	Sig Diff	Mean	SD	N	Sig Diff
	Freshwater Control	100	0.0	10		20.3	6.4	10	
	0.06 g/l KCl	100	0.0	10		23.3	4.3	10	
	0.13 g/l KCl	100	0.3	10		22.0	4.0	10	
	0.25 g/l KCl	100	0.0	10		23.8	3.1	10	
	0.50 g/l KCl	20	0.4	10	*	13.8	10.0	5	
	1.00 g/l KCl	0	0.0	10	*				

Survival:
NOEC: 0.25 g/l KCl LC50: 0.41 g/l KCl
Reproduction:
NOEC: ≥ 0.50 g/l KCl IC50: 0.43 g/l KCl

Test met all protocol acceptability criteria (>80% survival in controls and mean control reproduction >15 offspring). Results were within laboratory control chart limits for both survival and reproduction.

Sample characteristics (range among treatments during test):

Sample	pH	Dissolved Oxygen (mg/L)	Conductivity (umho/cm)	Hardness (mg/L)	Temp (°C)
Ref Tox					
Min:	8.00	7.8	294	88	24.0
Max:	8.30	8.2	2101	100	26.1

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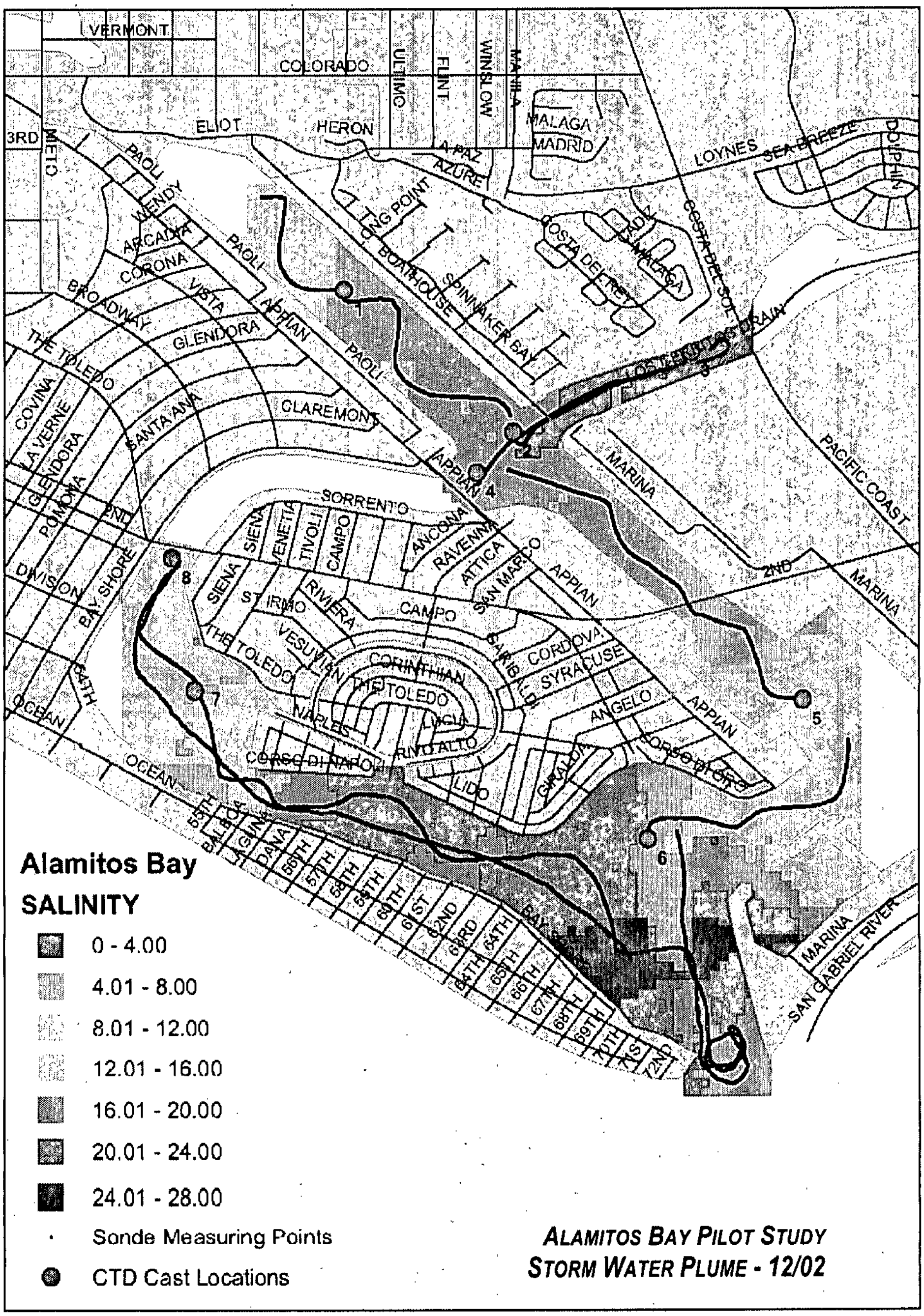

Submitted By
City
Of
Long
Beach

July 2003

Prepared By
Kinnetic Laboratories, Inc.

City of Long Beach
Storm Water Monitoring Report 2002-2003

NPDES Permit No. CAS004003 (CI 8052)

JULY *2003*

Prepared By

Kinnetic Laboratories, Inc.

and

Southern California Coastal
Water Research Project

Submitted By

City
Of
Long
Beach

CITY OF LONG BEACH
STORMWATER MONITORING REPORT 2002/2003

NPDES Permit No. CAS004003 (CI 8052)

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ACRONYMNS AND ABBREVIATIONS LIST

ASTM - American Society for Testing and Materials
BHC - Benzene hexachloride
BMP - Best Management Practice
BOD- Biological Oxygen Demand
CCC – Criterion Continuous Concentration
CD - Compact Disk
CFU - Colony Forming Units
CMC – Criterion Maximum Concentration
COD - Chemical Oxygen Demand
CRWQCB – California Regional Water Quality Control Board
CTR - California Toxics Rule
2,4 D - 2,4-dichlorophenoxy
2,4 DB - (2,4-dichlorophenoxy) butanoic acid
DDD - dichloro (p-chlorophenyl)ethane
DDE - dichloro (p-chlorophenyl)ethylene
DDT - dichlorodiphenyl trichloroethane
DF - dilution factor
DI - Deionized
DL - Detection Limit (considered the same as RL)
DO - Dissolved Oxygen
EC_{50} - Concentration causing effects to 50% of the test population
EDTA - ethylene diamine triacetic acid
EMC- Event mean concentration
GIS - Geographic Information System
IC25 - Concentration causing 25% inhibition in growth or reproduction
IC50 - Concentration causing 50% inhibition in growth or reproduction
ICP-MS - Inductively Coupled Plasma-Mass Spectrometry
Halocline – a locally steepened vertical gradient of salinity
KLASS - Kinnetic Laboratories Automated Sampling System
KLI - Kinnetic Laboratories, Inc.
LC_{50} - Bioassay concentration that produces 50% lethality
LDPE - Low Density Polyethylene
LOEC - Lowest Observed Effect Concentration
LPC - Limiting Permissible Concentration
MBAS - methylene-blue-active substances
MCPA - 2-methyl-4-chloro-phenoxy acetic acid
MCPP - 2-(4-chloro-2-methylphenoxy) propanoic acid
ML – Minimum level as defined in State Implementation Plan
MPN- Most Probable Number
MS4 - Multiple Separate Storm Sewer System
MTBE- Methyl Tertiary Butyl Ether
NADP-National Atmospheric Deposition Program
NCDC-National Climate Data Center
NPDES –National Pollutant Discharge Elimination System
NOEC - No observed effect concentration
NTS - Not to Scale
NTU - nephelometric turbidity units

NURP- Nationwide Urban Runoff Program
PAH - Polynuclear Aromatic Hydrocarbons
PCB - Polychlorinated bi-phenyls
PDF - Portable Document Format
ppb - Parts per Billion
Q - Flow
QA/QC - Quality Assurance/Quality Control
RMP - Regional Monitoring Program
RL- Reporting Limit (considered the same as DL)
RPD- Relative Percent Difference
SAP - Sampling and Analysis Plan
SCCWRP - Southern California Coastal Water Research Project
sf- Square Feet
SIP – State Implementation Plan
SM- Standard Methods for the Examination of Water and Wastewater
SOP - Standard Operating Procedure
SRM - Standard Reference Material
STS - sodium tetradecyl sulfate
SV - Semi-Volatile Compound
SWRCB-State Water Resource Control Board
2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid
2, 4, 5-T - 2,4,5-trichlorophenoxy
TDS – Total Dissolved Solids
TIE – Toxicity Identification Evaluation
TKN- Total Kjeldahl Nitrogen
TOC - Total Organic Carbons
2, 4, 5-TP - 2-(2,4,5-trichlorophenoxy) propanoic acid
TPH - total petroleum hydrocarbons
TRPH - Total Recoverable Petroleum Hydrocarbons
TSI - ToxScan, Inc.
TSS –Total Suspended Solids
TU - Toxicity Unit
TUc – Chronic Toxicity Unit
USEPA - U.S. Environmental Protection Agency
WQO - Water Quality Objective
WQS - Water Quality Standard

CITY OF LONG BEACH
STORMWATER MONITORING REPORT 2002/2003

NPDES Permit No. CAS004003 (CI 8052)

1.0 EXECUTIVE SUMMARY

1.1 Background and Purpose

The City of Long Beach was required to conduct a water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) beginning in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052).

The monitoring program called for monitoring mass emissions and toxicity at three representative mass emission sites during the first wet season and four sites for subsequent wet seasons. Four wet weather storm events were to be monitored annually. Monitoring during the first two years also included a receiving water site (Alamitos Bay) be monitored with each wet weather storm event.

Dry weather inspections and the collection and analysis of dry weather discharges were required at each of these monitoring sites over two different 24-hour periods during each dry season. Water samples collected at the monitoring sites during each time period were to be analyzed for all parameters specified in the permit and tested for toxicity. The program also initially called for monitoring the receiving water body site (Alamitos Bay) for bacteria and toxicity to provide water quality information during the dry seasons and on the effectiveness of a dry-weather diversion.

Monitoring sites specified in the permit are as follows:

- Basin 14: Dominguez Gap Pump Station Monitoring Site
- Basin 20: Bouton Creek Monitoring Site
- Basin 23: Belmont Pump Station Monitoring Site
- Basin 27: Los Cerritos Channel Monitoring Site (Starting in Second Year)
- Alamitos Bay Receiving Water Monitoring Site

During the first 1999/2000 wet weather season, start-up delays associated with permitting for placement of stormwater monitoring equipment in the Los Angeles County Flood Control District facilities prevented the wet weather monitoring from being carried out. Instead, a special research study on Parking Lot Runoff was carried out with the permission of the Regional Water Quality Control Board staff. In addition, the required dry weather monitoring was carried out for this first year. A previous report (Kinnetic Laboratories, Inc., 2000) covered the first season dry-weather monitoring events performed in June of 2000 as well as one additional receiving water sampling in April 2000. Subsequent reports have summarized the results of both second (Kinnetic Laboratories, Inc., 2001) and third (Kinnetic Laboratories, Inc. 2002) wet and dry season monitoring programs.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the fourth year, 2002/2003. Kinnetic Laboratories, Inc. conducted this monitoring program as Prime Contractor to the City of Long Beach. Toxicity testing and chemical analyses were conducted by ToxScan, Inc. Analytical laboratory services were supplemented by other participating laboratories as necessary. North Coast Analytical analyzed the chlorinated herbicides and Associated Labs analyzed the grab samples for bacteria and hexavalent chromium.

1.2 Summary of Results

Wet weather sampling of storm events began in November 2002. The first major storm of the year was sampled on November 11. During this wet weather season, the targeted number of four storm events were monitored at all of the City of Long Beach's mass emission stations, with the exception of the Dominguez Gap Pump Station where only three overflow discharge events occurred. Discharges from the Dominguez Gap Pump Station all happened late in the storm season. Two of the events were sampled in concert with storm events at the other stations. The third event at this site was sampled only at the Dominguez Gap Pump Station since sampling requirements had been completed at the other mass emission sites.

In a letter dated November 13, 2002, the Executive Officer of the California Regional Water Quality Control Board, Los Angeles Region issued adjustments to the monitoring program. Included in the changes was implementation of a pilot receiving water study. This study was conducted on December 16th following the second event of the season. The horizontal and vertical extent of the stormwater plume in Alamitos Bay was delineated and water samples were taken from four different locations in the plume. Sampling locations represented a range of salinities within the plume that ranged from 8.7 to 24.9 ppt. Water samples were tested for toxicity and a subset of water quality parameters which included selected trace metals and organophosphorous pesticides.

Two dry weather inspections/monitoring events were conducted. The first was conducted in September 2002 prior to the winter rains. The second was conducted in May 2003 once winter rains had subsided. Dry weather monitoring was conducted for the three mass emission sites that exhibited dry weather flows. These included Bouton Creek, the Belmont Pump Station, and the Los Cerritos Channel.

The results of the City of Long Beach's 2002/2003 stormwater monitoring program are summarized as follows:

Wet Weather Chemical and Bacterial Results

Numerical standards do not exist for stormwater discharges. However, water quality criteria or objectives may provide reference points for assessing the relative importance of various stormwater contaminants, though specific receiving water studies are necessary to quantify the presence and magnitude of any actual water quality impacts. The California Ocean Plan (SWRCB 2002), the Los Angeles Region Basin Plan (CRWQCB, Los Angeles Region. 1994), AB411 public health criteria, and both saltwater and freshwater criteria from the California Toxics Rule (USEPA 2000) were used as benchmarks as requested by Regional Board staff. Not all of these criteria are appropriate for Long Beach discharges or for comparison with stormwater runoff water quality. In order for these comparisons to be useful it is important that a regional strategy be developed that provides consistent and appropriate benchmarks.

- Total suspended solids (TSS) in the Long Beach wet weather discharges exceeded the Ocean Plan criterion of 3 mg/L in all cases. This is an open ocean, not estuarine standard and all stormwater runoff would be expected to exceed this criterion. Therefore this standard is not applicable for evaluation of stormwater discharges.

- The pH of stormwater discharges from Long Beach typically ranged from 6.2 to 6.8. More than half of the stormwater samples had pH values that were below the lower Basin Plan limits of 6.5. Stormwater discharged from the Dominguez Gap Pump Station on February 25, 2003 had a pH of 5.4. Low pH in stormwater is not unusual since rainwater is slightly acidic due to dissolved carbon dioxide scavenged from the atmosphere. The average pH of rainwater in Southern California is reported to be approximately 5.2 (NADP 2003).

- Concentrations of bacteria (total coliform, fecal coliform, and enterococcus) in the Long Beach stormwater discharges routinely exceed public health criteria provided by AB411 and the Ocean Plan. Both total and fecal coliform concentrations exceeded criteria in 100 percent of the stormwater samples. Enterococcus concentrations exceeded AB411 criteria during all but one event when reported values were below criteria at three sites. Other studies have shown that such exceedances are not limited to urban stormwater sources but are also measured in stormwater discharges from undeveloped surrounding land.

- Total recoverable metal concentrations were compared against the Ocean Plan's aquatic life criteria and the Basin Plan drinking water quality objectives. Concentrations of total recoverable copper, lead and zinc exceeded Ocean Plan criteria in 80 to 100 percent of the samples. Stormwater runoff from the Dominguez Gap Pump Station tended to have lower levels of total metals. Lead and zinc criteria were exceeded in only one-third of the events at this site.

- Total recoverable aluminum exceeded the Basin Plan drinking water criterion of 1000 µg/L during all events at all sites. The Basin Plan drinking water criterion of 6 µg/L was slightly exceeded during one event in water discharged from the Los Cerritos Channel.

- Dissolved metal concentrations were compared against both saltwater and freshwater Criteria Continuous Concentrations (CCC) values from the California Toxics Rule (CTR). Dissolved copper, lead and zinc commonly exceeded the reference values. Concentrations of dissolved copper exceeded both the freshwater and saltwater CTR criteria at all sites during all storm events. Dissolved lead and zinc exceeded the CTR criteria during all storm events at Bouton Creek, the Belmont Pump Station and Los Cerritos Channel. Lead and zinc criteria were exceeded in two out of three events at the Dominguez Gap Pump Station.

- Very few organic compounds exceeded the reference criteria in runoff from the four mass emission sites. Concentrations of dieldrin exceeded the saltwater CTR criterion in one sample from the Belmont Pump site and another from the Los Cerritos Channel. In both cases, the reported value was less than twice the Minimum Level[1] (ML) of 0.01 µg/L. Simazine, an organophosphorus herbicide, exceeded the Basin Plan Maximum Contaminant Level (MCL) in one sample from the Los Cerritos Channel.

- Among the four mass emission sites, the Los Cerritos Channel consistently exhibited the highest overall loads of solids and total metals. Estimates of solids discharged at the Los Cerritos Channel site ranged from 92,163 to 704,927 pounds. Estimates of total copper, one of the most significant urban contaminants, ranged from 14 to 143 pounds. In contrast, the Belmont Pump Station was estimated to discharge between 397 and 4018 pounds of solids and 0.22 to 1.7 pounds of copper during each event.

[1] The minimum level represents the lowest quantifiable concentration in a sample based on the proper application of all method-based analytical procedures and the absence of any matrix interferences.

Dry Weather Chemical and Bacterial Results

- In general, the concentrations of suspended particulates and total recoverable metal concentrations continue to be low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. Concentrations of bacteria exceed public health criteria and are comparable to levels in stormwater runoff. Pesticides and semivolatiles were largely undetected.

- Sampling conducted at Bouton Creek in May 2003 resulted in elevated levels of TSS, turbidity, total recoverable metals (aluminum, copper, iron, lead, selenium, silver and zinc) and dissolved selenium. The results of this survey suggest that there was an upstream source of sediment at this location at that time. Possible sources are being investigated.

- As in previous years, no dry weather discharges were observed from the Dominguez Gap Pump Station.

Alamitos Bay Pilot Receiving Water Program

Monitoring of a stormwater plume in Alamitos Bay was conducted on December 16, 2002 following a brief, but intense storm event. The storm lasted for four to five hours producing 1.21 to 1.26 inches. Runoff during the storm resulted in a surface plume that extended throughout Alamitos Bay. Sampling was conducted at four dilutions within the plume for chemical and toxicological testing. Salinities of each sampling location were 24.7 ppt (RW1), 16.5 ppt (RW2), 10.9 ppt (RW3) and 8.7 ppt (RW4).

- Measured surface salinity within Alamitos Bay ranged from 1 to 28 ppt. The lower part of the range was found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred near the Bay entrance.

- The fresher water of stormwater plume generally formed a surface plume that was typically three to five feet in depth.

- The stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically one degree centigrade lower than the deeper marine waters. Turbidity in the surface plume ranged from 45 to 80 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 2 to 5 NTU.

- Total suspended solids increased from 10 to 28 mg/L as the surface salinity decreased from 24.7 to 8.7 ppt. Similarly, total copper, nickel, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Total cadmium was relatively constant with values ranging from 0.09 to 0.12 μg/L.

- Strong spatial trends were not evident in the distribution of dissolved metals.

- Organophosphate (OP) pesticides were mostly not detected. Simazine, an herbicide, was the only OP pesticide detected in the plume. Concentrations were similar at all locations with levels ranging from 1.1 to 1.3 μg/L.

- Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test showed negligible toxicity. All EC50s were >50%. Toxicity testing of stormwater discharges from the mass emission sites demonstrated a similar lack of toxicity, consistent with the high dilutions due to the large rainfall and low toxicity in stormwater runoff samples from the mass emission sites.

Temporal Trends in Constituents of Concern

Although data are not yet sufficient to make definitive statements supported by statistical test, several general trends are emerging. Major observations include:

- Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events.

- Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows.

- No distinct seasonal or year to year differences are evident in concentrations of total cadmium, total nickel, chlorpyrifos or diazinon.

- Characteristics of stormwater discharges from the Dominguez Gap Pump Station are consistent with earlier observations at this site. Discharges from this site tend have lower concentrations of total metals than the other mass emission sites.

Toxicity Results

- Toxicity to one or more test organisms was detected at three of the four stations sampled this year for each of the four wet weather storm events. Water flea toxicity was seen during the first two storms at the Belmont and Cerritos stations, but not at all at the Bouton station. No wet weather water flea toxicity was detected after the second storm. Sea urchin toxicity was seen during the first storm at Belmont, Bouton and Dominguez stations, and again during the second and fourth storms at Bouton and the third storm at Cerritos. No toxicity was detected at Dominguez during the only (third) storm when that station was sampled. The toxicity measured was less this year, possibly because there were fewer storms last year. The frequency and magnitude of stormwater toxicity from the Long Beach stations during this monitoring period were markedly reduced from both previous Long Beach stormwater programs and stormwater samples from other southern California watersheds. The Chollas Creek (San Diego) and Ballona Creek (Santa Monica)were most similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds relative to the Los Angeles River and San Gabriel River.

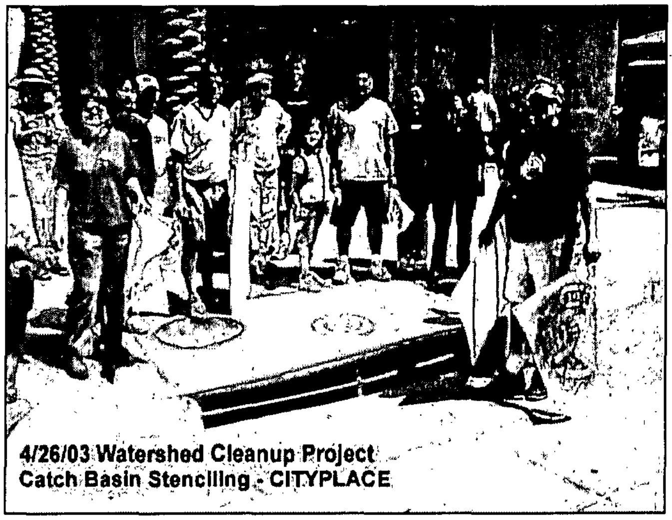
- Toxicity was measured in all of the dry weather samples except those from Belmont Pump station, where there was only very slight toxicity to water fleas in September. The magnitude of toxicity was not consistently less than that measured in the wet weather samples as seen in previous Long Beach studies. These results do not support the hypothesis suggesting significant differences in the composition of stormwater and dry weather discharge from the City of Long Beach.

- Perhaps indicative of the generally reduced magnitude of toxicity seen during this testing program, only five TIEs (four wet weather and one dry weather) were triggered in 2002/2003. There were limited TIE procedures incorporated into two additional dry weather samples.

Virtually all of the TIE attempts were abandoned due to loss of toxicity in the laboratory, but useful data were salvaged on 10 samples. The results of this year were consistent within each species and similar to those obtained from the previous year.

- All TIEs conducted using the water flea indicated that organophosphate pesticides were the most likely category of toxic constituents.

- The three-year toxicity data set also implicated dissolved metals, including copper, lead, nickel and zinc, as causes of stormwater toxicity. These conclusions are supported by the TIE results, by correlations of toxicity with chemical constituents, and by calculations of predicted toxicity based upon measured zinc and organophosphate pesticide concentrations in the stormwater.


4/26/03 Watershed Cleanup Project
Catch Basin Stenciling - CITYPLACE


21st Annual Coastal Cleanup

2.0 INTRODUCTION

The City of Long Beach serves a population of about 481,000[2] people in an area of approximately 50 square miles. The discharges from the MS4 system consist of surface runoff (non-stormwater and stormwater) from various land uses in the hydrologic drainage basins within the City. Approximately 44% of the land area discharges to the Los Angeles River, 7% to the San Gabriel River, and the remaining 49% drains directly to Long Beach Harbor and San Pedro Bay (City of Long Beach Municipal Stormwater Permit, 1999). The quality and quantity of these discharges vary considerably and are affected by the hydrology, geology, and land use characteristics of the watersheds; seasonal weather patterns; and frequency and duration of storm events. Impairments or threatened impairments of beneficial uses of water bodies in Long Beach include Alamitos Bay, Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont shore Beach, Bluff Park Beach, and Long Beach Shore.

The City of Long Beach received an NPDES Permit issued by the California Regional Water Quality Control Board, Los Angeles Region on 30 June 1999 (Order No 99-060, NPDES No. CAS004003, (CI 8052)). This order defined Waste Discharge Requirements for Municipal Stormwater and Urban Runoff discharges within the City of Long Beach. Specifically, the permit regulates discharges of stormwater and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems, into receiving waters of the Los Angeles Basin.

The NPDES permit requires the City of Long Beach to prepare, maintain, and update if necessary a monitoring plan. The specified monitoring plan required the City to monitor three (Year 1) and four (Years 2 through 5) discharge sites draining representative urban watersheds (mass emission sites) during the first two years of the monitoring program. Flow, chemical analysis of water quality, and toxicity were to be monitored at each of these sites for four representative storm events each year. During the dry season, inspections and monitoring of these same discharge sites were to be carried out, with the same water quality characterization and toxicity tests to be run. In addition, one receiving water body (Alamitos Bay) was to be monitored during the first two years of the program for bacteria and toxicity. Monitoring at the Alamitos Bay site was to be conducted during both the wet and the dry seasons and was to be used to document the effect of a dry weather diversion.

The Regional Board first modified the permit by letter on October 24, 2001 based upon review of the second year report and concurrent modifications being negotiated on the Los Angeles County stormwater permit. Permit modifications consisted of three primary elements. The first modification was an adjustment to the list of constituents and the required reporting limits for consistency with Minimum Levels (MLs) listed in the State's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (SIP). The second change addressed the requirements for triggering TIEs and a reduction in toxicity testing requirements for the mysid, *Americamysis*. TIE triggers were changed to enhance opportunities for defining toxicity that might be related to first flush or other early season events. Testing of mysids was reduced to conducting these tests only during the first event of the season. The final change was a requirement to compare stormwater quality data to water quality criteria applicable to specific beneficial uses in each receiving water body.

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[2] Population estimate as of January 1, 2003. State of California Department of Finance Demographic Research Unit

After reviewing the third year report, the Regional Board issued another letter on November 13, 2002 that provided further adjustments to the monitoring program. Major changes included:

- continuation of monitoring at the Dominguez Pump Station site but suspension of toxicity testing at this site,
- elimination of monitoring requirements for semi-volatile organic compounds during the 2002/2003 season while investigating alternative sampling and analytical approaches to obtain lower detection limits in subsequent years,
- elimination of the Alamitos Bay Receiving Water Site,
- implementation of a pilot receiving water program, and
- implementation of upstream investigations if extreme pH values are encountered during Dry Weather monitoring at any of the Mass Emission Stations.

The purpose of this report is analyze the samples and data collected during the 2002/2003 permit year and to present the results from the fourth year of the City of Long Beach's stormwater monitoring program.

3.0 STUDY AREA DESCRIPTION

The four sites for mass emissions monitoring were originally selected by the City of Long Beach with the assistance of the Southern California Coastal Water Research Project (SCCWRP), with input from the Los Angeles Department of Public Works, the environmental community, and with the approval of the Regional Water Quality Control Board. These sites were then specified in the NPDES permit after an analysis of the drainage basins and receiving waters. They were selected to be representative of the stormwater discharges from the City's storm drain system, as well as to be practical sites to carry out stormwater and dry weather monitoring. An additional site in Alamitos Bay was also selected as representative of receiving waters and for evaluation of the effectiveness of a dry weather diversion.

3.1 Regional Setting

3.1.1 Geography

The City of Long Beach is located in the center and southern part of the Los Angeles Basin (Figure 3.1) and is part of the highly urbanized Los Angeles region. In addition to residential and other uses, the City also encompasses heavy industrial and commercial areas and includes a major port facility, one of the largest in the United States. The City's waterfront is protected from the open Pacific Ocean by the extensive rock dikes encircling the outer harbor area of the Port of Los Angeles/Port of Long Beach complex. The waterfront includes port facilities along with a downtown commercial/residential area that includes small boat marinas, recreational areas, and convention facilities. Topography within the City boundaries can be generally characterized as low relief, with Signal Hill being the most prominent topographic feature (Figure 3.2).

3.1.2 Major Watersheds

Major water bodies receiving stormwater discharges from the City of Long Beach include the Los Angeles River located near the western boundary of the City, the San Gabriel River located near the eastern boundary, and the outer Harbor of the Los Angeles/Long Beach area. The City of Long Beach has fifteen pump stations that discharge into the Los Angeles River, and one pump station that discharges into the San Gabriel River. Receiving water sub-areas of importance include the extensive Alamitos Bay, heavily developed for marina and recreational uses, and the inner harbor areas of the City, heavily developed as port facilities. Other receiving water sub-areas include the Los Angeles River, El Dorado Lake, Los Angeles River Reach 1 and Reach 2, San Gabriel River Estuary, San Gabriel River Reach 1, Colorado Lagoon, and Los Cerritos Channel. These areas also include coastal shorelines, including Alamitos Bay Beaches, Belmont Shore Beach, Bluff Park Beach, and Long Beach Shore. The drainage from the City is characterized by major creeks or storm channels, usually diked and/or concrete lined such as the Los Cerritos Channel that originates in Long Beach, flows near the eastern City boundary, and discharges into the Marine Stadium and then into Alamitos Bay. Other such regional drains include:

- Coyote Creek, which passes through a small portion of Long Beach before it discharges to the San Gabriel River;
- Heather Channel and Los Cerritos Line E that both enter Long Beach from the City of Lakewood and discharge into the Los Cerritos Channel; and the
- Artesia-Norwalk Drain that enters Long Beach from Hawaiian Gardens and discharges into Coyote Creek.

The City of Long Beach, including the City of Signal Hill, is divided into 30 watersheds as shown in Figure 3.3. Data presently in the City of Long Beach GIS database on total areas and specific land use categories for each basin are given in Table 3.1 (City of Long Beach 2001). Specific watersheds selected by the City of Long Beach for this present stormwater monitoring program are described in more detail in the following section.

3.1.3 Annual Rainfall and Climate

The City of Long Beach is located in the semi-arid Southern California coastal area and receives significant rainfall on a seasonal basis. The rain season generally extends from October through April, with the heavier rains more likely in the months of November through March (see Figure 5.1 for average rainfall by month and seasonal total rainfall as measured at the Long Beach Airport). The long-term average rainfall for October through April at the Long Beach Airport is 12.27 inches per year.

The City lies in the Los Angeles Plain, which is south of the Santa Monica and San Gabriel Mountains and west of the San Jose and the Puente Hills. The Los Angeles River is the largest stream on the Plain and it drains the San Fernando Valley and much of the San Gabriel Mountains. Most of the streams are dry during the summer and there are no lakes or ponds, other than temporary ponding behind dunes (Miles & Goudy, 1998). The climate is mild, with a 30-year average temperature of 23.4 °C (74.1°F) at the Long Beach Daugherty Airport (NCDC, 2000).

3.1.4 Population and Land Use Characteristics

The population of the City of Long Beach totaled approximately 481,000 residents in January 2003 (California Department of Finance Demographic Research Unit, 2003). The total population of the County of Los Angeles, in which it resides, was 9,979,600. The independent city of Signal Hill, located on a promontory, is surrounded by the City of Long Beach. Signal Hill's population was recently estimated to be 10,300. Signal Hill contributes runoff to drainage basins 6, 7, 8, 9 and 18.

The City of Long Beach has a total area of 26,616 acres. Of that total 16,926 acres (64%) are classified as residential, 4,784 acres (18%) as commercial, 2,269 acres (8.5%) as industrial, 1,846 (7%) as institutional, and 786 acres (3%) as open space (City of Long Beach, 1999). The drainage basins sampled for the stormwater monitoring study follow this general pattern of land use.

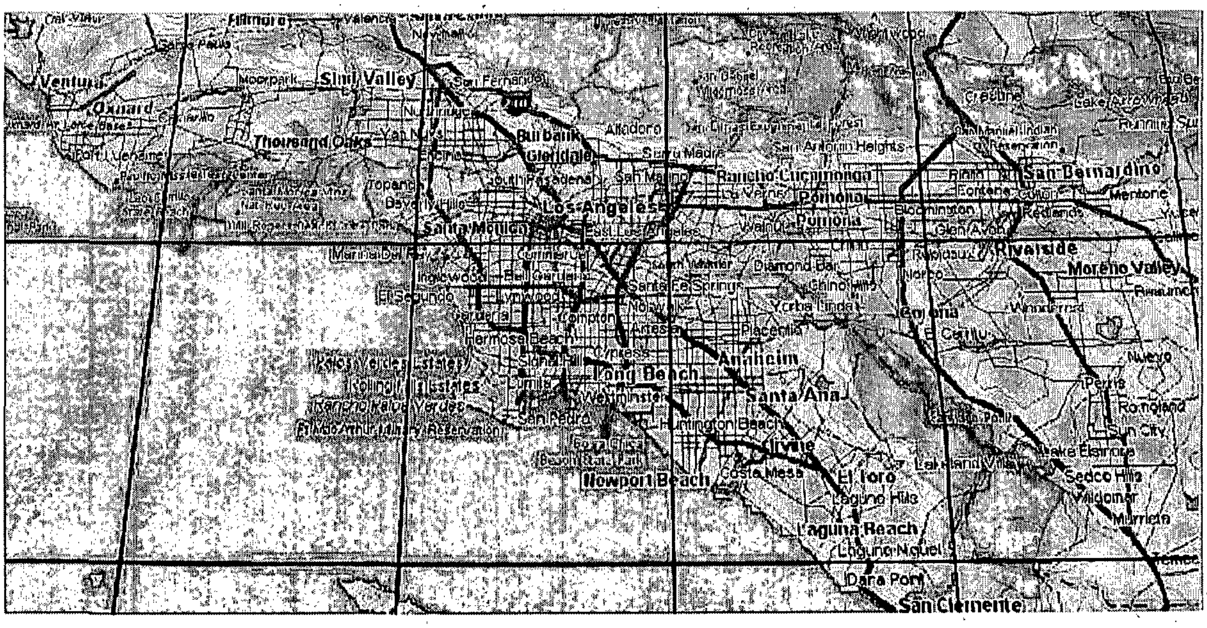


Figure 3.1 Los Angeles Basin. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

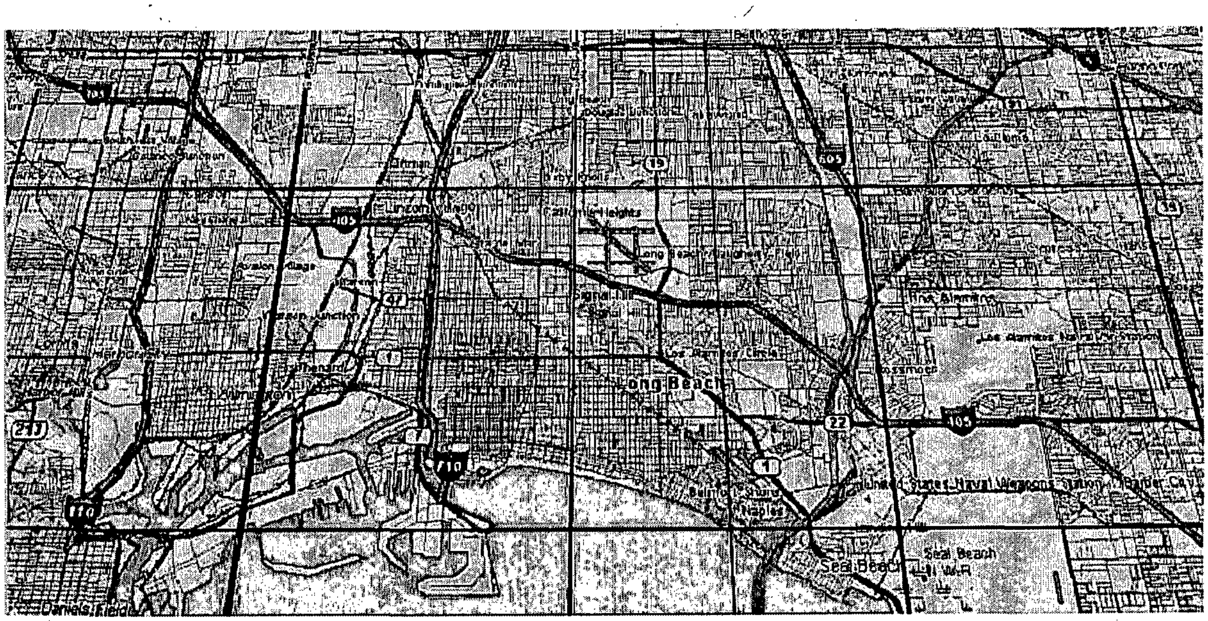


Figure 3.2 City of Long Beach. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

Major Drainage Basins and Monitoring Sites

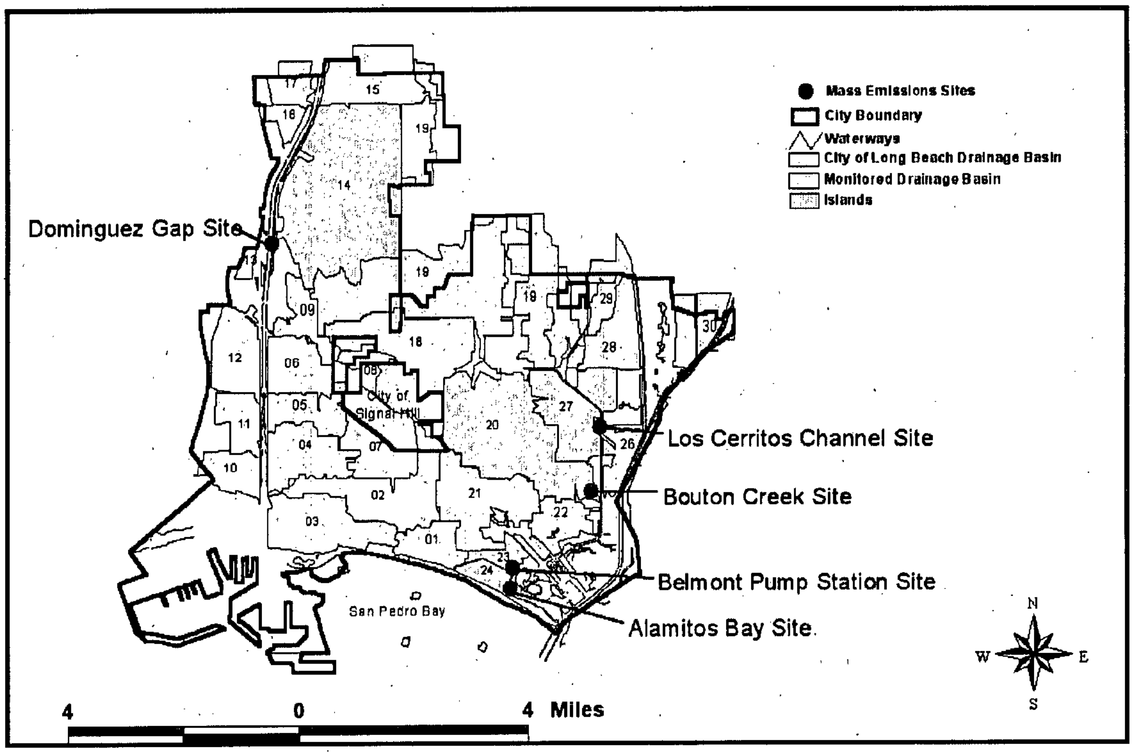


Figure 3.3 City of Long Beach Major Drainage Basins (Source: City of Long Beach, Department of Technology Services, last update 1994) and City of Long Beach Stormwater Monitoring Sites.

Table 3.1 **Total Areas and Land Use for City of Long Beach Watersheds.**

Drainage Basin	Drainage Pattern	Sub-basins	Total Acres	Residential Acres	Commercial Acres	Industrial Acres	Institutional Acres	Open Space Acres
1	N to S	4	456	393	44	0	7	12
2	E to W	1	1,276	905	287	22	59	3
3	E to W	3	1,083	367	642	7	58	9
4	E to W	2	810	426	176	140	56	12
5	E to W	1	546	434	97	0	13	2
6	S & SE	1	695	475	125	0	73	17
7	to center	1	1,029	858	89	11	53	18
8	E to W	1	248	163	27	58	0	0
9	SW & NW	1	399	295	91	0	12	1
10	S & E	3	416	16	49	351	0	0
11	S & E	1	424	338	64	3	18	1
12	S & E	1	719	556	98	9	41	15
13	S & E	1	84	0	7	77	0	0
14	S & W	2	3,374	2,445	392	148	273	116
15	S & W	1	958	569	167	197	25	0
16	N to S	1	194	113	61	8	5	7
17	S & E	1	317	244	68	0	5	0
18	E	1	1,814	804	262	729	19	0
19	E	20	3,898	2,475	610	439	228	146
20	S & E	1	2,259	1,215	412	70	492	70
21	S & E	3	1,172	773	125	0	55	219
22	variable	9	520	38	428	0	54	0
23	S	1	213	110	85	0	14	4
24	SE & NW	1	281	188	30	0	0	63
25	W & E	2	90	70	9	0	4	7
26	S & W	3	355	304	22	0	29	0
27	E & S	9	1,083	825	109	0	143	6
28	S & E	1	630	386	179	0	65	0
29	S	8	727	633	10	0	26	58
30	SW(6) & SE(1)	7	546	508	19	0	19	0
		Total Acres	26,616	16,926	4,784	2,269	1,846	786

4.0 MONITORING PROGRAM

4.1. Monitoring Program Objectives

The stated long-term objectives of the stormwater monitoring program are as follows:

1. Estimate annual mass emissions of pollutants discharged to surface waters through the MS4;
2. Evaluate water column and sediment toxicity in receiving waters;
3. Evaluate impact of stormwater/urban runoff on marine life in receiving waters;
4. Determine and prioritize pollutants of concern in stormwater;
5. Identify pollutant sources on the basis of flow sampling, facility inspections, and ICID investigations; and
6. Evaluate BMP effectiveness.

The emphasis during the first three years of monitoring efforts has been directed towards characterizing the chemical and toxicological characteristics of discharges from the city's MS4 during both storm events and dry weather periods to develop the data needed address the first five objectives listed above. In addition, a start on BMP investigations through the special Parking Lot Study was implemented during the first full year of monitoring. Specific objectives of this year's work included the following:

1. Obtain monitoring data from four (4) storm events for each mass emission station during the 2002-2003 storm season.
2. Conduct a pilot program to document the extent of stormwater plumes in Alamitos Bay and measure associated toxicity and water chemistry at four different dilutions.
3. Carry out dry weather inspections and obtain samples of dry weather flow at each of the four mass emission stations. Perform this dry weather work twice during the dry season that extends from May through October.
4. Perform chemical analyses for the specified suite of analytes at the appropriate detection limits for all stormwater samples collected.
5. Perform toxicity testing of the stormwater samples collected, and Toxicity Identification Evaluations (TIEs) if warranted by the toxicity results at a given site.
6. Report the above results and evaluate the monitoring data with respect to receiving water quality criteria.

4.2 Monitoring Site Descriptions

Four mass emission monitoring sites are routinely monitored as part of the City's stormwater program. The general locations of the drainage basins sampled by each of these sites and each monitoring location are shown in Figure 3.3. The latitude and longitude of each site are shown in Table 4.1. Brief descriptions of each drainage basin and land use are provided in the following sections. For more detailed descriptions including photographs and storm drain maps refer to previous annual reports (Kinnetic Laboratories, Inc. 2001 and 2002).

4.2.1 Basin 14: Dominguez Gap Monitoring Site

The sampling station located at the Dominguez Gap Pump Station is intended to monitor Basin 14 that covers 3,374 acres. Land use in this basin is 72% residential, 12% commercial, 8% institutional, 4% industrial, and 4% open space (Figure 4.1). The basin is located in the northwestern portion of Long

Beach just east of the Los Angeles River and is bounded on the north, south, east, and west by Artesia Boulevard, Roosevelt Road, the railroad, and the Los Angeles River respectively (City of Long Beach, 2001).

Normally in the summer, the retention basin located adjacent to the pump station would be dry according to the Flood Maintenance Division of the Los Angeles Public Works. However, current practice is to have the pumps locked off for the summer with water diverted into the retention basin from the Los Angeles River to recharge the groundwater aquifer and to study the feasibility of a wetland habitat in the area. During winter storms, the retention basin fills from stormwater discharge, which then infiltrates into the groundwater. During intense rains, when the retention basin fills to a specified level, the pump station pumps the water over the levee and discharges it into the Los Angeles River.

The stormwater monitoring equipment was located within the Dominguez Gap Pump Station. The automatic sampler utilized a peristaltic pump to collect water from the pump station's sump. The sampler was activated at the same set point (sump elevation) that activated the main discharge pumps, thus obtaining water samples during discharge to the Los Angeles River. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged was obtained by integrating this data over the period of time each pump discharged.

4.2.2 Basin 20: Bouton Creek Monitoring Site

This site collects water from Basin 20 covering 2,259 acres. Basin 20 is 54% residential, 22% institutional, 18% commercial, 3% industrial, and 3% open space (Figure 4.2). This basin is located in the east central portion of the City and is bounded on the north, south, east, and west by Spring Street, 8th Avenue, the Los Cerritos Channel and Redondo Avenue, respectively. The sampling station is located a short way upstream from the point of discharge into Los Cerritos Channel, along side of the Alamitos Maintenance Yard of the Los Angeles County Public Works Department.

At the sampling station, Bouton Creek is a 35 ft wide, 8.5 ft deep open concrete box channel. The elevation of the channel bed is approximately one inch lower at the side than the center. About a quarter of a mile to the southeast, Bouton Creek flows into Los Cerritos Channel. Based on numerous observations of conductivity at various tides, this site has saltwater influence at tide levels above three feet. The automatic sampling equipment was therefore configured and programmed to measure discharge flow and to obtain flow composited samples of the freshwater discharge down the creek, avoiding the tidal contributions by using real-time conductivity sensors. A velocity sensor was mounted on the invert of the box channel near the center of flow. Two conductivity sensors were mounted on the wall of the channel near the bottom and 2 feet above the bottom. A third conductivity sensor and the sample intake were mounted on a floating arm that kept them near the surface.

4.2.3 Basin 23: Belmont Pump Station Monitoring Site

This site collects water from Basin 23 that covers 213 acres. Land use in the basin is 52% residential, 40% commercial, 0% industrial, 6% institutional, and 2% open space (Figure 4.3). This basin is located in the southeastern portion of the City and is bounded on the north, south, east, and west by Colorado Street, Division Street, Ultimo Avenue and Belmont Avenue respectively. The Belmont Pump Station is located at 222 Claremont Avenue.

Water enters the forebay of the facility via a nine-foot diameter underground storm pipe. A trash rack catches debris before water drops four feet into the sump area. A single sump pump typically comes on and discharges about two feet of water from the sump area every evening at around 2300 hours. Four main pumps are available to remove water during storm events. Water from these pumps is discharged into Alamitos Bay.

The stormwater monitoring equipment was located outside the pump station but on the grounds of the pump station inside a steel utility box. The sensors and sampling hose were installed inside the pump station sump adjacent to the large discharge pumps. The automatic sampler utilized a peristaltic pump to sample from the sump. The sampler was activated at the same set point (sump elevation) that activated the discharge pumps, thus obtaining water samples during the discharge to Alamitos Bay. Sump elevation was determined with a pressure transducer. Flow rates were determined from the individual pump curves of each pump, and total volume discharged obtained by integrating this data over the period of time each pump discharged.

4.2.4 Basin 27: Los Cerritos Channel Monitoring Site

Basin 27 is 1,083 acres and land use is 76% residential, 10% commercial, 13% institutional, and 1% open space (Figure 4.4). It is located in the east central portion of Long Beach and is bound on the north, south, east, and west by Spring Street, Rendina Street, the San Gabriel River, and Bellflower Boulevard, respectively.

The drainage pattern is to the east and south on the west side of the Los Cerritos Channel and to the west and south on the east side. There are eight major storm drain systems with a total of three major storm drain lines contributing runoff. All eight major systems discharge into the Los Cerritos Channel.

The stormwater monitoring station was installed in a steel utility box located on the west side of the channel south of Stearns Street. Flow sensors and sampling tubing was installed on the bottom of the large concrete lined channel. This sampling site is above tidewater on Los Cerritos Channel. Flow rates based upon flow velocity and channel dimensions are used to control the composite sampler, and to calculate total flow at the end of the storm event.

4.3 Monitoring Station Design and Configuration

Each of the four land use stations monitored in Long Beach were equipped with Kinnetic Laboratories Automatic Sampling System (KLASS). Figure 4.5 illustrates the configuration of a typical KLASS. This system consists of several commercially available components that Kinnetic Laboratories has integrated and programmed into an efficient flow-based stormwater compositing sampler. The receiving water site was not equipped with a KLASS.

The integral components of this system consist of an acoustic Doppler flow meter or a pressure transducer, a data logger/controller module, cellular or landline telecommunications equipment, a rain gauge, and a peristaltic sampler. The system installed at Bouton Creek also incorporated several conductivity cells for distinguishing tidal flow from fresh water runoff.

The equipment was installed with intakes and sensors securely mounted, tubing and wires in conduits, and all above ground instruments protected within a security enclosure. Section 4.2 described how the equipment was placed at each station.

All materials used in the collection of stormwater samples and in contact with the samples met strict criteria in order to prevent any form of contamination of the sample. These materials must allow both inorganic and organic trace toxicant analyses from the same sampler and composite bottle. Only the highest grade of borosilicate glass is suitable for both trace metal and organic analyses from the same composite sample bottle. Sample hoses were Teflon®.

All bottles and hoses were cleaned according to EPA-approved protocols consistent with approved methodology for analysis of stormwater samples (USEPA, 1983). These bottles and hoses were then evaluated through a blanking process to verify that the hoses and composite bottles were contamination-free and appropriately cleaned for analyses of both inorganic and organic constituents.

4.4 Field Monitoring Procedures

The following sections provide a summary of the field methods and procedures used to collect and process data for both the wet and dry weather surveys.

4.4.1 Wet Weather Monitoring

Stormwater runoff was collected using two primary methods. Composite sampling was conducted to collect water for both chemical analysis and toxicity testing. A few analytes such as bacteria must be sampled using grab sampling methods and thus reflect conditions only at the time of sampling. This season, wet weather monitoring also included a pilot study designed to investigate the spatial extent conducted in the receiving waters of Alamitos Bay. The following sections provide details of methods used for composite sampling, grab sampling and for the pilot receiving water water study in Alamitos Bay.

4.4.1.1 Composite Sample Collection

A priority objective of the storm monitoring was to maximize the percent storm capture of the composite sample, while ensuring that the composite bottle collects enough water to support all the required analyses. This study required volumes of up to 70 liters of sample from each of the four land use sites to meet these analytical needs.

All aspects of the sampling events were continuously tracked from an office command and control center (Storm Control) located at our Santa Cruz laboratory. The status of each station was monitored through telecommunication links to each site. Station data were downloaded, and the stations were controlled and reprogrammed remotely. Weather information, including Doppler displays of rainfall for each area being monitored were also available on screen at the Storm Control center. In addition, Storm Control was in contact by cellular phone with the field crews.

When a storm was likely, all stations were made ready to sample. This preparation included entering the correct volume of runoff required for each sample aliquot ("Volume to Sample"), setting the automatic sampler and the data logger to sampling mode, pre-icing the composite sample bottle, and performing a general equipment inspection. A brief physical inspection of the equipment was made if possible to make certain that there were no obvious problems such as broken conduit, a kinked hose, or debris.

Once a storm event ended, the stations were shut down either on site or remotely by Storm Control. The station was left ready for the next storm event in case there was insufficient time for a maintenance visit between storms. Data were retrieved remotely via telecommunications from the data logger on a daily basis throughout the wet weather season.

All water samples were kept chilled (4°C) and were transferred to the analytical laboratories within holding times. Prior to sample shipping, sub-sampling from the composite container into sample containers was accomplished using protocol cleaned Teflon and silicone sub-sampling hoses and a peristaltic pump. Using a large magnetic stirrer, all composite water was first mixed together thoroughly and then continuously mixed while the sub-sampling took place. All sub-sampling took place at a staging area near Long Beach. Documentation accompanying samples to the laboratories included Chain of Custody forms, and Analysis Request forms (complete with detection limits).

4.4.1.2 Grab Sampling

During each storm event, grab samples for oil and grease, total recoverable petroleum hydrocarbons (TRPH), total and fecal coliform, enterococcus, and methyl tertiary butyl ether (MTBE) were collected. The timing of grab sampling efforts was often driven by the short holding times for the bacterial analyses. The ability to deliver samples to the microbiological laboratory within the 6-hour holding time was always a major consideration.

Except at the pump stations, all grab samples were taken near the center of flow as possible or at least in an area of sufficient velocity to ensure good mixing. At the Dominguez Gap sampling site, grabs were taken from the sump. At the Belmont pump station, grabs were taken at the point of discharge for the pumps. Some sites required the use of a pole to obtain the samples. Poles used were fitted with special bottle holders to secure the sampling containers. Care was taken not to overfill the sample containers for some of the containers contained preservative. For the MTBE samples, care was taken to assure that no air bubbles were trapped in the sample vial.

4.4.1.3 Alamitos Bay Pilot Receiving Water Study

This element of the stormwater monitoring program was initiated during the annual program review with Regional Board staff. The primary objectives of the pilot receiving water program were to:

- Define the general vertical and horizontal extent of stormwater in Alamitos Bay, Marine Stadium and Los Cerritos Channel.
- Evaluate toxicity and associated water quality characteristics of the stormwater plume.

Alamitos Bay, located approximately 10 miles southeast of Long Beach Harbor, is a 1 by ¾ mile, multi-use harbor. The opening of the harbor is at the southeast corner. The center of the harbor is occupied by Naples Island, which effectively gives it the structure of a ring. The bay receives fresh water from a variety of sources, the largest being Cerritos Creek, which drains the Long Beach Area and regions further inland. The upper end of Marine Stadium also can receive significant stormwater discharge volumes from Colorado Lagoon.

This pilot program was intended to be conducted once during the early portion of the 2002/2003 wet-weather season. The study area included all of Alamitos Bay, Marine Stadium and the Los Cerritos Channel up to the first upstream bridge. The study was to target an event where total rainfall was expected to exceed 0.5 inches to provide higher probabilities of encountering suitable ranges of stormwater concentrations in the study area. Field sampling was to be initiated within 12 to 24 hours following the end of rainfall.

The first task of this field program was to roughly define the horizontal and vertical extent of the stormwater plume. This required rapid characterization of the plume by use of a towed YSI Multiparameter Sonde deployed from a boom off the side of KLI's research vessel, the *D.W. Hood*. For establishing the horizontal extent of the plume, the sonde was towed at a depth of approximately 0.5 feet. Data from the Sonde was recorded on a portable computer. Sonde parameters included time, salinity, temperature, turbidity, pH and dissolved oxygen. A Garmin differential global positioning system (DGPS) unit was linked to a separate portable computer to record location and time and provide a real-time display of position. The Sonde and DGPS unit were synchronized to the nearest second to ensure concurrent locational data for all water quality data.

Occasional depth profiles were conducted in the plume to determine the depth of freshwater influence. Profiles were made to a depth of 10 feet with near surface data being recorded at six-inch depth intervals. After defining the halocline, recording depth intervals were increased to 1-foot. After establishing the general distribution of stormwater in receiving waters, sites were selected for collection of water samples based upon salinity. Four sites were selected to be representative of four different stormwater dilutions. To the extent practical, sites were intended to be selected from locations within the defined study area where receiving water salinities ranged from approximately 15 to 30 ppt.

The following table summarizes the target ranges of conditions to be sampled in the field. The target ranges were to provide a general framework and strategy for selection of sampling locations. This was intended to provide stormwater concentrations ranging from 12 to 56 percent. As anticipated, the actual ranges varied due to specific field conditions during the survey such as the general extent of the stormwater plume and characteristics of the vertical profiles of the plume.

Receiving Water Station Designation	Salinity (ppt)	Est. % Stormwater
RW-1	15	56
RW-2	20	41
RW-3	25	26
RW-4	30	12

Each receiving water sample was subjected to the sea urchin fertilization test. This is the only test that has been found to suggest potential for toxicity in the marine/estuarine receiving waters of Alamitos Bay. These samples were also analyzed for a subset of the analytes required for the stormwater monitoring program. Analytes were selected based upon previous results of toxicity testing and Toxicity Identification Evaluations (TIEs) conducted on the stormwater samples as well as general potential for toxicity. Chemical analyses of receiving water samples included total and dissolved trace metals (Cd, Cu, Ni, Pb and Zn), TSS, ammonia-N, pH, conductivity, salinity and organophosphate pesticides.

The data files from the YSI Sonde that contained time and water quality measurements, and from the Garmin DGPS that contained time and position data were merged by the time field. This combined data was entered into ArcInfo and contours based upon the point measured values of salinity were generated. The contours were plotted on a map of Alamitos Bay to show the salinity throughout the bay a few hours after the end of the strong rainfall.

4.4.2 Dry Weather Sampling

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations as well as samples to be taken at the Alamitos Bay receiving water site.

Inspections at each site included whether water was present and whether this water was flowing or just ponded. At sites that were found not to have flowing water, inspections were done in the upstream drains to verify that flow was not occurring into the site. This situation was encountered again this year at the Dominguez Gap Pump station where remnants of water were still ponded in the basin in front of the pump station, but the storm drain discharges into this basin were dry.

When flowing water was present at one of these mass emission sites, then water quality measurements, flow estimates, and water samples were taken along with observations of site conditions. Flowing water was present and all measurements were taken at Bouton Creek, the Belmont Pump Station, and at Los Cerritos Channel. Temperature and conductivity were measured with an Orion Model 140 meter, pH with an Orion Model 250 meter, and oxygen was measured the Orion Model 840.

Water samples were collected at the Belmont Pump Station and the Los Cerritos Channel Station by use of an automatic peristaltic pump sampler that collected aliquots every half hour for a 24-hour period. For the Bouton Creek Station where tidal influences are present, a similar sample was collected over a 2-4 hour period of low tide in order to isolate sampling of just the fresh water discharge down the creek. Additional grab samples were taken just after the time-composited samples for MTBE, TPH, and bacteria. All samples were chilled to 4 °C and transported to the appropriate laboratory for analysis.

4.5 Laboratory Analyses

The water quality constituents selected for this program were established based upon the requirements of the City of Long Beach NPDES permit for stormwater discharges. Analytical methods are based upon approved USEPA methodology. The following sections detail laboratory methods for chemical and biological testing.

4.5.1 Analytical Suite and Methods

Conventional, bacteriological, and chemical constituents selected for inclusion in this stormwater quality program are presented in Table 4.2. Analytical method numbers, holding times, and reporting limits are also indicated for each analysis. Semivolatile organic compounds listed in the table apply only to the September 2002 dry weather monitoring event as these constituents were not required as part of the 2002/2003 monitoring program.

4.5.1.1 Laboratory QA/QC

Quality Assurance/ Quality Control (QA/QC) activities associated with laboratory analyses are detailed in Appendix A.

The laboratory QA/QC activities provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness. Analytical quality assurance for this program included the following:

- Employing analytical chemists trained in the procedures to be followed.
- Adherence to documented procedures, USEPA methods and written SOPs.
- Calibration of analytical instruments.
- Use of quality control samples, internal standards, surrogates and SRMs.
- Complete documentation of sample tracking and analysis.

Internal laboratory quality control checks included the use of internal standards, method blanks, matrix spike/spike duplicates, duplicates, laboratory control spikes and Standard Reference Materials (SRMs).

Data validation was performed in accordance with the National Functional Guidelines for Organic Data Review (EPA540/R-94/012), Inorganic Data Review (EPA540/R-94/013), and Guidance on the Documentation and Evaluation of Trace Metals Data Collected for the Clean Water Act Compliance Monitoring (EPA/821/B/95/002).

4.5.2 Toxicity Testing Procedures

Upon receipt in the laboratory, stormwater discharge and receiving water samples were stored at 4 °C, in the dark until used in toxicity testing. Toxicity testing commenced within 72 hours of sample collection for most samples (Appendix Table A2-2). The relative toxicity of each discharge sample was evaluated using three chronic test methods: the water flea (*Ceriodaphnia dubia*) reproduction and survival test (freshwater), the purple sea urchin (*Strongylocentrotus purpuratus*) fertilization test (marine), and the mysid (*Americamysis bahia*) growth and survival test (marine). ToxScan, Inc. conducted the freshwater toxicity tests using the water flea, *Ceriodaphnia dubia*. Marine toxicity tests used the purple sea urchin (*Strongylocentrotus purpuratus*) and the mysid (*Americamysis bahia*). Tests using the mysid were limited to the first event of the season. Each of the methods is recommended by the USEPA for the measurement of effluent and receiving water toxicity. Water samples were diluted with laboratory water to produce a concentration series using procedures specific to each test method.

4.5.2.1 Water Flea Reproduction and Survival Test

Toxicity tests using the water flea, *Ceriodaphnia dubia*, were conducted in accordance with methods recommended by USEPA (1994a). The test procedure consisted of exposing 10 *C. dubia* neonates (less than 24 hours old) to the samples for six days. One animal was placed in each of 10 individual polystyrene cups containing approximately 20 mL of test solution. The test temperature was 25 ± 1 °C and the photoperiod was 16 hours light: 8 hours dark. Daily water changes were accomplished by transferring each individual to a fresh cup of test solution; water quality measurements and observations of survival and reproduction (number of offspring) were made at this time also. Prior to transfer, each cup was inoculated with food (100 µL of a 3:1 mixture of *Selenastrum* culture, density approximately 3.5 x 10^8 cells/mL, and *Ceriodaphnia* chow).

The test organisms were obtained from in-house cultures that were established from broodstock obtained from USEPA (Duluth, MN). The laboratory water used for cultures, controls, and preparation of sample dilutions was synthetic moderately hard freshwater, prepared with deionized water and reagent chemicals. Test samples were poured through a 60 µm Nitex screen in order to remove indigenous organisms prior to preparation of the test concentrations. Serial dilutions of the test sample were prepared, resulting in test concentrations of 100, 50, 25, 12, and 6 %.

The quality assurance program for this test consisted of three components. First, a control sample (laboratory water) was included in all tests in order to document the health of the test organisms. Second, a reference toxicant test consisting of a concentration series of potassium chloride (KCl) was conducted with each batch of samples to evaluate test sensitivity and precision. Third, the results were compared to established performance criteria for control survival, reproduction, reference toxicant sensitivity, sample storage, and test conditions. Any deviations from the performance criteria were noted in the laboratory records and prompted corrective action, ranging from a repeat of the test to adjustment of laboratory equipment.

4.5.2.2 Mysid Growth and Survival Test

Samples of wet weather discharge and receiving water were assessed for chronic toxicity using the marine mysid, *Americamysis bahia* (formerly named *Mysidopsis bahia*). Test procedures followed the guidelines established by USEPA (1994b). The procedure consisted of a seven-day exposure of juvenile (7 day old) mysids to the samples. Eight replicate test chambers (250 mL beakers), each containing five mysids, were tested for each concentration. The beakers contained 150 mL of test solution, which was changed daily. The test temperature was 26 ± 1 °C and the photoperiod was 16 hours light: 8 hours dark. Water quality and mysid survival measurements were recorded during each water change. Mysids were fed a standardized amount of newly hatched brine shrimp twice daily. At the end of the test, the surviving animals were dried and weighed to the nearest 0.001 mg to determine effects on growth.

The discharge water samples were adjusted to a salinity of 30 g/kg before testing. This was accomplished by adding a sea salt mixture (TropicMarin™) to the samples. The addition of sea salts was carried out the day before a test was initiated. The receiving water samples from Alamitos Bay had salinities greater than 30 g/kg and were tested without adjustment of the salinity. The salinity-adjusted samples were then diluted with seawater to produce test concentrations of 100, 50, 25, 12, and 6%. The test organisms were lab-reared *A. bahia* that were purchased from a commercial supplier. For most of the tests, the animals were received the day before the test started and were acclimated to the test temperature and salinity overnight.

Negative control (1.0 μm and activated carbon filtered natural seawater from ToxScan's Marine Bioassay facility at Long Marine Laboratory in Santa Cruz was diluted to 30 g/kg with deionized water) and sea salt control samples (deionized water mixed with sea salts) were included in each test series for quality control purposes. In addition, a reference toxicant test was included with each batch of test samples. Each reference toxicant test consisted of a concentration series of copper chloride with eight replicates tested per concentration. The median lethal concentration (LC50) was calculated from the data and compared to control limits based upon the cumulative mean and two standard deviations from recent experiments. Control and water quality data were also compared to established performance objectives; any deviations from these were noted and corrected, if possible.

4.5.2.3 Sea Urchin Fertilization Test

All discharge and receiving water samples of stormwater were also evaluated for toxicity using the purple sea urchin fertilization test (USEPA 1995). This test measures toxic effects on sea urchin sperm, which are expressed as a reduction in their ability to fertilize eggs. The test consisted of a 20-minute exposure of sperm to the samples. Eggs were then added and given 20 minutes for fertilization to occur. The eggs were then preserved and examined later with a microscope to assess the percentage of successful fertilization. Toxic effects are expressed as a reduction in fertilization percentage. Purple sea urchins (*Strongylocentrotus purpuratus*) used in the tests were supplied by U.C. Davis – Granite Canyon. The tests were conducted in glass shell vials containing 10 mL of solution at a temperature of 15 ± 1 °C. Five replicates were tested at each sample concentration.

All samples were adjusted to a salinity of 33.5 g/kg for the fertilization test. Previous experience has determined that many sea salt mixes are toxic to sea urchin sperm. Therefore, the salinity for the urchin test was adjusted by the addition of hypersaline brine. The brine was prepared by freezing and partially thawing seawater. Since the addition of brine dilutes the sample, the highest stormwater concentration that could be tested for the sperm cell test was 50%. The adjusted samples were diluted with seawater to produce test concentrations of 50, 25, 12, 6, and 3%.

Seawater control (1.0 μm filtered natural seawater from ToxScan's Long Marine Laboratory facility) and brine control samples (50% deionized water and 50% brine) were included in each test series for quality control purposes. Water quality parameters (temperature, dissolved oxygen, pH, ammonia, and salinity) were measured on the test samples to ensure that the experimental conditions were within desired ranges and did not create unintended stress on the test organisms. In addition, a reference toxicant test was included with each stormwater test series in order to document intralaboratory variability. Each reference toxicant test consisted of a concentration series of copper sulfate with four replicates tested per concentration. The median effective concentration (EC50) was estimated from the data and compared to control limits based upon the cumulative mean and two standard deviations of recent experiments.

4.5.2.4 Toxicity Identification Evaluations (TIEs)

Phase I TIEs were conducted on selected runoff samples from stations that exhibited substantial ($\geq$ 2 TU_{cc}) toxicity, in order to determine the characteristics of the toxicants present. Each sample was subjected to treatments designed to selectively remove or neutralize classes of compounds (e.g., metals, nonpolar organics) and thus the toxicity that may be associated with them. Treated samples were then tested to determine the change in toxicity using the sea urchin fertilization test.

Four or five treatments were applied to each sample. These treatments were: particle removal, trace metal chelation, nonpolar organic extraction, organophosphate (OP) deactivation (except urchins) and chemical reduction. With the exception of the organics extraction, each treatment was applied independently on a salinity-adjusted sample. A control sample (lab dilution water) was included with each type of treatment to verify that the manipulation itself was not causing toxicity. If the TIE was not conducted concurrently with the initial testing of a sample, then a reduced set of concentrations of untreated sample was tested at the time of the TIE to determine the baseline toxicity and control for changes in toxicity due to sample storage.

Ethylene diamine tetraacetic acid (EDTA), a chelator of metals, was added to a concentration of 60 mg/L to the marine test samples. EDTA additions to the *Ceriodaphnia* samples were based upon sample hardness (USEPA 1991). Sodium thiosulfate (STS), a treatment that reduces oxidants such as chlorine and also decreases the toxicity of some metals was added to a concentration of 50 mg/L to separate portions of each marine sample. STS additions to the *Ceriodaphnia* samples were at 500, 250 and 125 mg/L. The EDTA and sodium thiosulfate treatments were given at least one hour to interact with the sample prior to the start of toxicity testing. Pipernyl butoxide, which inhibits activation of OP pesticides was added to a concentration of 100 mg/L for mysids and at three concentrations (125, 250 and 500 mg/L) for *Ceriodaphnia.*

Samples were centrifuged for 30 min at 3000 X g to remove particle-borne contaminants and tested for toxicity. A portion of the centrifuged sample was also passed through a 360 mg Sep-Pak™ C18 solid phase extraction column in order to remove nonpolar organic compounds. C18 columns have also been found to remove some metals from aqueous solutions.

4.5.2.5 Statistical Analysis

The toxicity test results were normalized to the control response in order to facilitate comparisons of toxicity between experiments. Normalization was accomplished by expressing the test responses as a percentage of the control value. Four statistical parameters (NOEC, LOEC, median effect, and TUc) were calculated to describe the magnitude of stormwater toxicity. The NOEC (highest test concentration not producing a statistically significant reduction in fertilization or survival) and LOEC (lowest test concentration producing a statistically significant reduction in fertilization or survival) were calculated by comparing the response at each concentration to the dilution water control. Various statistical tests were used to make this comparison, depending upon the characteristics of the data. Water flea survival and reproduction data were usually tested against the control using Fisher's Exact and Steel's Many-One Rank test, respectively. Sea urchin fertilization and mysid survival data were evaluated for significant differences using Dunnett's multiple comparison test, provided that the data met criteria for homogeneity of variance and normal distribution. Data that did not meet these criteria were analyzed by the non-parametric Steel's Many-One Rank or Wilcoxon's tests.

Measures of median effect for each test were calculated as the LC50 (concentration producing a 50% reduction in survival) for mysid and water flea survival, the EC50 (concentration effective on 50% of eggs) for sea urchin fertilization, or the IC50 (concentration inhibitory to 50% of individuals) for water flea reproduction and IC25 for mysid growth. The LC50 or EC50 was calculated using either probit analysis or the trimmed Spearman-Karber method. The IC25 and IC50 were calculated using linear interpolation analysis. All procedures for calculation of median effects followed USEPA guidelines.

The toxicity results were also expressed as chronic Toxic Units (TUc). This statistic was calculated as: 100/NOEC. Increased values of toxic units indicate relatively greater toxicity, whereas greater toxicity for the NOEC, LOEC, and median effect statistics is indicated by a lower value.

Comparisons of chemical or physical parameters with toxicity results were made using the non-parametric Spearman rank order correlation.

Land Use of Drainage Basin 14

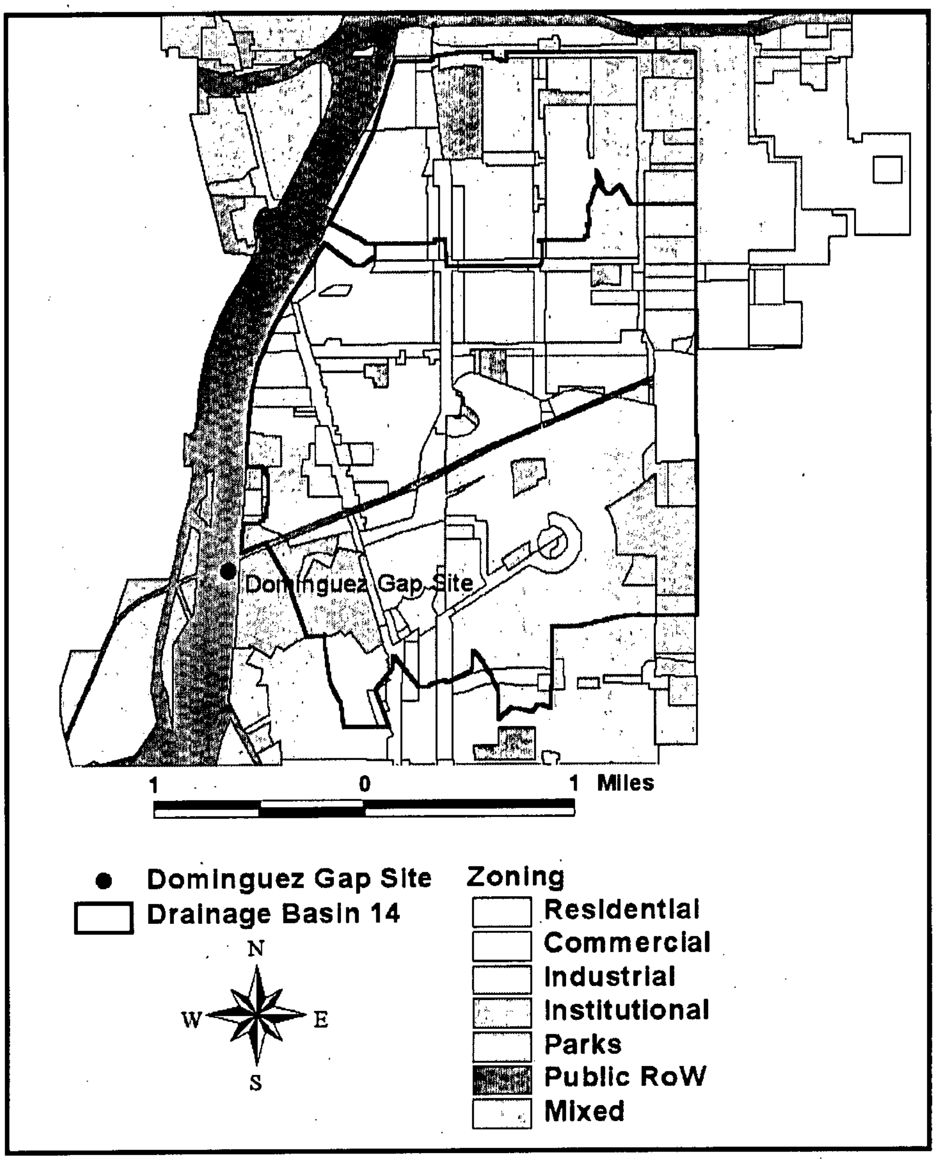


Figure 4.1 Land Use of Drainage Basin #14 which Drains to the Dominguez Gap Mass Emissions Site (Source: City of Long Beach Department of Technology Services, last update 12/20/00).

Land Use of Drainage Basin 20

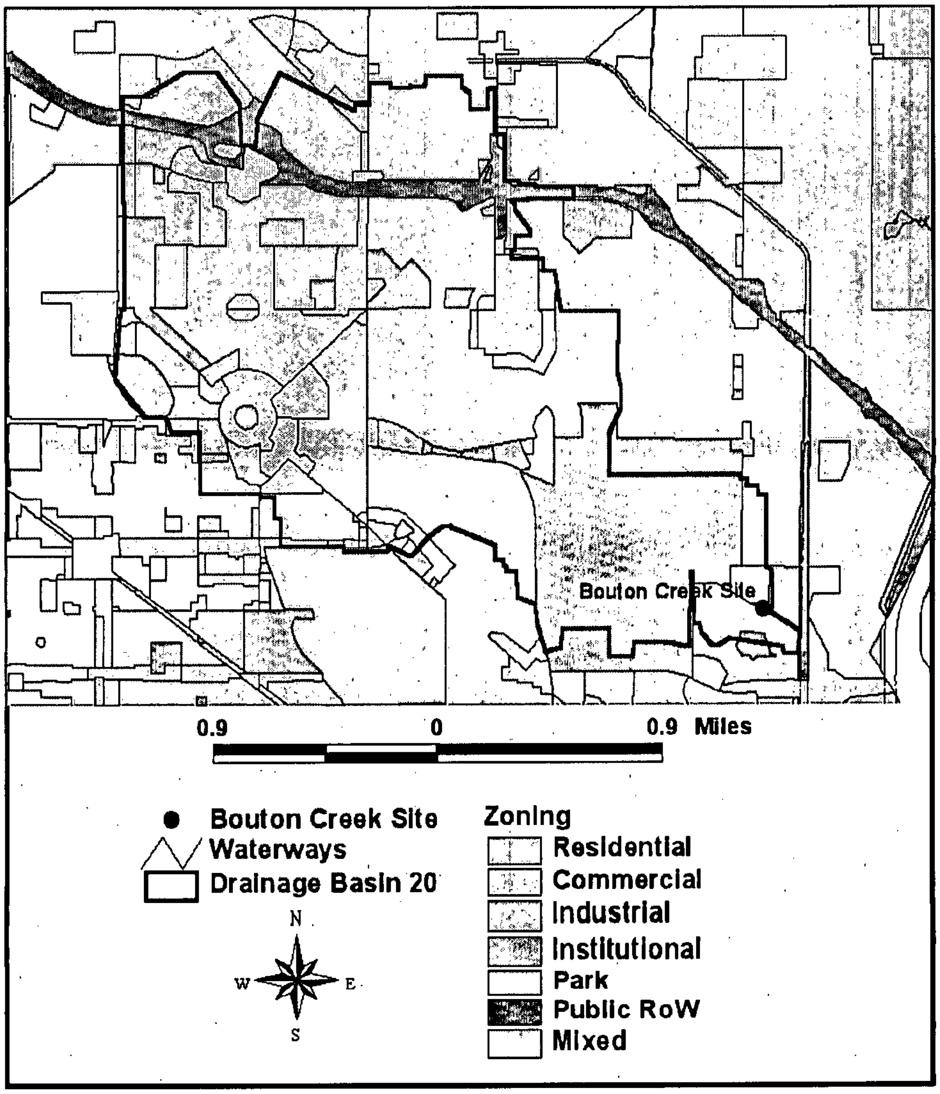


Figure 4.2 Land Use of Drainage Basin #20 which drains to the Bouton Creek Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00).

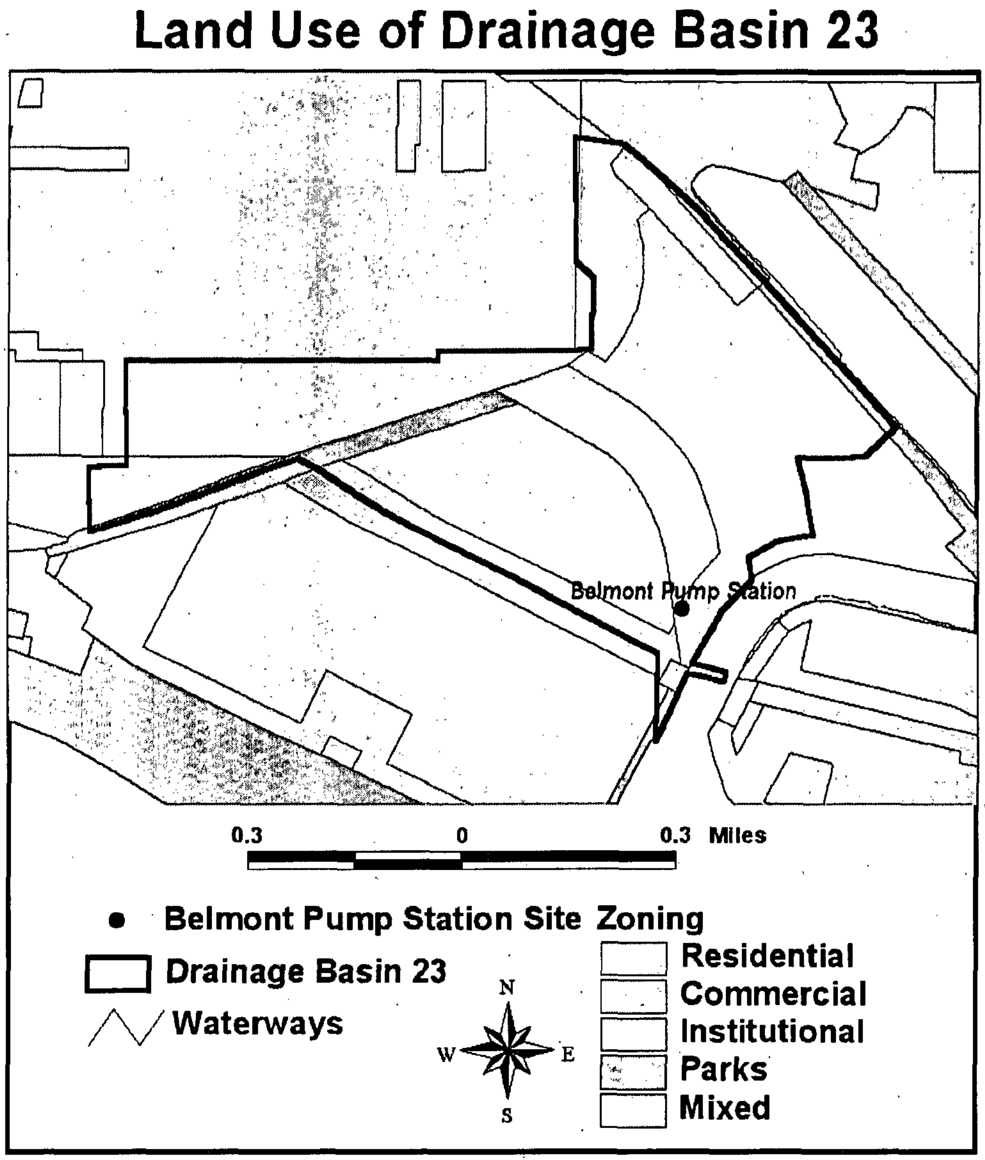


Figure 4.3 **Land Use of Drainage Basin #23 which Drains to the Belmont Pump Station Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00)**

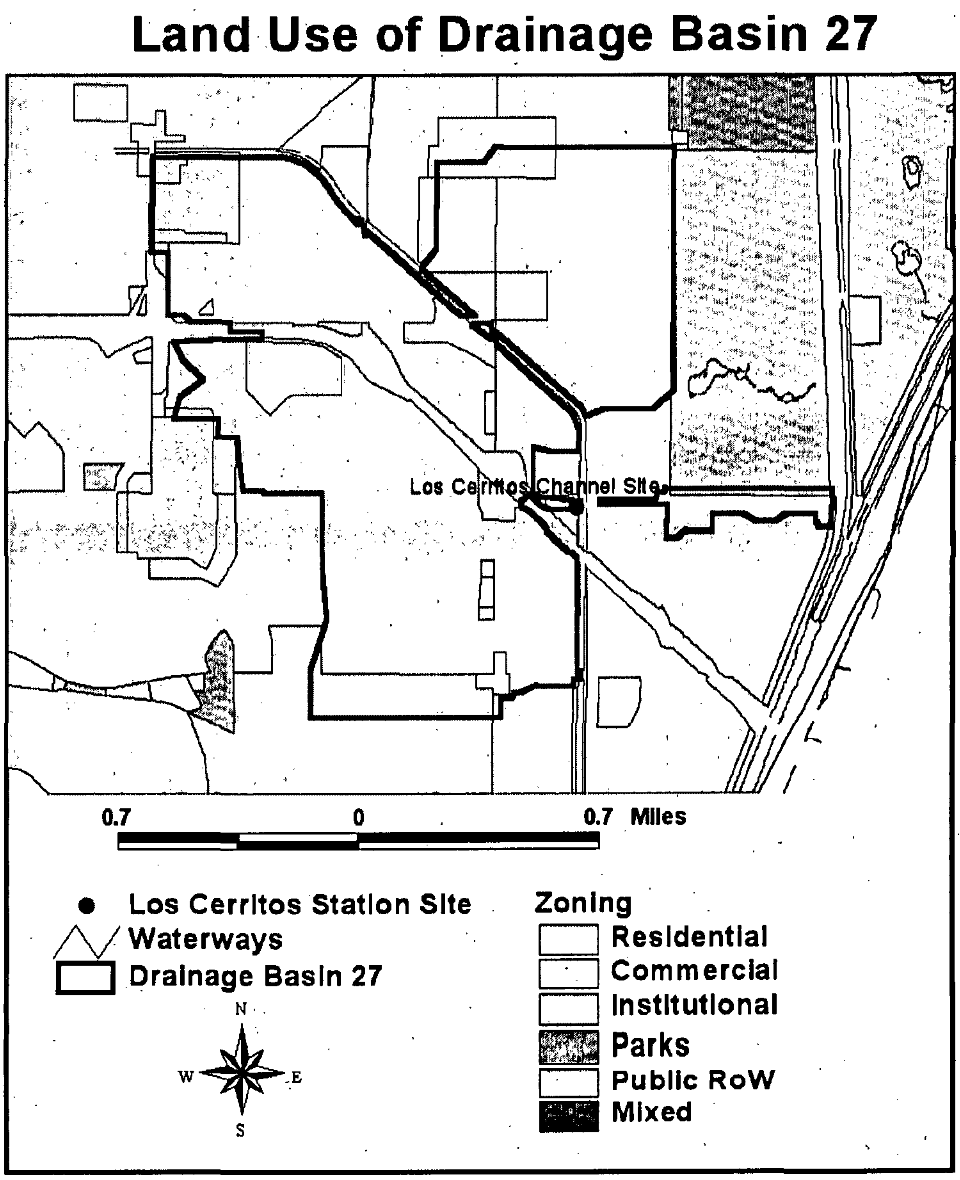


Figure 4.4 Land Use of Drainage Basin #27 which Drains to the Los Cerritos Channel Monitoring Site (Source: City of Long Beach, Department of Technology Services, last update 12/20/00).

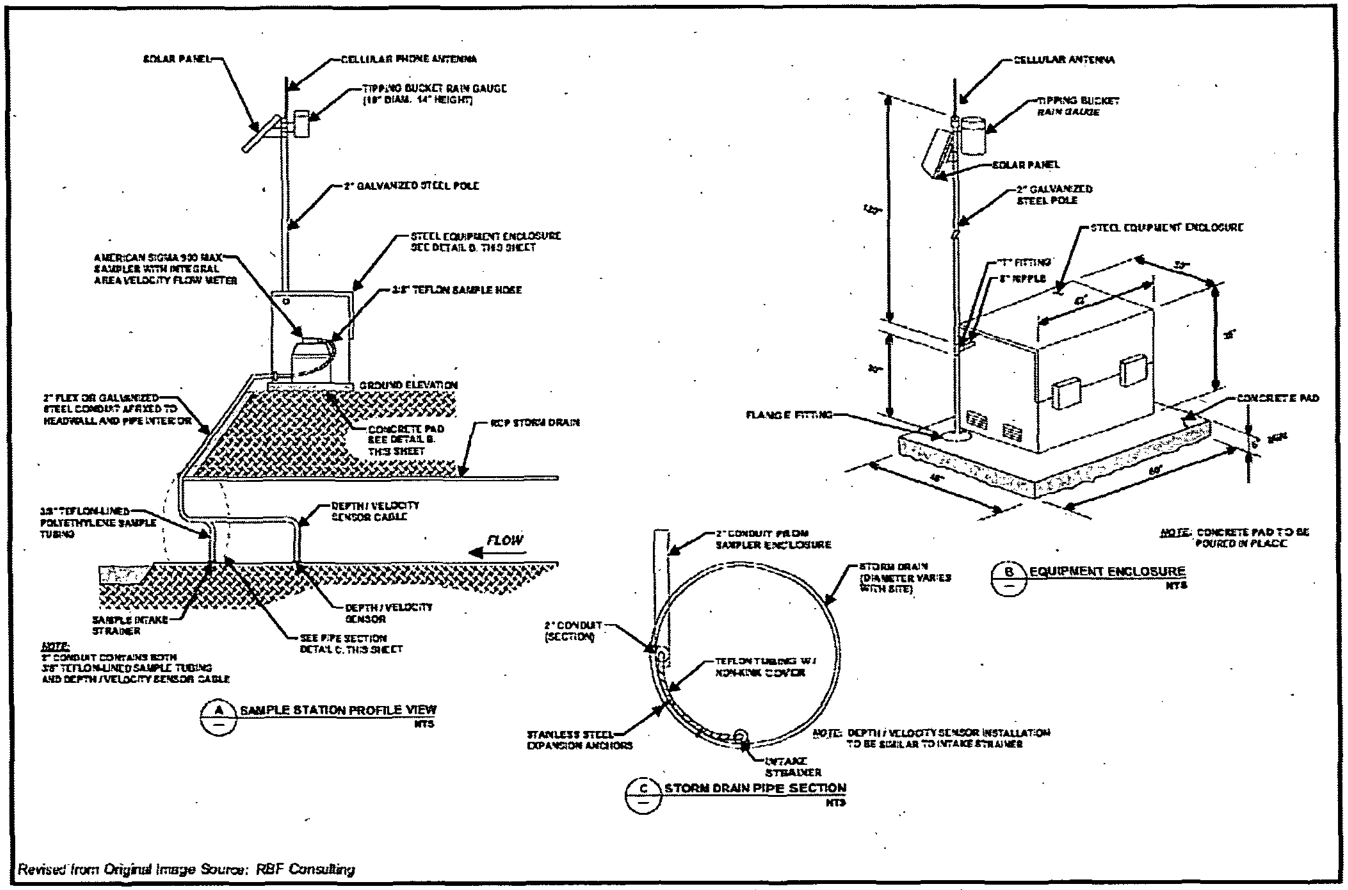


Figure 4.5 Typical KLASS Stormwater Monitoring Station.

Table 4.1 Location Coordinates of Monitoring Stations for the City of Long Beach Stormwater Monitoring Program.

Station Name	State Plane Coordinates: Zone 5 Northing (ft)	State Plane Coordinates: Zone 5 Easting (ft)	North American Datum (NAD) 83 Latitude	North American Datum (NAD) 83 Longitude
Belmont Pump	1734834.9	6522091.2	33° 45' 36.6"N	118° 07' 48.7"W
Bouton Creek	1741960.5	6529305.2	33° 46' 44.3"N	118° 06' 23.4"W
Cerritos Channel	1747935.9	6530153.2	33° 47' 43.3"N	118° 06'13.4"W
Dominguez Gap	1764025.0	6500042.5	33° 50' 22.1"N	118° 12' 10.5"W

Table 4.2 Analytical Methods, Holding Times, and Reporting Limits.

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit or ML
CONVENTIONAL PARAMETERS			
Oil and Grease (mg/L)	1664	28 days	5.0
Total Phenols (mg/L)	420.1	28 days	0.1
Cyanide (µg/L)	335.2	14 days	0.005
pH (units)	150.1	ASAP	0 – 14
Dissolved Phosphorus (mg/L)	365.3	48 hours	0.01
Total Phosphorus (mg/L)	365.3	28 days	0.05
Turbidity (NTU)	180.1	48 hours	1.0
Total Suspended Solids (mg/L)	160.2	7 days	1.0
Total Dissolved Solids (mg/L)	160.1	7 days	1.0
Volatile Suspended Solids (mg/L)	160.4	7 days	1.0
Total Organic Carbon (mg/L)	415.1	28 days	1.0
Total Recoverable Petroleum Hydrocarbon (mg/L)	1664	28 days	5.0
Biochemical Oxygen Demand (mg/L)	405.1	48 hours	4.0
Chemical Oxygen Demand (mg/L)	410.1	28 days	4.0
Total Ammonia-Nitrogen (mg/L)	350.2	28 days	0.1
Total Kjeldahl Nitrogen (mg/L)	351.3	28 days	0.1
Nitrite Nitrogen (mg/L)	300.0	48 hours	0.1
Nitrate Nitrogen (mg/L)	300.0	48 hours	0.1
Alkalinity, as $CaCO3$ (mg/L)	310.1	48 hours	5.0
Specific Conductance (umhos/cm)	120.1	48 hours	1.0
Total Hardness (mg/L)	130.2	180 days	1.0
MBAS (mg/L)	425.1	48 hours	0.02
Chloride (mg/L)	300.0	48 hours	1.0
Fluoride (mg/L)	300.0	48 hours	0.1
Methyl-tertiary butyl ether (MTBE) (µg/L)	8020A/8260	14 days	0.5
BACTERIA (MPN/100ml)			
Total Coliform	SM 9221B	6 hours	<20
Fecal Coliform	SM 9221B	6 hours	<20
Enterococcus	SM 9230C	6 hours	<20
TOTAL AND DISSOLVED METALS (µg/L)[1]			
Aluminum	200.8	180 days	25
Antimony	200.8	180 days	0.5
Arsenic	200.8	180 days	0.5
Beryllium	200.8	180 days	0.5
Cadmium	200.8	180 days	0.25
Chromium	200.8	180 days	0.5
Copper	200.8	180 days	0.5
Hexavalent Chromium (total)	SM 3500D	24 hours	0.3-20
Iron	236.1	180 days	25
Lead	200.8	180 days	0.5
Mercury	245.7	28 days	0.2
Nickel	200.8	180 days	1.0
Selenium	200.8	180 days	1.0
Silver	200.8	180 days	0.25
Thallium	200.8	180 days	1.0
Zinc	200.8	180 days	1.0

1. Samples to be analyzed for dissolved metals are to be filtered within 48 hours.

Table 4.2 **Analytical Methods, Holding Times, and Reporting Limits. (continued)**

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
CHLORINATED PESTICIDES (µg/L)			
Aldrin	8081A	7 days	0.005
alpha-BHC	8081A	7 days	0.01
beta-BHC	8081A	7 days	0.005
delta-BHC	8081A	7 days	0.005
gamma-BHC (lindane)	8081A	7 days	0.02
alpha-Chlordane	8081A	7 days	0.1
gamma-Chlordane	8081A	7 days	0.1
4,4'-DDD	8081A	7 days	0.05
4,4'-DDE	8081A	7 days	0.05
4,4'-DDT	8081A	7 days	0.01
Dieldrin	8081A	7 days	0.01
Endosulfan I	8081A	7 days	0.02
Endosulfan II	8081A	7 days	0.01
Endosulfan sulfate	8081A	7 days	0.05
Endrin	8081A	7 days	0.01
Endrin Aldehyde	8081A	7 days	0.01
Heptachlor	8081A	7 days	0.01
Heptachlor Epoxide	8081A	7 days	0.01
Toxaphene	8081A	7 days	0.5
AROCLORS (µg/L)			
Aroclor-1016	8081A	7 days	0.5
Aroclor-1221	8081A	7 days	0.5
Aroclor-1232	8081A	7 days	0.5
Aroclor-1242	8081A	7 days	0.5
Aroclor-1248	8081A	7 days	0.5
Aroclor-1254	8081A	7 days	0.5
Aroclor-1260	8081A	7 days	0.5
Total PCBs	8081A	7 days	0.5
ORGANOPHOSPHATE PESTICIDES (µg/L)			
Diazinon	8141A	7 days	0.01
Chlorpyrifos (Dursban)	8141A	7 days	0.05
Malathion	8141A	7 days	1.0
Prometryn	8141A	7 days	1.0
Atrazine	8141A	7 days	1.0
Simazine	8141A	7 days	1.0
Cyanazine	8141A	7 days	1.0
HERBICIDES (µg/L)			
2,4-D	8151A	7 days	1.0
2,4,5-TP-Silvex	8151A	7 days	0.50
Glyphosate	547	14 days	5.0

Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)			
Acenaphthene	625	7 days	1.0
Acenaphthylene	625	7 days	1.0
Anthracene	625	7 days	1.0
Benzidine	625	7 days	1.0
Benzo(a)anthracene	625	7 days	1.0
Benzo(b)fluoranthene	625	7 days	1.0
Benzo(k)fluoranthene	625	7 days	1.0
Benzo(g,h,i)perylene	625	7 days	1.0
Benzo(a)pyrene	625	7 days	1.0
Benzyl butyl phthalate	625	7 days	1.0
Bis(2-chloroethyl)ether	625	7 days	1.0
Bis(2-chloroethoxy)methane	625	7 days	2.0
Bis(2-ethylhexyl)phthalate	625	7 days	1.0
Bis(2-chlorisopropyl)ether	625	7 days	1.0
4-Bromophenyl phenyl ether	625	7 days	1.0
2-Chloroethyl vinyl ether	625	7 days	-
2-Chloronaphthalene	625	7 days	1.0
4-Chlorophenyl phenyl ether	625	7 days	1.0
Chrysene	625	7 days	1.0
Dibenzo(a,h)anthracene	625	7 days	1.0
1,3-Dichlorobenzene	625	7 days	1.0
1,2-Dichlorobenzene	625	7 days	1.0
1,4-Dichlorobenzene	625	7 days	1.0
3,3-Dichlorobenzidine	625	7 days	1.0
Diethylphthalate	625	7 days	1.0
Dimethylphthalate	625	7 days	1.0
Di-n-Butyl phthalate	625	7 days	1.0
2,4-Dinitrotoluene	625	7 days	1.0
2,6-Dinitrotoluene	625	7 days	1.0
4,6 Dinitro-2-methylphenol	625	7 days	2.0
1,2-Diphenylhydrazine	625	7 days	1.0
Di-n-Octyl phthalate	625	7 days	1.0
Fluoranthene	625	7 days	1.0
Fluorene	625	7 days	1.0
Hexachlorobenzene	625	7 days	1.0
Hexachlorobutadiene	625	7 days	1.0
Hexachloro-cyclopentadiene	625	7 days	1.0
Hexachloroethane	625	7 days	1.0
Indeno[1,2,3-cd]pyrene	625	7 days	1.0
Isophorone	625	7 days	1.0
Naphthalene	625	7 days	1.0
Nitrobenzene	625	7 days	1.0
N-Nitroso-dimethyl amine	625	7 days	-
N-Nitroso-diphenyl amine	625	7 days	1.0
N-Nitroso-di-n-propyl amine	625	7 days	5.0

Table 4.2 Analytical Methods, Holding Times, and Reporting Limits. (continued)

Analyte and Reporting Unit	EPA Method Number	Holding Time	Target Reporting Limit
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L) (continued)			
Phenanthrene	625	7 days	1.0
Pyrene	625	7 days	1.0
1,2,4-Trichlorobenzene	625	7 days	1.0
4-Chloro-3-methylphenol	625	7 days	1.0
2-Chlorophenol	625	7 days	2.0
2,4-Dichlorophenol	625	7 days	2.0
2,4-Dimethylphenol	625	7 days	1.0
2,4-Dinitrophenol	625	7 days	5.0
2-Nitrophenol	625	7 days	1.0
4-Nitrophenol	625	7 days	1.0
Pentachlorophenol	625	7 days	1.0
Phenol	625	7 days	1.0
2,4,6-Trichlorophenol	625	7 days	1.0

SM = Method number from *Standard Methods for the Examination of Water and Wastewater* (APHA 1995).
1. Samples must be filtered within 48 hours.
\- indicates analyte not reported.

5.0 RAINFALL AND HYDROLOGY

All Long Beach monitoring stations were fully operational during the 2002/2003 wet weather season. Precipitation and discharge were continuously monitored throughout the season. The first two major storm events of the season were captured at three of the stations including the Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Neither of the events were sufficient to produce a discharge at the Dominguez Gap Pump Station. As required by the NPDES permit, four events were sampled at Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Only three events were monitored at Dominguez Gap Pump Station since this site did not discharge until late in the season following a series of events where runoff volumes finally exceeded infiltration capacity of the basin to cause discharge of stormwater from this station. All discharge events at the Dominguez Gap Pump Station site were sampled during this monitoring year.

5.1 Precipitation during the 2002/2003 Storm Season

Precipitation during the 2002/2003 water year was slightly below normal in Long Beach according to the National Weather Service climate station at Long Beach Daugherty Airport (Figure 5.1) but well above levels from the previous year. During the prior season, only 1.99 inches of rain was recorded at the Long Beach Airport from October 2001 to April 2002. This season, a total of 8.62 inches of rainfall was recorded at the airport during this time period. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches.

Rainfall was relatively uniform at each of the monitoring stations with seasonal totals ranging from 11.13 inches at the Dominguez Pump Station to 12.11 inches at the Los Cerritos Creek stormwater monitoring site.

5.1.1 Monthly Precipitation

Normal rainfall during January averages nearly three inches making it one of the wettest months of the storm season (Figure 5.1) in Long Beach. During January 2003 no rainfall was measured at the Long Beach Airport or any of the stormwater monitoring stations. This lack of rain was made up for by an above normal February, which had 4.40 inches of rain. The combined rainfall for January and February 2003 was 4.40 inches, nearly 74 percent of the normal for those two months.

5.1.2 Precipitation during Monitored Events

Precipitation during each storm event was characterized by total rainfall, duration of rainfall, maximum intensity, days since last rainfall, and the magnitude of the event immediately preceding the monitored storm event (antecedent rainfall). Precipitation characteristics for each event are summarized in Table 5.1 and resulting flow in Table 5.2. Cumulative descriptive statistics for the season at each monitoring station are presented in Table 5.3. Cumulative rainfall and intensity are summarized graphically for each monitored event at each station in Figures 5.2 through 5.16.

Total rainfall measured during each of the five monitored events in the 2002/2003 wet season varied from 0.99 to 2.70 inches The third event was the largest with an average rainfall among sampling stations of 2.70 inches and the fourth event was the smallest with an average rainfall of 0.99 inches. All rainfall monitored during the 2002/2003 storm season was above normal for single events The mean rainfall amount for all monitored events ranged from 1.43 inches at the Belmont Pump Station to 1.89 inches at the Dominguez Gap Pump Station.

Maximum rainfall intensities were particularly impressive during the 2002/2003 storm season. The mean maximum rainfall intensities among monitored events ranged from 0.72 inches per hour at Bouton Creek to 0.92 inches per hour at the Dominguez Gap Pump Station.

Except for Event 4 on 24 February 2003 at the Belmont Pump Station, all storm events monitored were spaced by at least 5 days of no antecedent rainfall. The fourth event at Belmont Pump Station was preceded by 0.12 inches of rainfall 0.4 days earlier. The 51 days preceding the third event on February 11, 2003 was the driest period prior to a monitored event. Overall the mean period of dry conditions between monitored events ranged from 23.2 days at Dominguez Gap Pump Station to 49.7 days at Los Cerritos Creek.

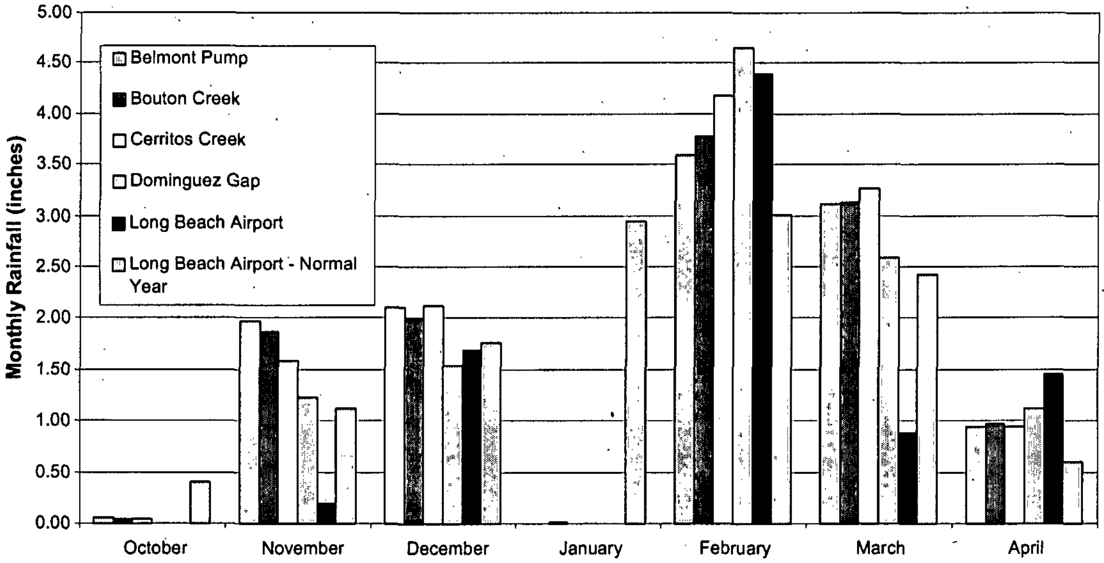
5.2 Stormwater Runoff during Monitored Events

Monitoring was designed to isolate rainfall events and the runoff created by those events. Table 5.2 summarizes flow characteristics among monitored events at each station. Table 5.3 provides descriptive statistics for all monitored events since the beginning of the 2002/2003 season. This information complements Event Mean Concentration (EMC) statistics for each monitored analyte at these sites. Figures 5.2 through 5.16 graphically depict flow during each monitored event at each station in response to rainfall. These figures also show how the aliquoting of each composite sample was conducted.

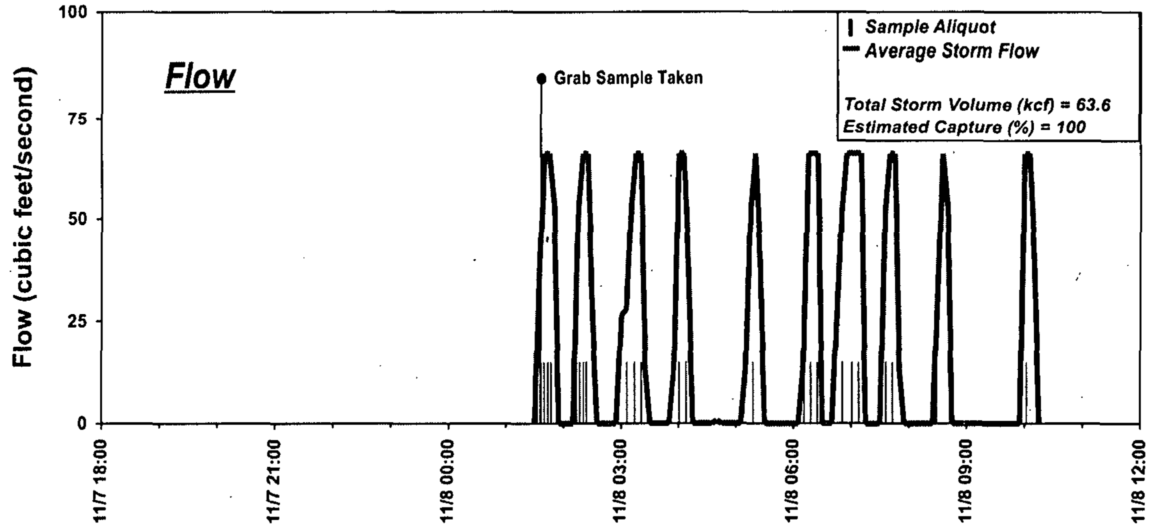
There was high variability between the stations in duration of flow during each event. Flow duration was typically greatest at Bouton Creek due to tidal effects. During incoming tides, low flows are backed up and held back by the tide. As the tide recedes, stormwater is detected at the station and sampling continues. This effect was most notable during the first and third events (Figure 5.3 and 5.9). Los Cerritos Creek also had long flow durations, and during Event 2 it had an extremely high total flow volume in a short amount of time. The station briefly exceeded the maximum rated stage causing a failure in the sampling strategy. Since the sampling was halted when the flow rating was exceeded, only a first flush sample was collected representing the rising hydrograph and approximately the first 20 percent of the runoff. Normally, this sample would have been discarded. However, since receiving water samples were collected in Los Alamitos Bay during this event and the sample represented a worst case situation, the sample was retained for comparative purposes.

The percent storm captures (percentage of the total storm event volume effectively represented by the flow-weighted composite sample) were acceptable in most cases. The storm capture at the Los Cerritos Creek Station during Event 2 was low due to the circumstances described above and the extreme intensity of rainfall and runoff, which caused bottles to fill rapidly before crews could get to the sites to change bottles and settings. In all cases the rising limb of the hydrograph and periods of high flow were well represented by the samples.

Figure 5.1 **Monthly Rainfall Totals for the 2002/2003 Wet Weather Season and Normal Rainfall at Long Beach Daugherty Air Field.**



	Belmont Pump	Bouton Creek	Los Cerritos Creek	Dominguez Gap	Long Beach Airport	Long Beach Airport-Normal
October	0.06	0.05	0.04	0.00	0.00	0.40
November	1.97	1.87	1.58	1.23	0.19	1.12
December	2.11	1.99	2.12	1.54	1.69	1.76
January	0.00	0.01	0.00	0.00	0.00	2.95
February	3.60	3.77	4.17	4.65	4.40	3.01
March	3.11	3.13	3.26	2.59	0.89	2.43
April	0.94	0.98	0.94	1.12	1.45	0.60
Season Totals	**11.79**	**11.80**	**12.11**	**11.13**	**8.62**	**12.27**



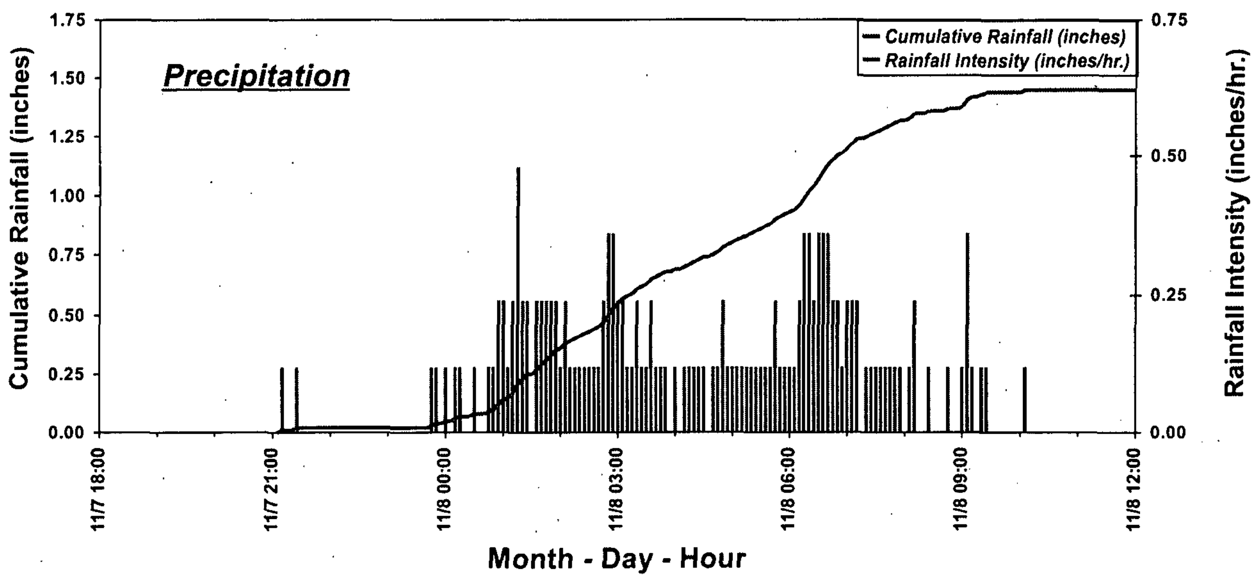


Figure 5.2 - Belmont Pump Station - Event 1 (7 - 8 November, 2002)

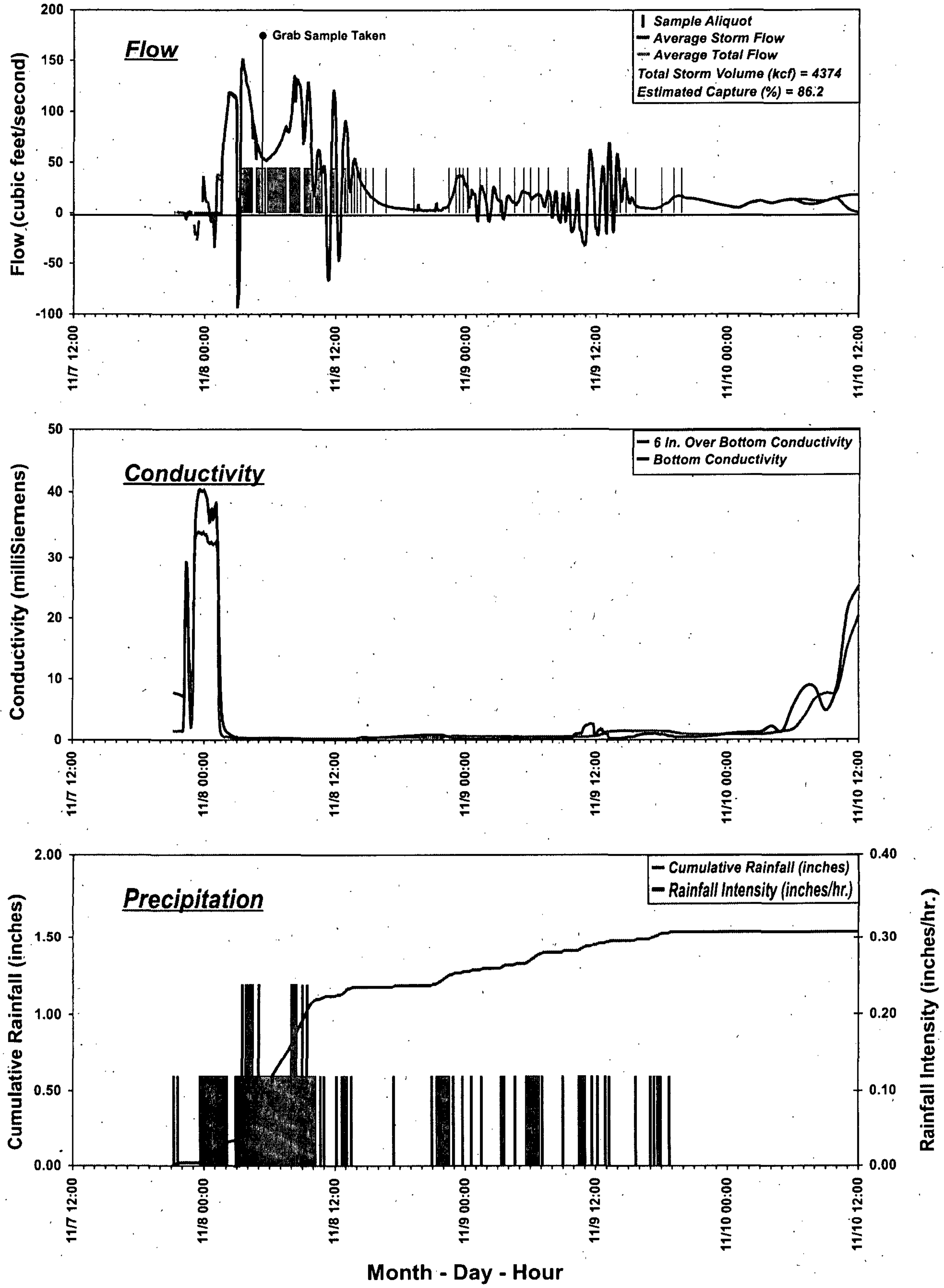


Figure 5.3 - Bouton Creek - Event 1 (7 - 10 November, 2002)

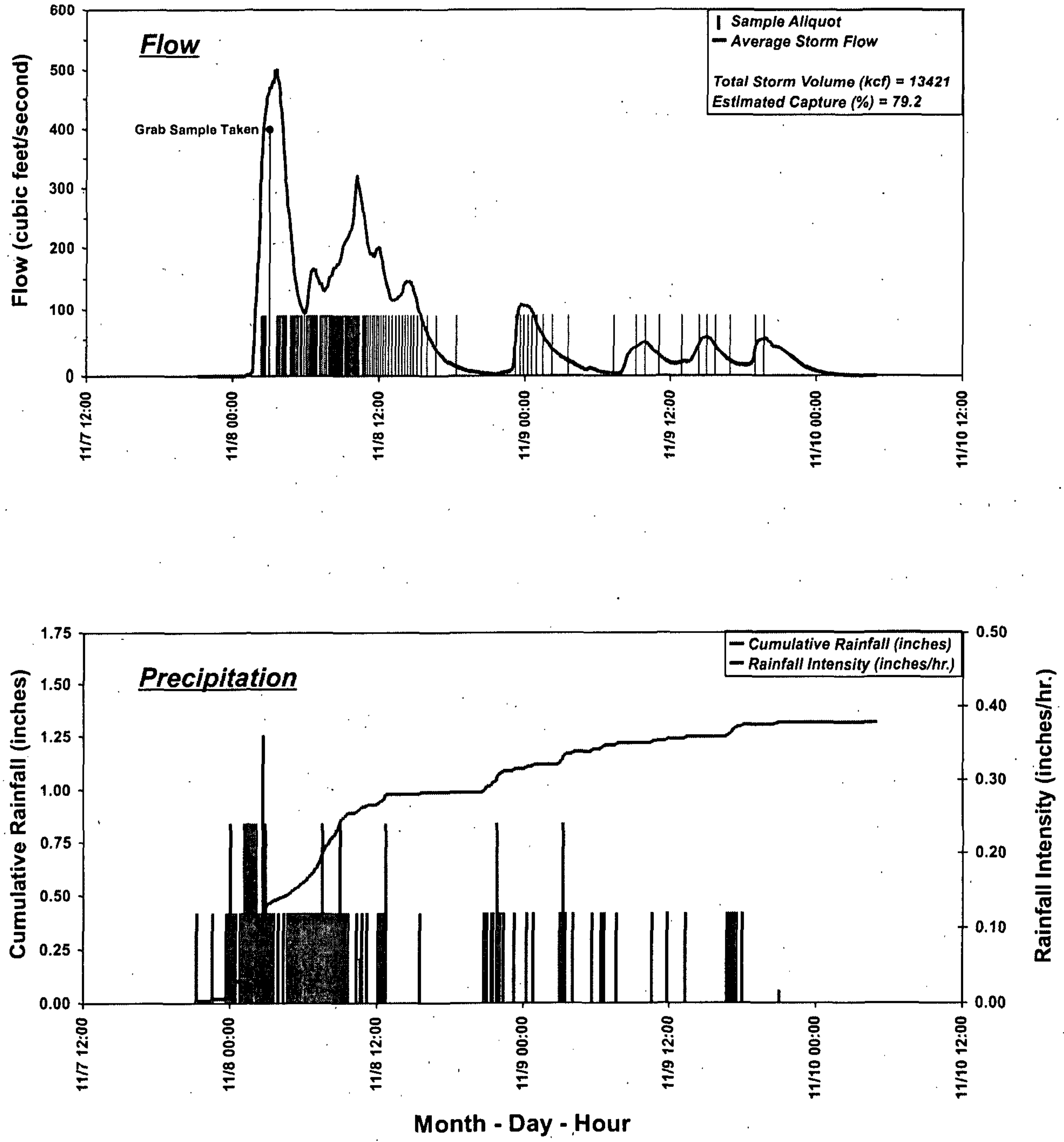
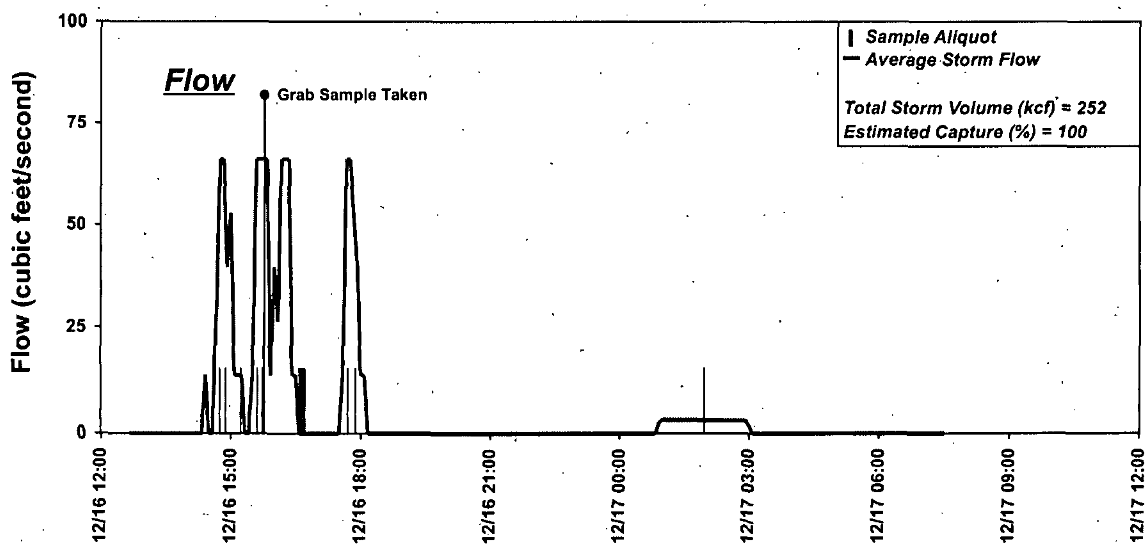


Figure 5.4 - Los Cerritos Channel - Event 1 (8 - 10 November, 2002)



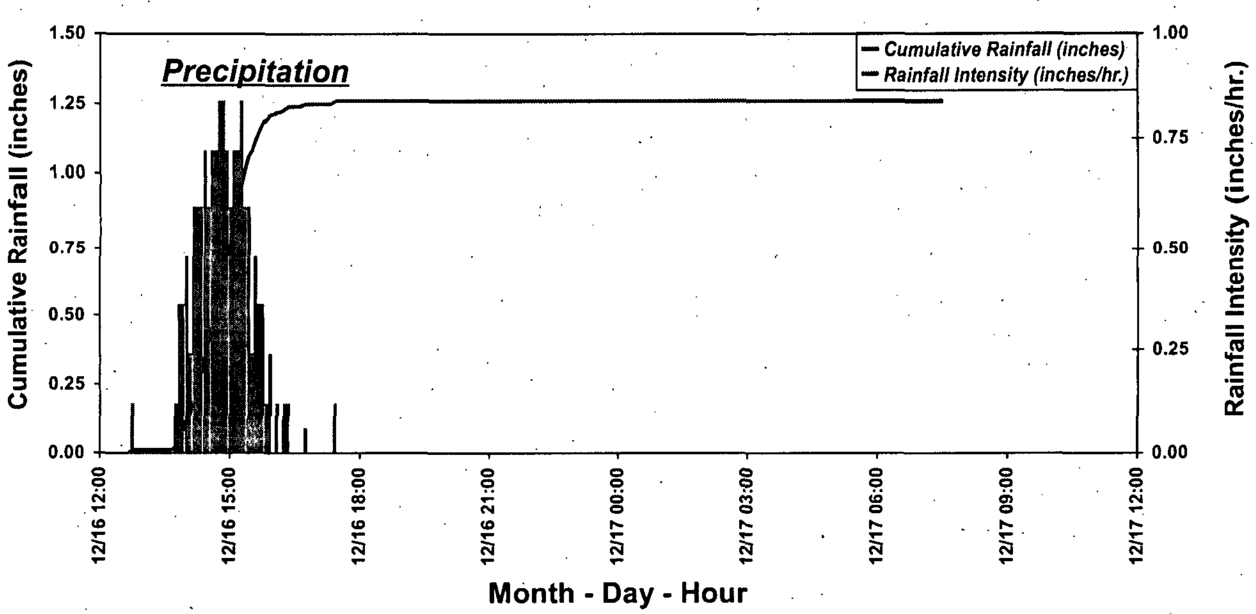


Figure 5.5 - Belmont Pump Station - Event 2 (16 - 17 December, 2002)

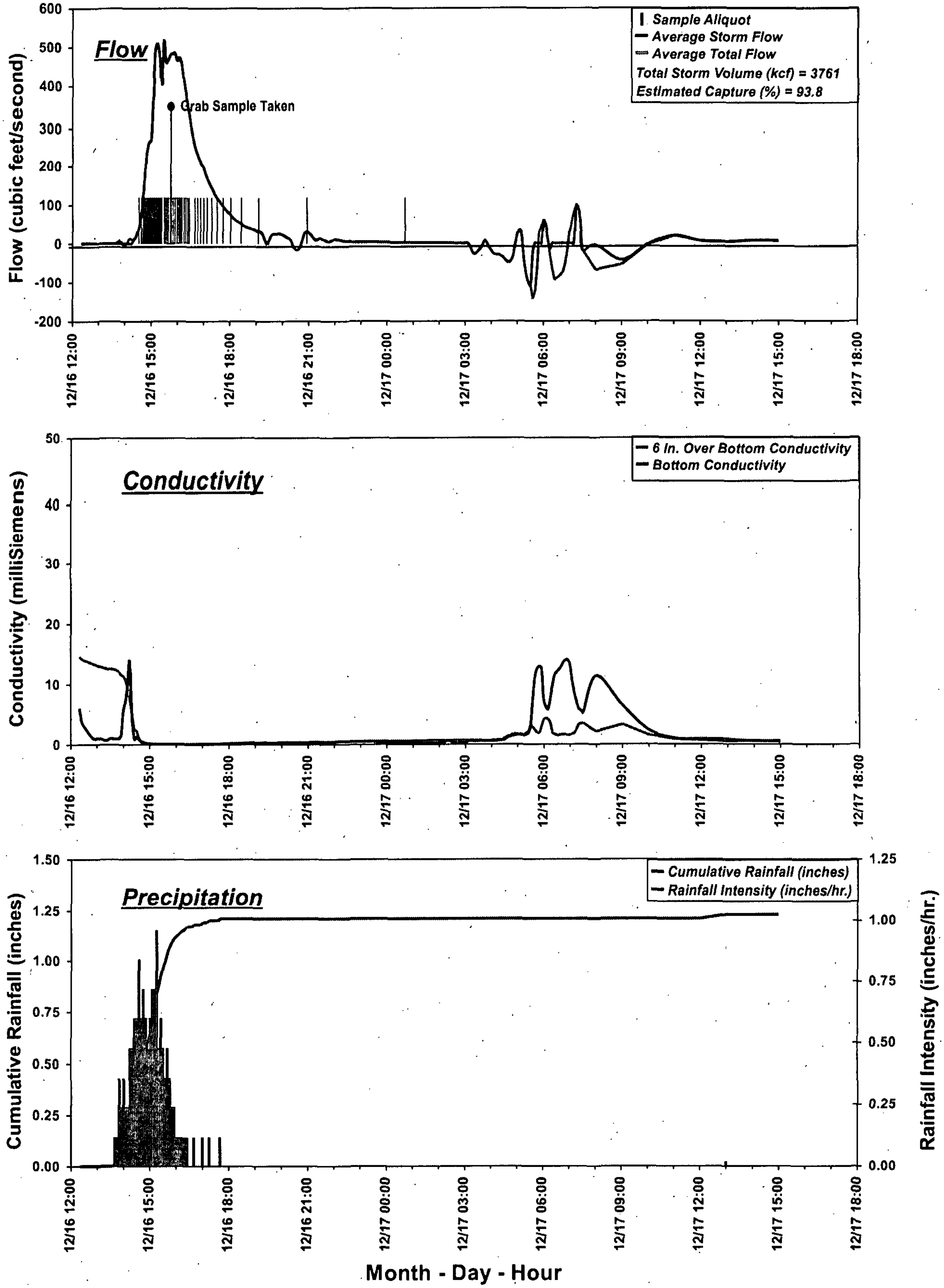
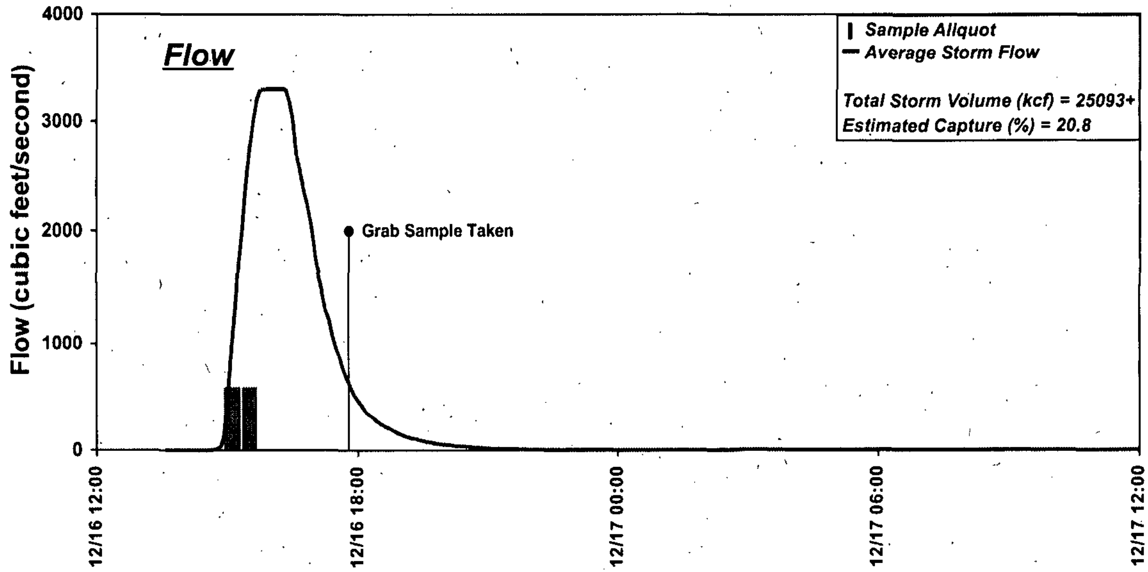


Figure 5.6 - Bouton Creek - Event 2 (16 - 17 December, 2002)



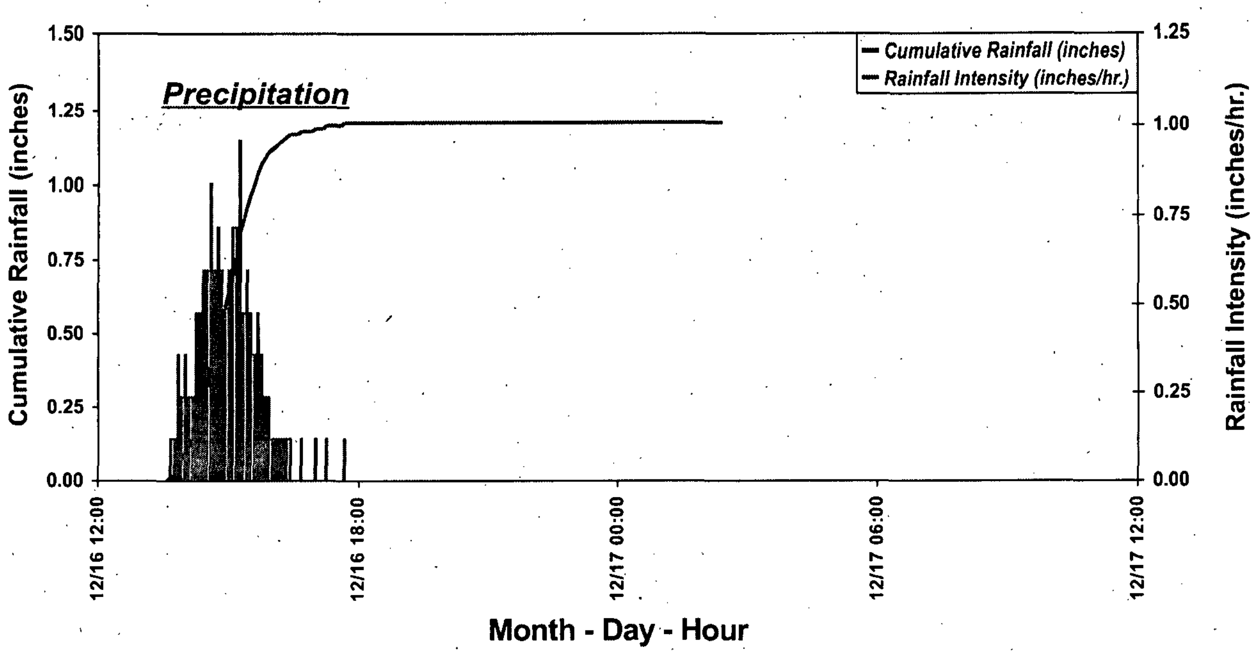
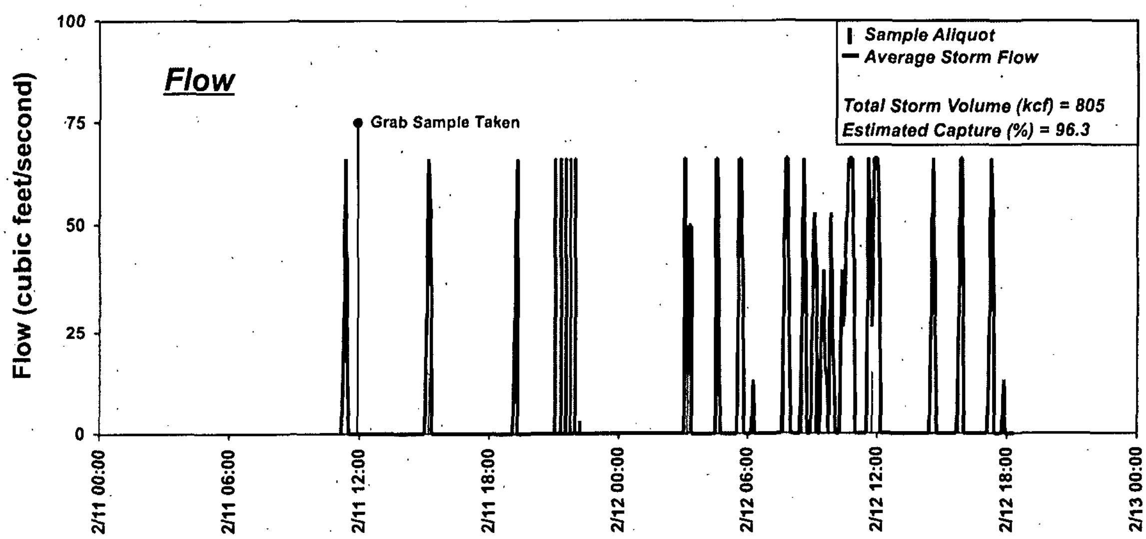


Figure 5.7 - Los Cerritos Channel - Event 2 (16 - 17 December, 2002)



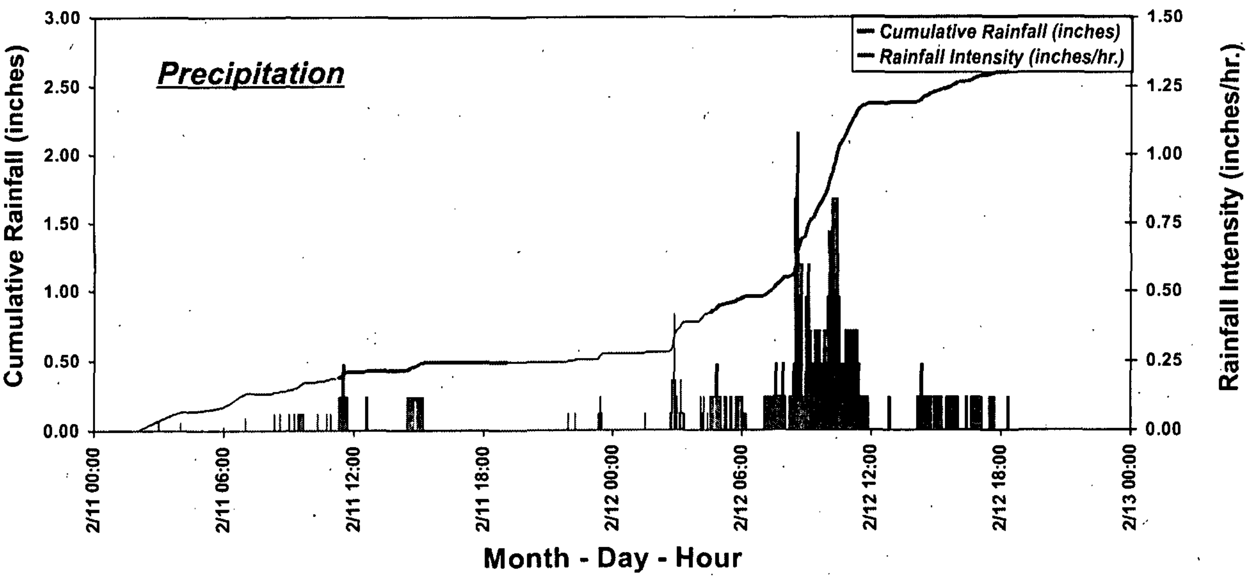


Figure 5.8 - Belmont Pump Station - Event 3 (11 - 12 February, 2003)

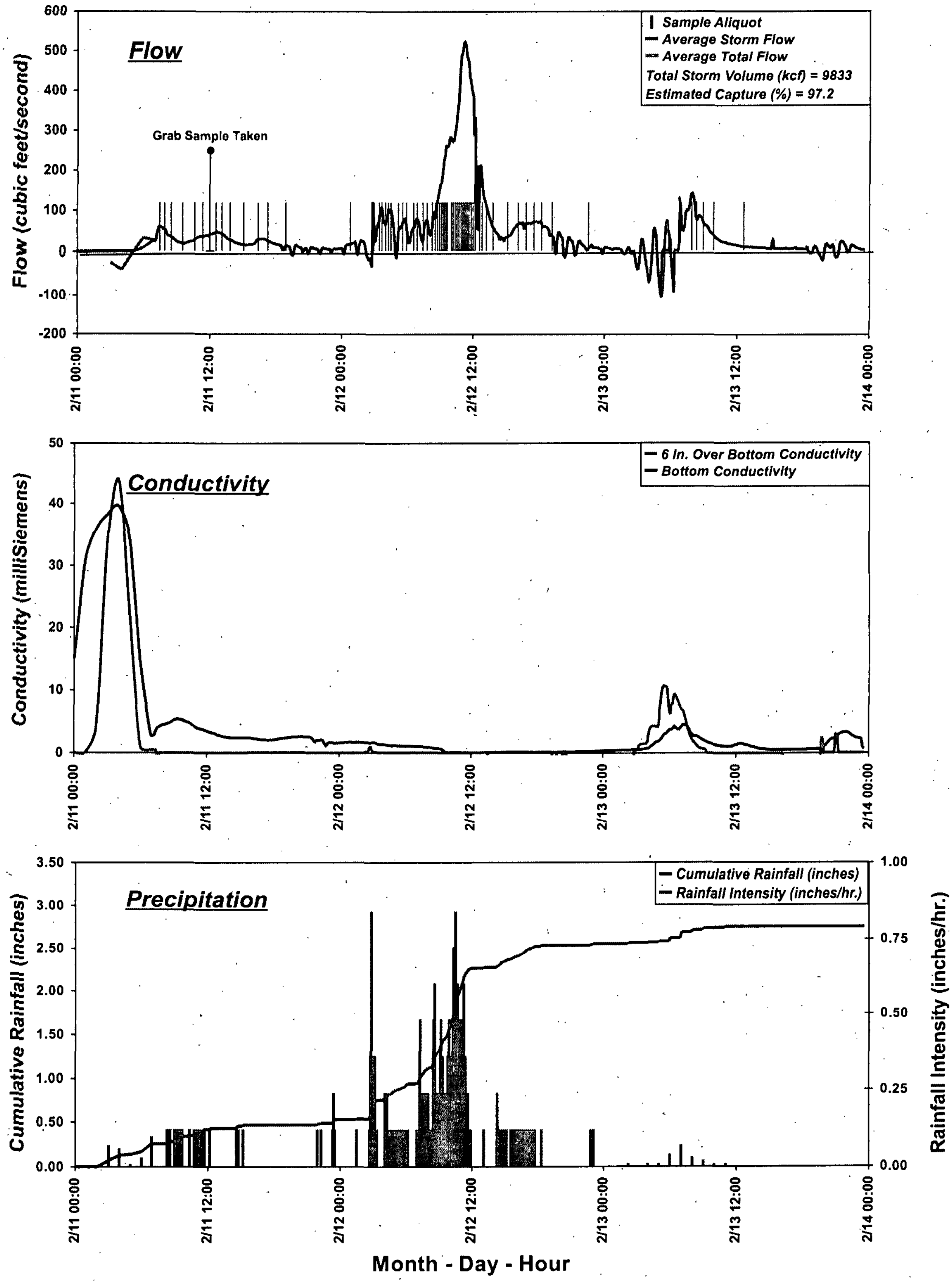


Figure 5.9 - Bouton Creek - Event 3 (11 - 13 February, 2003)

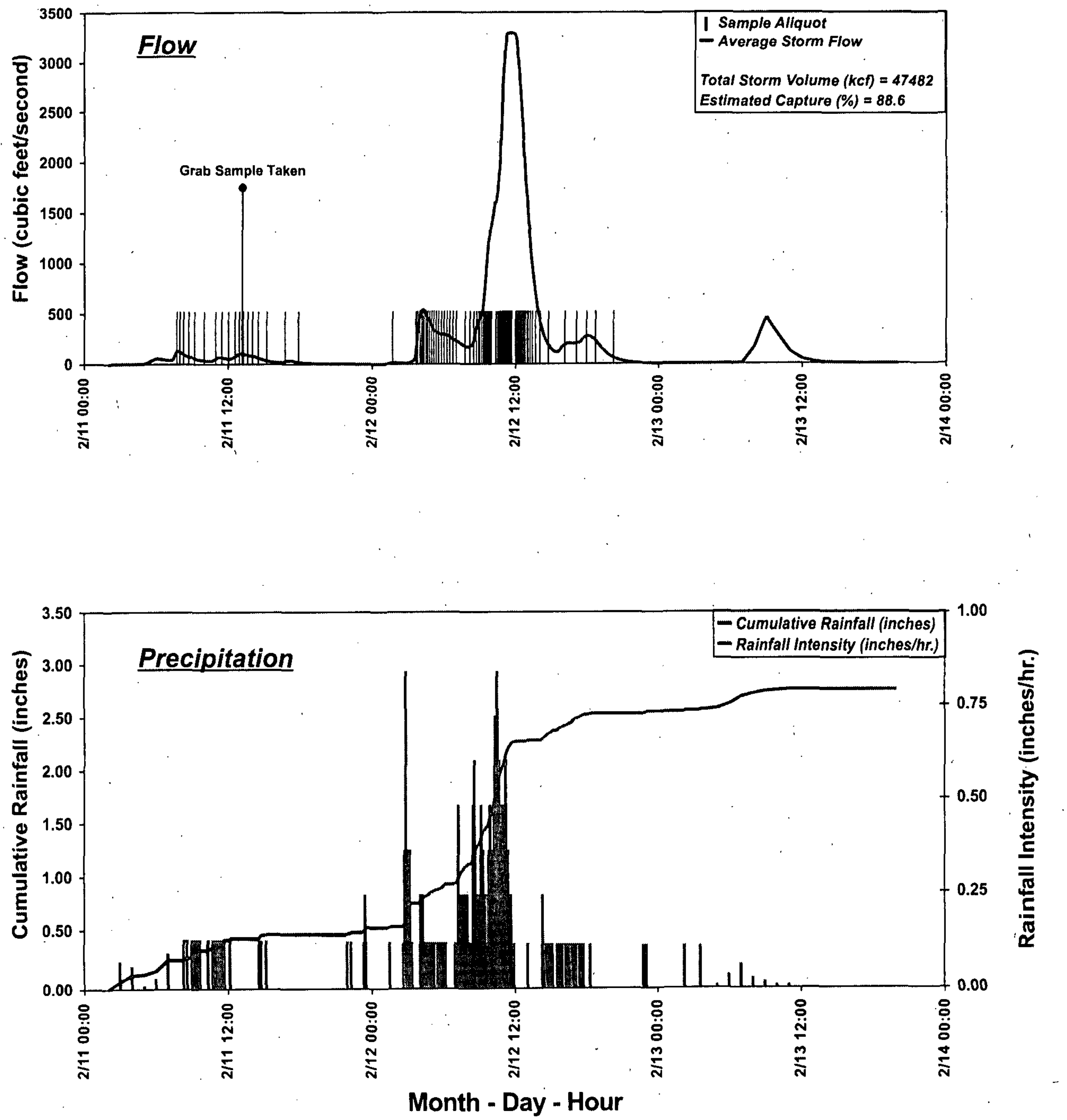


Figure 5.10 - Los Cerritos Channel - Event 3 (11 - 13 February, 2003)

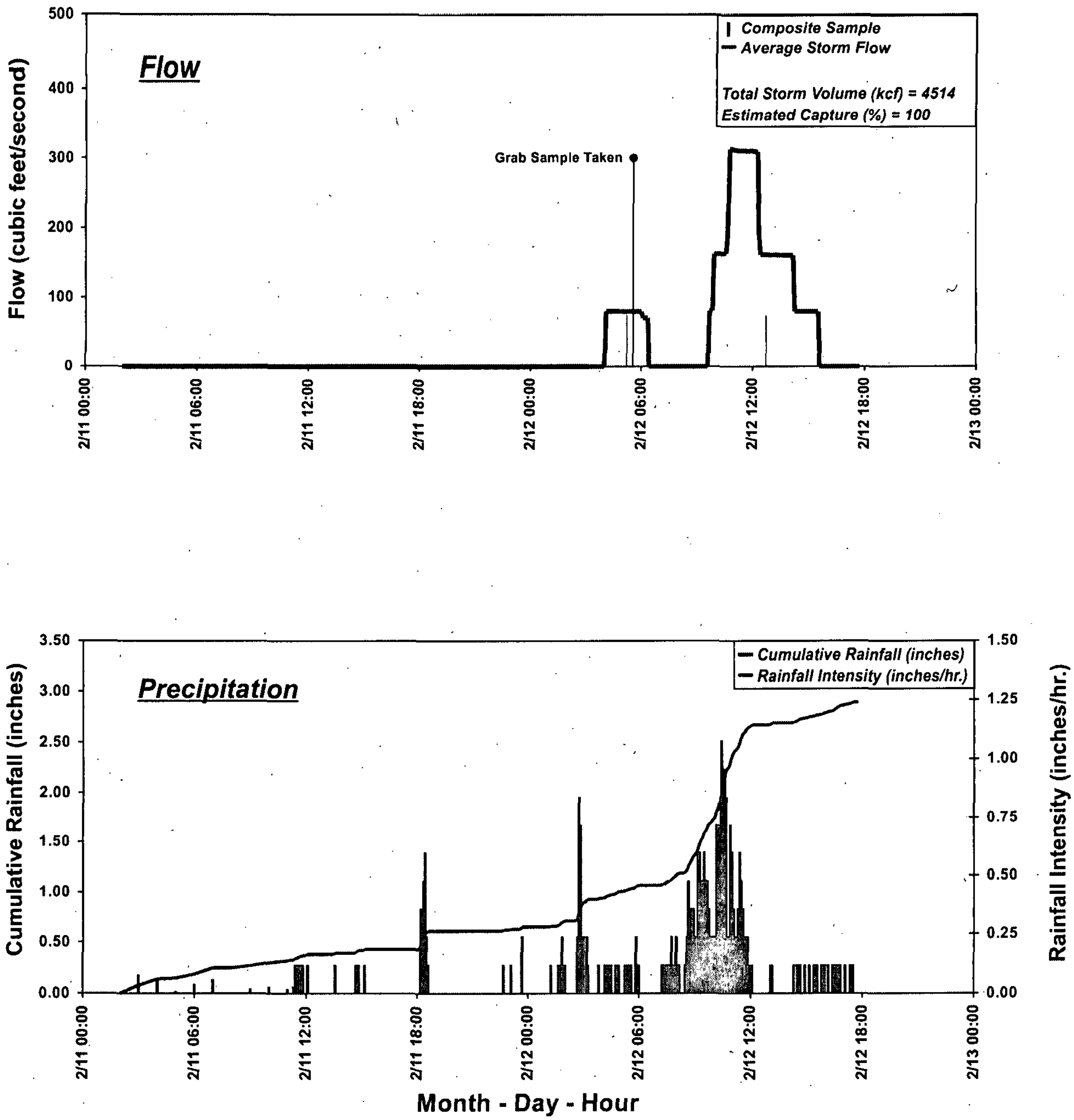


Figure 5.11 - Dominguez Gap Pump Station - Event 3 (11 - 12 February, 2003)

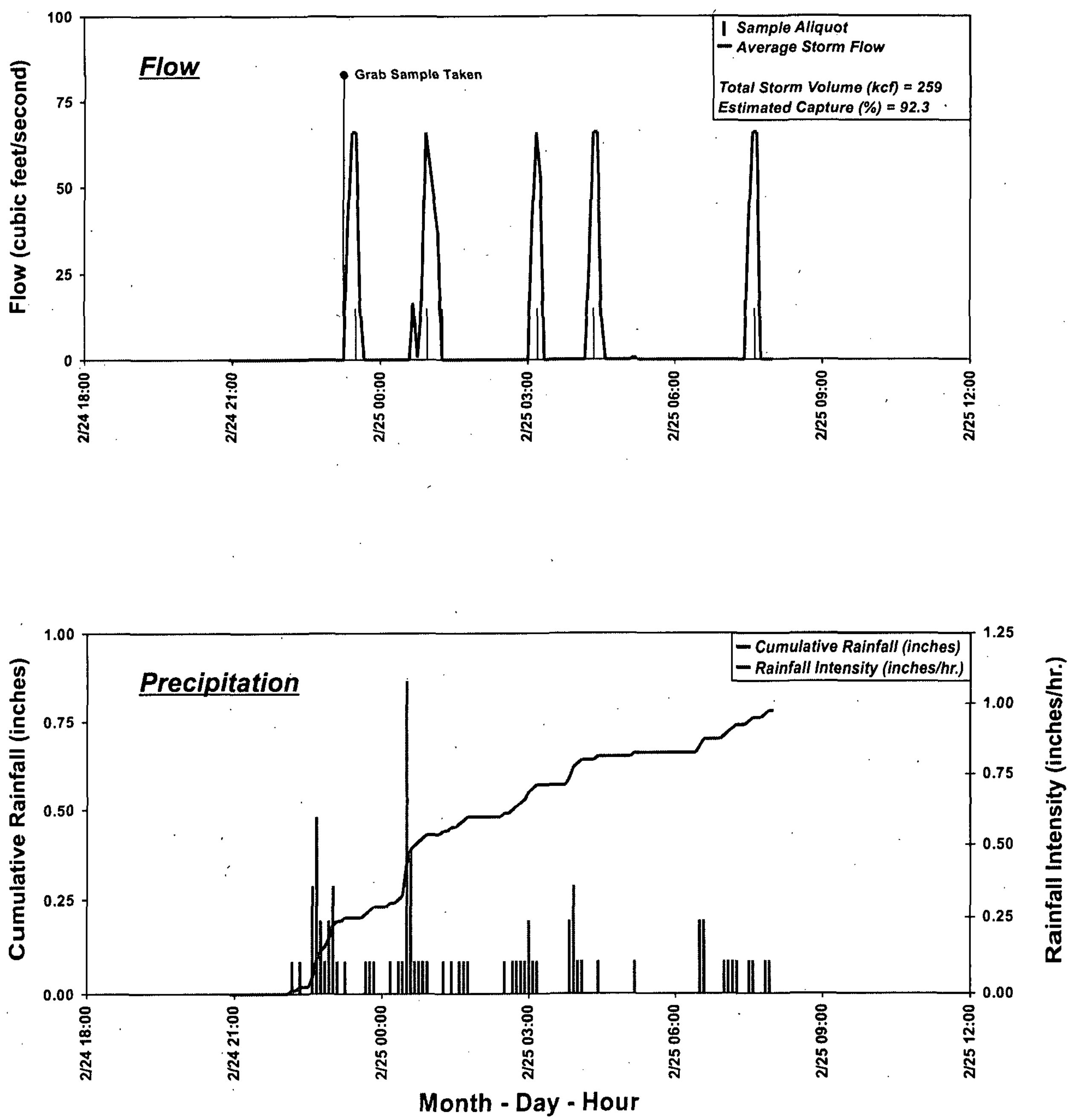


Figure 5.12 - Belmont Pump Station - Event 4 (24 - 25 February, 2003)

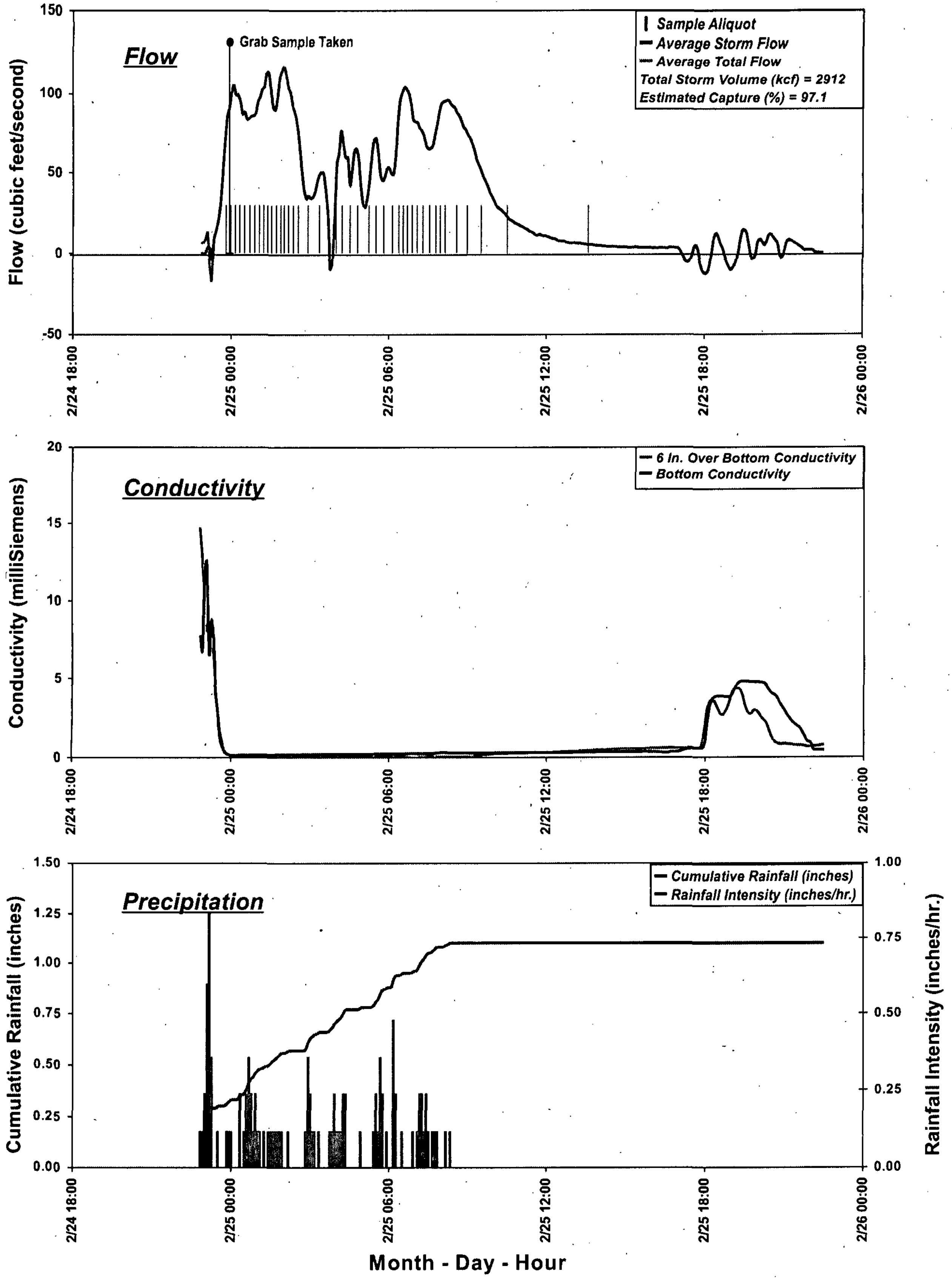


Figure 5.13 - Bouton Creek - Event 4 (24 - 25 February, 2003)

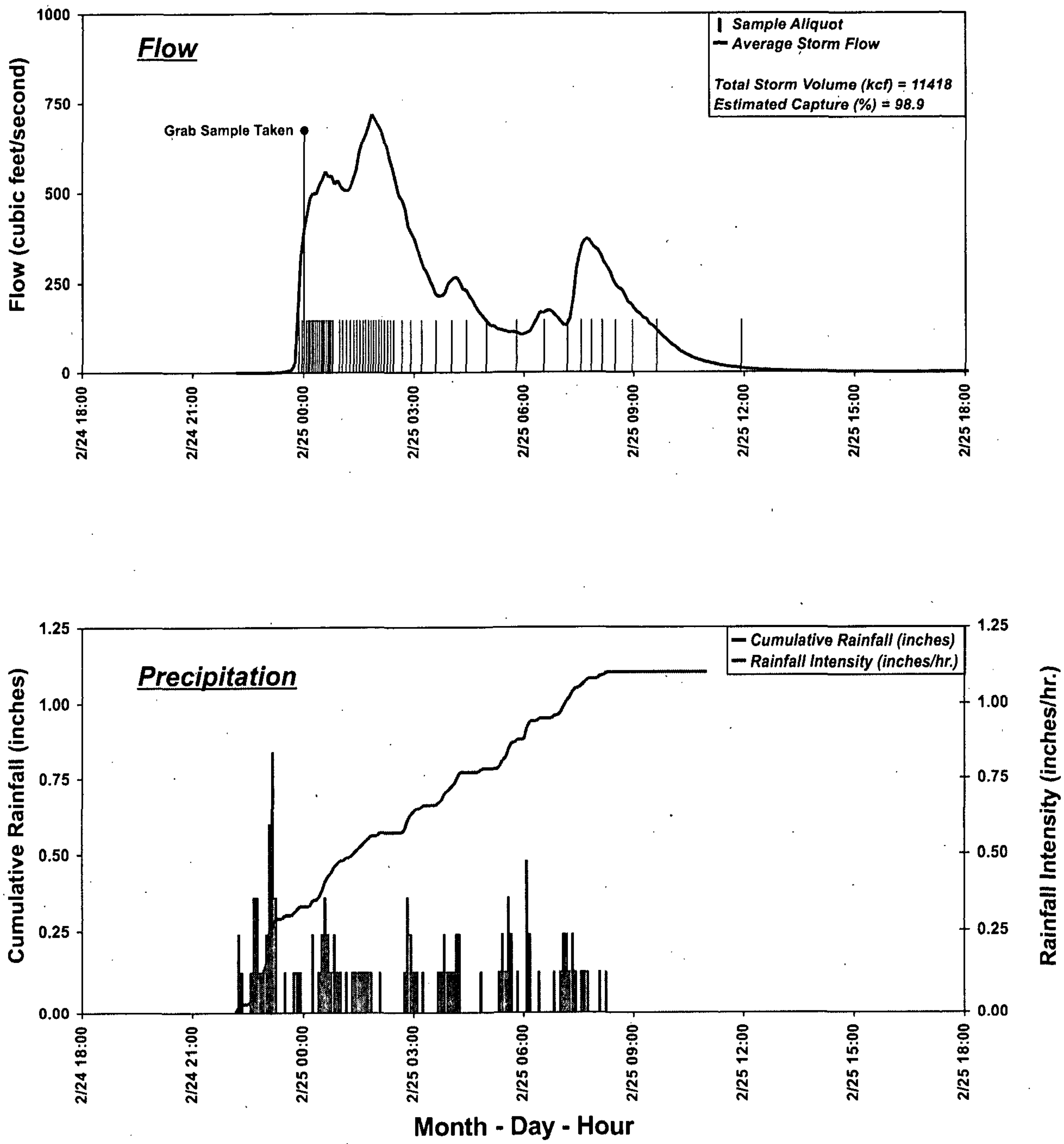
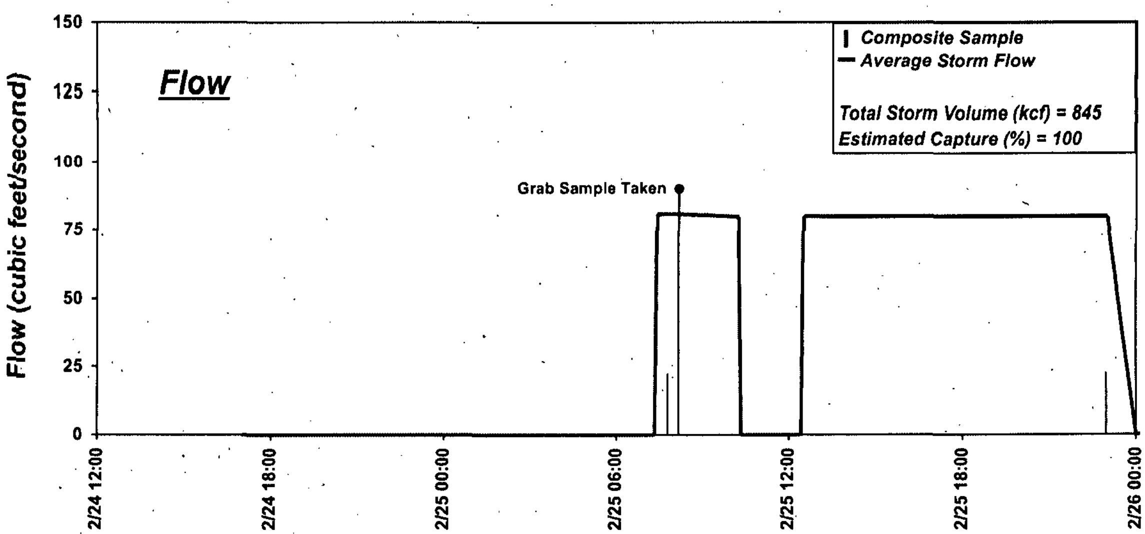


Figure 5.14 - Los Cerritos Channel - Event 4 (24 - 25 February, 2003)



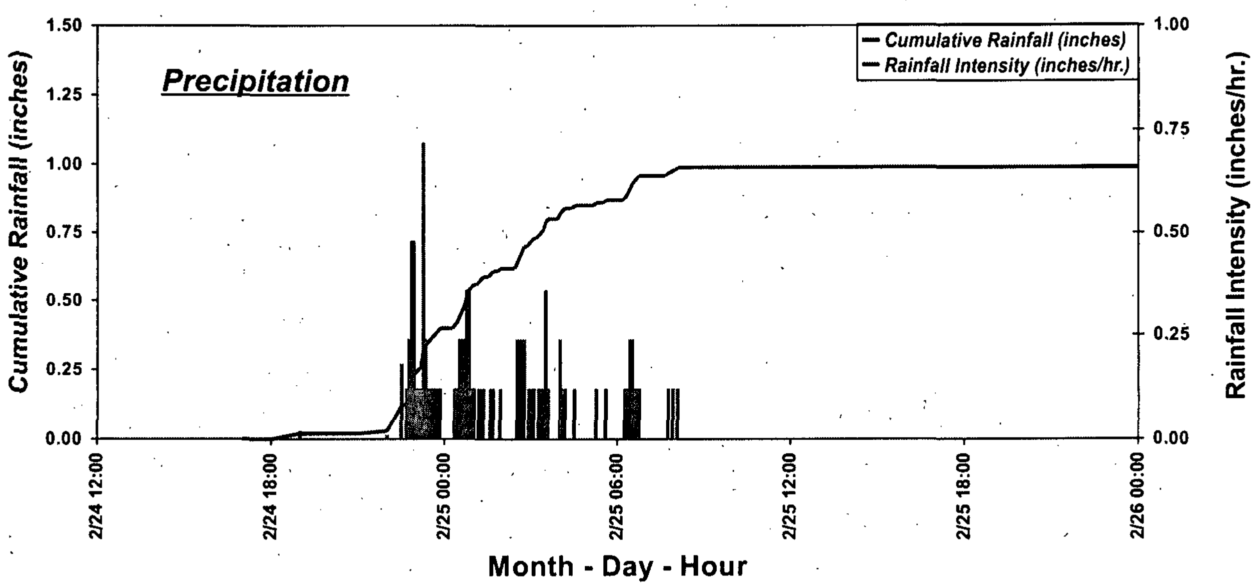


Figure 5.15 - Dominguez Gap Pump Station - Event 4 (24 - 25 February, 2003)

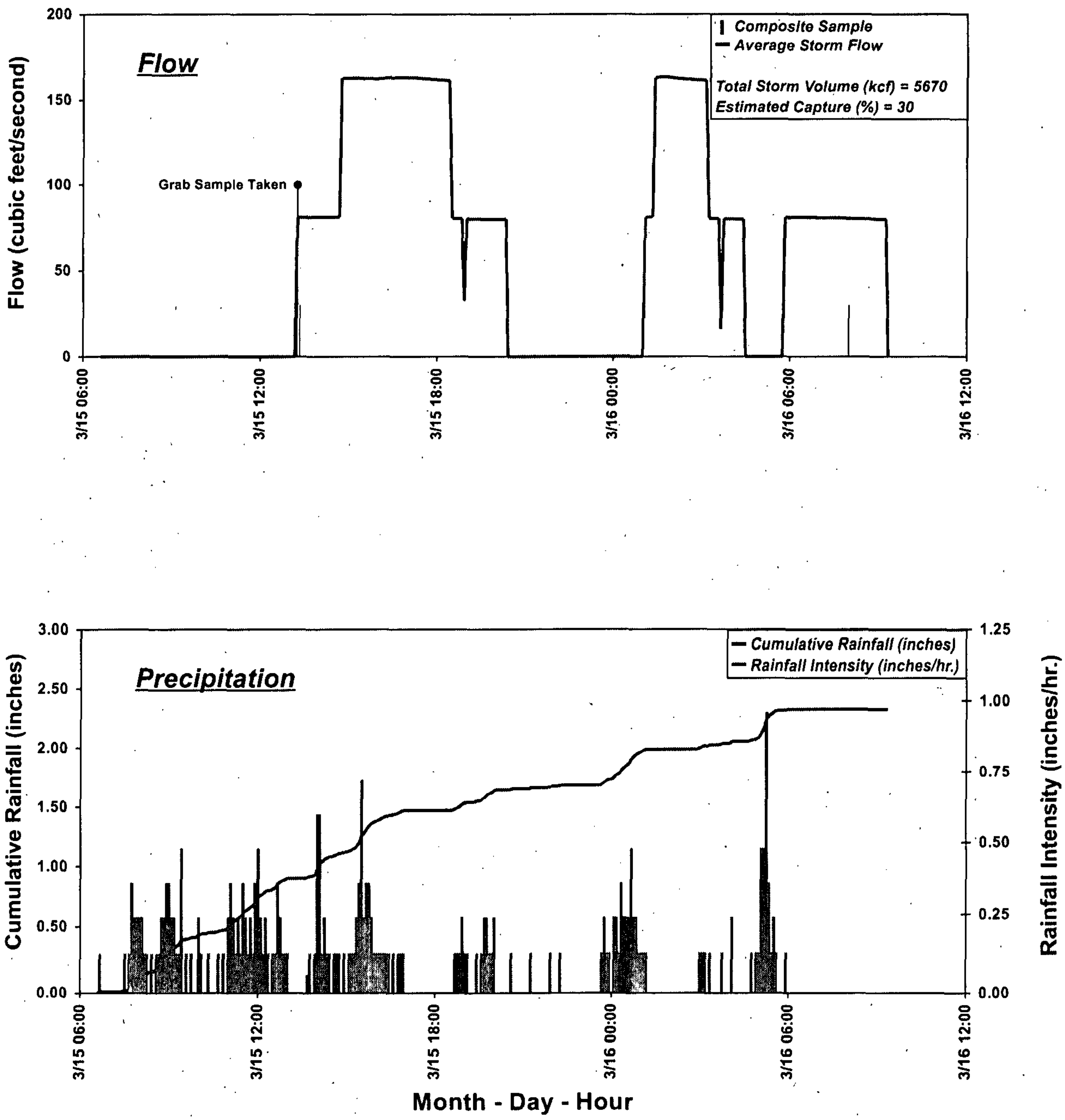


Figure 5.16 - Dominguez Gap Pump Station - Event 5 (15 - 16 March, 2003)

Table 5.1 **Rainfall for Monitored Events during the 2002/2003 Wet-Weather Season.**

Site/Event	Start Rain		End Rain		Duration Rain (hrs:mins)	Total Rain (inches)	Max Intensity (Inches/hr)	Antecedent Rain (days)	Antecedent Rain (inches)
	Date	Time	Date	Time					
EVENT 1									
Belmont Pump Station	11/7/02	21:07	11/8/02	10:05	12:58:00	1.45	0.48	>120	-
Bouton Creek	11/7/02	21:15	11/9/02	18:45	45:30:00	1.54	0.24	>120	-
Los Cerritos Creek	11/7/02	21:15	11/9/02	21:00	47:45:00	1.32	0.36	>120	-
EVENT 2									
Belmont Pump Station	12/16/02	12:45	12/16/02	17:25	4:40:00	1.26	0.84	16.4	0.23
Bouton Creek	12/16/02	13:40	12/16/02	17:40	4:00:00	1.21	0.96	16.1	0.32
Los Cerritos Creek	12/16/02	13:50	12/16/02	17:40	3:50:00	1.21	0.96	16.2	0.16
EVENT 3									
Belmont Pump Station	2/11/03	11:15	2/12/03	18:20	31:05:00	2.19	1.08	51.3	0.60
Bouton Creek	2/11/03	3:00	2/13/03	11:00	56:00:00	2.77	0.84	51	0.69
Los Cerritos Creek	2/11/03	3:00	2/13/03	2:15	47:15:00	2.57	0.84	51	0.16
Dominguez Gap Pump Station	2/11/03	3:00	2/13/03	10:00	55:00:00	3.26	1.08	51.1	0.43
EVENT 4									
Belmont Pump Station	2/24/03	22:10	2/25/03	10:35	12:25:00	0.8	1.08	0.4	0.12
Bouton Creek	2/24/03	22:15	2/25/03	8:15	10:00:00	1.1	0.84	11.5	2.57
Los Cerritos Creek	2/24/03	22:15	2/25/03	8:15	10:00:00	1.1	0.84	11.5	2.57
Dominguez Gap Pump Station	2/24/03	22:00	2/25/03	8:05	10:05:00	0.97	0.72	11.5	3.26
EVENT 5									
Dominguez Gap Pump Station	3/15/03	6:40	3/16/03	5:55	23:15:00	1.43	0.96	6.9	0.26

Table 5.2 Flow for Monitored Events during the 2002/2003 Wet-Weather Season.

Site/Event	Start Flow		End Flow		Duration Flow (hrs:mins)	Total Flow (kilo-cubic feet)	No. of Sample Aliquots Collected	Peak Flow (cfs)	% Capture	Peak Capture
	Date	Time	Date	Time						
EVENT 1										
Belmont Pump Station	11/8/02	1:33	11/8/02	10:02	8:29:00	63.6	25	66	100	Y
Bouton Creek	11/8/02	1:35	11/11/02	2:00	72:25:00	4374	133	154	86.2	Y
Los Cerritos Creek	11/7/02	23:55	11/10/02	4:00	52:05:00	13421	154 (141)	502	79.2	Y
EVENT 2										
Belmont Pump Station	12/16/02	14:23	12/17/02	3:00	12:37:00	252	8	66	100	Y
Bouton Creek	12/16/02	14:02	12/17/02	7:25	17:23:00	3761	70	527	93.8	Y
Los Cerritos Creek	12/16/02	13:50	12/17/02	13:00	23:10:00	>25093	38	>3295	20.8	N
EVENT 3										
Belmont Pump Station	2/11/03	11:14	2/12/03	17:50	30:36:00	805	12	66	96.3	Y
Bouton Creek	2/11/03	6:54	2/13/03	23:30	64:36:00	9833	73	523	97.2	Y
Los Cerritos Creek	2/11/03	4:00	2/13/03	19:00	63:00:00	47482	100	>3295	88.6	Y
Dominguez Gap Pump Station	2/12/03	4:05	2/13/03	15:30	35:25:00	4514	2	312	N/A	
EVENT 4										
Belmont Pump Station	2/24/03	22:20	2/25/03	10:05	11:45:00	259	6	66	92.3	Y
Bouton Creek	2/24/03	23:05	2/25/03	22:25	23:20:00	2912	42	118	97.1	Y
Los Cerritos Creek	2/24/03	23:10	2/25/03	18:00	18:50:00	11418	55	719	98.9	Y
Dominguez Gap Pump Station	2/25/03	7:25	2/25/03	10:15	2:50:00	845	2	81	N/A	
EVENT 5										
Dominguez Gap Pump Station	3/15/03	13:15	3/16/03	9:15	20:00:00	5670	10	163	N/A	N

Table 5.3 Cumulative Descriptive Statistics for Rainfall and Flow Data for All Monitored Events (2002/2003)

Site / Parameter	n	Min	Max	Mean	Standard Deviation	1st Quartile	Median	3rd Quartile
BELMONT PUMP ST.								
Duration Flow (days)	4	0.35	1.28	0.66	0.42	0.46	0.51	0.71
Total Storm Vol. (kcf)	4	63.6	805	345	320	205	255	395
Duration Rain (days)	4	0.19	1.30	0.64	0.47	0.44	0.53	0.73
Total Rain (in)	4	0.80	2.19	1.43	0.58	1.15	1.36	1.64
Max Intensity (in/hr)	4	0.48	1.08	0.87	0.28	0.75	0.96	1.08
Antecedent Dry (days)	4	0.40	120.00	47.03	53.09	12.40	33.85	68.48
Antecedent Rain (in)	3	0.12	0.60	0.32	0.25	0.18	0.23	0.42
BOUTON CREEK								
Duration Flow (days)	4	0.72	3.02	1.85	1.17	0.91	1.83	2.77
Total Storm Vol. (kcf)	4	2910	9830	5220	3130	3550	4070	5740
Duration Rain (days)	4	0.17	2.33	1.20	1.07	0.35	1.16	2.01
Total Rain (in)	4	1.10	2.77	1.66	0.77	1.18	1.38	1.85
Max Intensity (in/hr)	4	0.24	0.96	0.72	0.32	0.69	0.84	0.87
Antecedent Dry (days)	4	11.50	120.00	49.65	50.11	14.95	33.55	68.25
Antecedent Rain (in)	3	0.32	2.57	1.19	1.21	0.51	0.69	1.63
LOS CERRITOS CHANNEL								
Duration Flow (days)	4	0.78	2.63	1.64	0.90	0.92	1.57	2.28
Total Storm Vol. (kcf)	4	11400	47500	24400	16600	12900	19300	30700
Duration Rain (days)	4	0.16	1.99	1.13	0.98	0.35	1.19	1.97
Total Rain (in)	4	1.10	2.57	1.55	0.69	1.18	1.27	1.63
Max Intensity (in/hr)	4	0.36	0.96	0.75	0.27	0.72	0.84	0.87
Antecedent Dry (days)	4	11.50	120.00	49.68	50.08	15.03	33.60	68.25
Antecedent Rain (in)	3	0.16	2.57	0.96	1.39	0.16	0.16	1.37
DOMINGUEZ GAP PUMP ST.								
Duration Flow (days)	3	0.12	1.48	0.81	0.68	0.48	0.83	1.15
Total Storm Vol. (kcf)	3	845	5670	3680	2520	2680	4510	5090
Duration Rain (days)	3	0.42	2.29	1.23	0.96	0.69	0.97	1.63
Total Rain (in)	3	0.97	3.26	1.89	1.21	1.20	1.43	2.35
Max Intensity (in/hr)	3	0.72	1.08	0.92	0.18	0.84	0.96	1.02
Antecedent Dry (days)	3	6.90	51.10	23.17	24.30	9.20	11.50	31.30
Antecedent Rain (in)	3	0.26	3.26	1.32	1.69	0.35	0.43	1.85

6.0 CHEMISTRY RESULTS

6.1 Wet Weather Chemistry Results

Despite the fact that total seasonal rainfall was still below normal, more events were monitored during the 2002/2003 season than any previous monitoring year. Four storm events were monitored at the Bouton Creek, Belmont Pump and Los Cerritos Channel sites and three events were monitored from the Dominguez Gap Pump Station site. The three events monitored at the Dominguez Gap Pump Station were all late season events from February and March. These were the only stormwater discharges that occurred at this location during the monitoring year (Table 6.1).

For each of these monitored events, all chemical constituents except for the semivolatile organic compounds summarized in Table 4.2 were analyzed in the resulting samples for each station. Analysis of semivolatile organic compounds were suspended for the current monitoring year in order to investigate alternatives for lower detection limits for the polycyclic aromatic hydrocarbons. Composite samples collected during these storm events were also tested for toxicity with two species, the water flea (freshwater crustacean) and sea urchin (marine).

The results of the chemical analysis of these composite and grab stormwater samples are summarized in Table 6.2 and 63. Toxicity results for the composite samples and the receiving water samples from these monitored events are given in Section 7 below.

6.2 Wet Weather Load Calculations

Estimates of total pollutant loads associated with stormwater runoff during each storm event are provided in Tables 6.4 through 6.7. Load calculations were made by multiplying the measured concentration times the total stormwater discharge along with the appropriate unit conversion factors. The following calculation is an example of the process used for analytes such as TSS that are measured in mg/L. The specific example is for the third storm event at Bouton Creek

(72 mg/L) x [(9833 kcf)(28317 L/kcf)] x (1 pound/453592 mg) = 44,197 pounds

Among the four mass emission sites, the Los Cerritos Channel consistently results in the highest overall loads of solids and total metals. Estimates of solids discharged at the Los Cerritos Channel site ranged from 92,163 to 704,927 pounds. Estimates of total copper ranged from 14 to 143 pounds. In contrast, the Belmont Pump Station was estimated to discharge between 397 and 4018 pounds of solids and 0.22 to 1.7 pounds of copper during each event.

Loading estimates for solids and total recoverable metals from the Dominguez Gap Pump Station were 20 to 40 times lower than those from the Los Cerritos Channel during the two storms when both sites were monitored. The drainage area for the Dominguez Gap Pump station is approximately three times greater than the drainage area for the Los Cerritos Channel site.

6.3 Dry Weather Sampling Results

The NPDES Permit calls for two dry weather inspections and sampling events to be carried out during the summer dry weather period at each of the four mass emission stations. During the 1999/2000 year, the two dry weather inspections/sampling events were done in late June so that the results could be reported in the annual report due 15 July 2000. For the second year, the first of these dry weather inspections/samplings was done at all sites in June 2001 and the results are reported in the 2001 annual report. The second sampling event was conducted later in the summer, and the results from this second event were reported as an addendum to the 2002 annual report. The 2002 report also included a sampling event in May 2002.

In the 2002/2003 year, dry weather inspection/sampling events were again performed before the beginning of the storm season, in September 2002, and at the end of the storm season, in May 2003. All dry weather events monitored during the during previous monitoring seasons are summarized in Table 6.8 below. Events 7 and 8 conducted during the 2002/2003 season are shaded. Field measurements are provided in Table 6.9. Chemical analyses performed in the laboratory are summarized in Table 6.10.

6.3.1 Basin 14: Dominguez Gap Monitoring Site

Inspections for dry weather flow were conducted at the Dominguez Gap Pump Station on 04 September 2002 and on 19 May 2003. No dry weather flow was observed on either occasion. The basin in front of the pump house had standing water in it but field crews were unable to reach the water to measure the depth. The source of this ponded water was not determined due to the lack of flow. The concrete lined channel that extends east from, and discharges into, the basin had small, isolated pools of standing water, but there was no flow. There was also no flow observed from the north part of the basin. It is apparent that water from the Los Angeles River was not being diverted into the swale for ground water recharge as observed in 2001.

6.3.2 Basin 20: Bouton Creek Monitoring Site

On 5 September 2002, Bouton Creek was sampled from 4:00 a.m. to 5:00 a.m. This time corresponded to a period of low tide when the flow in the creek was not impeded by seawater backing into the creek. The tide levels at this time were between negative 0.43 and negative 0.3 feet in the Long Beach area. This assured that the flow was fresh water flowing downstream in the creek and that that saline tidal water did not commingle with the dry weather discharge of fresh water.

Every 10 minutes during the 1-hour period, a 2.86-liter aliquot of water was pumped from the creek using the automatic sampler installed at the site. An aliquot was deposited into each of four 20-liter borosilicate glass bottles. At the conclusion of the sampling, grab samples for MTBE, TPH and bacteria were collected.

Bouton Creek was also sampled on 20 May 2003 from 9:00 a.m. to 9:30 a.m. Samples were collected from the creek and deposited into four 20-liter borosilicate glass bottles using the automatic sampler. For this event, the sampler was moved from the station to the creek bed because the water level was very low. Also, samples were continuously collected rather than collected in 10-minute intervals as previously done to ensure that the freshwater flow was captured. The tide levels at this time were between negative 0.45 and negative 0.46 feet in the Long Beach area. At the conclusion of the sampling at 9:50 a.m., grab samples for MTBE, TPH and bacteria were collected.

6.3.3 Basin 23: Belmont Pump Station Monitoring Site

Time-weighted composite sampling was conducted over a 24-hour period starting on 4 September 2002 and ending on 5 September 2002. Samples were collected from the sump using the automated sampler installed outside of the pump house. Samples were collected into three 20-liter borosilicate bottles. Every half-hour for the 24 hours, an aliquot of approximately 1.25 liters of water was pumped from the sump into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite. Upon completion of the 24-hour sampling, on 5 September 2002 at 7:30 a.m., grab samples for MTBE, TPH and bacteria were manually collected from the sump.

Time-weighted composite sampling was again conducted over a 24-hour period starting on 19 May 2003 and ending on 20 May 2003. Samples were collected into a total of three 20-liter borosilicate bottles and chilled to 4°C with ice during sampling and transportation. An aliquot of approximately 1.25 liters was pumped every half hour into a 20-liter bottle, which was changed after 8 hours. Upon completion of the sampling, the three bottles of water were combined into a composite. At the end of the 24-hour period, on 20 May 2003 at 10:43 a.m., grab samples for MTBE, TPH and bacteria were manually collected from the sump.

6.3.4 Basin 27: Los Cerritos Channel Monitoring Site

Time-weighted sampling was conducted over a 24-hour period of the water flowing through the channel. Sampling began on 4 September 2002 and ended on 5 September 2002. A separate sampling event began on 19 May 2003 and ended on 20 May 2003.

Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. In September 2002, the dry weather flow was a narrow stream approximately 10 feet wide and 1.5 inches deep located in the middle of the channel. To reach the water, the sampling hose that is used for sampling stormwater was extended an additional 33 feet. Every half-hour for 24 hours, an aliquot of approximately 1.25 liters of water was pumped into a 20-liter bottle. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite sample. After the 24-hour sampling, on 5 September 2002 at 6:30 a.m., grab samples were manually collected for MTBE, TPH and bacteria.

In May 2003, the dry weather flow was a narrow stream approximately 42 feet wide and 0.25 inches deep located in the middle of the channel. To reach the stream, the sampling hose was extended an additional 40 feet. Samples were collected into three 20-liter borosilicate bottles. As in the previous sampling event, an aliquot of approximately 1.25 liters of water was pumped into a 20-liter bottle every half-hour for 24 hours. The bottles were changed every eight hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the three bottles of water were combined into a composite sample. After completion of the 24-hour sampling, on May 20 at 10:00 a.m., grab samples were manually collected for MTBE, TPH and bacteria.

Table 6.1 Monitored Storm Events, 2002-2003

Station	Event 1 11/11/02	Event 2 12/12/02	Event 3 2/12/03	Event 4 2/26/03	Event 5 3/16/03
Bouton Creek	X	X	X	X	
Belmont Pump	X	X	X	X	
Los Cerritos Channel	X	X	X	X	
Dominguez Gap			X	X	X

Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 1 of 4)

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
CONVENTIONALS										
BOD (mg/L)	**6.7**	4.0U		**4.1**	**5.7**	**12**	4.0U	4.0U	**5.5**	**7.3**
COD (mg/L)	**76**	**26**		**98**	**52**	**91**	**34**	**40**	**120**	**5.6**
EC (umhos/cm)	**200**	**110**		**100**	**100**	**150**	**110**	**110**	**110**	**130**
TOC (mg/L)	**20**	**11**		**5.7**	**9.8**	**13**	**8.4**	**9.2**	**8.5**	**8.3**
Hardness (mg/L)	**36**	**21J**		**23**	**22**	**27**	**24J**	**20**	**22**	**26**
Alkalinity (mg/L)	**32**	**18**		**22**	**19**	**30**	**50**	**22**	**27**	**24**
Cyanide (ug/L)	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
Chloride (mg/L)	**31**	**15**		**16**	**16**	**16**	**15**	**15**	**13**	**18**
Fluoride (mg/L)	**0.31**	**0.19**		**0.17**	**0.13**	**0.22**	**0.16**	**0.17**	**0.13**	0.10U
TKN (mg/L)	**2.7**	**1.3**		**1.2**	**1.0**	**2.7**	**1.7**	**1.4**	**1.3**	**1.3**
Ammonia as N (mg/L)	**0.92**	**0.31**		**0.30**	**0.21**	**0.72**	**0.36**	**0.32**	**0.37**	**0.22**
Nitrite N (mg/L)	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Nitrate N (mg/L)	**1.0**	**0.54**		**0.52**	**0.47**	**1.1**	**0.7**	**0.69**	**0.64**	**0.49**
Total P (mg/L)	**0.49**	**0.51**		**0.42**	**0.27**	**0.73**	**0.6**	**0.57**	**0.72**	**0.49**
Ortho-P (Dissolved). (mg/L)	**0.5**	**0.23**		**0.18**	**0.15**	**0.68**	**0.38**	**0.37**	**0.28**	**0.25**
MBAS (mg/L)	**0.15**	**0.07**		**0.098**	**0.069**	**0.10**	**0.064**	**0.023**	**0.12**	**0.076**
MTBE (ug/L)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
Turbidity (NTU)	**32**	**82**		**44**	**31**	**45**	**58**	**77**	**32**	**27**
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
TSS (mg/L)	**52**	**140**		**72**	**48**	**100**	**90**	**74**	**80**	**78**
TDS (mg/L)	**150**	**74**		**74**	**66**	**100**	**70**	**70**	**82**	**74**
TVS (mg/L)	**32**	R		**12**	**46**	**42**	R	R	**12**	**44**

Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 2 of 4)

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03	11 Nov '02	12 Dec '02	12 Dec '02	12 Feb '03	25 Feb '03
BACTERIA (mpn/100ml)										
Enterococcus	1140	8560	8370	57	2950	588	3390		39	3390
Fecal Coliform	11000	3000	11000	13000	11000	50000	8000		13000	13000
Total Coliform	50000	160000	90000	30000	80000	240000	>160000		160000	28000
TOTAL METALS (µg/L)										
Aluminum	2100	4300		2100	1200	3400	2800	2500	2000	1300
Antimony	3.7	3.1		2.2	1.6	3.2	2.8	2.6	2.9	1.9
Arsenic	2.4	2.5		2.1	1.5	2.5	2.4	2.2	2.5	1.8
Beryllium	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.61	0.82		0.53	0.45	0.88	0.72	0.64	0.72	0.25U
Chromium	18	24		18	16	7.9	6.7	6.0	6.0	4.3
Hex Chromium		0.02U		0.02U	0.02U		0.02U	0.02U	0.02U	0.02U
Copper	28	35		23	17	55	33	29	34	34
Iron	2200	5100		2300	1600	3400	3800	3000	2100	2300
Mercury	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	9.4	9.8		7.9	5.6	10	6.8	6.2	6.6	5.0
Lead	16	32		20	13	40	34	30	28	28
Selenium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.74	0.25U		0.25	0.25U	1.5	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	180	220J		150	100	290	220J	190J	220	190
DISSOLVED METALS (µg/L)										
Aluminum	180	57		71	25U	29	43	46	230	25U
Antimony	2.3	1.1		1.2	0.93	1.2	0.96	0.94	1.5	1.1
Arsenic	1.7	1.2		1.3	1.2	1.7	1.4	1.4	1.6	1.3
Beryllium	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.30	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Chromium	3.3	2.6		3.2	3.1	0.88	1.0	0.94	1.1	0.61
Copper	18	7.7		7.7	7.5	11	7.6	7.6	10	9.1

Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 3 of 4)

	Bouton Creek 1	Bouton Creek 2	Bouton Creek 2FD	Bouton Creek 3	Bouton Creek 4	Belmont Pump 1	Belmont Pump 2	Belmont Pump 2FD	Belmont Pump 3	Belmont Pump 4
ANALYTE	**11 Nov '02**	**12 Dec '02**	**12 Dec '02**	**12 Feb '03**	**25 Feb '03**	**11 Nov '02**	**12 Dec '02**	**12 Dec '02**	**12 Feb '03**	**25 Feb '03**
Iron	**190**	**80**		**86**	**79**	**63**	**71**	**82**	**47**	**43**
Mercury	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U	.020U	0.20U
Nickel	**6.5**	**3.2**		**3.6**	**3.2**	**4.8**	**2.1**	**2.1**	**2.5**	**1.7**
Lead	**5.0**	**1.7**		**1.8**	**1.4**	**1.6**	**1.4**	**1.3**	**0.89**	**0.64**
Selenium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	**160**	**69**		**49**	**64J**	**100**	**67**	**75**	**60**	**63J**
CHLORINATED PESTICIDES (µg/L)										
4,4'-DDD	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDE	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDT	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Aldrin	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
alpha-Chlordane	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
alpha-Endosulfan	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U
beta-BHC	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
delta-BHC	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Endosulfan Sulfate	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Endrin	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Endrin Aldehyde	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Dieldrin	0.010U	0.010U		0.010U	0.010U	**0.019**	0.010U	0.010U	0.010U	0.010U
gamma-BHC	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U
gamma-Chlordane	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
Heptachlor	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Heptachlor Epoxide	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Toxaphene	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U

Table 6.2 **Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 4 of 4)**

	Bouton Creek 1	**Bouton Creek 2**	**Bouton Creek 2FD**	**Bouton Creek 3**	**Bouton Creek 4**	**Belmont Pump 1**	**Belmont Pump 2**	**Belmont Pump 2FD**	**Belmont Pump 3**	**Belmont Pump 4**
ANALYTE	**11 Nov '02**	**12 Dec '02**	**12 Dec '02**	**12 Feb '03**	**25 Feb '03**	**11 Nov '02**	**12 Dec '02**	**12 Dec '02**	**12 Feb '03**	**25 Feb '03**
AROCLORS (µg/L)										
Aroclor 1016	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1221	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1232	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1242	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1248	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1254	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1260	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Total PCB's	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
ORGANOPHOSPHATE PESTICIDES (µg/L)										
Atrazine	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Chlorpyrifos	0.05U	0.05U		0.05U	0.05U	0.05U	**0.26Y**	**0.21Y**	0.05U	0.050U
Cyanazine	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Diazinon	**0.19Y**	**0.21**		**0.11**	**0.23Y**	**0.31**	**0.35**	**0.27**	**0.22**	**0.15Y**
Malathion	1.0U	1.0U		1.0U	1.0U	**1.1**	1.0U	1.0U	1.0U	1.0U
Prometryn	2.0U	2.0U		1.0U	0.50U	2.0U	2.0U	2.0U	1.0U	0.50U
Simazine	2.0U	**2.6**		1.0U	**3.0**	2.0U	2.0U	2.0U	1.0U	0.50U
HERBICIDES (µg/L)										
2,4,5-TP (Silvex)	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U
2,4-D	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Glyphosate	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Indicates analyte not tested.

Y=% Difference between primary and confirmation column is >40%. U=Not detected at the associated value. J=Analyte is considered an estimate, value detected below quantitation limits.

11 Nov 2002 Event - Atrazine, Cyanazine, Prometryn, Simazine and Malathion done by ToxScan.

12 Dec 2002 Event - All OP Pest done by APPL.

12 and 25 Feb 2002 Events - Prometryn, Atrazine, Simazine and Cyanazine done by ToxScan. Chlorpyrifos, Malathion and Diazinon.

16 Mar 2003 Event - All OP Pest done by ToxScan.

Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 1 of 4)

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	**11 Nov '02**	**11 Nov '02**	**12 Dec '02**	**12 Feb '03**	**12 Feb '03**	**25 Feb '03**	**25 Feb '03**	**12 Feb '03**	**25 Feb '03**	**25 Feb '03**	**16 Mar '03**	**16 Mar '03**
CONVENTIONALS												
BOD (mg/L)	4.5	8.0	4.0U	4.0U	4.0U	6.0		4.0U	4.0U	4.0U	4.8	4.9
COD (mg/L)	75	98	32	180	94	69		81	38	54	29	24
EC (umhos/cm)	120	200	97	55	54	59		210	48	48	74	74
TOC (mg/L)	19	21	13	6.7	5.7	8.0		7.8	5.8	6.0	11	10
Hardness (mg/L)	38	31	27J	17	15	21		49	14	12	17	18
Alkalinity (mg/L)	34	32	25	21	130	19		46	18	18	24	21
pH (pH units)	6.8	6.8	6.7	6.2	6.2	6.3		6.6	5.4	6.3	6.4	6.5
Cyanide (ug/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U
Chloride (mg/L)	8.2	33	9.6	3.2	3.3	4.3		26	3.4	3.3	11	5.7
Fluoride (mg/L)	0.24	0.32	0.2	0.10U	0.10U	0.10U		0.22	0.10U	0.10U	0.12	0.10U
TKN (mg/L)	2.5	2.5	2.6	1.1	1.1	1.0		2.1	0.73	0.78	1.2	1.2
Ammonia as N (mg/L)	0.90	0.92	0.51	0.29	0.29	0.29		1.1	0.29	0.16	0.39	0.36
Nitrite N (mg/L)	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.20	0.10U	0.10U	0.10U	0.10U
Nitrate N (mg/L)	1.1	1.1	0.72	0.47	0.47	0.46		1.0	0.30	0.31	0.38	0.37
Total P (mg/L)	0.83	0.51	1.3	0.93	0.67	0.49		0.57	0.35	0.35	0.37	0.37
Ortho-P (Dissolved). (mg/L)	0.44	0.45	0.17	0.15	0.15	0.14		0.30	0.24	0.24	0.27	0.27
MBAS (mg/L)	0.18	0.15	0.11	0.029	0.057	0.078		0.07	0.031	0.036	0.051	0.062
MTBE (ug/L)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U
Turbidity (NTU)	48	33	140	78	74	69		14	30	28	29	30
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U			
TSS (mg/L)	110	54	450	220	200	130		80	40	40	38	40
TDS (mg/L)	110	150	78	32	32	56		140	40	36	74	66
TVS (mg/L)	38	26	R	24	30	50		28	48	48	24	23

4 of 7 samples (pH)
2 stations

Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 2 of 4)

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
BACTERIA (mpn/100ml)												
Enterococcus	1178	1100	6670	144	225	4400	4530	26	5200		6560	6350
Fecal Coliform	11000	8000	90000	3000	8000	11000	8000	8000	30000		50000	22000
Total Coliform	80000	30000	>160000	50000	24000	>160000	>160000	90000	30000		160000	160000
TOTAL METALS (µg/L)												
Aluminum	2100	4600	13000	4800	4700	1400		3000	1500	580	2000	540
Antimony	3.5	3.4	6.4	1.9	1.9	1.0		1.4	0.65	0.50U	1.1	0.64
Arsenic	2.3	4.5	5.5	3.0	3.1	1.6		2.6	1.7	1.1	1.8	2
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.59	2.2	2.9	1.0	1.1	0.61		0.45	0.25U	0.25U	0.25U	0.25U
Chromium	18	11	23	9.3	9.9	4.4		5.8	3.4	1.9	3.2	1.6
Hex Chromium			0.02U	0.02U	0.02U	0.02U		0.02U	0.02U	0.02U	0.02U	0.02U
Copper	27	52	91	46	26	20		20	11	9.3	11	9.3
Iron	2200	4300	12000	4000	4500	5100		2600	1900	1700	1700	1500
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	9.1	15	23	8.0	8.3	5.1		6.5	3.1	2.3	3.4	2.5
Lead	16	42	120	31	32	22		19	12	10	10	8.7
Selenium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Silver	0.54	0.76	0.32	0.25U	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	180	500	680J	250	500	160		140	60J	54	59	57
DISSOLVED METALS (µg/L)												
Aluminum	420	100	65	51	56	40		34	25	32	150	140
Antimony	2.8	2.4	2.1	1.1	1.1	0.91		0.69	0.50U	0.50U	0.6	0.61
Arsenic	2.1	1.8	1.6	1.5	1.4	1.4		1.5	1.4	1.3	1.8	1.8
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
Cadmium	0.36	0.29	0.25U	0.25U	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U
Chromium	3.2	2.4	1.4	1.1	1.1	1.1		0.79	0.56	0.56	0.83	0.8
Copper	19	15	8.1	5.0	5.0	5.6		5.8	4.4	4.5	7.3	7.4
Iron	490	110	95	52	62	72		57	76	99	180	180
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	0.20U
Nickel	7.1	6.0	2.6	1.3	1.2	1.5		2.2	1.0	1.0U	1.7	1.7
Lead	7.6	3.8	1.4	0.79	0.90	0.97		1.0	1.2	0.99	1.8	1.8
Selenium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U

Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 3 of 4)

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	**11 Nov '02**	**11 Nov '02**	**12 Dec '02**	**12 Feb '03**	**12 Feb '03**	**25 Feb '03**	**25 Feb '03**	**12 Feb '03**	**25 Feb '03**	**25 Feb '03**	**16 Mar '03**	**16 Mar '03**
Silver	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U		0.25U	0.25U	0.25U	0.25U	0.25U
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Zinc	**160**	**140**	**60**	**35**	**33**	**63J**		**37**	**41J**	**46J**	**39J**	**38J**
CHLORINATED PESTICIDES (µg/L)												
4,4'-DDD	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDE	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
4,4'-DDT	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Aldrin	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
alpha-Chlordane	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U
alpha-Endosulfan	0.020U	0.020U	0.020U	0.020U	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U
beta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
delta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U		0.005U	0.005U	0.005U	0.005U	0.005U
Endosulfan Sulfate	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	0.050U
Endrin	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Endrin Aldehyde	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Dieldrin	**0.016**	**0.021**	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
gamma-BHC	0.020U	0.020U	**0.12**	0.020U	0.020U	0.020U		0.020U	0.020U	0.020U	0.020U	0.020U
gamma-Chlordane	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U		0.10U	0.10U	0.10U	0.10U	0.10U
Heptachlor	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Heptachlor Epoxide	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	0.010U
Toxaphene	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
AROCLORS (µg/L)												
Aroclor 1016	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1221	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1232	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1242	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1248	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1254	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Aroclor 1260	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U
Total PCB's	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U		0.5U	0.5U	0.5U	0.5U	0.5U

Table 6.3 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 4 of 4)

	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 3	Los Cerritos Channel 3FD	Los Cerritos Channel 4	Los Cerritos Channel 4FD	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 2FD	Dominguez Gap 3	Dominguez Gap 3FD
ANALYTE	11 Nov '02	11 Nov '02	12 Dec '02	12 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	12 Feb '03	25 Feb '03	25 Feb '03	16 Mar '03	16 Mar '03
ORGANOPHOSPHATE PESTICIDES (µg/L)												
Atrazine	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Chlorpyrifos	**0.25Y**	0.05U	0.05U	0.05U	0.05U	0.05U		0.05U	0.05U	0.05U	0.05U	0.062U
Cyanazine	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Diazinon	**0.27Y**	**0.20Y**	**0.25**	**0.11**	**0.12**	**0.13Y**		**0.09**	**0.14Y**	**0.10Y**	**0.023**	**0.023**
Malathion	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.2U
Prometryn	2.0U	2.0U	2.0U	1.0U	1.0U	0.50U		1.0U	0.50U	0.50U	1.0U	1.0U
Simazine	2.0U	2.0U	**27**	1.0U	1.0U	**2.4**		1.0U	**1.4**	**1.5**	**1.8**	**1.4**
HERBICIDES (µg/L)												
2,4,5-TP (Silvex)	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U		0.50U	0.50U	0.50U	0.50U	0.50U
2,4-D	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	1.0U	1.0U
Glyphosate	5.2U	5.0U	5.0U	5.0U	5.0U	5.0U		5.0U	5.0U	5.0U	5.0U	5.0U

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Indicates analyte not tested.
Y=% Difference between primary and confirmation column is >40%. U=Not detected at the associated value. J=Analyte is considered an estimate, value detected below quantitation limits.

11 Nov 2002 Event - Atrazine, Cyanazine, Prometryn, Simazine and Malathion done by ToxScan.
12 Dec 2002 Event - All OP Pest done by APPL.
12 and 25 Feb 2002 Events - Prometryn, Atrazine, Simazine and Cyanazine done by ToxScan. Chlorpyrifos, Malathion and Diazinon.
16 Mar 2003 Event - All OP Pest done by ToxScan.

Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek

Analyte	ML[1]	11/8/2002 Bouton Creek	12/12/2002 Bouton Creek	2/12/2003 Bouton Creek	2/25/2003 Bouton Creek
Conventionals					
BOD	4 mg/L	1830	0	2517	1036
COD	4 mg/L	20753	615	60158	9453
TOC	1 mg/L	5461	2583	3499	1782
Hardness	1 mg/L	9830	4884	14119	3999
Alkalinity	5 mg/L	8738	4226	13505	3454
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	8465	3522	9822	2909
Fluoride	0.1 mg/L	85	45	104	24
TKN	0.1 mg/L	737	35	737	182
NH3-N	0.1 mg/L	251	72	184	38
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	273	127	319	85
P (Total)	0.05 mg/L	134	120	258	49
Ortho-P (Dissolved)	0.01 mg/L	137	54	110	27
MBAS (Surfactants)	0.02 mg/L	41	16	60	13
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	14199	3288	44197	8726
TDS	1 mg/L	40959	17375	45425	11998
Total Metals					
Al	25 ug/L	573	845	1289	218
Sb	0.5 ug/L	1.0	0.73	1.4	0.29
As	0.5 ug/L	0.66	0.59	1.3	0.27
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.17	0.19	0.33	0.082
Cr	0.5 ug/L	4.9	5.6	11	2.9
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	7.6	8.2	14	3.1
Fe	25 ug/L	601	1197	1412	291
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	2.6	2.3	4.8	1.0
Pb	0.5 ug/L	4.4	7.5	12	2.4
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0.20	0	0.15	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	49	52	92	18

Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek. (continued)

Analyte	ML[1]	11/8/2002 Bouton Creek	12/12/2002 Bouton Creek	2/12/2003 Bouton Creek	2/25/2003 Bouton Creek
Dissolved Metals					
Al	25 ug/L	49	13	44	0
Sb	0.5 ug/L	0.63	0.26	0.74	0.17
As	0.5 ug/L	0.46	0.28	0.80	0.22
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.082	0	0	0
Cr	0.5 ug/L	0.90	0.61	2.0	0.56
Cu	0.5 ug/L	4.9	1.8	4.7	1.4
Fe	25 ug/L	52	19	53	14
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	1.8	0.75	2.2	0.58
Pb	0.5 ug/L	1.4	0.40	1.1	0.25
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	44	16	30	12
Chlorinated Pesticides					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0	0	0	0
gamma-BHC	0.02 ug/L	0	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
Aroclors					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

Table 6.4 Load Calculations (pounds) for each Storm Event at Bouton Creek. (continued)

Analyte	ML[1]	11/8/2002 Bouton Creek	12/12/2002 Bouton Creek	2/12/2003 Bouton Creek	2/25/2003 Bouton Creek
Organophosphates					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.052	0.049	0.07	0.042
Malathion	1 ug/L	0	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	0.61	0	0.55
Chorinated Herbicides					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	5 ug/L	1.1	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station.

Analyte	ML[1]	11/8/2002 Belmont Pump	12/12/2002 Belmont Pump	2/12/2003 Belmont Pump	2/25/2003 Belmont Pump
Conventionals					
BOD	4 mg/L	48	0	276	118
COD	4 mg/L	361	534	6027	91
TOC	1 mg/L	52	132	427	134
Hardness	1 mg/L	107	374	1105	420
Alkalinity	5 mg/L	119	786	1356	388
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	64	236	653	291
Fluoride	0.1 mg/L	0.87	2.5	6.5	0
TKN	0.1 mg/L	11	27	65	21
NH3-N	0.1 mg/L	2.9	5.6	19	3.6
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	4.37	11	32	7.9
P (Total)	0.05 mg/L	2.90	9.4	36	7.9
Ortho-P (Dissolved)	0.01 mg/L	2.70	6.0	14	4.0
MBAS (Surfactants)	0.02 mg/L	0.40	1.0	6.0	0
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	397	1414	4018	1261
TDS	1 mg/L	397	1100	4119	1196
Total Metals					
Al	25 ug/L	13	36	100	21
Sb	0.5 ug/L	0.013	0.044	0.15	0.031
As	0.5 ug/L	0.010	0.038	0.13	0.029
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.0035	0.011	0.04	0
Cr	0.5 ug/L	0.031	0.11	0.30	0.070
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	0.22	0.52	1.7	0.55
Fe	25 ug/L	13	60	105	37
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	0.040	0.11	0.33	0.081
Pb	0.5 ug/L	0.16	0.53	1.4	0.45
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	1.2	3.5	11	3.1

Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station. (continued)

Analyte	ML[1]	11/8/2002 Belmont Pump	12/12/2002 Belmont Pump	2/12/2003 Belmont Pump	2/25/2003 Belmont Pump
Dissolved Metals					
Al	25 ug/L	0.12	0.68	12	0
Sb	0.5 ug/L	0.0048	0.015	0.075	0.018
As	0.5 ug/L	0.0067	0.022	0.080	0.021
Be	0.5 ug/L	0.0020	0	0	0
Cd	0.25 ug/L	0	0	0	0
Cr	0.5 ug/L	0.0035	0.02	0.06	0.010
Cu	0.5 ug/L	0.044	0.12	0.50	0.15
Fe	25 ug/L	0.25	1.1	2.4	0.70
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	0.02	0.033	0.13	0.027
Pb	0.5 ug/L	0.01	0.022	0.045	0.010
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	0.40	1.1	3.0	1.0
Chlorinated Pesticides					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0.000075	0	0	0
gamma-BHC	0.02 ug/L	0	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
Aroclors					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station. (continued)

Analyte	ML[1]	11/8/2002 Belmont Pump	12/12/2002 Belmont Pump	2/12/2003 Belmont Pump	2/25/2003 Belmont Pump
Organophosphates					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.0012	0.0055	0.14	0.0024
Malathion	1 ug/L	0.0044	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	0	0	0
Chorinated Herbicides					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	0.05 ug/L	0.016	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel.

Analyte	ML[1]	11/8/2002 Los Cerritos Channel	12/12/2002 Los Cerritos Channel	2/12/2003 Los Cerritos Channel	2/25/2003 Los Cerritos Channel
Conventionals					
BOD	4 mg/L	3770	0	0	4277
COD	4 mg/L	62838	50128	533557	49183
TOC	1 mg/L	15919	20365	19860	5702
Hardness	1 mg/L	31838	41826	50391	14969
Alkalinity	5 mg/L	28487	39163	62248	13543
Cyanide	5 ug/L	0	0	0	0
Chloride	1 mg/L	6870	15038	9485	3065
Fluoride	0.1 mg/L	201	313	0	0
TKN	0.1 mg/L	2095	4073	3261	713
NH3-N	0.1 mg/L	754	799	860	207
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0
NO3-N (Nitrate)	0.1 mg/L	922	1128	1393	328
P (Total)	0.05 mg/L	695	2036	2757	349
Ortho-P (Dissolved)	0.01 mg/L	369	266	445	100
MBAS (Surfactants)	0.02 mg/L	151	172	86	56
MTBE	0.05 ug/L	0	0	0	0
Total Phenols	0.01 mg/L	0	0	0	0
Oil & Grease	5 mg/L	0	0	0	0
TRPH	5 mg/L	0	0	0	0
TSS	1 mg/L	92163	704927	652125	92664
TDS	1 mg/L	92163	122187	94855	39917
Total Metals					
Al	25 ug/L	1759	15665	14228	998
Sb	0.5 ug/L	2.9	10	5.6	0.71
As	0.5 ug/L	1.9	8.6	8.9	1.1
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.49	4.5	3.0	0.43
Cr	0.5 ug/L	15	36	28	3.1
Cr(VI)	0.3-1 mg/L		0	0	0
Cu	0.5 ug/L	22.6	143	136	14
Fe	25 ug/L	1843	18799	11857	3635
Hg	0.2 ug/L	0.00	0	0	0
Ni	1 ug/L	7.6	36	24	3.6
Pb	0.5 ug/L	13	188	92	16
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0.45	0.50	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	151	1065	741	114

Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel. (continued)

Analyte	ML[1]	11/8/2002 Los Cerritos Channel	12/12/2002 Los Cerritos Channel	2/12/2003 Los Cerritos Channel	2/25/2003 Los Cerritos Channel
Dissolved Metals					
Al	25 ug/L	352	102	151	29
Sb	0.5 ug/L	2.3	3.3	3.3	0.65
As	0.5 ug/L	1.8	2.5	4.4	1.0
Be	0.5 ug/L	0	0	0	0
Cd	0.25 ug/L	0.30	0	0	0
Cr	0.5 ug/L	2.7	2.2	3.3	0.78
Cu	0.5 ug/L	16	13	15	4.0
Fe	25 ug/L	411	149	154	51
Hg	0.2 ug/L	0	0	0	0
Ni	1 ug/L	5.9	4.1	3.9	1.1
Pb	0.5 ug/L	6.4	2.2	2.3	0.69
Se	1 ug/L	0	0	0	0
Ag	0.25 ug/L	0	0	0	0
Tl	1 ug/L	0	0	0	0
Zn	1 ug/L	134	94	104	45
Chlorinated Pesticides					
4,4'-DDD	0.05 ug/L	0	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0	0
Aldrin	0.005 ug/L	0	0	0	0
alpha-BHC	0.01 ug/L	0	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0	0
beta-BHC	0.005 ug/L	0	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0	0
delta-BHC	0.005 ug/L	0	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0	0
Endrin	0.01 ug/L	0	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0	0
Dieldrin	0.01 ug/L	0.013	0	0	0
gamma-BHC	0.02 ug/L	0	0.19	0	0
gamma-Chlordane	0.01 ug/L	0	0	0	0
Heptachlor	0.01 ug/L	0	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0	0
Toxaphene	0.5 ug/L	0	0	0	0
Aroclors					
Aroclor 1016	0.5 ug/L	0	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0	0
Total PCB's	0.5 ug/L	0	0	0	0

Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel. (continued)

Analyte	ML[1]	11/8/2002 Los Cerritos Channel	12/12/2002 Los Cerritos Channel	2/12/2003 Los Cerritos Channel	2/25/2003 Los Cerritos Channel
Organophosphates					
Atrazine	1 ug/L	0	0	0	0
Chlorpyrifos	0.05 ug/L	0.21	0	0	0
Cyanazine	1 ug/L	0	0	0	0
Diazinon	0.01 ug/L	0.23	0.39	0.0055	0.093
Malathion	1 ug/L	0	0	0	0
Prometryn	1 ug/L	0	0	0	0
Simazine	1 ug/L	0	42	0	1.7
Chorinated Herbicides					
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0	0
2,4-D	1 ug/L	0	0	0	0
Glyphosate	5 ug/L	4.4	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station.

Analyte	ML[1]	2/12/2003 Dominguez	2/25/2003 Dominguez	3/16/2003 Dominguez
Conventionals				
BOD	4 mg/L	0	0	253
COD	4 mg/L	22826	2005	1530
TOC	1 mg/L	2198	306	580
Hardness	1 mg/L	13808	739	918
Alkalinity	5 mg/L	12963	950	1266
Cyanide	5 ug/L	0	0	0
Chloride	1 mg/L	7327	179	580
Fluoride	0.1 mg/L	62	0	6.3
TKN	0.1 mg/L	592	39	63
NH3-N	0.1 mg/L	310	15	21
NO2-N (Nitrite)	0.1 mg/L	56	0	0
NO3-N (Nitrate)	0.1 mg/L	282	16	20
P (Total)	0.05 mg/L	161	18	20
Ortho-P (Dissolved)	0.01 mg/L	85	13	14
MBAS (Surfactants)	0.02 mg/L	20	1.6	2.7
MTBE	0.05 ug/L	0	0	0
Total Phenols	0.01 mg/L	0	0	0
Oil & Grease	5 mg/L	0	0	0
TRPH	5 mg/L	0	0	0
TSS	1 mg/L	22544	2110	2005
TDS	1 mg/L	39452	2110	3904
Total Metals				
Al	25 ug/L	845	79	106
Sb	0.5 ug/L	0.39	0.034	0.058
As	0.5 ug/L	0.73	0.090	0.095
Be	0.5 ug/L	0	0	0
Cd	0.25 ug/L	0.13	0	0
Cr	0.5 ug/L	1.6	0.18	0.17
Cr(VI)	0.3-1 mg/L	0	0	0
Cu	0.5 ug/L	5.6	0.58	0.58
Fe	25 ug/L	733	100	90
Hg	0.2 ug/L	0	0	0
Ni	1 ug/L	1.8	0.16	0.18
Pb	0.5 ug/L	5.4	0.63	0.53
Se	1 ug/L	0	0	0
Ag	0.25 ug/L	0	0	0
Tl	1 ug/L	0	0	0
Zn	1 ug/L	39	3.2	3.1

Table 6.7 **Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station. (continued)**

Analyte	ML[1]	2/12/2003 Dominguez	2/25/2003 Dominguez	3/16/2003 Dominguez
Dissolved Metals				
Al	25 ug/L	10	1.7	7.9
Sb	0.5 ug/L	0.19	0	0.032
As	0.5 ug/L	0.42	0.069	0.095
Be	0.5 ug/L	0	0	0
Cd	0.25 ug/L	0	0	0
Cr	0.5 ug/L	0.22	0.030	0.044
Cu	0.5 ug/L	1.6	0.24	0.39
Fe	25 ug/L	16	5.2	9.5
Hg	0.2 ug/L	0	0	0
Ni	1 ug/L	0.62	0	0.090
Pb	0.5 ug/L	0.28	0.052	0.095
Se	1 ug/L	0	0	0
Ag	0.25 ug/L	0	0	0
Tl	1 ug/L	0	0	0
Zn	1 ug/L	10	2.4	2.1
Chlorinated Pesticides				
4,4'-DDD	0.05 ug/L	0	0	0
4,4'-DDE	0.05 ug/L	0	0	0
4,4'-DDT	0.01 ug/L	0	0	0
Aldrin	0.005 ug/L	0	0	0
alpha-BHC	0.01 ug/L	0	0	0
alpha-Chlordane	0.1 ug/L	0	0	0
alpha-Endosulfan	0.1 ug/L	0	0	0
beta-BHC	0.005 ug/L	0	0	0
beta-Endosulfan	0.01 ug/L	0	0	0
delta-BHC	0.005 ug/L	0	0	0
Endosulfan Sulfate	0.05 ug/L	0	0	0
Endrin	0.01 ug/L	0	0	0
Endrin Aldehyde	0.01 ug/L	0	0	0
Dieldrin	0.01 ug/L	0	0	0
gamma-BHC	0.02 ug/L	0	0	0
gamma-Chlordane	0.01 ug/L	0	0	0
Heptachlor	0.01 ug/L	0	0	0
Heptachlor Epoxide	0.01 ug/L	0	0	0
Toxaphene	0.5 ug/L	0	0	0
Aroclors				
Aroclor 1016	0.5 ug/L	0	0	0
Aroclor 1221	0.5 ug/L	0	0	0
Aroclor 1232	0.5 ug/L	0	0	0
Aroclor 1242	0.5 ug/L	0	0	0
Aroclor 1248	0.5 ug/L	0	0	0
Aroclor 1254	0.5 ug/L	0	0	0
Aroclor 1260	0.5 ug/L	0	0	0
Total PCB's	0.5 ug/L	0	0	0

Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Pump Station. (continued)

Analyte	ML[1]	2/12/2003 Dominguez	2/25/2003 Dominguez	3/16/2003 Dominguez
Organophosphates				
Atrazine	1 ug/L	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0
Cyanazine	1 ug/L	0	0	0
Diazinon	0.01 ug/L	0.27	0.0053	0.0012
Malathion	1 ug/L	0	0	0
Prometryn	1 ug/L	0	0	0
Simazine	1 ug/L	0	0.079	0.095
Chorinated Herbicides				
2,4,5-TP (Silvex)	0.05 ug/L	0	0	0
2,4-D	1 ug/L	0	0	0
Glyphosate	0.05 ug/L	0	0	0

1. ML = Minimum Level as defined in the State Implementation Plan.

Notes:

A "0" indicates that an analysis was performed but the analyte was not detected. A blank cell indicates that the analysis was not performed.

02-03

7.0 TOXICITY RESULTS

Toxicity tests were conducted on subsamples of the composites collected for chemical analysis. Wet weather samples were collected from four storm events: November 8-9, 2002, December 16-17, 2002, February 12-13, 2003 and February 25, 2003. Composite samples were collected during separate storm events and were tested with either two or three species. The water flea (freshwater crustacean), mysid (marine crustacean), and sea urchin (marine echinoderm) were used on the first storm sample, and only the water flea and sea urchin were used on the final three storm samples.

Dry weather sampling occurred on September 5, 2002 and May 20, 2003.

7.1 Wet Weather Discharge

The following sections describe the results of toxicity testing at each of the mass emission station. Toxicity tests were conducted on water from all four storm events at the Belmont Pump Station, Bouton Creek and the Los Cerritos Channel. A single sample was obtained from the Dominguez Gap Pump Station during the third storm.

7.1.1 Belmont Pump

The first sample from the Belmont Pump Station was collected on November 8, 2002. This sample caused toxic effects to all three test species (Table 7.1), with the fertilization test being the most sensitive, showing 8 TUc (Figure 7.1). Both the water flea survival and reproduction endpoints showed the presence of toxicity (4 TUc) with the survival endpoint slightly more sensitive (Figure 7.1). Both mysid survival and growth, were adversely affected by the sample.

The second Belmont Pump Station sample was collected on December 16 2002 and produced toxic responses in water fleas but not in sea urchins.. The water flea test was the most sensitive indicator of toxicity with a NOEC of 50% sample (2 TUc) and 73% sample calculated to cause a 50% reduction in survival (Table 7.1). Significant reductions in water flea survival and reproduction were found only at the 100% concentration. Water flea survival showed a greater degree of response than did the reproduction endpoint (Figure 7.1).

The third Belmont Pump Station sample was collected on February 12, 2003 and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.1 and Figure 7.1).

The fourth Belmont Pump Station sample was collected on February 25, 2003. This sample produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.1 and Figure 7.1).

7.1.2 Bouton Creek

The first sample from the Bouton Creek station was collected on November 9, 2001. Toxicity to this sample was detected by sea urchins but not by water fleas or mysids (Table 7.2). Sea urchin egg fertilization was by far the most sensitive test method, with 16 TUc (Figure 7.2).

The second Bouton Creek sample was collected on December 17, 2002 and caused a toxic response (4 TUc) to sea urchins but no toxicity to water fleas (Table 7.2 and Figure 7.2).

The third Bouton Creek sample was collected on February 13, 2003 and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.2 and Figure 7.2).

The fourth Bouton Creek sample was collected on February 25, 2003 and produced no toxic response in water flea survival/reproduction but produced a marked reduction in sea urchin fertilization, with a NOEC of 3.125%, and 32 TUc (Table 7.2 and Figure 7.2).

7.1.3 Los Cerritos Channel

The first sample from the Los Cerritos Channel station was collected on November 9, 2002. This sample caused a toxic response in all three test species (Table 7.3 and Figure 7.3). The sea urchin was the most sensitive of the three species, with a NOEC of 6.25% (16 TUc) and an EC50 of 29.5%. Both endpoints (survival and reproduction) in the water flea bioassay showed the presence of toxicity (4 TUc) as did both survival and growth of the mysid.

The second Los Cerritos Channel sample was collected on December 16, 2002 and elicited a toxic response from the water flea survival and reproduction test (NOEC = 50%, 2 TUc) but no toxicity was demonstrated in the sea urchin fertilization test (NOEC = >50%, Table 7.3).

The third Los Cerritos Channel sample was collected on February 12, 2003. A toxic response was seen in the sea urchin fertilization test (NOEC = 25%, 4 TUc), but no toxicity was produced to either survival or reproduction in the water flea bioassay (Table 7.3).

The fourth storm sample was collected from Los Cerritos Channel on February 25, 2003, and produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.3 and Figure 7.3).

7.1.4 Dominguez Gap

The sampling station at Dominguez Gap was triggered only during the third storm, and the sample was collected on February 12, 2003. Bioassay testing produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.4 and Figure 7.4).

7.2 Toxicity Identification Evaluations (TIEs) of Stormwater

The trigger for performing a TIE was modified prior to the 2002/2003 wet season. A TIE was initiated when a LC50 of ≤50% (equivalent to ≥2 acute TU) was obtained for the water flea or mysid test, or an EC50 of ≤50% (≥2 acute TU) was obtained for the sea urchin fertilization test. This TIE trigger was exceeded 4 times among the tests conducted on four wet weather samples (Table 7.5). Of the three species, only tests conducted with water fleas and urchins exceeded the TIE trigger.

During the monitoring period, TIEs were triggered only for the first wet weather sampling event. TIEs were initiated on samples from Belmont Pump and Los Cerritos Channel for the water flea test, and on the Bouton Creek and Los Cerritos Channel samples for the sea urchin test. A reduction in toxicity relative to the initial test result was obtained for all four TIEs, resulting in a baseline toxicity of less than 2 TU, which prompted termination of these TIEs. However, despite the weak TIE signals available, some evidence of toxicant identity was obtained by inspection of the raw TIE data sets along with their statistical evaluation.

7.2.1 Belmont Pump Station

The results of the TIE conducted on the November 8 sample from the Belmont pump station are summarized in Figure 7.5. Extraction of the sample using a C18 column was highly effective in reducing toxicity in the water flea test. PBO treatment also eliminated the toxicity. Increased toxicity was present in the blank for the STS treatment. The increase in toxicity of the Belmont pump sample seen after this treatment (Figure 7.5) is an artifact of this blank toxicity and confounds the interpretation of this portion of the results. The effectiveness of the C18 treatment and elimination of toxicity obtained with the PBO treatment suggest that a nonpolar organic, probably an organophosphate (OP) pesticide, is a likely toxicant of concern in this sample.

7.2.2 Bouton Creek Station

One TIE was conducted on stormwater from Bouton Creek. The November 9th sample was tested using the sea urchin fertilization test. The TIE results obtained for this sample showed that addition of EDTA eliminated the toxicity of the sample. Addition of STS, centrifugation, and extraction using a C18 column did not have a substantial impact on the toxicity of this sample. This suggests that divalent cationic metals were likely toxicants in this sample.

7.2.3 Los Cerritos Channel Station

A TIE was conducted on stormwater collected on November 9th from the Los Cerritos Channel site. The sea urchin fertilization test test was used for this TIE. The results obtained for this sample showed addition of EDTA and STS eliminated the toxicity of the sample. Extraction using a C18 column reduced toxicity by about 20%. Centrifugation did not have a substantial impact on the toxicity of this sample. These results suggest that divalent metals were the most likely toxicants of concern in this sample.

7.2.4 Dominguez Gap Pump Station

No TIEs were conducted on samples from the Dominguez Gap Pump Station during this monitoring period.

7.3 Dry Weather Discharge

Toxicity tests were conducted on samples from two dry weather sampling events, on September 5, 2002 and May 20, 2003. The Bouton Creek sample collected in September 2002 contained 8.7 g/kg salinity, which was more than twice the LC50 for the fresh water organism (water flea), and this sample was not tested with the water flea. In the May 2003 sampling, the salinity of the Bouton Creek sample was 5 g/kg, approximately 1.6X the published LC50. The water flea was tested with the less saline September sample, but the results were interpreted with awareness of the probable contribution of salinity to observed toxicity at Bouton Creek.

7.3.1 Belmont Pump Station

In September 2002 the undiluted Belmont Pump sample did not produce measurably decreased survival in the water flea, but did produce decreased reproduction; the NOEC for reproduction was 50% (2 TUc). The Belmont Pump Station sample was not toxic to sea urchins (Table 7.6).

The May 2003 dry weather sample produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.6 and Figure 7.6).

7.3.2 Bouton Creek

The September 2002 Bouton Creek sample was not tested with the water flea due to elevated sample salinity. Significant toxicity to sea urchins (NOEC = 12.5%) was demonstrated in the September sample.

In May 2003, the Bouton Creek dry weather sample produced toxicity to water flea survival (NOEC=50%) and reproduction (NOEC=25%). Bouton Creek sample also produced severe toxicity (NOEC=<3.1%) to sea urchins in May. Note that the toxicity to water fleas may have been exacerbated by salinity stress in this freshwater organism.

7.3.3 Los Cerritos Channel

Both of the Los Cerritos dry weather samples were toxic to both water fleas and sea urchins. The September 2002 sample produced NOECs of 50% and 25% in water flea survival and reproduction (TUc ranging from 2 to 4), and a NOEC of 6.25% (16 TUc) in sea urchin fertilization.

The May 2003 Los Cerritos Channel dry weather sample was more toxic to both species, showing NOECs of 25% and 12.5% in water flea survival and reproduction (4-8 TUc) and a NOEC of <3.1% (>32 TUc) in sea urchin fertilization.

7.4 Dry Weather Toxicity Identification Evaluations

A sea urchin TIE was initiated on the September 5 2002 dry weather sample from Los Cerritos station. Marginally sufficient baseline toxicity was present in the sample to complete the TIE. The toxicity of the Los Cerritos sample was slightly reduced by addition of EDTA (Figure 7.7). The remaining treatments did not alter the toxicity of the sample. The pattern of response of the sea urchin sperm to the TIE treatments is consistent with the presence of toxic concentrations of divalent trace metals.

Limited TIE treatments were also incorporated into the sea urchin bioassays of the dry weather samples from Belmont Pump, Bouton Creek and Los Cerritos Channel stations of 20 May 2003. Only the highest (50%) concentration of each sample was manipulated with the addition of EDTA and STS. In the Bouton Creek and Los Cerritos Channel samples EDTA reduced toxicity (increased fertilization success) by 79.9% and 62.1%, respectively. Treatment with STS did not substantially affect toxicity in either of the samples. As above, this response pattern is consistent with the presence of toxic concentrations of divalent trace metals. The Belmont Pump Station did not produce sufficient toxicity to warrant analysis of the TIE treatments.

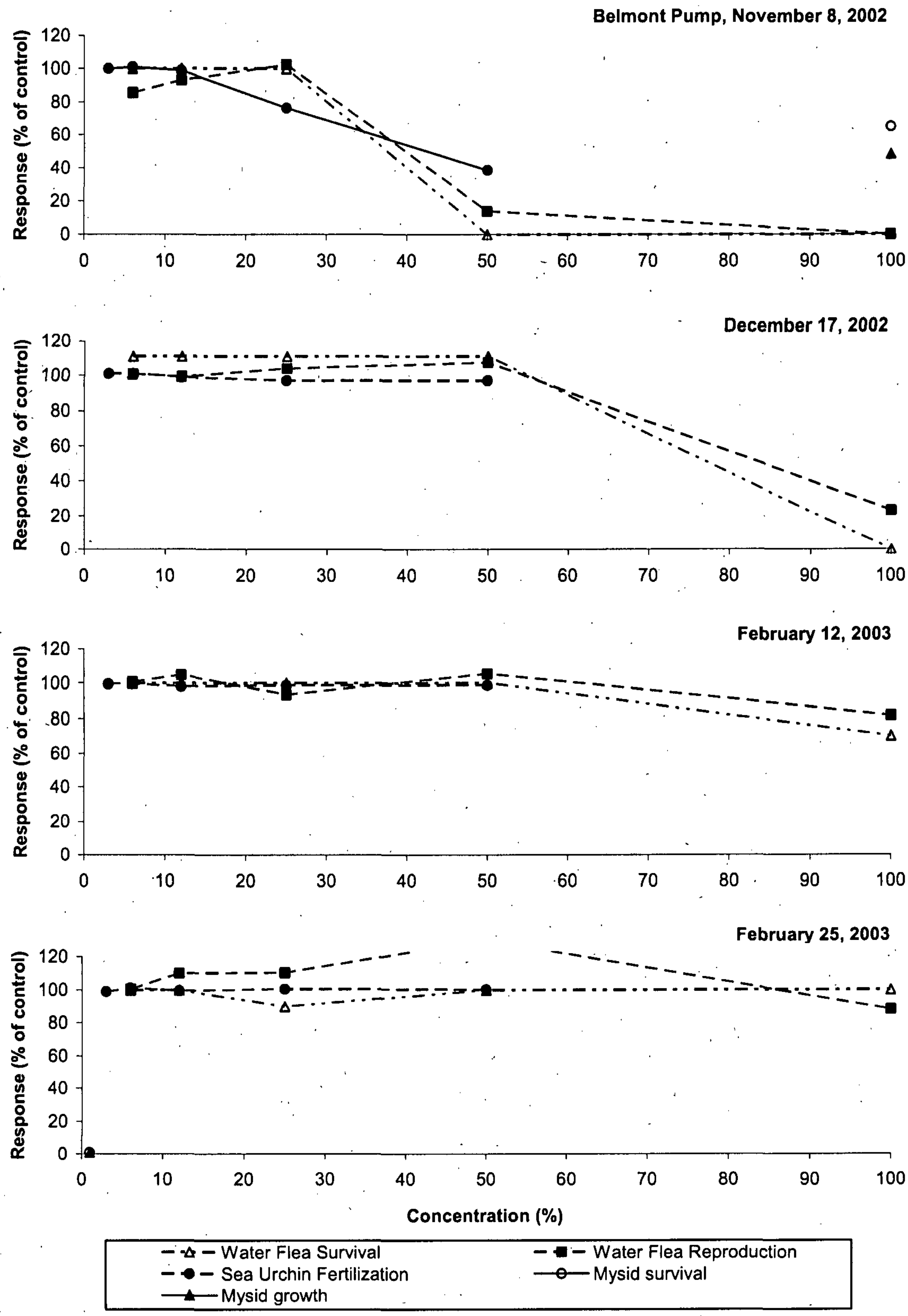


Figure 7.1. Toxicity Dose Response Plots for Storm Water Samples Collected from Belmont Pump.

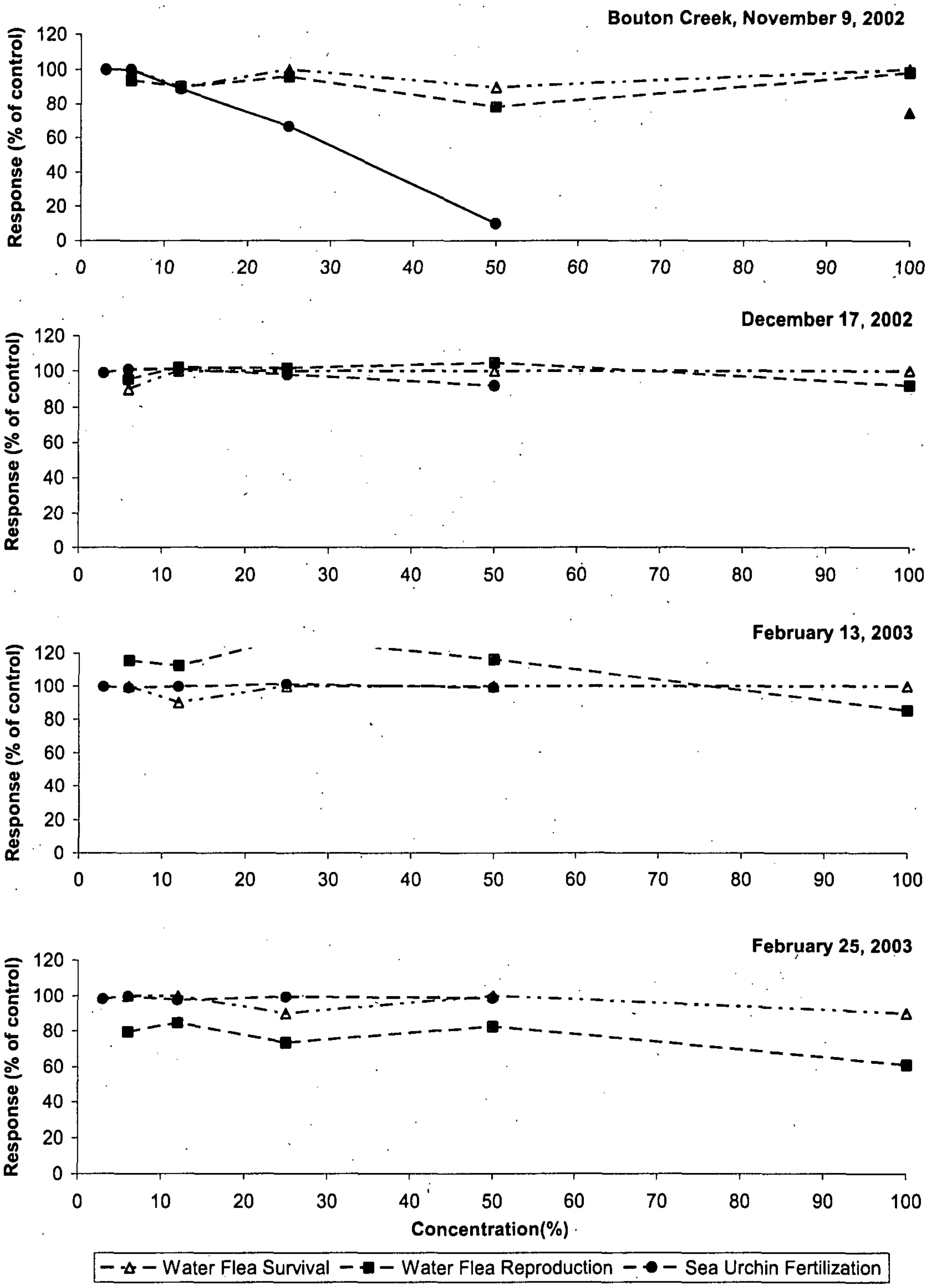


Figure 7.2. Toxicity Dose Response Plots for Storm Water Samples Collected from Bouton Creek.

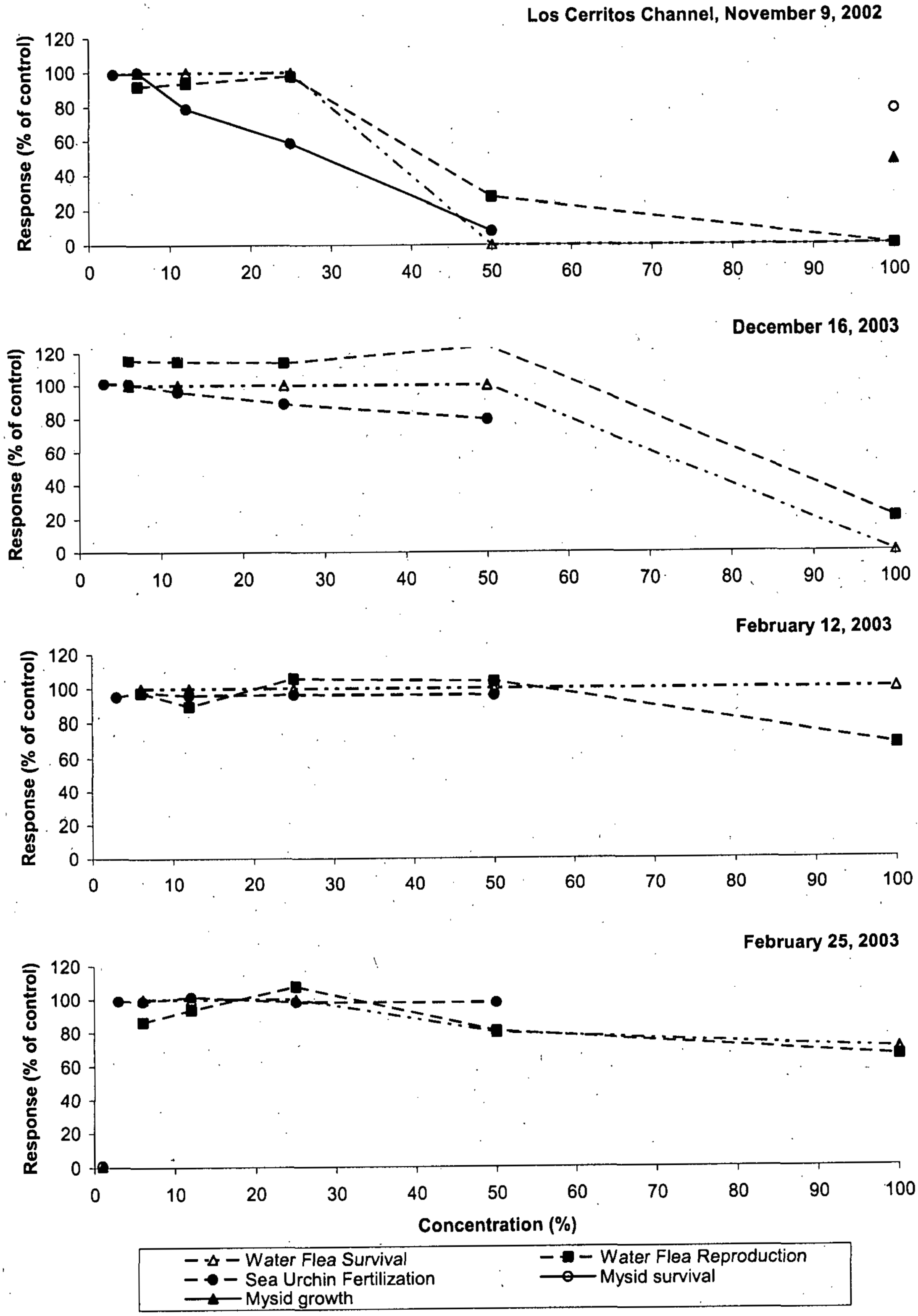


Figure 7.3. Toxicity Dose Response Plots for Storm Water Samples Collected from Los Cerritos Channel.

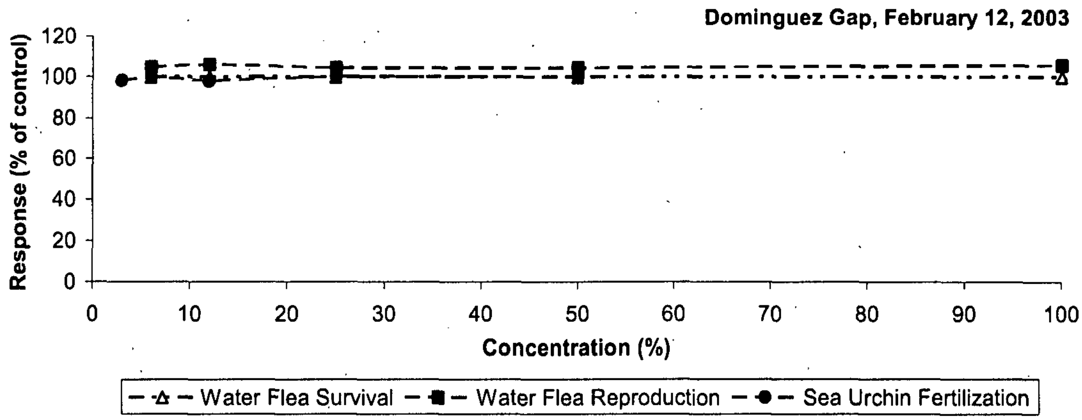


Figure 7.4. Toxicity Dose Response Plots for Storm Water Samples Collected from Dominguez Gap.

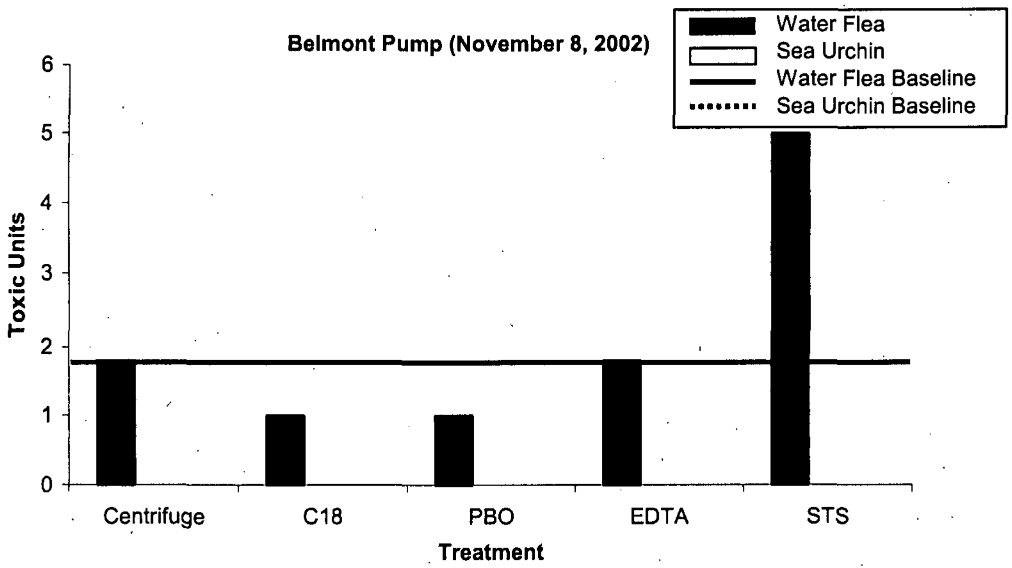


Figure 7.5. Summary of Phase I TIE Analyses on Stormwater Samples from the Belmont Pump Station.

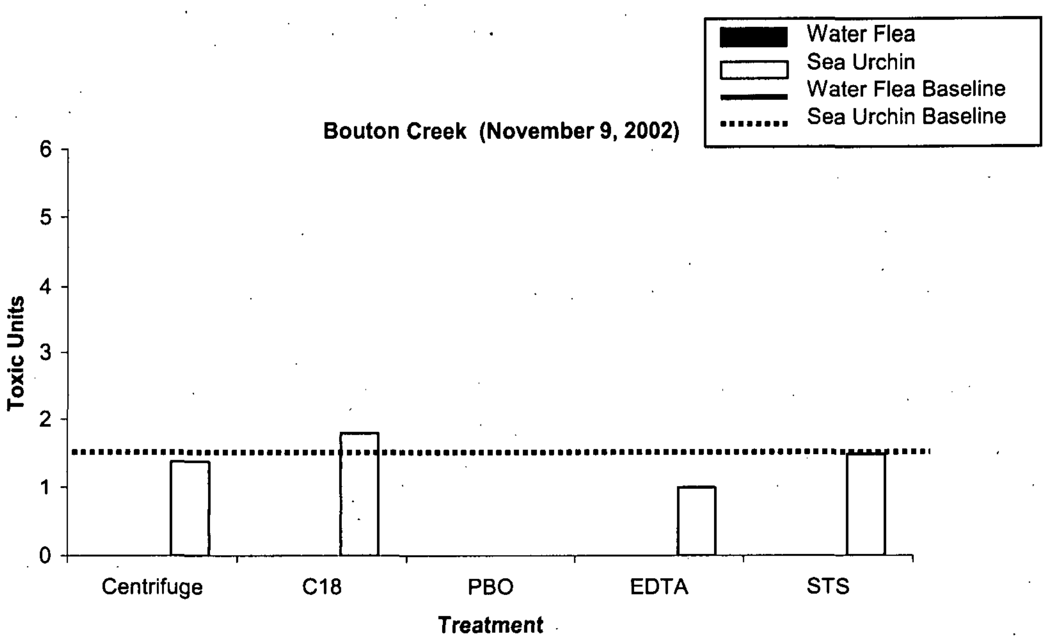
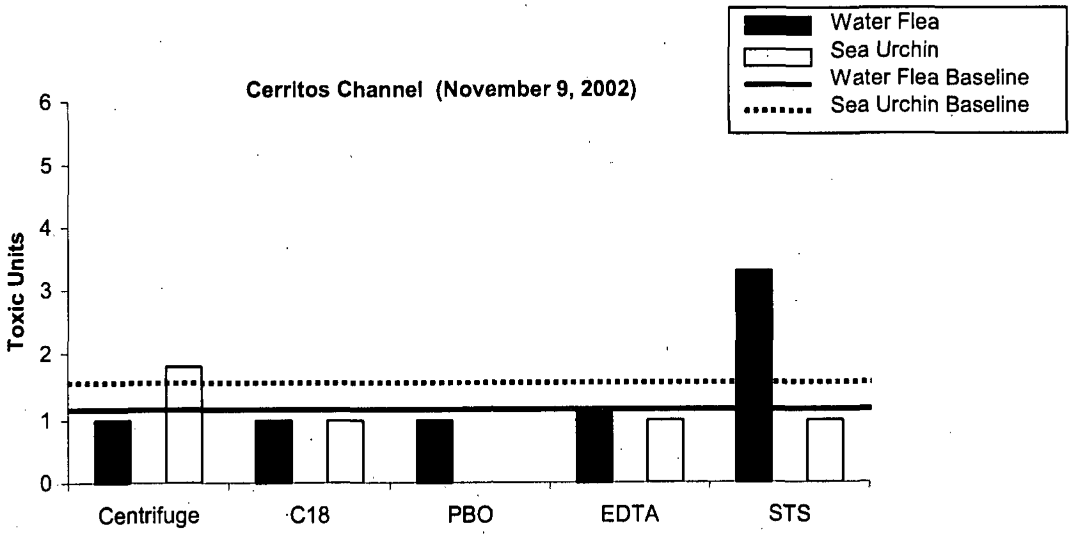


Figure 7.6. Summary of Phase I TIE Analyses on Stormwater Samples from the Bouton Creek Station.



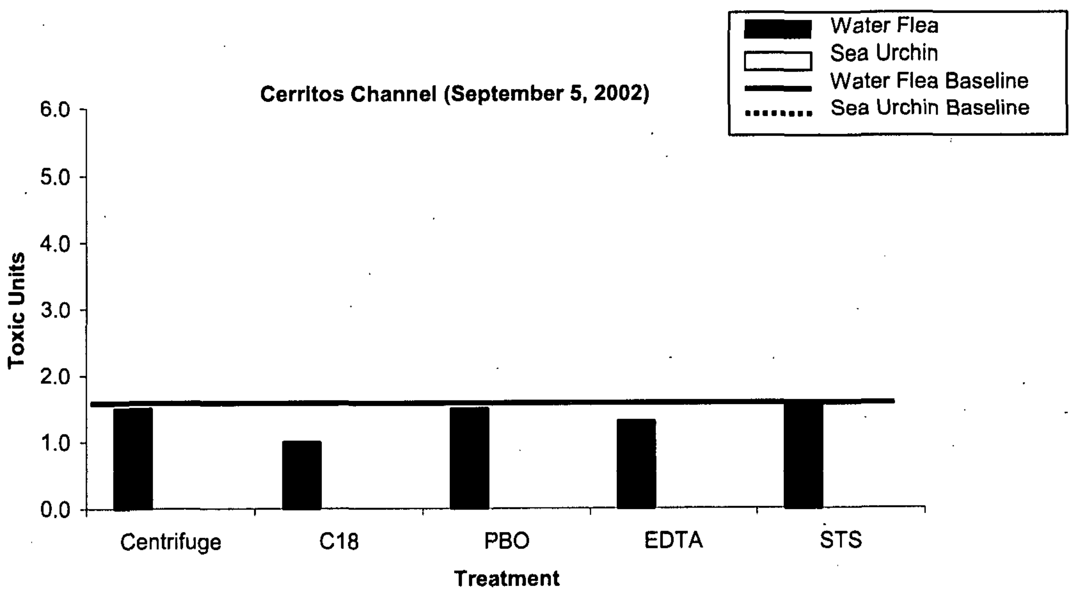


Figure 7.7. Summary of Phase I TIE Analyses on Stormwater Samples from the Los Cerritos Channel Station.

Table 7.1. **Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid tests were conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/8/02	**Water Flea Survival**	**25**	**50**	**37.5**	**4**
11/8/02	**Water Flea Reproduction**	**25**	**50**	**38.7**	**4**
11/8/02	**Mysid Survival**	**≤50**	**100**	**na**	**≥2**
11/8/02	**Mysid Growth**	**≤50**	**100**	**na**	**≥2**
11/8/02	**Sea Urchin Fertilization**	**12**	**25**	**40.5**	**8**
12/17/02	**Water Flea Survival**	**50**	**100**	**73.2**	**2**
12/17/02	**Water Flea Reproduction**	**50**	**100**	**82.3**	**2**
12/17/02	Sea Urchin Fertilization	>50	>50	>50	>2
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	Water Flea Reproduction	100	>100	>100	1
2/12/03	Sea Urchin Fertilization	>50	>50	>50	>2
2/25/03	Water Flea Survival	100	>100	>100	1
2/25/03	Water Flea Reproduction	100	>100	>100	1
2/25/03	Sea Urchin Fertilization	50	>50	>50	2

Table 7.2. Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2002/2003 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/9/02	Water Flea Survival	>100	>100	>100	>1.0
11/9/02	Water Flea Reproduction	>100	>100	>100	>1.0
11/9/02	Mysid Survival	100	100	na	>1.0
11/9/02	Mysid Growth	100	100	na	>1.0
11/9/02	**Sea Urchin Fertilization**	**6**	**12**	**32.4**	**16**
12/17/02	Water Flea Survival	100	>100	>100	>1.0
12/17/02	Water Flea Reproduction	100	>100	>100	>1.0
12/17/02	**Sea Urchin Fertilization**	**25**	**50**	**>50**	**4**
2/13/03	Water Flea Survival	100	>100	>100	1
2/13/03	**Water Flea Reproduction**	**50**	**100**	**>100**	**2**
2/13/03	Sea Urchin Fertilization	>50	>50	>50	>2
2/25/03	Water Flea Survival	100	>100	>100	1
2/25/03	**Water Flea Reproduction**	**50**	**100**	**>100**	**2**
2/25/03	**Sea Urchin Fertilization**	**<3**	**6**	**>50**	**33**

Table 7.3. **Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/9/02	**Water Flea Survival**	**25**	**50**	**37.5**	**4**
11/9/02	**Water Flea Reproduction**	**25**	**50**	**41.6**	**4**
11/9/02	**Mysid Survival**	**≤50**	**≤100**	**na**	**≥2**
11/9/02	**Mysid Growth**	**≤50**	**≤100**	**na**	**≥2**
11/9/02	**Sea Urchin Fertilization**	**6**	**12**	**29.5**	**16**
12/16/02	**Water Flea Survival**	**50**	**100**	**70.7**	**2**
12/16/02	**Water Flea Reproduction**	**50**	**100**	**80.5**	**2**
12/16/02	**Sea Urchin Fertilization**	**6**	**12**	**>50**	**16**
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	**Water Flea Reproduction**	**50**	**100**	**>100**	**2**
2/12/03	**Sea Urchin Fertilization**	**25**	**50**	**>50**	**4**
2/25/03	Water Flea Survival	100	>100	>100	1
2/25/03	**Water Flea Reproduction**	**50**	**100**	**>100**	**2**
2/25/03	Sea Urchin Fertilization	50	>50	>50	2

Table 7.4. **Toxicity of Wet Weather Samples Collected from the City of Long Beach Dominguez Gap Station during the 2002/2003 Monitoring Season.** Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
2/12/03	Water Flea Survival	100	>100	>100	1
2/12/03	Water Flea Reproduction	100	>100	>100	1
2/12/03	Sea Urchin Fertilization	>50	>50	>50	>2

Table 7.5. **Summary of TIE Activities.** Acute Toxic Units for the initial (TU-I) and TIE baseline (TU-B) tests are shown (96 hr exposure time for water flea), along with the TIE-related action taken. TIEs were abandoned when the baseline TU value was less than 2.0.

Date	Test	Water Flea			Mysid			Sea Urchin		
		TU-I	TU-B	Action	TU-I	TU-B	Action	TU-I	TU-B	Action
Wet Weather Event:										
11/8/02	Belmont	2.7	1.8	abandon	na	na	na	na	na	na
11/9/02	Bouton	na	na	na	na	na	na	3.1	1.5	abandon
11/9/02	Los Cerritos	2.7	1.1	abandon	na	na	na	3.1	1.5	abandon
Dry Weather Event:										
9/5/02	Belmont	na	na	na	na	na	na	na	na	na
9/5/02	Bouton	na	na	na	na	na	na	na	na	na
9/5/02	Los Cerritos	1.5	1.5	abandon	na	na	na	na	na	na

na = not applicable; insufficient toxicity to trigger TIE

Table 7.6. **Toxicity of Dry Weather Samples from the City of Long Beach.** Test results indicating toxicity are shown in bold type.

Station	Date	Test	Test Response (% sample)			TUc[d]
			NOEC[a]	LOEC[b]	Median Response[c]	
Belmont	9/5/02	Water Flea Survival	100	>100	>100	1
Belmont	**9/5/02**	**Water Flea Reproduction**	**50**	**100**	**>100**	**2**
Belmont	9/5/02	Sea Urchin Fertilization	50	>50	>50	2
Belmont	5/20/03	Water Flea Survival	100	>100	>100	1
Belmont	5/20/03	Water Flea Reproduction	100	>100	>100	1
Belmont	5/20/03	Sea Urchin Fertilization	50	>50	>50	2
Bouton	**9/5/02**	**Water Flea Survival[e]**	**na**	**na**	**na**	**na**
Bouton	**9/5/02**	**Water Flea Reproduction[e]**	**na**	**na**	**na**	**na**
Bouton.	**9/5/02**	**Sea Urchin Fertilization**	**12**	**25**	**>50**	**8**
Bouton	**5/20/03**	**Water Flea Survival[e]**	**50**	**100**	**48.4**	**2**
Bouton	**5/20/03**	**Water Flea Reproduction[e]**	**25**	**50**	**33.3**	**4**
Bouton.	**5/20/03**	**Sea Urchin Fertilization**	**<3**	**6**	**18**	**33**
Los Cerritos	**9/5/02**	**Water Flea Survival**	**50**	**100**	**66**	**2**
Los Cerritos	**9/5/02**	**Water Flea Reproduction**	**25**	**50**	**34.1**	**4**
Los Cerritos	**9/5/02**	**Sea Urchin Fertilization**	**6**	**12**	**15**	**16**
Los Cerritos	**5/20/03**	**Water Flea Survival**	**25**	**50**	**45.8**	**4**
Los Cerritos	**5/20/03**	**Water Flea Reproduction**	**12**	**25**	**17.4**	**8**
Los Cerritos	**5/20/03**	**Sea Urchin Fertilization**	**<3**	**6**	**27.1**	**33**

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8.0 ALAMITOS BAY PILOT RECEIVING WATER STUDY RESULTS

8.1 Vertical and Horizontal Extent of the Stormwater Plume

Runoff during the December 16, 2002 storm resulted in a surface plume that extended throughout Alamitos Bay (Figure 8.1). Rainfall measures at the Long Beach mass emission sites ranged from 1.21 to 1.26 inches over a period of roughly four to five hours. In the upper elevations of the Los Angeles Basin, rainfall totaled 3.5 inches over a 24-hour period and was the second highest 24-hour rainfall recorded since records were first maintained in the late 19th century.

Based upon the plume characteristics, the Los Cerritos Channel was the major source of stormwater entering Alamitos Bay. The surface salinity increased from essentially fresh levels in the Los Cerritos Channel on a steady, continuous basis around Naples Island to nearly open coast levels at the harbor entrance. Measured surface salinity within Alamitos Bay ranged from 1 to 28 ppt. The lower part of the range was found within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The higher surface salinities occurred near the Bay entrance. Although salinity was relatively low within the upper reaches of Marine Stadium, the plume from this portion of the watershed was minor in comparison to the plume emanating from the Los Cerritos Channel.

The fresher water of stormwater plume generally formed a surface plume that was typically three to five feet in depth (Figures 8.3a to 8.3h). The layer was thickest and most distinct in Cerritos Creek (Figure 8.3c). The structure of the plume became far less defined near the harbor entrance (Figure 8.3f).

The characteristics of the stormwater plume in western Alamitos Bay differed from those measured elsewhere in the Bay. The stormwater plume in this region tended to be only two to three feet in depth. The plume was most distinct near the Second Street Bridge.

In all cases, the stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically one degree centigrade lower than the deeper marine waters. Turbidity in the surface plume ranged from 45 to 80 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 2 to 5 NTU.

8.2 Chemical Characterization

Four sites within the plume were selected on the basis of salinity. The location of these sites is shown in Figure 8.2. After mapping the plume, sampling was initiated at RW1 where salinity within the plume was 24.7 ppt. Three additional sites were sampled with recorded salinities of 16.5 ppt (RW2), 10.9 ppt (RW3) and 8.7 ppt (RW4).

Total suspended solids increased from 10 to 28 mg/L as the surface salinity decreased from 24.7 to 8.7 ppt. Similarly, total copper, nickel, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Total cadmium was relatively constant with values ranging from 0.09 to 0.12 μg/L.

Strong spatial trends were not evident in the distribution of dissolved metals. Concentrations of dissolved cadmium, copper, lead and zinc were all highest at RW1, the station closest to the entrance to the Bay and with the least stormwater influence. The lowest concentrations of dissolved cadmium, copper, lead and zinc occurred at RW2 where the plume was roughly 50% seawater. Salinity at this site was 16.5 ppt. Overall, however, concentrations of dissolved metals differed by no more than 32 percent at RW2, RW3 and RW4; the three stations with the greatest stormwater influence.

Organophosphate (OP) pesticides were mostly not detected. Simazine, an herbicide, was the only OP pesticide detected in the plume. Concentrations were similar at all locations with levels ranging from 1.1 to 1.3 µg/L.

8.3 Toxicological Characterization

Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test and showed negligible toxicity (Table 8.2, Figure 8.3). Although all EC50s were >50%, the NOECs ranged from 12.5 to 25% in the three sites most influenced by stormwater runoff. Despite the fact the statistical tests indicated significant effects in these three cases, the magnitude of the response was minor (Figure 8.3). The maximum response was observed in tests conducted in water from RW4 where fertilization was 94% of controls in the maximum concentration.

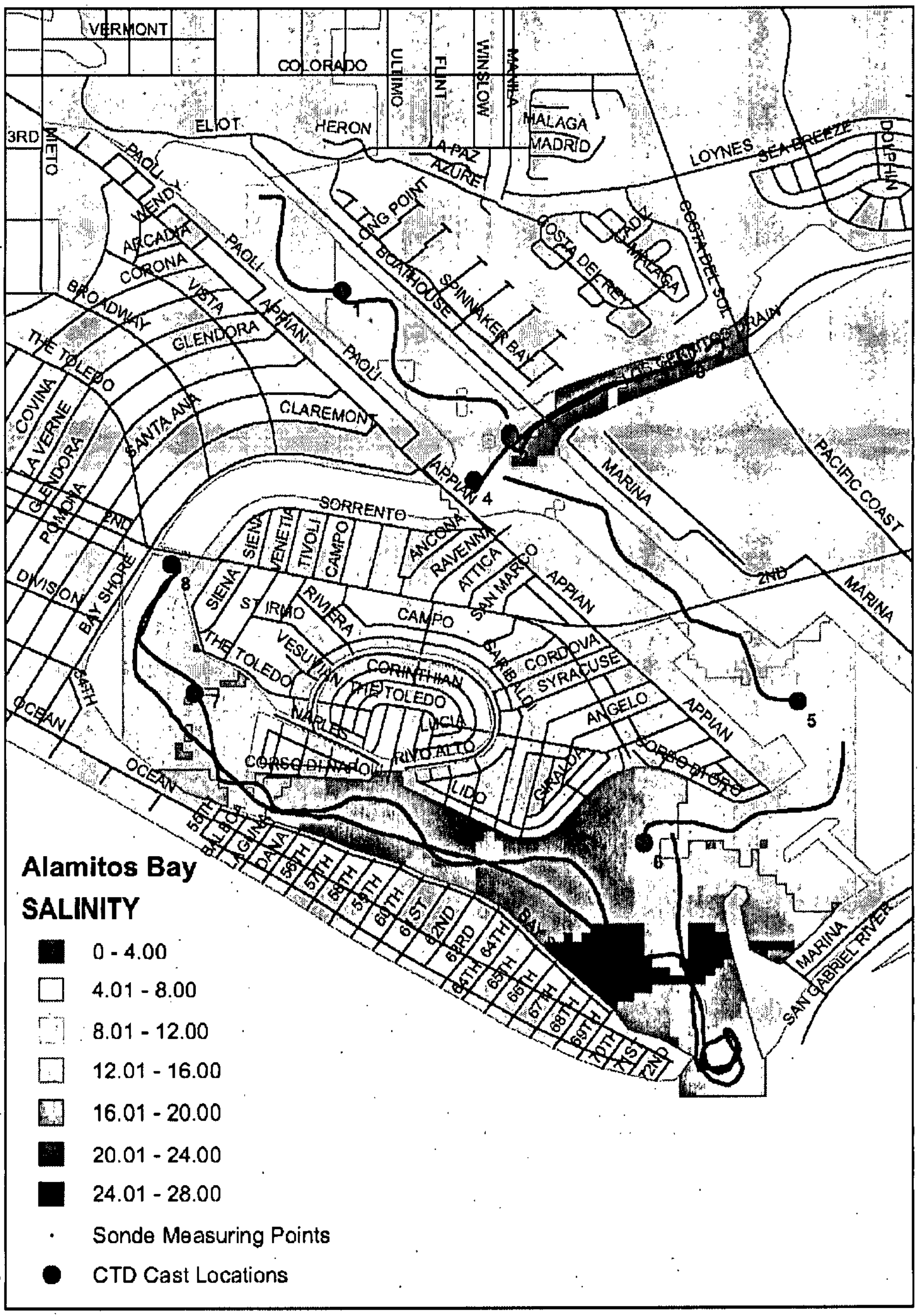


Figure 8.1 Map of Surface Salinity in Alamitos Bay with Locations of Eight Water Quality Profiling Sites, 12/16/2003.

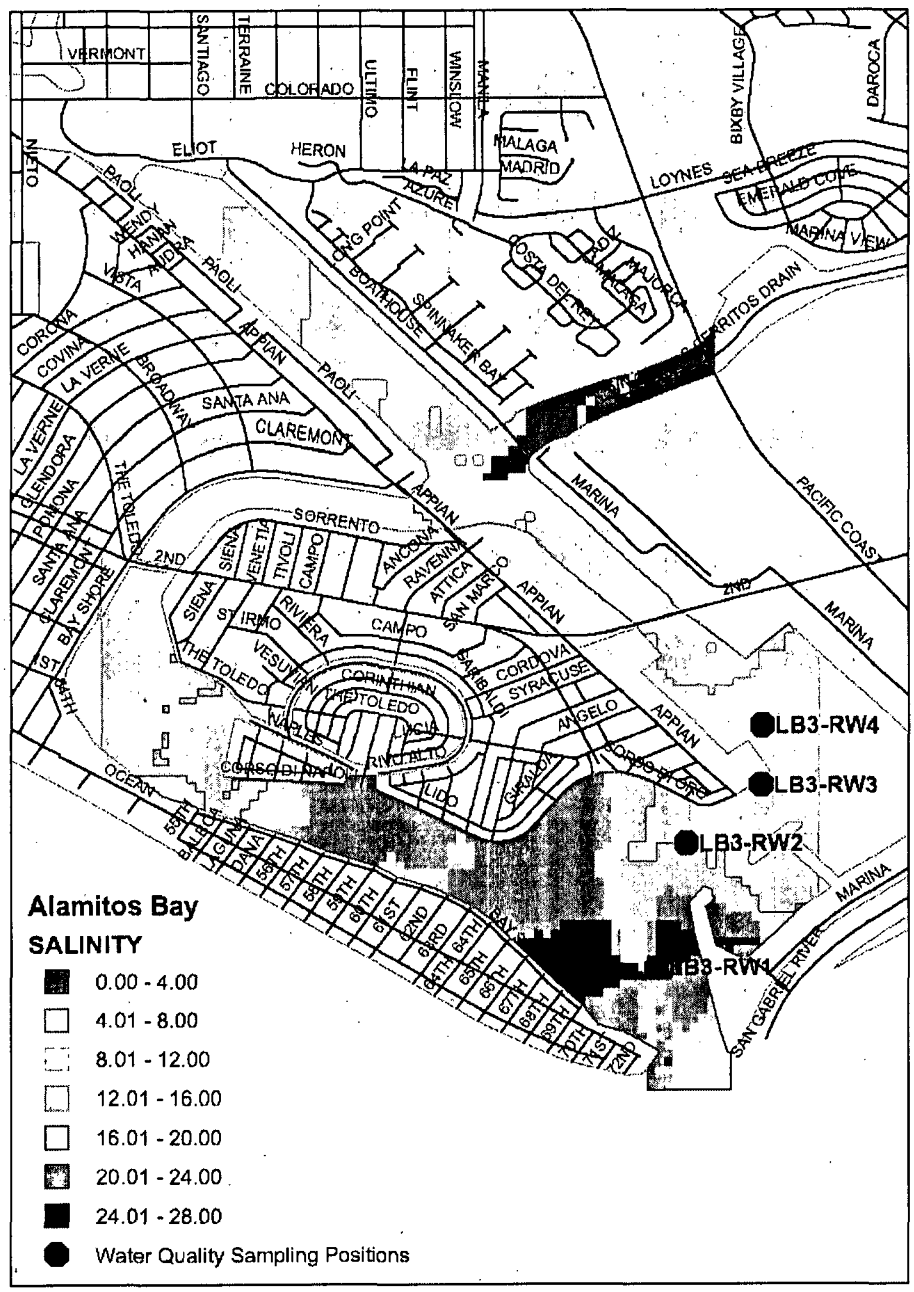


Figure 8.2 **Map of Surface Salinity in Alamitos Bay with Water Quality Sampling Locations, 12/16/2003.**

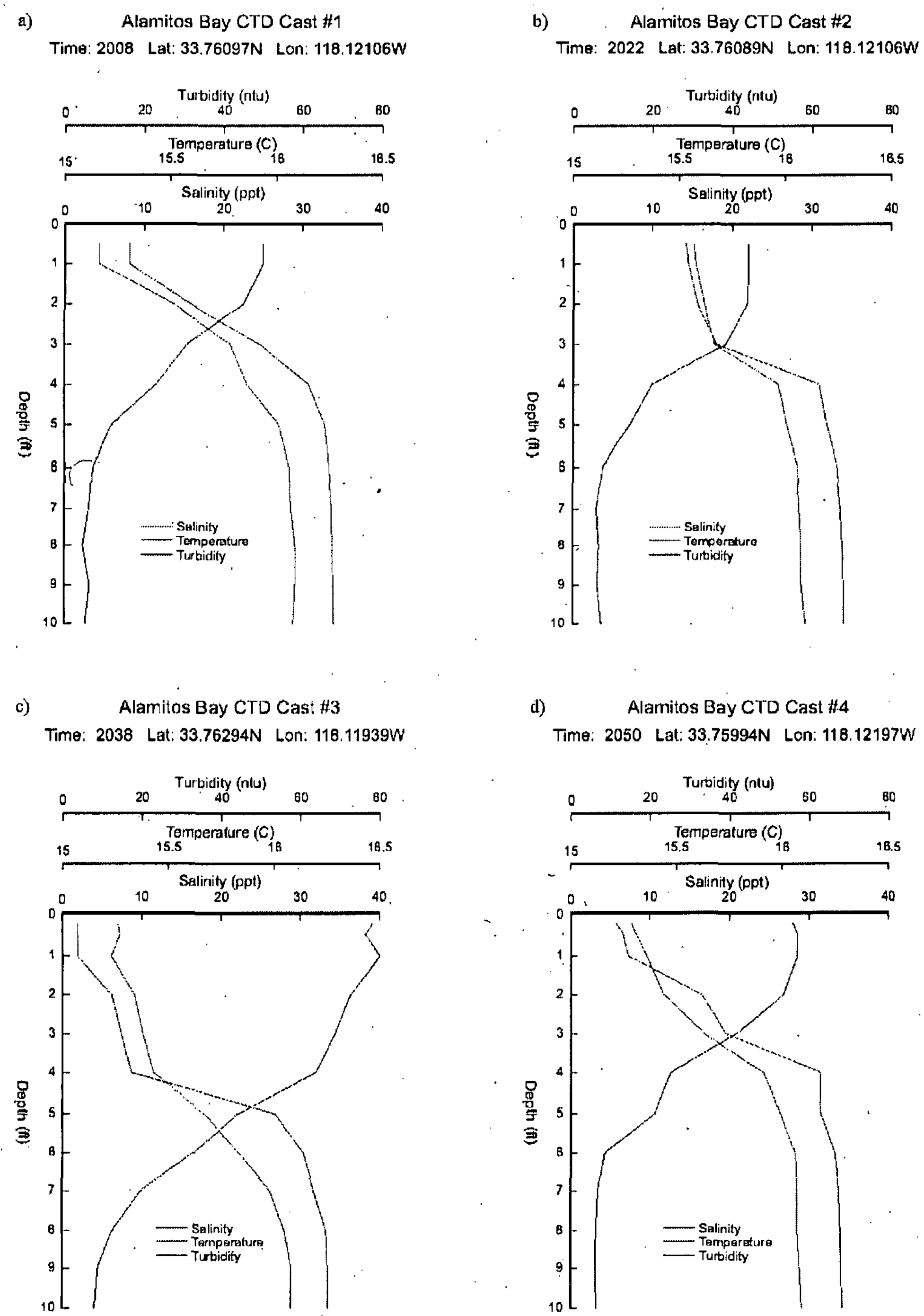


Figure 8.3(a-d) CTD Casts taken during Alamitos Bay Receiving Water Study

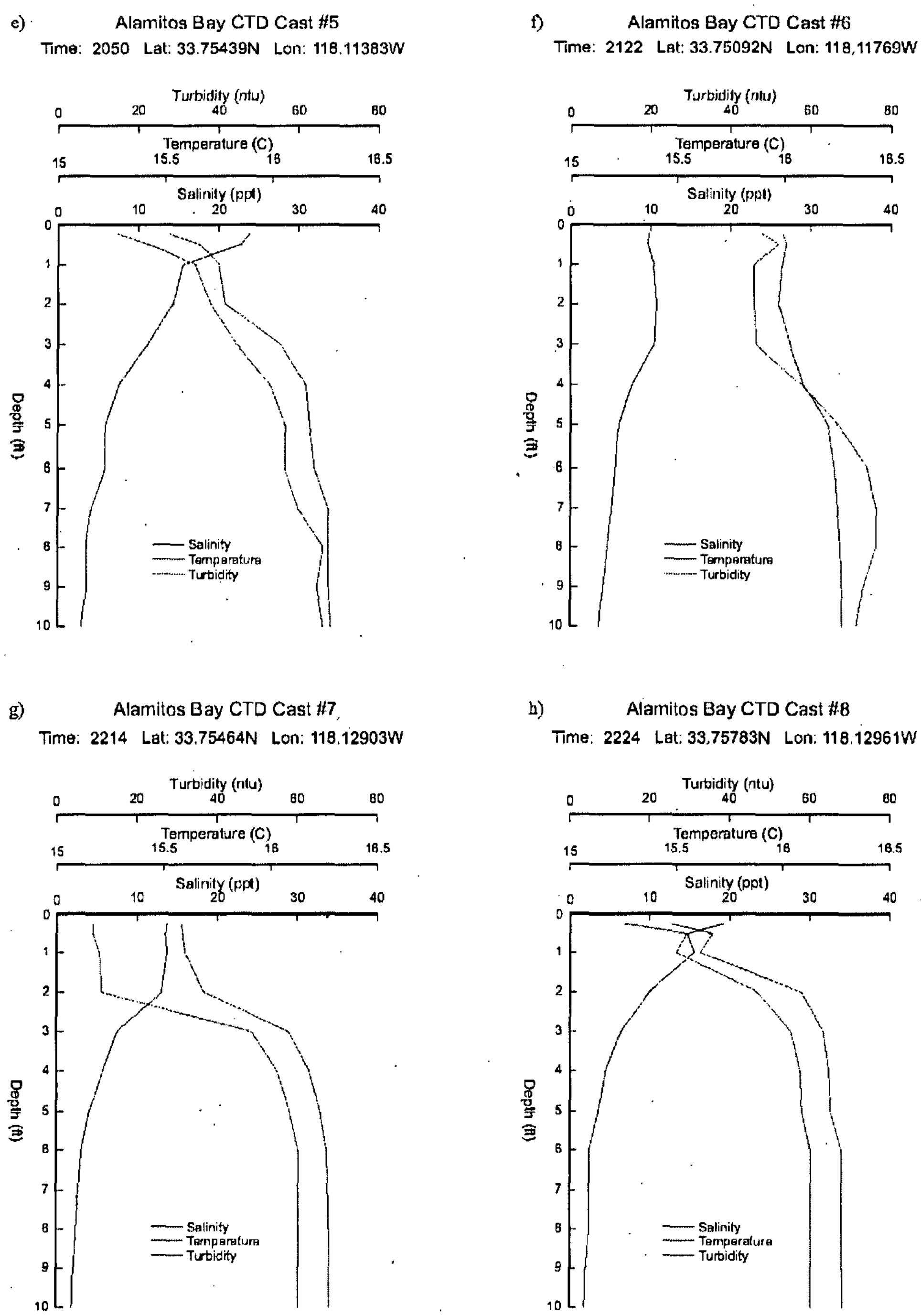


Figure 8.3(e-h) CTD Casts taken during Alamitos Bay Receiving Water Study. (Locations of each cast are shown on Figure 8.1)

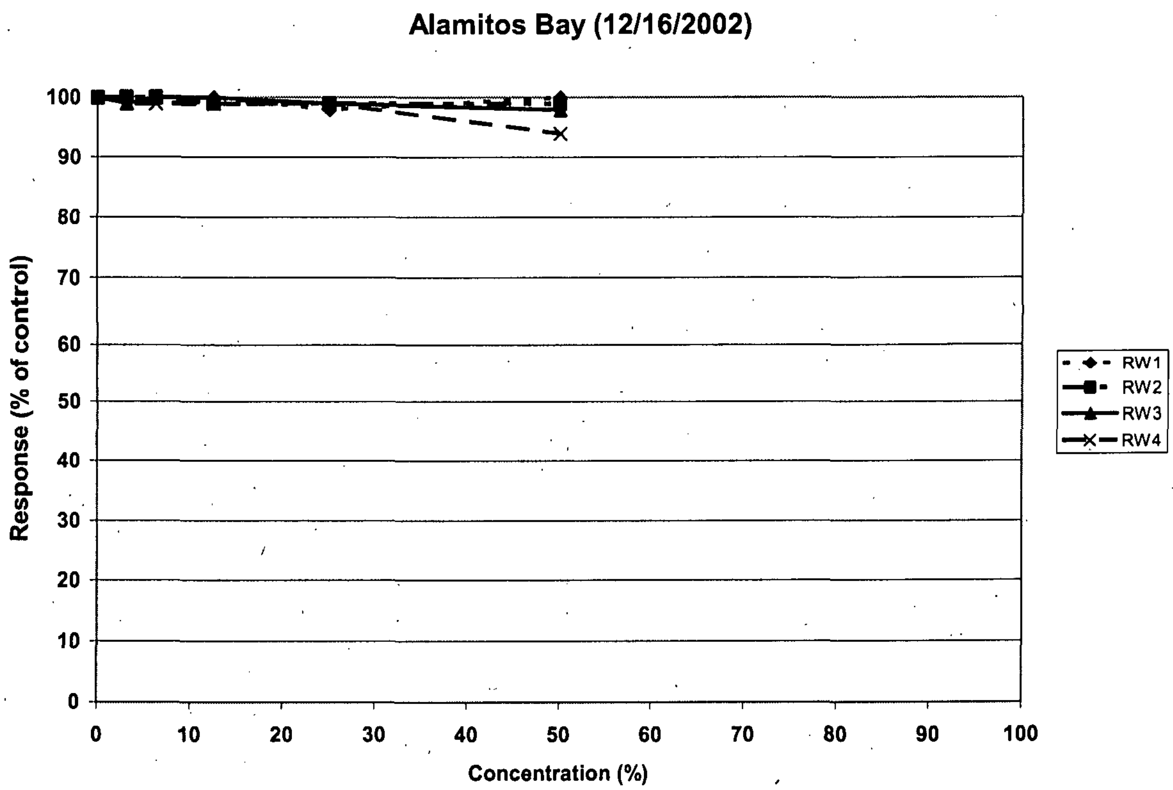


Figure 8.4 **Toxicity Dose Response Plots for Sea Urchin Fertilization Tests using Stormwater Plume Samples collected from Alamitos Bay.**

Table 8.1 Summary of Receiving Water Quality in Stormwater Plume Samples from Alamitos Bay.

ANALYTE	Receiving Water Monitoring Sites RW1	RW2	RW3	RW4
Conventionals				
pH	7.8	7.7	7.7	7.7
Specific Conductance (EC – µmhos/cm)	35500	24900	17400	14200
Salinity (ppt)	24.7	16.5	10.9	8.7
Total Suspended Solids	10	19	25	28
Ammonia as N (mg/L)	0.24	0.34	0.36	0.34
Total Metals (µg/L)				
Cd	0.09	0.10	0.12	0.11
Cu	4.5	5.6	7.5	7.9
Ni	1.2	1.8	2.5	2.8
Pb	1.7	2.3	3.8	3.5
Zn	17	21	29	38
Dissolved Metals (µg/L)				
Cd	0.06	0.03	0.04	0.04
Cu	2.0	1.1	1.2	1.3
Ni	0.91	1.1	0.94	1.3
Pb	0.74	0.24	0.34	0.40
Zn	12	8.5	9.1	8.7
Organophosphate Pesticides (µg/L)				
Chlorpyrifos (Dursban)	0.05U	0.05U	0.05U	0.05U
Diazinon	0.01U	0.01U	0.01U	0.01U
Atrazine	2U	2U	2U	2U
Cyanazine	2U	2U	2U	2U
Malathion	1U	1U	1U	1U
Prometryn	2U	2U	2U	2U
Simazine	1.1	1.3	1.3	1.2

Table 8.2 Toxicity of Receiving Water Samples Collected from Alamitos Bay during the 2002/2003 Storm Season.

		Receiving Water Monitoring Sites			
Test Species	Endpoint	RW1	RW2	RW3	RW4
S. purpuratus-Fertilization	EC_{50}	>50%	>50%	>50%	>50%
	NOEC	>50%	12.5%	25%	25%

9.0 DISCUSSION

9.1 Wet Season Water Quality

Numerical standards are not available for stormwater discharges. Water quality criteria or objectives, however, can provide valuable reference points for assessing the relative importance of various stormwater contaminants. Ultimately, specific beneficial uses of the receiving water body should be considered when selecting the appropriate benchmarks. Existing, potential and intermittent beneficial uses are provided in Table 9.1 for the receiving waters associated with each discharge point.

Tables 9.2 through 9.5 provide a comparison of Event Mean Concentrations (EMCs) for each measured constituent with various water quality criteria. These benchmarks are intended to serve as a tool for interpreting the stormwater quality data and assuring beneficial uses are not impacted. Exceedances of these receiving water quality benchmarks do not necessarily indicate impairment. Other factors such as dilution, duration and transformation in the receiving waters must also be considered.

For comparative purposes, an EMC was considered to be an exceedance if the value was higher than any of the reference values. In using these benchmarks, it is important that the source of the specific criterion is considered. For instance, metals concentrations derived from California Toxics Rule freshwater criteria for protection of aquatic life are based upon dissolved concentrations and are often a function of hardness. Values listed are based upon a default hardness of 50 mg/L. Evaluation of possible exceedances are based upon the hardness EMC for that site and event. Saltwater objectives listed for metals under the CTR are also based upon dissolved concentrations while those listed under the California Ocean Plan are based upon total recoverable measurements. Although Ocean Plan numbers are used for comparative purposes, the marine and estuarine receiving waters in the vicinity of Long Beach would only be subject the CTR saltwater values since Alamitos Bay and the coastal waters of Long Beach are considered enclosed bays and estuaries. Values provided for the Basin Plan are primarily based upon drinking water standards.

9.1.1 Conventionals and Bacteria

Between 50 and 67 percent of the stormwater samples had measured pH values that were below the lower Basin Plan limits of 6.5. In each case pH concentrations were in the range of 6.2 to 6.5. The pH of stormwater is often slightly acidic since rainwater normally tends to be slightly acidic. This is mostly due to dissolved carbon dioxide that the rain "scrubs" from the atmosphere. Other gases such as sulfur dioxide (SO2) and nitrogen oxides (NOx) can cause further acidification of the rainfall. In Southern California, the National Atmospheric Deposition Program (NADP 2003) indicates that pH associated with rainfall is typically 5.2.

One hundred percent of the samples had TSS concentrations that exceeded the Ocean Plan limit of 3 mg/L. Appropriate benchmarks are not available under the other guideline documents.

As previously noted in this and other stormwater programs, bacteria are commonly found at very high concentrations in stormwater. Total and fecal coliform concentrations exceeded public health criteria under AB411 in 100 percent of the samples. Enterococcus concentrations exceeded AB411 criteria in most, but not all, cases. Enterococcus concentrations measured in runoff from three of the four sites during the event on February 12, 2003 were below AB411 criteria.

9.1.2 Trace Metals

Reference values were exceeded at least once for a total of five different total recoverable metals. These included copper, lead, zinc, aluminum, and antimony. Concentrations of total recoverable copper, lead and zinc in runoff from the mass emission sites commonly exceeded Ocean Plan criteria. These criteria were exceeded for all runoff samples from Bouton Creek, the Belmont Pump Station, and the Los Cerritos Channel. Stormwater runoff from the Dominguez Gap Pump Station site had far fewer exceedances with total recoverable zinc and copper criteria being exceeded in only one-third of the events. The Ocean Plan lead criterion of 8 µg/L was exceeded in runoff from all three events at the Dominguez Pump Station.

Two trace metals measured in stormwater were found to exceed primary Maximum Contaminant Level[3] (MCL) for drinking water cited in the Basin Plan. The criterion of 1000 µg/L of total recoverable aluminum was exceeded in all cases. The concentration of antimony exceeded a primary MCL for drinking water on one occasion in runoff from the Los Cerritos Channel.

Dissolved copper, lead and zinc commonly exceeded the reference values. Concentrations of dissolved copper exceeded both the freshwater and saltwater California Toxics Rule (CTR) criteria at all sites during all storm events. Dissolved lead and zinc exceeded the CTR criteria during all storm events at Bouton Creek, the Belmont Pump Station and Los Cerritos Channel. Lead and zinc criteria were exceeded in two out of three events at the Dominguez Gap Pump Station.

9.1.3 Chlorinated Pesticides and Organophosphate Pesticides

Very few organic compounds exceeded the reference criteria in runoff from the four mass emission sites. Concentrations of dieldrin exceeded the saltwater CTR criterion in one sample from the Belmont Pump site and another from the Los Cerritos Channel. In both cases, the reported value was less than twice the ML of 0.01 µg/L. Simazine, an organophosphorus herbicide, exceeded the Basin Plan MCL in one sample from the Los Cerritos Channel.

Although the CTR, Basin Plan and Ocean Plans all lack criteria for both diazinon, this pesticide was ubiquitous in the stormwater samples. Another organophosphorous compound of concern, chlorpyrifos, was detected in 25 percent of the stormwater samples from the Belmont Pump Station and Los Cerritos Creek.

9.2 Dry Season Water Quality

In previous years, dry season water quality did not vary greatly between sites or sampling dates. In general, the concentrations of suspended particulates and total recoverable metal concentrations are low in dry weather runoff. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. Concentrations of bacteria are comparable to levels in winter, stormwater runoff. Pesticides and semivolatiles were largely undetected.

Although the previous observations held true at most sites during the past season, sampling conducted at Bouton Creek in May 2003 resulted in elevated levels of TSS, turbidity, total recoverable metals (aluminum, copper, iron, lead, selenium, silver and zinc) and dissolved selenium. For many of these

[3] The Maximum Contaminant Level (MCL) is a drinking water standard. The MCL is the concentration that is not expected to produce adverse health effects after a lifetime of exposure, based upon toxicity data and risk assessment principles.

constituents, these were among the highest dry weather concentrations encountered at this site since the start of the NPDES monitoring program. The results of this survey suggest that there was an upstream source of soils. The potential source of these sediments has not yet been investigated since the results of the chemical analyses were only recently received and evaluated.

Previous dry weather monitoring within both Bouton Creek and the Los Cerritos Channel have resulted in occasional elevations of pH. The program now calls for immediate upstream investigations to be conducted whenever pH levels are found to exceed 9.0. This year none of the field measurements indicated high pH levels in the receiving water. Despite moderate to high levels of alkalinity (130 to 420 mg/L), laboratory measurements taken within 48 hours of sampling resulted in several cases where pH levels exceeded 9.0.

Sampling and measurement differences may have contributed to some of the differences but the major factor is likely to be the delay associated with measuring pH in the laboratory. Field measurements were taken directly from the water body whereas laboratory measurements were taken in subsamples of the composite water.

9.3 Temporal Trends of Selected Metals and Organic Compounds

Temporal trends were examined for selected trace metals and organic compounds that are often high in storm drain discharges or suspected to be primary sources of toxicity (Figures 9.1 through 9.12). Time series are presented for five trace metals including cadmium, copper, nickel, lead and zinc. Time series are also provided for two important organophosphate pesticides, diazinon and chlorpyrifos, that have been implicated as major sources of toxicity. The figures include all wet and dry weather data for the past three years at each monitoring site. Periods of dry weather are indicated by the shaded areas. Due to the typically large differences between total and dissolved lead concentrations, a separate graphic is included to detail changes in dissolved lead over time.

Although data are not yet sufficient to make definitive statements supported by statistical test, several general trends are emerging. Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events. Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows. Seasonal differences in total cadmium and nickel are less evident. Similarly, no distinct seasonal trends were noted for either chlorpyrifos of diazinon. In the case of the latter two organophosphate compounds, earlier detection limits were not suitable to provide measurements of these analytes at the levels typically encountered in the discharges.

Characteristics of stormwater discharges from the Dominguez Gap Pump Station also are consistent with earlier observations at this site. Prior to this year, only three storms were sampled at this site. During the 2001/2002 monitoring year rainfall was not sufficient to cause the pumps to be activated at this site. This year another three storm events were monitored. Discharges from this site tend to have lower concentrations of total metals than the other mass emission sites.

Given adequate rainfall in the 2003/2004 monitoring year, hypotheses testing will be conducted to determine if seasonal trends observed for these key contaminants are statistically significant. The seasonal trends in concentrations and partitioning between dissolved and particulate forms will be important in developing control strategies for these constituents.

9.4 Stormwater Toxicity

A total of thirteen wet weather samples were analyzed for toxicity during the monitoring period. All thirteen samples were tested with water fleas and sea urchins (26 total bioassays), and a subset of three of those samples was tested with mysids. There was, then, a total of 29 bioassays performed on thirteen water samples.

Each storm produced similar toxicity results in samples from the Belmont Pump station and the Los Cerritos Channel station, in that the same group of species showed significant toxic efects. Toxicity results were quite different in samples from the Bouton Creek station, with different storms producing toxicity only to sea urchins.

The sea urchin test detected toxicity in six of thirteen storm samples, while the water flea test showed significant toxicity in four of thirteen samples. Mysids showed toxic results in two of three samples tested..

The toxicity of the wet weather samples analyzed during the monitoring period was generally less than that measured during the previous monitoring period (Figure 9.13). One of the Bouton Creek samples contained a high level of toxicity to sea urchins (32 TUc) matching that of Bouton Creek samples tested previously.

9.4.1 Dry Weather Toxicity

The sample of dry weather discharge collected from Belmont Pump station in September 2002 was not toxic to sea urchins, but was toxic to water flea reproduction (but not survival). The magnitude of reproductive toxicity was the same or slightly less than the stormwater samples analyzed during 2002-2003 (Figure 9.13). The Belmont Pump dry weather sample collected in May 2003 produced no toxicity to either water fleas or sea urchins.

The dry weather samples collected from Bouton Creek were both characterized by elevated salinity. The water flea test was not performed on the September 2002 sample. The slightly less saline sample collected in May 2003 was tested, however, and showed both lethal and reproductive toxicity. Some portion of this toxicity may have been due to salinity stress on this freshwater test organism. Both the September 2002 and May 2003 dry weather samples from Bouton Creek were toxic to sea urchins, with TUc values of 8 and 32, respectively. The magnitude of the toxicity to sea urchins was comparable to that seen in three of the four storm samples tested in the 2002-2003 monitoring period.

Both dry weather samples from the Los Cerritos Channel were toxic to both test species. The September 2002 dry weather sample produced 2-4 TUc of toxicity to water fleas and 16 TUc of toxicity to sea urchins. The May 2003 dry weather sample showed about twice as much toxicity to each species, producing 4-8 TUc to water fleas and 32 TUc to sea urchins. The magnitude of dry weather toxicity in September 2002 was comparable to that seen in wet weather samples analyzed during 2002-2003, but toxicity in the May 2003 dry weather samples was greater than that seen in wet weather samples.

Data from the previous (2001-2002) monitoring period suggested that dry weather samples collected in May 2002 were generally less toxic than wet weather samples collected during the winter of 2001-2002, and that this pattern was consistent with dry weather results from the 2000-2001 monitoring period Threse toxicity results were cited to support the indication that "there are significant differences in the composition of stormwater and dry weather discharge from the City of Long Beach" (Kinnetic Laboratories Inc. and Southern California Coastal Water Research Project July 2002)

Data from the 2002/2003 monitoring period indicate that the magnitude of dry weather toxicity was somewhat less than wet weather toxicity at the Belmont Pump station. At the Bouton Creek station, dry weather and wet weather toxicities were of similar magnitude, while at the Los Cerritos Channel station dry weather discharge showed equal or greater toxicity to stormwater, with particularly elevated toxicity to sea urchins in the May 2003 collection. Current toxicity data, then, do not necessarily support the indication of significantly different composition of seasonal discharges.

9.4.2 Temporal Toxicity Patterns

The toxicity data from the 2000/2001 and 2001/2002 monitoring periods suggest that seasonal flushing may be an important factor affecting the variability in stormwater toxicity, and current data from the 2002/2003 monitoring period generally support that suggestion.

At the Belmont Pump station significant toxicity was seen in all three species during the first storm event (4 TUc and 8 TUc to water fleas and sea urchins, respectively). The second storm produced reduced toxicity (2TUc) to water fleas only, and storms three and four showed no measurable toxicity to any species.

Bouton Creek samples showed toxicity only to sea urchins. The first storm produced 16 TUc, the second storm produced 4 TUc and the third storm produced no urchin toxicity. The fourth storm, however, produced the highest toxicity (32 TUc) of any wet weather samples tested during this period.

Cerritos Channel samples produced toxicity to all three species in the first storm, with 4 TUc to water fleas and 16 TUc to sea urchins The second storm produced no toxicity to urchins and only 2 TUc to water fleas. The third storm showed no water flea toxicity and 4 TUc to urchins, and the fourth storm produced no toxicity to either species.

With the obvious exception of storm four at Bouton Creek, there is a clear trend toward decreasing toxicity with increased flushing

In previous studies, it was found that early season storm water runoff from Ballona Creek (Los Angeles County) was more toxic than samples obtained later in the season (Bay *et al.* 1999).

9.4.3 Comparative Sensitivity of Test Species

There were a total of twelve wet weather samples tested for toxicity with both water fleas and sea urchins. Toxicity was detected to one or both species in eight of those samples and the sea urchin fertilization test was the most sensitive toxicity test method in six of those eight samples. The water flea survival/reproduction test was the most sensitive method for the December 16 sample from Los Cerritos Channel and the December 17 sample from the Belmont Pump station. Neither of those stormwater samples was toxic to sea urchins. In additon there were six dry weather discharge samples tested using water fleas and sea urchins. Of those six samples, five showed toxicity and the sea urchin was the more sensitive test in four of those five. Thus, of the thirteen water samples showing toxicity, the sea urchin test was the more sensitive in 10 samples (77%).

The relative sensitivity of the mysid toxicity test could not be evaluated for this monitoring period because only the 100% stormwater concentration was tested, which prevented estimation of a precise value for the EC50 or NOEC. Mysid survival and growth in 100% stormwater generally indicated less toxicity than the sea urchin or water flea results for similar sample concentrations, indicating that the mysid test was the least sensitive of the three methods.

This same pattern of sensitivity (sea urchin > water flea > mysid) was also observed during the 2000/2001 monitoring program and in a study of urban stormwater toxicity in San Diego (Southern California Coastal Water Research Project 1999).

9.4.4 Relative Toxicity of Stormwater

Table 9.6 compares the frequency and magnitude of stormwater toxicity from the Long Beach stations in 2002/2003 with that of stormwater samples from Long Beach in previous years and with toxicity in other southern California watersheds. The data suggest a marked decrease from previous years in the frequency of Long Beach stormwater toxicity during the 2002/2003 monitoring year and also show a decreased magnitude of toxicity to water fleas. Both frequency and magnitude are also decreased from those reported for other nearby watersheds.

Results from the Chollas Creek and Ballona Creek studies would be expected to be similar to the Long Beach study, as these samples were obtained from smaller highly urbanized watersheds, relative to the samples from the L.A. River and San Gabriel River. The data suggest such comparability for Long Beach samples from the first two monitoring periods, but clearly indicate the changes seen during the 2002/2003 monitoring period. Toxicity in Long Beach samples and in those from other watersheds is variable among storms, and stormwater toxicity is most often detected using the sea urchin fertilization test.

9.4.5 Toxicity Characterization

The TIE testing program for this monitoring period was limited due to overall low levels of toxicity in the stormwater samples during the past year. Phase I TIEs were attempted on four wet weather and one dry weather samples and they yielded useful information for all five samples. In addition, two more samples on which limited TIEs were run concurrently with initial toxicity testing of the samples yielded useful information for sea urchins. The remaining TIE was not useful due to the substantial loss of toxicity with time in the laboratory.

The results of the 2002/2003 TIE analyses were consistent within each species and generally similar to the data obtained from the previous year (Table 9.7). One of the TIEs conducted using the water flea indicated that organophosphate (OP) pesticides was the most likely category of toxic constituents. This conclusion is supported by the effectiveness of the C-18 and PBO treatments for reducing toxicity to the water flea. Other monitoring programs in California have obtained similar Phase I TIE results and subsequent studies have verified that OP pesticides are frequently the cause of urban stormwater toxicity to this species. In the other water flea TIE, an uncategorized non-polar organic (NPO) toxicant was implicated because the C18 treatment was effective and the PBO treatment was not effective.

EDTA was consistently the most effective treatment for removing toxicity in the sea urchin TIEs. EDTA is effective at chelating divalent metals, such as copper, cadmium and zinc, thus rendering them biologically unavailable. Studies in other watersheds have also found EDTA to be successful at removing toxicity from runoff (Jirik *et al.* 1998, Schiff *et al.* 2001). In these studies, copper and zinc were found to be the specific metals most likely causing toxicity. Solid phase extraction using C-18 was partially effective at removing toxicity to sea urchins from the Los Cerritos Channel sample. This treatment is intended to remove non-polar organic contaminants from the sample. However, C-18 treatment has also been shown to remove significant amounts of toxicity associated with copper and zinc from the water

(Schiff *et al.* 2001). Toxicity in the Los Cerritos Channel sample was also reduced by treatment with STS, which can reduce toxicity to some metals (e.g., cadmium, copper, zinc). Since solid phase extraction, STS and EDTA were all highly effective in this sample, it is likely that divalent metals, rather than organics, caused the observed toxicity. The other possibility is that both metals and non-polar organics are present and acting in a synergistic manner so that the removal of one effectively eliminates most of the toxicity in the sample. Additional tests are necessary to confirm the unlikely presence of such a synergistic effect.

The removal of particles by centrifugation was not effective in reducing toxicity in any sample. Previous studies have also found particle removal to be an ineffective method for the removal of toxicity from stormwater (Bay *et al.* 1999). However, particles may contribute to the chemical-associated toxicity of stormwater from the desorption of bound contaminants into the water. A previous study found that urban stormwater particles released toxic quantities of unidentified materials into clean seawater in less than 24 hours (Noblet *et al.* 2001).

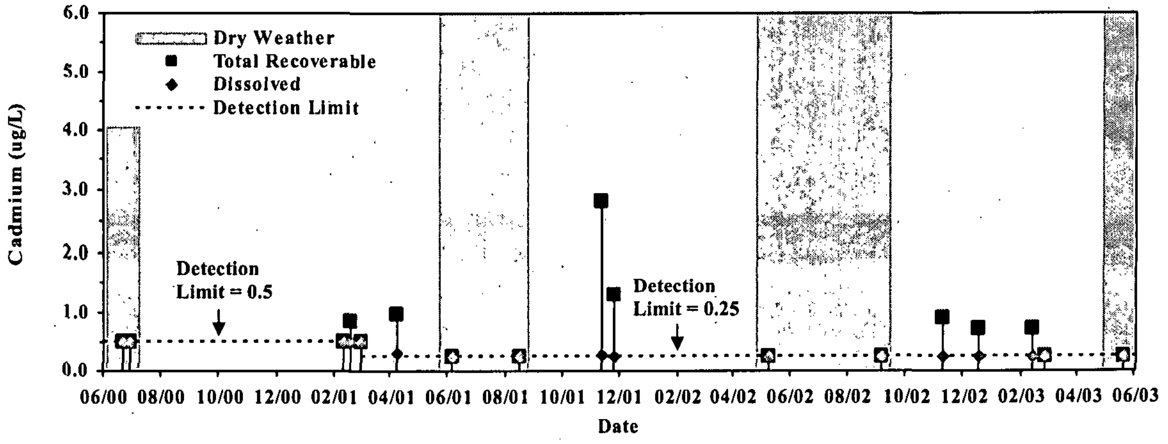
Correlation analysis of the toxicity and chemistry data provides an additional test of the association between stormwater toxicity and chemical contamination. The data from all three years of monitoring were pooled for the correlation analyses, except for the test using diazinon, which was detected only in the second and third years of monitoring. The correlation analyses confirm the results from the first year of study: that the toxic responses measured in this study are related to the chemical composition of the stormwater samples. The toxic responses of sea urchins and/or water fleas were significantly correlated with increased concentrations of several stormwater constituents, including dissolved metals, TSS, TDS and TOC (Table 9.8). Dissolved lead, nickel and zinc were significantly correlated with toxicity to both species. As in last years report, zinc showed the strongest correlation with reduced sea urchin fertilization, closely followed by copper. Lead and nickel were also significantly correlated with sea urchin fertilization. These results differed from those obtained using only the first two years of monitoring data, which showed significant correlations only with dissolved copper and zinc.

A larger number of constituents were significantly correlated with toxicity to the water flea, including TSS, TOC, and dissolved metals including lead, nickel and zinc (Table 9.8). Increased concentrations of the OP pesticide diazinon had correlations with water flea toxicity ($r=0.22$ to 0.24) that were reduced from the values reported in 2001/2002 ($r=0.54$). The association was clearly not statistically significant, perhaps due to the small number of data points available and/or the high frequency of samples in which diazinon was not detected.

The presence of significant correlations between toxicity and selected chemicals generally supports the TIE results and provides information to help identify key constituents of concern, but the statistical results do not prove that those constituents are the cause of toxicity. The true cause of toxicity may be another (possibly unmeasured) constituent that has a similar pattern of occurrence in the samples.

A third method, comparing the measured and predicted toxic units of the samples was used to assess the importance of zinc, copper, and pesticides as a cause of the toxicity of Long Beach stormwater. The predicted toxicity of the sample was calculated from the measured concentrations of the chemical constituents and their corresponding EC50 or LC50. This toxic unit comparison showed that all three stormwater samples that produced toxicity to sea urchins contained sufficient dissolved zinc and copper to account for all of the sea urchin toxicity measured (Figure 9.14). Note that the predicted toxicity of the toxic samples was markedly higher than that of the remaining stormwater samples. These results were similar to those obtained for the monitoring data from the first two years.

Comparison of the measured and predicted toxic units for the water flea tests (Figure 9.15) showed a different pattern from that obtained for the sea urchin tests. The toxicity of two of the four samples containing substantial toxicity could be accounted for by the measured concentrations of diazinon and chlorpyrifos. While zinc was estimated to contribute ≤1 toxic unit, the addition of zinc toxicity to the predicted pesticide toxic units for the second storm sample from Los Cerritos could account for all of the measured toxicity. The measured concentrations of OP pesticides and zinc accounted for only about 70% of the toxicity of the first Belmont Pump Station sample, suggesting that additional unmeasured toxicants are present. Alternatively, the undetected poor recovery of chemical analytes or losses during storage may have reduced the measured concentrations of some constituents and resulted in low predicted toxicity values.



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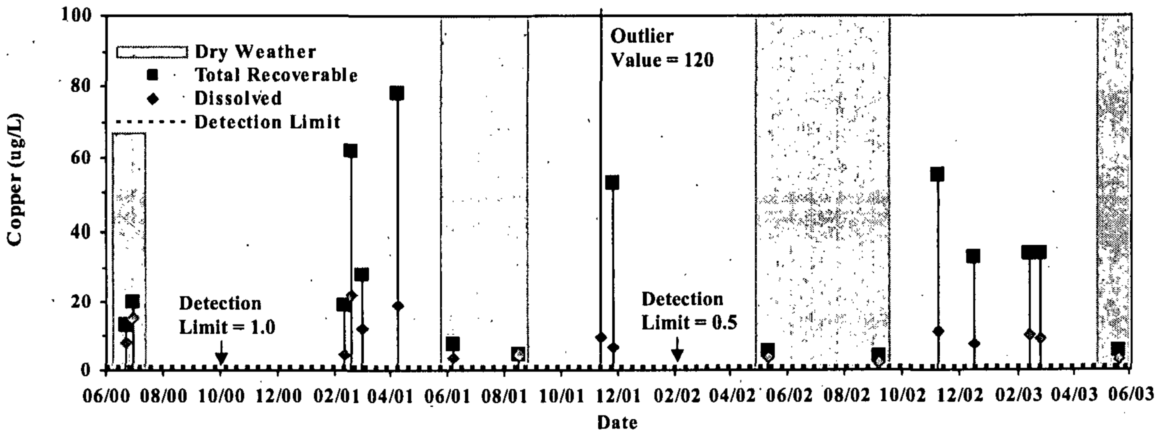

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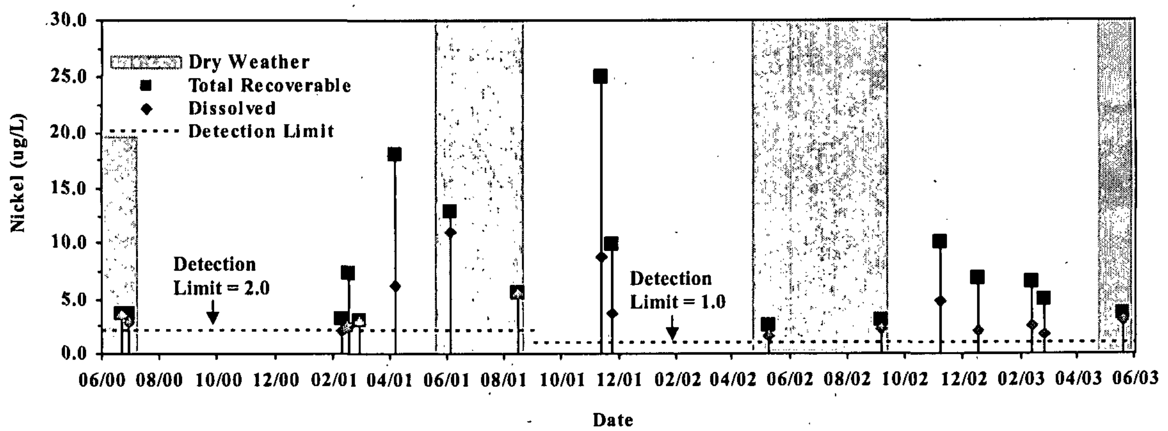
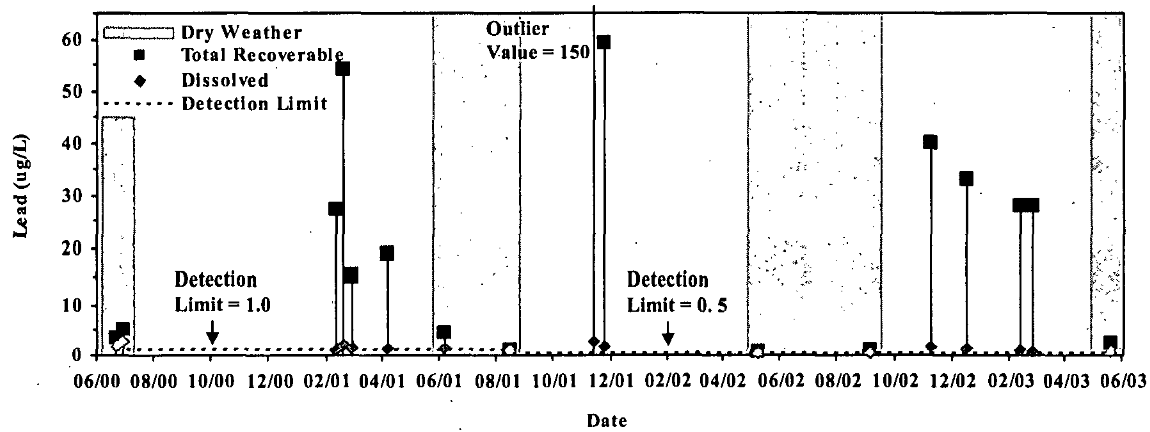


c)

Figure 9.1 Belmont Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



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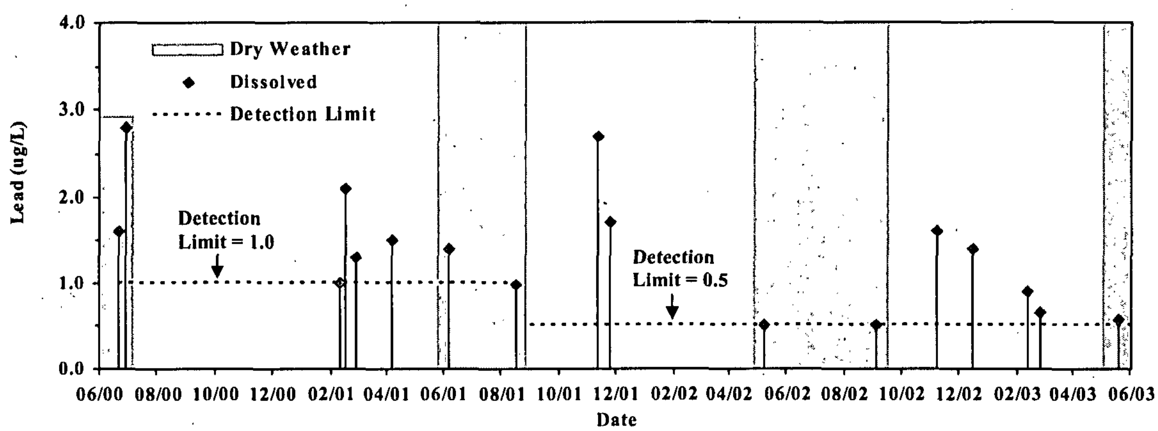

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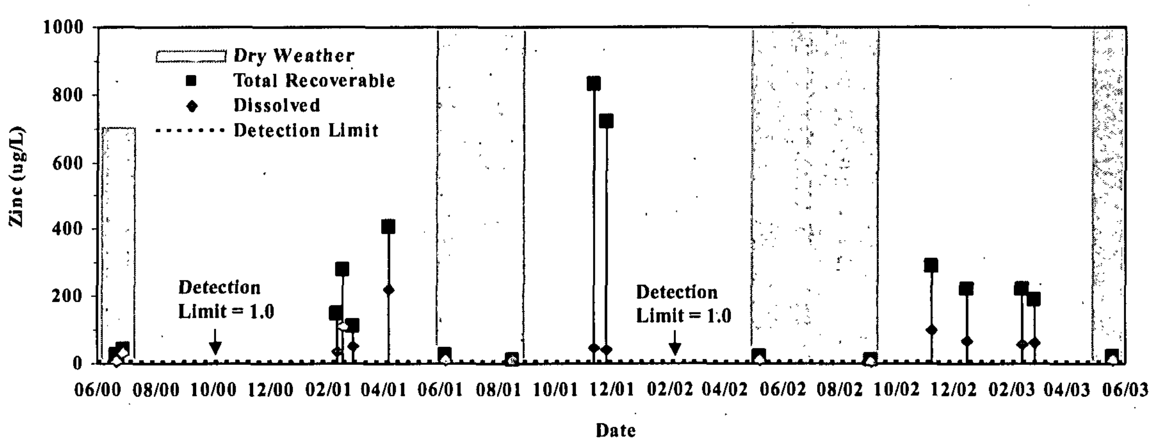
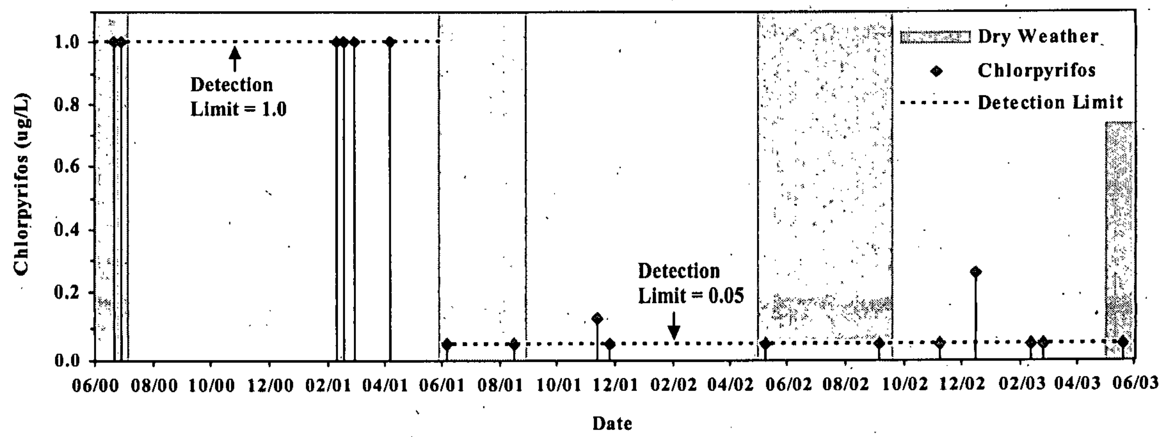


c)

Figure 9.2 Belmont Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.



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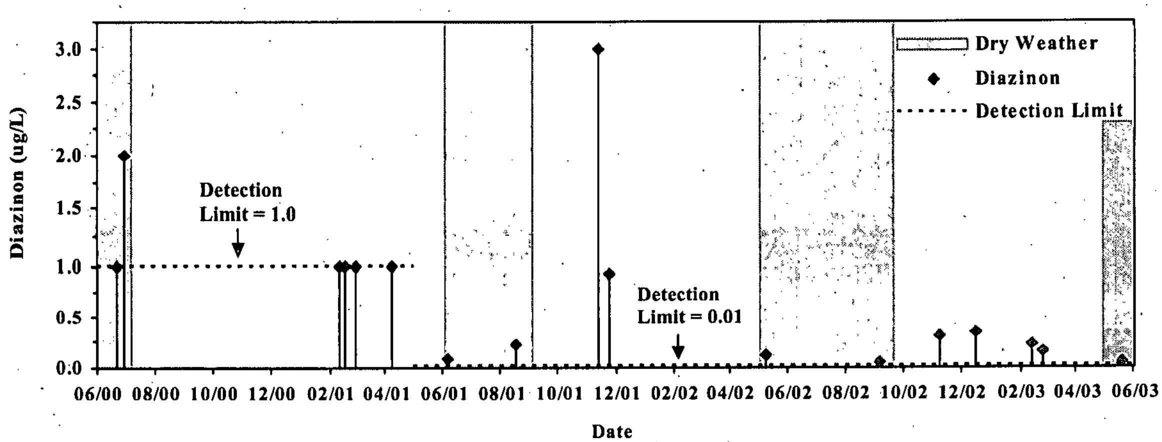


b)

Figure 9.3 **Belmont Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon.**

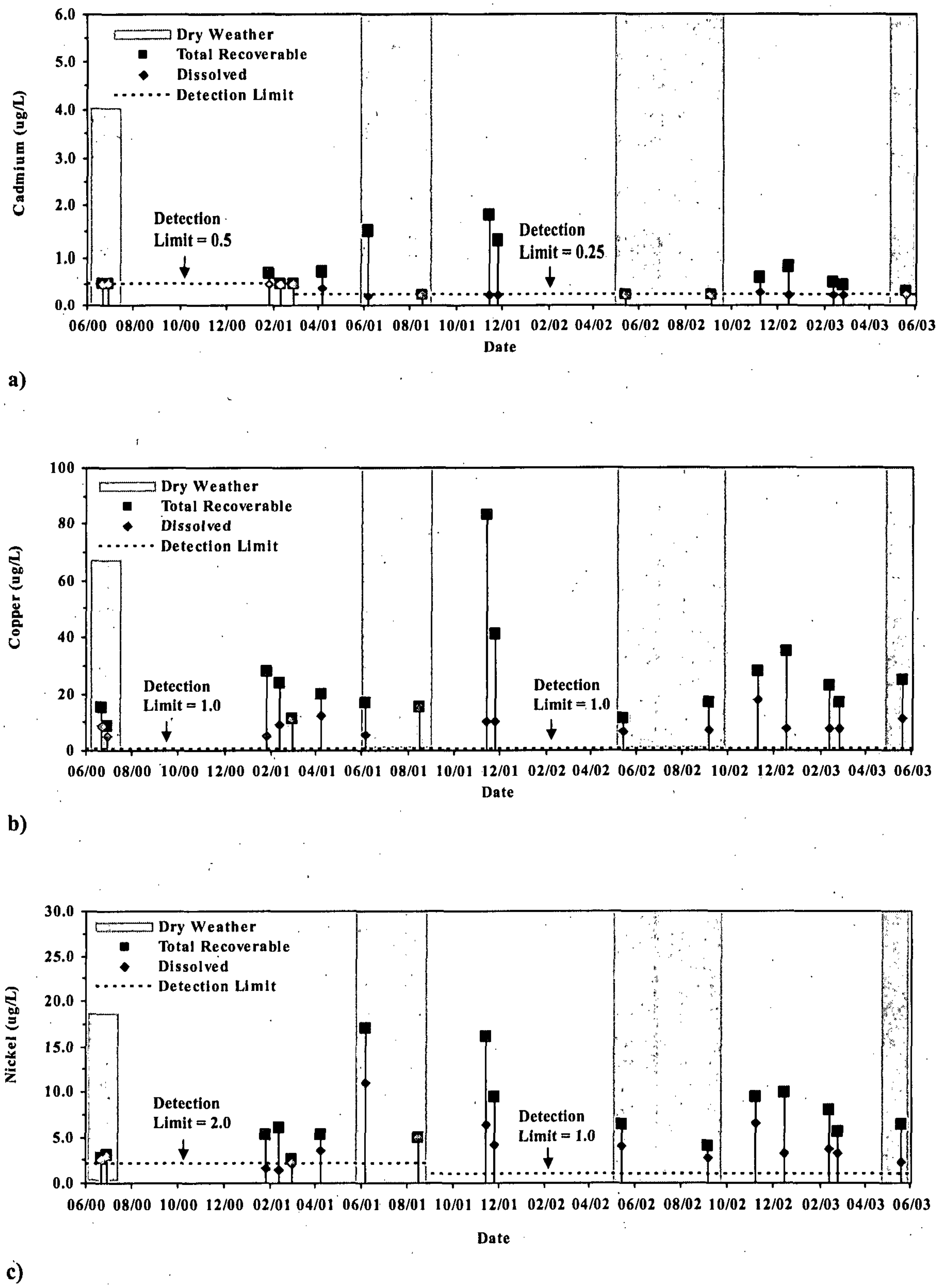
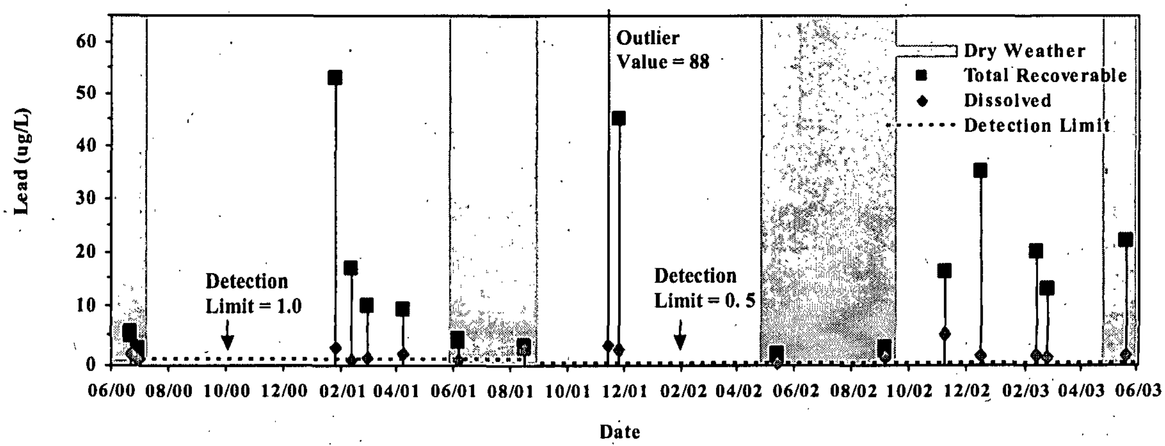


Figure 9.4 Bouton Creek Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



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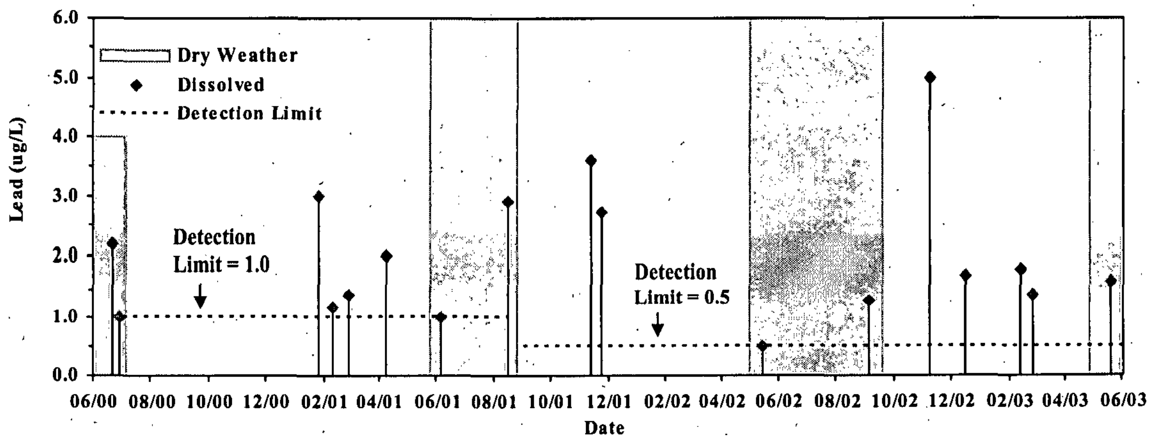

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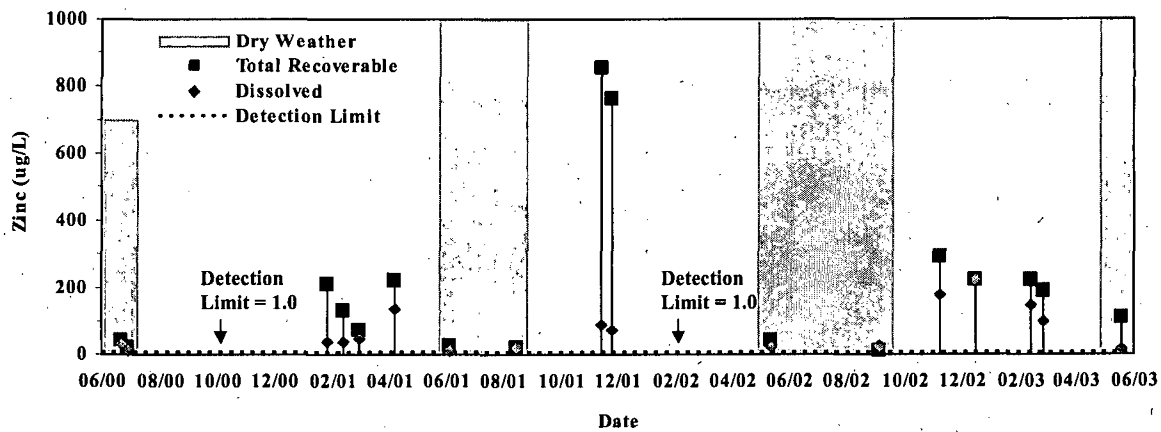
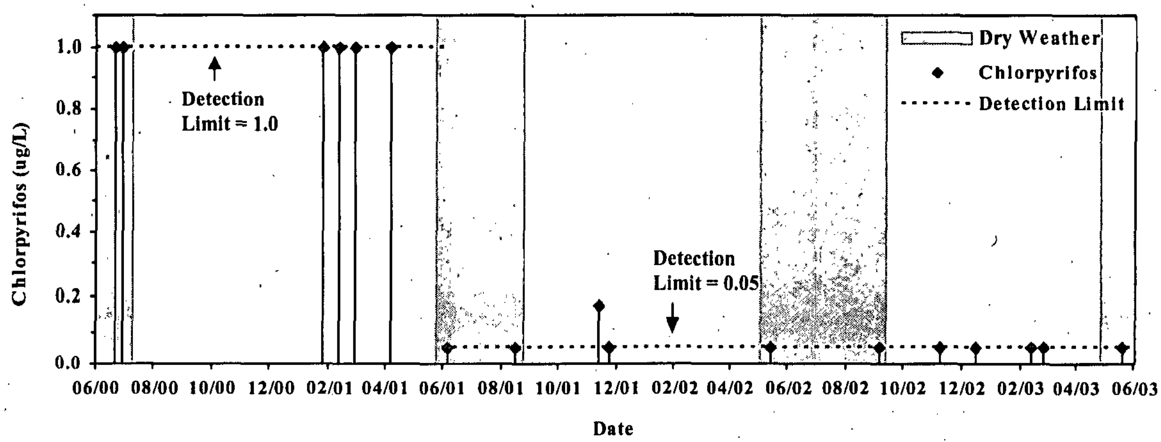


c)

Figure 9.5 **Bouton Creek Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**



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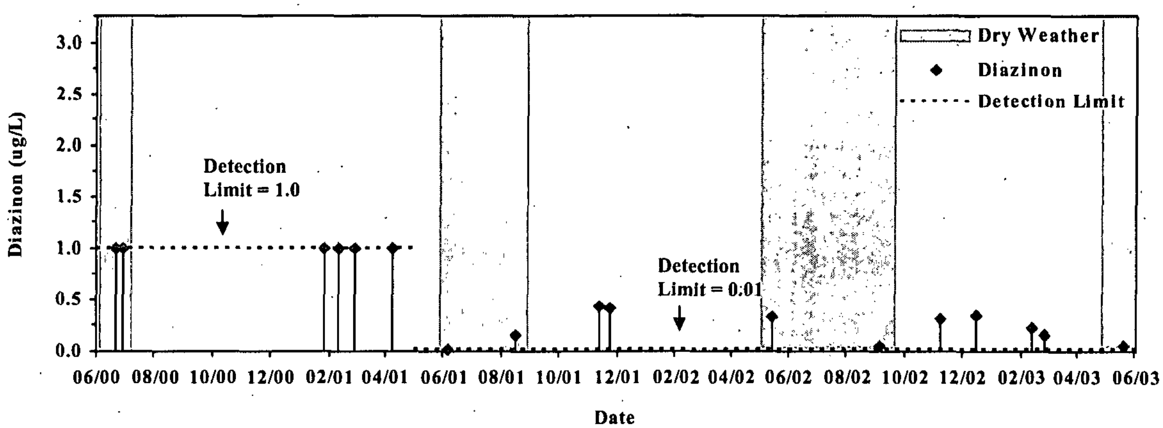


b)

Figure 9.6 Bouton Creek Chemistry Results: a) Chlorpyrifos; b) Diazinon.

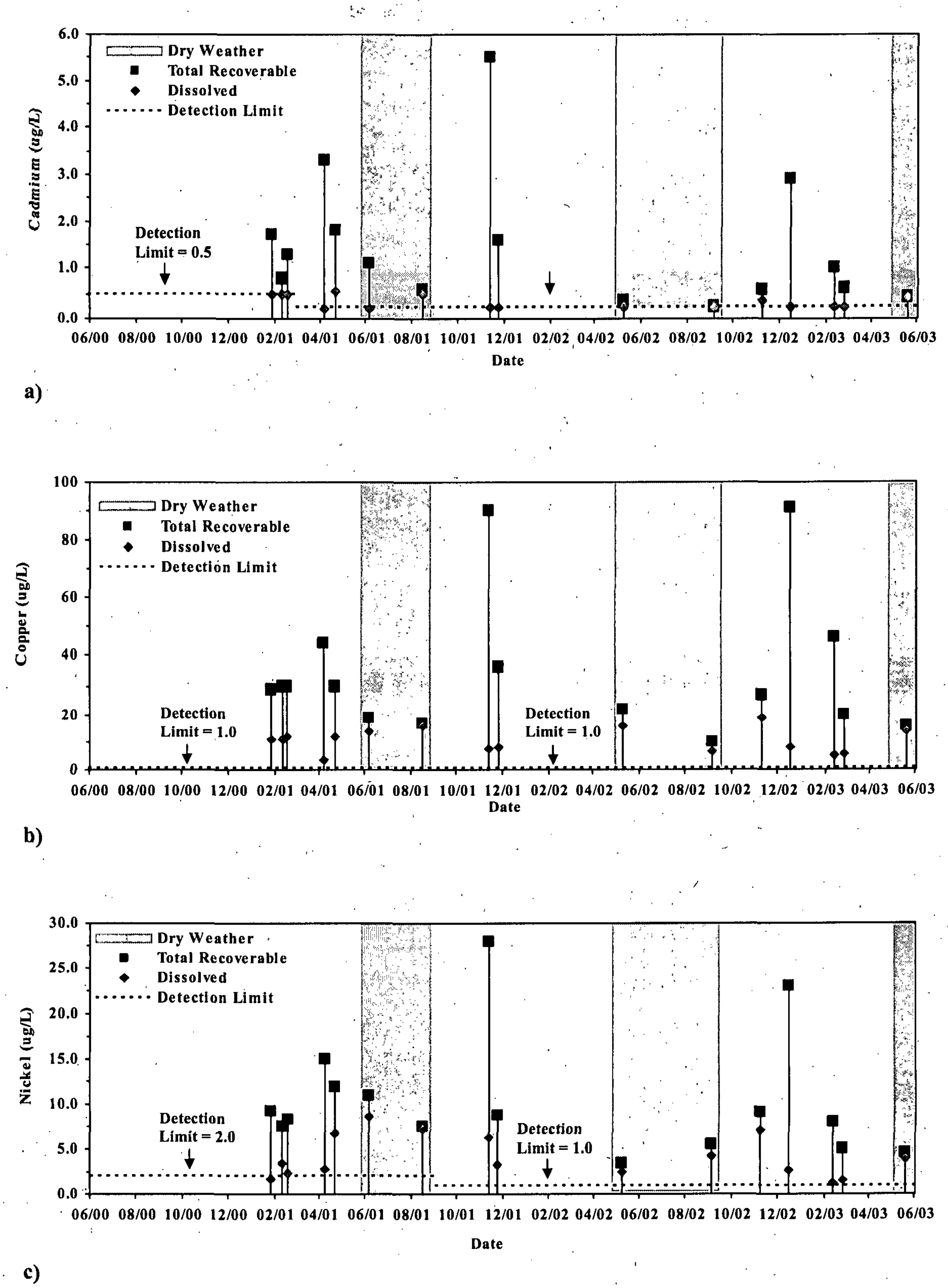
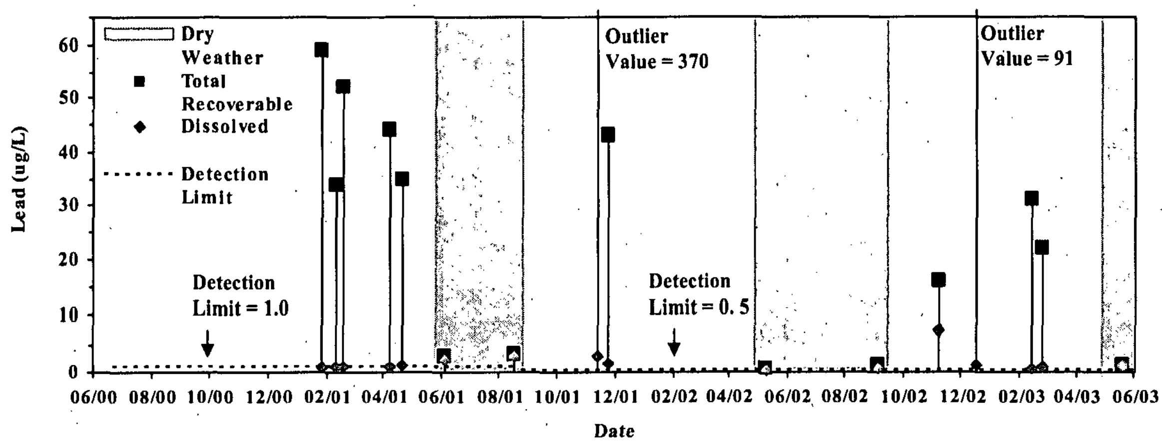
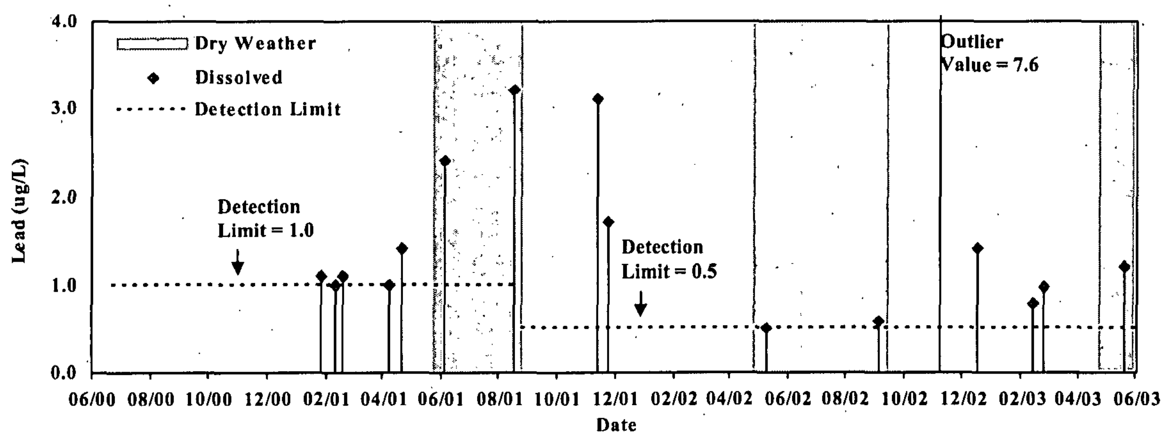


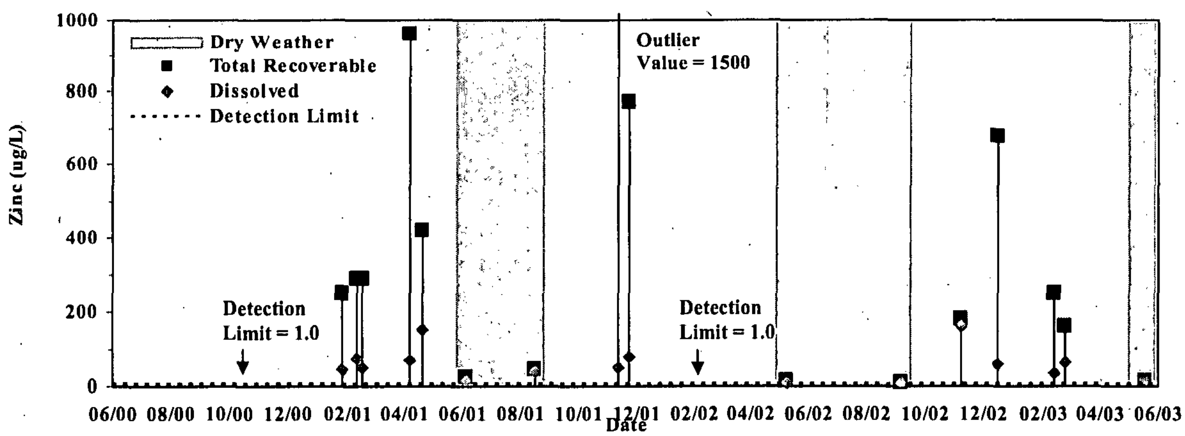
Figure 9.7 Los Cerritos Channel Chemistry Results: a) Cadmium; b) Copper; c) Nickel.



a)

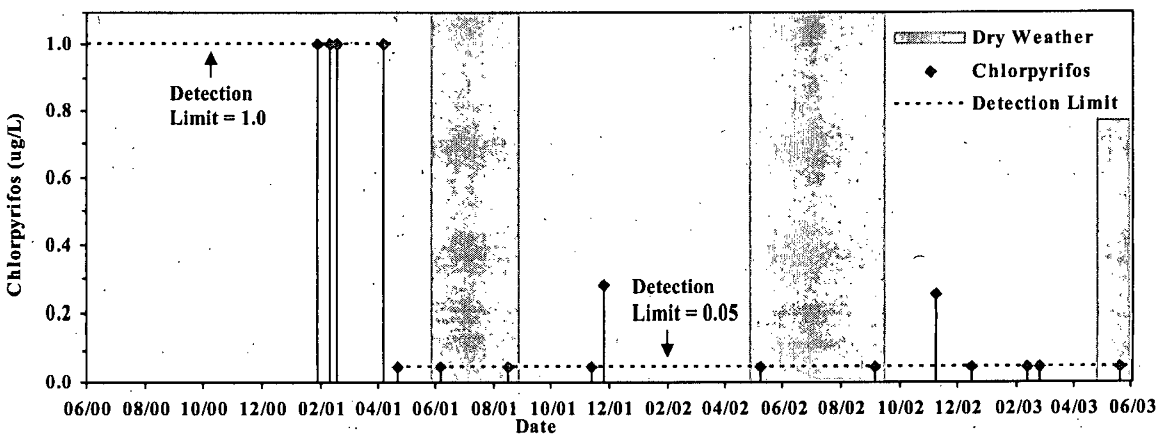


b)

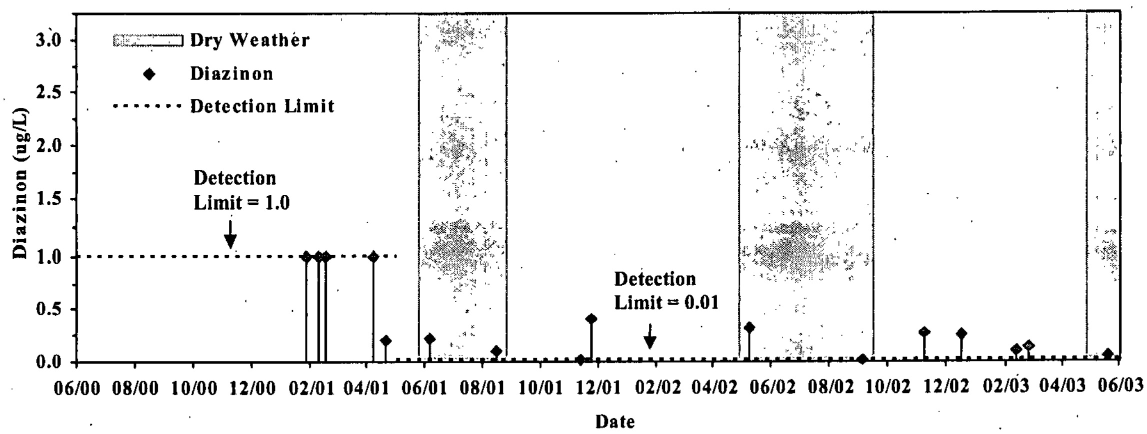


c)

Figure 9.8 **Los Cerritos Channel Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**

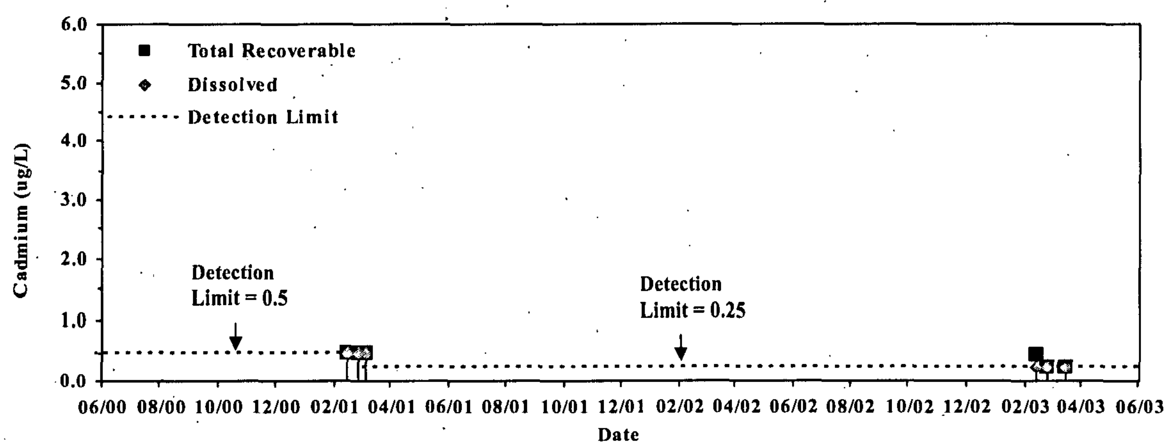


a)

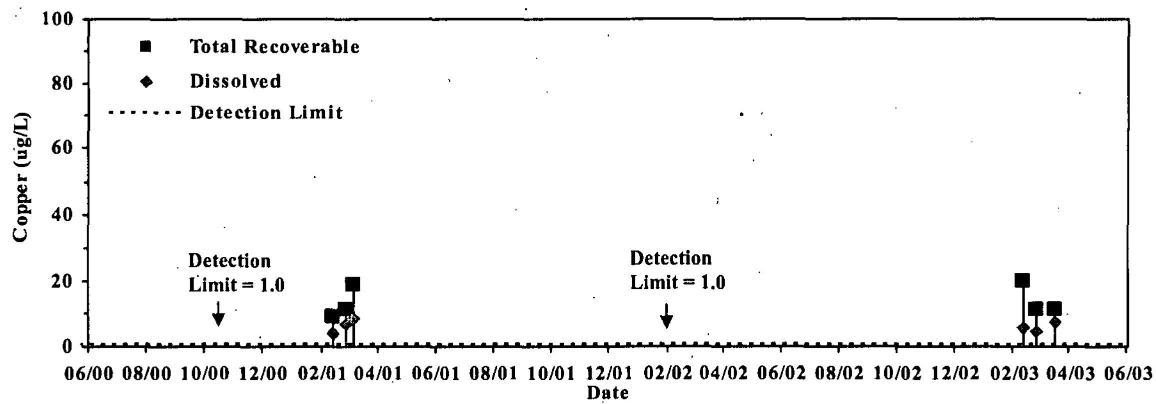


b)

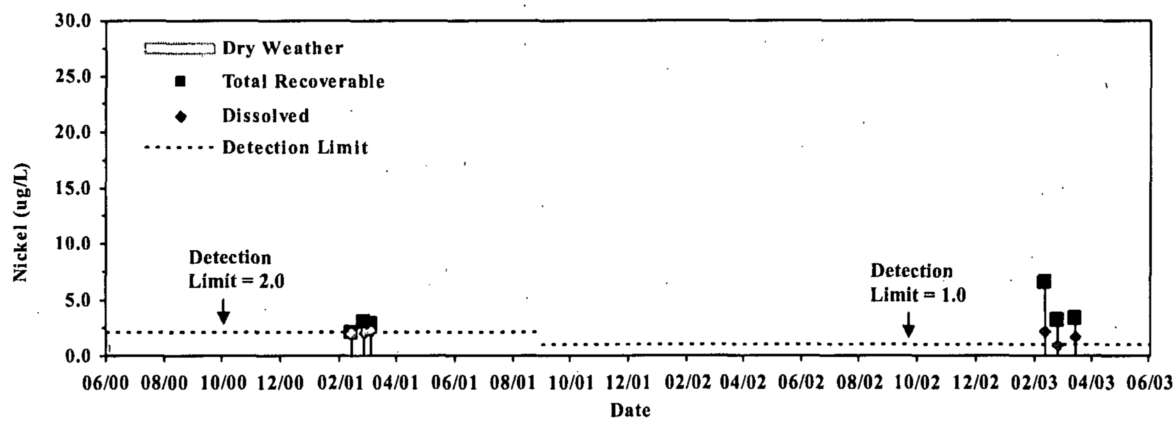
Figure 9.9 Los Cerritos Channel Chemistry Results: a) Chlorpyrifos; b) Diazinon.



a)

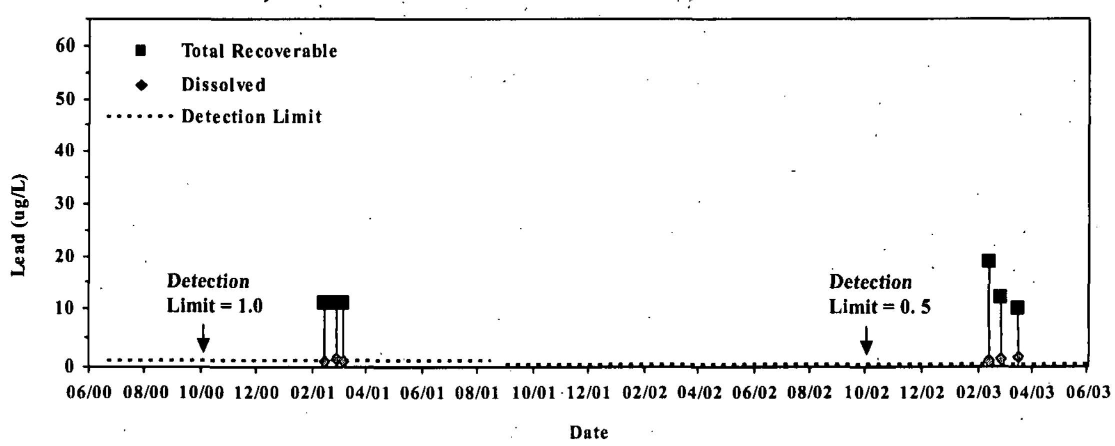


b)

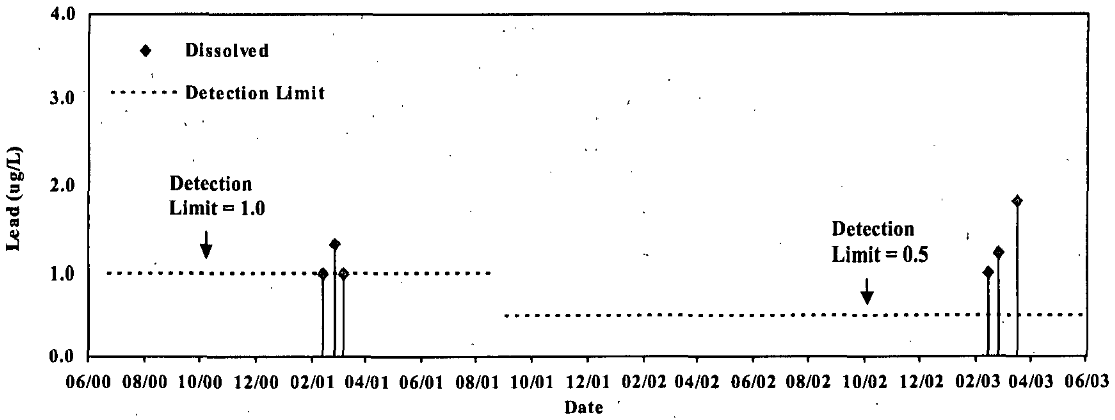


c)

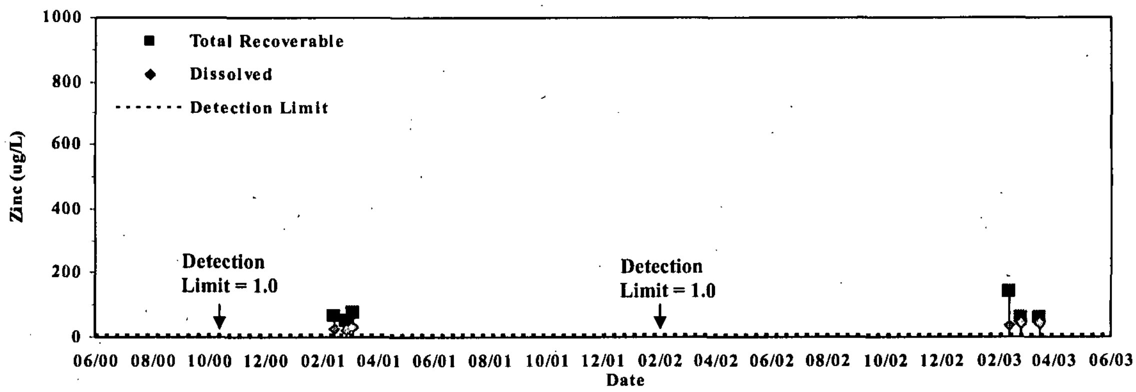
Figure 9.10 **Dominguez Gap Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel.**



a)

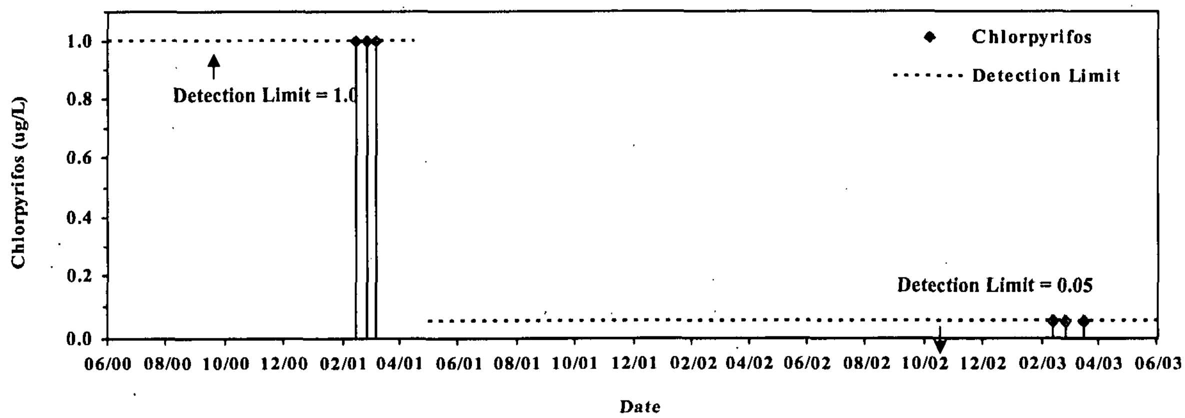


b)

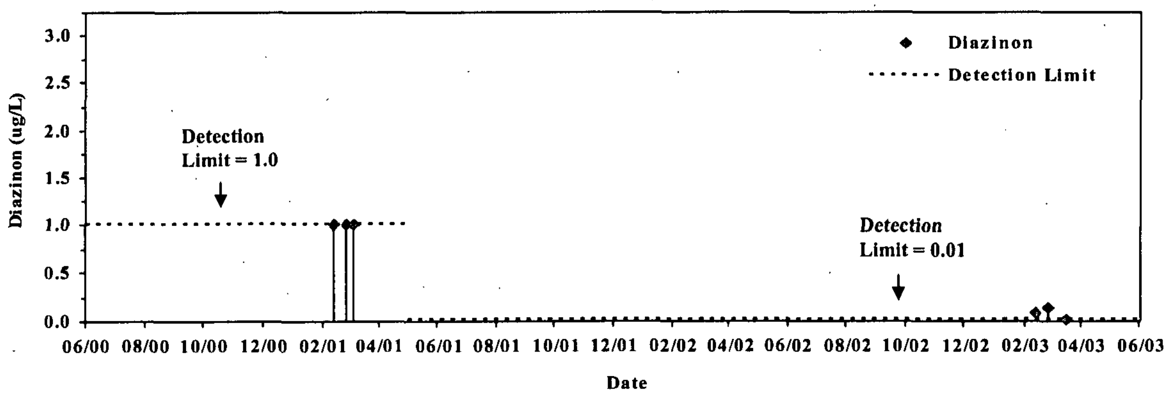


c)

Figure 9.11 **Dominguez Gap Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**



a)



b)

Figure 9.12 Dominguez Gap Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon.

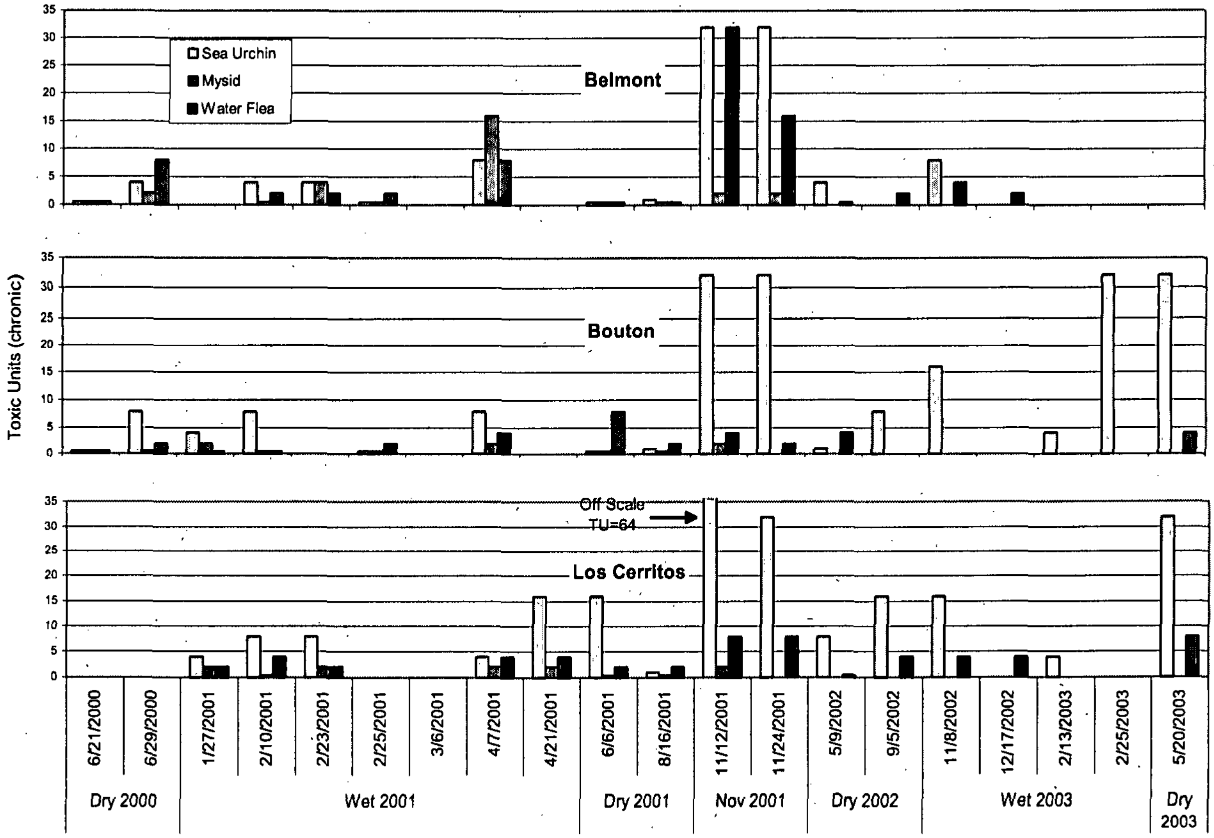


Figure 9.13 Summary of Wet and Dry Weather Toxicity Results for all Long Beach Samples.

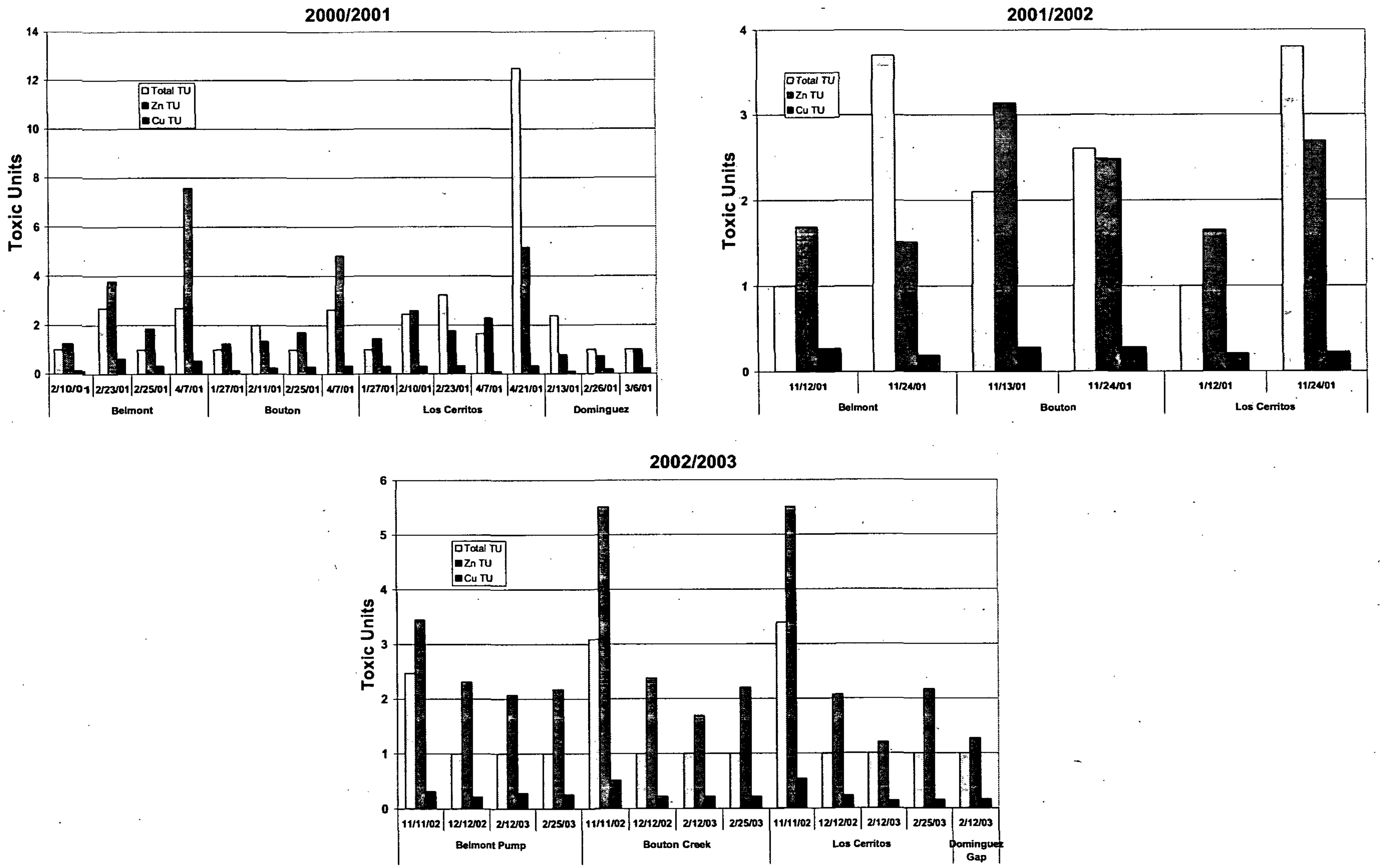


Figure 9.14 **Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples.** Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50>100%.

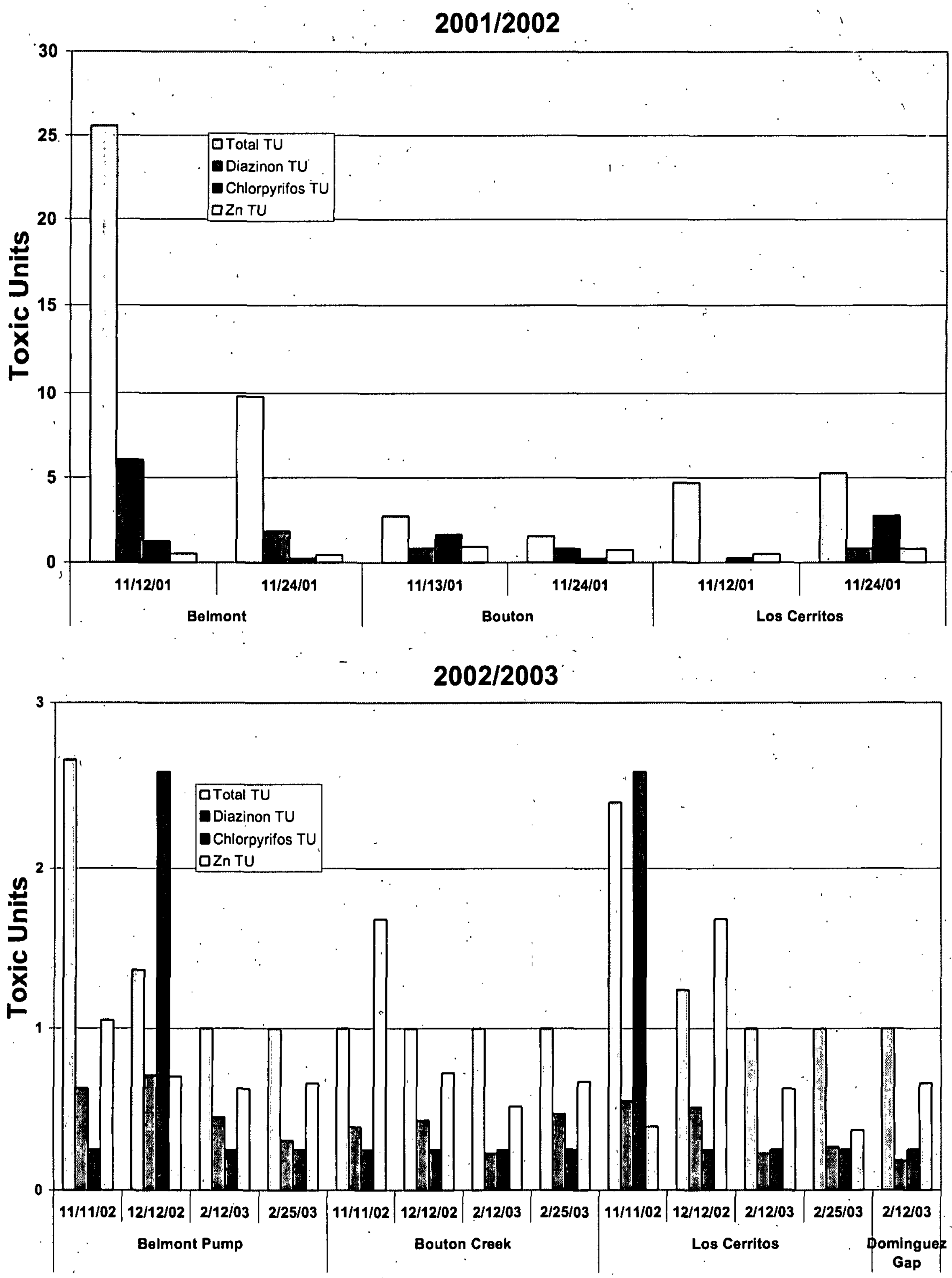


Figure 9.15 Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentration of Chlorpyrifos, Diazinon and Dissolved Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/nontoxic samples having an estimated EC50 of >100.

Table 9.1 Summary of Beneficial Uses for Receiving Water Bodies Associated with each Monitoring Location[1]

DISCHARGE LOCATION	HYDRO. UNIT	COMM	EST	GWR	IND	MAR	MUN	NAV	RARE	REC1	REC2	SHELL	WARM	WET	WILD
Bouton Creek	405.15						P			P	I		I		E
Los Cerritos Channel	405.15						P			P	I		I		E
Dominguez Gap Pump Sta.	405. 15			E	P		P			E	E		E		P
Belmont Pump Sta./Alamitos Bay	405.12	E	E		E	E		E	E	E	E	E		E	E

1. Source: California Regional Water Quality Control Board, Los Angeles Region. 1994. Water Quality Control Plan, Los Angeles Region, Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. P=Potential, E=Existing, and I=Intermittent

Commercial and Sport Fishing (COMM): Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Estuarine Habitat (EST): Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Ground Water Recharge (GWR): Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Industrial Service Supply (IND): Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Marine Habitat (MAR): Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation, such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Municipal and Domestic Supply (MUN): Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water.

Navigation (NAV): Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Rare, Threatened, or Endangered Species (RARE): Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Water Contact Recreation (REC-1): Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2): Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sun bathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Shellfish Harvesting (SHELL): Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

Warm Freshwater Habitat (WARM): Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Wetland Habitat (WET): Uses if water that support wetland ecosystems including, but not limited to, preservation or enhancement of wetland habitats, vegetation, fish, shellfish, or wildlife, and other unique wetland functions which enhance water quality, such as providing flood and erosion control, stream bank stabilization, and filtration and purification of naturally occurring contaminants.

Wildlife Habitat (WILD): Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., Mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards

Bouton Creek			Guidelines and Standards					Mass Emission				
Class Constituent	**ML**	**Units**	**Ocean Plan 2001[d]**	**Basin Plan**	**AB411**	**CTR (saltwater)[b]**	**CTR (freshwater)[a,b]**	**No. of Samples**	**No. of Nondetects[c]**	**Percent Detects**	**No. of Exceed.**	**Percent Exceed.**
CONVENTIONALS												
BOD	4	mg/l						4	1	75		
COD	4-900	mg/l						4	0	100		
EC								4	0	100		
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	2	50
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	0	100		
Fluoride	0.1	mg/l						4	0	100		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P.	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	0	100	0	0
TRPH	5	mg/l						4	4	0		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)

Bouton Creek			Guidelines and Standards					Mass Emission					
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.	
BACTERIA (mpn/100ml)													
Enterococcus	<20	MPN/100ml			104 (instantaneous)			4	0	100	3	75	Listed
Fecal Coliform	<20	MPN/100ml	400 (instantaneous)	200	400 (instantaneous)			4	0	100	4	100	
Total Coliform	<20	MPN/100ml	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100	
TOTAL METALS													
Aluminum	25	ug/L		1000				4	0	100	4	100	
Antimony	0.5	ug/L	220[h]	6				4	0	100	0	0	
Arsenic	0.5	ug/L	32	50				4	0	100	0	0	
Beryllium	0.5	ug/L	0.033[h]	4				4	4	0	0	0	
Cadmium	0.25	ug/L	4	5				4	0	100	0	0	
Chromium	0.5	ug/L		50				4	0	100	0	0	
Hex Chromium	20	ug/L	8				11	3	3	0	0	0	
Copper	0.5	ug/L	12					4	0	100	4	100	Listed
Iron	25	ug/L						4	0	100			
Mercury	0.2	ug/L	0.16	2				4	4	0	0	0	
Nickel	1	ug/L	20	100				4	0	100	0	0	
Lead	0.5	ug/L	8					4	0	100	4	100	Listed
Selenium	1	ug/L	60	50				4	4	0	0	0	
Silver	0.25	ug/L	2.8					4	2	50	0	0	
Thallium	1	ug/L	2.0[h]	2				4	4	0	0	0	
Zinc	1	ug/L	80					4	0	100	4	100	Listed
DISSOLVED METALS													
Aluminum	25	ug/L						4	1	75			
Antimony	0.5	ug/L						4	0	100			
Arsenic	0.5	ug/L				36	150	4	0	100	0	0	
Beryllium	0.5	ug/L						4	4	0			
Cadmium	0.25	ug/L				9.3	1.3	4	3	25	0	0	
Chromium	0.5	ug/L					100	4	0	100	0	0	
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100	Listed

Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)

Bouton Creek			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L						4	4	0		
Nickel	1	ug/L				8.2	29	4	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100
Selenium	1	ug/L				71	5.0[e]	4	4	0	0	0
Silver	0.25	ug/L					1.1[c]	4	4	0	0	0
Thallium	1	ug/L					1.2[c]	4	4	0	0	0
Zinc	1	ug/L				81	66	4	0	100	4	100
CHLORINATED PESTICIDES												
4,4'-DDD	0.05	ug/L						4	4	0		
4,4'-DDE	0.05	ug/L						4	4	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0
Aldrin	0.05	ug/L	0.000022[h]			1.3[c]	3[c]	4	4	0	0	0
alpha-BHC	0.05	ug/L						4	4	0		
alpha-Chlordane	0.5	ug/L						4	4	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
beta-BHC	0.05	ug/L						4	4	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
delta-BHC	0.05	ug/L						4	4	0		
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0	0	0
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0
Endrin Aldehyde	0.01	ug/L						4	4	0		
Dieldrin	0.01	ug/L	0.00004[h]			0.0019	0.056	4	4	0	0	0
gamma-BHC	0.05	ug/L				0.95[c]	0.16[c]	4	4	0	0	0
gamma-Chlordane	0.5	ug/L						4	4	0		
Heptachlor	0.01	ug/L	0.00005[h]	0.01		0.0036	0.0038	4	4	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002[h]	0.01		0.0036	0.0038	4	4	0	0	0
Toxaphene	0.5	ug/L	0.00021[h]	3		0.0002	0.0002	4	4	0	0	0

Table 9.2 Comparison of Water Quality Measurements from Bouton Creek with Guidelines and Standards (continued)

Bouton Creek			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,h]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
AROCLORS												
Aroclor 1016	0.5	ug/L						4	4	0		
Aroclor 1221	0.5	ug/L						4	4	0		
Aroclor 1232	0.5	ug/L						4	4	0		
Aroclor 1242	0.5	ug/L						4	4	0		
Aroclor 1248	0.5	ug/L						4	4	0		
Aroclor 1254	0.5	ug/L						4	4	0		
Aroclor 1260	0.5	ug/L						4	4	0		
Total PCBs	0.5	ug/L						4	4	0		
ORGANOPHOSPHATE PESTICIDES												
Atrazine	1	ug/L		3				4	4	0	0	0
Chlorpyrifos	0.05	ug/L						4	4	0		
Cyanazine	1	ug/L						4	4	0		
Diazinon	0.01	ug/L						4	0	100		
Malathion	1	ug/L						4	4	0		
Prometryn	1	ug/L						4	4	0		
Simazine	1	ug/L		4				4	2	50	1	25
HERBICIDES												
2,4,5-TP (Silvex)	0.5	ug/L		50				4	4	0	0	0
2,4-D	1	ug/L		70				4	4	0	0	0
Glyphosate	5	ug/L		700				4	4	0	0	0

[a] Based on a hardness of 50 mg/L

[b] Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

[c] Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

[d] Criteria based on daily maximum

[e] Expressed as total recoverable

[f] ML= Minimum Level

[g] Non-detect refers to a lab result value that is below them minimum level

[h] Criteria based on 30 day average

Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards

Belmont Pump			Guidelines and Standards					Mass Emission				
Class Constituent	**ML**	**Units**	**Ocean Plan 2001[d]**	**Basin Plan**	**AB411**	**CTR (saltwater)[b]**	**CTR (freshwater)[a,b]**	**No. of Samples**	**No. of Nondetects[g]**	**Percent Detects**	**No. of Exceed.**	**Percent Exceed.**
CONVENTIONALS												
BOD	4	mg/l										
COD	4-900	mg/l										
EC												
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	1	25
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	4	100		
Fluoride	0.1	mg/l						4	1	75		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	4	0	0	0
TRPH	5	mg/l						4	0	100		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)

Belmont Pump			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
BACTERIA (mpn/100ml)												
Enterococcus	<20	MPN/100ml			104 (instantaneous)			4	0	100	3	75
Fecal Coliform	<20	MPN/100ml	400 (instantaneous)		400 (instantaneous)			4	0	100	4	100
Total Coliform	<20	MPN/100ml	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100
TOTAL METALS												
Aluminum	25	ug/L		1000				4	0	100	4	100
Antimony	0.5	ug/L	220[h]	6				4	0	100	0	0
Arsenic	0.5	ug/L	32	50				4	0	100	0	0
Beryllium	0.5	ug/L	0.033[h]	4				4	4	0	0	0
Cadmium	0.25	ug/L	4	5				4	1	75	0	0
Chromium	0.5	ug/L		50				4	0	100	0	0
Hex Chromium	20	ug/L	8					3	3	0	0	0
Copper	0.5	ug/L	12					4	0	100	4	100
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L	0.16	2				4	4	0	4	100
Nickel	1	ug/L	20	100				4	0	100	0	0
Lead	0.5	ug/L	8					4	0	100	4	100
Selenium	1	ug/L	60	50				4	4	0	0	0
Silver	0.25	ug/L	2.8					4	3	25	0	0
Thallium	1	ug/L	2.0[h]	2				4	4	0	0	0
Zinc	1	ug/L	80					4	0	100	4	100
DISSOLVED METALS												
Aluminum	25	ug/L						4	1	75		
Antimony	0.5	ug/L						4	0	100		
Arsenic	0.5	ug/L				36	150	4	0	100	0	0
Beryllium	0.5	ug/L						4	4	0		
Cadmium	0.25	ug/L				9.3	1.3	4	4	0	0	0
Chromium	0.5	ug/L					100	4	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100

Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)

Belmont Pump			Guidelines and Standards					Mass Emission					
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.	
Iron	25	ug/L						4	0	100			
Mercury	0.2	ug/L						4	4	0			
Nickel	1	ug/L				8.2	29	4	0	100	0	0	
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100	Listed
Selenium	1	ug/L				71	5.0[e]	4	4	0	0	0	
Silver	0.25	ug/L					1.1[c]	4	4	0	0	0	
Thallium	1	ug/L					1.2[c]	4	4	0	0	0	
Zinc	1	ug/L				81	66	4	0	100	4	100	Listed
CHLORINATED PESTICIDES													
4,4'-DDD	0.05	ug/L						4	4	0			
4,4'-DDE	0.05	ug/L						4	4	0			
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0	
Aldrin	0.05	ug/L	0.000022[h]			1.3 [c]	3 [c]	4	4	0	0	0	
alpha-BHC	0.05	ug/L						4	4	0			
alpha-Chlordane	0.5	ug/L						4	4	0			
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0	
beta-BHC	0.05	ug/L						4	4	0			
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0	
delta-BHC	0.05	ug/L						4	4	0			
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0			
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0	
Endrin Aldehyde	0.01	ug/L						4	4	0			
Dieldrin	0.01	ug/L	0.00004[h]			0.0019	0.056	4	3	25	1	25	
gamma-BHC	0.05	ug/L				0.95 [c]	0.16[c]	4	4	0	0	0	
gamma-Chlordane	0.5	ug/L						4	4	0			
Heptachlor	0.01	ug/L	0.00005[h]	0.01		0.0036	0.0038	4	4	0	0	0	
Heptachlor Epoxide	0.01	ug/L	0.00002[h]	0.01		0.0036	0.0038	4	4	0	0	0	
Toxaphene	0.5	ug/L	0.00021[h]	3		0.0002	0.0002	4	4	0	0	0	

Table 9.3 Comparison of Water Quality Measurements from Belmont Pump Station with Guidelines and Standards (continued)

Belmont Pump			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
AROCLORS								4	4	0		
Aroclor 1016	0.5	ug/L						4	4	0		
Aroclor 1221	0.5	ug/L						4	4	0		
Aroclor 1232	0.5	ug/L						4	4	0		
Aroclor 1242	0.5	ug/L						4	4	0		
Aroclor 1248	0.5	ug/L						4	4	0		
Aroclor 1254	0.5	ug/L						4	4	0		
Aroclor 1260	0.5	ug/L						4	4	0		
Total PCBs	0.5	ug/L						4	4	0		
ORGANOPHOSPHATE PESTICIDES												
Atrazine	1	ug/L		3				4	4	0	0	0
Chlorpyrifos	0.05	ug/L						4	3	25		
Cyanazine	1	ug/L						4	4	0		
Diazinon	0.01	ug/L						4	0	100		
Malathion	1	ug/L						4	3	25		
Prometryn	1	ug/L						4	4	0		
Simazine	1	ug/L		4				4	4	0	0	0
HERBICIDES								4	4	0		
2,4,5-TP (Silvex)	0.5	ug/L		50				4	4	0	0	0
2,4-D	1	ug/L		70				4	4	0	0	0
Glyphosate	5	ug/L		700				4	4	0	0	0

[a] Based on a hardness of 50 mg/L

[b] Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

[c] Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

[d] Criteria based on daily maximum

[e] Expressed as total recoverable

[f] ML= Minimum Level

[g] Non-detect refers to a lab result value that is below them minimum level

[h] Criteria based on 30 day average

Table 9.4 **Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards**

Los Cerritos Channel			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
CONVENTIONALS												
BOD	4	mg/l						4	2	50		
COD	4-900	mg/l						4	0	100		
EC								4	0	100		
TOC	1	mg/l						4	0	100		
Hardness	1	mg/l						4	0	100		
Alkalinity	5	mg/l						4	0	100		
pH	0-14			<6.5 & >8.5				4	0	100	2	50
Cyanide	0.005	mg/l	0.004	0.2			0.0052	4	4	0	0	0
Chloride	1	mg/l						4	0	100		
Fluoride	0.1	mg/l						4	1	75		
TKN	0.1	mg/l						4	0	100		
Ammonia as N	0.1	mg/l	2.4					4	0	100	0	0
Nitrite N	0.01	mg/l						4	4	0		
Nitrate N	0.01	mg/l						4	0	100		
Total P	0.05	mg/l						4	0	100		
Diss. P	0.01	mg/l						4	0	100		
MBAS	0.02	mg/l		0.5				4	0	100	0	0
MTBE	0.5	mg/l						4	4	0		
Total Phenols	0.1	mg/l						4	4	0		
Oil & Grease	5	mg/l	75					4	4	0	0	0
Turbidity	1	NTU	225					4	0	100	0	0
TRPH	5	mg/l						4	0	100		
TSS	1	mg/l	3					4	0	100	4	100
TDS	1	mg/l						4	0	100		
TVS	1	mg/l						4	1	75		

Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)

Los Cerritos Channel			Guidelines and Standards					Mass Emission				
Class Constituent	**ML**	**Units**	**Ocean Plan 2001[d]**	**Basin Plan**	**AB411**	**CTR (saltwater)[b]**	**CTR (freshwater)[a,b]**	**No. of Samples**	**No. of Nondetects[g]**	**Percent Detects**	**No. of Exceed.**	**Percent Exceed.**
BACTERIA (mpn/100ml)												
Enterococcus	<20	MPN/100ml			104 (instantaneous)			4	0	100	4	100
Fecal Coliform	<20	MPN/100ml	400 (instantaneous)	200	400 (instantaneous)			4	0	100	4	100
Total Coliform	<20	MPN/100ml	10,000 (instantaneous)		10,000 (instantaneous)			4	0	100	4	100
TOTAL METALS												
Aluminum	25	ug/L		1000				4	0	100	4	100
Antimony	0.5	ug/L	220h	6				4	0	100	1	25
Arsenic	0.5	ug/L	32	50				4	0	100	0	0
Beryllium	0.5	ug/L	0.033h	4				4	4	0	0	0
Cadmium	0.25	ug/L	4	5				4	0	100	0	0
Chromium	0.5	ug/L		50				4	0	100	0	0
Hex Chromium	20	ug/L	8					3	3	100	0	0
Copper	0.5	ug/L	12					4	0	100	4	100
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L	0.16	2				4	4	0	0	0
Nickel	1	ug/L	20	100				4	0	100	1	25
Lead	0.5	ug/L	8					4	0	100	4	100
Selenium	1	ug/L	60	50				4	4	0	0	0
Silver	0.25	ug/L	2.8					4	2	50	0	0
Thallium	1	ug/L	2.0h	2				4	4	0	0	0
Zinc	1	ug/L	80					4	0	100	4	100
DISSOLVED METALS												
Aluminum	25	ug/L						4	0	100		
Antimony	0.5	ug/L						4	0	100		
Arsenic	0.5	ug/L				36	150	4	0	100	0	0
Beryllium	0.5	ug/L						4	4	0		
Cadmium	0.25	ug/L				9.3	1.3	4	3	25	0	0
Chromium	0.5	ug/L					100	4	0	100	0	0
Copper	0.5	ug/L				3.1	5.0	4	0	100	4	100

Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)

Los Cerritos Channel			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
Iron	25	ug/L						4	0	100		
Mercury	0.2	ug/L						4	4	0		
Nickel	1	ug/L				8.2	29	4	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	4	0	100	4	100
Selenium	1	ug/L				71	5.0e	4	4	0	0	0
Silver	0.25	ug/L					1.1c	4	4	0	0	0
Thallium	1	ug/L					1.2c	4	4	0	0	0
Zinc	1	ug/L				81	66	4	0	100	4	100
CHLORINATED PESTICIDES												
4,4'-DDD	0.05	ug/L						4	4	0		
4,4'-DDE	0.05	ug/L						4	4	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	4	4	0	0	0
Aldrin	0.05	ug/L	0.000022h			1.3 c	3 c	4	4	0	0	0
alpha-BHC	0.05	ug/L						4	4	0		
alpha-Chlordane	0.5	ug/L						4	4	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
beta-BHC	0.05	ug/L						4	4	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	4	4	0	0	0
delta-BHC	0.05	ug/L						4	4	0		
Endosulfan Sulfate	0.05	ug/L	0.018					4	4	0	0	0
Endrin	0.01	ug/L	0.004	2		0.0023	0.036	4	4	0	0	0
Endrin Aldehyde	0.01	ug/L						4	4	0		
Dieldrin	0.01	ug/L	0.00004h			0.0019	0.056	4	3	25	1	25
gamma-BHC	0.05	ug/L				0.95 c	0.16c	4	3	25	0	0
gamma-Chlordane	0.5	ug/L						4	4	0		
Heptachlor	0.01	ug/L	0.00005h	0.01		0.0036	0.0038	4	4	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002h	0.01		0.0036	0.0038	4	4	0	0	0
Toxaphene	0.5	ug/L	0.00021h	3		0.0002	0.0002	4	4	0	0	0

Table 9.4 Comparison of Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards (continued)

Los Cerritos Channel			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
AROCLORS								4	4	0		
Aroclor 1016	0.5	ug/L						4	4	0		
Aroclor 1221	0.5	ug/L						4	4	0		
Aroclor 1232	0.5	ug/L						4	4	0		
Aroclor 1242	0.5	ug/L						4	4	0		
Aroclor 1248	0.5	ug/L						4	4	0		
Aroclor 1254	0.5	ug/L						4	4	0		
Aroclor 1260	0.5	ug/L						4	4	0		
Total PCBs	0.5	ug/L						4	4	0		
ORGANOPHOSPHATE PESTICIDES												
Atrazine	1	ug/L		3				4	4	0	0	0
Chlorpyrifos	0.05	ug/L						4	3	25		
Cyanazine	1	ug/L						4	4	0		
Diazinon	0.01	ug/L						4	0	100		
Malathion	1	ug/L						4	4	0		
Prometryn	1	ug/L						4	4	0		
Simazine	1	ug/L		4				4	2	50	1	25
HERBICIDES												
2,4,5-TP (Silvex)	0.5	ug/L		50				4	4	0	0	0
2,4-D	1	ug/L		70				4	4	0	0	0
Glyphosate	5	ug/L		700				4	3	25	0	0

[a] Based on a hardness of 50 mg/L

[b] Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

[c] Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

[d] Criteria based on daily maximum

[e] Expressed as total recoverable

[f] ML= Minimum Level

[g] Non-detect refers to a lab result value that is below them minimum level

[h] Criteria based on 30 day average

Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards.

Dominguez Pump			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
CONVENTIONALS												
BOD	4	mg/l						3	2	33		
COD	4-900	mg/l						3	0	100		
EC								3	0	100		
TOC	1	mg/l						3	0	100		
Hardness	1	mg/l						3	0	100		
Alkalinity	5	mg/l						3	0	100		
pH	0-14			<6.5 & >8.5				3	0	100	2	67
Cyanide	0.005	mg/l	0.004	0.2			0.0052	3	3	0	0	0
Chloride	1	mg/l						3	0	100		
Fluoride	0.1	mg/l						3	1	67		
TKN	0.1	mg/l						3	0	100		
Ammonia as N	0.1	mg/l	2.4					3	0	100	0	0
Nitrite N	0.01	mg/l						3	2	33		
Nitrate N	0.01	mg/l						3	0	100		
Total P	0.05	mg/l						3	0	100		
Diss. P	0.01	mg/l						3	0	100		
MBAS	0.02	mg/l		0.5				3	0	100	0	0
MTBE	0.5	mg/l						3	3	0		
Total Phenols	0.1	mg/l						3	3	0		
Oil & Grease	5	mg/l	75					3	3	0	0	0
Turbidity	1	NTU	225					3	0	100	0	0
TRPH	5	mg/l						2	2	0		
TSS	1	mg/l	3					3	0	100	3	100
TDS	1	mg/l						3	0	100		
TVS	1	mg/l						3	0	100		

Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)

Dominguez Pump			Guidelines and Standards					Mass Emission					
Class Constituent	**ML**	**Units**	**Ocean Plan 2001[d]**	**Basin Plan**	**AB411**	**CTR (saltwater)[b]**	**CTR (freshwater)[a,b]**	**No. of Samples**	**No. of Nondetects[g]**	**Percent Detects**	**No. of Exceed.**	**Percent Exceed.**	
BACTERIA (mpn/100ml)													
Enterococcus	<20	MPN/100ml			104 (instantaneous)			3	0	100	2	66	
Fecal Coliform	<20	MPN/100ml	400 (instantaneous)	200	400 (instantaneous)			3	0	100	3	100	
Total Coliform	<20	MPN/100ml	10,000 (instantaneous)		10,000 (instantaneous)			3	0	100	3	100	
TOTAL METALS													
Aluminum	25	ug/L		1000				3	0	100	3	100	
Antimony	0.5	ug/L	220[h]	6				3	0	100	0	0	
Arsenic	0.5	ug/L	32	50				3	0	100	0	0	
Beryllium	0.5	ug/L	0.033[h]	4				3	3	0	0	0	
Cadmium	0.25	ug/L	4	5				3	2	33	0	0	
Chromium	0.5	ug/L		50				3	0	100	0	0	
Hex Chromium	20	ug/L	8					3	3	0	0	0	
Copper	0.5	ug/L	12					3	0	100	1	33	
Iron	25	ug/L						3	0	100			
Mercury	0.2	ug/L	0.16	2				3	3	0	0	0	
Nickel	1	ug/L	20	100				3	0	100	0	0	
Lead	0.5	ug/L	8					3	0	100	3	100	Listed
Selenium	1	ug/L	60	50				3	3	0	0	0	
Silver	0.25	ug/L	2.8					3	3	0	0	0	
Thallium	1	ug/L	2.0[h]	2				3	3	0	0	0	
Zinc	1	ug/L	80					3	0	100	1	33	
DISSOLVED METALS													
Aluminum	25	ug/L						3	0	100			
Antimony	0.5	ug/L						3	1	67			
Arsenic	0.5	ug/L				36	150	3	0	100			
Beryllium	0.5	ug/L						3	3	0			
Cadmium	0.25	ug/L				9.3	1.3	3	3	0	0	0	
Chromium	0.5	ug/L					100	3	0	100	0	0	
Copper	0.5	ug/L				3.1	5.0	3	0	100	3	100	Listed

Table 9.5 **Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)**

Dominguez Pump			Guidelines and Standards					Mass Emission				
Class Constituent	**ML**	**Units**	**Ocean Plan 2001**[d]	**Basin Plan**	**AB411**	**CTR (saltwater)**[b]	**CTR (freshwater)**[a,b]	**No. of Samples**	**No. of Nondetects**[g]	**Percent Detects**	**No. of Exceed.**	**Percent Exceed.**
Iron	25	ug/L						3	0	100		
Mercury	0.2	ug/L						3	3	0		
Nickel	1	ug/L				8.2	29	3	0	100	0	0
Lead	0.5	ug/L				8.1	1.2	3	0	100	2	67
Selenium	1	ug/L				71	5.0[c]	3	3	0	0	0
Silver	0.25	ug/L					1.1[c]	3	3	0	0	0
Thallium	1	ug/L					1.2[c]	3	3	0	0	0
Zinc	1	ug/L				81	66	3	0	100	2	67
CHLORINATED PESTICIDES												
4,4'-DDD	0.05	ug/L						3	3	0		
4,4'-DDE	0.05	ug/L						3	3	0		
4,4'-DDT	0.01	ug/L				0.001	0.001	3	3	0	0	0
Aldrin	0.05	ug/L	0.000022[h]			1.3 [c]	3 [c]	3	3	0	0	0
alpha-BHC	0.05	ug/L						3	3	0		
alpha-Chlordane	0.5	ug/L						3	3	0		
alpha-Endosulfan	0.05	ug/L				0.0087	0.056	3	3	0	0	0
beta-BHC	0.05	ug/L						3	3	0		
beta-Endosulfan	0.05	ug/L				0.0087	0.056	3	3	0	0	0
delta-BHC	0.05	ug/L						3	3	0		
Endosulfan Sulfate	0.05	ug/L	0.018					3	3	0		
Endrin	0.01	ug/L	0.004			0.0023	0.036	3	3	0	0	0
Endrin Aldehyde	0.01	ug/L						3	3	0		
Dieldrin	0.01	ug/L	0.00004[h]			0.0019	0.056	3	3	0	0	0
gamma-BHC	0.05	ug/L				0.95 [c]	0.16[c]	3	3	0	0	0
gamma-Chlordane	0.5	ug/L						3	3	0		
Heptachlor	0.01	ug/L	0.00005[h]			0.0036	0.0038	3	3	0	0	0
Heptachlor Epoxide	0.01	ug/L	0.00002[h]			0.0036	0.0038	3	3	0	0	0
Toxaphene	0.5	ug/L	0.00021[h]			0.0002	0.0002	3	3	0	0	0

Table 9.5 Comparison of Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)

Dominguez Pump			Guidelines and Standards					Mass Emission				
Class Constituent	ML	Units	Ocean Plan 2001[d]	Basin Plan	AB411	CTR (saltwater)[b]	CTR (freshwater)[a,b]	No. of Samples	No. of Nondetects[g]	Percent Detects	No. of Exceed.	Percent Exceed.
AROCLORS								3	3	0		
Aroclor 1016	0.5	ug/L						3	3	0		
Aroclor 1221	0.5	ug/L						3	3	0		
Aroclor 1232	0.5	ug/L						3	3	0		
Aroclor 1242	0.5	ug/L						3	3	0		
Aroclor 1248	0.5	ug/L						3	3	0		
Aroclor 1254	0.5	ug/L						3	3	0		
Aroclor 1260	0.5	ug/L						3	3	0		
Total PCB's	0.5	ug/L						3	3	0		
ORGANOPHOSPHATE PESTICIDES												
Atrazine	1	ug/L		3				3	3	0	0	0
Chlorpyrifos	0.05	ug/L						3	3	0		
Cyanazine	1	ug/L						3	3	0		
Diazinon	0.01	ug/L						3	0	100		
Malathion	1	ug/L						3	3	0		
Prometryn	1	ug/L						3	3	0		
Simazine	1	ug/L		4				3	1	67	0	0
HERBICIDES												
2,4,5-TP (Silvex)	0.5	ug/L		50				3	3	0	0	0
2,4-D	1	ug/L		70				3	3	0	0	0
Glyphosate	5	ug/L		700				3	3	0	0	0

[a] Based on a hardness of 50

[b] Criteria continuous concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.

[c] Criteria maximum concentration which equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects

[d] Criteria based on daily maximum

[e] Expressed as total recoverable

[f] ML= Minimum Level

[g] Non-detect refers to a lab result value that is below them minimum level

[h] Criteria based on 30 day average

Table 9.6 **Summary of Toxicity Characteristics of Stormwater from Various Southern California Watersheds.** Test Types: SF = sea urchin fertilization, MS = mysid survival/growth, DS = daphnid survival/reproduction.

Location	Date	Test Type	Number of Samples	%Toxic	TUc
Long Beach	2002-2003	SF	13	46	≤2-32
Long Beach	2002-2003	DS	13	31	1-4
Long Beach	2000-2002	SF	22	86	≤2-32
Long Beach	2000-2002	MS	20	55	1-16
Long Beach	2000-2002	DS	22	77	1->16
Los Angeles River	1997-1999	SF	4	100	4-8
San Gabriel River	1997-1999	SF	4	50	≤2-4
Ballona Creek	1996-1997	SF	13	85	≤4-32
Chollas Creek	1999-2000	SF	5	100	8-32
Chollas Creek	1999	MS	3	0	1
Chollas Creek	1999	DS	3	67	1-2

Table 9.7 **Summary of TIE Results for Each Sample.** The primary toxicant category indicates the chemical class most strongly indicated by the results. The secondary category indicates the chemical class indicated from partially effective TIE treatments.

Date	Station	Water Flea		Mysid		Sea Urchin	
		Primary Category[a]	Secondary Category[a]	Primary Category	Secondary Category	Primary Category	Secondary Category
Wet Weather Event:							
11/8/02	Belmont	OP	--	--	--	--	--
11/9/02	Bouton	--	--	--	--	Metal	--
11/9/02	Cerritos	--	--	--	--	Metal	NPO
Dry Weather Events:							
9/5/02	Cerritos	NPO	Metal (?)	--	--	--	--
5/20/03	Bouton	--	--	--	--	Metal	--
5/20/03	Cerritos	--	--	--	--	Metal	--

[a] OP = organophosphate pesticide, METAL = divalent trace metal, NPO = unspecified nonpolar organic, PARTICLE = toxicity associated with particulate fraction of sample.

Table 9.8 **Nonparametric Spearman Correlation Coefficients Showing the Relationship between Change in Chemical Concentration and Toxic Units for the Sea Urchin and Water Flea Toxicity Tests.** Toxic units are based on the EC50 (sea urchin fertilization, water flea reproduction) or LC50 (water flea survival). Values in bold are statistically significant at p≤0.05 (*) or p≤0.01 (**) or or p≤0.001 (***). N=35 for all constituents except for diazinon, where n=19.

Constituent		Sea Urchin Fertilization TUa	Water Flea Survival TUa	Water Flea Reproduction TUa
TSS		0.02	**0.48****	**0.51****
TDS		0.13	**0.46****	**0.43***
TOC		**0.36***	**0.72*****	**0.74*****
Cadmium	Dissolved	0.23	-0.04	-0.01
Chromium	Dissolved	0.09	-0.01	-0.01
Copper	Dissolved	**0.57*****	0.32	0.25
Lead	Dissolved	**0.43***	**0.42***	**0.40***
Nickel	Dissolved	**0.50****	**0.65*****	**0.64*****
Zinc	Dissolved	**0.57*****	**0.44***	**0.42***
Diazinon		0.04	0.26	0.22

10.0 CONCLUSIONS

The City of Long Beach's water quality monitoring program for stormwater and dry weather discharges through the City's municipal separate storm sewer system (MS4) began in the 1999/2000 wet weather season under terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052). Since that time about 37 wet weather monitoring events have been conducted at the four Long Beach mass emission stations, along with 32 dry weather inspections/ monitoring events. Receiving water studies were also carried out in lower Alamitos Bay to document dry weather diversion effects on bacterial contamination and on toxicity associated with wet weather flow events. This last year, a pilot wet weather receiving water study was conducted throughout Alamitos Bay to document potential toxicity effects in the receiving waters in the Bay.

The Long Beach stormwater monitoring program has emphasized an approach of paired chemical analysis and toxicity testing of discharges of municipal stormwater. The purpose of this approach was to first identify the constituents in the City of Long Beaches stormwater discharges that exhibited potential water quality impacts. Also, since numerical stormwater quality standards do not exist, it was desired to measure the impacts of these discharges in the Long Beach receiving waters.

General conclusions that may be made from the data collected to this time are as follows:

- Exceedances of available benchmark values based upon receiving water, ocean water, drinking water or other available comparisons have been identified for some metals, primarily zinc and copper, and for diazinon and chlorpyrifos (organophosphate pesticides). Indicator bacterial counts also were high compared to standards for both wet weather and for dry weather discharges. Other factors such as dilution, duration, and transformation in the receiving waters must also be considered, along with California Toxics Rule (CTR) receiving water standards that apply to the Long Beach estuarine receiving waters or those applicable to the Los Angeles River.

- Several general temporal trends are emerging. Dissolved concentrations of cadmium, copper, nickel and lead appear to be comparable during both wet and dry weather periods. Unlike these four metals, dissolved zinc concentrations are consistently higher during storm events. Concentrations of total copper, lead and zinc are distinctly higher in association with storm flows. No distinct seasonal or year to year differences are evident in concentrations of total cadmium, total nickel, chlorpyrifos or diazinon. Characteristics of stormwater discharges from the Dominguez Gap Pump Station are consistent with earlier observations at this site. Discharges from this site tend have lower concentrations of total metals than the other mass emission sites. In addition, stormwater discharges are less frequent at Dominguez Gap because of the infiltration that occurs in the basin associated with this pump station.

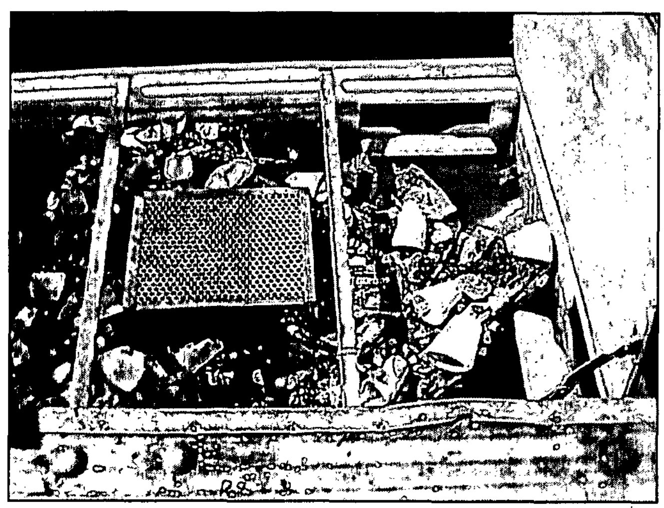
- Stormwater discharges have consistently shown measured toxicity to freshwater and marine test species, but lesser or no toxicity after a series of storms or very large runoff events.

- Toxicity Identification Evaluations (TIEs) implicate organophosphate pesticides (diazinon and chlorpyrifos) in causing toxicity to the freshwater water flea (freshwater test). In addition, dissolved metals, primarily zinc and perhaps copper, are implicated in the toxicity to the purple sea urchin (marine test).

- The lower Alamitos Bay receiving water site monitored in previous years did not show measured toxicity to the marine test species (sea urchin fertilization test), consistent with the results of the laboratory toxicity tests, and with the measured dilutions in the receiving waters.

- This year's Pilot Receiving Water Program mapped the vertical and horizontal extent of a stormwater plume that developed in Alamitos Bay in association with a brief, intense storm. The storm yielded 1.21 to 1.26 inches of rain in less than five hours. The plume extended from the surface down to depths of 3 to 6 feet throughout Alamitos Bay, with salinities varying from 1 to 28 parts per thousand (ppt). Turbidity in the surface plume ranged from 45 to 80 Nephelometric Turbidity Units (NTU) in contrast to just 2 to 5 NTU in the underlying Alamitos Bay water. The plume originated primarily from the Los Cerritos Channel. Total metals were highest at the lowest salinities, indicating stormwater as the source. Concentrations of total metals in the surface plume increased by about a factor of two from the higher salinity water near the mouth of the Bay (24.7 ppt) to the lowest salinity tested (8.7 ppt). Strong spatial trends were not evident in the distribution of dissolved metals. Organophosphate pesticides (OP pesticides) were mostly not detected, with Simazine, an herbicide being the only OP pesticide detected. Receiving water CTR standards were not violated in any of the four plume monitoring sites.

- Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test and showed negligible toxicity. Toxicity testing of discharges from the mass emission sites demonstrated a similar lack of toxicity, consistent with the high dilutions due to the large rainfall and low toxicity in stormwater runoff samples from the mass emission sites.



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Appendix B

2001/2002 Data Tables

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 1 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
CONVENTIONALS											
BOD5 (mg/L)	24	22	22J	31	19J	49	-	16J	23J	-	-
COD (mg/L)	94	110	68	120	68	95	-	48	46	-	-
TOC (mg/L)	49J	57	22	52J	32	58J	-	21	22	-	-
EC (umhos/cm)	460	470	150	710	180	180	-	96	95	-	-
Hardness (mg/L)	100	92	37	100	46	68	-	27	39	-	-
Alkalinity (mg/L)	71	78	21	33	22	120	-	17	17	-	-
pH (units)	7.8	7.4	7.2	7.3	7.3	7.4	-	7.4	7.4	-	-
Cyanide (ug/L)	5U	5U	5U	5U	5U	5U	-	5U	5U	-	-
Chloride (mg/L)	72J	63J	20J	170J	26J	52J	-	6.7J	6.2J	-	-
Fluoride (mg/L)	0.86J	0.90J	0.32J	1.3J	0.41J	0.66J	-	0.30J	0.28J	-	-
TKN (mg/L)	8.1	8.9	3.4	9.2	4.2	21	-	4.4	3.1	-	-
Ammonia-N (mg/L)	1.1	1.1	0.73	1.2	0.88	1.5	-	0.69	0.67	-	-
Nitrite N (mg/L)	0.2U	0.2U	0.2U	0.2U	0.2U	0.2U	-	0.2U	0.2U	-	-
Nitrate N (mg/L)	2.9	2.9	1.5	3.0	1.6	2.5	-	1.2	1.2	-	-
Total Nitrogen	11.1	11.9	5	12.3	5.9	23.6	-	5.7	4.4	-	-
Total P (mg/L)	2.10	2.20	0.990	1.70	0.800	6.20	-	1.40	0.710	-	-
Diss. P (mg/L)	0.510	0.490	0.590	0.380	0.380	0.470	-	0.320	0.310	-	-
MBAS (mg/L)	0.20	0.24	0.14	0.18	0.17	0.16	-	0.18	0.16	-	-
MTBE (ug/L)	0.5U	0.5U	1.0U	0.5U	1.0U	0.5U	-	1.0U	1.0U	-	-
Tot. Phenols (mg/L)	0.1UJ	0.1UJ	0.1U	0.1UJ	0.1U	0.1UJ	-	0.1U	0.1U	-	-
Oil&Grease (mg/L)	7.4	-	5.0U	5.0U	5.0U	7.4	29	5.0U	5.0U	-	-
TRPH (mg/L)	5U	10	5U	5U	5U	5U	-	5U	5U	-	-
TSS (mg/L)	620	580	220	380	200	1700	-	200	250	-	-
TDS (mg/L)	280	300	120	470	150	140	-	56	88	-	-
Turbidity (NTU)	230	210	92	120	76	290	-	78	70	-	-
TVS (mg/L)	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	-	R[1]	R[1]	-	-
BACTERIA (mpn/100ml)											
Fecal Coliform	50000J	-	>160000J	50000J	>160000J	50000J	30000J	50000J	90000J	3000J	800J
Fecal Enterococci	13600	-	10160	8420	18480	13210	11020	7520	10240	820	720
Total Coliform	>160000J	-	>160000J	>160000J	>160000J	>160000J	>160000J	>160000J	>160000J	3000J	1300J

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected. U=not detected at the associated value J=estimated value

\- Analyte not tested

FD Field Duplicate

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 2 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
TOTAL METALS (ug/L)											
Aluminum	**4200**	**4000**	**1600**	**2600**	**1400**	**4800**	-	**1400**	**1400**	-	-
Antimony	**2.3**	**2.6**	**1.6J**	**4.4**	**5.4J**	**5.1**	-	**2.2J**	**2.9J**	-	-
Arsenic	**4.8**	**4.7**	**3.0**	**3.4**	**2.5**	**9.7**	-	**2.9**	**3.1**	-	-
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	-	0.50U	0.50U	-	-
Cadmium	**2.80**	**2.70**	**1.30**	**1.80**	**1.30**	**5.50**	-	**1.60**	**1.70**	-	-
Chromium	**12**	**15**	**3.1**	**9.6**	**3.5**	**25**	-	**2.8**	**3.1**	-	-
Hex Chromium	0.02U	0.02U	0.02U	0.02U	0.02U	0.02U		0.02U	0.02U	-	-
Copper	**120**	**120**	**53**	**83**	**41**	**90**	-	**36**	**40**	-	-
Iron	**5000**	**5500**	**360J**	**3100**	**1700J**	**11000**	-	**1900J**	**1900J**	-	-
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	-	0.20U	0.20U	-	-
Nickel	**25**	**23**	**9.9**	**16**	**9.3**	**28**	-	**8.8**	**9.0**	-	-
Lead	**150**	**190**	**59**	**88**	**45**	**370**	-	**43**	**46**	-	-
Selenium	1.0U	1.0U	1.0U	**1.2**	**1.8**	1.0U	-	1.0U	**2.0**	-	-
Silver	0.25U	0.25U	0.25U	0.76	0.25U	0.25U	-	0.25U	0.25U	-	-
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Zinc	**830**	**820**	**720**	**710**	**760**	**1500**	-	**770**	**780**	-	-
DISSOLVED METALS (ug/L)											
Aluminum	**53**	**46**	**25**	**48**	**64**	**210**	-	**110**	**110**	-	-
Antimony	**2.5**	**2.2**	**1.3**	**1.7**	**1.3**	**2.1**	-	**1.0**	**0.98**	-	-
Arsenic	**1.9**	**1.8**	**1.2**	**1.3**	**1.1**	**1.9**	-	**1.2**	**1.1**	-	-
Beryllium	0.50U	0.50U	0.50U	0.50U	0.50U	0.50U	-	0.50U	0.50U	-	-
Cadmium	**0.28**	**0.28**	0.25U	0.25U	0.25U	0.25U	-	0.25U	0.25U	-	-
Chromium	**1.0**	**0.91**	0.50U	1.2U	**0.69**	**1.3**	-	**0.79**	**0.71**	-	-
Copper	**9.5**	**9.3**	**6.8**	**10**	**10**	**7.4**	-	**7.9**	**7.4**	-	-
Iron	50U	50U	**360**	50U	**300**	**94**	-	**110**	**160**	-	-
Mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	-	0.20U	0.20U	-	-
Nickel	**8.7**	**8.5**	**3.7**	**6.4**	**4.1**	**6.3**	-	3.3U	3.0U	-	-
Lead	**2.7**	**2.5**	**1.7**	**3.6**	**2.7**	**3.1**	-	**1.7**	**1.6**	-	-
Selenium	1.0U	1.0U	1.0U	1.0U	**1.4**	1.0U	-	1.0U	1.0U	-	-
Silver	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U	-	0.25U	0.25U	-	-
Thallium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Zinc	**49**	**48**	**44**	**91**	**72**	**48**	-	**78**	**65**	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected. U=not detected at the associated value J=estimated value

\- Analyte not tested.

FD Field Duplicate

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 3 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
CHLORINATED PESTICIDES (ug/L)											
4,4'-DDD	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
4,4'-DDE	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
4,4'-DDT	0.01U	0.01U	**0.04**	0.01U	**0.05**	0.01U	-	0.01U	0.01U	-	-
Aldrin	0.005U	0.005U	**0.066**	0.005U	**0.042**	0.005U	-	**0.071**	**0.079**	-	-
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.07	0.05U	-	0.05U	0.05U	-	-
alpha-Chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
alpha-Endosulfan	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
beta-Endosulfan	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Endosulfan Sulfate	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
Endrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
Endrin Aldehyde	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
gamma-BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	-	0.05U	0.05U	-	-
gamma-Chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
Heptachlor	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	-	0.012	0.011	-	-
Heptachlor Epoxide	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	0.01U	0.01U	-	-
Total PCBs	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Toxaphene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
AROCLORS (ug/L)											
Arochlor 1016	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1221	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1232	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1242	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1248	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1254	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Arochlor 1260	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
ORGANOPHOSPHATE PESTICIDES (ug/L)											
Atrazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Dursban(chlorpyrifos)	**0.13**	**0.07**	0.05U	**0.17**	0.05U	0.05U	-	**0.28**	**0.31**	-	-
Cyanazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Diazinon	**3.0**	**2.4**	**0.92**	**0.43**	**0.42**	0.01U	-	**0.41**	**0.35**	-	-
Malathion	**1.1**	**1.3**	**1.4**	1.0U	1.0U	1.0U	-	1.0U	1.0U	-	-
Prometryn	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Simazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected. U=not detected at the associated value J=estimated value

\- Analyte not tested.

FD Field Duplicate

Table 6.2. Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 4 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
HERBICIDES (ug/L)											
2,4,5-TP (Silvex)	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	-	0.5U	0.5U	-	-
2,4-D	4UJ	4UJ	1UJ	4UJ	1UJ	4UJ	-	1UJ	1UJ	-	-
Glyphosate	5U	5U	5UJ	5U	5UJ	5U	-	5UJ	5UJ	-	-
SEMIVOLATILES (ug/L)											
1,2,4-Trichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,2-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,2-Diphenylhydrazine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,3-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
1,4-Dichlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,4,6-Trichlorophenol	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,4-Dichlorophenol	2U	2U	2U	2U	2U	2U	-	2U	2U	-	-
2,4-Dimethylphenol	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
2,4-Dinitrophenol	5.0U	5.0U	5.0U	5.0U	**5.2**	5.0U	-	**5.5**	**7.1**	-	-
2,4-Dinitrotoluene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2,6-Dinitrotoluene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2-Chloroethylvinyl ether	-	-	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
2-Chlorophenol	2U	2U	2U	2U	2U	2U	-	2U	2U	-	-
2-Nitrophenol	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
3,3'-Dichlorobenzidine	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
4,6 Dinitro-2-methylphenol	2U	2U	5U	2U	5U	2U	-	5U	5U	-	-
4-Bromophenyl Phenyl Ether	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Chloro-3-methylphenol	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Chlorophenyl Phenyl Ether	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
4-Nitrophenol	**1.5**	**1.8**	5.0U	**1.9**	**6.6**	1.0U	-	**5.9**	**6.3**	-	-
Acenaphthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Acenaphthylene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Anthracene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzidine	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(a)Anthracene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(a)Pyrene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-

Bolded values indicate results that were greater than the reporting detection limit.

R[1] Indicates data were not valid. Data were rejected. U=not detected at the associated value J=estimated value

\- Analyte not tested.

Table 6.2 Stormwater Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 5 of 5)

ANALYTE	Belmont Pump 1	Belmont Pump 1FD	Belmont Pump 2	Bouton Creek 1	Bouton Creek 2	Los Cerritos Channel 1	Los Cerritos Channel 1FD	Los Cerritos Channel 2	Los Cerritos Channel 2FD	Alamitos Bay 1	Alamitos Bay 2
	12 Nov '01	12 Nov '01	24 Nov '01	13 Nov '01	24 Nov '01	12 Nov '01	12 Nov '01	24 Nov '01	24 Nov '01	12 Nov '01	24 Nov '01
SEMI-VOLATILES (ug/L)											
Benzo(b)Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Benzo(ghi)Perylene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Benzo(k)Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Bis(2-chloroethoxy)Methane	2U	2U	10U	2U	10U	2U	-	10U	10U	-	-
Bis(2-chloroethyl)Ether	1U	1U	10U	1U	10U	1U	-	10U	10U	-	-
Bis(2-chloroisopropyl)Ether	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Bis(2-Ethylhexyl)Phthalate	1.0U	1.0U	**8.0**	1.0U	**10**	1.0U	-	**8.8**	**9.4**	-	-
Butylbenzyl Phthalate	1.0 U	1.0U	**1.1**	1.0U	**1.7**	1.0 U	-	**1.2**	**1.6**	-	-
Chrysene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Dibenzo(a,h)Anthracene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Dieldrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U	-	**0.13**	0.01U	-	-
Diethyl Phthalate	1U	1U	4U	1U	4U	1U	-	4U	4U	-	-
Dimethyl Phthalate	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Di-n-Butyl Phthalate	**2.4**	**1.6**	4.0U	1.3UJ	4.0U	**2.3**	-	4.0U	4.0U	-	-
Di-n-Octyl Phthalate	1.0U	1.0U	**1.7**	**1.1**	**4.5**	1.0U	-	**4.4**	**4.5**	-	-
Fluoranthene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Fluorene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Hexachlorobenzene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Hexachlorobutadiene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Hexachlorocyclopentadiene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Hexachloroethane	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Indeno(1,2,3-c,d)Pyrene	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Isophorone	1U	1U	5U	1U	5U	1U	-	5U	5U	-	-
Naphthalene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Nitrobenzene	1U	1U	5U	1U	5U	1U	-	5U	5U	-	-
N-Nitrosodimethylamine	-	-	-	-	-	-	-	-	-	-	-
N-Nitrosodi-n-Propylamine	5U	5U	10U	5U	10U	5U	-	10U	10U	-	-
N-Nitrosodiphenylamine	1U	1U	2U	1U	2U	1U	-	2U	2U	-	-
Pentachlorophenol	1.0U	**1.5**	**8.3**	1.0U	5.0U	1.0U	-	5.0U	5.0U	-	-
Phenanthrene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Pyrene	1U	1U	1U	1U	1U	1U	-	1U	1U	-	-
Phenol	1U	1U	2.0U	1U	2.0U	**5.7**	-	2.0U	2.0U	-	-

Bolded values indicate results that were greater than the reporting detection limit.
R[1] Indicates data were not valid. Data were rejected.
\- Analyte not tested.

Table 6.3. Monitored Dry Weather Events, 1999-2002

Station	Event 1 10 Apr. '00	Event 2 21 Jun. '00	Event 3 29 Jun. '00	Event 4 5 Jun.'01	16 Aug 01	Event 6 9,14 May 02
Bouton Creek		X	X	X	X	X
Belmont Pump		X	X	X	X	X
Los Cerritos Channel				X	X	X
Dominguez Gap		X[1]	X[1]	X[1]	X[1]	X[1]
Alamitos Bay	X	X	X	X	X	X

1 Intake to basin was observed to be dry. Therefore, no samples were collected.
Shading indicates 2001/2002 Dry Weather Surveys included in this report. Data from Event 5 reported in earlier letter report that is included as Appendix F. Summary data from this event are included in the data tables.

Table 6.4. Dry and Wet Weather Bacteria Results for Alamitos Bay Receiving Waters (2001/2002)

Date	16 Aug '01[2]	12 Nov '01[1]	24 Nov '01[1]	9 May '02[2]
Total Coliform	11	3000J	1300J	240
Fecal Coliform	4	3000J	800J	7
Fecal Enterococci	1.0U[3]	820	720	10

1. Wet weather sampling event. Data also included in Table 6.3 for comparison with stormwater monitoring sites.
2. Dry weather sampling event.
3. Fecal Streptococci was measured during the 16 Aug 2001 survey. Analytical requirements were changed to enterococci for all subsequent events.

Table 6.5. Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, Dry Weather Season (2001/2002).

	Bouton Creek		Belmont Pump		Los Cerritos	
Date	**8/16/01**	**5/14/02**	**8/16/01**	**5/9/02**	**8/16/01**	**5/9/02**
Time	**02:00**	**07:30**	**06:40**	**07:20**	**05:35**	**05:00**
Temperature (^{0}C)	20.8	17.0	21.8	16.1	19.9	13.9
pH	8.15	8.41	8.45	8.39	8.17	8.72
Conductivity (mmho/cm)	7.17	9.57	2.63	2.21	0.84	0.66
Flow (cfs)	1.48[1]	0.15[3]	0..086[4]	1.82[4]	3.55[1]	2.75[1]
Dissolved Oxygen (mg/L)	2.27[2]	9	5.17	11	2.77	9

1. Flow was determined by measuring the depth and width of the water channel, as well as the velocity of a floating object in the water.
2. Value based on 100% saturation conditions, measured temperature and salinity values.
3. The flow rate was determined with the KLASS flow meter installed at the station.
4. The flow rate was determined by observing changes in water level in the sump area over a 24-hour period.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 1 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
CONVENTIONALS										
Biochemical Oxygen Demand (mg/L)	5.0U	**27J**	**26J**	**21J**	-	-	10U	**18**	10U	10U
Chemical Oxygen Demand (mg/L)	**180**	**210**	**100**	**760**	-	-	**220**	**100**	**440**	**390**
Total Organic Carbon (mg/L)	11U	13U	15U	12U	-	-	**8**	**24**	**18**	**20**
Specific Conductance (umhos/cm)	**2800**	**840**	**7800**	**7700**	-	-	**2700**	**650**	**12000**	**12000**
Total Hardness (mg/L)	**350**	**170**	**890**	**910**	-	-	**330**	**130**	**1300**	**1300**
Alkalinity, as CaCO3 (mg/L)	**440**	**150**	**140**	**140**	-	-	**380**	**120**	**170**	**170**
pH (units)	**8.4**	**8.6**	**7.8**	**8.0**	-	-	8.41	9.66	7.71	7.72
Cyanide (ug/L)	5.0U	5.0U	5.0U	5.0U	-	-	5UJ	5UJ	5UJ	5UJ
Chloride (mg/L)	**560**	**120**	**2500**	**2700**	-	-	**570**	**83**	**4200**	**4000**
Fluoride (mg/L)	**1.6**	**0.69**	**0.9**	**0.91**	-	-	**1.7**	**0.76**	**1.7**	**1.4**
Total Kjeldahl Nitrogen (mg/L)	**0.90**	**1.8**	**4.1**	**1.8**	-	-	**0.89J**	**1.8J**	**1.5**	**1.7**
Total Ammonia-Nitrogen (mg/L)	**0.13**	**0.58**	**0.11**	**0.23**	-	-	**0.11**	**0.15**	0.1U	0.1U
Nitrite Nitrogen (mg/L)	0.2U	0.2U	0.2U	0.2U	-	-	0.2U	0.1U	1U	1U
Nitrate Nitrogen (mg/L)	**1.3**	**0.068**	0.01U	0.01U	-	-	**1.2**	0.1U	1U	1U
Total Nitrogen	**2.3**	**2.0**	**4.2**	**1.9**	-	-	**2.19**	**2**	**2.6**	**2.8**
Total Phosphorus (mg/L)	**0.86**	**0.12**	**0.36**	**0.11**	-	-	**0.86**	**0.17**	**0.11**	**0.13**
Dissolved Phosphorus (mg/L)	**0.87**	**0.046**	**0.025**	**0.029**	-	-	**0.96**	**0.046**	**0.031**	**0.031**
MBAS (mg/L)	**0.046**	**0.054**	**0.064**	**0.040**	-	-	**0.037**	0.02U	**0.037**	**0.033**
MTBE (ug/L)	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	0.5U	0.5U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U	-	-	0.1UJ	0.1UJ	0.1UJ	0.1UJ
Oil & Grease (mg/L)	5.0U	-	5.0U	5.0U	-	-	5U	5U	5U	5U
TRPH (mg/L)	5.0U	5.0U	5.0U	5.0U	-	-	5U	5U	5U	5U
Total Suspended Solids (mg/L)	1.0U	**58**	**10**	**10**	-	-	**2**	**2**	1U	1U
Total Dissolved Solids (mg/L)	**1800**	**600**	**5100**	**5100**	-	-	**1600**	**430**	**7400**	**7400**
Turbidity (NTU)	**11**	**36**	**10**	**9.2**	-	-	**1.8**	**4.9**	**2.5**	**2.6**
Total Volatile Solids (mg/L)	1.0U	1.0U	1.0U	1.0U	-	-	R[1]	R[1]	R[1]	R[1]
BACTERIA (mpn/100ml)										
Fecal Coliform	**2,300**	**2300**	**230**	**2300**	**4**	**7**	**2400**	**1100**	**170**	**300**
Fecal Enterococci	-	-	-	-	-	**10**	**1760**	**910**	**1720**	**910**
Total Coliform	**8,000**	**30,000**	**3,000**	**2300**	**11**	**240**	**90000**	**3000**	**17000**	**5000**

Bolded values indicate results that were greater than the reporting detection limit. U=not detected at the associated value J=estimated value

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 2 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
TOTAL METALS (ug/L)										
Aluminum	**140**	**97**	**84**	**88**	-	-	**31**	**25**	**39**	**29**
Antimony	-	-	-	-	-	-	**0.6**	**3.7**	**1.1**	**1**
Arsenic	3.9U	1.2U	1.8U	1.6U	-	-	**3.3**	**7**	0.5U	0.5U
Beryllium	0.50U	0.50U	0.50U	0.50U	-	-	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	**0.57**	0.25U	0.25U	-	-	0.25U	**0.36**	0.25U	0.25U
Chromium	**2.5**	**1.5**	**2.4**	**2.4**	-	-	**51**	**15**	**41**	**36**
Hexavalent Chromium	**4.91J**	**6.20**	**4.91J**	**5.43**	-	-	0.02U	0.02U	0.02U	0.02U
Copper	4.8U	**17**	**15**	**16**	-	-	**5.4**	**22**	**11**	**10**
Iron	**330**	**320**	**220**	**220**	-	-	**100J**	50UJ	**310J**	**280J**
Mercury	0.20U	**3.5**	0.20U	0.20U	-	-	0.2U	0.2U	0.2U	0.2U
Nickel	**5.6**	**7.5**	**5.0**	**5.2**	-	-	**2.6**	**3.5**	**6.3**	**5.6**
Lead	**0.99**	**3.5**	**3**	**3.5**	-	-	**0.68**	**0.78**	**1.7**	**1.6**
Selenium	-	-	-	-	-	-	**2.5**	**2.2**	**4.7**	**2.7**
Silver	-	-	-	-	-	-	0.25U	**0.62**	**0.56**	0.25U
Thallium	-	-	-	-	-	-	1U	1U	1U	1U
Zinc	**13**	**43**	**21**	**23**	-	-	**19**	**17**	**41**	**39**
DISSOLVED METALS (ug/L)										
Aluminum	**140**	**88**	**80**	**75**	-	-	25U	25U	25U	25U
Antimony	-	-	-	-	-	-	0.5U	**1.2**	**0.7**	**0.7**
Arsenic	3.9U	1.1U	1.5U	1.6U	-	-	**2.3**	**4.7**	0.5U	0.5U
Beryllium	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
Cadmium	0.25U	0.5	0.25U	0.25U	-	-	0.25U	0.25U	0.25U	0.25U
Chromium	**2.4**	**1.3**	**2.4**	**2.1**	-	-	**39**	**8.8**	**22**	**22**
Copper	**4.8**	**16**	**15**	**14**	-	-	**3.8**	**16**	**6.7**	**6.7**
Iron	**50**	**40**	**60**	**70**	-	-	**110**	50U	**210**	**220**
Mercury	0.2U	0.2U	0.2U	0.2U	-	-	0.2U	0.2U	0.2U	0.2U
Nickel	**5.4**	**7.2**	**4.9**	**5.1**	-	-	**1.6**	**2.5**	**3.9**	**3.8**
Lead	**0.97**	**3.2**	**2.9**	**3**	-	-	0.5U	0.5U	0.5U	0.5U
Selenium	-	-	-	-	-	-	**1.9**	**1.1**	**4.2**	1U
Silver	-	-	-	-	-	-	0.25U	0.25U	0.25U	0.25U
Thallium	-	-	-	-	-	-	1U	1U	1U	1U
Zinc	**13**	**39**	**21**	**20**	-	-	**12**	**9.3**	**23**	**26**

Bolded values indicate results that were greater than the reporting detection limit. U=not detected at the associated value J=estimated value

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 3 of 5)

ANALYTE	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD	Alamitos Bay	Alamitos Bay	Belmont Pump	Los Cerritos Channel	Bouton Creek	Bouton Creek FD
	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	16 Aug '01	9 May '02	9 May '02	9 May '02	14 May '02	14 May '02
CHLORINATED PESTICIDES (ug/L)										
4,4'-DDD	0.5U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
4,4'-DDE	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
4,4'-DDT	0.05U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Aldrin	0.005U	0.005U	0.005U	0.005U	-	-	0.005U	0.005U	0.005U	0.005U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
alpha-Chlordane	0.5U	0.5U	0.5U	0.5U	-	-	0.1U	0.1U	0.1U	0.1U
alpha-Endosulfan	0.05U	0.05U	0.05U	0.05U	-	-	0.02U	0.02U	0.02U	0.02U
beta-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.005U	0.005U	0.005U	0.005U
beta-Endosulfan	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
delta-BHC	0.05U	0.05U	0.05U	0.05U	-	-	0.005U	0.005U	**0.019**	**0.021**
Endosulfan Sulfate	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
Endrin	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Endrin Aldehyde	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
gamma-BHC (lindane)	0.05U	0.05U	0.05U	0.05U	-	-	0.01U	0.01U	0.01U	0.01U
gamma-Chlordane	0.5U	0.5U	0.5U	0.5U	-	-	0.02U	0.02U	0.02U	0.02U
Heptachlor	0.01U	0.01U	0.01U	0.01U	-	-	0.1U	0.1U	0.1U	0.1U
Heptachlor Epoxide	0.01U	0.01U	0.01U	0.01U	-	-	0.01U	0.01U	0.01U	0.01U
Total PCBs	1.0U	1.0U	1.0U	1.0U	-	-	0.01U	0.01U	0.01U	0.01U
Toxaphene	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
AROCLORS (ug/L)										
Arochlor 1016	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1221	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1232	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1242	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1248	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1254	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Arochlor 1260	1.0U	1.0U	1.0U	1.0U	-	-	0.5U	0.5U	0.5U	0.5U
Atrazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Dursban (chlorpyrifos)	0.05U	0.05U	0.05U	0.05U	-	-	0.05U	0.05U	0.05U	0.05U
Cyanazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Diazinon	**0.22**	**0.096**	**0.15**	**0.15**	-	-	**0.12**	**0.32**	**0.33**	**0.34**
Malathion	0.1U	0.1U	0.1U	0.1U	-	-	1U	1U	1U	1U
Prometryn	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Simazine	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U

Bolded values indicate results that were greater than the reporting detection limit. U=not detected at the associated value J=estimated value

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 4 of 5)

ANALYTE	Belmont Pump 16 Aug '01	Los Cerritos Channel 16 Aug '01	Bouton Creek 16 Aug '01	Bouton Creek FD 16 Aug '01	Alamitos Bay 16 Aug '01	Alamitos Bay 9 May '02	Belmont Pump 9 May '02	Los Cerritos Channel 9 May '02	Bouton Creek 14 May '02	Bouton Creek FD 14 May '02
HERBICIDES (ug/L)										
2,4,5-TP (Silvex)	0.5U	0.5U	0.5U	0.5U	-	-	0.5U	0.5U	0.5U	0.5U
2,4-D	1U	1U	1U	1.0U	-	-	**1.2**	**5.5**	**3**	**3**
Glyphosate	5U	5U	5U	5.0U	-	-	5UJ	5UJ	5UJ	5UJ
SEMI-VOLATILES (ug/L)										
1,2,4-Trichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,2-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,2-Diphenylhydrazine	3.0U	3.0U	0.5U	3.0U	-	-	1U	1U	1U	1U
1,3-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
1,4-Dichlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2,4,6-Trichlorophenol	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
2,4-Dichlorophenol	2.0U	2.0U	2.0U	2.0U	-	-	2U	2U	2U	2U
2,4-Dimethylphenol	2.0U	2.0U	2.0U	2.0U	-	-	1U	1U	1U	1U
2,4-Dinitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	5U	5U	5U	5U
2,4-Dinitrotoluene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2,6-Dinitrotoluene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
2-Chloroethylvinyl ether	-	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	-	-	-	-	-	-	1U	1U	1U	1U
2-Chlorophenol	2.0U	2.0U	2.0U	2.0U	-	-	2U	2U	2U	2U
2-Nitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
3,3'-Dichlorobenzidine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
4,6 Dinitro-2-methylphenol	3.0U	3.0U	3.0U	3.0U	-	-	2U	2U	2U	2U
4-Bromophenyl Phenyl Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
4-Chloro-3-methylphenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
4-Chlorophenyl Phenyl Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
4-Nitrophenol	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Acenaphthene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Acenaphthylene	0.2U	0.2U	0.2U	0.2U	-	-	1U	1U	1U	1U
Anthracene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Benzidine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Benzo(a)Anthracene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(a)Pyrene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(b)Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Benzo(ghi)Perylene	-	-	-	-	-	-	1U	1U	1U	1U
Benzo(k)Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U

Bolded values indicate results that were greater than the reporting detection limit. U=not detected at the associated value J=estimated value

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate.

Table 6.6. Dry Weather Chemistry Results: City of Long Beach Storm Monitoring Project. (Page 5 of 5)

ANALYTE	Belmont Pump 16 Aug '01	Los Cerritos Channel 16 Aug '01	Bouton Creek 16 Aug '01	Bouton Creek FD 16 Aug '01	Alamitos Bay 16 Aug '01	Alamitos Bay 9 May '02	Belmont Pump 9 May '02	Los Cerritos Channel 9 May '02	Bouton Creek 14 May '02	Bouton Creek FD 14 May '02
SEMIVOLATILES (ug/L)										
Bis(2-chloroethoxy)Methane	1.0U	1.0U	1.0U	1.0U	-	-	2U	2U	2U	2U
Bis(2-chloroethyl)Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Bis(2-chloroisopropyl)Ether	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Bis(2-Ethylhexyl)Phthalate	**3.1**	**15.8**	**8.9**	**10.7**	-	-	1U	1U	1U	1U
Butylbenzyl Phthalate	-	-	-	-	-	-	1U	1U	1U	1U
Chrysene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Dibenzo(a,h)Anthracene	-	-	-	-	-	-	0.1U	0.1U	0.2U	0.2U
Dieldrin	0.01U	0.01U	0.01U	0.01U	-	-	1U	1U	1U	1U
Diethyl Phthalate	0.5U	**0.8**	**0.9**	0.5U	-	-	1U	1U	1U	1U
Dimethyl Phthalate	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Di-n-Butyl Phthalate	3.0U	**6.0**	3.0U	**3.1**	-	-	1U	1U	1U	1U
Di-n-Octyl Phthalate	3.0U	3.0U	**3.8**	**3.1**	-	-	0.05U	0.05U	0.05U	0.05U
Fluoranthene	1.0U	1.0U	1.0U	1.0U	-	-	0.1U	0.1U	0.1U	0.1U
Fluorene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Hexachlorobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Hexachlorobutadiene	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Hexachlorocyclopentadiene	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Hexachloroethane	1.0U	1.0U	1.0U	1.0U	-	-	1U	1U	1U	1U
Indeno(1,2,3-c,d)Pyrene	1.0U	1.0U	1.0U	1.0U	-	-	0.05U	0.05U	0.2U	0.2U
Isophorone	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
Naphthalene	0.5U	0.5U	0.5U	0.5U	-	-	0.2U	0.2U	0.2U	0.2U
Nitrobenzene	0.5U	0.5U	0.5U	0.5U	-	-	1U	1U	1U	1U
N-Nitrosodimethylamine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
N-Nitrosodi-n-Propylamine	1.0U	1.0U	1.0U	1.0U	-	-	5U	5U	5U	5U
N-Nitrosodiphenylamine	3.0U	3.0U	3.0U	3.0U	-	-	1U	1U	1U	1U
Pentachlorophenol	2.0U	3.0U	2.0U	2.0U	-	-	1U	1U	1U	1U
Phenanthrene	0.5U	0.5U	0.5U	0.5U	-	-	0.05U	0.05U	0.05U	0.05U
Pyrene	0.5U	0.5U	0.5U	0.5U	-	-	0.1U	0.1U	0.1U	0.1U
Phenol	1.0U	1.0U	1.0U	1.0U	-	-	0.05U	0.05U	0.05U	0.05U

Bolded values indicate results that were greater than the reporting detection limit. U=not detected at the associated value J=estimated value

R[1] Indicates data were not valid. Data were rejected.

\- Analyte not tested

FD Field Duplicate.

Table 7.1. Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2001/2002 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid tests were conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/12/2001	**Water Flea Survival**	**<6**	**6**	**3.9**	**>16**
11/12/2001	**Water Flea Reproduction**	**6**	**12**	**8.0**	**16**
11/12/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/12/2001	Mysid Growth	nm[f]	nm	na	na
11/12/2001	**Sea Urchin Fertilization**	**3**	**6**	**>50**	**32**
11/24/2001	**Water Flea Survival**	**6**	**12**	**10.2**	**16**
11/24/2001	**Water Flea Reproduction**	**12**	**25**	**15.7**	**8**
11/24/2001	**Mysid Survival**	**≤50**	**≤100**	**na**	**≥2**
11/24/2001	**Mysid Growth**	**≤50**	**≤100**	**na**	**≥2**
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**27.1**	**32**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).

[d] Chronic toxicity units = 100/NOEC.

[e] Not applicable.

[f] Not measured due to lack of survivors.

Table 7.2. Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2001/2002 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
11/13/2001	**Water Flea Survival**	**25**	**50**	**36.1**	**4**
11/13/2001	**Water Flea Reproduction**	**25**	**50**	**42.2**	**4**
11/13/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/13/2001	**Mysid Growth**	**≤50**	**≤100**	**na**	**≥2**
11/13/2001	**Sea Urchin Fertilization**	**3**	**6**	**47.0**	**32**
11/24/2001	**Water Flea Survival**	**50**	**100**	**64.3**	**2**
11/24/2001	**Water Flea Reproduction**	**50**	**100**	**70.1**	**2**
11/24/2001	**Mysid Survival**	**na**	**na**	**na**	**na**
11/24/2001	**Mysid Growth**	**na**	**na**	**na**	**na**
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**38.4**	**32**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).

[d] Chronic toxicity units = 100/NOEC.

[e] Not applicable.

Table 7.3. Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2001/2002 Monitoring Season. Test results indicating toxicity are shown in bold type. The mysid test was conducted using 100% sample only.

		Test Response (% sample)			
Date	Test	NOEC[a]	LOEC[b]	Median Response[c]	TUc[d]
11/12/2001	**Water Flea Survival**	**12**	**25**	**21.4**	**8**
11/12/2001	**Water Flea Reproduction**	**12**	**25**	**19.9**	**8**
11/12/2001	**Mysid Survival**	**≤50**	**≤100**	**na[e]**	**≥2**
11/12/2001	**Mysid Growth**	**≤50**	**≤100**	**Na**	**≥2**
11/12/2001	**Sea Urchin Fertilization**	**<3**	**3**	**>50**	**>32**
11/24/2001	**Water Flea Survival**	**12**	**50**	**18.8**	**8**
11/24/2001	**Water Flea Reproduction**	**12**	**50**	**19.3**	**8**
11/24/2001	Mysid Survival	na	na	Na	na
11/24/2001	Mysid Growth	na	na	Na	na
11/24/2001	**Sea Urchin Fertilization**	**3**	**6**	**26.5**	**32**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.
[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50) or 50% reduction in sea urchin fertilization (EC50).
[d] Chronic toxicity units = 100/NOEC.
[e] Not applicable.

Table 7.4. Toxicity of Receiving Water Samples Collected from Alamitos Bay during the 2001/2002 Storm Season. Water flea tests were not conducted on these samples.

Date	Test	Estimated % Runoff	NOEC[a]	TUc[b]
11/12/2001	Mysid Survival	2	Nontoxic	<1
11/12/2001	Mysid Growth	2	Nontoxic	<1
11/12/2001	Sea Urchin	2	Nontoxic	<1
11/24/2001	Mysid Survival	1	Nontoxic	<1
11/24/2001	Mysid Growth	1	Nontoxic	<1
11/24/2001	Sea Urchin	1	Nontoxic	<1

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.
[b] Chronic toxicity units = 100/NOEC. These values are estimated since the NOEC was not determined through analysis of a dilution series.

Table 7.5. **Summary of TIE Activities.** Acute Toxic Units for the initial (TU-1) and TIE baseline (TU-B) tests are shown (96 hr exposure time for water flea and mysid tests), along with the TIE-related action taken. TIEs were aborted when the baseline TU value was less than 2.0.

		Water Flea			Mysid			Sea Urchin		
Date	**Test**	**TU-I**	**TUB**	**Action**	**TU-I**	**TU-B**	**Action**	**TU-I**	**TU-B**	**Action**
11/12	Belmont	10.7	12	TIE	>1	3.4	TIE	≤2	na	none
11/13	Bouton	1.4	1.2	abort	1	na	none	2.1	1.3	abort
11/12	Los Cerritos	2.8	3.3	TIE	<1	na	none	<2	na	none
11/24	Belmont	9.8	3.5	TIE	>1	1.7	TIE	3.7	4.8	TIE
11/24	Bouton	1.6	<1	abort	na	na	none	2.6	6.1	TIE
11/24	Los Cerritos	5.3	3.3	TIE	na	na		3.8	6.2	TIE

Table 7.6. **Toxicity of Dry Weather Samples from the City of Long Beach.** Test results indicating toxicity are shown in bold type.

Station	Date	Test	Test Response (% sample) NOEC[a]	LOEC[b]	Median Response[c]	TUc[d]
Belmont	5/9/2002	Water Flea Survival	≥100	>100	>100	≤1
Belmont	5/9/2002	Water Flea Reproduction	≥100	>100	>100	≤1
Belmont	**5/9/2002**	**Sea Urchin Fertilization**	**25**	**50**	**47.6**	**4**
Bouton	**5/14/2002**	**Water Flea Survival[e]**	**25**	**50**	**37.5**	**4**
Bouton	**5/14/2002**	**Water Flea Reproduction[e]**	**6**	**12**	**29.6**	**16**
Bouton.	5/14/2002	Sea Urchin Fertilization	≥50	>50	>50	≤2
Los Cerritos	5/9/2002	Water Flea Survival	≥100	>100	>100	≤1
Los Cerritos	5/9/2002	Water Flea Reproduction	≥100	>100	>100	≤1
Los Cerritos	**5/9/2002**	**Sea Urchin Fertilization**	**12**	**25**	**31.8**	**8**

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Lowest Observed Effect Concentration: the lowest concentration producing a test response that was significantly different from the control.

[c] Concentration causing 50% mortality to mysids or water fleas (LC50), 50% inhibition in water flea reproduction (IC50), or 50% reduction in sea urchin fertilization or mysid growth (EC50).

[d] Chronic Toxicity Units = 100/NOEC.

[e] The conductivity of this sample was believed to exceed the osmotic tolerance of the water flea.

Table 7.7 Toxicity of the Receiving Water Sample Collected from Alamitos Bay during the 2001/2002 Storm Season.

Date	Test	NOEC[a]	TUc[b]
5/9/2002	Sea Urchin	Nontoxic	≤1

[a] No Observed Effect Concentration: the highest concentration with a test response not significantly different from the control.

[b] Chronic toxicity units = 100/NOEC. These values are estimated since the NOEC was not determined through analysis of a dilution series.