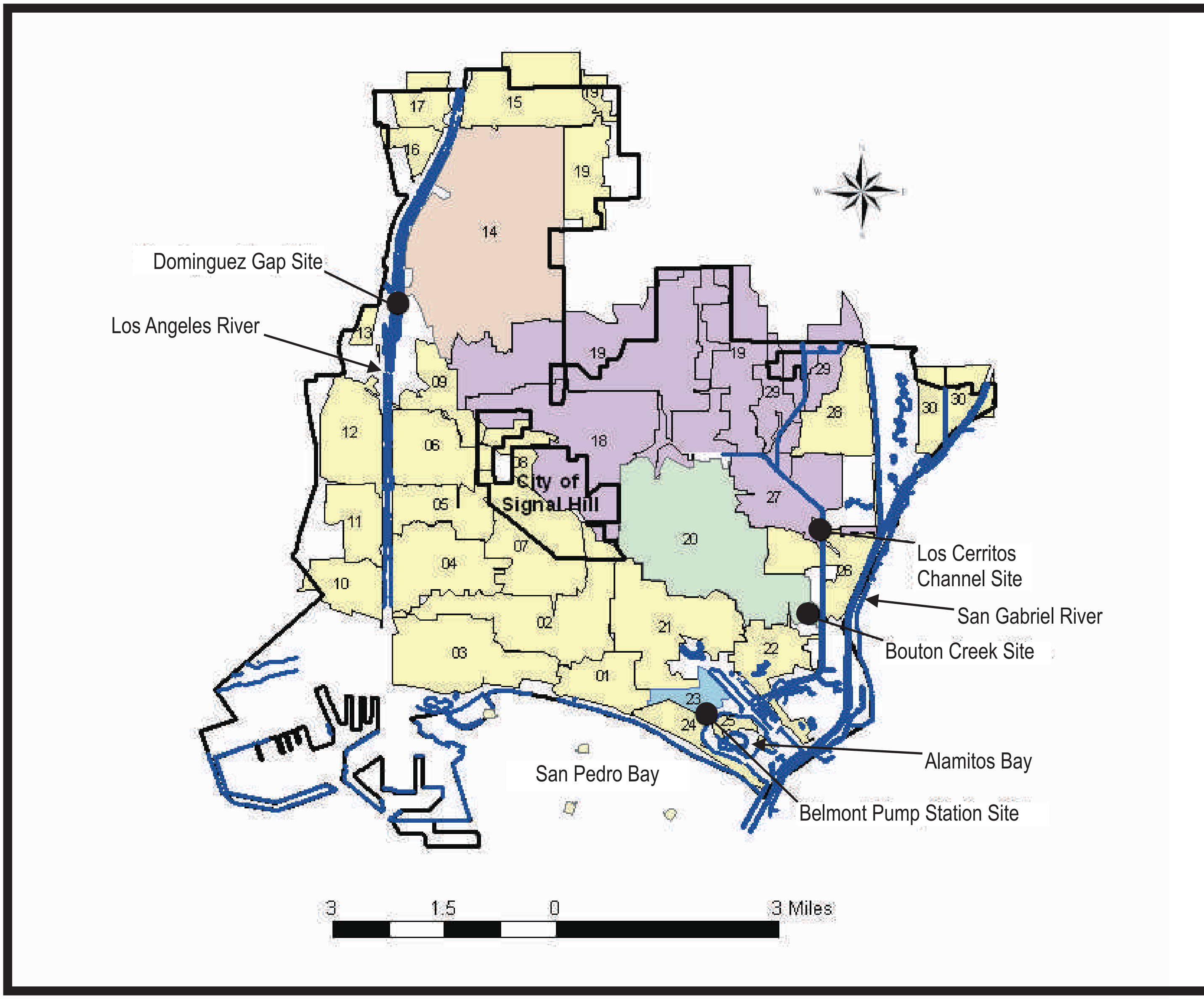
City of Long Beach
Stormwater Monitoring Report 2003/2004

NPDES Permit No. CAS004003 (CI 8052)

15 July 2004



Submitted By

City
Of
Long
Beach

Prepared By

Kinnetic Laboratories Incorporated

CITY OF LONG BEACH

DEPARTMENT OF PUBLIC WORKS

333 West Ocean Boulevard • Long Beach, CA 90802 • (562) 570-6383 • FAX (562) 570-6012

July 15, 2004

Jonathan Bishop, Interim Executive Officer
California Environmental Protection Agency
Los Angeles Regional Water Quality Control Board
320 West 4th Street, Suite 200
Los Angeles, CA 90013-2343

SUBJECT: City of Long Beach Storm Water Monitoring Report 2003– 2004

Dear Mr. Bishop:

The City of Long Beach is pleased to submit their fifth annual "Storm Water Monitoring Report 2003-2004" in compliance with Order No. 99-060, for the Municipal National Pollutant Discharge Elimination System (NPDES) Permit No. CAS004003 (CI8052).

We have worked collaboratively with our contractor, Kinnetic Laboratories, Inc., and their subcontractors to produce a report that we believe contains very useful information.

Please contact Tom Leary, Stormwater Program Officer, at (562) 570-6023, should you have any questions in regard to the attached report.

Sincerely,

Mark Christoffels
City Engineer

MC:ll
Attachments

ADMINISTRATION, PLANNING & FACILITIES
333 W. Ocean Blvd., 9th Floor
Long Beach, CA 90802
Ph. (562) 570-6383
Fax (562) 570-6012

AIRPORT
4100 Donald Douglas Dr.
Long Beach, CA 90808
Ph. (562) 570-2600
Fax (562) 570-2601

ENGINEERING & STREET MAINTENANCE
333 W. Ocean Blvd., 9th Floor
Long Beach, CA. 90802
Ph. (562) 570-6634
Fax (562) 570-6012

TRAFFIC & TRANSPORTATION
333 W. Ocean Blvd., 10th Floor
Long Beach, CA 90802
Ph. (562) 570-6331
Fax (562) 570-7161

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CITY OF LONG BEACH
STORMWATER MONITORING REPORT 2003/2004

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
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

PCB - Polychlorinated biphenyls
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
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
SWRCB-State Water Resource Control Board
TDS – Total Dissolved Solids
TIE – Toxicity Identification Evaluation
TKN - Total Kjeldahl Nitrogen
TOC - Total Organic Carbons
TPH - total petroleum hydrocarbons
TSI - ToxScan, Inc.
TSS – Total Suspended Solids
TU - Toxicity Unit
TU_a – Acute Toxicity Unit
TUc – Chronic Toxicity Unit
USEPA - U.S. Environmental Protection Agency
WQO - Water Quality Objective
WQS - Water Quality Standard

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CITY OF LONG BEACH
STORMWATER MONITORING REPORT 2003/2004

NPDES Permit No. CAS004003 (CI 8052)

1.0 EXECUTIVE SUMMARY

This report provides a summary of the results of the fifth year of monitoring conducted under the terms of Order No. 99-060 National Pollutant Discharge Elimination Systems Municipal Permit No. CAS004003 (CI 8052) for City of Long Beach. Included in this report is a synthesis of key elements of the data set as developed over the past five years. The following section provides a summary of the background for the program including annual adjustments for each year of the program and a summary of key findings from this report.

1.1 Background and Purpose

Under the terms of Order No. 99-060, 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. The permit was initially issued for the term of five years.

The initial 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. The first monitoring 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 (Kinnetic Laboratories, Inc., 2001, 2002 and 2003) have included both wet and dry season monitoring programs and presented cumulative data results.
Over the past five years, the program has been adapted to better focus on specific issues. Each year, the Regional Board and the City of Long Beach have worked together to improve the program based upon results of previous years of work. Among the key changes have been:

- Iplementation of a receiving water quality element over the past two years to examine the extent and impacts of the stormwater plume in Alamitos Bay.
- Supension of toxicity testing at the Dominguez Gap site.
- Sspension of analyses of PAHs as well as a number of analytes not commonly detected or that are detected consistently at levels well below receiving water quality criteria.
- Ading TSS monitoring for all events.
- Adustment of the trigger point for TIEs in order to enable greater sensitivity in the identification of toxicants.

The purpose of this present report is to submit the results of the City of Long Beach's stormwater monitoring program for the fifth and final year (2003/2004) under the current permit.

1.2 Summary of Results

Wet weather sampling of storm events began in October 2003. The first major storm of the year occurred on December 25th and 26th, 2003 but this sampling was unsuccessful due to large discrepancies between the forecasted storm and actual rainfall. This resulted in samples that did not meet quality control criteria. The first monitored storm event of the season occurred on February 2, 2004.

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. A fifth event was monitored at the Belmont Pump, Bouton Creek, and Los Cerritos Channel stations for TSS.

The second year of a receiving water study was conducted to monitor the horizontal and vertical extent of the stormwater plume in Alamitos Bay and to characterize key contaminants and toxicity within the plume. This study was conducted on February 2nd, 2004, following the second event of the season. The plume 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 12.8 to 31.6 ppt. Water samples were tested for toxicity and a subset of water quality parameters which included selected trace metals and organophosphate pesticides.

Two dry weather inspections/monitoring events were conducted. The first was conducted in September 2003 prior to the winter rains. The second was conducted in May 2004 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 2003/2004 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), California Department of Fish and Game (Siepmann and Finlayson 2002) criteria for diazinon and chlorpyrifos, 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.

- Concentrations of bacteria (total coliform, fecal coliform, and enterococcus) in the Long Beach stormwater discharges routinely exceed public health criteria provided by the Basin Plan and the Ocean Plan. In most years, 100 percent of the stormwater samples exceed the criteria. During the past season, one out of four samples taken in Bouton Creek had total and fecal coliform concentrations within the single sample criteria of 10,000 mpn/100ml for total coliform and 400 mpn/100 ml for fecal coliform. Enterococcus concentrations exceeded Basin Plan criteria during during all wet weather monitoring events. 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 100 percent of the samples from the Belmont Pump Station, Bouton Creek and the Los Cerritos Channel. Stormwater runoff from the Dominguez Gap Pump Station tended to have lower levels of total metals with 2/3 of the samples exceeding the copper criterion and only 1/3 of the samples exceeding the lead and zinc criteria..

- Total recoverable aluminum exceeded the Basin Plan drinking water criterion of 1000 μg/L during in roughly 75% of the samples from all sites.

- Dissolved metal concentrations were compared against both saltwater and freshwater Criteria Continuous Concentrations (CCC) values from the California Toxics Rule (CTR). As noted in previous years, dissolved copper, lead and zinc commonly exceed these reference values however exceedances were less common this year. In the case of dissolved copper, 73% of the samples exceeded the freshwater CTR criteria and 93% exceeded the saltwater CTR criteria. Dissolved lead exceeded the freshwater CTR criteria in 27% of the samples and never exceeded the saltwater CTR criteria. Similarly, dissolved zinc exceeded freshwater CTR criteria in 40% of the samples but never exceeded saltwater CTR criteria. This contrasts with the previous year when dissolved lead and zinc exceeded both criteria in all but one case.

- Very few organic compounds exceeded the reference criteria in runoff from the four mass emission sites. Concentrations of dieldrin exceeded the saltwater CTR and Ocean Plan criteria in one sample from Bouton Creek, and two samples from the Los Cerritos Channel. In all cases, the reported value was less than twice the ML[1] of 0.01 μg/L and were detected during early season events. Simazine, an organophosphorus herbicide, exceeded the Basin Plan MCL in three of the

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[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.

eleven stormwater composite samples. Simazine exceeded the Basin Plan MCL (Maximum Contaminant Level) in single samples from the Bouton Creek, the Los Cerritos Channel and the Dominguez Gap Pump Station. The only other organic constituent exceeding reference criteria was DDT. DDT compounds were present in excess of criteria in two samples from the Belmont Pump Station and one from Los Cerritos Creek. Measured concentrations were less than 3 times the reporting limits in all cases.

- Among the four mass emission sites, the Los Cerritos Channel consistently exhibited the highest overall loads of solids and total metals due to the large size of the watershed monitored at this location. Due to the large size differences amoung watersheds, loads were normalized to a unit of 1000 acres in order to provide a more meaningful comparison for key stormwater contaminants. These loading rates were then compared graphically. Loading rates for total and dissolved aluminum, copper, lead and zinc were similar at both the Belmont Pump Station and Bouton Creek sites. Loading rates for these same metals at the Dominguez Gap Pump Station are typically much lower. The lower loading rates from the Dominguez Gap Pump Station are most evident during the larger storm events. Pollutant loading rates from the Los Cerritos Channel site tend to increase substantially during higher flow events while lower flows such as experienced this past year result in loading rates comparable to those observed in Bouton Creek and at the Belmont Pump Station. Higher loading rates during larger events may be due to mobilization of an upstream source of particulate metals from either the watershed or resuspension and transport of instream sources.

Dry Weather Chemical and Bacterial Results

- Over the life of the NPDES permit, dry weather runoff has consistently been characterized by lower concentrations of suspended particulates and total recoverable metal concentrations. Trace metals are predominantly in the dissolved form. Hardness is also consistently high which tends to mitigate the effects of the dissolved metals. None of the dissolved metals exceed freshwater CTR criteria this year and very few have exceeded these criteria since implementation of the monitoring program.

- Concentrations of bacteria exceed Basin Plan public health criteria and are comparable to levels in stormwater runoff in most cases. The only exception is that total and fecal coliform measured in Bouton Creek during dry weather have often been less than the Basin Plan single sample criteria.

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

Alamitos Bay Receiving Water Program

Monitoring of a stormwater plume in Alamitos Bay was conducted following a storm event on February 2, 2004 that resulted in 0.67 to 0.77 inches of rainfall at each mass emission monitoring site. Rainfall at each site lasted for roughly two and a quarter to three and a half hours from approximately 20:00 to 23:35 hours on the night of February 2, 2004. The plume characteristics were evaluated on the morning of February 3, 2004 from 0521 to 0954 hours. After mapping the plume, sampling was initiated at RW1 where salinity within the plume was 12.8 ppt. Three additional sites were sampled with recorded salinities of 23.2 ppt (RW2), 25.1 ppt (RW3) and 31.6 ppt (RW4). Influence of stormwater would, therefore, be highest at RW1 and lowest at RW4.

This was the second plume study conducted in Alamitos Bay. The first study was associated with an event that yielded roughly 1.25 inches of rainfall in a period of four to five hours. The February 2, 2004 event yielded roughly half the rainfall of the first event.

- Measured salinity within the study area varied from 1 to 32 ppt. The lowest salinities were measured within the lower reaches of the Los Cerritos Channel near the Pacific Coast Highway Bridge. The plume quickly dissipated as it entered Marine Stadium and the main portion of Alamitos Bay.

- The fresher water of the stormwater plume generally formed a surface plume that was typically one to three feet in depth. The layer was thickest and most distinct in Cerritos Creek.

- The stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically six degrees centigrade lower at the surface than the deeper marine waters. Turbidity in the surface plume ranged from 5 to 16 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 1.3 to 5 NTU.

- Total suspended solids increased from 2 to 12 mg/L as the surface salinity decreased from 31.6 to 12.8 ppt. Similarly, total copper, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Concentrations were highest inside Cerritos Channel and lowest at station RW4 in Alamitos Bay. Total nickel reversed the trend with increasing concentrations with increasing salinity. Total cadmium was not detected in any of the samples.

- As noted in the previous year, no strong spatial trends were evident in the distribution of dissolved metals. Dissolved zinc was the only metal that showed a positive relationship to increasing proportions of stormwater.

- Organophosphate (OP) pesticides were mostly not detected. Diazinon was the the only OP pesticide detected in the plume and it was detected at 0.093 ug/L at RW1 where the stormwater plume was most distinct.

- Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test. Samples from each of the Receiving Water stations were tested at five concentrations (3.1%, 6.25%, 12.5%, 25%, and 50%) and showed modest to negligible toxicity with a gradient of increasing toxicity from samples with a low percentage of stormwater (RW4 - 7% stormwater) to samples with a high percentage of plume water (RW1 - 62% stormwater). NOECs ranged from 25% to 50% sample, and EC_{50}s ranged from 44.7% to >50%. Mean proportion fertilized in the highest (50%) sample concentrations ranged from 38.2% to 95.6% with the RW1 sample having the greatest toxicity and the RW4 sample having the lowest.

- In similar studies conducted in Santa Monica Bay (Bay and Schiff, 1999) and in San Diego Bay (Schiff, Bay and Diehl, 2001) much higher toxicity has been observed in stormwater plumes. Stormwater plumes from Ballona Creek resulted in substantial toxic effects when stormwater was diluted as low as 10%. In San Diego Bay, a stormwater plume from Chollas Creek produced substantial toxicity in samples comprised of greater than 25% stormwater. In contrast, receiving water from our study at RW1 contained 68% stormwater and had a NOEC of 25% and an EC_{50} of 44.7% (TUa=2.2). TUa, Acute Toxicity Unit is equivalent $100/EC_{50}$. The lower levels of toxicity of the stormwater plume in Alamitos Bay are consistent with lower concentrations of dissolved zinc relative to both the Ballona Creek and San Diego Bay studies.

Temporal Trends in Constituents of Concern

Temporal trends were examined over the life of the NPDES permit for selected trace metals and organic compounds, TSS, and bacteria. 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 often 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 but the highest concentrations still tend to occur during winter storm events. 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.

- Over the past three years, the highest concentrations of two organophosphate compounds, chlorpyrifos and diazinon, have occurred during wet weather runoff but no seasonal trends were noted for either compound. The highest concentrations of both these contaminants were reported during the 2001/2002 wet weather season. Since that time, concentrations appear to be declining. This could simple be an artifact or initial evidence of reduced use of these chemicals in response to public education efforts.

- Characteristics of stormwater discharges from the Dominguez Gap Pump Station are consistent with earlier observations at this site. A total of nine events have been monitored over the past five years. Concentrations of total and dissolved cadmium, copper, nickel, and zinc have remained relatively constant. Discharges from this site still tend to have lower concentrations of total metals than the other mass emission sites.

Relationships of Dissolved Metals to Hardness and freshwater CTR Water Quality Criteria

- During the past five years three dissolved metals (copper, lead and zinc) tended to frequently exceed CTR freshwater quality criteria. The criteria for these metals are all strongly related to water hardness. In order to explore this relationship, the concentrations of these three metals were graphed against hardness data using data from the full five years of the monitoring program

- Although the range of concentrations for dissolved copper are similar during wet and dry weather, concentrations of dissolved copper rarely exceed the criteria due to elevated hardness. The Los Cerritos Channel site was the only monitoring site where dissolved copper exceeded water quality criteria during dry weather. During wet weather conditions, exceedances of the freshwater CTR criteria for dissolved copper are common at all sites including the Dominguez Gap Pump Station.

- High hardness values during dry weather also tended to mitigate potential exceedance of the CTR freshwater criteria. Dry weather concentrations of dissolved lead exceeded the CTR criteria twice in Bouton and once at the Belmont Pump Station. In general, both of these sites also tended to have higher concentrations than encountered at the Los Cerritos Channel site. All wet weather measurements at both the Bouton and Belmont Pump Station monitoring locations consistently exceeded the chronic lead criteria but none exceeded the acute lead criteria.

- Plots of dissolved zinc versus hardness (Figure 9.19) further reinforce temporal trends noted in the previous section. Concentrations of dissolved zinc during dry weather are consistently lower than during wet weather. Combined with elevated hardness values, no dissolved zinc concentrations even came close to the CTR freshwater chronic criteria. Although the concentrations of dissolved zinc measured during wet weather at the Los Cerritos Channel site were similar to those measured at both the Belmont Pump Station and Bouton Creek sites, exceedances were more common due to lower hardness values associated with the samples.

Relationships of TSS and Total Metals to Storm Flow,

- Three of the monitoring locations, including the Los Cerritos Channel, Belmont Pump and Bouton Creek sites, show similar responses between TSS and all four total metal (Al, Cu, Pb, and Zn) concentrations. The highest concentrations generally occur in association with low flow events. Lower concentrations tend to occur in association with higher flow events. This type of relationship is consistent with build up / washoff type model where a finite source of material is diluted by increasingly larger volumes of runoff. This type of relationship appears to be unique to urban environments. In larger river systems there is typically log-linear relationship between TSS and flow.

- The Dominguez Gap Pump Station differs substantially from the other three sites in how concentrations of TSS and total metals respond to flow. Concentrations of TSS and total metals generally show little response to total flow.

- At all sites, dissolved metals are relatively constant over a wide range of flow. This is consistent with temporal observations that show that dissolved metal concentrations do not covary with concentrations of total metals.

Relationships between TSS and Total Metals,

- Data from wet and dry weather studies over the past years were examined to determine if significant relationships existed between TSS and total recoverable metals. Concentrations of total recoverable lead were found to be explained largely by TSS at each station. Regressions of TSS and other total recoverable metals showed strong, but more variable relationships among sites.

Toxicity Results

- Toxicity to one or both test organisms was detected at all three of the stations sampled this year during the first two wet weather storm events. Water flea toxicity was seen only during the second storm at the Cerritos station, but not at all at the Belmont and Bouton stations. Sea urchin toxicity was seen during the first two storms at Belmont and Bouton stations, and only during the second storm at Cerritos. No wet weather toxicity to either species was detected after the second storm. The frequency and magnitude of stormwater toxicity from the Long Beach stations during this monitoring period were markedly reduced from all three previous Long Beach stormwater programs. The only exception to this generalization was the high and possibly spurious (see discussion) urchin toxicity measured during the second storm at Belmont. Frequency and magnitude of stormwater toxicity were also reduced compared with 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 Fall dry weather samples and all of the Spring dry weather samples except those from Belmont Pump station. The magnitude of toxicity was not consistently less than that measured in the wet weather samples as seen in the first two Long Beach studies. These results do not support a 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 six TIEs (four wet weather and two dry weather) were triggered in 2003/2004,. Of these six TIEs, three were abandoned without evaluation when toxicity fell below minimum values in baseline samples. The three remaining TIEs yielded useful information. The results of this year were consistent within each species and somewhat different from those obtained in previous years.

- In contrast to previous years, neither of the TIEs conducted using the water flea indicated that organophosphate pesticides were likely toxic constituents, but rather unidentified non-polar organics and metals were implicated.

- The toxicity data also implicated dissolved metals, including copper, lead nickel and zinc, as causes of stormwater toxicity. These conclusions are generally supported by 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.

A Continuous Deflective Separation (CDS-PSW100-80) Unit being installed in the City near the intersections of 20th Street and Walnut Avenue tributary to Hamilton Bowl, a County-owned flood retention basin.

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 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.

Since issuance of the 1999 NPDES permit, the population served by City of Long Beach has increased by nearly 8 percent. When the permit was issued, the population was estimated at 452,000. Current estimates place the City's population at 487,000[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[3].

2.1 Annual Program Adjustments

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 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.

[2] Population estimate. State of California Department of Finance Demographic Research Unit

[3] Los Angeles Regional Water Quality Control Board, 2002 303(d) list

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.

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.

Major program adjustments implemented in the final year of the current permit were detailed in the September 12, 2003 letter from the Executive Officer. Adjustments were based upon meetings with Regional Board staff, the City of Long Beach, Kinnetic Laboratories, Inc., and SCCWRP. The following summarizes the most significant changes.

- Suspend analyses of parameters that have been infrequently detected and/or typically detected at low levels not considered to be ecologically important. Specific analytes included antimony, beryllium, hexavalent chromium, mercury, thallium, total recoverable petroleum hydrocarbons (TRPH), MTBE, cyanide, glyphosate, 2,4,D and 2,4,5-TP (Silvex).
- Continue with the plume study. Target first storm of the season that exceeds 0.25-0.30 inches of rainfall in the study area.
- Suspend mysid toxicity tests previously conducted in conjunction with the first storm of the season.
- Raise the trigger point for implementation of TIEs from 2 Toxicity Units (TUs) to 3 TUs.
- Change the monitoring strategy to emphasize sampling runoff during early season storm events
- Suspend PAHs and semivolatile organic compounds from analysis during the 2003/2004 (final year) of the permit since the current detection limits are not low enough to provide any meaningful data. The model monitoring program being developed by the Southern California Stormwater Monitoring Coalition (SMC) is expected to develop consistent monitoring designs, sampling and analysis, and quality assurance protocols.
- Monitor Total Suspended Solids (TSS) and stormwater discharges for all storm events at all four monitoring stations.

The purpose of this report is to present and analyze the samples and data collected during the fifth year of permit and to provide an overall synthesis of major finding from initial term of the permit.

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 section 4.0.

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 487,000 residents in January 2004 (California Department of Finance Demographic Research Unit, 2004). The total population of the County of Los Angeles, in which it resides, was 10,103,000. 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 10,700. 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.

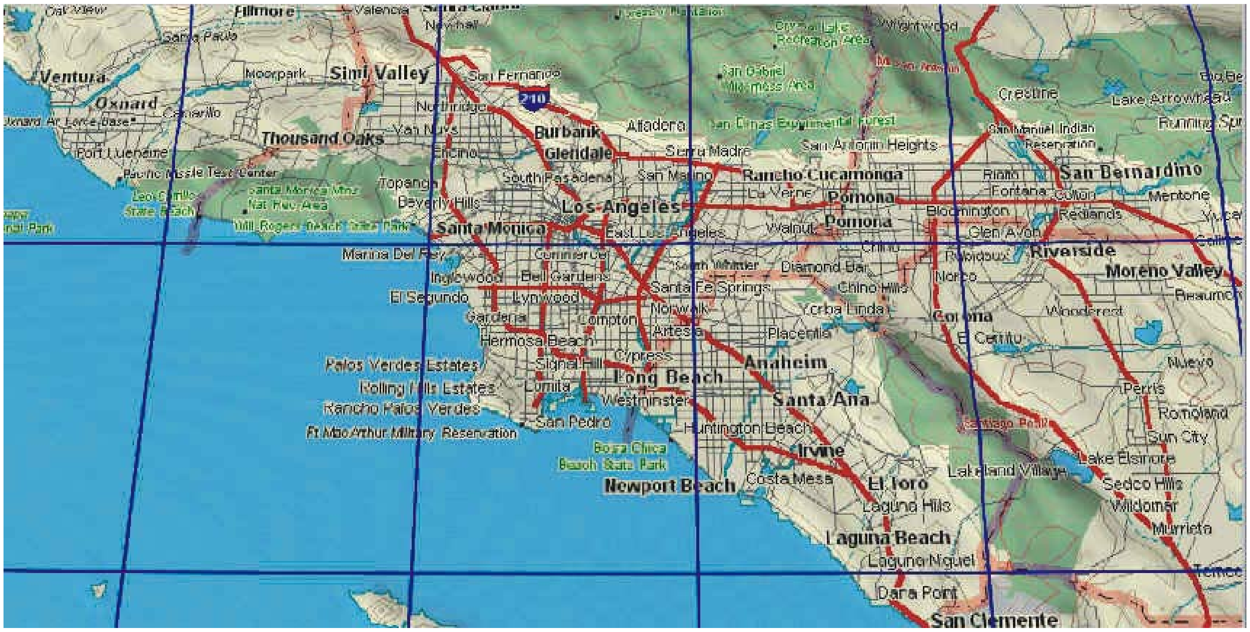

Figure 3.1 Los Angeles Basin. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

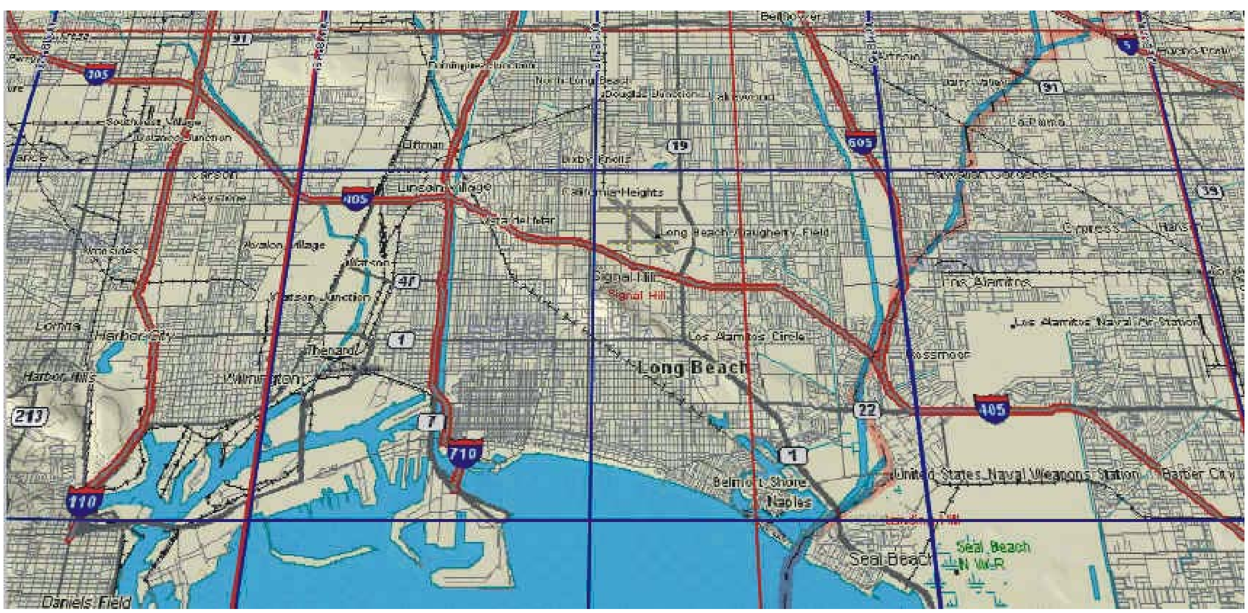

Figure 3.2 City of Long Beach. (Source: 3-D TopoQuads Copyright 1999 DelLorme, Yarmouth, ME 04096).

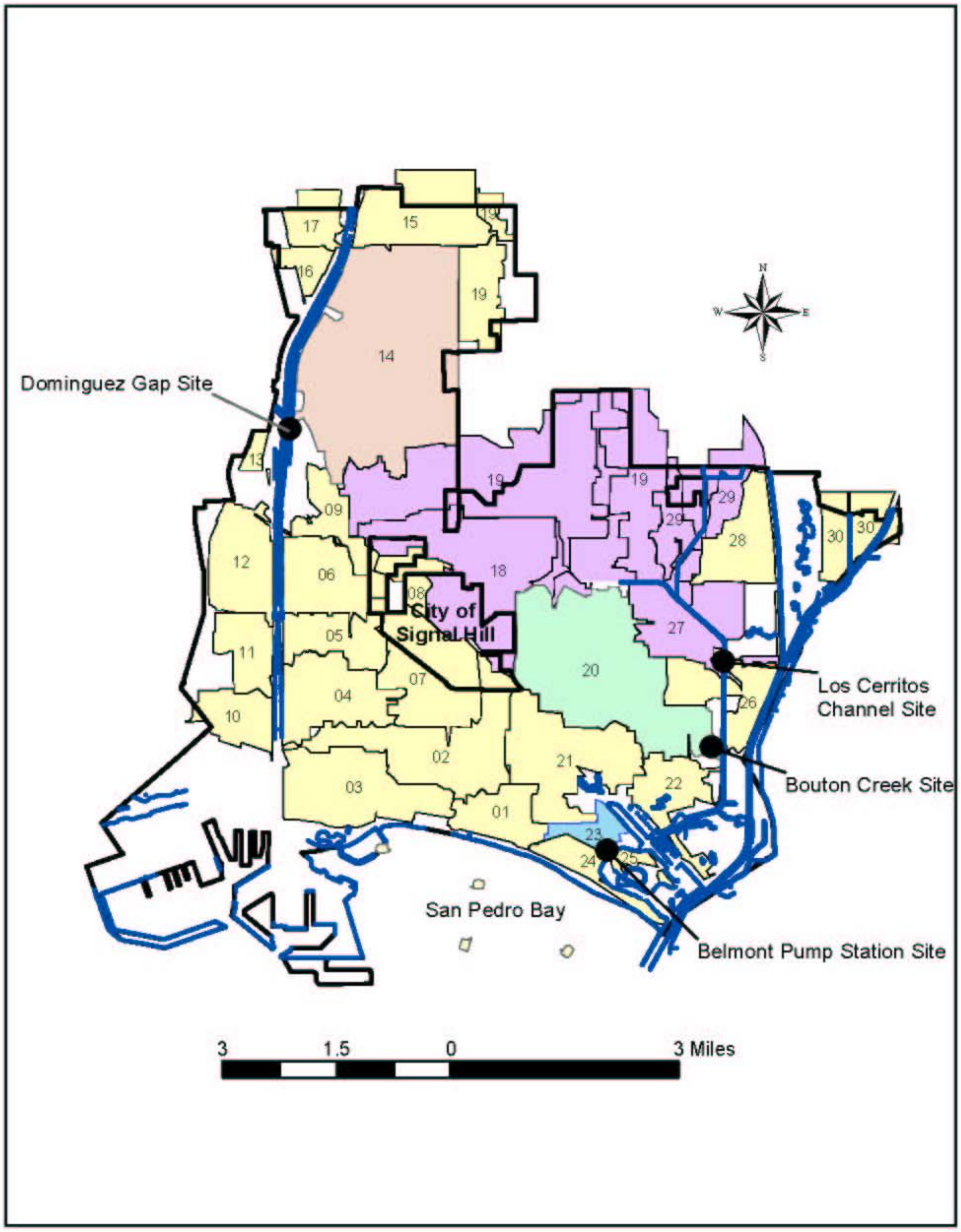

Figure 3.3 City of Long Beach Major Drainage Basins (Source: City of Long Beach, Department of Technology Services, last update 1994) and City of Long Beach Stormwater Monitoring Sites.

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

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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.

Monitoring efforts during the first term of the permit have emphasized 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 2003/2004 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.

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 Portions of Basins 18, 19, 27 and 29: Los Cerritos Channel Monitoring Site

The Los Cerritos Channel Monitoring Site receives runoff from all or portions of four different basins. Small portions of the watershed are located outside of the City of Long Beach. This includes roughly 577 acres of the City of Lakewood and 581 acres of the City of Signal Hill.

The total area of watershed above the sampling site is approximately 7685 acres. Land use within the watershed consists of 65% residential, 12% commercial, 12% institutional and 5% open space (Figure4.4).

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 second 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 receiving 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 20 to 30 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 (4ºC) 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 and fecal coliform, and enterococcus 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.

4.4.1.3 Alamitos Bay Receiving Water Study

This element of the stormwater monitoring program was initiated during the 2001/2002 annual program review with Regional Board staff. A pilot receiving water program was first conducted during the 2002/2003 season. This program was retained as a component of the 2003/2004 monitoring effort. The primary objectives of the 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 program was intended to be conducted once during the early portion of the 2003/2004 wet-weather season. The study area included all of Alamitos Bay, Marine Stadium and the Los Cerritos Channel up to the first upstream bridge. This year's study was to target an early season event of smaller magnitude than the storm monitored during the 2002/2003 season. The target event was an early season event where total rainfall was expected to range from 0.25 to 0.50 inches. 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 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 TPH and bacteria. All samples were chilled to 4 ºC 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 as modified through the annual review process. 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.

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 USEPA Functional Guidelines for Low Level Concentration Organic Data Review (EPA540-R-00-006), USEPA Functional Guidelines for Inorganic Data Review (EPA 540-R-01-008), 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 A.11). This year the relative toxicity of each discharge sample was evaluated using two chronic test methods: the water flea (*Ceriodaphnia dubia*) reproduction and survival test (freshwater) and the purple sea urchin (*Strongylocentrotus purpuratus*) fertilization test (marine). In earlier years, the mysid (*Americamysis bahia*) growth and survival test (marine) was also used. This year, ToxScan, Inc. conducted all toxicity tests.

Toxicity tests using the marine mysid (*Americamysis bahia*) were conducted during the first three years but these requirements were suspended for the final year of monitoring under the current permit. This report incorporates the mysid toxicity data for comparisons of toxicity over the entire permit period test. Marine toxicity tests were conducted by SCCWRP during the first year of the program.

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 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.

4.5.2.3 Toxicity Identification Evaluations (TIEs)

Phase I TIEs were conducted on selected runoff samples from stations that exhibited substantial (≥ 3 TU) 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.

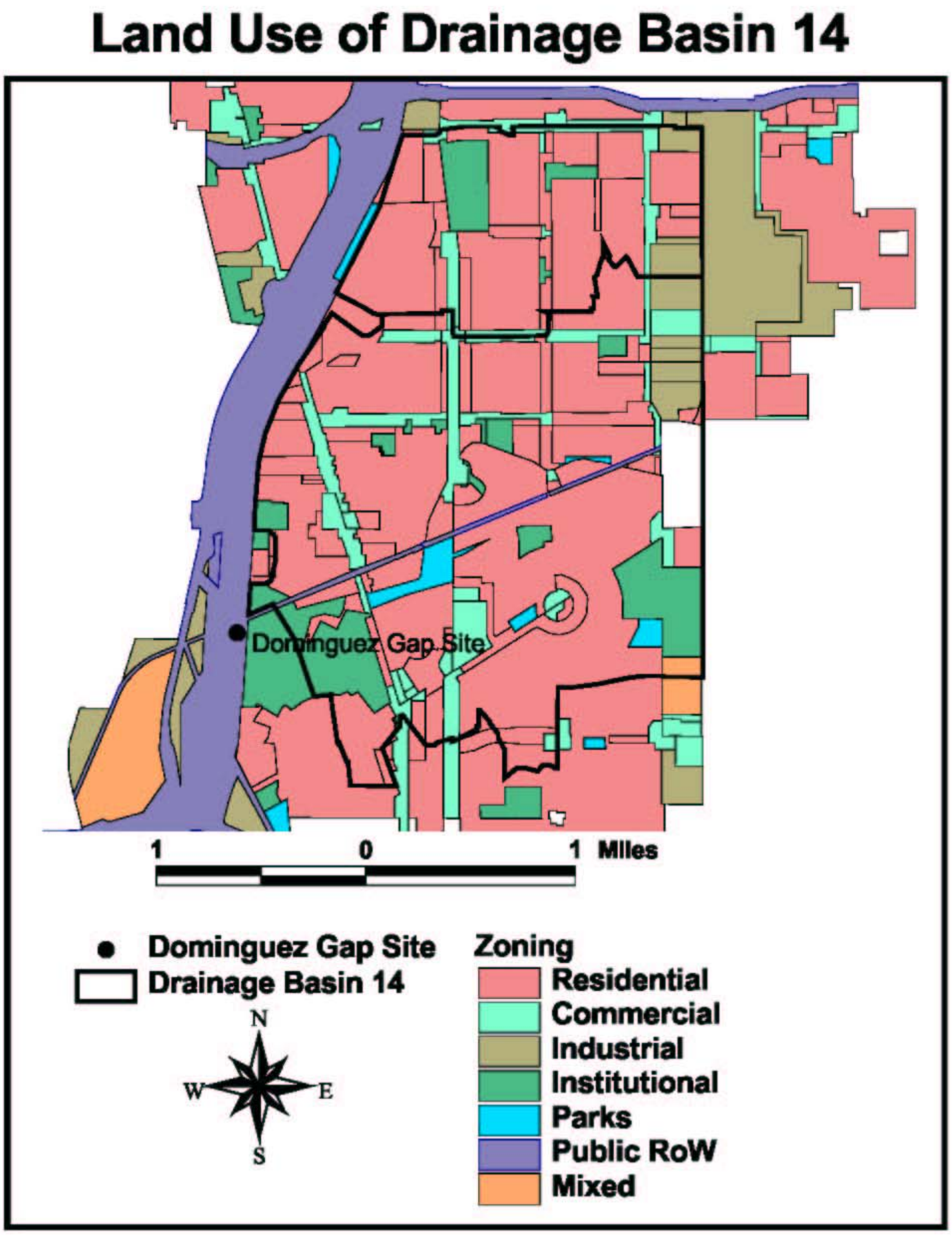


Figure 4.1 Land Use of Drainage Basin #14 which Drains to the Dominguez Gap Mass Emissions Site (Source: City of Long Beach Department of Technology Services, last update 12/20/00).

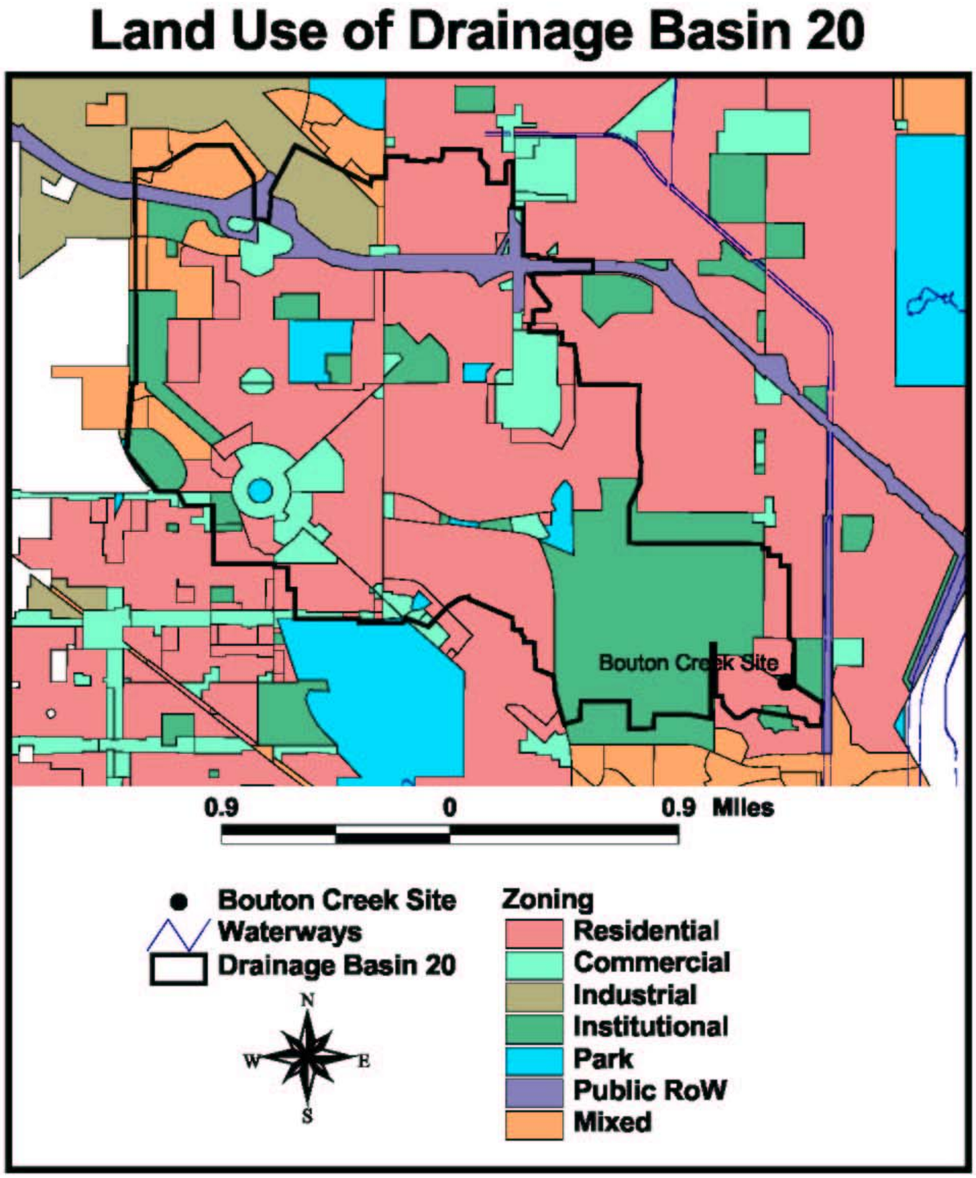


Figure 4.2 Land Use of Drainage Basin #20 which drains to the Bouton Creek Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00).

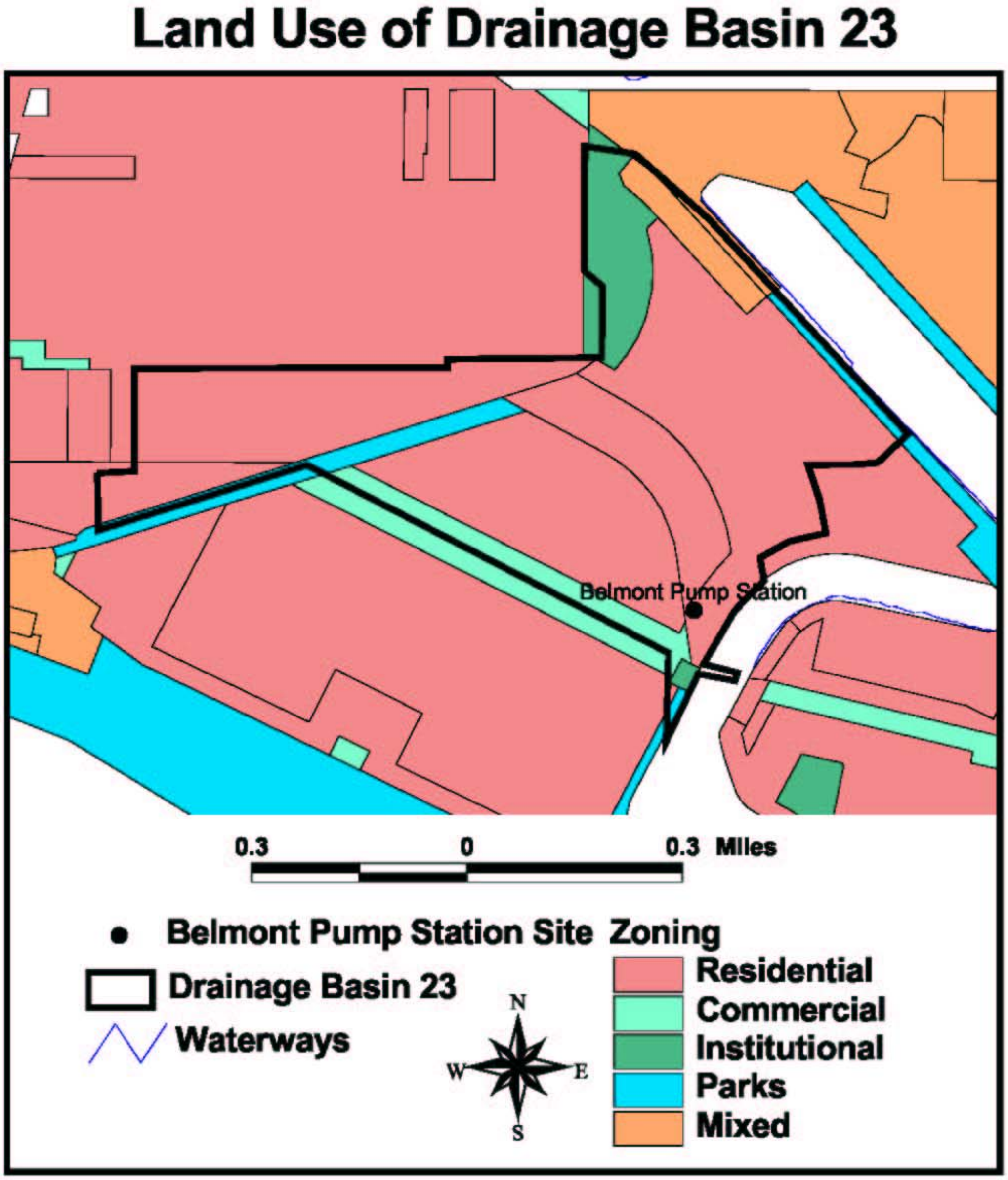


Figure 4.3 Land Use of Drainage Basin #23 which Drains to the Belmont Pump Station Mass Emissions Site (Source: City of Long Beach, Department of Technology Services, last updated 12/20/00)

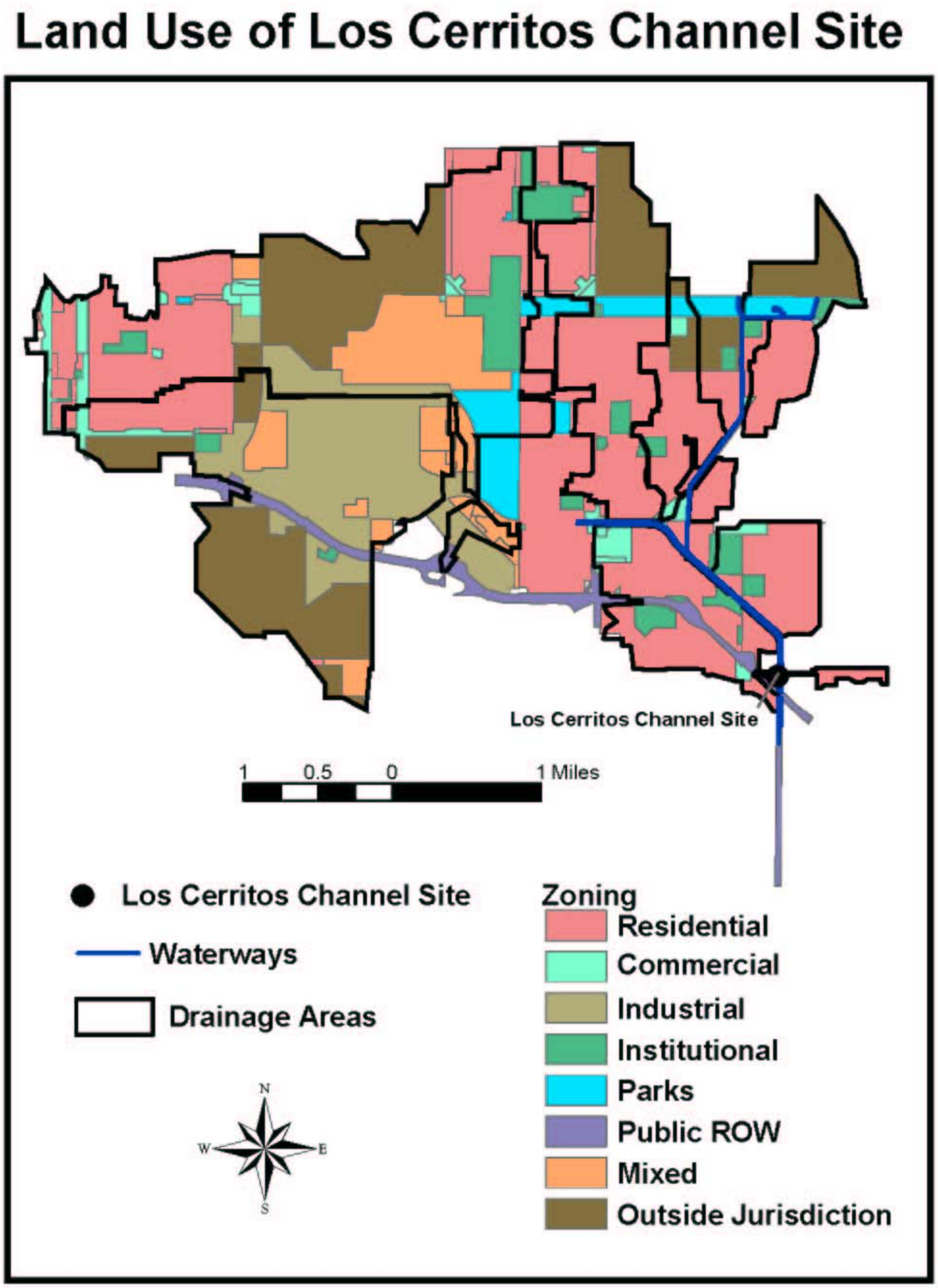


Figure 4.4 Land Use of Drainage Basins which Drain to the Los Cerritos Channel Monitoring Site. (Source: City of Long Beach, Department of Technology Services, last update 12/20/00).

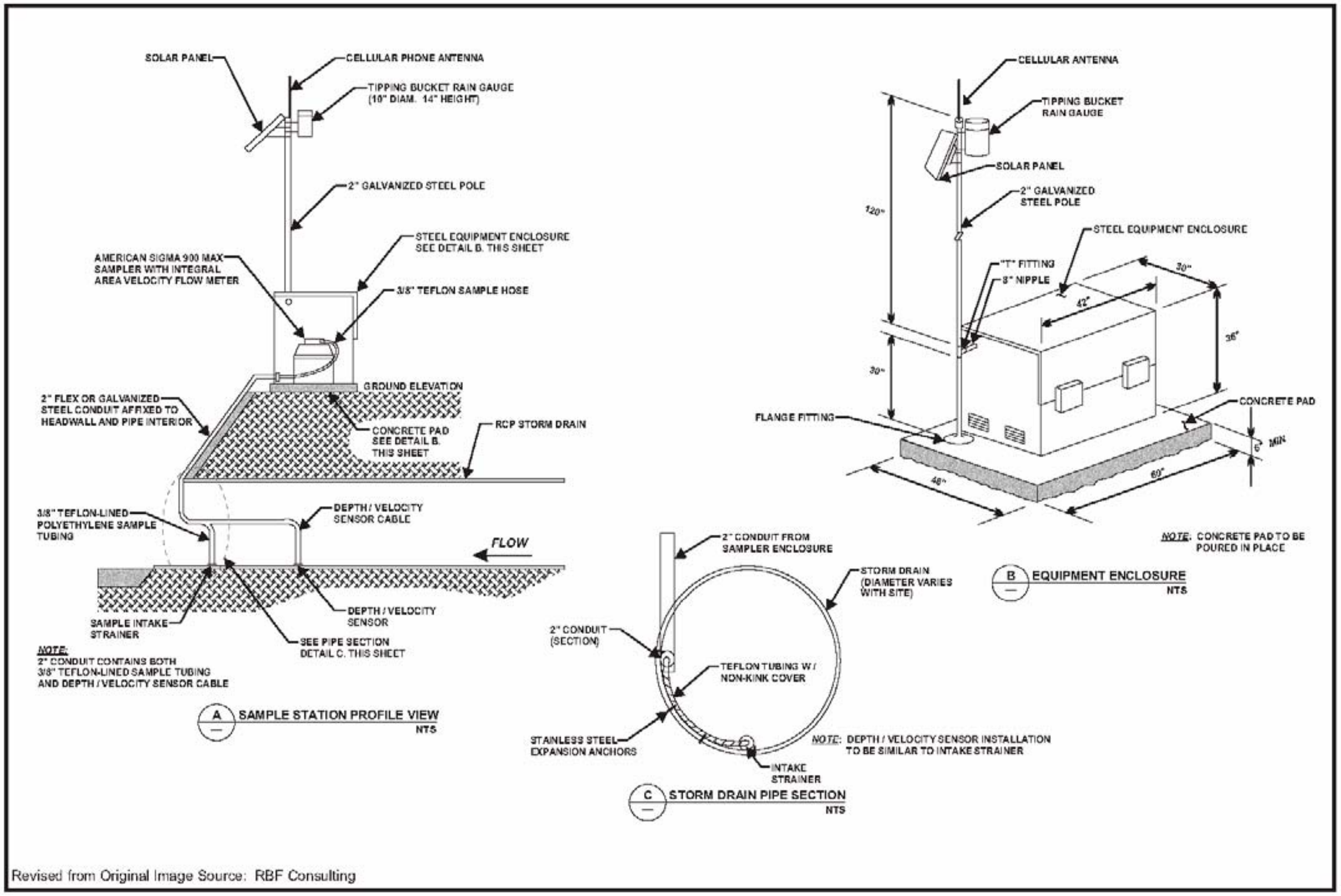


Figure 4.5 Typical KLASS Stormwater Monitoring Station.

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

	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
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
pH (units)	150.1	ASAP	0 – 14
Orthophosphate-P (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
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	0.5
Chloride (mg/L)	300.0	48 hours	1.0
Fluoride (mg/L)	300.0	48 hours	0.1
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
Arsenic	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
Iron	236.1	180 days	25
Lead	200.8	180 days	0.5
Nickel	200.8	180 days	1.0
Selenium	200.8	180 days	1.0
Silver	200.8	180 days	0.25
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
PCBs (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

5.0 RAINFALL AND HYDROLOGY

All Long Beach monitoring stations were fully operational at the end of September 2003 prior to the start of the 2003/2004 wet weather season. For the most part, precipitation and discharge were continuously monitored throughout the season. Due to the lack of rain and poor timing, the first storm event successfully sampled was not until February 2, 2004. In all though, five events were monitored at the Belmont Pump Station, Los Cerritos Creek and Bouton Creek. Only three events were monitored at Dominguez Gap Pump Station due to the lack of discharge flow at this station. The fifth event monitored at the Belmont Pump Station, Los Cerritos Creek and Bouton Creek was for the purpose of total suspended solids analysis only.

5.1 Precipitation during the 2003/2004 Storm Season

The 2003/2004 storm season marked the third straight year of lower than normal precipitation in Long Beach. Normal precipitation for October through April at the Long Beach Airport is 12.27 inches. Three years ago, only 1.99 inches was recorded during this time period. During the 2002/2003 season, 8.62 inches of rain was recorded at the Long Beach Airport. This season, a total of 7.41 inches of rainfall was recorded at the airport during the same time period (Figure 5.1).

Rainfall was relatively uniform at each of the monitoring stations with seasonal totals ranging from 4.68 inches at the Dominguez Pump Station to 5.85 inches at the Bouton Creek stormwater monitoring site.

5.1.1 Monthly Precipitation

Above normal rainfall in Long Beach occurred during the month of February (Figure 5.1), which had 4.66 inches recorded at Long Beach Airport, and the remaining months of the water year were characterized by below normal rainfall. Below normal rainfall was especially evident in January and March, which typically sees nearly three inches of rain at Long Beach Airport in January and nearly 2.5 inches in March. This season, only 0.63 inches fell in January and 0.11 inches fell in March. Although only 0.11 inches was recorded at the Long Beach Airport in March rainfall recorded at each monitoring station in March was around 0.6 inches which was still about 25% of normal.

Total rainfall for the period of October through December was about 60% of normal at Long Beach Airport. The majority of rainfall for this period came from numerous small events totaling less than 0.25-inches each. There was one event that occurred on December 25 and 26, 2003 that totaled around a half an inch. This event was not successfully monitored.

5.1.2 Precipitation during Monitored Events

Precipitation during each storm event has been 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 5.2. Cumulative rainfall and intensity are summarized graphically for each monitored event at each station in Figures 5.2 through 5.15. Note that due to equipment failure, rainfall at the Dominguez Gap Pump Station was not recorded for the March 1, 2004 event. The missing data was substituted with Cerritos Creek data.

Total rainfall varied between 0.24 and 1.78 inches during the five events monitored during the 2003/2004 wet weather season. The fourth event (February 25 and 26, 2004) was the largest with rainfall totals ranging from 1.11 inches at the Dominguez Gap Pump Station to 1.78 inches at Bouton Creek. The smallest event occurred February 18, 2004 (Event 2). Total rainfall from this event ranged from 0.24 inches at the Dominguez Gap Pump Station to 0.29 inches at Cerritos Creek. The mean rainfall amount for all monitored events ranged from 0.65 inches at the Dominguez Gap Pump Station to 0.79 inches at Bouton Creek.

As was seen during the 2002/2003 season, maximum rainfall intensities were again impressive during the 2003/2004 storm season. The mean maximum rainfall intensities among monitored events ranged from 0.56 inches per hour at the Dominguez Gap Pump Station to 0.96 inches per hour at Bouton Creek. Rainfall intensities were as high as 1.92 inches per hour at Bouton Creek during Event 1 (February 2, 2004). The Event 1 rainfall was from a narrow front of intense shower activity that swept through the area within a few hours. Conversely, the Event 3 (February 21 and 22, 2004) maximum rainfall intensities were the weakest (0.24 to 0.36 inches per hour). This event was characterized by light rain that persisted for almost 24 hours.

With some minor exceptions, all storm events monitored were spaced by at least three days of no rainfall. Stations monitored for Events 3 and 4 were either right at three days without rain or within a couple hours of three days. The 16 days preceding the second event on February 18, 2004 was the driest period prior to a monitored event. Overall the mean period of dry conditions between monitored events ranged from 6.2 days at Bouton Creek to 7.7 days at the Dominguez Gap Pump Station.

5.2 Stormwater Runoff during Monitored Events

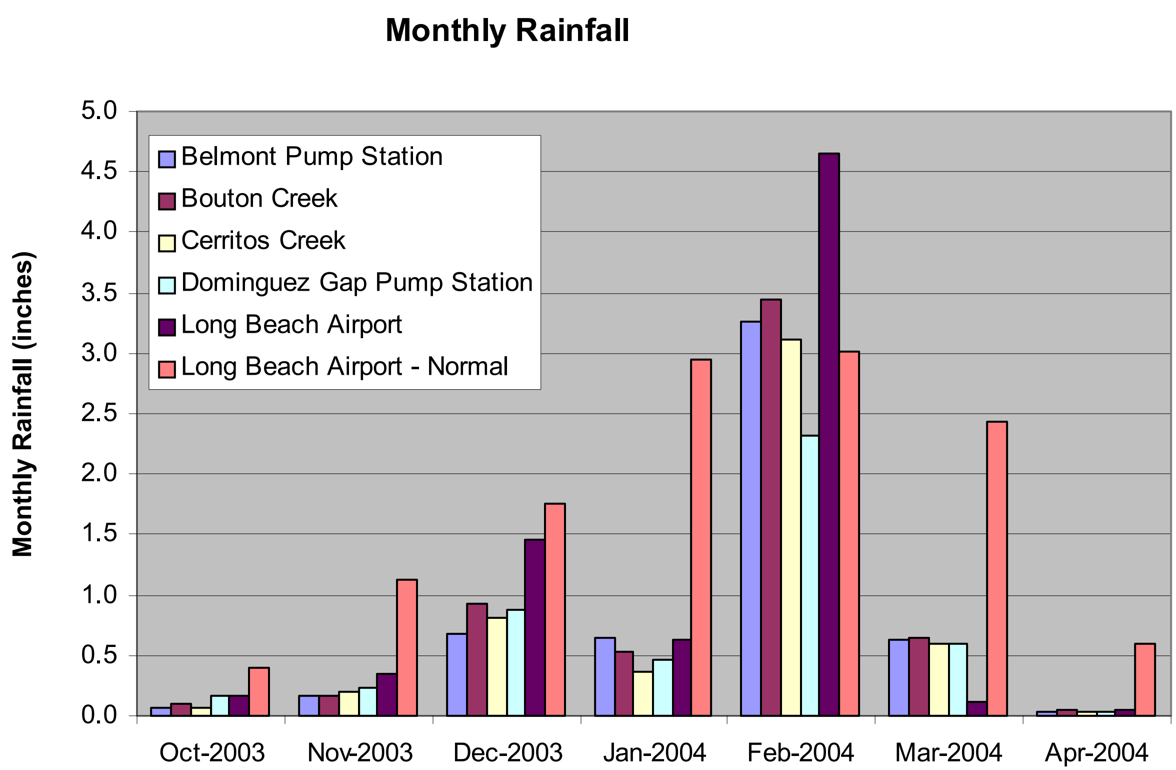
In order to properly estimate Event Mean Concentrations (EMCs) and constituent loadings, monitoring was designed to quantify rainfall events in their entirety and the majority of runoff created by those events. Table 5.3 summarizes flow characteristics among monitored events at each station including the duration of discharge/flow, total discharge volume, and peak discharge/flow. Table 5.2 provides descriptive statistics for all five events monitored during the 2003/2004 season. This information complements the calculated EMCs for each monitored analyte at these sites. Figures 5.2 through 5.15 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.

Flow duration or the period of discharge varied between stations and events. Flow duration was typically greatest at Bouton Creek due to tidal effects and Cerritos Creek due to the large drainage area. During incoming tides at Bouton Creek, low flows are backed up and held back by the tide. As the tide recedes, stormwater is detected at the station using the conductivity sensors and sampling continues. In contrast, the period of discharge at the Dominguez Gap Pump Station was the smallest since most of the runoff from this drainage must fill a reservoir prior to discharge. Because of this reservoir and the relatively small rainfall events monitored this season, discharge at the Dominguez Gap Pump Station most likely would not have occurred automatically during the first event of the season. All discharges from this site were the result of County personnel manually operating the pumps since the Pump Station was not functioning properly.

The duration of discharge reported in Table 5.3 for the Belmont and Dominguez Gap pump stations are often overestimated because of the on and off cycling of the pumps. The discharge durations reported in Table 5.3 represents the period between the first time a pump came on to the time all pumps became silent. One should refer to the hydrographs developed for the pump stations for a better estimate of the duration of discharge.

The percent storm captures (percentage of the total storm event volume effectively represented by the flow-weighted composite sample) were acceptable (>70%) in all cases except possibly one. The total percent storm capture for the last event sampled at the Dominguez Pump Station (March 1, 2004) is unknown due to a communications interruption with the discharge pumps while they were manually operated. Since the water level of the sump was recorded, the discharge volume could be determined, using previous data, during the normal operating range of pumps. Discharge volume below the normal operating range of the pumps could not be determined. Since the sump sample was collected during the normal operating range of the pumps, the discharge volume reported in Table 5.3 is associated only with that normal operating period and any loading estimates calculated are for that period only.

Figure 5.1 Monthly Rainfall Totals for the 2003/2004 Wet Weather Season and Normal Rainfall at Long Beach Daugherty Air Field.



	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04
Belmont Pump Station	0.07	0.16	0.68	0.64	3.26	0.63	0.03
Bouton Creek	0.10	0.17	0.92	0.53	3.44	0.64	0.05
Cerritos Creek	0.06	0.20	0.81	0.37	3.12	0.60	0.04
Dominguez Gap Pump Station	0.16	0.24	0.88	0.46	2.31	0.60	0.03
Long Beach Airport	0.17	0.34	1.45	0.63	4.66	0.11	0.05
Long Beach Airport - Normal	0.40	1.12	1.76	2.95	3.01	2.43	0.60

Figure 5.2. Belmont Pump Station – Event 1 (2 February, 2004).

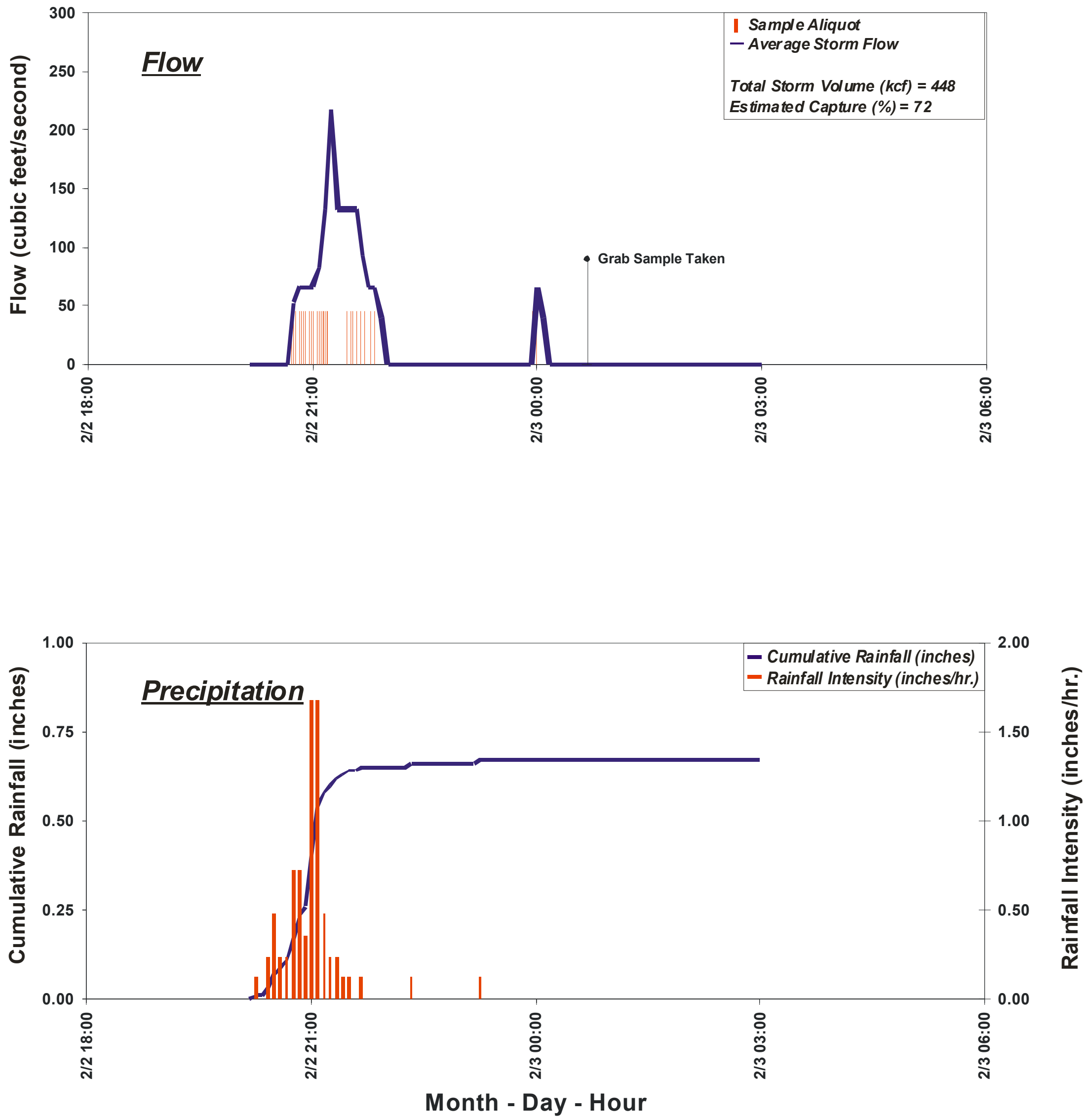


Figure 5.3. Bouton Creek – Event 1 (2-3 February, 2004).

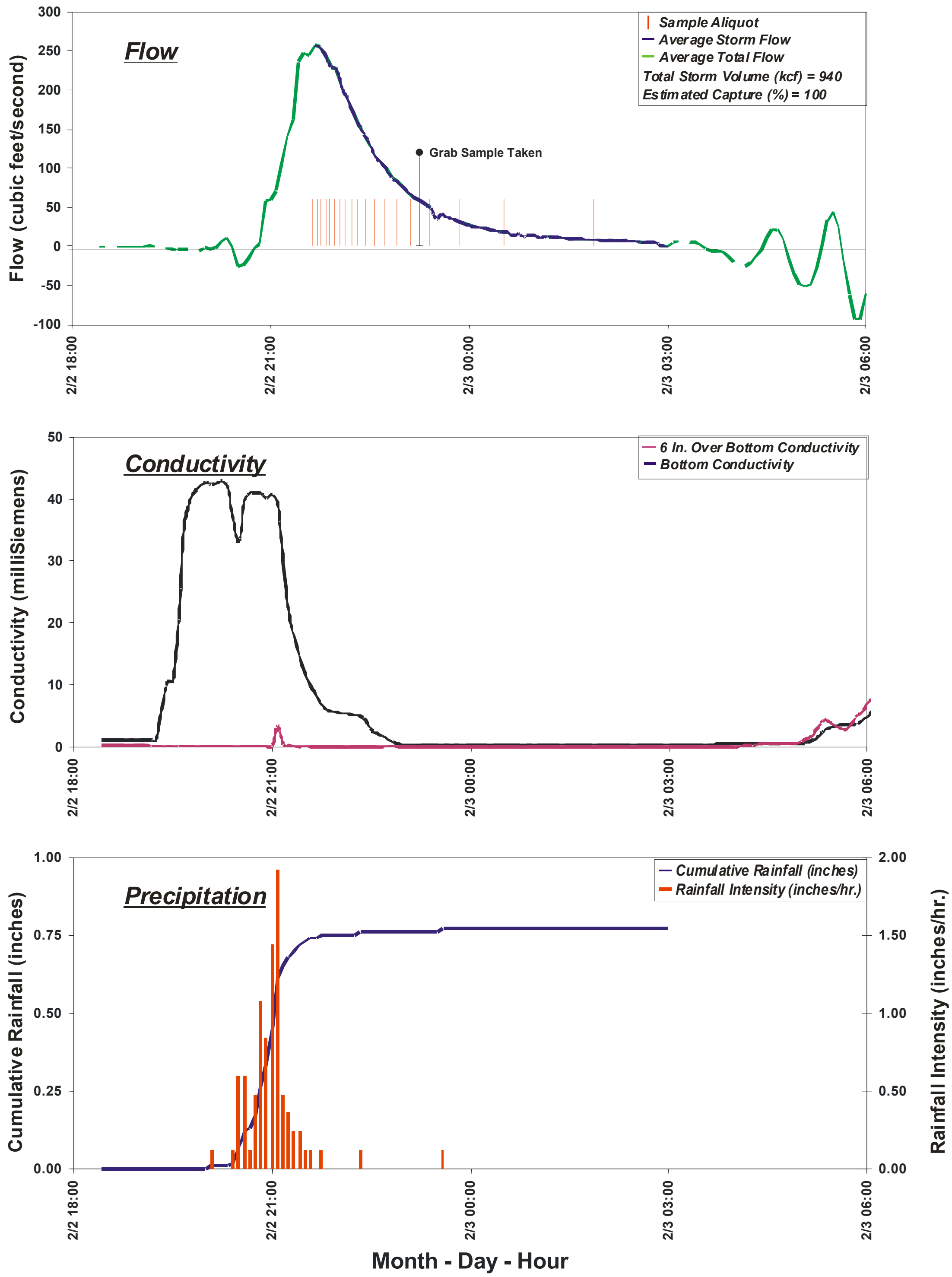
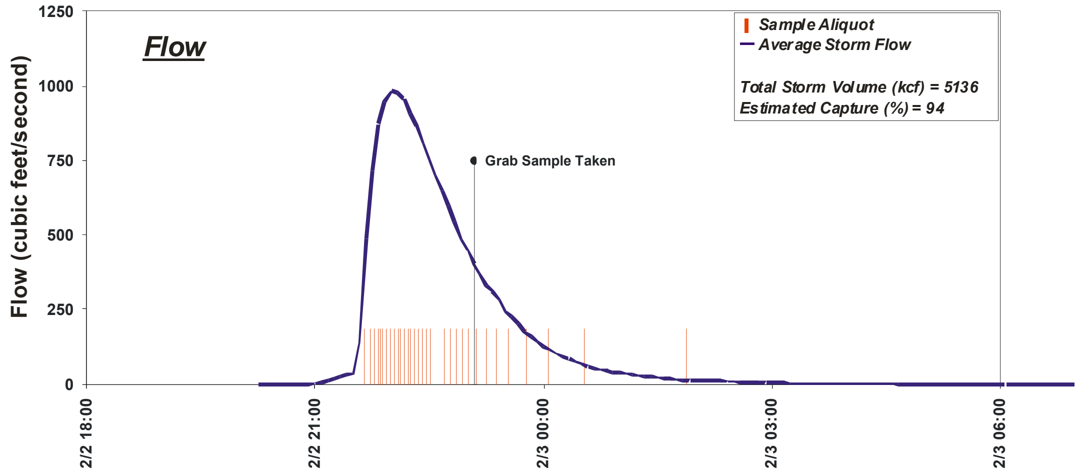


Figure 5.4. Los Cerritos Channel – Event 1 (2-3 February, 2004).



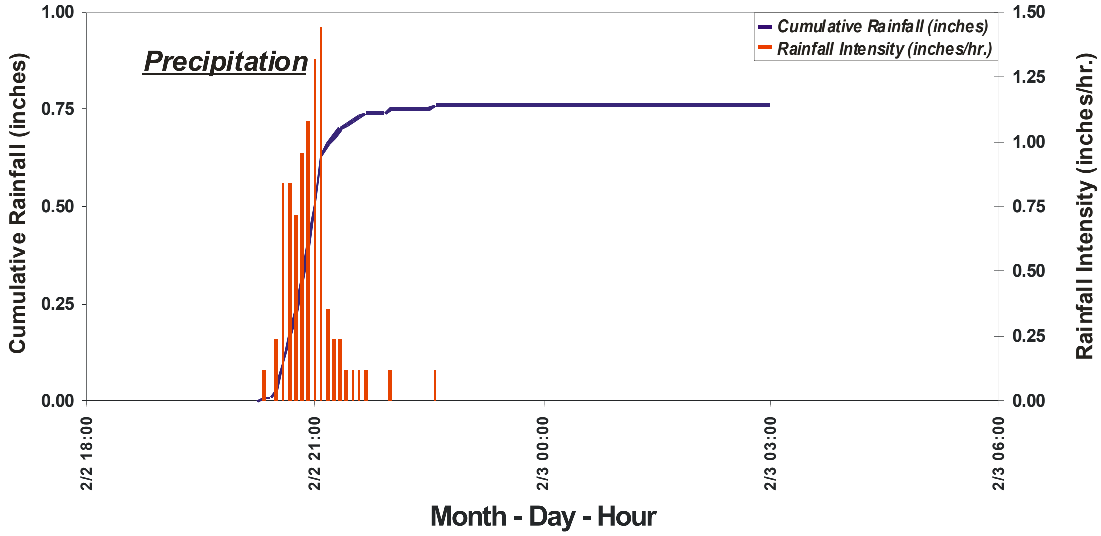
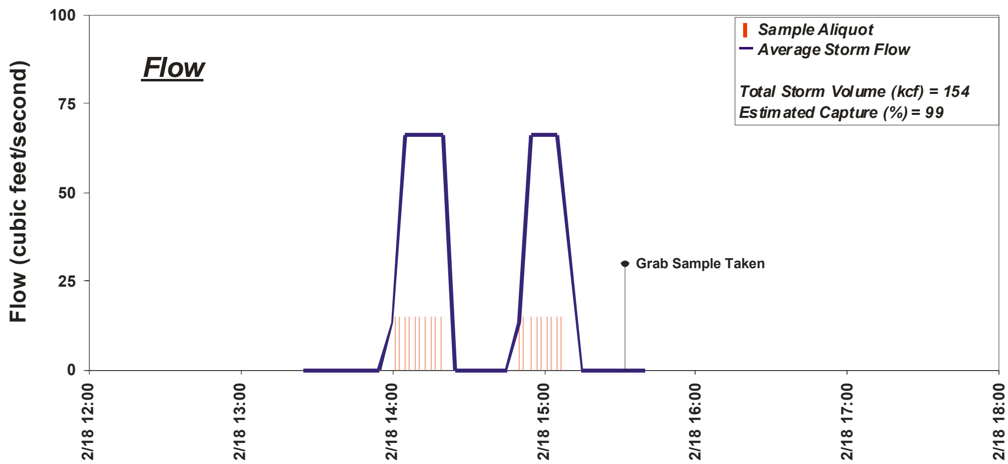


Figure 5.5. Belmont Pump Station – Event 2 (18 February, 2004).



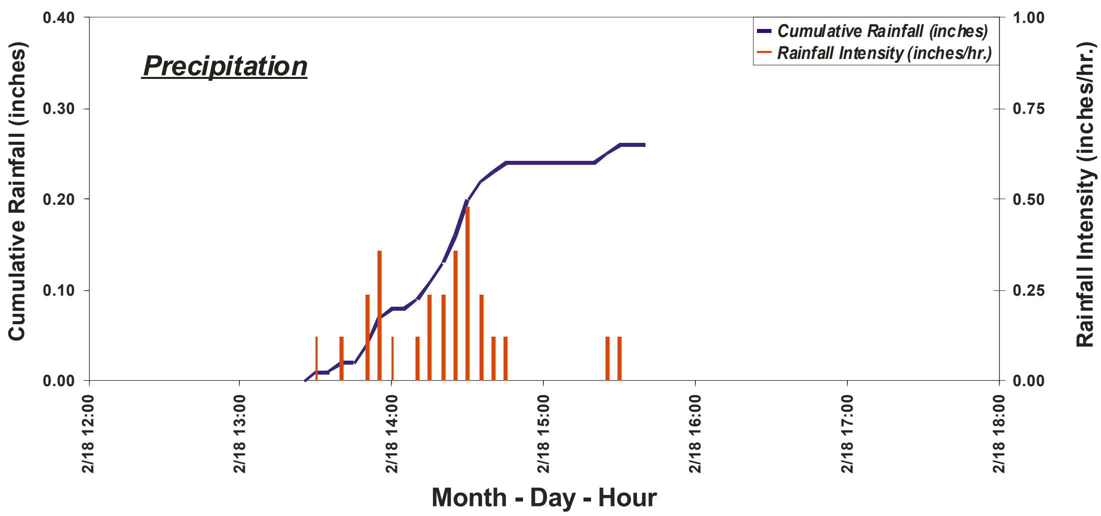


Figure 5.6. Bouton Creek – Event 2 (18 February, 2004).

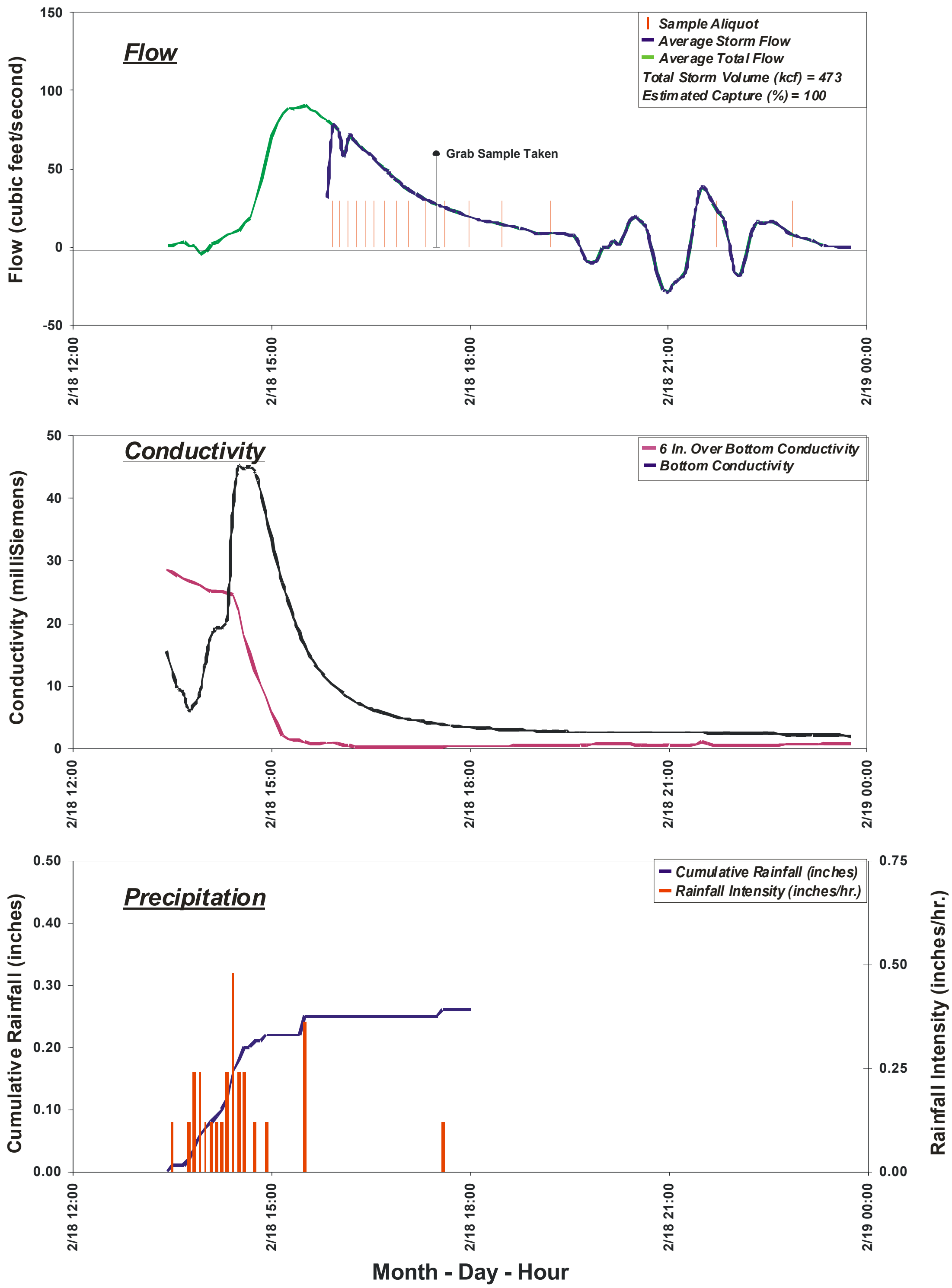
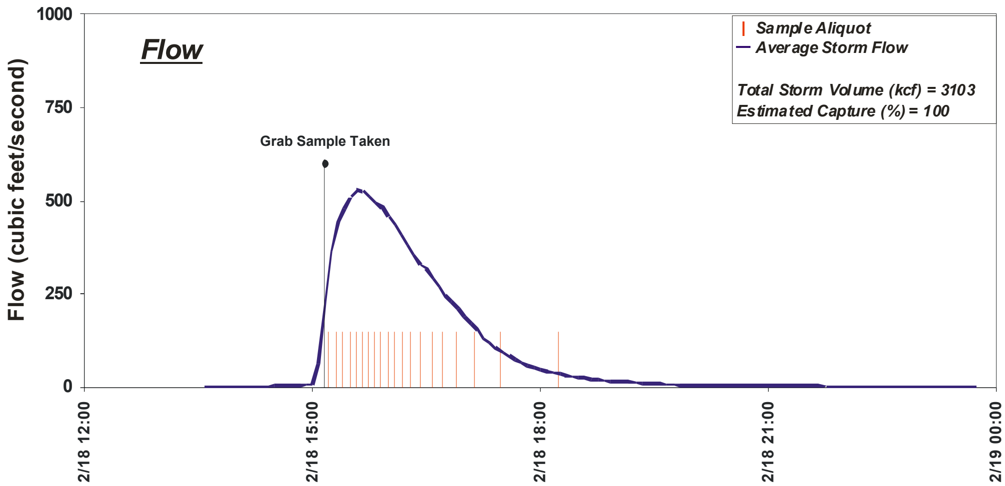


Figure 5.7. Los Cerritos Channel – Event 2 (18 February, 2004).



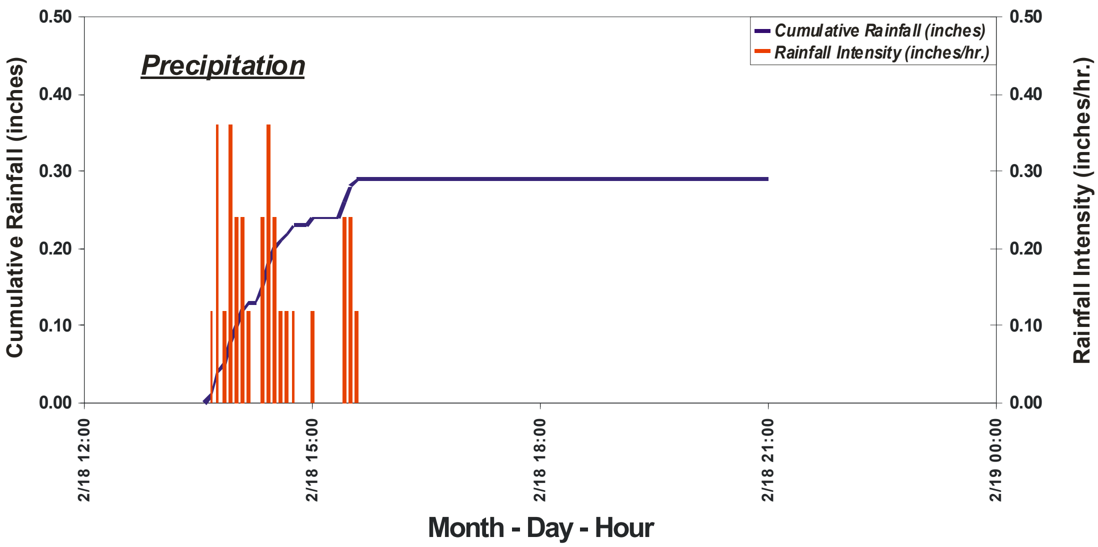
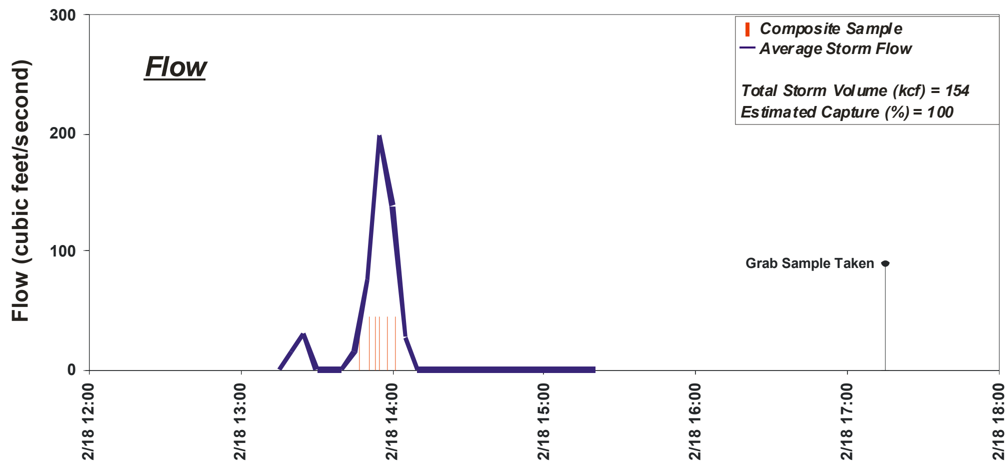


Figure 5.8. Dominguez Gap Pump Station – Event 2 (18 February, 2004).



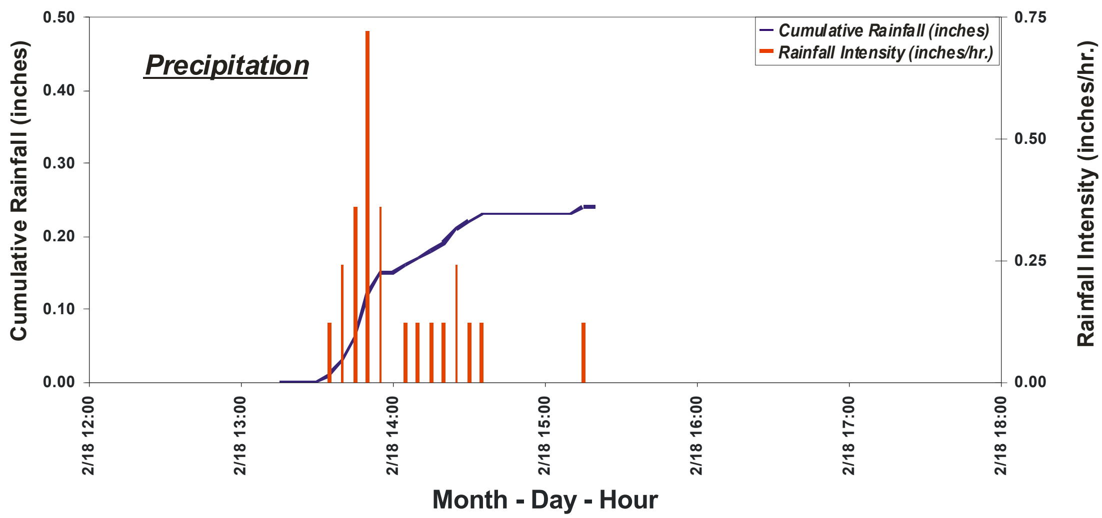
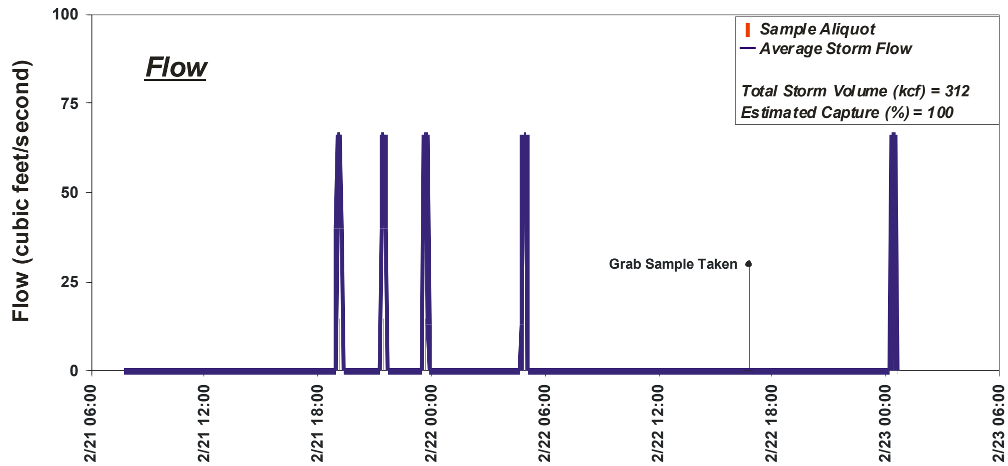


Figure 5.9. Belmont Pump Station – Event 3 (21-23 February, 2004).



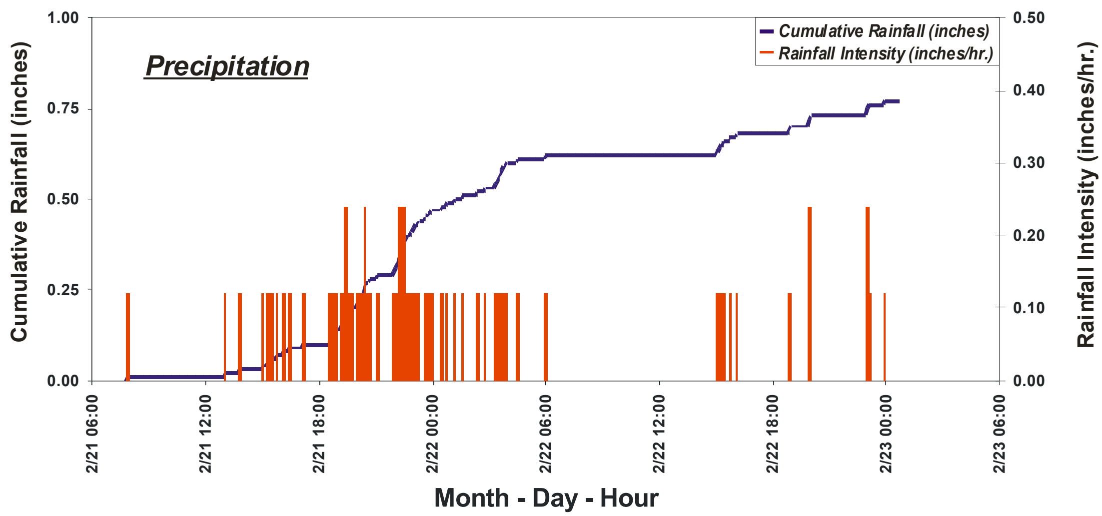


Figure 5.10. Bouton Creek – Event 3 (21-22 February, 2004).

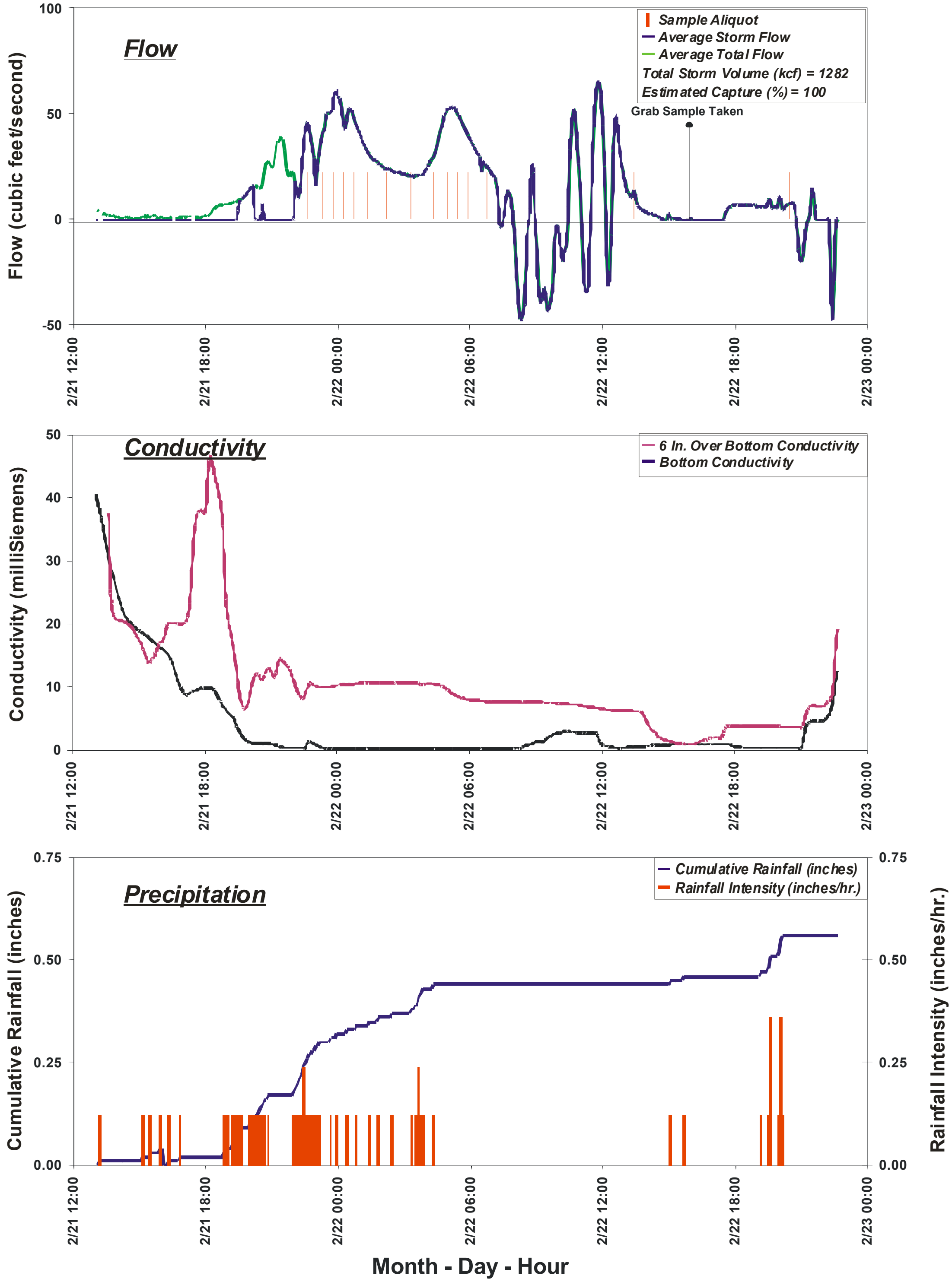


Figure 5.11. Los Cerritos Channel – Event 3 (21-23, February, 2004).

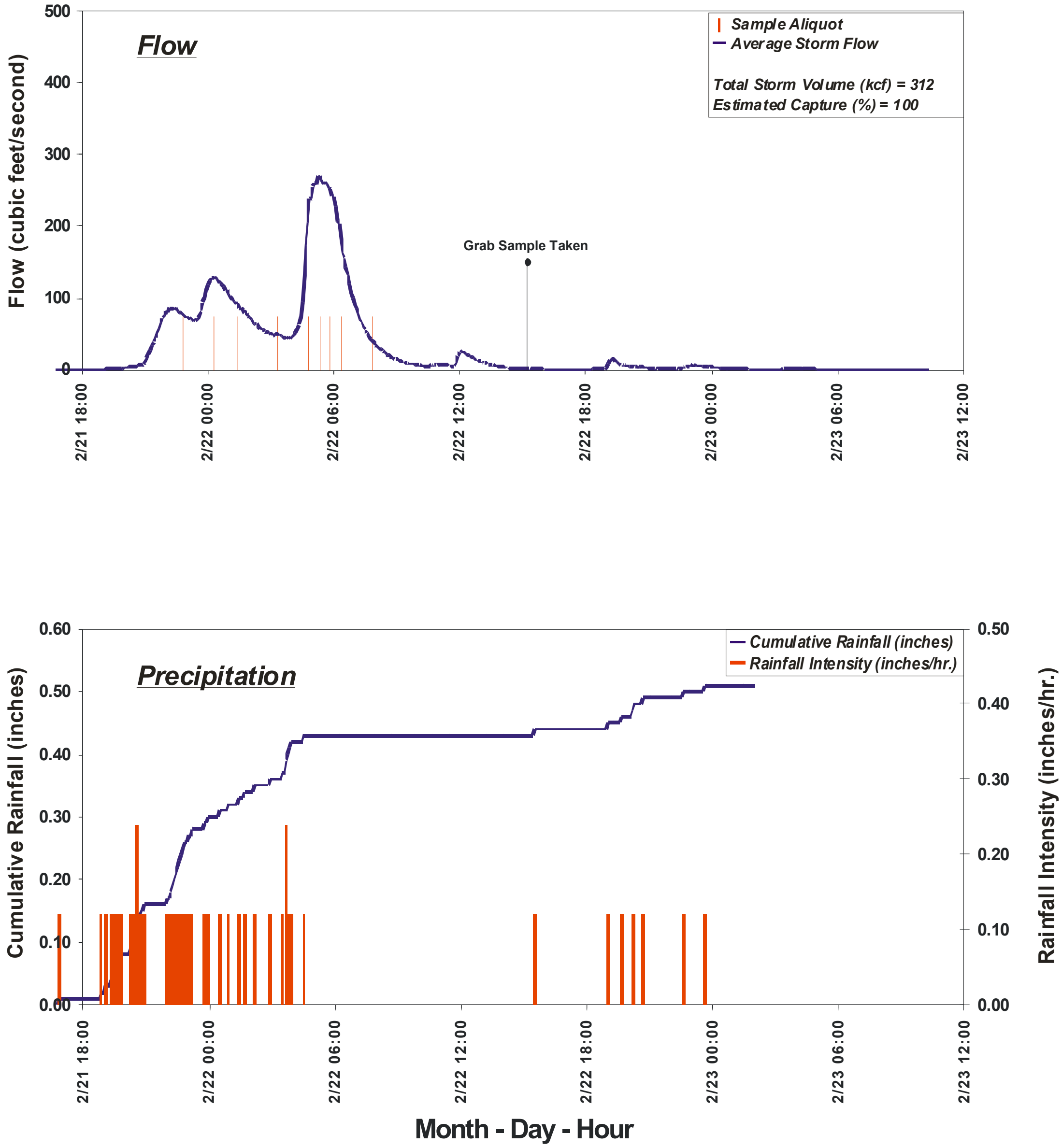
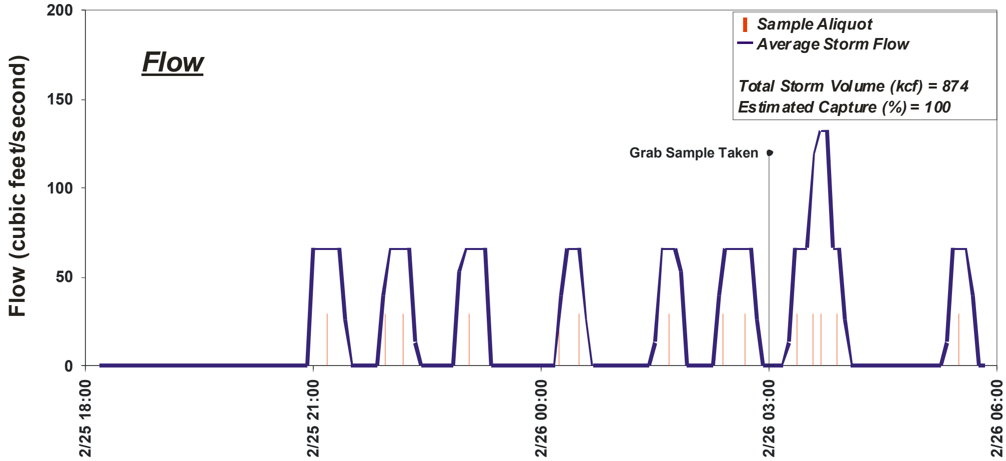


Figure 5.12. Belmont Pump Station – Event 4 (25-26 February, 2004).



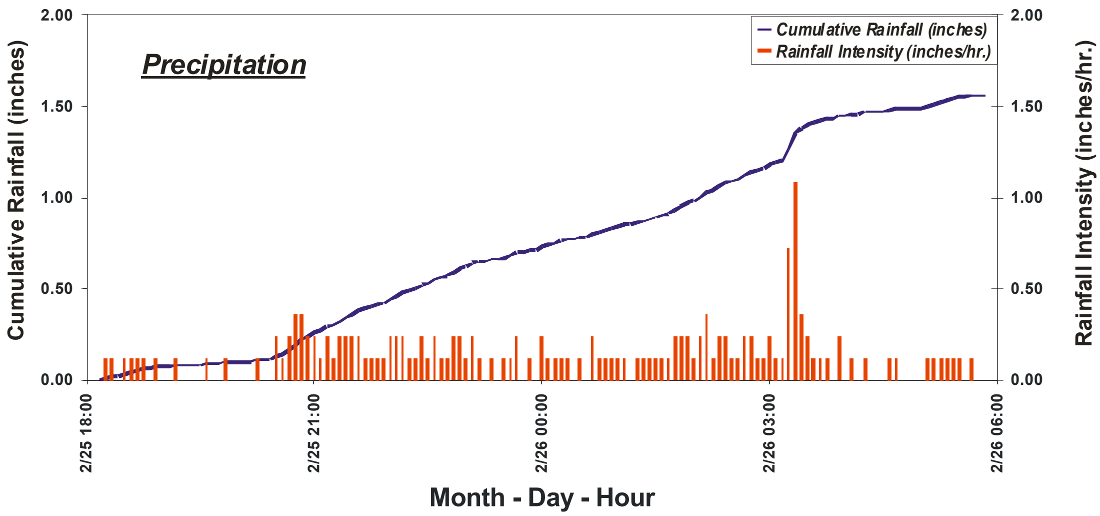


Figure 5.13. Bouton Creek – Event 4 (25-26 February, 2004).

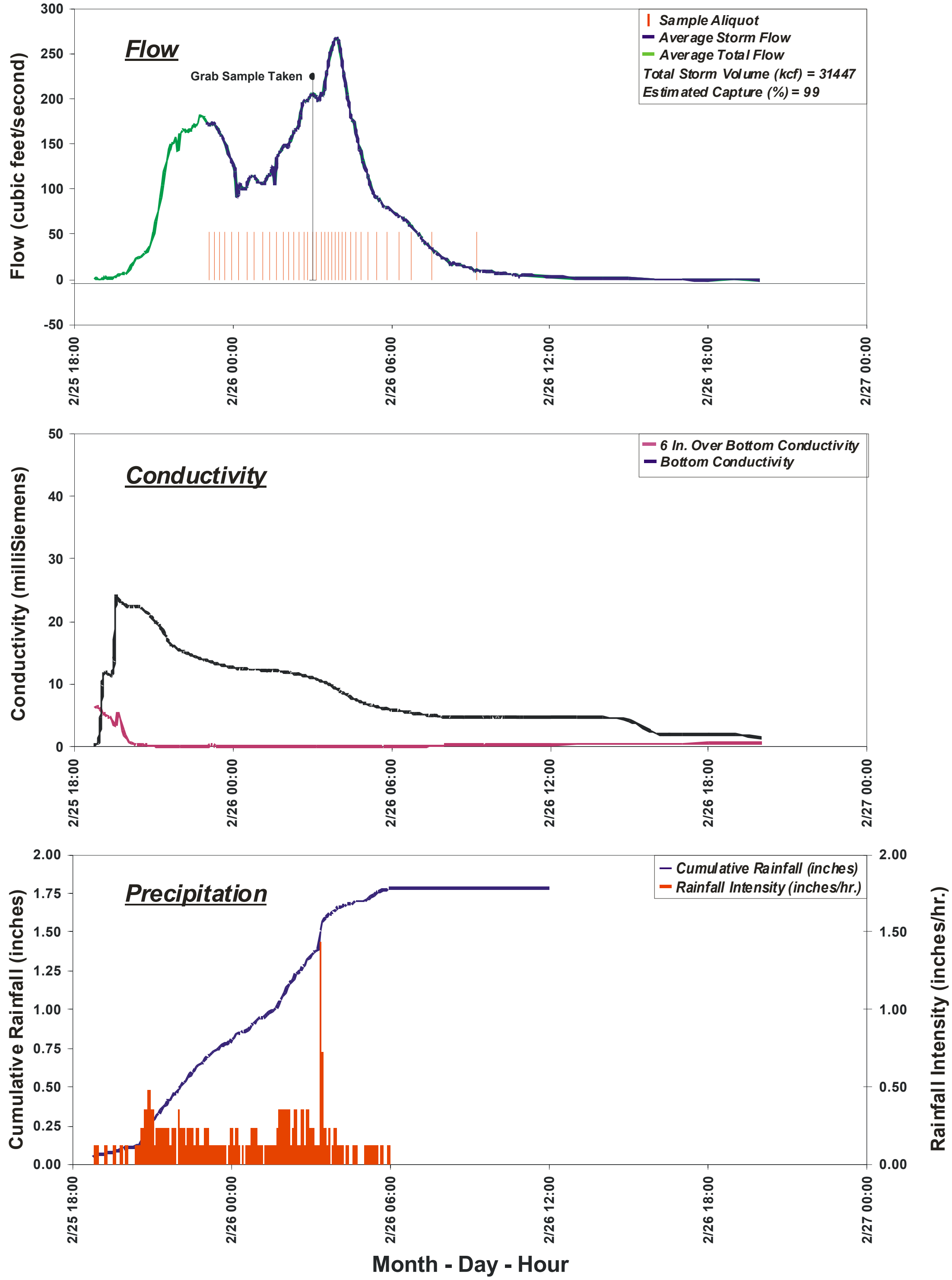
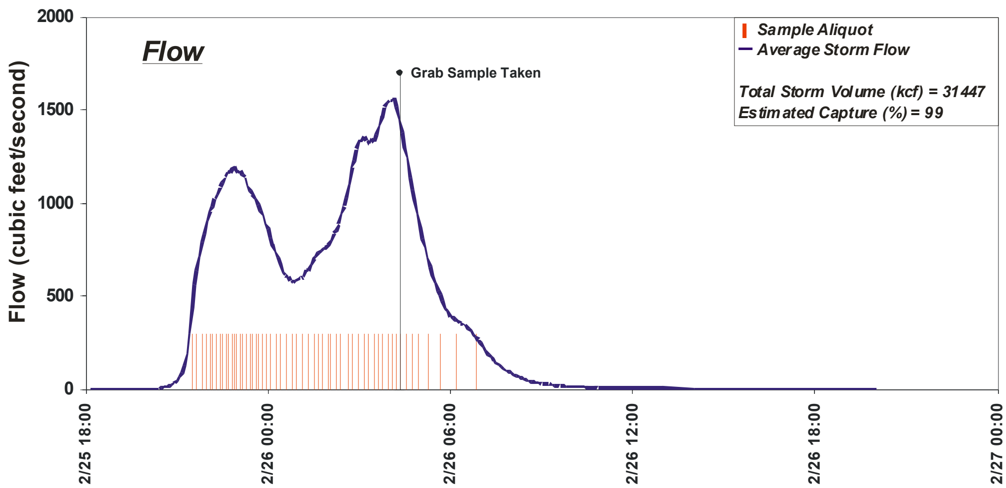


Figure 5.14. Los Cerritos Channel – Event 4 (25-26 February, 2004)



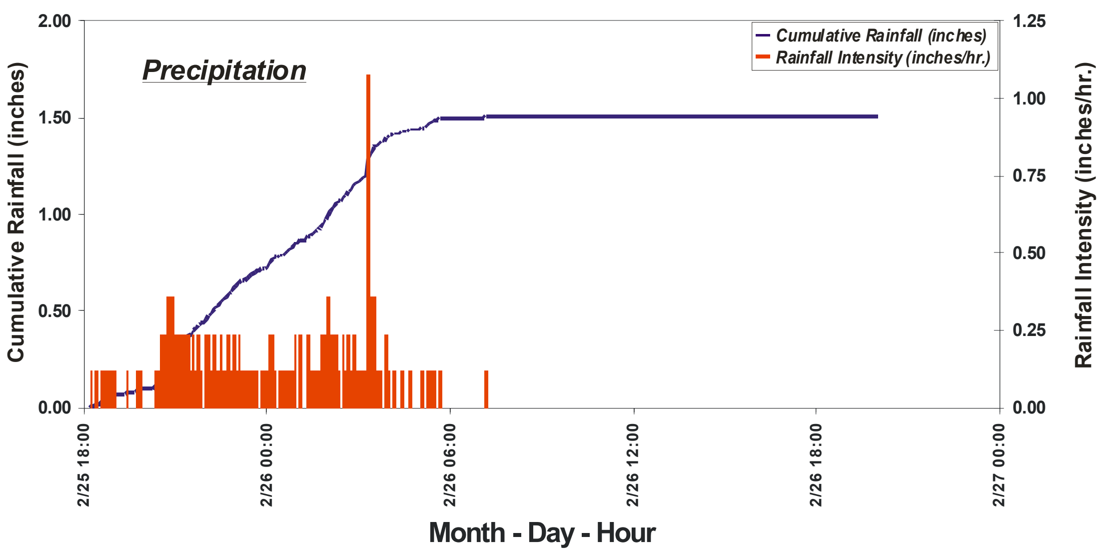
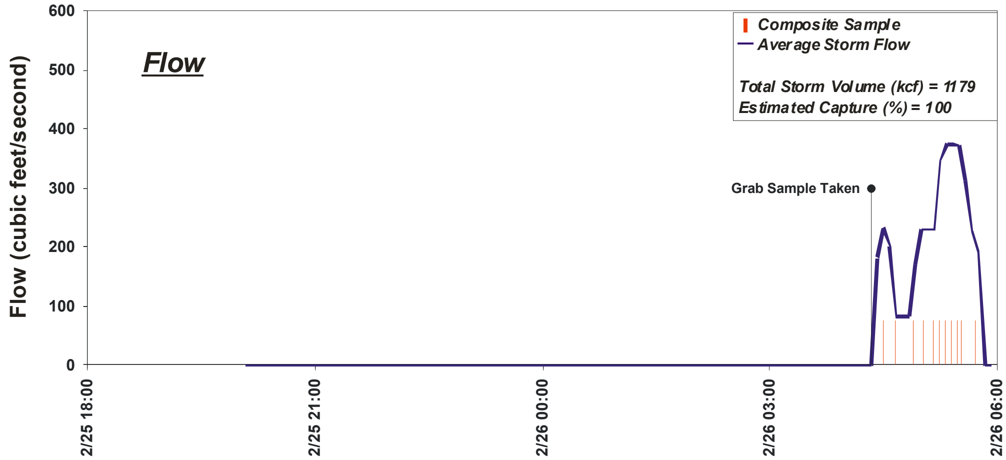


Figure 5.15. Dominguez Gap Pump Station – Event 4 (26 February, 2004)



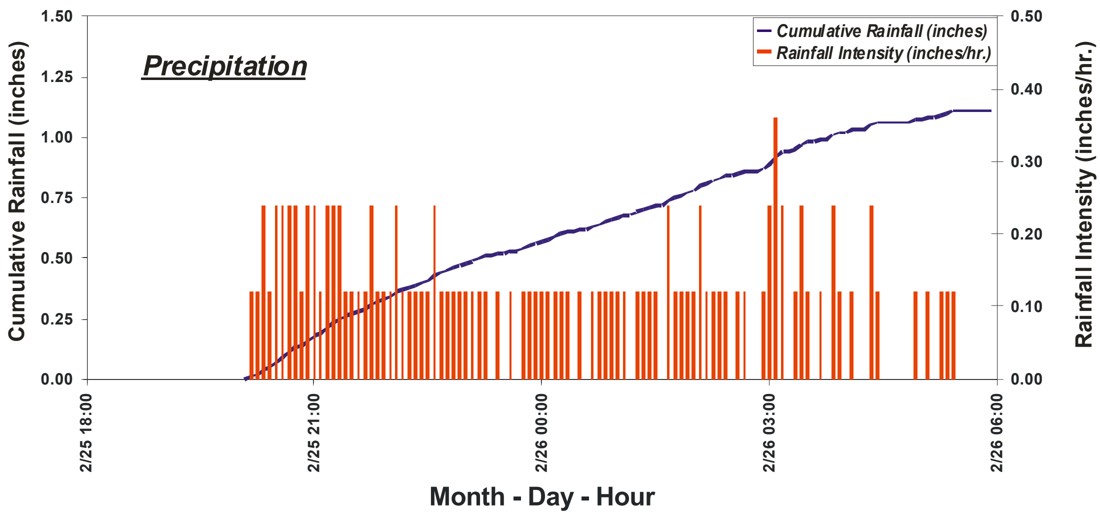


Table 5.1 Rainfall for Monitored Events During the 2003/2004 Wet-Weather Season.

	Start Rain		End Rain						
Site/Event	**Date**	**Time**	**Date**	**Time**	**Duration Rain (hrs:mins)**	**Total Rain (inches)**	**Max Intensity (Inches/hr)**	**Antecedent Rain (days)**	**Antecedent Rain (inches)**
Event 1									
Belmont Pump St.	2/2/2004	20:15	2/2/2004	23:15	3:00:00	0.67	1.68	5.6	0.17
Bouton Creek	2/2/2004	20:05	2/2/2004	23:35	3:30:00	0.77	1.92	5.3	0.20
Cerritos Creek	2/2/2004	20:20	2/2/2004	22:35	2:15:00	0.76	1.44	5.9	0.14
Event 2									
Belmont Pump St.	2/18/2004	13:30	2/18/2004	15:30	2:00:00	0.26	0.48	15.8	0.67
Bouton Creek	2/18/2004	13:30	2/18/2004	17:35	4:05:00	0.26	0.48	15.6	0.77
Cerritos Creek	2/18/2004	13:40	2/18/2004	15:35	1:55:00	0.29	0.36	15.6	0.76
Dominguez Pump St.	2/18/2004	13:35	2/18/2004	15:15	1:40:00	0.24	0.72	15.6	0.42
Event 3									
Belmont Pump St.	2/21/2004	7:50	2/22/2004	23:55	40:05:00	0.77	0.24	2.7	0.26
Bouton Creek	2/21/2004	13:10	2/22/2004	20:10	31:00:00	0.56	0.36	3.0	0.26
Cerritos Creek	2/21/2004	16:50	2/22/2004	23:35	30:45:00	0.51	0.24	3.1	0.29
Event 4									
Belmont Pump St.	2/25/2004	18:15	2/26/2004	5:40	11:25:00	1.56	1.08	2.8	0.77
Bouton Creek	2/25/2004	18:15	2/26/2004	5:55	11:40:00	1.78	1.44	2.9	0.56
Cerritos Creek	2/25/2004	18:15	2/26/2004	7:10	12:55:00	1.51	1.08	2.8	0.51
Dominguez Pump St.	2/25/2004	20:10	2/26/2004	5:25	9:15:00	1.11	0.36	3.0	0.53
Event 5									
Belmont Pump St.	3/1/2004	18:20	3/1/2004	23:55	5:35:00	0.60	0.72	4.5	1.56
Bouton Creek	3/1/2004	15:25	3/2/2004	5:00	13:35:00	0.60	0.6	4.4	1.78
Cerritos Creek	3/1/2004	17:20	3/2/2004	18:00	24:40:00	0.60	0.6	4.4	1.51
Dominguez Pump St.	3/1/2004	17:20	3/2/2004	18:00	24:40:00	0.60	0.6	4.4	1.51

Table 5.2 Descriptive Statistics for Rainfall and Flow Data for All Monitored Events (2003/2004).

Site / Parameter	n	Min	Max	Mean	Standard Deviation	1st Quartile	Median	3rd Quartile
BELMONT PUMP ST.								
Duration Flow	5	0.05	1.23	0.45	0.47	0.14	0.36	0.46
Total Flow	5	153.5	874	425	272	312	337	448
Duration Rain	5	0.08	1.67	0.52	0.66	0.13	0.23	0.48
Total Rain	5	0.26	1.56	0.77	0.48	0.60	0.67	0.77
Max Intensity	5	0.24	1.68	0.84	0.56	0.48	0.72	1.08
Antecedent Dry	5	2.70	15.80	6.28	5.46	2.80	4.50	5.60
Antecedent Rain	5	0.17	1.56	0.69	0.55	0.26	0.67	0.77
BOUTON CREEK								
Duration Flow	5	0.22	1.09	0.70	0.40	0.33	0.84	1.04
Total Flow	5	473	4403	1705	1552	940	1282	1430
Duration Rain	5	0.15	1.29	0.53	0.46	0.17	0.49	0.57
Total Rain	5	0.26	1.78	0.79	0.58	0.56	0.60	0.77
Max Intensity	5	0.36	1.92	0.96	0.68	0.48	0.60	1.44
Antecedent Dry	5	2.90	15.60	6.24	5.33	3.00	4.40	5.30
Antecedent Rain	5	0.20	1.78	0.71	0.64	0.26	0.56	0.77
CERRITOS CREEK								
Duration Flow	5	0.41	1.64	0.93	0.53	0.44	0.95	1.23
Total Flow	5	3103	31447	11247	11819	4443	5136	12106
Duration Rain	5	0.08	1.28	0.60	0.54	0.09	0.54	1.03
Total Rain	5	0.29	1.51	0.73	0.47	0.51	0.60	0.76
Max Intensity	5	0.24	1.44	0.74	0.50	0.36	0.60	1.08
Antecedent Dry	5	2.80	15.60	6.36	5.31	3.10	4.40	5.90
Antecedent Rain	5	0.14	1.51	0.64	0.54	0.29	0.51	0.76
DOMINGUEZ GAP PUMP ST.								
Duration Flow	3	0.03	0.11	0.07	0.04	0.04	0.06	0.09
Total Flow	3	154	1179	592	529	298	442	811
Duration Rain	3	0.07	1.03	0.49	0.49	0.23	0.39	0.71
Total Rain	3	0.24	1.11	0.65	0.44	0.42	0.60	0.86
Max Intensity	3	0.36	0.72	0.56	0.18	0.48	0.60	0.66
Antecedent Dry	3	3.00	15.60	7.67	6.91	3.70	4.40	10.00
Antecedent Rain	3	0.42	1.51	0.82	0.60	0.48	0.53	1.02

Table 5.3 Flow for Monitored Events During the 2003/2004 Wet Weather Season.

Site/Event	Start Flow Date	Start Flow Time	End Flow Date	End Flow Time	Flow or Discharge Duration (hrs:mins)	Total Flow (kcf)	No. of Sample Aliquots Collected	Peak Flow (cfs)	% Storm Capture	Peak Capture
Event 1										
Belmont Pump St.	2/2/2004	20:45	2/3/2004	0:05	3:20:00	448	28	279	71.9	Y
Bouton Creek	2/2/2004	21:35	2/3/2004	2:55	5:20:00	940	19	257	100	Y
Los Cerritos Creek	2/2/2004	20:35	2/3/2004	7:05	10:30:00	5136	32	988	94.4	Y
Event 2										
Belmont Pump St.	2/18/2004	13:59	2/18/2004	15:07	1:08:00	154	19	66	99.4	Y
Bouton Creek	2/18/2004	15:50	2/18/2004	23:40	7:50:00	473	16	78	100	Y
Los Cerritos Creek	2/18/2004	13:55	2/18/2004	23:40	9:45:00	3103	20	530	100	Y
Dominguez Pump St.	2/18/2004	13:20	2/18/2004	14:02	0:42:00	154	6	198	100	Y
Event 3										
Belmont Pump St.	2/21/2004	18:57	2/23/2004	0:30	29:33:00	312	13	66	100	Y
Bouton Creek	2/21/2004	19:30	2/22/2004	21:35	26:05:00	1282	15	66	100	Y
Los Cerritos Creek	2/21/2004	18:55	2/23/2004	10:15	39:20:00	4443	9	15	100	Y
					0:00:00					
Event 4										
Belmont Pump St.	2/25/2004	20:55	2/26/2004	5:40	8:45:00	874	14	132	100	Y
Bouton Creek	2/25/2004	18:05	2/26/2004	19:00	24:55:00	4403	37	267	98.4	Y
Los Cerritos Creek	2/25/2004	20:10	2/26/2004	19:00	22:50:00	31447	57	1562	98.8	Y
Dominguez Pump St.	2/25/2004	4:21	2/26/2004	5:46	1:25:00	1179	11	374	100	Y
Event 5										
Belmont Pump St.	3/1/2004	12:57	3/2/2004	0:05	11:08:00	337	7	66	100	Y
Bouton Creek	3/1/2004	18:22	3/2/2004	14:28	20:06:00	1430	16	180	100	Y
Los Cerritos Creek	3/1/2004	20:35	3/3/2004	2:00	29:25:00	12106	19	1177	71.6	Y
Dominguez Pump St.	3/3/2004	9:00	3/3/2004	11:40	2:40:00	442	1	--	--	--

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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 2003/2004 season than any previous monitoring year. Four storm events were monitored at the Bouton Creek, Belmont Pump and Los Cerritos Channel sites for the full set of analytical constituents. In all but one case composite samples collected during these storm events were also tested for toxicity with two species, the water flea (freshwater crustacean) and sea urchin (marine). Sample volumes during the second event at Los Cerritos Channel were not sufficient to conduct the toxicity testing. A fifth storm event was monitored at each of these sites for measurement of TSS only.

Three events were monitored from the Dominguez Gap Pump Station site. As in previous years, 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).

The results of the chemical analysis of these composite and grab stormwater samples are summarized in Table 6.2 and 6.3. 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 first storm event at the Los Cerritos Channel site

$$(314 \text{ mg/L}) \times [(5135.7 \text{ kcf})(28317 \text{ L/kcf})] \times (1 \text{ pound}/453592 \text{ mg}) = 100{,}672 \text{ pounds}$$

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 13,313 to 157,056 pounds. Estimates of total copper ranged from 4.7 to 53 pounds. In contrast, the Belmont Pump Station was estimated to discharge between 336 and 2618 pounds of solids and 0.50 to 1.1 pounds of copper during each event.

Loading estimates for solids and total recoverable metals from the Dominguez Gap Pump Station were 30 to 150 times lower than those from the Los Cerritos Channel during the three storms when both sites were monitored. The drainage area for the Dominguez Gap Pump station is approximately 42% of 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. During the 2002/2003 monitoring 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 9 and 10 conducted during the 2003/2004 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 September 8, 2003 and on May 4, 2003. No dry weather flow was observed on either occasion.

6.3.2 Basin 20: Bouton Creek Monitoring Site

Bouton Creek was sampled 2-3 hours after the low tide on September 11, 2003 from 07:30 to 07:42 a.m. and on May 5, 2004 from 08:30 to 08:55 a.m. At these times, flow in the creek was not impeded by seawater backing into the creek. This assured that the flow was fresh water flowing downstream and that the saline tidal water did not commingle with the dry weather discharge of fresh water.

Continuous sampling was performed to collect water from the Creek when the effects of residual salinity in the channel were minimized. Samples were collected from the creek and deposited into a 20-liter borosilicate glass bottles using the automatic sampler. At the beginning of the sampling, grab samples for 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 September 9, 2003 and ending on September 10, 2003. Samples were collected from the sump using the automated sampler installed inside of the pump house. Samples were collected into 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 8 hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the bottles of water were combined into a composite. Upon completion of the 24-hour sampling, on September 10, 2003 at 7:10 a.m., grab samples for TPH and bacteria were manually collected from the sump.

Time-weighted composite sampling was again conducted over a 24-hour period starting on May 4, 2004 and ending on May 5, 2003. At the beginning of the 24-hour period, on May 4, 2003 at 10:56 a.m., grab samples for 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 September 9, 2003 and ended on September 10, 2003. A separate sampling event began on May 4, 2004 and ended on May 5, 2004.

Samples were taken from the middle of the channel using the automated sampler installed on the bank of the channel. Dry weather flows consisted of a shallow, narrow stream located near the middle of the channel. To reach the water, the sampling hose that is used for sampling stormwater was extended an additional 33-38 feet. Every half-hour for 24 hours, an aliquot of approximately 1.25 liters of water (0.75 liters in May) was pumped into a 20-liter bottle. The bottles were changed every 8-12 hours and chilled to 4°C with ice during sampling and transportation. Following completion of the sampling, the bottles of water were combined into a composite sample. Grab samples were manually collected for TPH and bacteria at the end of the 24-hour sampling on September 10, 2003 at 8:00 am and at the beginning of the 24-hour sampling on May 4, 2004 at 10:20 am.

Table 6.1. Monitored Storm Events, 2003/2004.

Station	Event 1 2/3/04	Event 2 2/18/04	Event 3 2/22/04	Event 4 2/26/04	Event 5 3/1-2/04
Bouton Creek	X	X	X	X	
Belmont Pump	X	X	X	X	
Los Cerritos Channel	X	X[a]	X	X	
Dominguez Gap		X		X	X

[a]Insufficient sample volumes were available for toxicity testing.

Table 6.2. Stormwater Chemisty Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 1 of 4).

Analyte	Bouton Creek 1 03-Feb-04	Bouton Creek 2 18-Feb-04	Bouton Creek 3 22-Feb-04	Bouton Creek 4 26-Feb-04	Bouton Creek 5 02-Mar-04	Belmont Pump 1 03-Feb-04	Belmont Pump 2 18-Feb-04	Belmont Pump 3 23-Feb-04	Belmont Pump 4 26-Feb-04	Belmont Pump 5 01-Mar-04
Conventionals										
BOD (mg/L)	15	19	6.3	5.3		16	16	8.2	6.6	
COD (mg/L)	140	110	74	25		76	150	62	62	
EC (umhos/cm)	165	342	250	81.5		760	1640	289	122	
pH (pH Units)	7.69	7.36	7.57	7.21		7.49	7.52	7.15	7.35	
TOC (mg/L)	11	26	9.3	5.3		12	16	11	6.3	
Hardness (mg/L)	30	143	32.2	15.1		124	193	48.2	32.2	
Alkalinity (mg/L)	16	21	19	14		97	210	43	22	
Chloride (mg/L)	33	79	53	12		150	330	46	17	
Fluoride (mg/L)	0.18	0.26	0.22	0.11		0.35	0.74	0.2	0.12	
TKN (mg/L)	2.1	1.9	1.0	0.74		1.8	2.3	1.4	1	
Ammonia as N (mg/L)	0.43	0.71	0.39	0.19		0.63	0.63	0.40	0.24	
Nitrite N (mg/L)	0.1U	0.1U	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	
Nitrate N (mg/L)	0.63	0.81	0.38	0.22		0.67	0.84	0.52	0.34	
Total P (mg/L)	0.60	0.31	0.20	0.24		0.55	0.77	0.36	0.34	
Ortho-P (Dissolved) (mg/L)	0.2	0.24	0.16	0.18		0.42	0.59	0.29	0.27	
MBAS (mg/L)	0.059	0.049	0.033	0.025U		0.078	0.037	0.033	0.025U	
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U		0.1U	0.1U	0.1U	0.1U	
Oil & Grease (mg/L)	5.0UJ	7.7J-	5.0UJ	5.0UJ		5.0UJ	6.1J-	5.0UJ	5.0UJ	
Turbidity (NTU)	62	56	21	44		18.7	51	28	35	
TSS (mg/L)	140	52J	14	54	72	12	90J	34	48	50
TDS (mg/L)	94	192	134	50		468	910	148	60	
TVS (mg/L)	90			30.0		62			34	

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
4 Value exceeds the California Ocean Plan.
5 Value exceeds the California Toxics Rule CCC for both Fresh and Salt Water.
6 Value exceeds the LA Basin Plan and the CA Ocean Plan.
7 Value exceeds the California Toxics Rule CCCfor Saltwater and the CA Ocean Plan.
8 Value exceeds the California Fish and Game for Freshwater.

Table 6.2. Stormwater Chemisty 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 3	Bouton Creek 4	Bouton Creek 5	Belmont Pump 1	Belmont Pump 2	Belmont Pump 3	Belmont Pump 4	Belmont Pump 5
Analyte	03-Feb-04	18-Feb-04	22-Feb-04	26-Feb-04	02-Mar-04	03-Feb-04	18-Feb-04	23-Feb-04	26-Feb-04	01-Mar-04
***Total Metals* (µg/L)**										
Aluminum	**6400**[3]	**2500**[3]	950	**3200J**[3]		800	**3800**[3]	**1400**[3]	**1700J**[3]	
Arsenic	1.5	2.12	1.42	2.60		1.35	4.22	2.18	2.20	
Cadmium	1.2	0.63	0.22J	0.37		0.28	1.1	0.44	0.52	
Chromium	**90**[3]	**72**[3]	37	11J		3.0	9.3	4.7	4.4J	
Copper	**44**[4]	**34**[4]	**13**[4]	**13**[4]		**18**[4]	**55**[4]	**29**[4]	**21**[4]	
Iron	7700	3200	950	2900		1100	3200	1300	1700	
Lead	**57**[4]	**25**[4]	**10**[4]	**16**[4]		**13**[4]	**73**[4]	**23**[4]	**25**[4]	
Nickel	15	15	11	5.3		8.3	10	4.8	4.3	
Selenium	1.00U	0.78J	1.34	0.88J		1.00U	1.00U	1.18	0.52J	
Silver	0.14J	0.071J	0.0275J	0.053J		0.032J	0.25U	0.061J	0.065J	
Zinc	**350**[4]	**180**[4]	**90**[4]	**130**[4]		**110**[4]	**360**[4]	**180**[4]	**160**[4]	
Dissolved Metals (µg/L)										
Aluminum	42J	19J	23J	300		4J	8.9J	17J	31J	
Arsenic	0.88J	2.32	1.30	2.00		1.32	2.9	1.48	1.48	
Cadmium	0.11J	0.11J	0.079J	0.10J		0.11J	0.12J	0.075J	0.072J	
Chromium	4.0	5.7	11	2.8		1.9	4.5	1.9	0.91	
Copper	**7.6**[5]	**9.7**[2]	**6.2**[5]	**4.9**[5]		**7.9**[2]	**7.4**[2]	**11**[5]	**6.4**[5]	
Iron	140	110	98	110		91	73	47	42	
Lead	**1.0**[1]	1.4	1.0	**2.2**[1]		1.2	1.2	0.52	0.73	
Nickel	3.2	4.9	7.6	2.6		2.3	3.0	1.8	0.82J	
Selenium	1.0U	1.0U	1.0U	0.88J		1.0U	0.84J	0.56J	0.66J	
Silver	0.25U	0.25U	0.031J	0.25U		0.25U	0.25U	0.018J	0.25U	
Zinc	**48**[1]	53	40	**51**[1]		55	44	58	**47**[1]	

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
4 Value exceeds the California Ocean Plan.
5 Value exceeds the California Toxics Rule CCC for both Fresh and Salt Water.
6 Value exceeds the LA Basin Plan and the CA Ocean Plan.
7 Value exceeds the California Toxics Rule CCCfor Saltwater and the CA Ocean Plan.
8 Value exceeds the California Fish and Game for Freshwater.

Table 6.2. Stormwater Chemisty Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 3 of 4).

Analyte	Bouton Creek 1 03-Feb-04	Bouton Creek 2 18-Feb-04	Bouton Creek 3 22-Feb-04	Bouton Creek 4 26-Feb-04	Bouton Creek 5 02-Mar-04	Belmont Pump 1 03-Feb-04	Belmont Pump 2 18-Feb-04	Belmont Pump 3 23-Feb-04	Belmont Pump 4 26-Feb-04	Belmont Pump 5 01-Mar-04
Chlorinated Pesticides (µg/L)										
4,4'-DDD	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
4,4'-DDE	0.013	0.010U	0.010U	0.010U		0.010U	0.011	0.010U	0.010U	
4,4'-DDT	0.010U	0.010U	0.010U	0.010U		0.010U	**0.029**[5]	0.010U	**0.012**[5]	
Aldrin	0.0050U	0.0050U	0.0050U	0.0050U		0.0050U	0.0050U	0.0050U	0.0050U	
alpha-BHC	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
alpha-Chlordane	0.010U	0.010U	0.010U	0.010U		0.010U	0.017	0.010U	0.010U	
beta-BHC	0.0050U	0.0050U	0.0050U	0.0050U		0.0050U	0.0050U	0.0050U	0.0050U	
Chlordane	0.10U	0.10U	0.10U	0.10U		0.10U	0.1	0.10U	0.10U	
delta-BHC	0.0050U	0.0050U	0.0050U	0.0050U		0.0050U	0.0050U	0.0050U	0.0050U	
Dieldrin	**0.011**[7]	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
Endosulfan I	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
Endosulfan II	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
Endosulfan sulfate	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
Endrin	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	
Endrin ketone	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
gamma-BHC (Lindane)	0.02	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U	0.010U	
gamma-Chlordane	0.010U	0.010U	0.010U	0.010U		0.010U	0.011	0.010U	0.010U	
Heptachlor	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	
Methoxychlor	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	
Toxaphene	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
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5 Value exceeds the California Toxics Rule CCC for both Fresh and Salt Water.
6 Value exceeds the LA Basin Plan and the CA Ocean Plan.
7 Value exceeds the California Toxics Rule CCCfor Saltwater and the CA Ocean Plan.
8 Value exceeds the California Fish and Game for Freshwater.

Table 6.2 Stormwater Chemisty Results: City of Long Beach Storm Monitoring Project, Bouton Creek and Belmont Pump Station (Page 4 of 4).

Analyte	Bouton Creek 1 03-Feb-04	Bouton Creek 2 18-Feb-04	Bouton Creek 3 22-Feb-04	Bouton Creek 4 26-Feb-04	Bouton Creek 5 02-Mar-04	Belmont Pump 1 03-Feb-04	Belmont Pump 2 18-Feb-04	Belmont Pump 3 23-Feb-04	Belmont Pump 4 26-Feb-04	Belmont Pump 5 01-Mar-04
PCBs (µg/L)										
Aroclor 1016	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1221	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1232	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1242	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1248	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1254	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Aroclor 1260	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Total PCB's	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U	0.20U	
Organophosphate Pesticides (µg/L)										
Atrazine	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U	2.0U	
Chlorpyrifos	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	
Cyanazine	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U	2.0U	
Diazinon	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U	0.050U	
Malathion	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U	0.085J	
Prometryn	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U	2.0U	
Simazine	**4.8**[3]	2.9	2.0U	1.0J		2.0U	2.0U	2.0U	2.0U	
Bacteriological										
Enterococcus (cfu/100ml)	**16100J**[3]	**18900**[3]	**2400**[3]	**8050**[3]		**18500J**[3]	**15300**[3]	**16600**[3]	**1650**[3]	
Fecal Coliform (mpn/100ml)	**2400J**[6]	**80000J**[6]	230	**1700**[6]		**22000J**[6]	**50000J**[6]	**7000**[6]	**17000**[6]	
Total Coliform (mpn/100ml)	**24000J**[6]	**80000J**[6]	700	**11000**[6]		**22000J**[6]	**50000J**[6]	**30000**[6]	**50000**[6]	

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
4 Value exceeds the California Ocean Plan.
5 Value exceeds the California Toxics Rule CCC for both Fresh and Salt Water.
6 Value exceeds the LA Basin Plan and the CA Ocean Plan.
7 Value exceeds the California Toxics Rule CCCfor Saltwater and the CA Ocean Plan.
8 Value exceeds the California Fish and Game for Freshwater.

Table 6.3. Stormwater Chemisty Results: City of Long Beach Storm Monitoring Project, Los Cerritos Channel and Dominguez Gap (Page 1 of 4).

Analyte	Los Cerritos Channel 1 03-Feb-04	Los Cerritos Channel 2 18-Feb-04	Los Cerritos Channel 3 22-Feb-04	Los Cerritos Channel 4 26-Feb-04	Los Cerritos Channel 5 02-Mar-04	Dominguez Gap 1 18-Feb-04	Dominguez Gap 2 26-Feb-04	Dominguez Gap 3 02-Mar-04
Conventionals								
BOD (mg/L)	22	18	6.6J	5		6.9	5.6	4.9
COD (mg/L)	170	160	75	32		130	55	17
EC (umhos/cm)	68.1	87.7	65.4	47.6		1080	62.4	135
pH (pH Units)		7.1	8.0	6.7		7.9	8.8	7.1
TOC (mg/L)	12	22	7	5.9		10	7.8	7.6
Hardness (mg/L)	32.1	21.1	17.1	12.1		259	14.1	31.4
Alkalinity (mg/L)	21	24	18	14		170	17	25
Chloride (mg/L)	3.8	5.8	4.1	3.2		130	4.9	13
Fluoride (mg/L)	0.062	0.23	0.14	0.1		0.68	0.11	0.14
TKN (mg/L)	2.4	2.8	0.99	0.82		6.2	0.95	0.99
Ammonia as N (mg/L)	0.54	0.719	0.392	0.231		**5.11**[4]	0.287	0.479
Nitrite N (mg/L)	0.1U	0.1U	0.1UJ	0.1U		0.1U	0.1U	0.1U
Nitrate N (mg/L)	0.63	0.78	0.42J	0.26		5.0	0.29	0.31
Total P (mg/L)	1.2	0.56	0.22	0.19		1.3	0.4	0.41
Ortho-P (Dissolved) (mg/L)	0.18	0.19	0.14J	0.19		1.3	0.28	0.30
MBAS (mg/L)	0.036	0.055	0.025J	0.025U		0.025U	0.025U	0.025U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U		0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.0UJ	6.1J-	5.0UJ	5.0UJ		5.9J-	5.0UJ	5.0UJ
Turbidity (NTU)	84	100	40J	61		10	57	24
TSS (mg/L)	314	166J	48	80	110	10J	64	20
TDS (mg/L)	88	72	40	46		658	50	70
TVS (mg/L)	108			28			42	52

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
4 Value exceeds the California Ocean Plan.
5 Value exceeds the California Toxics Rule CCC for both Fresh and Salt Water.
6 Value exceeds the LA Basin Plan and the CA Ocean Plan.
7 Value exceeds the California Toxics Rule CCCfor Saltwater and the CA Ocean Plan.
8 Value exceeds the California Fish and Game for Freshwater.

Table 6.3. Stormwater Chemisty 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 2	Los Cerritos Channel 3	Los Cerritos Channel 4	Los Cerritos Channel 5	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 3
Analyte	03-Feb-04	18-Feb-04	22-Feb-04	26-Feb-04	02-Mar-04	18-Feb-04	26-Feb-04	02-Mar-04
Total Metals (µg/L)								
Aluminum	**11000**[3]	**4800**[3]	**1700**[3]	940J		390	**4300J**[3]	**1300**[3]
Arsenic	2.3	2.95	1.85	2.25		1.85	2.12	1.48
Cadmium	2.6	2.0	0.62	0.66		0.43	0.36	0.17J
Chromium	21	12	3.9	2.3		2.0J	5.6	2.5J
Copper	**62**[4]	**58**[4]	**17**[4]	**27**[4]		**15**[4]	**16**[4]	9.4
Iron	10000	9600	2200	3600		620	3200	1300
Lead	**93**[4]	**59**[4]	**19**[4]	**20**[4]		4.7	**18**[4]	7.6
Nickel	18	15	5.8	3.4		5.4	5.1	4.1
Selenium	1.0U	1.0U	1.3	0.80J		0.86J	0.84J	1.0U
Silver	0.38	0.16J	0.25U	0.018J		0.20J	0.085J	0.25U
Zinc	**590**[4]	**490**[4]	**210**[4]	**180**[4]		64	**120**[4]	51
Dissolved Metals (µg/L)								
Aluminum	42J	42J	43J	170		1.1J	99J	100
Arsenic	1.02	1.68	1.40	1.40		1.85	1.58	1.45
Cadmium	0.16J	0.19J	0.12J	0.099J		0.31	0.048J	0.058J
Chromium	0.94	1.5	1.1	1.4		3.9J	0.54	0.68
Copper	**7.2**[5]	**12**[5]	**5.0**[5]	**4.4**[5]		**8.9**[2]	**2.8**[1]	**4.3**[5]
Iron	150	77	120	180		27	150	180
Lead	0.82	**1.0**[1]	0.48J	**0.61**[1]		1.1	**0.71**[1]	**1.1**[1]
Nickel	1.4	3.0	0.78J	0.88J		4.6	0.57J	1.6
Selenium	1.0U	0.52J	1.0U	1.0U		0.68J	0.84J	1.0U
Silver	0.25U	0.25U	0.25U	0.25U		0.084J	0.25U	0.058J
Zinc	**55**[1]	**71**[1]	**52**[1]	**37**[1]		45	**28**[1]	27

1 Value exceeds the California Toxics Rule CCC for Freshwater.
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Table 6.3. Stormwater Chemisty 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 2	Los Cerritos Channel 3	Los Cerritos Channel 4	Los Cerritos Channel 5	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 3
Analyte	03-Feb-04	18-Feb-04	22-Feb-04	26-Feb-04	02-Mar-04	18-Feb-04	26-Feb-04	02-Mar-04
Chlorinated Pesticides (µg/L)								
4,4'-DDD	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
4,4'-DDE	0.013	0.022	0.010U	0.010U		0.010U	0.010U	0.010U
4,4'-DDT	0.010U	**0.031**[5]	0.010U	0.010U		0.010U	0.010U	0.010U
Aldrin	0.0050U	0.0050U	0.0050U	0.0050U		0.0050U	0.0050U	0.0050U
alpha-BHC	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
alpha-Chlordane	0.010U	0.016	0.010U	0.010U		0.010U	0.010U	0.010U
beta-BHC	0.0050U	0.0050U	0.0050U	0.0050U		0.015	0.0050U	0.0050U
Chlordane	0.10U	0.13	0.10U	0.10U		0.10U	0.10U	0.10U
delta-BHC	0.0050U	0.0050U	0.0050U	0.0050U		0.0050U	0.0050U	0.0050U
Dieldrin	**0.01**[7]	**0.014**[7]	0.010U	0.010U		0.010U	0.010U	0.010U
Endosulfan I	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
Endosulfan II	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
Endosulfan sulfate	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
Endrin	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
Endrin ketone	0.010U	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
gamma-BHC (Lindane)	0.021	0.010U	0.010U	0.010U		0.010U	0.010U	0.010U
gamma-Chlordane	0.010U	0.011	0.010U	0.010U		0.010U	0.010U	0.010U
Heptachlor	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
Methoxychlor	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U
Toxaphene	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U

1 Value exceeds the California Toxics Rule CCC for Freshwater.
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Table 6.3. Stormwater Chemisty 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 2	Los Cerritos Channel 3	Los Cerritos Channel 4	Los Cerritos Channel 5	Dominguez Gap 1	Dominguez Gap 2	Dominguez Gap 3
Analyte	03-Feb-04	18-Feb-04	22-Feb-04	26-Feb-04	02-Mar-04	18-Feb-04	26-Feb-04	02-Mar-04
PCBs (µg/L)								
Aroclor 1016	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1221	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1232	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1242	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1248	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1254	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Aroclor 1260	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Total PCB's	0.20U	0.20U	0.20U	0.20U		0.20U	0.20U	0.20U
Organophosphate Pesticides (µg/L)								
Atrazine	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U
Chlorpyrifos	0.050U	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U
Cyanazine	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U
Diazinon	0.071	0.050U	0.050U	0.050U		0.050U	0.050U	0.050U
Malathion	1.0U	1.0U	1.0U	1.0U		1.0U	1.0U	1.0U
Prometryn	2.0U	2.0U	2.0U	2.0U		2.0U	2.0U	2.0U
Simazine	**4.4**[3]	3.4	2.0U	2.0		2.0U	**8.3**[3]	2.5
Bacteriological								
Enterococcus (cfu/100ml)	**24400J**[3]	**93000**[3]	**12800**[3]	**9650**[3]		**54000**[3]	**8100**[3]	**25000**[3]
Fecal Coliform (mpn/100ml)	**13000J**[6]	**130000J**[6]	**8000**[6]	**3000**[6]		**50000J**[6]	**7000**[6]	**8000**[6]
Total Coliform (mpn/100ml)	**24000J**[6]	**130000J**[6]	**30000**[6]	**13000**[6]		**50000J**[6]	**130000**[6]	**50000**[6]

1 Value exceeds the California Toxics Rule CCC for Freshwater.
2 Value exceeds the California Toxics Rule for CCC Saltwater.
3 Value exceeds the LA Basin Plan.
4 Value exceeds the California Ocean Plan.
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8 Value exceeds the California Fish and Game for Freshwater.

Table 6.4. Load Calculations (pounds) for Each Storm Event at Bouton Creek.

Analyte	ML	2/3/2004	2/18/2004	2/22/2004	2/26/2004	3/2/2004
Conventionals						
BOD	2 mg/L	880	560	504	1457	
COD	20-900 mg/L	8217	3245	5921	6871	
Chloride	2 mg/L	1937	2330	4240	3298	
Fluoride	0.1 mg/L	11	8	18	30	
Hardness	2 mg/L	1761	4218	2576	4150	
MBAS (Surfactants)	0.05 mg/L	3	1	3	0	
NH3-N	0.1 mg/L	25	21	31	51	
TKN	0.01 mg/L	123	56	80	203	
NO3-N (Nitrate)	0.1 mg/L	37	24	30	60	
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0	
Oil & Grease	5 mg/L	0	228	0	0	
Total Phenols	0.1 mg/L	0	0	0	0	
P (Total)	0.05 mg/L	35	9	16	66	
Ortho-P (Dissolved)	0.05 mg/L	12	7	13	49	
TDS	2 mg/L	5517	5663	10721	13743	
TOC	1 mg/L	646	767	744	1457	
TSS	2 mg/L	8217	1534	1120	14842	6428
TVS	2 mg/L	5283			8246	
Total Metals						
Al	100 ug/L	382	74	76	880	
As	1 ug/L	0.09	0.06	0.11	0.71	
Cd	0.25 ug/L	0.07	0.02	0.02	0.10	
Cr	0.05 ug/L	5.3	2.1	3.0	3.0	
Cu	0.05 ug/L	2.6	1.0	1.0	3.6	
Fe	100 ug/L	452	94	76	797	
Pb	0.5 ug/L	3.3	0.74	0.80	4.4	
Ni	1 ug/L	0.88	0.44	0.88	1.5	
Se	1 ug/L	0.00	0.02	0.11	0.24	
Ag	0.25 ug/L	0.01	0.00	0.00	0.01	
Zn	1 ug/L	21	5.3	7.2	36	
Dissolved Metals						
Al	100 ug/L	2.5	0.56	1.8	82	
As	1 ug/L	0.05	0.07	0.10	0.55	
Cd	0.25 ug/L	0.01	0.00	0.01	0.03	
Cr	0.05 ug/L	0.23	0.17	0.88	0.77	
Cu	0.05 ug/L	0.45	0.29	0.50	1.35	
Fe	100 ug/L	8.2	3.2	7.8	30	
Pb	0.5 ug/L	0.06	0.04	0.08	0.60	
Ni	1 ug/L	0.19	0.14	0.61	0.71	
Se	1 ug/L	0	0	0	0.24	
Ag	0.25 ug/L	0	0	0	0.0	
Zn	1 ug/L	2.8	1.6	3.2	14	
PCBs						
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	

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.
A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.4. Load Calculations (pounds) for Each Storm Event at Bouton Creek. (continued)

Analyte	ML	2/3/2004	2/18/2004	2/22/2004	2/26/2004	3/2/2004
Chlorinated Pesticides						
4,4'-DDD	0.05 ug/L	0	0	0	0	
4,4'-DDE	0.0 5 ug/L	0.00	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	
beta-BHC	0.005 ug/L	0	0	0	0	
Chlordane	0.1 ug/L	0	0	0	0	
delta-BHC	0.005 ug/L	0	0	0	0	
Dieldrin	0.01 ug/L	0.00	0	0	0	
alpha-Endosulfan	0.02 ug/L	0	0	0	0	
beta-Endosulfan	0.01 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	
Endrin ketone	0.01 ug/L	0	0	0	0	
gamma-BHC	0.02 ug/L	0.00	0	0	0	
gamma-Chlordane	0.1 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	
Methoxychlor	0.05 ug/L	0	0	0	0	
Toxaphene	0.5 ug/L	0	0	0	0	
Organophosphates						
Atrazine	2 ug/L	0	0	0	0	
Chlorpyrifos	0.05 ug/L	0	0	0	0	
Cyanazine	2 ug/L	0	0	0	0	
Diazinon	0.01 ug/L	0	0	0	0	
Malathion	1 ug/L	0	0	0	0	
Prometryn	2 ug/L	0	0	0	0	
Simazine	2 ug/L	0.28	0.09	0	0.27	

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.

A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station.

Analyte	ML	2/3/2004	2/18/2004	2/23/2004	2/26/2004	3/1/2004
Conventionals						
BOD	2 mg/L	448	153	160	360	
COD	20-900 mg/L	2127	1437	1207	3382	
Chloride	2 mg/L	4199	3162	896	927	
Fluoride	0.1 mg/L	10	7	4	7	
Hardness	2 mg/L	3471	1849	939	1756	
MBAS (Surfactants)	0.05 mg/L	2	0	1	0	
NH3-N	0.1 mg/L	18	6	8	13	
TKN	0.01 mg/L	50	22	27	55	
NO3-N (Nitrate)	0.1 mg/L	19	8	10	19	
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0	
Oil & Grease	5 mg/L	0	58	0	0	
Total Phenols	0.1 mg/L	0	0	0	0	
P (Total)	0.05 mg/L	15	7	7	19	
Ortho-P (Dissolved)	0.05 mg/L	12	6	6	15	
TDS	2 mg/L	13101	8720	2882	3273	
TOC	1 mg/L	336	153	214	344	
TSS	2 mg/L	336	862	662	2618	1051
TVS	2 mg/L	1736	0	0	1854	
Total Metals						
Al	100 ug/L	22	36	27	93	
As	1 ug/L	0.04	0.04	0.04	0.12	
Cd	0.25 ug/L	0.01	0.01	0.01	0.03	
Cr	0.05 ug/L	0.08	0.09	0.09	0.24	
Cu	0.05 ug/L	0.50	0.53	0.56	1.1	
Fe	100 ug/L	31	31	25	93	
Pb	0.5 ug/L	0.36	0.70	0.45	1.4	
Ni	1 ug/L	0.23	0.10	0.09	0.23	
Se	1 ug/L	0	0	0.02	0.03	
Ag	0.25 ug/L	0.00	0	0.00	0.00	
Zn	1 ug/L	3.1	3.4	3.5	8.7	
Dissolved Metals						
Al	100 ug/L	0.11	0.09	0.3	1.7	
As	1 ug/L	0.04	0.03	0.03	0.08	
Cd	0.25 ug/L	0.00	0.00	0.00	0.00	
Cr	0.05 ug/L	0.05	0.04	0.04	0.05	
Cu	0.05 ug/L	0.22	0.07	0.21	0.35	
Fe	100 ug/L	2.5	0.70	0.92	2.3	
Pb	0.5 ug/L	0.03	0.01	0.01	0.04	
Ni	1 ug/L	0.06	0.03	0.04	0.04	
Se	1 ug/L	0	0.01	0.01	0.04	
Ag	0.25 ug/L	0	0	0.00	0	
Zn	1 ug/L	1.5	0.42	1.1	2.6	
PCBss						
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	

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.

A “0.00” indidates the calculated load was less than 0.005 pounds.

Table 6.5 Load Calculations (pounds) for each Storm Event at the Belmont Pump Station. (continued)

Analyte	ML	2/3/2004	2/18/2004	2/23/2004	2/26/2004	3/1/2004
Chlorinated Pesticides						
4,4'-DDD	0.05 ug/L	0	0	0	0	
4,4'-DDE	0.0 5 ug/L	0	0.00	0	0	
4,4'-DDT	0.01 ug/L	0	0.00	0	0.00	
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	0.00	0	0	
beta-BHC	0.005 ug/L	0	0	0	0	
Chlordane	0.1 ug/L	0	0.00	0	0	
delta-BHC	0.005 ug/L	0	0	0	0	
Dieldrin	0.01 ug/L	0	0	0	0	
alpha-Endosulfan	0.02 ug/L	0	0	0	0	
beta-Endosulfan	0.01 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	
Endrin ketone	0.01 ug/L	0	0	0	0	
gamma-BHC	0.02 ug/L	0	0	0	0	
gamma-Chlordane	0.1 ug/L	0	0.00	0	0	
Heptachlor	0.01 ug/L	0	0	0	0	
Heptachlor epoxide	0.01 ug/L	0	0	0	0	
Methoxychlor	0.05 ug/L	0	0	0	0	
Toxaphene	0.5 ug/L	0	0	0	0	
Organophosphates						
Atrazine	2 ug/L	0	0	0	0	
Chlorpyrifos	0.05 ug/L	0	0	0	0	
Cyanazine	2 ug/L	0	0	0	0	
Diazinon	0.01 ug/L	0	0	0	0	
Malathion	1 ug/L	0	0	0	0.00	
Prometryn	2 ug/L	0	0	0	0	
Simazine	2 ug/L	0.00	0.00	0.00	0.00	

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.
A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel.

Analyte	ML	2/3/2004	2/18/2004	2/22/2004	2/26/2004	3/2/2004
Conventionals						
BOD	2 mg/L	7053	3486	1831	9816	
COD	20-900 mg/L	54504	30989	20802	62822	
Chloride	2 mg/L	1218	1123	1137	6282	
Fluoride	0.1 mg/L	20	45	39	196	
Hardness	2 mg/L	10292	4087	4743	23755	
MBAS (Surfactants)	0.05 mg/L	12	11	7	0	
NH3-N	0.1 mg/L	173	139	109	453	
TKN	0.01 mg/L	769	542	275	1610	
NO3-N (Nitrate)	0.1 mg/L	202	151	116	510	
NO2-N (Nitrite)	0.1 mg/L	0	0	0	0	
Oil & Grease	5 mg/L	0	1172	0	0	
Total Phenols	0.1 mg/L	0	0	0	0	
P (Total)	0.05 mg/L	385	108	61	373	
Ortho-P (Dissolved)	0.05 mg/L	58	37	39	373	
TDS	2 mg/L	28214	13945	11094	90307	
TOC	1 mg/L	3847	4261	1942	11583	
TSS	2 mg/L	100672	32151	13313	157056	83130
TVS	2 mg/L	34626	0	0	54970	
Total Metals						
Al	100 ug/L	3527	930	472	1845	
As	1 ug/L	0.74	0.57	0.51	4.4	
Cd	0.25 ug/L	0.83	0.39	0.17	1.3	
Cr	0.05 ug/L	6.7	2.3	1.1	4.5	
Cu	0.05 ug/L	20	11	4.7	53	
Fe	100 ug/L	3206	1859	610	7068	
Pb	0.5 ug/L	30	11	5.3	39	
Ni	1 ug/L	5.8	2.9	1.6	6.7	
Se	1 ug/L	0.00	0.00	0.36	1.6	
Ag	0.25 ug/L	0.12	0.03	0.00	0.04	
Zn	1 ug/L	189	95	58	353	
Dissolved Metals						
Al	100 ug/L	13	8	12	334	
As	1 ug/L	0.33	0.33	0.39	2.7	
Cd	0.25 ug/L	0.05	0.04	0.03	0.19	
Cr	0.05 ug/L	0.30	0.29	0.31	2.7	
Cu	0.05 ug/L	2.3	2.3	1.4	8.6	
Fe	100 ug/L	48	15	33	353	
Pb	0.5 ug/L	0.26	0.19	0.13	1.20	
Ni	1 ug/L	0.45	0.58	0.22	1.73	
Se	1 ug/L	0	0.10	0	0	
Ag	0.25 ug/L	0	0	0	0	
Zn	1 ug/L	18	14	14	73	
PCBs						
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	

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.
A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.6 Load Calculations (pounds) for each Storm Event at Los Cerritos Channel. (continued)

Analyte	ML	2/3/2004	2/18/2004	2/22/2004	2/26/2004	3/2/2004
Chlorinated Pesticides						
4,4'-DDD	0.05 ug/L	0	0	0	0	
4,4'-DDE	0.0 5 ug/L	0.00	0.00	0	0	
4,4'-DDT	0.01 ug/L	0	0.01	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	0.00	0	0	
beta-BHC	0.005 ug/L	0	0	0	0	
Chlordane	0.1 ug/L	0	0.03	0	0	
delta-BHC	0.005 ug/L	0	0.00	0	0	
Dieldrin	0.01 ug/L	0.00	0.00	0	0	
alpha-Endosulfan	0.02 ug/L	0	0	0	0	
beta-Endosulfan	0.01 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	
Endrin ketone	0.01 ug/L	0	0	0	0	
gamma-BHC	0.02 ug/L	0.01	0	0	0	
gamma-Chlordane	0.1 ug/L	0	0.00	0	0	
Heptachlor	0.01 ug/L	0	0	0	0	
Heptachlor epoxide	0.01 ug/L	0	0	0	0	
Methoxychlor	0.05 ug/L	0	0	0	0	
Toxaphene	0.5 ug/L	0	0	0	0	
Organophosphates						
Atrazine	2 ug/L	0	0	0	0	
Chlorpyrifos	0.05 ug/L	0	0	0	0	
Cyanazine	2 ug/L	0	0	0	0	
Diazinon	0.01 ug/L	0.02	0	0	0	
Malathion	1 ug/L	0	0	0	0	
Prometryn	2 ug/L	0	0	0	0	
Simazine	2 ug/L	1.4	0.66	0	3.9	

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.

A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.7 Load Calculations (pounds) for each Storm Event at the Dominguez Gap Pump Station.

Analyte	ML	2/18/2004	2/26/2004	3/02/2004
Conventionals				
Alkalinity	2 mg/L	1635	1251	690
BOD	2 mg/L	66	412	135
COD	20-900 mg/L	1251	4049	469
Chloride	2 mg/L	1251	361	359
Fluoride	0.1 mg/L	7	8	4
Hardness	2 mg/L	2492	1038	866
MBAS (Surfactants)	0.05 mg/L	0	0	0
NH3-N	0.1 mg/L	49	21	13
TKN	0.01 mg/L	60	70	27
NO3-N (Nitrate)	0.1 mg/L	48	21	9
NO2-N (Nitrite)	0.1 mg/L	0	0	0
Oil & Grease	5 mg/L	56	0	0
Total Phenols	0.1 mg/L	0	0	0
P (Total)	0.05 mg/L	13	29	11
Ortho-P (Dissolved)	0.05 mg/L	13	21	8
TDS	2 mg/L	6330	3681	1932
TOC	1 mg/L	96	574	210
TSS	2 mg/L	96	4711	552
TVS	2 mg/L	0	3092	1435
Total Metals				
Al	100 ug/L	3.8	317	36
As	1 ug/L	0.02	0.16	0.04
Cd	0.25 ug/L	0.00	0.03	0.00
Cr	0.05 ug/L	0.02	0.41	0.07
Cu	0.05 ug/L	0.14	1.2	0.26
Fe	100 ug/L	6.0	236	36
Pb	0.5 ug/L	0.05	1.3	0.21
Ni	1 ug/L	0.05	0.38	0.11
Se	1 ug/L	0.01	0.06	0.00
Ag	0.25 ug/L	0.00	0.01	0
Zn	1 ug/L	0.62	8.8	1.4
Dissolved Metals				
Al	100 ug/L	0.01	7.3	2.8
As	1 ug/L	0.02	0.12	0.04
Cd	0.25 ug/L	0.00	0.00	0.00
Cr	0.05 ug/L	0.04	0.04	0.02
Cu	0.05 ug/L	0.09	0.21	0.12
Fe	100 ug/L	0.26	11	5.0
Pb	0.5 ug/L	0.01	0.05	0.03
Ni	1 ug/L	0.04	0.04	0.04
Se	1 ug/L	0.01	0.06	0
Ag	0.25 ug/L	0.00	0	0.00
Zn	1 ug/L	0.43	2.1	0.75
PCBs				
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

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.
A "0.00" indidates the calculated load was less than 0.005 pounds.

Table 6.7. Total Load (pounds) Calculated for Each Storm Event at Dominguez Gap Pump Station. (continued)

Analyte	ML	2/18/2004	2/26/2004	3/02/2004
Chlorinated Pesticides				
4,4'-DDD	0.05 ug/L	0	0	0
4,4'-DDE	0.0 5 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
beta-BHC	0.005 ug/L	0.00	0	0
Chlordane	0.1 ug/L	0	0	0
delta-BHC	0.005 ug/L	0	0	0
Dieldrin	0.01 ug/L	0	0	0
alpha-Endosulfan	0.02 ug/L	0	0	0
beta-Endosulfan	0.01 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
Endrin ketone	0.01 ug/L	0	0	0
gamma-BHC	0.02 ug/L	0	0	0
gamma-Chlordane	0.1 ug/L	0	0	0
Heptachlor	0.01 ug/L	0	0	0
Heptachlor epoxide	0.01 ug/L	0	0	0
Methoxychlor	0.05 ug/L	0	0	0
Toxaphene	0.5 ug/L	0	0	0
Organophosphates				
Atrazine	2 ug/L	0	0	0
Chlorpyrifos	0.05 ug/L	0	0	0
Cyanazine	2 ug/L	0	0	0
Diazinon	0.01 ug/L	0	0	0
Malathion	1 ug/L	0	0	0
Prometryn	2 ug/L	0	0	0
Simazine	2 ug/L	0	0.61	0.07

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.
A “0.00” indidates the calculated load was less than 0.005 pounds.

Table 6.8 Monitored Dry Weather Events, 1999-2004

Station	EVENT 1 10/4/00	2 6/21/00	3 6/29/00	4 6/5/01	5 8/16/01	6 5/9,14/02	7 9/5/02	8 5/20/03	9 9/ll/03	10 5/4/04
Bouton Creek		X	X	X	X	X	X	X	X	X
Belmont Pump		X	X	X	X	X	X	X	X	X
Los Cerritos Channel				X	X	X	X	X	X	X
Dominguez Gap		X[1]	X[1]	X[1]	X[1]	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 2003-2004 Dry Weather Surveys included in this report.

Table 6.9 Field Measurements for Bouton Creek, Belmont Pump, and Los Cerritos Channel, Dry Weather Season (2003/2004).

	Bouton Creek		Belmont Pump		Los Cerritos	
Date	**9/11/03**	**5/5/04**	**9/10/03**	**5/4/04**	**9/10/03**	**5/4/04**
Time	**07:42**	**08:30**	**06:50**	**10:56**	**08:00**	**10:20**
Temperature (^{0}C)	18.2	20.4	23.0	19.8	18.5	27.5
pH	8.3	8.2	8.4	8.0	8.5	8.8
Specific Conductivity (mS/cm)	8.83	10.8	3.15	2.89	8.84	0.56
Flow (cfs)	0.23[1]	0.35[1]	0.041[2]	0.047[2]	2.1[1]	2.4[1]
Dissolved Oxygen (mg/L)	4.6	12.9	8.2	13	8.6	14.5

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 The flow rate was determined by observing changes in water level in the sump area over a 24-hour period.

Table 6.10. Summary of Chemical Analyses of Dry Weather Monitoring, 2003/2004 (Page 1 of 3)

Analyte	Belmont Pump	Bouton Creek	Los Cerritos Channel	Belmont Pump	Bouton Creek	Los Cerritos Channel
	Dry Weather Event 1			Dry Weather Event 2		
Conventionals						
BOD (mg/L)	9.7	7.5	16	2.3	4.4	16
COD (mg/L)	22	350	48	79	190	84
TOC (mg/L)	7.1	15	11	9.1	20	21
EC (umhos/cm)	3070	8820	621	2900	9800	820
Hardness (mg/L)	382	987	202	345	1070	176
Alkalinity (mg/L)	160	420	160	400	160	120
pH (pH Units)	8.44	8.00	8.45	7.97	8.19	**8.82**[3]
Chloride (mg/L)	710	3100	63	610	3600	95
Fluoride (mg/L)	1.6	0.81	0.49	1.4	0.9	0.89
TKN (mg/L)	1	0.98	2.9	1.1	6.4	3.3
Ammonia as N (mg/L)	0.115	0.139	0.100U	0.1U	0.1U	0.1U
Nitrate N (mg/L)	3.7	0.5U	0.1U	0.1U	0.1U	0.1U
Nitrite N (mg/L)	0.5U	0.5U	0.1U	0.1U	0.1U	0.1U
Total Phosphorus (mg/L)	0.97	0.3	0.3	0.81	0.078	0.62
Ortho-P (Dissolved) (mg/L)	0.92	0.024	0.01U	0.7	0.01U	0.01U
MBAS (mg/L)	0.025	0.031	0.034	0.025U	0.025U	0.025U
Total Phenols (mg/L)	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
Oil & Grease (mg/L)	5.00U	5.00U	5.00U	5.00UJ	5.00UJ	5.00UJ
TSS (mg/L)	1.00U	1.00U	56	1.00U	1.00U	128
TDS (mg/L)	1780	5220	384	1730	6230	522
Turbidity (NTU)	2.2	3.3	27	1.9	4	16
TVS (mg/L)	110	95	95	96.0	1170	188
***Total Metals* (µg/L)**						
Aluminum	300J	60J	680J	20J	20J	**1100**[3]
Arsenic	3.9	1.1	3.58	3.28	1.58	2.10
Cadmium	0.11J	0.097J	0.27	0.18J	0.094J	0.85
Chromium	1.7J+	0.75J+	1.9J+	1.1	1.2	3.1
Copper	9	11	15	9.1	7.6	26
Iron	910J	120J	440J	66	38	1500
Lead	0.79	1.5	6.5	1.8	1.8	17
Nickel	2.5J+	2.4J+	2.9J+	4.4	4.5	7.6
Selenium	1.00U	1.00U	1.00U	1.00U	1.00U	1.00U
Silver	0.13J	0.53	0.25U	0.25U	0.088J	0.049J
Zinc	21	22	92	27	12	190

1Value exceeds the California Toxics Rule for Freshwater.
2Value exceeds the California Toxics Rule for Saltwater.
3Value exceeds the LA Basin Plan.
4Value exceeds the California Ocean Plan.
5Value exceeds the California Toxics Rule for both Fresh and Salt Water.
6Value exceeds the LA Basin Plan and the CA Ocean Plan.
7Value exceeds the CTR for Saltwater and the CA Ocean Plan.
8Value exceeds the California Fish and Game Criteria for Freshwater.

Table 6.10. Summary of Chemical Analyses of Dry Weather Monitoring, 2003/2004 (Page 2 of 3)

Analyte	Belmont Pump	Bouton Creek	Los Cerritos Channel	Belmont Pump	Bouton Creek	Los Cerritos Channel
	Dry Weather Event 1			Dry Weather Event 2		
***Dissolved Metals* (µg/L)**						
Aluminum	1.1J	63J	100U	100U	100U	100U
Arsenic	3.22	0.95J	2.95	3.35	1.52	1.00
Cadmium	0.25U	0.25U	0.25U	0.13J	0.068J	0.23J
Chromium	0.71	0.78	0.50U	2.9	1.4	0.80
Copper	**4.1**[2]	**7.8**[2]	**3.4**[2]	**6.1**[2]	**5.7**[2]	**7.7**[2]
Iron	25U	49	25U	25U	25U	27
Lead	0.33J	0.6	0.57	0.47J	0.58	0.60
Nickel	1.9	1.0U	1.0U	3.3	4.1	3.2
Selenium	0.16J	1.00U	1.00U	1.00U	1.00U	1.00U
Silver	0.17J	0.25UJ	0.25UJ	0.25UJ	0.17J	0.25UJ
Zinc	15	19	17	19	10	8.8
Chlorinated Pesticides (µg/L)						
4,4'-DDD	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
4,4'-DDE	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
4,4'-DDT	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
alpha-BHC	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
alpha-Chlordane	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
beta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Chlordane	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U
delta-BHC	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Dieldrin	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endosulfan I	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endosulfan II	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endosulfan sulfate	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Endrin	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
Endrin ketone	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
gamma-BHC (Lindane)	0.01U	0.01U	0.01U	0.01UJ	0.01UJ	0.01UJ
gamma-Chlordane	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Heptachlor	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Heptachlor epoxide	0.01U	0.01U	0.01U	0.01U	0.01U	0.01U
Methoxychlor	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
Toxaphene	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U

1Value exceeds the California Toxics Rule for Freshwater.
2Value exceeds the California Toxics Rule for Saltwater.
3Value exceeds the LA Basin Plan.
4Value exceeds the California Ocean Plan.
5Value exceeds the California Toxics Rule for both Fresh and Salt Water.
6Value exceeds the LA Basin Plan and the CA Ocean Plan.
7Value exceeds the CTR for Saltwater and the CA Ocean Plan.
8Value exceeds the California Fish and Game Criteria for Freshwater.

Table 6.10. Summary of Chemical Analyses of Dry Weather Monitoring, 2003/2004. (Page 3 of 3)

Analyte	Belmont Pump	Bouton Creek	Los Cerritos Channel	Belmont Pump	Bouton Creek	Los Cerritos Channel
	Dry Weather Event 1			Dry Weather Event 2		
PCBS (µg/L))						
PCB-1016 (Aroclor 1016)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1221 (Aroclor 1221)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1232 (Aroclor 1232)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1242 (Aroclor 1242)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1248 (Aroclor 1248)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1254 (Aroclor 1254)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
PCB-1260 (Aroclor 1260)	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
Total PCBss	0.20U	0.20U	0.20U	0.50U	0.50U	0.50U
Organophosphate Pesticides (µg/L)						
Atrazine	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
Chlorpyrifos	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
Cyanazine	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
Diazinon	**0.18**[8]	0.05U	**0.064**[8]	0.05U	0.05U	0.05U
Malathion	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Prometryn	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
Simazine	2.0U	2.0U	2.0U	2.0U	0.25J	0.30J
Bacteriological						
Fecal Coliform	**2600**[6]	40	**1100**[6]	**4000**[6]	400	**4000**[6]
Coliform, Total	**80000**[6]	1300	**24000**[6]	**30000**[6]	2300	**110000**[6]
Enterococcus	**1490**[3]	70	**600**[3]	**1840**[3]	**1190**[3]	**3200**[3]

1Value exceeds the California Toxics Rule for Freshwater.
2Value exceeds the California Toxics Rule for Saltwater.
3Value exceeds the LA Basin Plan.
4Value exceeds the California Ocean Plan.
5Value exceeds the California Toxics Rule for both Fresh and Salt Water.
6Value exceeds the LA Basin Plan and the CA Ocean Plan.
7Value exceeds the CTR for Saltwater and the CA Ocean Plan.
8Value exceeds the California Fish and Game Criteria for Freshwater.

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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: February 3, 2004, February 18, 2004, February 23, 2004 and February 26, 2004. Composite samples were collected during separate storm events and were tested with two species, the water flea (freshwater crustacean), and the sea urchin (marine echinoderm). The runoff plume in Alamitos Bay was sampled on February 4th just after the February 3rd storm event and was tested only with the sea urchin.

Dry weather sampling occurred on September 10, 2003 and May 5, 2004.

7.1 Wet Weather Discharge

7.1.1 Belmont Pump

The first sample from the Belmont Pump station was collected on February 3, 2003. This sample caused measurable toxic effects only in the sea urchin (Table 7.1), with the fertilization test showing a NOEC of 6.25% sample (16 TUc) and a LOEC of 12.5% sample. No concentration tested produced a reduction of fertilization as high as 50%, and there were <1 TUa in this sample (Figure 7.1). Neither of the water flea test endpoints (survival or reproduction) showed the presence of toxicity.

The second Belmont Pump sample was collected on February 18 2004 and produced toxic responses in sea urchins but not in water fleas. The sea urchin fertilization test was the most sensitive indicator of toxicity with a NOEC of <3.12% sample (>32 TUc) and an EC50 of 3.48% sample (28.7 TUa) (Table 7.1). No significant reduction of water flea survival or reproduction was found at any concentration.

The third Belmont Pump sample was collected on February 23 2004 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 sample was collected on February 26, 2004 and 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 February 3, 2004. Toxicity to this sample was detected by sea urchins but not by water fleas (Table 7.2). The sea urchin fertilization bioassay showed a NOEC of 6.25% sample (16 TUc) and an EC50 of 34.5% (2.9 TUa) (Figure 7.2).

The second Bouton Creek sample was collected on February 18, 2004 and caused a toxic response to sea urchins but no toxicity to water fleas. The fertilization NOEC was 6.25% sample (16 TUc) and the EC50 was 39.5% sample (2.53 TUa) (Table 7.2 and Figure 7.2).

The third Bouton Creek sample was collected on February 23, 2004 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 26, 2004 and produced no toxic response in either water flea survival/reproduction or sea urchin fertilization (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 February 3, 2004. This sample caused no toxic response in either water flea survival /reproduction or sea urchin fertilization.(Table 7.3 and Figure 7.3).

The second Los Cerritos Channel sample was collected on February 18, 2004 and elicited a toxic response from water flea survival (NOEC was 50% sample, 2 TUc), but no toxicity was shown by water flea reproduction.(NOEC = 100%). The LC50 for survival was 70% sample (1.43 TUa)and the IC50 for reproduction was 90.2% sample (1.11 TUa). The sea urchin test also showed toxicity. The NOEC for fertilization was 6.25% sample (16 TUc) and the EC50 was 23.7% sample (4.22 TUa) (Table 7.3 and Figure 7.3).

The Los Cerritos Channel was not sampled for toxicity during the third storm on February 23, 2004.sample due to insufficient sample volumes.

The Los Cerritos Channel was sampled during the fourth storm on February 26, 2004. This sample produced no toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.3 and Figure 7.3).

7.1.4 Alamitos Bay Plume Samples

Four samples were collected from the runoff plume in Alamitos Bay during the storm of 3 February, 2004. The four samples were of differing salinities, ranging from 31.6 ppt to 12.8 ppt, representing progressively higher proportions of runoff water in the receiving marine environment. The Alamitos Bay samples were tested only with the sea urchin. Sample 1 showed a salinity of 12.8 ppt, a NOEC of 25% sample (4 TUc) and an EC50 0f 44.7% sample (2.24 TUa). Sample 2 (salinity = 23.2 ppt) showed a NOEC of 25% sample (4 TUc) and an EC50 of 65.3% sample (1.53 TUa). Sample 3, salinity = 25.1ppt, showed a NOEC of 25% (4 TUc) and an EC50 of >50% sample (<2 TUa). Sample 4, almost full-strength seawater (31.6 ppt), showed a NOEC of 50% sample (2 TUc) and an EC50 of >50% sample (<2 TUa).. Thus the plume samples exhibited a high to low gradient of toxicity corresponding to the high to low proportion of runoff water they contained.

7.2 Toxicity Identification Evaluations (TIEs) of Stormwater

The trigger for performing a TIE was modified prior to the 2003-2004 wet season. A TIE was initiated when a LC50 of ≤ 33% (equivalent to ≥ 3 acute TU) was obtained for water flea survival or an EC50 of ≤ 33% (≥ 3 acute TU) was obtained for the sea urchin fertilization test. Sample manipulations were performed when the TIE trigger was exceeded, but the manipulated samples were subjected to toxicity evaluations only if the baseline toxicity showed persistent toxicity of at least 2 TUa. TIEs were initiated four times during wet weather testing (Table 7.4). Only sea urchins showed sufficient toxicity to exceed the TIE trigger.

During the monitoring period, TIEs were triggered for the first and second wet weather sampling events. For the first storm, TIEs were initiated on samples from Bouton Creek and Los Cerritos Channel using the sea urchin test. A reduction in toxicity relative to the initial test result was obtained for both TIEs, resulting in a baseline toxicity of less than 2 TUa, which prompted abandonment of these TIEs. For the second storm, sea urchin TIEs were initiated for the Belmont Pump and Los Cerritos Channel samples. Baseline toxicity of the Belmont Pump sample decreased to < 2 TUa and the TIE was abandoned.

7.2.1 Los Cerritos Channel Station

A TIE was conducted on the February 18 stormwater from Los Cerritos Channel using the sea urchin fertilization test. The TIE results obtained for this sample showed that both addition of EDTA and C18 column extraction virtually eliminated the toxicity of the sample. Centrifugation slightly increased the toxicity of the sample, and STS treatment produced a very slight reduction in toxicity The effect of STS treatment was so small that it was probably not significant. The toxicity-increasing effect of centrifugation may suggest that particulates in the sample were protective of urchin sperm. Overall, the results suggest that non-polar organics and/or selected divalent metals (nickel, zinc and possibly copper) were toxicants of concern in this sample.

7.3 Dry Weather Discharge

Toxicity tests were conducted on samples from two dry weather sampling events, on September 10, 2003 and May 5, 2004 (Table 7.5). The Bouton Creek sample collected in September 2003 contained 5.0 g/kg salinity, which is about 1.6X the LC50 for the water flea. The May 2004 Bouton Creek sample was similarly elevated, at 5.8 g/kg. For both samples 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 2003 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) and the IC50 was >100% sample (<1 TUa). The LC50 and IC50 for survival were both >100% sample.

There was significantly decreased fertilization of sea urchins in the 50% concentration of the Belmont Pump Station sample. The NOEC was 25% sample (4TUc) and the IC50 was 73.2% sample (1.37 TUa) (Table 7.5).

The May 2004 dry weather samples did not produce measurable toxic responses in either water flea survival/reproduction or sea urchin fertilization (Table 7.5).

7.3.2 Bouton Creek

The September 2003 bioassays showed significantly decreased survival and reproduction of *Ceriodaphnia* in all test concentrations. The NOEC for both endpoints was <6.25% (>16 TUc). The LC50 for survival was 3.91% sample (25.6 TUa)and the IC50 for reproduction was 3.12% sample (32.1 TUc). A TIE was triggered for water fleas on this sample.

Toxicity to water fleas was also demonstrated in the May 2004 dry weather sample. The NOEC for both survival and reproduction was 25% sample (4 TUc), the LC50 for survival was 58.3% sample (1.71 TUa) and the IC50 for reproduction was 35.6% sample (2.81 TUa). Since there were less than 3 TUa, a TIE was not initiated for this sample.

No significant toxicity to sea urchins (NOEC = >50%) was demonstrated in either the September 2003 or the May 2004 sample.

7.3.3 Los Cerritos Channel

The September 2003 sample from Los Cerritos Channel produced a survival NOEC of 25% (4 TUc) and a reproduction NOEC of 12.5% (8 TUc) in Ceriodaphnia. The LC50 was 37.5%sample (2.7 TUa) and the IC50 was 18% sample (5.55 TUa). Sea urchin fertilization was significantly reduced in the 50%sample concentration. The NOECwas 25% (4TUc) and the EC50 was 86% sample (1.16TUa) (Table 7.5).

The May 2004 Los Cerritos Channel dry weather sample showed similar toxicity to water fleas, with a survival NOEC of 25% (4 TUc) and an LC50 of 38.9% sample (2.6 TUa). The reproduction NOEC was12.5% (8 TUc) and the IC50 was 20.7% (4.8 TUa). A *Ceriodaphnia* TIE was performed on this sample.

The sea urchin fertilization test showed no measurable toxicity (EC50 > 50%, < 2TU).

7.4 Dry Weather Toxicity Identification Evaluations

A water flea TIE was initiated on the September 10 2003 dry weather sample from Bouton Creek station. Baseline toxicity increased to 17.6 TU from the initial toxicity of 14.3 TU. Sample toxicity was slightly reduced by centrifugation and was virtually eliminated by C18 SPE treatment. PBO and EDTA treatments produced slightly increased sample toxicity (20-22 TU), and STS treatment resulted in markedly elevated toxicity (57.1 TU).

These results suggest that some toxicity was associated with sample particulates and that a non-polar organic compound was the primary toxicant. Organophosphate pesticides are contraindicated by the elevated toxicity produced by PBO, but this effect may implicate pyrethroid pesticides. Divalent metals are also not suggested as toxicants due to increased toxicity produced by EDTA treatment. Note that there was substantial blank toxicity in the STS treatment.

A water flea TIE was performed on the May 5 2004 sample collected from Los Cerritos Channel. At 2.3 TUa, baseline toxicity was slightly diminished from initial toxicity (2.6 TUa). Centrifugation and treatment with PBO produced toxicity (2.8 TUa) that was mildly elevated over baseline level.. C18 SPE treatment virtually eliminated toxicity (<1.1 TUa), while EDTA treatment reduced toxicity by about 20% (to 1.8-1.9 TUa) in the two concentrations that did not cause blank toxicity. STS treatment markedly enhanced toxicity (5.4-9.1 TUa) but also produced blank toxicity in two of three concentrations.

These results suggest a non-polar organic compound as the primary toxicant. Organophosphate pesticides probably did not contribute to sample toxicity, since PBO treatment was ineffective in toxicity reduction. Since toxicity was slightly enhanced by PBO, it is possible that pyrethrin-based pesticides may have had a small toxic effect. The reduction in sample toxicity produced by EDTA suggests that a secondary toxicant was one of several divalent cationic metals. C18 SPE not only removes non-polar organics, but also can remove toxicity caused by Zn and Cu.

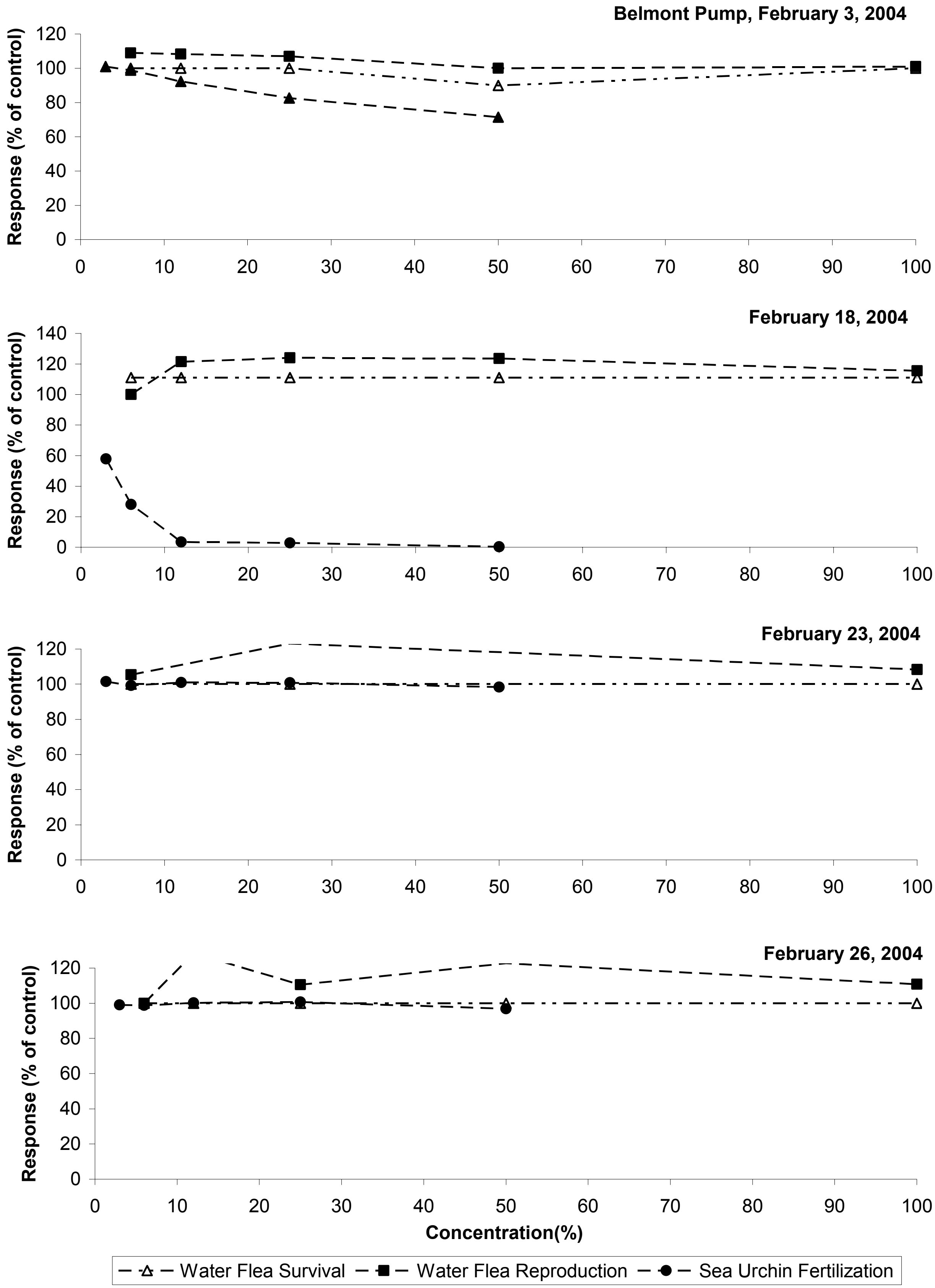

Figure 7.1. Toxicity Dose-Response plots for stormwater samples collected from Belmont Pump. Dose-response plots for 2/18 and 2/26 based upon 6.25 percent concentration.

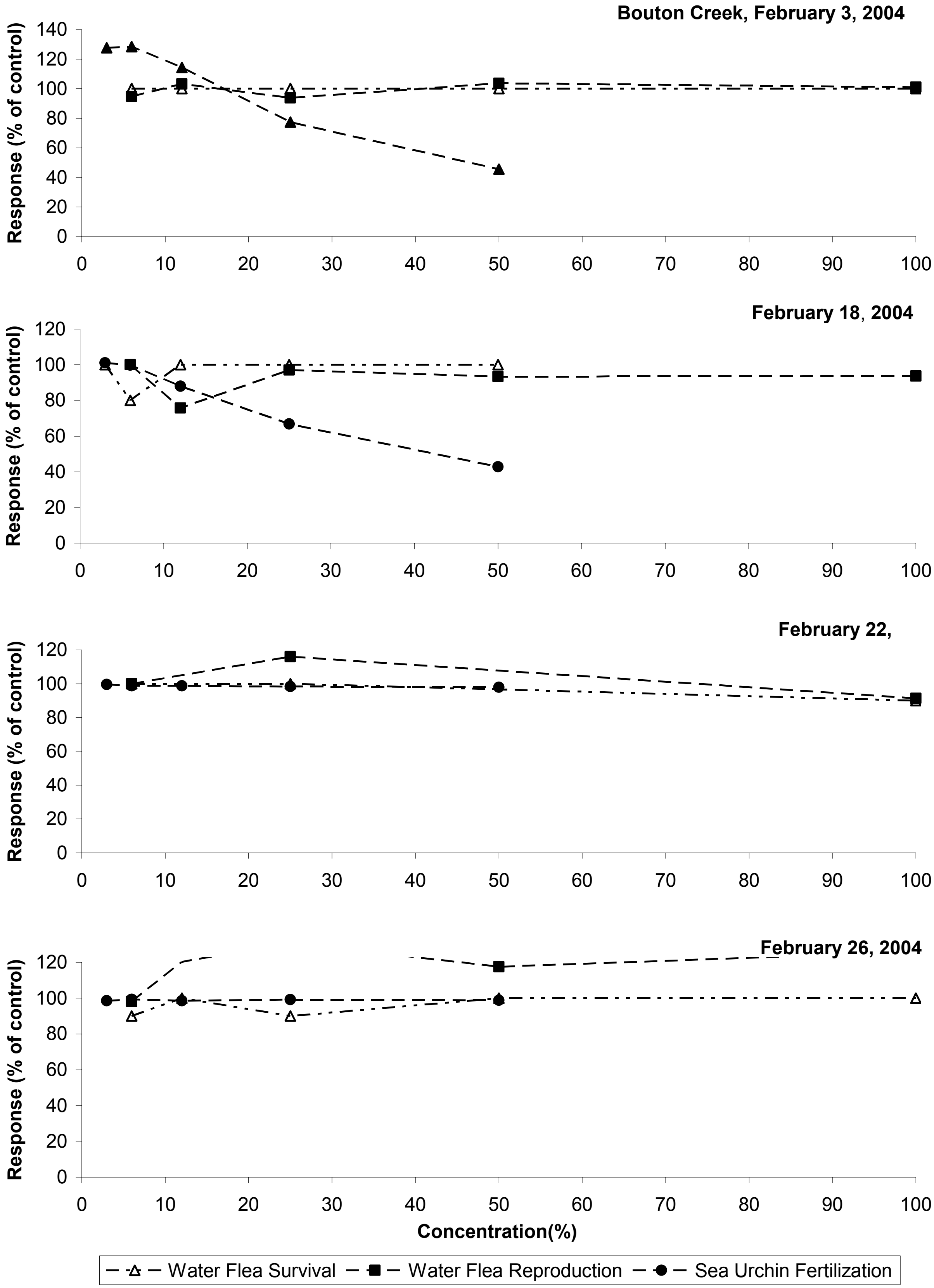

Figure 7.2 Toxicity Dose-Response plots for stormwater samples collected from Bouton Creek. Dose-response plots for 2/18 and 2/22 based upon 6.25 percent concentration.

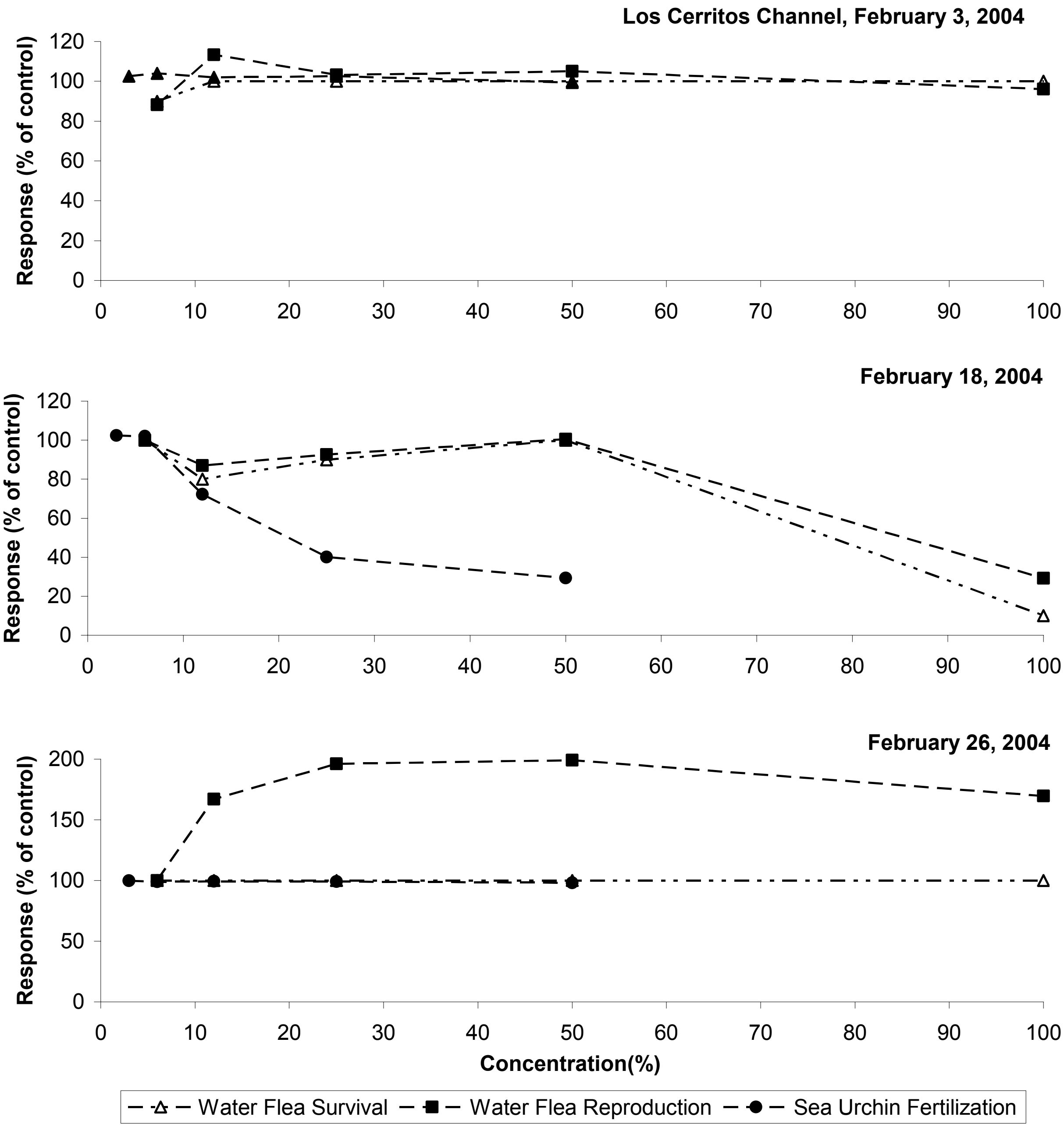

Figure 7.3. Toxicity Dose-Response plots for stormwater samples collected from Los Cerritos Channel. Dose-response plots for 2/18 and 2/26 based upon 6.25 percent concentration.

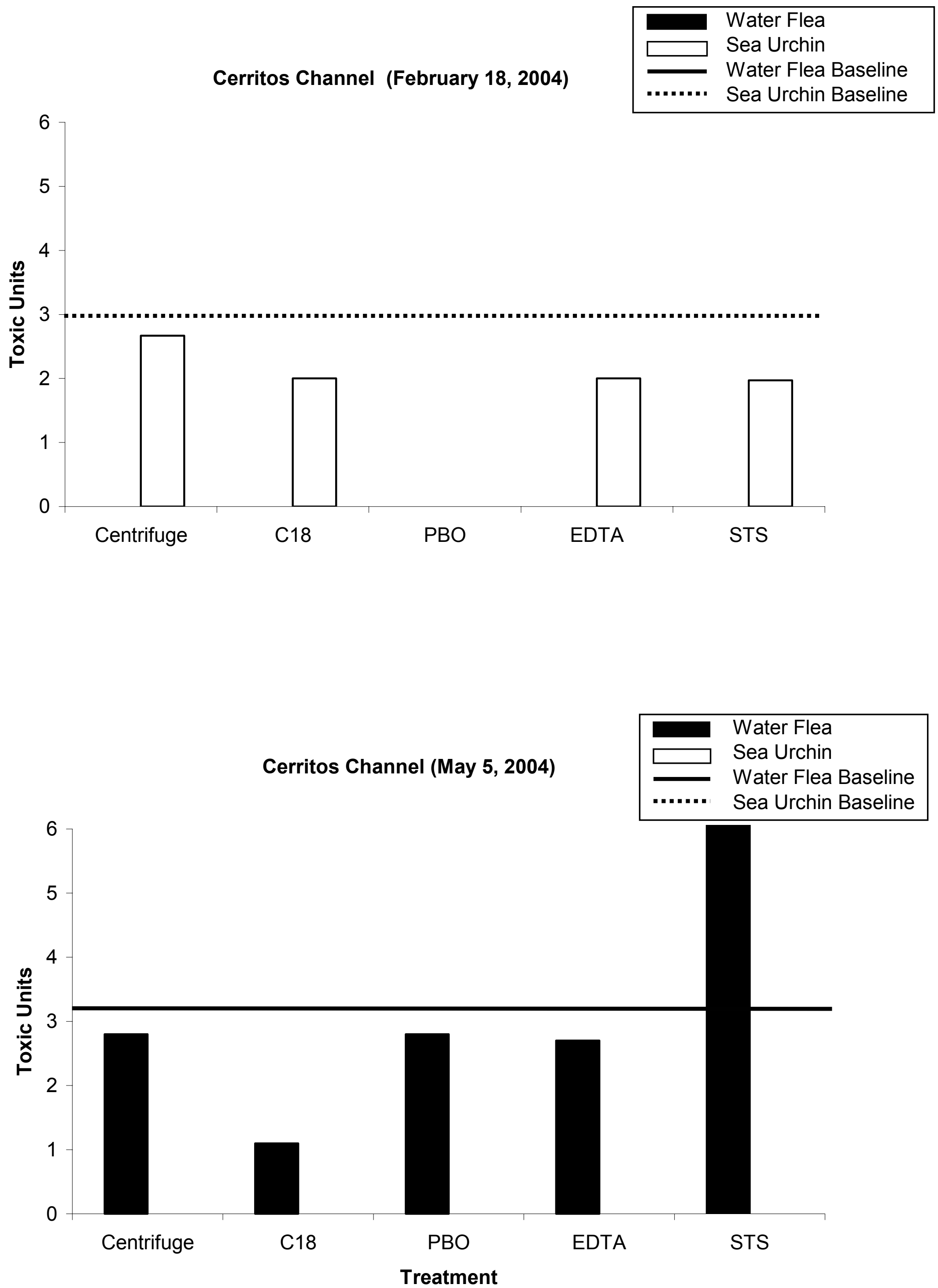

Figure 7.4. Summary of Phase I TIE Analyses on Stormwater Samples from the Los Cerritos Channel Station, February and May 2003.

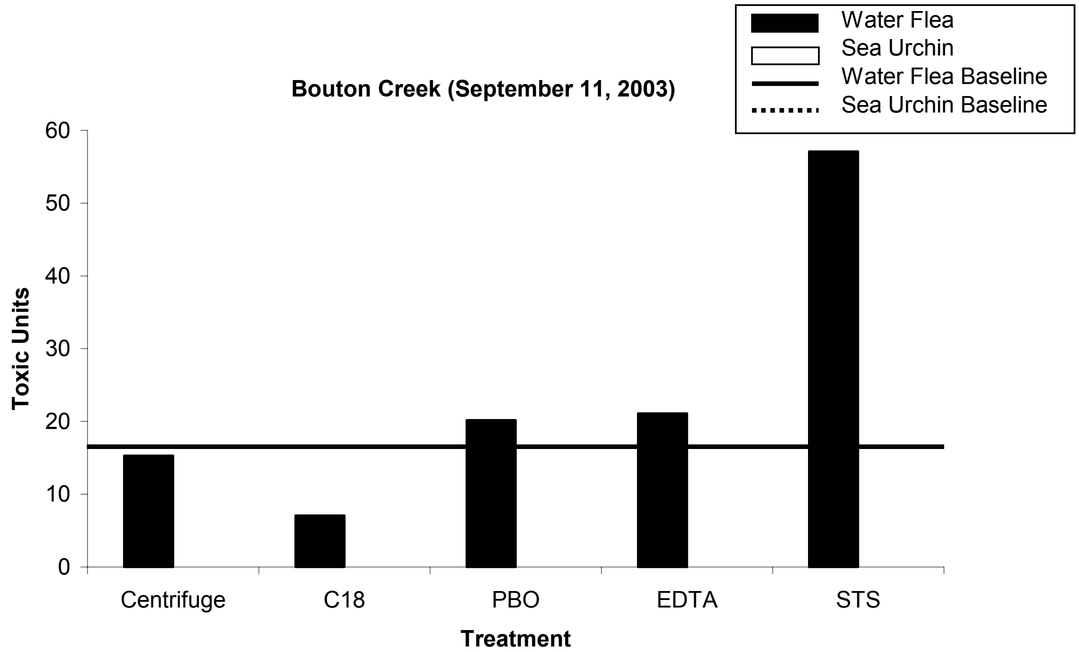

Figure 7.5. Summary of Phase I TIE Analyses on Dry Weather Samples from the Bouton Creek Station, September 2003.

Table 7.1. Toxicity of Wet Weather Samples Collected from the City of Long Beach Belmont Pump Station during the 2003/2004 Monitoring Season. Test results indicating toxicity are shown in bold type.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
2/03/04	Water Flea Survival	100	>100	>100	<1
2/03/04	Water Flea Reproduction	100	>100	>100	<1
2/03/04	**Sea Urchin Fertilization**	**6.25**	**12.5**	**>50**	**16**
2/18/04	Water Flea Survival	100	>100	>100	<1
2/18/04	Water Flea Reproduction	100	>100	>100	<1
2/18/04	**Sea Urchin Fertilization**	**<3.12**	**3.12**	**3.48**	**>32**
2/23/04	Water Flea Survival	100	>100	>100	<1
2/23/04	Water Flea Reproduction	100	>100	>100	<1
2/23/04	Sea Urchin Fertilization	50	>50	>50	<2
2/26/04	Water Flea Survival	100	>100	>100	<1
2/26/04	Water Flea Reproduction	100	>100	>100	<1
2/26/04	Sea Urchin Fertilization	50	>50	>50	<2

[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.

Table 7.2. Toxicity of Wet Weather Samples Collected from the City of Long Beach Bouton Creek Station during the 2003/2004 Monitoring Season. Test results indicating toxicity are shown in bold type.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
2/03/04	Water Flea Survival	100	>100	>100	<1.0
2/03/04	Water Flea Reproduction	100	>100	>100	<1.0
2/03/04	**Sea Urchin Fertilization**	**6.25**	**12.5**	**34.5**	**16**
2/18/04	Water Flea Survival	100	>100	>100	<1.0
2/18/04	Water Flea Reproduction	100	>100	>100	<1.0
2/18/04	**Sea Urchin Fertilization**	**6.25**	**12.5**	**39.5**	**16**
2/23/04	Water Flea Survival	100	>100	>100	1
2/23/04	Water Flea Reproduction	100	>100	>100	<1
2/23/04	Sea Urchin Fertilization	50	>50	>50	<2
2/26/04	Water Flea Survival	100	>100	>100	<1
2/26/04	Water Flea Reproduction	100	>100	>100	<1
2/26/04	Sea Urchin Fertilization	50	>50	>50	<2

[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.

Table 7.3. Toxicity of Wet Weather Samples Collected from the City of Long Beach Los Cerritos Channel Station during the 2003/2004 Monitoring Season. Test results indicating toxicity are shown in bold type.

Date	Test	Test Response (% sample)			TUc[d]
		NOEC[a]	LOEC[b]	Median Response[c]	
2/03/04	Water Flea Survival	100	>100	>100	<1
2/03/04	Water Flea Reproduction	100	>100	>100	<1
2/03/04	Sea Urchin Fertilization	50	>50	>50	<2
2/18/04	**Water Flea Survival**	**50**	**100**	**70**	**2**
2/18/04	Water Flea Reproduction	100	>100	90.2	1.11
2/18/04	**Sea Urchin Fertilization**	**6.25**	**12.5**	**23.7**	**16**
2/26/04	Water Flea Survival	100	>100	>100	<1
2/26/04	Water Flea Reproduction	100	>100	>100	<1
2/26/04	Sea Urchin Fertilization	50	>50	>50	<2

[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.

Table 7.4. Summary of TIE Activities. Acute Toxic Units (TUa's) 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 TUa value fell below 2.0.

Date	Test	Water Flea			Sea Urchin		
		TU-I	TU-B	Action	TU-I	TU-B	Action
Wet Weather Events							
2/04/04	Bouton				2.9	<2	Abandon
2/04/04	Los Cerritos				2.87	<2	Abandon
Dry Weather Events							
9/11/03	Belmont				28.7	<2	Abandon
9/11/03	Los Cerritos				4.2	2.11	Proceed
5/5/04	Los Cerritos	2.6	2.3	Proceed			

Table 7.5. 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	9/10/03	Water Flea Survival	100	>100	>100	<1
Belmont	**9/10/03**	**Water Flea Reproduction**	**50**	**100**	**>100**	**<1**
Belmont	**9/10/03**	**Sea Urchin Fertilization**	**25**	**50**	**73.2**	**4**
Bouton	**9/10/03**	**Water Flea Survival[e]**	**<6.25**	**6.25**	**3.91**	**>16**
Bouton	**9/10/03**	**Water Flea Reproduction[e]**	**<6.25**	**6.25**	**3.12**	**>16**
Bouton.		Sea Urchin Fertilization	50	>50	>50	<2
Los Cerritos	**9/10/03**	**Water Flea Survival**	**25**	**50**	**37.5**	**4**
Los Cerritos	**9/10/03**	**Water Flea Reproduction**	**12.5**	**25**	**18**	**8**
Los Cerritos	**9/10/03**	**Sea Urchin Fertilization**	**25**	**50**	**86**	**4**
Belmont	5/5/04	Water Flea Survival	100	>100	>100	1
Belmont	5/5/04	Water Flea Reproduction	100	>100	>100	1
Belmont	5/5/04	Sea Urchin Fertilization	50	>50	>50	2
Bouton	**5/5/04**	**Water Flea Survival**	**25**	**50**	**58.3**	**4**
Bouton	**5/5/04**	**Water Flea Reproduction**	**25**	**50**	**35.6**	**4**
Bouton	5/5/04	Sea Urchin Fertilization	50	>50	>50	2
Los Cerritos	**5/5/04**	**Water Flea Survival**	**25**	**50**	**38.9**	**4**
Los Cerritos	**5/5/04**	**Water Flea Reproduction**	**12.5**	**25**	**20.7**	**8**
Los Cerritos	5/5/04	Sea Urchin Fertilization	50	>50	>50	2

[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.

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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 February 2, 2004 storm resulted in a surface plume that extended only in the lower reaches of Los Cerritos Channel and upper reaches of Marine Stadium (Figure 8.1). Rainfall measures at the Long Beach mass emission sites ranged from 0.67 inches to 0.77 inches over a period of roughly two and a quarter to three and a half hours from approximately 2000 to 2335 hours on the night of February 2, 2004. The plume characteristics were evaluated on the morning of February 3, 2004 from 0521 to 0954 hours.

Based upon the plume characteristics, the Los Cerritos Channel was the major source of stormwater entering Alamitos Bay. The surface salinity increased from nearly fresh levels in the Los Cerritos Channel to nearly open coast levels around Naples Island and the harbor entrance. Measured surface salinity within Alamitos Bay ranged from 1 to 32 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 the stormwater plume generally formed a surface plume that was typically one to three feet in depth (Figures 8.3b and 8.3g). The layer was thickest and most distinct in Cerritos Creek (Casts # 2 and #7, Figure 8.3b and 8.3g). The structure of the plume became increasing indistinct at the entrance to Alamitos Bay from Cerritos Creek (Casts # 6 and #5, Figure 8.3e and 8.3f) and disappeared upon entering the Bay.

In all cases, the stormwater plume tended to be cooler and more turbid than the underlying marine waters. Temperatures in the plume were typically six degrees centigrade lower at the surface than the deeper marine waters. Turbidity in the surface plume ranged from 5 to 16 NTU. Marine water under the plume was relatively clear with turbidity measurements typically in the range of 1.3 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 12.8 ppt. Three additional sites were sampled with recorded salinities of 23.2 ppt (RW2), 25.1 ppt (RW3) and 31.6 ppt (RW4). Influence of stormwater would, therefore, be highest at RW1 and lowest at RW4.

Total suspended solids increased from 2 to 12 mg/L as the surface salinity decreased from 31.6 to 12.8 ppt. Similarly, total copper, lead and zinc concentrations also increased with decreasing salinity. Concentrations generally doubled over the salinity gradient. Concentrations were highest inside Cerritos Channel and lowest at station RW4 in Alamitos Bay. Total nickel reversed the trend with increasing concentrations with increasing salinity. Total cadmium was not detected in any of the samples.

Concentrations of dissolved metals showed no clear pattern of stormwater influence. Concentrations of dissolved nickel increased from station RW1 to RW4, while concentrations of dissolved zinc were just the reverse. Concentrations of dissolved cadmium, copper and lead were essentially the same at each of the stations.

Organophosphate (OP) pesticides were mostly not detected. Diazinon was the only OP pesticide detected. It was detected at just above the detection limit at station RW1.

8.3 Toxicological Characterization

Water samples from the four plume sites were tested for toxicity using the sea urchin fertilization test. Samples from each of the Receiving Water stations were tested at five concentrations (3.1%, 6.25%, 12.5%, 25%, and 50%) and showed modest to negligible toxicity with a gradient of increasing toxicity from samples with a low percentage of stormwater (RW4 - 7% stormwater) to samples with a high percentage of plume water (RW1 - 62% stormwater), (Table 8.2, Figure 8.3). NOECs ranged from 25% to 50% sample, and EC_{50}s ranged from 44.7% to >50%. Mean proportion fertilized in the highest (50%) sample concentrations ranged from 38.2% to 95.6% with the RW1 sample having the greatest toxicity and the RW4 sample having the lowest.

In similar studies conducted in Santa Monica Bay (Bay and Schiff, 1999) and in San Diego Bay (Schiff, Bay and Diehl, 2001) much higher toxicity has been observed in stormwater plumes. Stormwater plumes from Ballona Creek resulted in substantial toxic effects when stormwater was diluted as low as 10%. In San Diego Bay, a stormwater plume from Chollas Creek produced substantial toxicity in samples comprised of greater than 25% stormwater. In contrast, water from our study at RW1 contained 68% stormwater and had a NOEC of 25% and an EC_{50} of 44.7% (TU=2.2).

In comparison to both Santa Monica Bay and San Diego Bay, the lower toxicity of stormwater plumes that have been monitored in Alamitos Bay appear most likely to be attributable to the lower concentrations of dissolved zinc. The concentration of dissolved zinc in RW1 was 27 ug/L which is roughly equivalent to the EC_{50} of 29 ug/L reported by the SCCWRP (Schiff, Bay and Stransky, 2001). Based upon a regression of salinity versus dissolved zinc, the baseline concentration of dissolved zinc in stormwater from Los Cerritos Channel was estimated at 39 ug/L zinc and background levels in the Bay were approximately 10 ug/L. This compares to concentrations of 92 to 152 ug/l dissolved zinc measured in stormwater from Chollas Creek during plume studies conducted in San Diego Bay (Schiff, Bay and Stransky, 2001)

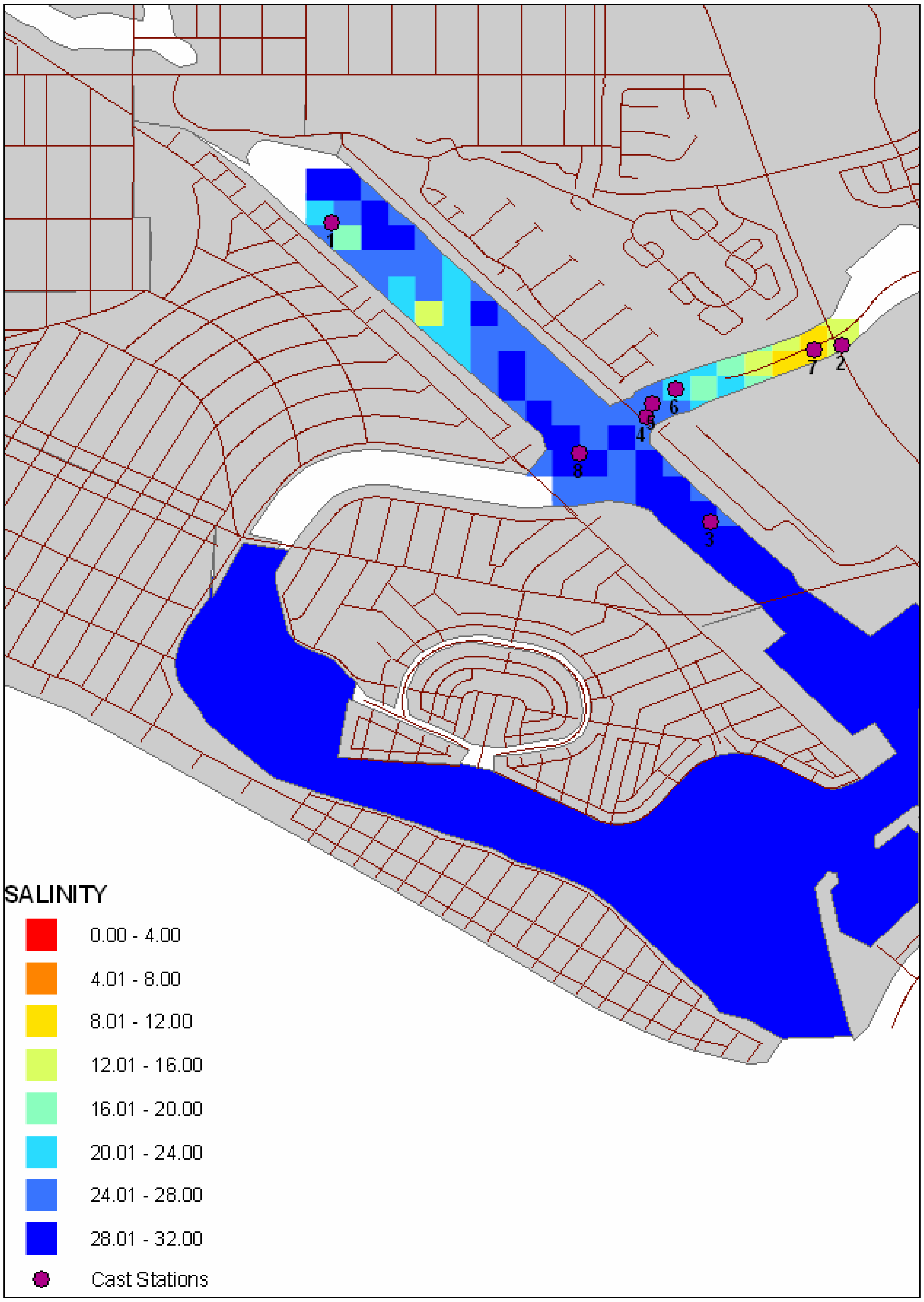


Figure 8.1 Map of Surface Salinity in Alamitos Bay with Locations of Eight Water Quality Profiling Sites, 2/3/2004.

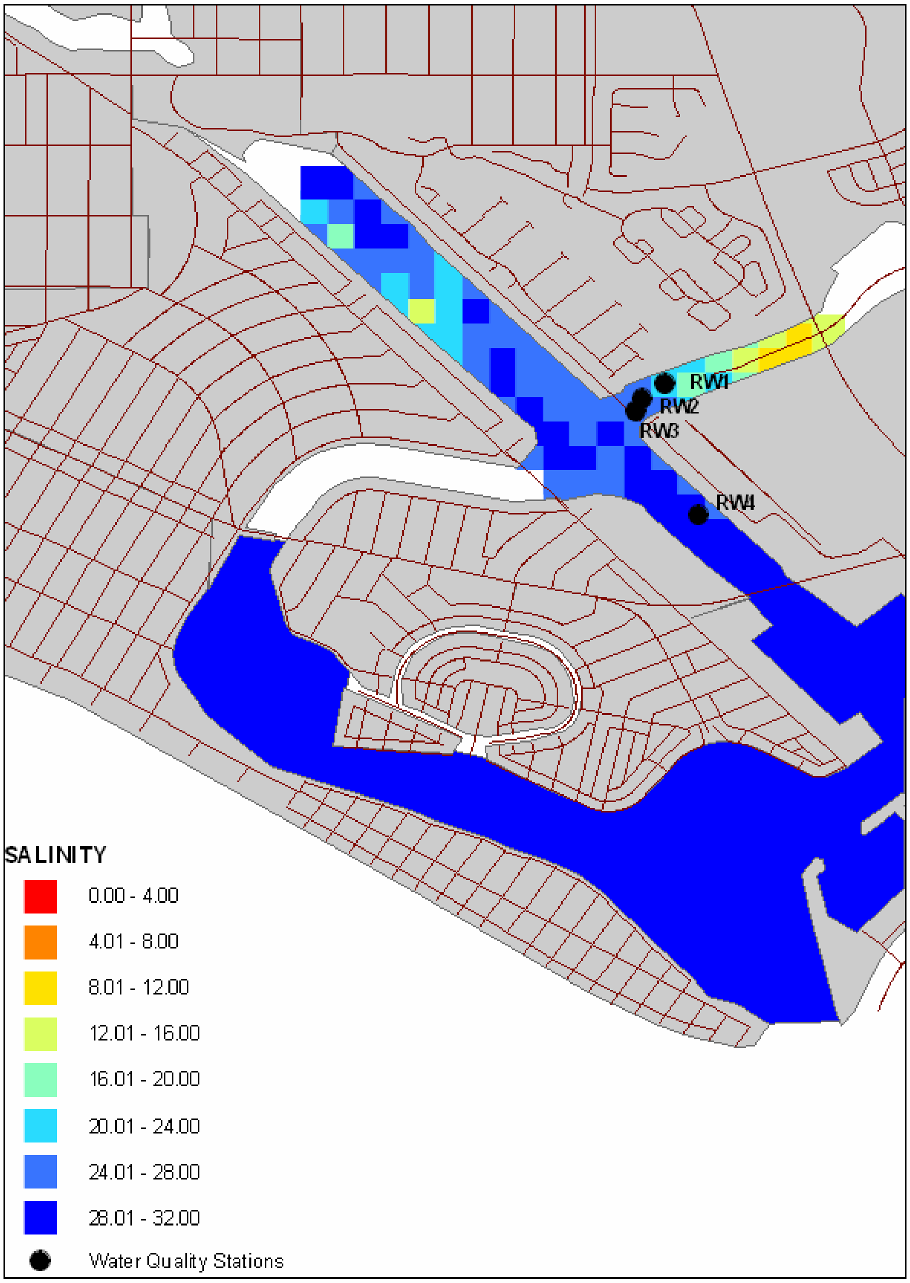


Figure 8.2 Map of Surface Salinity in Alamitos Bay with Water Quality Sampling Locations, 2/3/2004.

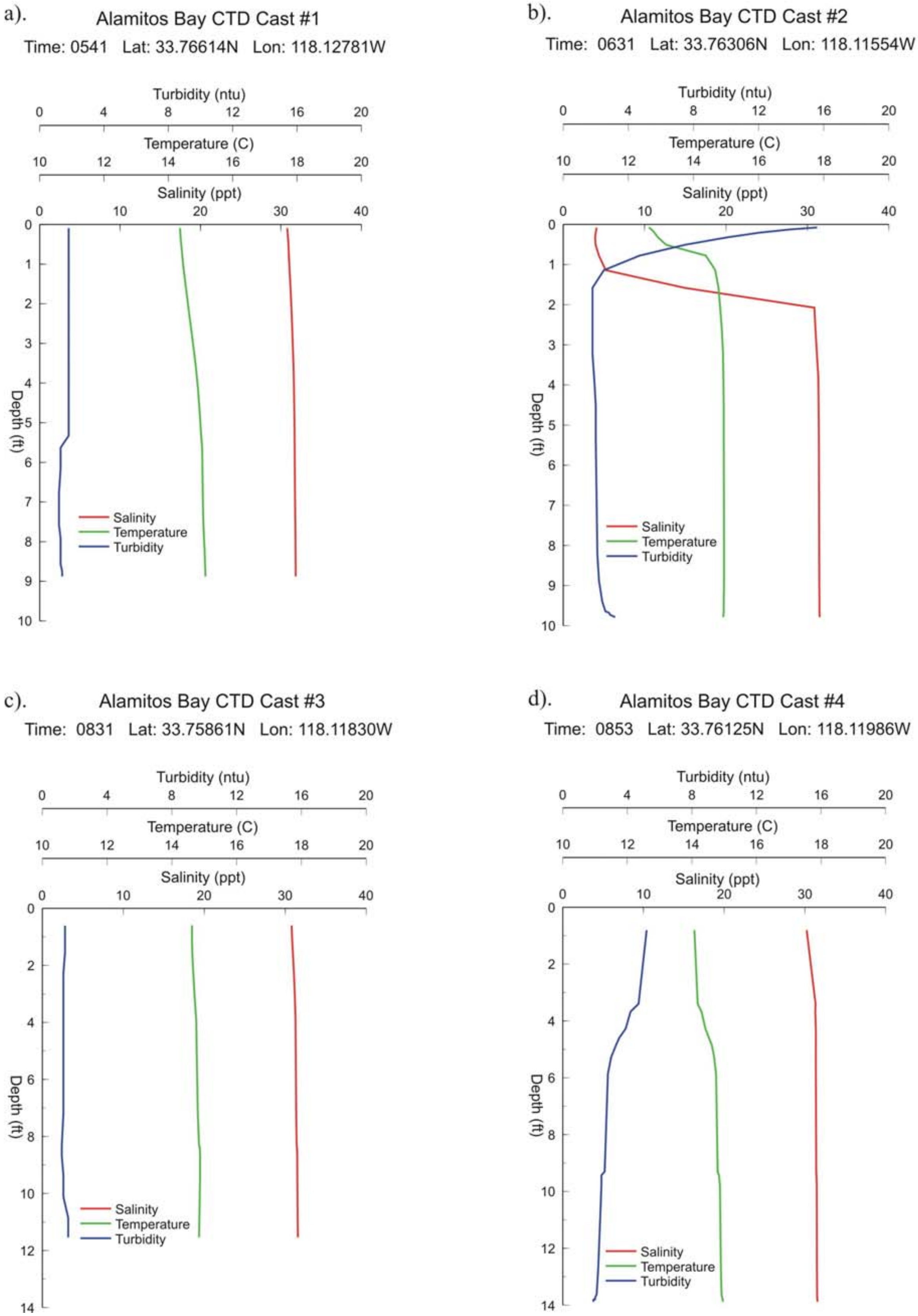


Figure 8.3(a-d) CTD Casts taken during Alamitos Bay Receiving Water Study. (Locations of each cast are shown on Figure 8.1)

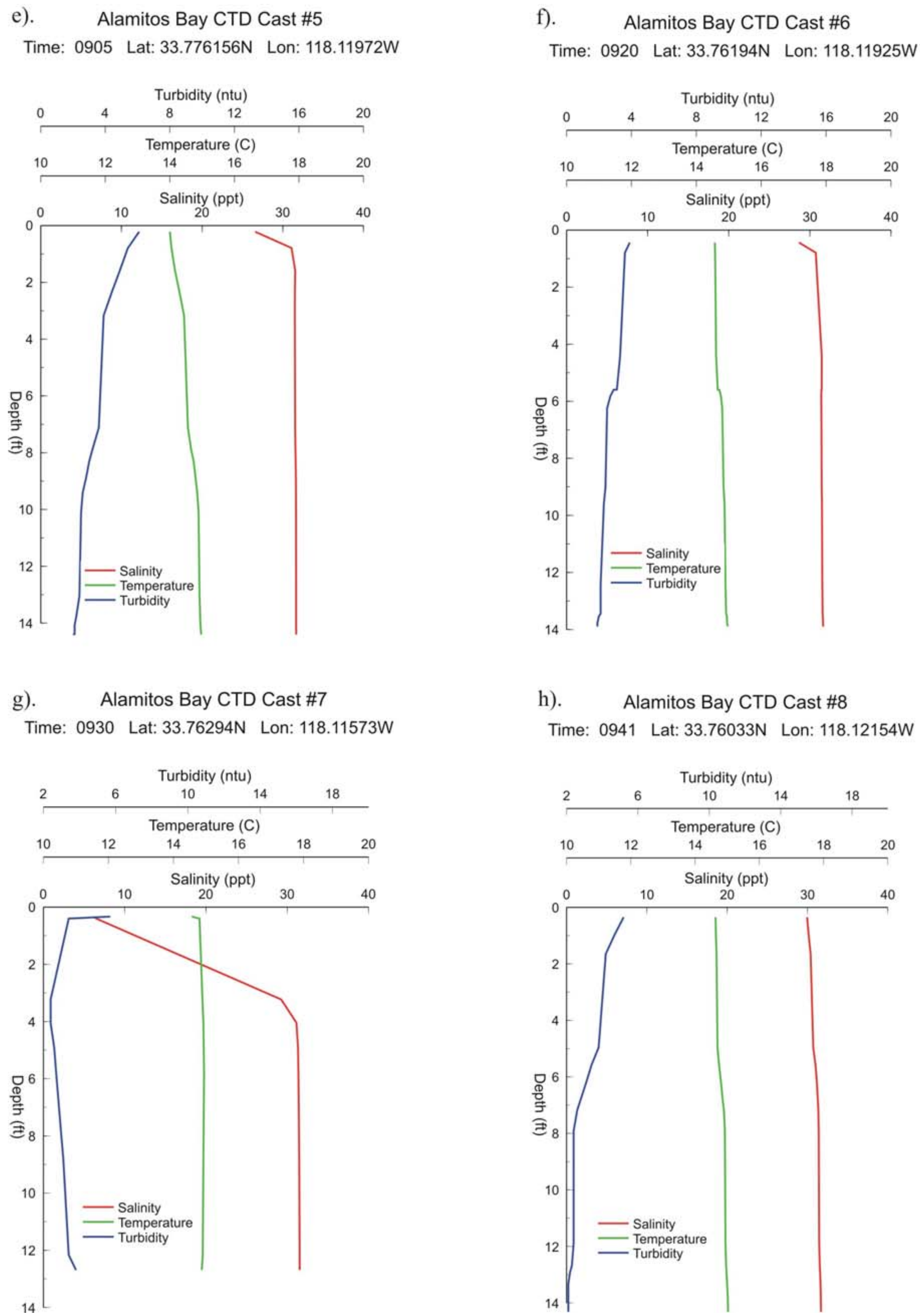


Figure 8.3(e-h) CTD Casts taken during Alamitos Bay Receiving Water Study. (Locations of each cast are shown on Figure 8.1)

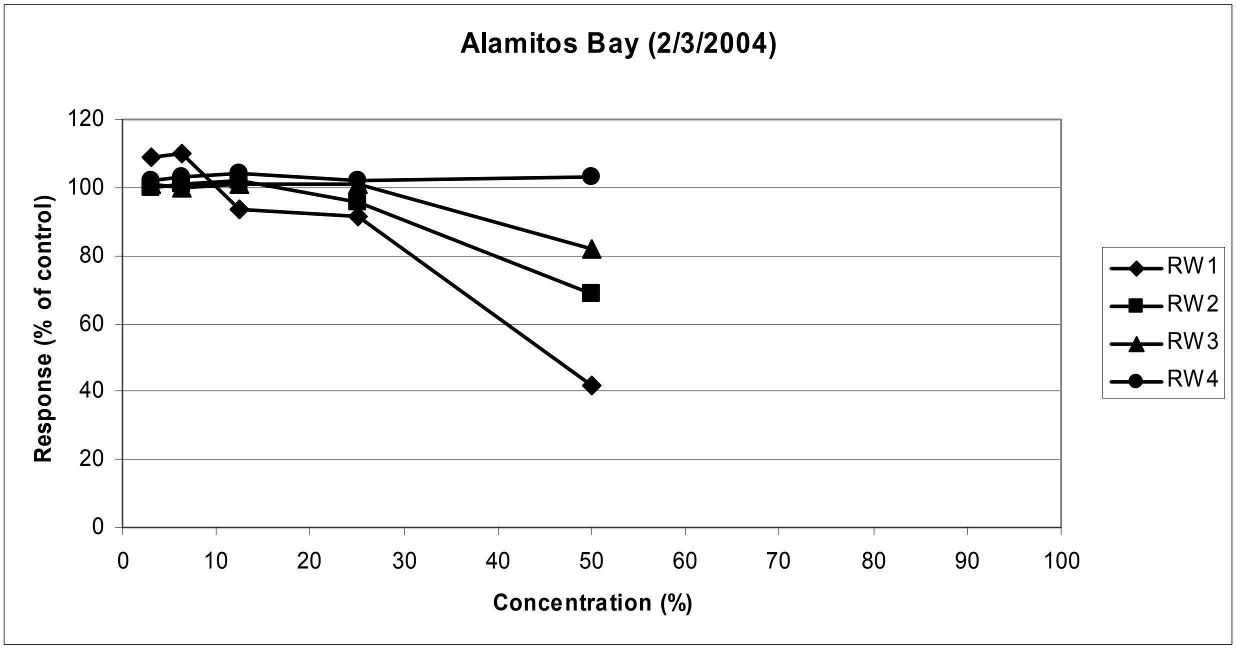


Figure 8.4 Toxicity Dose Response Plots for Sea Urchin Fertilization Tests using Stormwater Plume Samples collected from Alamitos Bay.

Table 8.1. Summary of Receiving Water Quality in Stormwater Plume Samples from Alamitos Bay.

	Receiving Water Monitoring Sites			
ANALYTE	**RW1**	**RW2**	**RW3**	**RW4**
Conventionals				
pH	7.6	7.7	7.7	7.8
Specific Conductance (EC – µmhos/cm)	20300	34900	37400	46100
Salinity (ppt)	12.8	23.2	25.1	31.6
Total Suspended Solids	12	12	6	2
Ammonia as N (mg/L)	0.320	0.218	0.196	0.127
Total Metals (µg/L)				
Cd	0.2U	0.2U	0.2U	0.2U
Cu	9.4	6.6	6.0	4.2
Ni	4.7	5.8	5.0	9.4
Pb	8.2	6.0	4.8	1.6
Zn	48	30	24	9.9
Dissolved Metals (µg/L)				
Cd	0.25U	0.25U	0.25U	0.25U
Cu	4.2	3.8	3.9	4.2
Ni	3.9	5.0	5.4	8.0
Pb	0.5U	0.53	0.52	0.5U
Zn	27	18	17	10
Organophosphate Pesticides (µg/L)				
Chlorpyrifos (Dursban)	0.05U	0.05U	0.05U	0.05U
Diazinon	0.093	0.05U	0.05U	0.05U
Atrazine	2U	2U	2U	2U
Cyanazine	2U	2U	2U	2U
Malathion	1U	1U	1U	1U
Prometryn	2U	2U	2U	2U
Simazine	2U	2U	2U	2U

Table 8.2. Toxicity of Receiving Water Samples Collected from Alamitos Bay during the 2003/2004 Storm Season.

		Receiving Water Monitoring Sites			
Test Species	**Endpoint**	**RW1**	**RW2**	**RW3**	**RW4**
S. purpuratus- Fertilization	EC_{50}	44.7%	65.3%[a]	>50%	>50%
	NOEC	25%	25%	25%	50%
	Percent Stormwater	62%	32%	26%	7%

[a] EC_{50} based upon extrapolation using the probit method

9.0 DISCUSSION

9.1 Comparison to Water Quality Criteria

9.1.1 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. Water quality criteria used as benchmarks are summarized in Table 9.2.

Tables 9.3 through 9.6 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 or benchmark values. Footnotes in Tables 9.3 through 9.6 identify the specific benchmarks exceeded by each EMC. 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 in Table 9.2 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.

The pH of stormwater runoff is typically 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. During the 2002/2003 monitoring period 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. This year none of the pH measurements were below 6.5. The only exceedance of Basin Plan criteria was a slightly elevated pH of 8.78 in stormwater discharged from the Dominguez Gap Pump Station.

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 Basin Plan single sample limits in 16 out of 17 samples. Enterococcus concentrations exceeded Basin Plan single sample criteria in all cases.

Reference values were commonly exceeded at least once for a total of four different total recoverable metals. These included aluminum, copper, lead, and zinc. The aluminum drinking water quality criteria of 1000 ug/L was exceeded in 75% of the samples from the Bouton Creek, the Belmont Pump Station and the Los Cerritos Channel and two-thirds of the samples from the Dominguez Gap Pump Station (Tables 9.3 through 9.6). Concentrations of total recoverable copper, lead and zinc in runoff from the mass emission sites consistently exceeded Ocean Plan criteria 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 lead and zinc criteria being exceeded in only one-third of the events. The Ocean Plan copper criterion of 4 μg/L was exceeded in runoff from two of the three events at the Dominguez Pump Station.

Dissolved copper, lead and zinc commonly exceeded the reference values (Tables 9.3 through 9.6). The California Toxics Rule (CTR) criteria for cadmium in saltwater was exceeded during just one event 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 and Ocean Plan criteria in one sample from Bouton Creek, two samples from the Los Cerritos Channel. In all cases, the reported value was less than twice the ML of 0.01 μg/L and were detected during early season events. Simazine, an organophosphorus herbicide, exceeded the Basin Plan MCL in three of the eleven stormwater composite samples. Simazine exceeded the Basin Plan MCL in single samples from the Bouton Creek, the Los Cerritos Channel and the Dominguez Gap Pump Station. The only other organic constituent exceeding reference criteria was DDT. DDT compounds were present in excess of criteria in two samples from the Belmont Pump Station and one from Los Cerritos Creek. Measured concentrations were less than 3 times the reporting limits in all cases.

In previous years, diazinon was typically found to be ubiquitous in the stormwater samples but this season, it was only detected in a single sample at levels below CF&G acute water quality criteria.

9.1.2 Dry Season Water Quality

Over the past five years, dry season water quality has not tended to 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 (Table 9.7 through 9.9). As a result, all trace metals were below CTR freshwater criteria during both dry weather sampling events. The only metal criterion exceeded in dry weather flows was the dissolved copper CTR criterion.

In comparison to the levels measured during storm events, concentrations of bacteria in dry weather runoff continue to be comparable to levels in winter, stormwater runoff. The only exception to this is total and fecal coliform water quality in Bouton Creek. During the two dry weather surveys conducted during this season, both total and fecal coliform measurements were below Basin Plan single sample criteria. Over the five years of monitoring dry weather flows at this site both total and fecal coliform concentrations have been below Basin Plan single sample criteria in over 50% of the dry weather samples. Only 7% of the all wet weather total and fecal coliform values were under the Basin Plan criteria.

9.2 Temporal Trends of Stormwater Contaminants

Temporal trends were examined for selected trace metals and organic compounds, TSS, and bacteria. The metals and organic compounds included in this assessment are those that are often high in storm drain discharges or suspected to be primary sources of toxicity (Figures 9.1 through 9.16). Time series are presented for total and dissolved concentrations of five trace metals including cadmium, copper, nickel, lead and zinc. 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. Time series are also provided for two important organophosphate pesticides, diazinon and chlorpyrifos, that have been implicated as major sources of toxicity. Temporal comparisons of bacteria include total and fecal coliform as well as enterococcus. The figures include all wet and dry weather data for the past five years at each monitoring site. Periods of dry weather are indicated by the shaded areas.

For the most part, 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 often 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 but the highest concentrations still tend to occur during winter storm events.

Over the past three years, the highest concentrations of two organophosphate compounds, chlorpyrifos and diazinon, have occurred during wet weather runoff but no seasonal trends were noted for either compound. The highest concentrations of both these contaminants were reported 2001/2002 wet weather season. Since that time, concentrations appear to be declining. This could simple be an artifact or initial evidence of reduced use of these chemicals in response to public education efforts.

Characteristics of stormwater discharges from the Dominguez Gap Pump Station also are consistent with earlier observations at this site (Figures 9.10 - 9.12, 9.16). A total of nine events have been monitored over the past five years. Concentrations of total and dissolved cadmium, copper, nickel, and zinc have remained relatively constant. Discharges from this site still tend to have lower concentrations of total metals than the other mass emission sites.

9.3 Relationships of Dissolved Copper, Lead and Zinc Concentrations to Hardness and CTR Freshwater Quality Criteria

During the past five years three dissolved metals (copper, lead and zinc) tended to frequently exceed CTR freshwater quality criteria. The criteria for these metals are all strongly related to water hardness. In order to explore this relationship, the concentrations of these three metals were graphed against hardness data using data from the full five years of the monitoring program (Figures 9.17 through 9.19). Symbols on the graphs identify the sampling year and type of sample. Filled symbols indicate dry weather samples while open symbols indicate stormwater samples. Two curves are plotted on each graph representing the hardness-dependent acute (CMCs) and chronic (CCCs) criteria. In the case of zinc, the CMC and CCC curves are extremely close such that samples exceeding the chronic criteria will typically exceed the acute criteria as well.

Although the range of concentrations for dissolved copper are similar during wet and dry weather, concentrations of dissolved copper rarely exceed the criteria due to elevated hardness (Figure 9.17). The Los Cerritos Channel site was the only monitoring site where dissolved copper exceeded water quality criteria during dry weather. During wet weather conditions, exceedances of the freshwater CTR criteria for dissolved copper are common at all including the Dominguez Gap Pump Station.

High hardness values during dry weather also tended to mitigate potential exceedance of the CTR freshwater criteria (Figure 9.18). Dry weather concentrations of dissolved lead exceeded the CTR criteria twice in Bouton and once at the Belmont Pump Station. In general, both of these sites also tended to have higher concentrations than encountered at the Los Cerritos Channel site. All wet weather measurements at both the Bouton and Belmont Pump Station monitoring locations consistently exceeded the chronic criteria but none exceeded the acute criteria.

Plots of dissolved zinc versus hardness (Figure 9.19) further reinforce temporal trends noted in the previous section. Concentrations of dissolved zinc during dry weather are consistently lower than during wet weather. Combined with elevated hardness values, no dissolved zinc concentrations even came close to the CTR freshwater chronic criteria. Although the concentrations of dissolved zinc measured during wet weather at the Los Cerritos Channel site were similar to those measured at both the Belmont Pump Station and Bouton Creek sites, exceedances were more common due to lower hardness values associated with the samples.

9.4 Relationships of TSS and Selected Metals to Total Flow

Stormwater runoff volume is known to be one potentially important factor impacting the concentrations of contaminants in stormwater. The relationship between flow and several key constituents is examined in Figures 9.20 through 9.24. Selected constituents include TSS as well as both the total and dissolved forms of aluminum, copper, lead and zinc. Aluminum is included in this assessment since it occurs at such high level in soils and can be used to normalize other metal data to examine potential enrichment factors.

Three of the monitoring locations, including the Los Cerritos Channel, Belmont Pump and Bouton Creek sites, show similar responses between TSS and all four total metal concentrations. The highest concentrations generally occur in association with low flow events. Lower concentrations tend to occur in association with higher flow events. This type of relationship is consistent with build up / washoff type model where a finite source of material is diluted by increasingly larger volumes of runoff. This type of relationship appears to be unique to urban environments. In larger river systems there is typically log-linear relationship between TSS and flow.

The Dominguez Gap Pump Station differs substantially from the other three sites in how concentrations of TSS and total metals respond to flow. Concentrations of TSS and total metals generally show little response to total flow.

At all sites, dissolved metals are relatively constant over a wide range of flow. This is consistent with temporal observations that show that dissolved metal concentrations do not covary with concentrations of total metals.

9.5 Relationships of Selected Total Metals to TSS

TSS has often been used as a surrogate measure for total metals since most of the metals discharged in stormwater runoff are in the particulate form. This section examines the relationships of total aluminum, copper, lead and zinc to TSS (Figures 9.25 through 9.28; Table 9.10) using all data from the past five years of monitoring.

In all cases, significant relationships were found between TSS and the four trace metals examined (Table 9.10). Very strong relationships were observed between lead and TSS at each site. Explained variances (r^2) ranged from 0.76 at the Belmont Pump Station to 0.94 at the Dominguez Pump Station.

The regressions suggest that TSS may be used to develop rough estimates of concentrations of other metals such as aluminum, copper and zinc but the precision may vary substantially among sites.

9.6 Loading Rate Assessment

Estimates of pollutant loading rates were developed for selected constituents at each site by normalizing loads to a unit of 1000 acres (Figures 9.29 through 9.33). For illustration purposes, loading rates were developed for aluminum, copper, lead, zinc, diazinon and chlorpyrifos. By normalizing the loads, direct comparisons can be made between drainage areas to assist in differentiating potential problem areas.

Loading rates for total and dissolved aluminum, copper, lead and zinc were similar at both the Belmont Pump Station and Bouton Creek sites. Loading rates for these same metals at the Dominguez Gap Pump Station are typically much lower. The lower loading rates from the Dominguez Gap Pump Station are most evident during the larger storm events. Pollutant loading rates from the Los Cerritos Channel site tend to increase substantially during higher flow events while lower flows such as experienced this past year result in loading rates comparable to those observed in Bouton Creek and at the Belmont Pump Station. This may be due to mobilization of an upstream source of particulate metals from either the watershed or resuspension of instream sources.

9.7 Stormwater Toxicity

A total of fifteen wet weather samples were analyzed for toxicity during the monitoring period. Eleven of those samples were tested with water fleas and sea urchins (22 total bioassays). The remaining four samples were collected from the discharge plume in Alamitos Bay, and were tested with sea urchins only. There was, then, a total of 26 bioassays performed on fifteen water samples.

Each storm produced similar toxicity results in samples from the Belmont Pump station and the Bouton Creek station, in that the first two storms showed significant toxic effects only to sea urchins. Toxicity results were different in samples from the Los Cerritos Channel station, with no toxicity to either species in the first storm, and the second storm producing toxicity to both sea urchins and water fleas. Samples from the last two storms produced no measurable toxicity at any of the three stations to either species.

The sea urchin test detected toxicity in five of eleven storm runoff samples and in three of the four plume samples from Alamitos Bay. The water flea test showed a significant reduction in survival in only one of eleven samples, and there was no reproductive toxicity in that sample.

The toxicity of the wet weather samples analyzed during the monitoring period was generally less than that measured during the previous monitoring period (Figure 9.34). One of the Belmont Pump samples contained a high level of initial toxicity to sea urchins (28.7 TUa, 32 TUc), markedly higher than that of any Belmont Pump sample tested during 2002-2003. This high toxicity proved to be transient, however, since baseline toxicity measured the following day, had fallen below 2 TUa. No Bouton Creek sample showed urchin toxicity as high as that measured in previous monitoring years. Los Cerritos Channel samples were generally less toxic to urchins than those tested in previous years. Toxicity to the water flea was virtually absent at all three monitoring stations during this monitoring period.

9.7.1 Dry Weather Toxicity

The sample of dry weather discharge collected from Belmont Pump station in September 2003. produced decreased water flea reproduction at the 100% concentration, but no decrease in daphnid survival was seen. This magnitude of reproductive toxicity was the same as in the stormwater samples analyzed during September 2002 (Figure 9.34). No water flea toxicity was produced by Belmont Pump dry weather samples collected in May of either 2003 or 2004.

The September 2003 dry weather Belmont sample was mildly toxic to sea urchins, producing decreased fertilization in the 50% concentration only. There was no urchin toxicity in the May 2004 sample, and there was no toxicity to sea urchins in either of the 2002/2003 dry weather samples from Belmont Pump.

The dry weather samples collected from Bouton Creek were characterized by elevated salinity. Both the September 2003 and the May 2004 samples were tested with both species, however, and both showed lethal and reproductive toxicity to water fleas. Some portion of this toxicity was very likely due to salinity stress on this freshwater test organism. The magnitude of the water flea toxicity in the September 2004 sample was comparable to that seen in the September 2003 dry weather test, and both showed much less toxicity than was demonstrated in the May 2004 sample. The early-season dry weather sample was not tested with water fleas in 2003 because it was too highly saline.

Neither of the dry weather samples from Bouton Creek were measurably toxic to sea urchins, with TU values of <2. This is in contrast to the urchin toxicity (2.5-2.9 TUa, 16 TUc) seen in two of the four wet weather samples tested in the current monitoring period and also in marked contrast to the urchin toxicity (5.6 TUa, 32 TUc) seen in the May 2003 dry weather sample (Figure 9.34).

The September 2003 dry weather samplefrom Los Cerritos Creek produced 4 TUc of lethal toxicity and 8 TUc of reproductive toxicity to water fleas, and 4 TUc of toxicity to sea urchins. The May 2004 dry weather sample showed similar toxicity to water fleas, producing 4-8 TUc, but showed no measurable toxicity to sea urchins. The magnitude of dry weather toxicity to water fleas was generally greater than that seen in wet weather samples and roughly similar to that seen in the 2002/2003 water flea data.

Sea urchin toxicity in the Los Cerritos Channel dry weather sample in September 2003 was present, showing 4 TUc and 1.16 TUa. The May 2004 sample showed no measurable toxicity to sea urchins. Wet weather urchin toxicity was not present in 2003-2004 except for the sample collected on 18 February 2004, which showed 16 TUc and 4.2 TUa. The magnitude of dry weather toxicity to urchins was much less than that exhibited in September 2002 (16 TUc, 6.7 TUa), and in May 2003 (32 TUc, 3.7 TUa).

In the 2000/2001 and 2001/2002 monitoring periods, dry weather samples collected in the Spring generally tended to be less toxic than stormwater samples collected in those respective winters. These 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 indicated that the magnitude of toxicity of spring dry weather samples was less than wet weather toxicity at the Belmont Pump station. At the Bouton Creek station, spring dry weather and wet weather toxicities were of similar magnitude, while at the

Los Cerritos Channel station Spring dry weather discharge showed generally greater toxicity than stormwaters, with particularly elevated toxicity to sea urchins in the May 2003 collection.

Toxicity results from the current (2003/2004) monitoring period suggest that at the Belmont Pump Station, wet weather toxicity to sea urchins was greater than spring dry weather toxicity, while toxicity to water fleas was absent. Bouton Creek samples were more toxic to water fleas during both dry weather sampling periods than during storms, probably due in large part to elevated sample salinity during dry weather. Los Cerritos Channel samples generally showed no toxicity to sea urchins during both wet and dry weather (except for the second storm). Toxicity to water fleas was much enhanced in the Spring dry weather sample.

Toxicity data from recent monitoring periods, then, do not support the hypothesis that spring dry weather samples, collected after the storm season has passed, show consistently decreased toxicity and possible seasonally-related composition.

9.7.2 Temporal Toxicity Patterns

The toxicity data from the 2000/2001, 2001/2002 and 2002/2003 monitoring periods suggest that seasonal flushing may be an important factor affecting the variability in stormwater toxicity, and current data from the 2003/2004 monitoring period generally support that suggestion.

At the Belmont Pump station significant toxicity was seen to sea urchins during the first storm event (16 TUc, <2 TUa).. The second storm produced much increased toxicity (>32 TUc, 28.7 TUa) to sea urchins only, and storms three and four showed no measurable toxicity to either species. The elevated toxicity during storm #2 may have been artifactual, however, since the disappearance of almost 29 units of acute toxicity after overnight cold storage of the sample is both unprecedented and unexplained. If valid, this suggests the presence of a volatile toxicant and would be the first time a volatile toxicant was implicated.

Bouton Creek samples showed toxicity only to sea urchins. The first and second storms produced 16 TUc, and the third and fourth storms produced no urchin toxicity.

Cerritos Channel samples produced no toxicity to either species in the first storm. The second storm produced 16 units of chronic toxicity to urchins and only 2 TUc to water flea survival. The third storm was not tested with a Cerritos Channel sample, and the fourth storm produced no toxicity to either species.

With the possible exception of storm two at Belmont Pump, 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). Although the initial storm event of the season that occurred on the 25th and 26th of December was not successfully sampled, the first successfully monitored event was preceded by a full month of with only a few scattered events yielding a total of just 0.37 to 0.64 inches of rainfall.

9.7.3 Comparative Sensitivity of Test Species

There were a total of eleven wet weather samples tested for toxicity with both water fleas and sea urchins. Toxicity was detected to one or both species in five of those samples and the sea urchin fertilization test was the most sensitive toxicity test method in all (100%) of those samples. The water flea survival/reproduction test showed toxicity only in a single stormwater sample (the February 20 sample from Los Cerritos Channel (1.43 TUa, 2 TUc). In this instance, water flea survival was significantly reduced but reproduction was not decreased. That same sample produced 4.22 TUa and 16 TUc to sea urchins.

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 slightly more sensitive in only one of those five. Thus, of the five dry weather samples showing toxicity, the sea urchin test was the more sensitive in one sample (20%).

These dry weather results may be somewhat misleading however, since two of the five dry weather samples showing toxicity to water fleas were from Bouton Creek, where elevated sample salinity probably contributed to the apparent toxicity. Assuming that high salinity was a primary "toxicant" at Bouton Creek and eliminating those two samples from the toxic category, there were three of six dry weather samples that showed toxicity, and one of those three (33%) showed sea urchins to be slightly more sensitive than water fleas.

This pattern of sensitivity (sea urchin>water flea) in storm waters was similar to that observed during the 2000/2001, 2001/2002 and 2002/2003 monitoring programs and in a study of urban stormwater toxicity in San Diego (Southern California Coastal Water Research Project 1999).

9.7.4 Relative Toxicity of Stormwater

Table 9.11 compares the frequency and magnitude of stormwater toxicity from the Long Beach stations in 2003/2004 with that of stormwater samples from Long Beach in previous years and with toxicity in other southern California watersheds. The data suggest little change from the previous year in the frequency of Long Beach stormwater toxicity to sea urchins The magnitude of 2003/2004 toxicity also seems similar to previous years, although the highest reported sea urchin toxicity during the current year was uncharacteristically transient.

There was a much-decreased frequency and magnitude of toxicity to water fleas in 2003/2004 compared with previous Long Beach study years. 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 and 2003/2004 monitoring periods. 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.

9.7.5 Toxicity Characterization

The TIE testing program for this monitoring period was marginally successful. Phase I TIEs were performed on one wet weather and two dry weather samples and they yielded useful information. In addition, three more samples showed loss of toxicity with time in the laboratory, and were abandoned without evaluation of toxicity tests.

There were fewer successful TIEs performed during this monitoring period than in previous years. The results of the 2003/2004 dry weather TIE analyses were similar to the data obtained from the previous year (Table 9.12).

This year's water flea data for the Bouton Creek dry weather sample of 11 September 2003 indicated that a non-polar organic (NPO) was the most likely category of the toxic constituents. This conclusion is supported by the effectiveness of the C-18 treatment for eliminating toxicity to the water flea. Organophosphate pesticides (OPs), a frequent cause of runoff toxicity to water fleas, did not seem to be an important toxicant in this sample because the C18 treatment was effective whereas the PBO treatment was not effective.

The water flea TIE performed on the Los Cerritos Channel dry weather sample of 5 May 2004 yielded essentially similar results. Once again, C18 SPE was completely effective in eliminating toxicity, while neither PBO treatment nor centrifugation were effective. EDTA treatment produced a slight (20%) reduction in baseline toxicity, STS treatment both enhanced sample toxicity and produced substantial blank toxicity. These results suggest an unidentified NPO as the primary toxicant, with possible additional toxicity contributed by divalent cationic metals. OPs were not implicated.

The sea urchin TIE results for the wet weather Los Cerritos Channel sample of 20 February 2004 identified EDTA and C18 extraction as the most effective treatments 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 also effective at removing toxicity to sea urchins from this Los Cerritos channel storm sample. This treatment, while primarily intended to remove non-polar organic contaminants from the sample, has also been shown to remove significant amounts of toxicity associated with copper and zinc (Schiff *et al.* 2001). Toxicity in the Los Cerritos Channel storm sample was very slightly reduced by treatment with STS, which can reduce toxicity caused by some metals (e.g., cadmium, copper, zinc).

Since solid phase extraction and EDTA were 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 very slightly effective in reducing toxicity in the Bouton Creek dry weather sample. Previous studies have generally 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). In contrast, centrifugation of the Los Cerritos wet weather sample seemed to add a small amount of toxicity to the sample. The low level toxicity of the sample, however, made it difficult to separate small toxicity changes after treatments from background noise.

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 four storms during the 2003/2004 monitoring period were pooled for the correlation analyses. The correlation analyses generally confirm the conclusion from the previous study years, 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, and TOC (Table 9.13). Dissolved lead, nickel and zinc were significantly correlated with toxicity to both species. In last years report, zinc and copper showed equally strong correlations with reduced sea urchin fertilization, closely followed by nickel. Lead was also significantly correlated with sea urchin fertilization. Results from the current testing year closely parallel those rankings, with copper showing a slightly higher correlation with urchin toxicity than zinc, followed by nickel and lead. These results differed from monitoring data from earlier study years, 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 cadmium, copper, lead, nickel and zinc (Table 9.8). Increased concentrations of the OP pesticide diazinon had significant correlations with water flea toxicity (r=0.39 to 0.43) that were increased from the values reported in 2002/2003 (r=0.22-0.24). Correlations in 2001/2002 were better (r=0.54) and were clearly statistically significant. .

The presence of significant correlations between toxicity and selected chemicals generally supports the sea urchin TIE results. Both water flea TIE, however, suggested that organophposphate pesticides were probably not implicated as primary toxicants this season while correlation analysis using the complete data set continues to identify diazinon as being correlated with water flea toxicity. These correlations provide 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 was of limited value for this storm year, since few wet weather samples showed much toxicity to sea urchins. Of the four samples that showed sufficient initial urchin toxicity to initiate TIEs, three contained sufficient dissolved zinc and copper to account for almost all of the toxicity measured (Figures 9.35a and b). The fourth toxic sample (Belmont Pump, 18 February, 2002) showed very high initial toxicity (28 TUa), but baseline toxicity assessment on the following day revealed a complete loss of toxicity. Figures 9.35a and b suggest that the concentrations of copper and zinc in that sample were low, and could not have been responsible for the high level of initial toxicity. Since the disappearance of such high toxicity over one day in cold storage is unprecedented and unexplained, it is likely that the initial toxicity measurement was in error or the result of a highly volatile toxicant. Unlike previous years, when the predicted toxicity of the toxic samples was markedly higher than that of the remaining stormwater sample, this was not the case during the current monitoring period, This is likely due to the general lack of toxic samples in 2003/2004.

Comparison of the measured and predicted toxic units for the water flea tests (Figures 9.36a and b) yielded little useful information, since virtually all of the wet weather samples were not toxic to the daphnids. The toxicity of the one sample containing substantial toxicity (Los Cerritos, 18 February 2004) could not be accounted for by the measured concentrations of zinc, diazinon, and chlorpyrifos. The measured concentrations of OP pesticides and zinc accounted for only about 70% of the toxicity of this Los Cerritos sample, suggesting that additional unmeasured toxicants are present. This suggestion is supported by the TIE results, which implicated a non-OP, non-polar organic and possibly some divalent metals as likely toxicants.

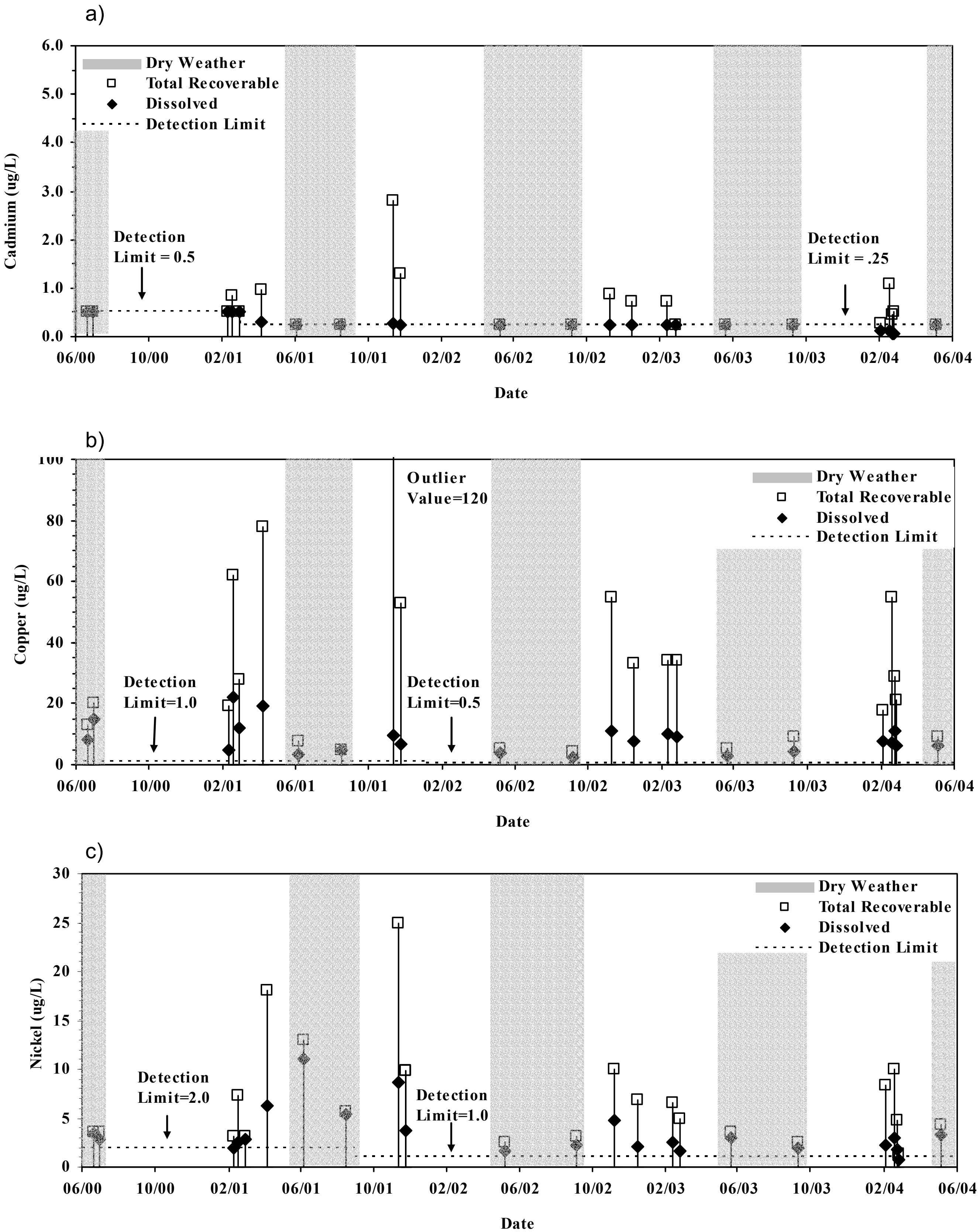


Figure 9.1. Belmont Pump Station Chemistry Results: a) Cadmium; b) Copper; c) Nickel.

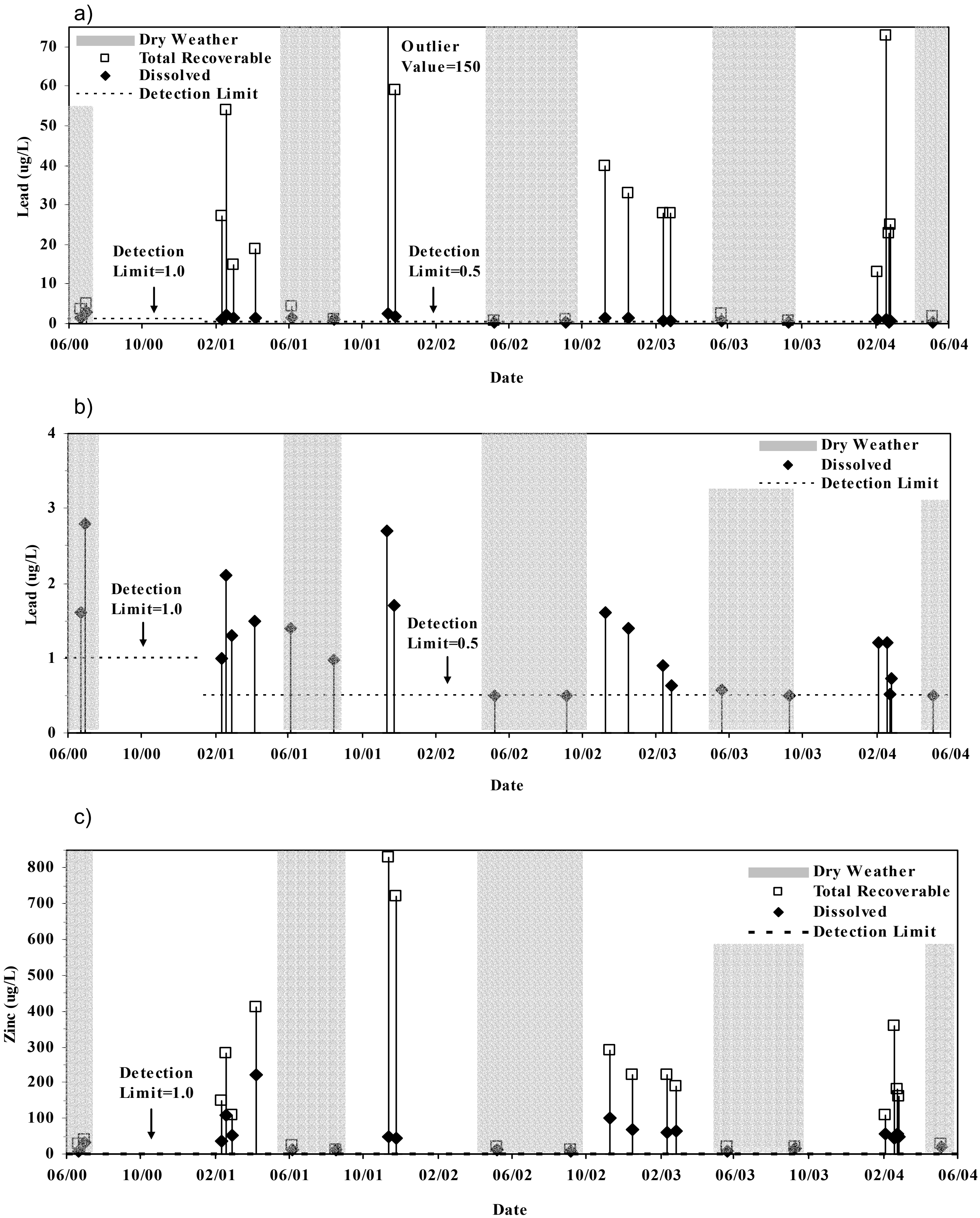


Figure 9.2. Belmont Pump Station Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.

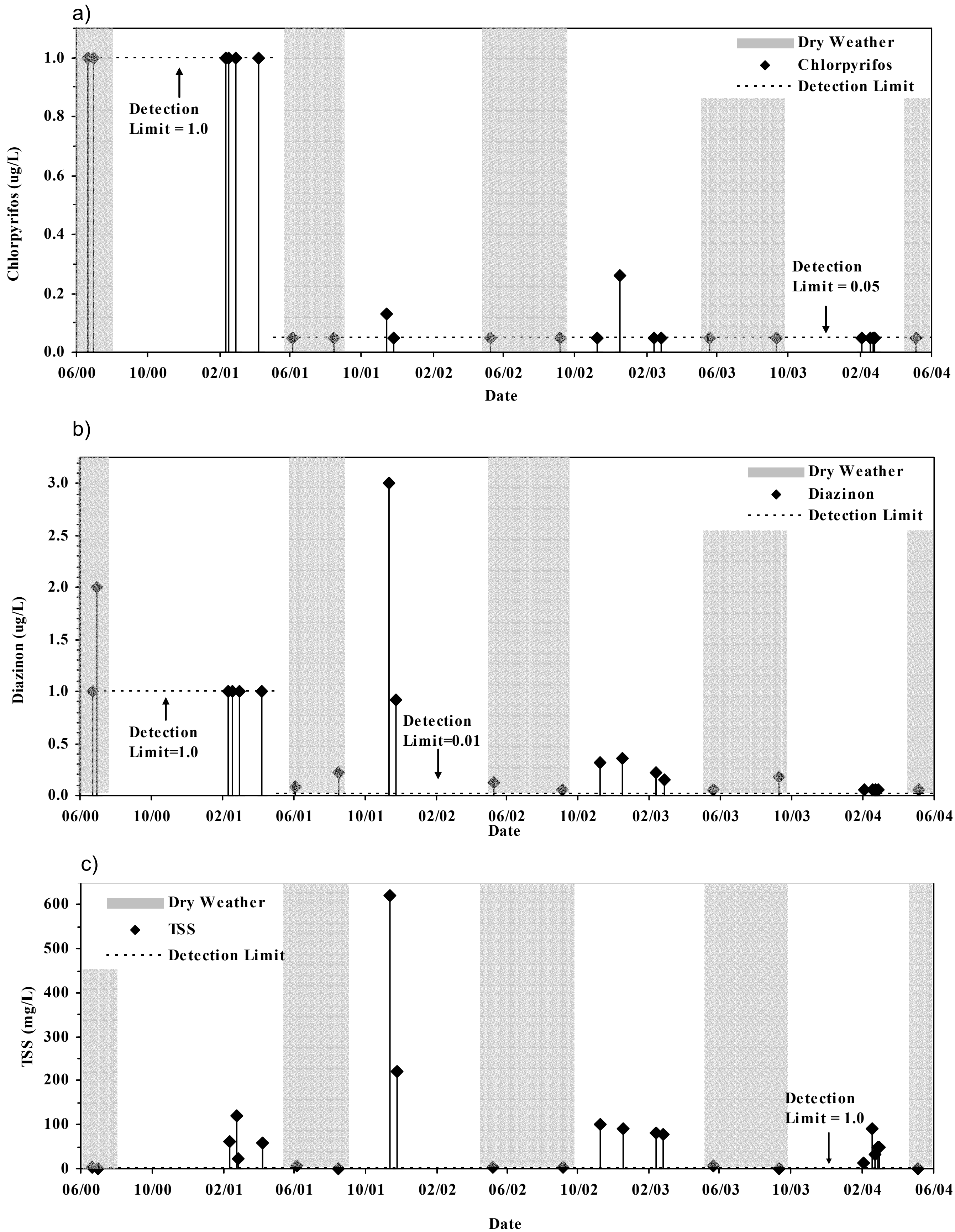


Figure 9.3. Belmont Pump Station Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) TSS.

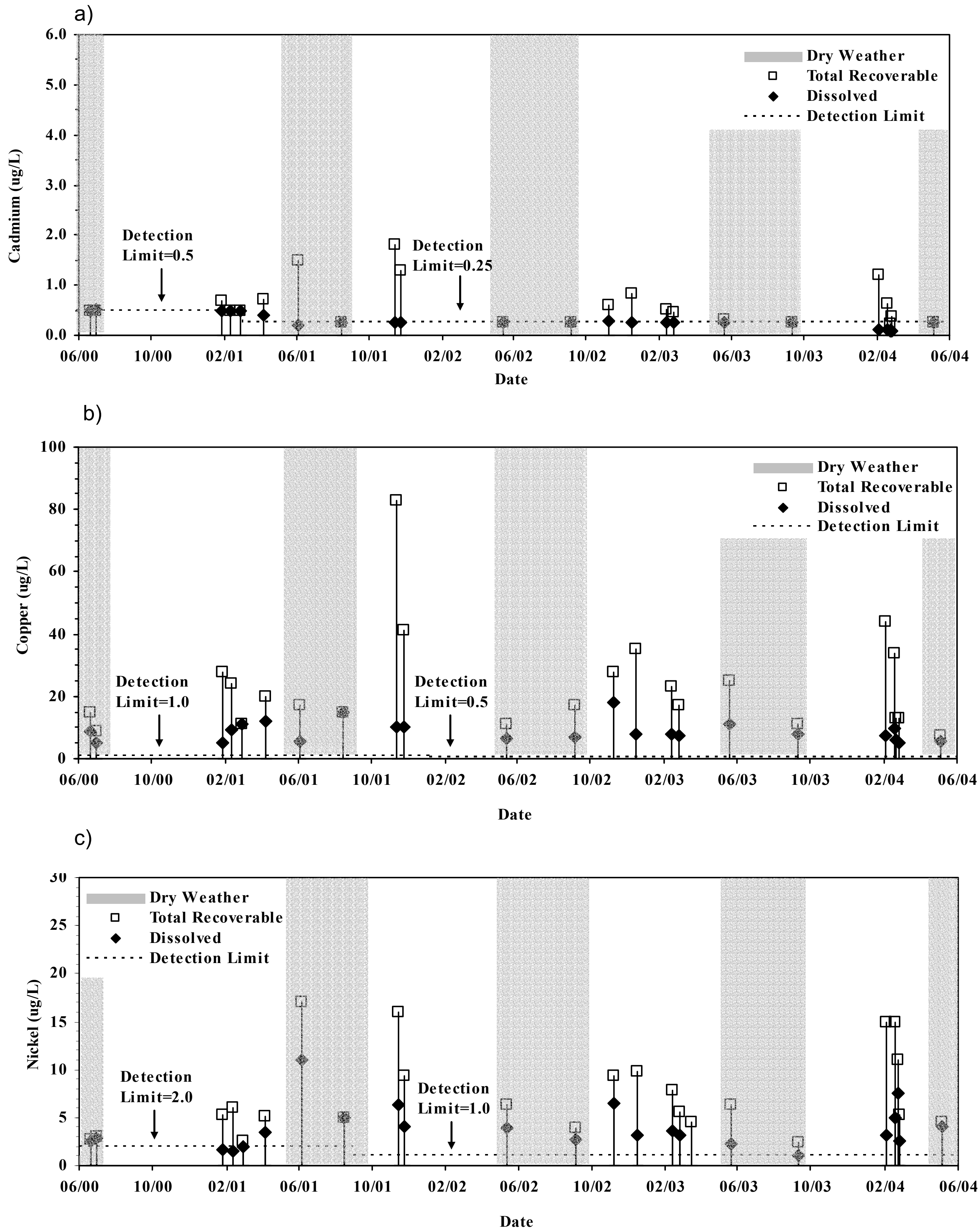


Figure 9.4. Bouton Creek Chemistry Results: a) Cadmium; b) Copper; c) Nickel.

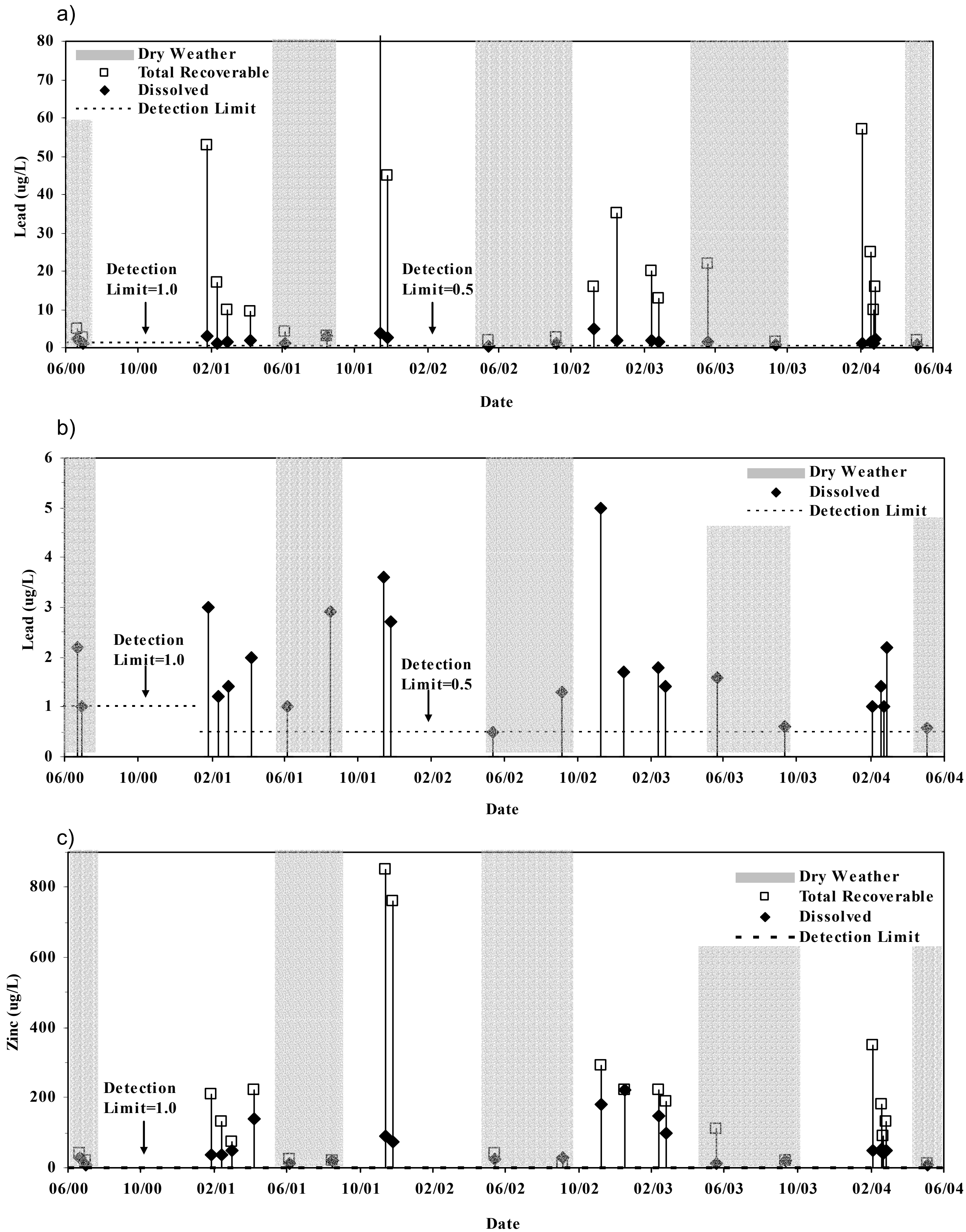


Figure 9.5. **Bouton Creek Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.**

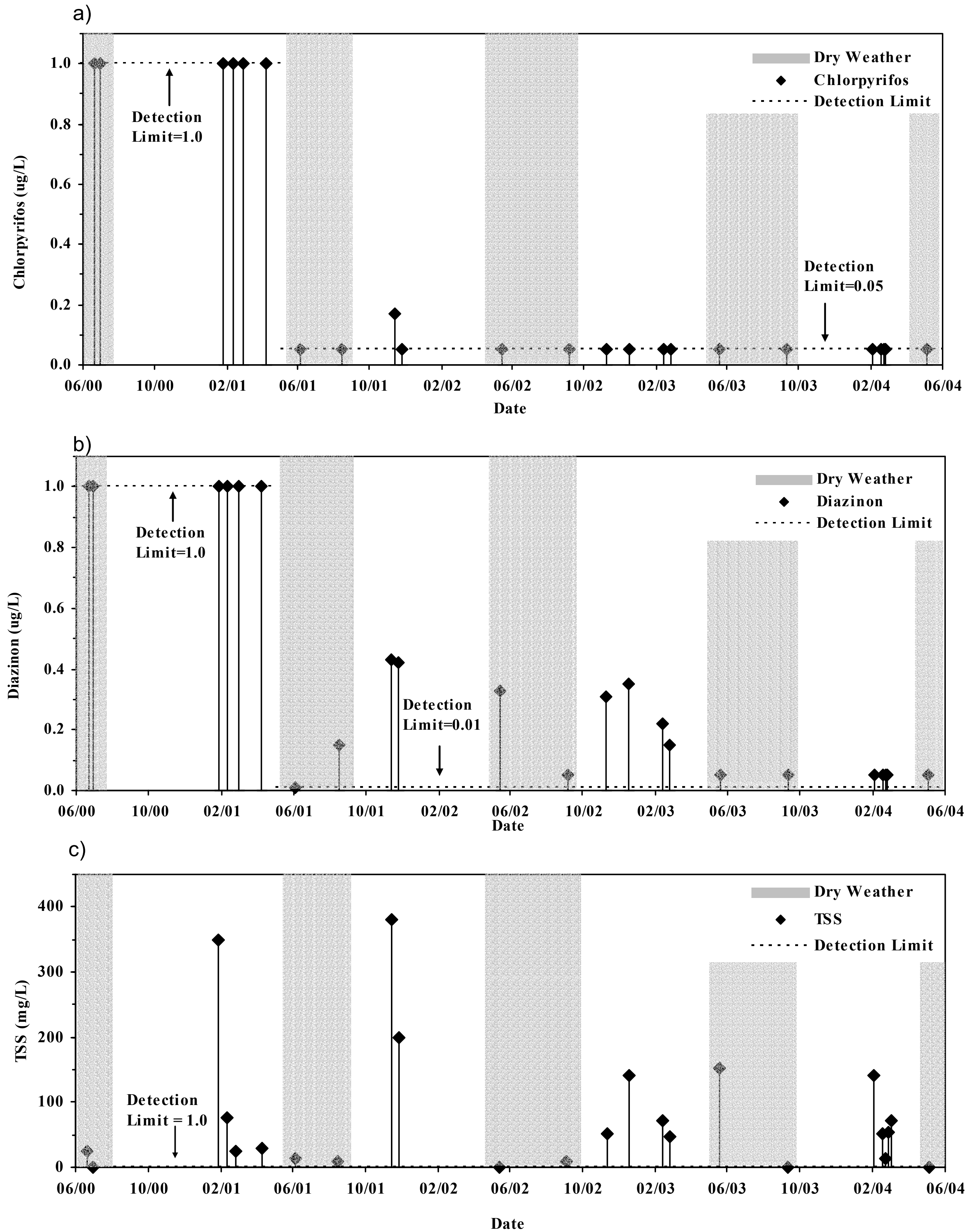


Figure 9.6. Bouton Creek Chemistry Results: a) Chlorpyrifos; b) Diazinon; c)TSS.

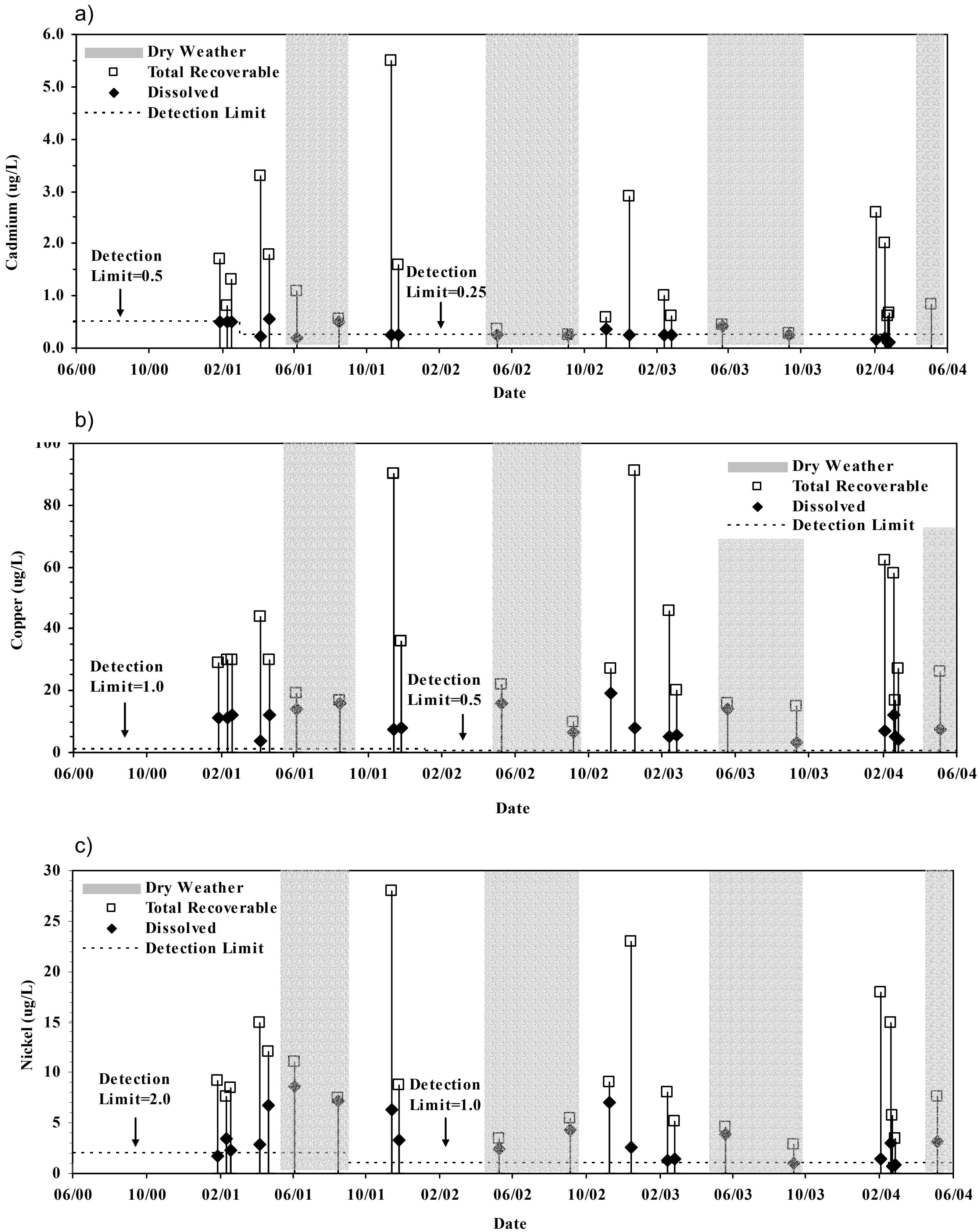


Figure 9.7. Los Cerritos Channel Chemistry Results: a) Cadmium; b) Copper; c) Nickel.

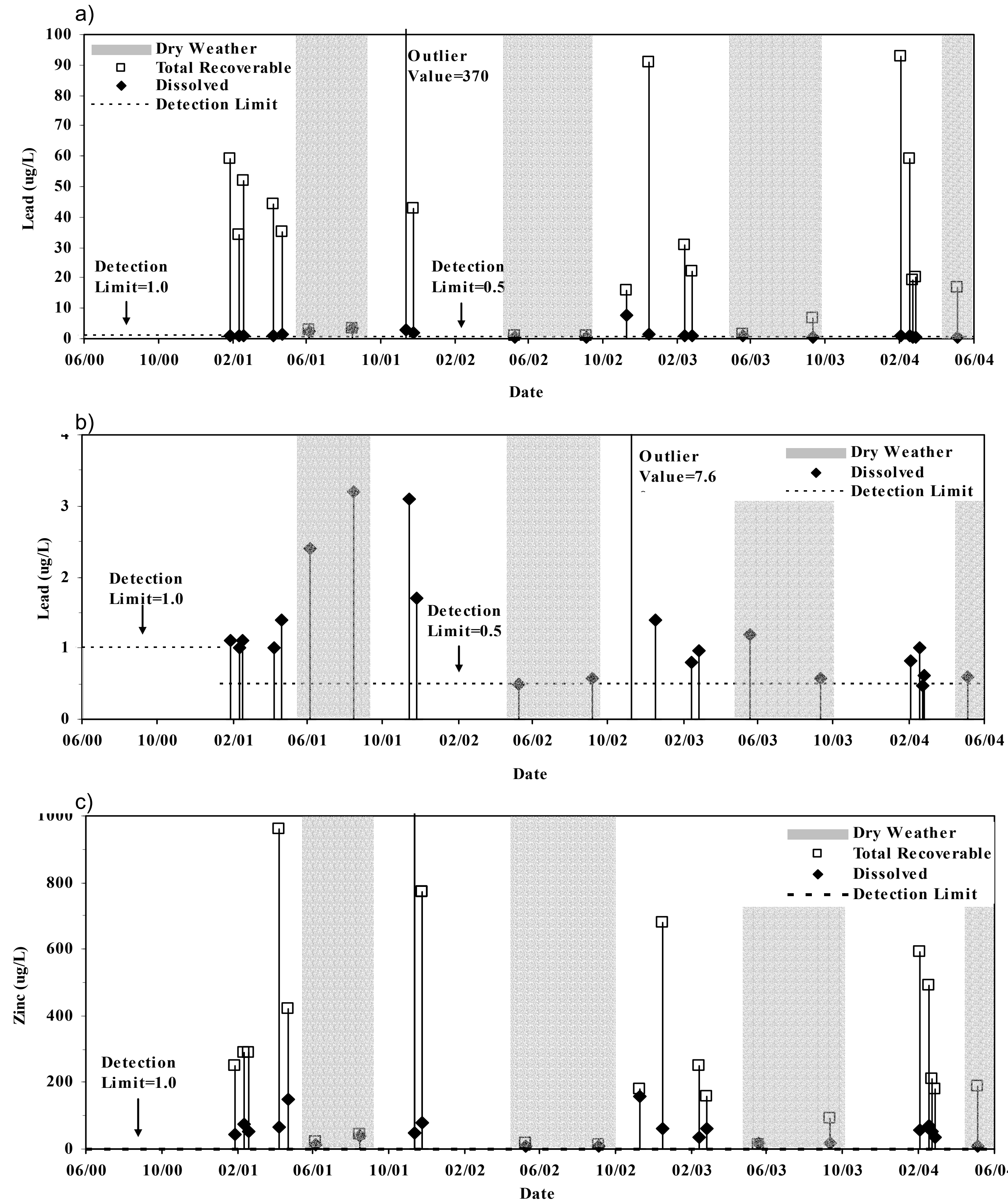


Figure 9.8. Los Cerritos Channel Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.

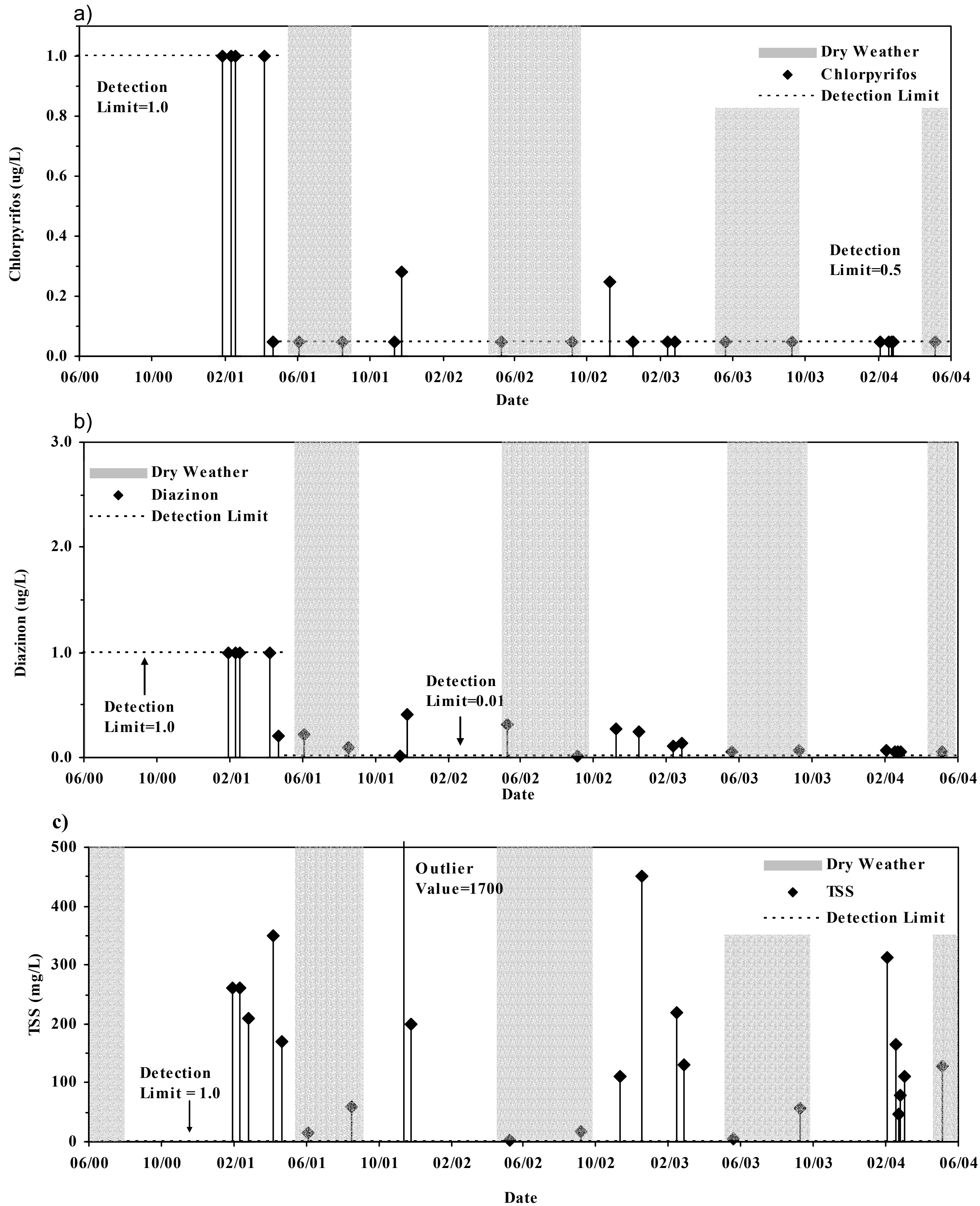


Figure 9.9. Los Cerritos Channel Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) TSS.

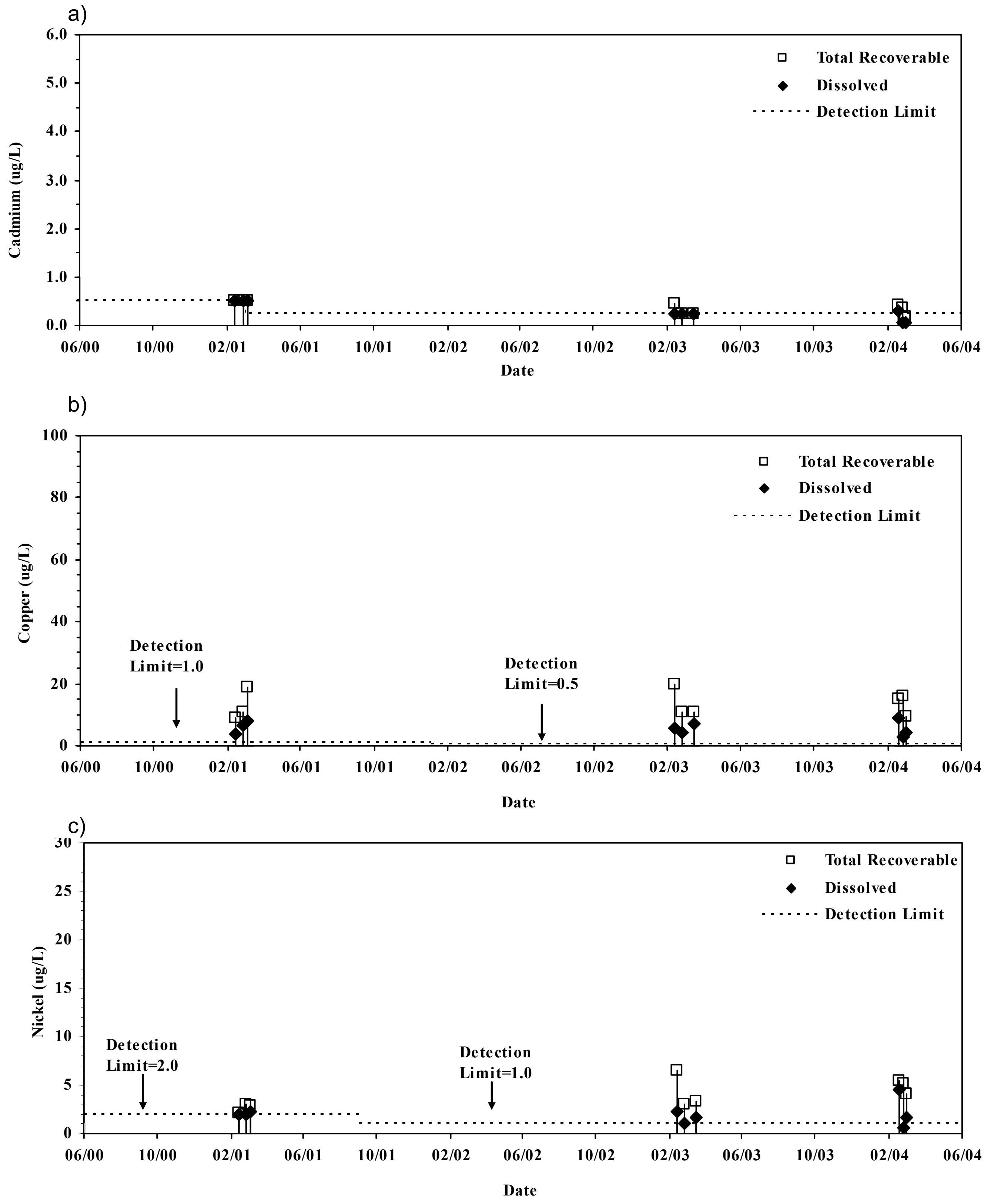


Figure 9.10. Dominguez Gap Chemistry Results: a) Cadmium; b) Copper; c) Nickel.

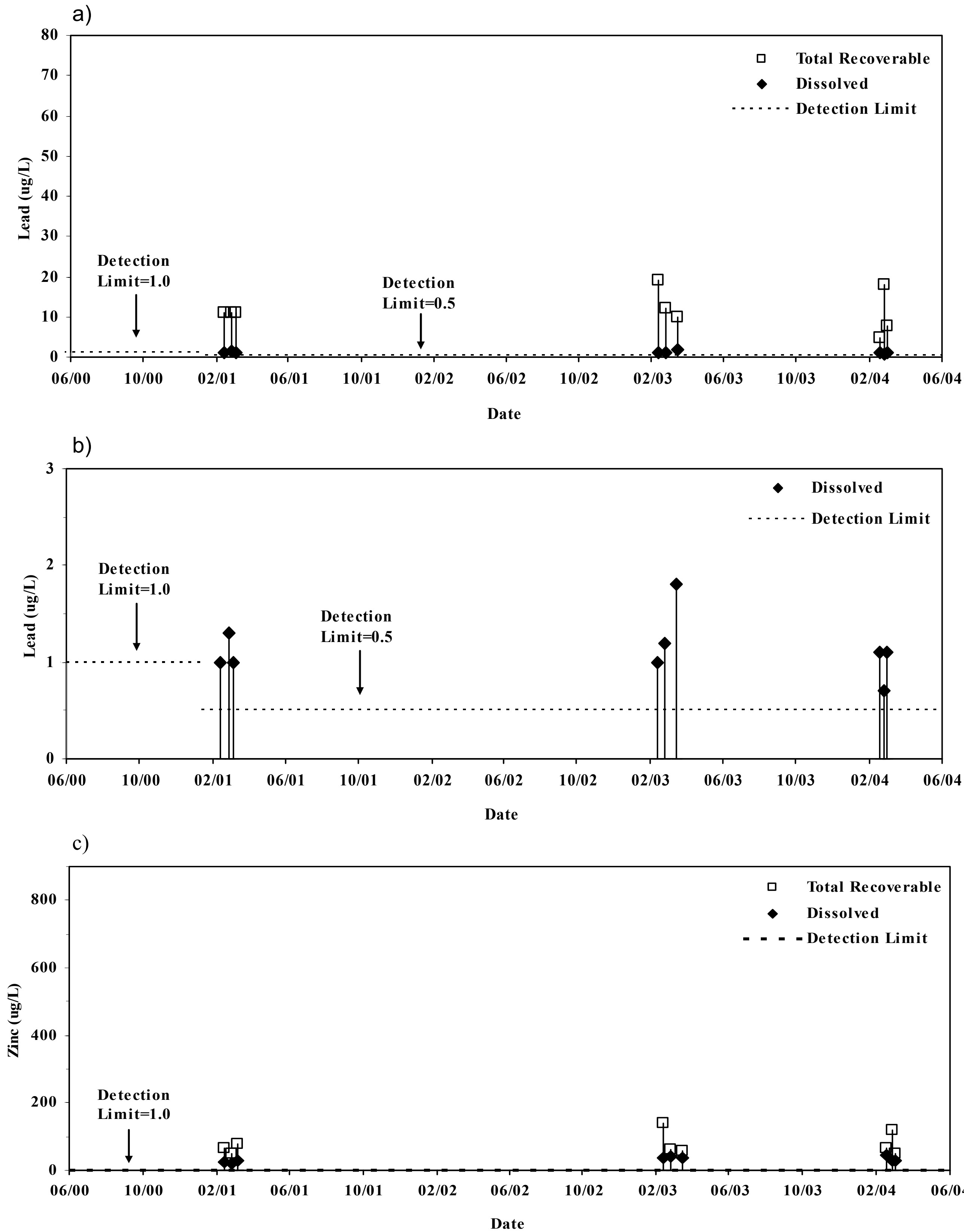


Figure 9.11. Dominguez Gap Chemistry Results: a) Lead (total and dissolved); b) Lead (dissolved); c) Zinc.

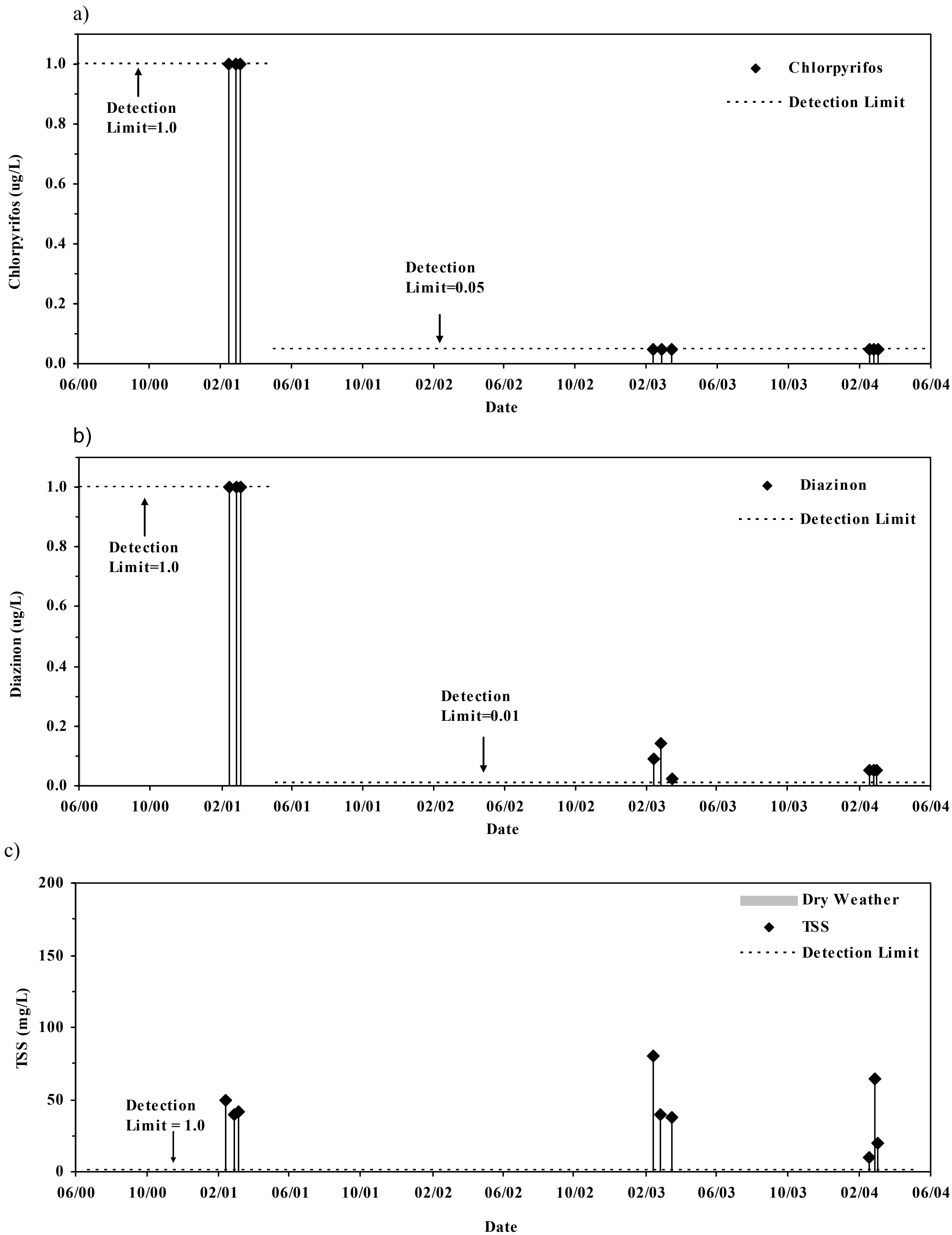


Figure 9.12. Dominguez Gap Chemistry Results: a) Chlorpyrifos; b) Diazinon; c) TSS.

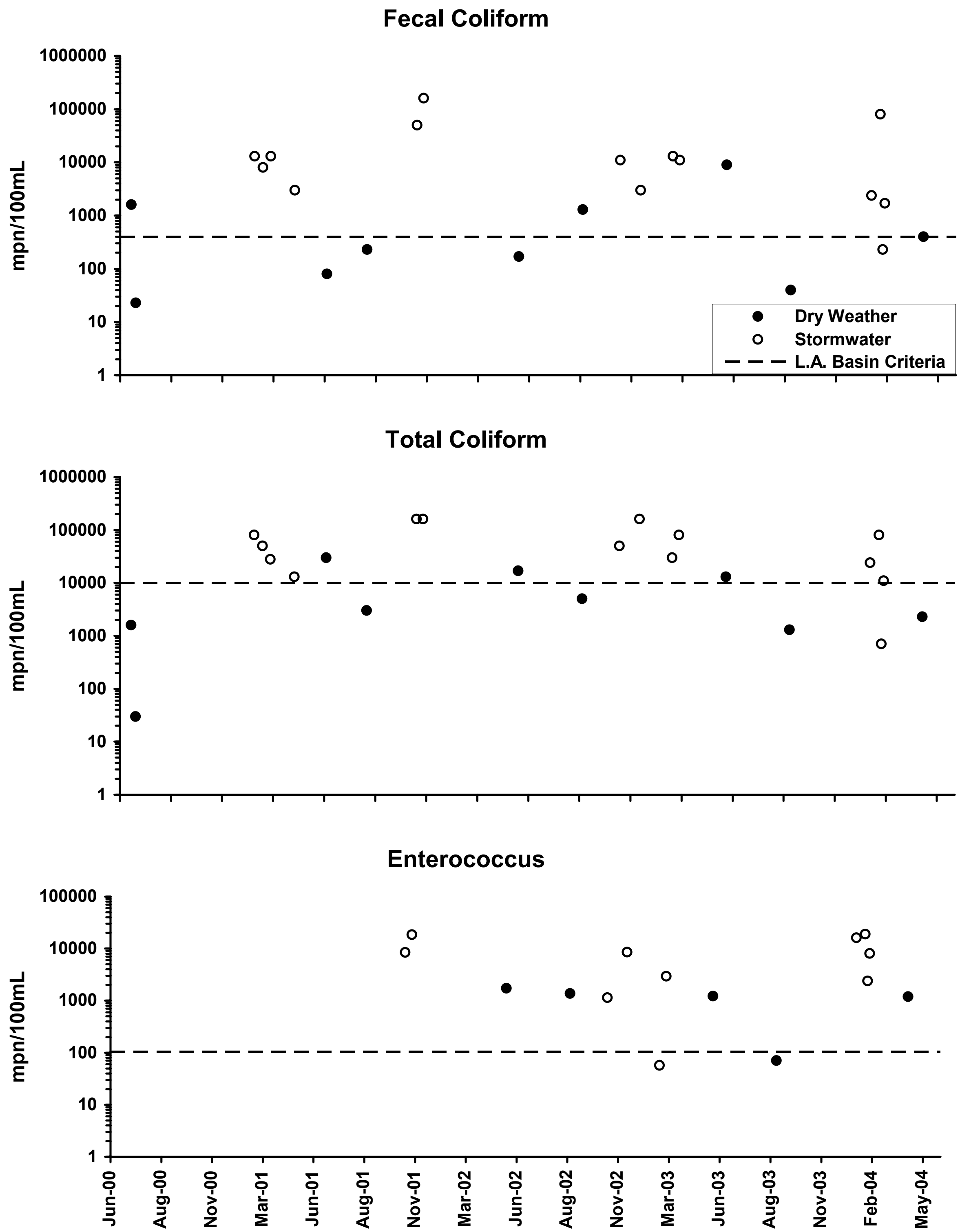


Figure 9.13. Bouton Creek bacteria concentrations for 2000 through 2004. The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

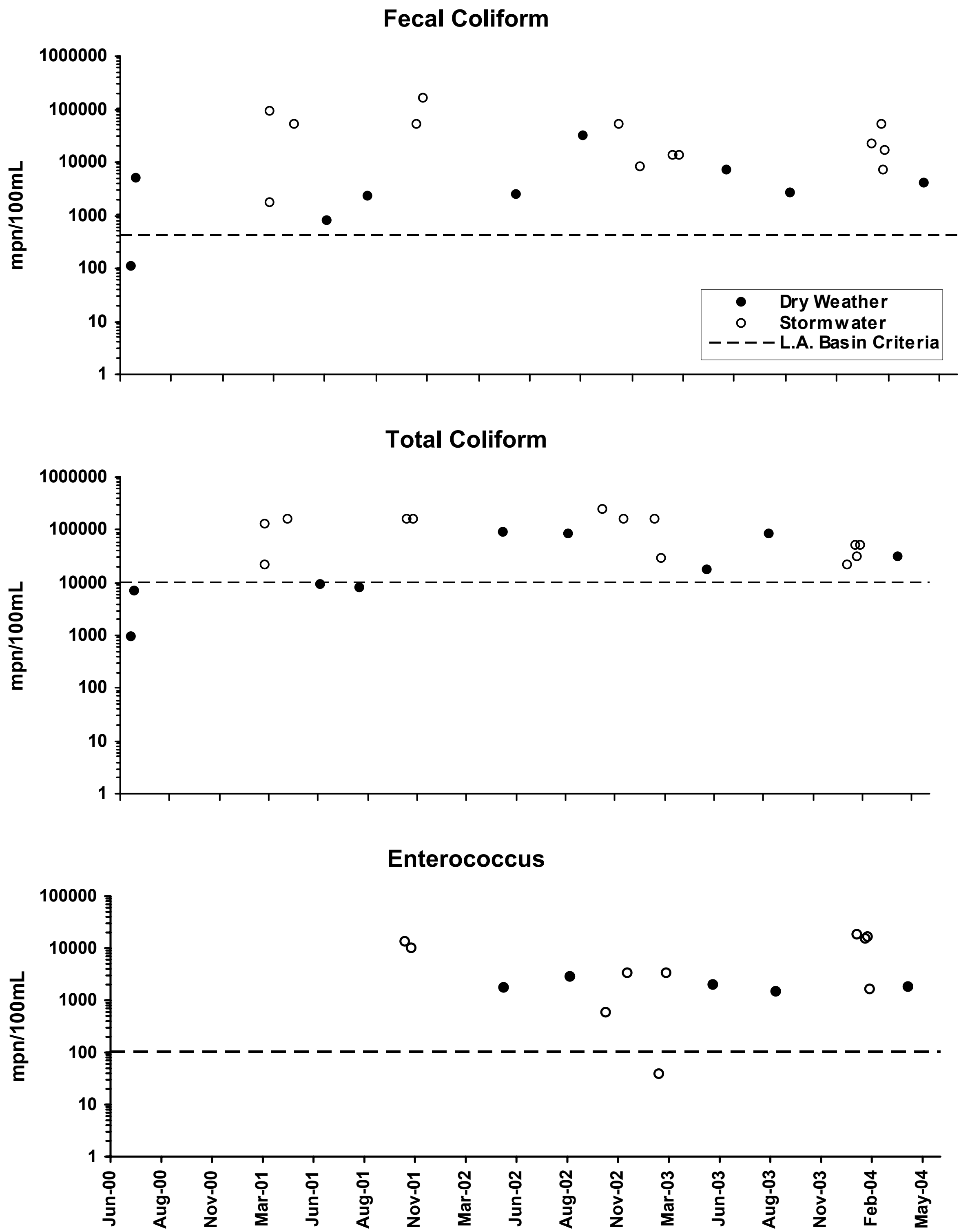


Figure 9.14. **Belmont Pump bacteria concentrations for 2000 through 2004.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan..

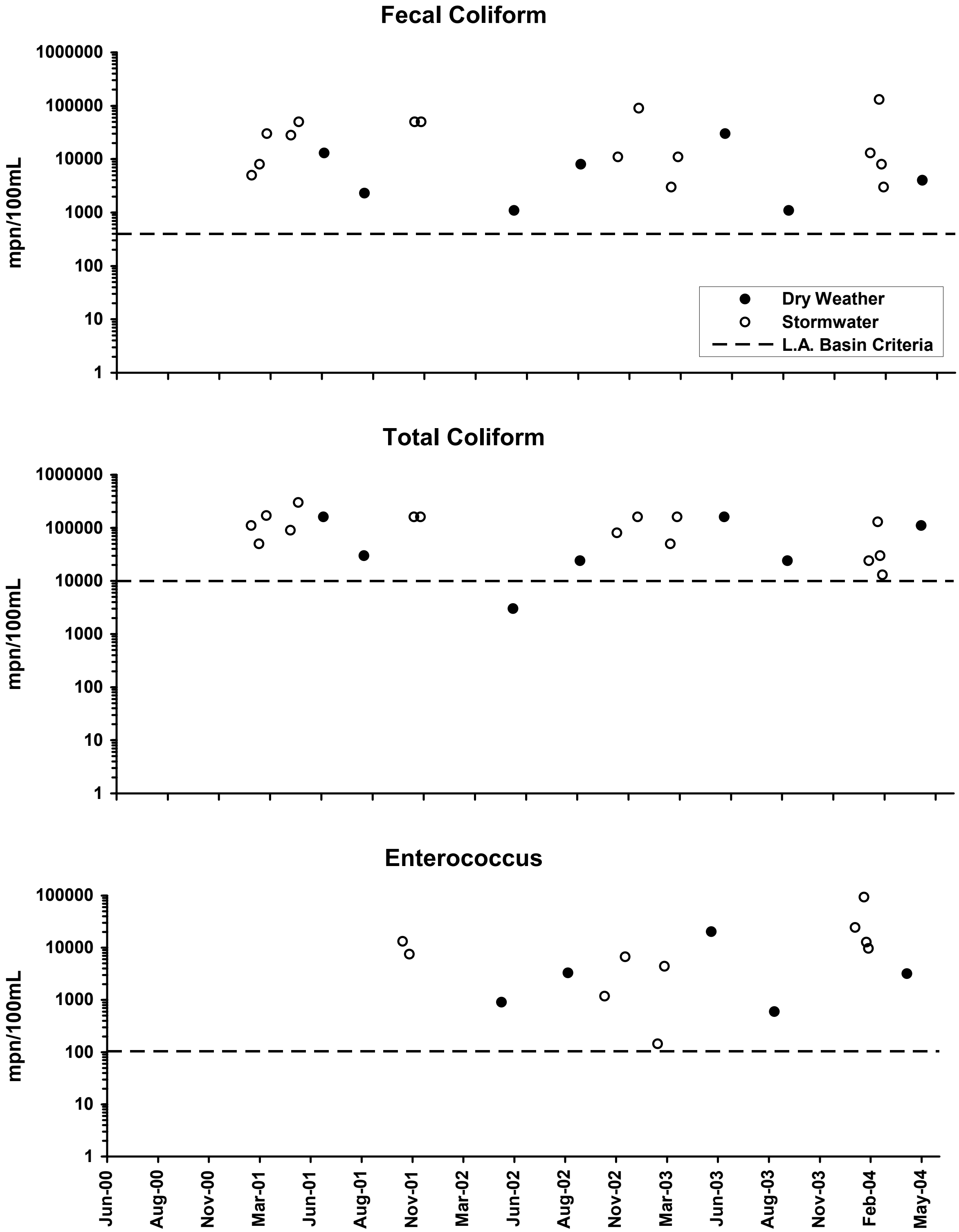


Figure 9.15. Los Cerritos Channel bacteria concentrations for 2000 through 2004. The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

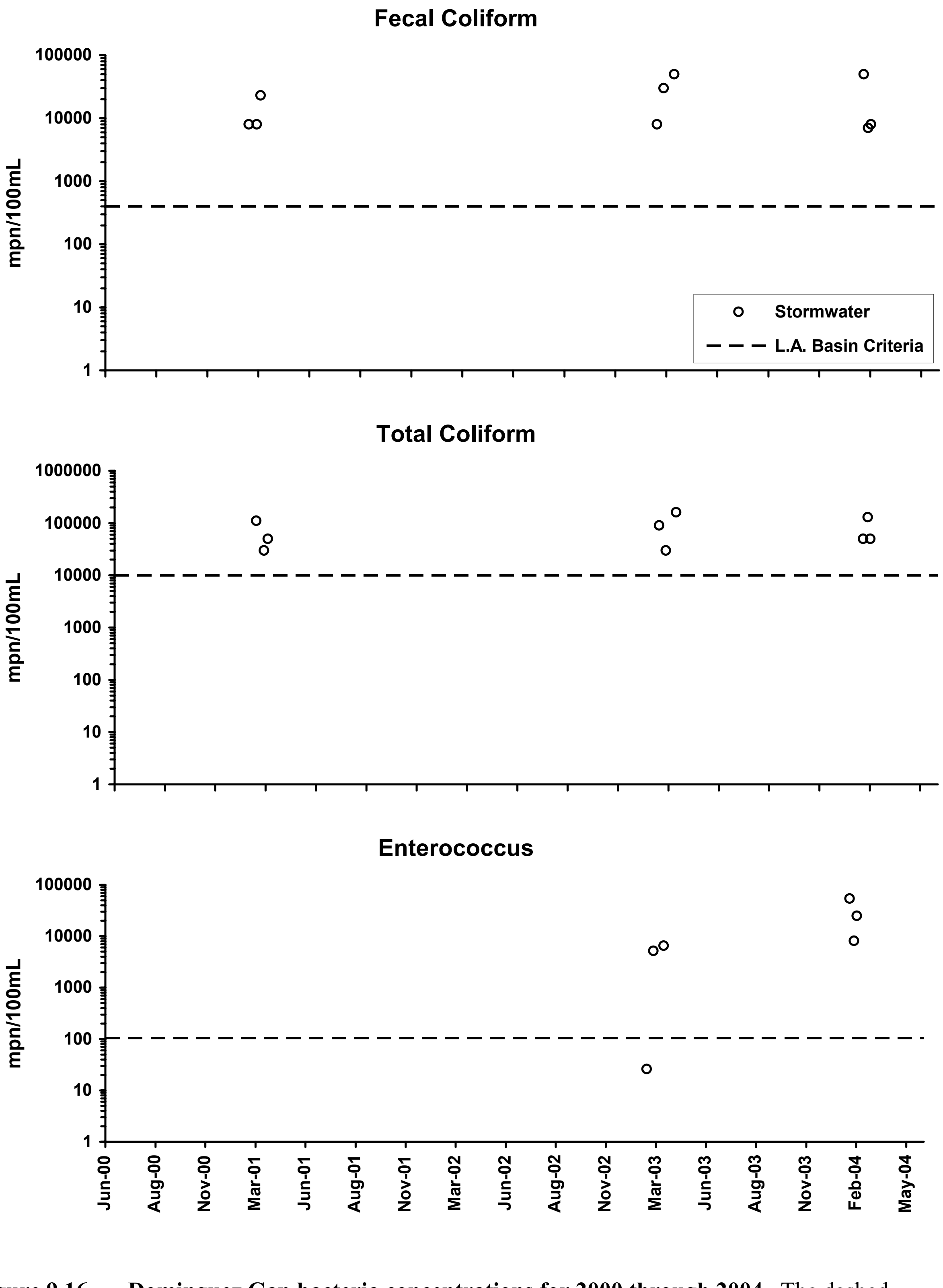


Figure 9.16. **Dominguez Gap bacteria concentrations for 2000 through 2004.** The dashed lines indicate the species-specific, single sample criteria based on the L.A. Basin Plan.

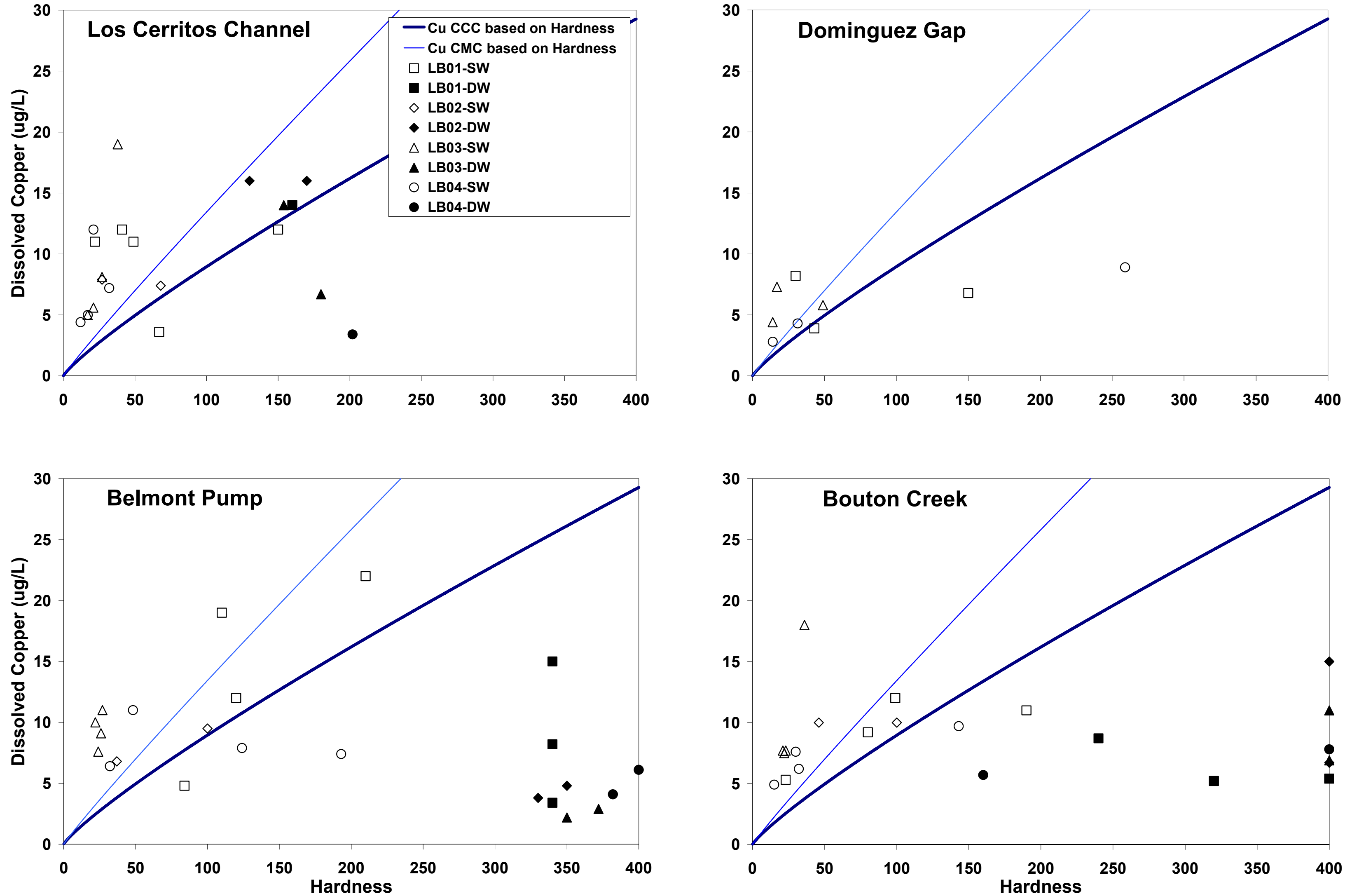


Figure 9.17. Dissolved copper concentrations versus Hardness for 2001 through 2004. Curves depict the Hardness-dependent acute (CMC) and chronic (CCC) freshwater criteria for dissolved copper.

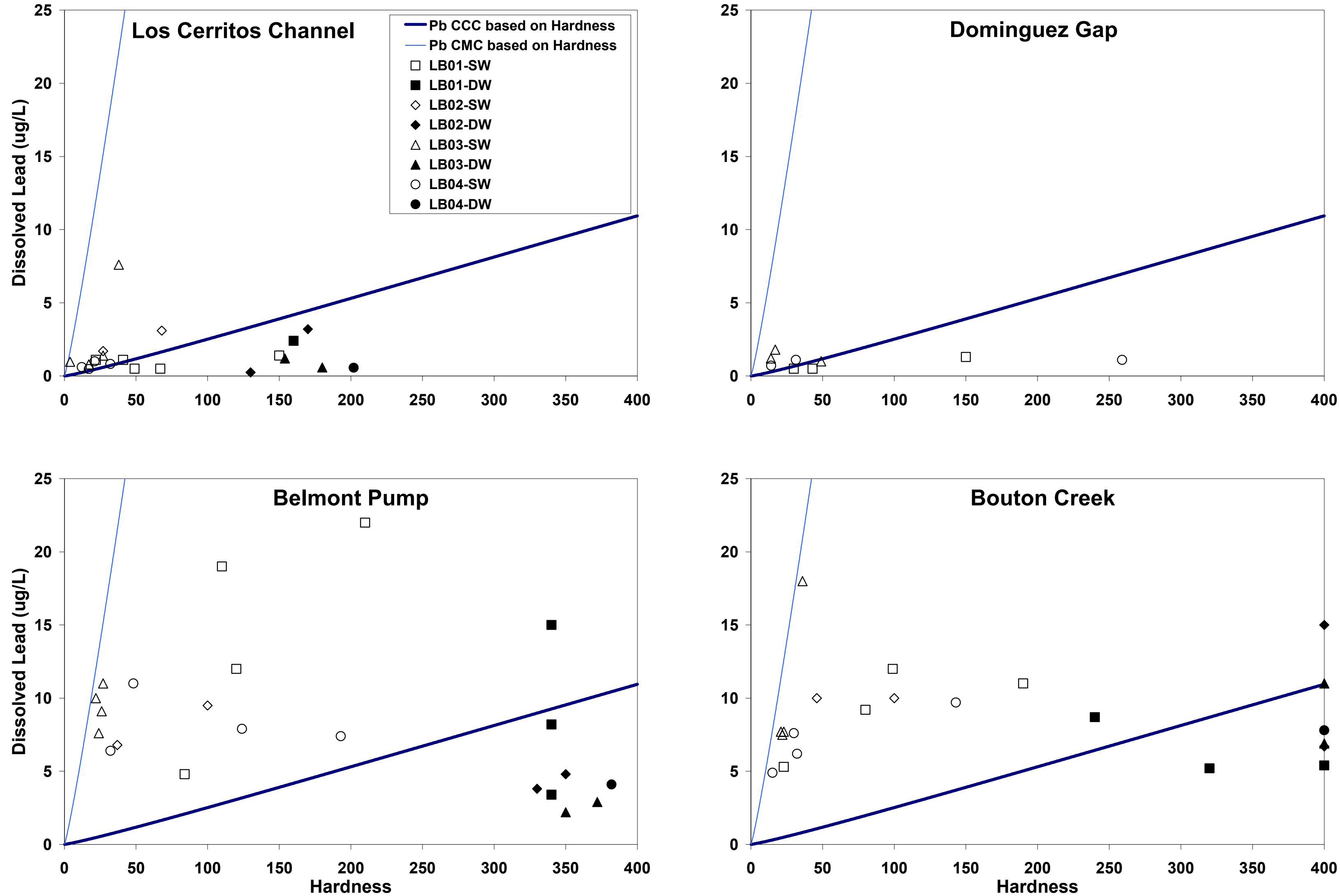


Figure 9.18. Dissolved lead concentrations versus Hardness for 2001 through 2004. Curves depict the Hardness-dependent acute (CMC) and chronic (CCC) freshwater criteria for dissolved lead.

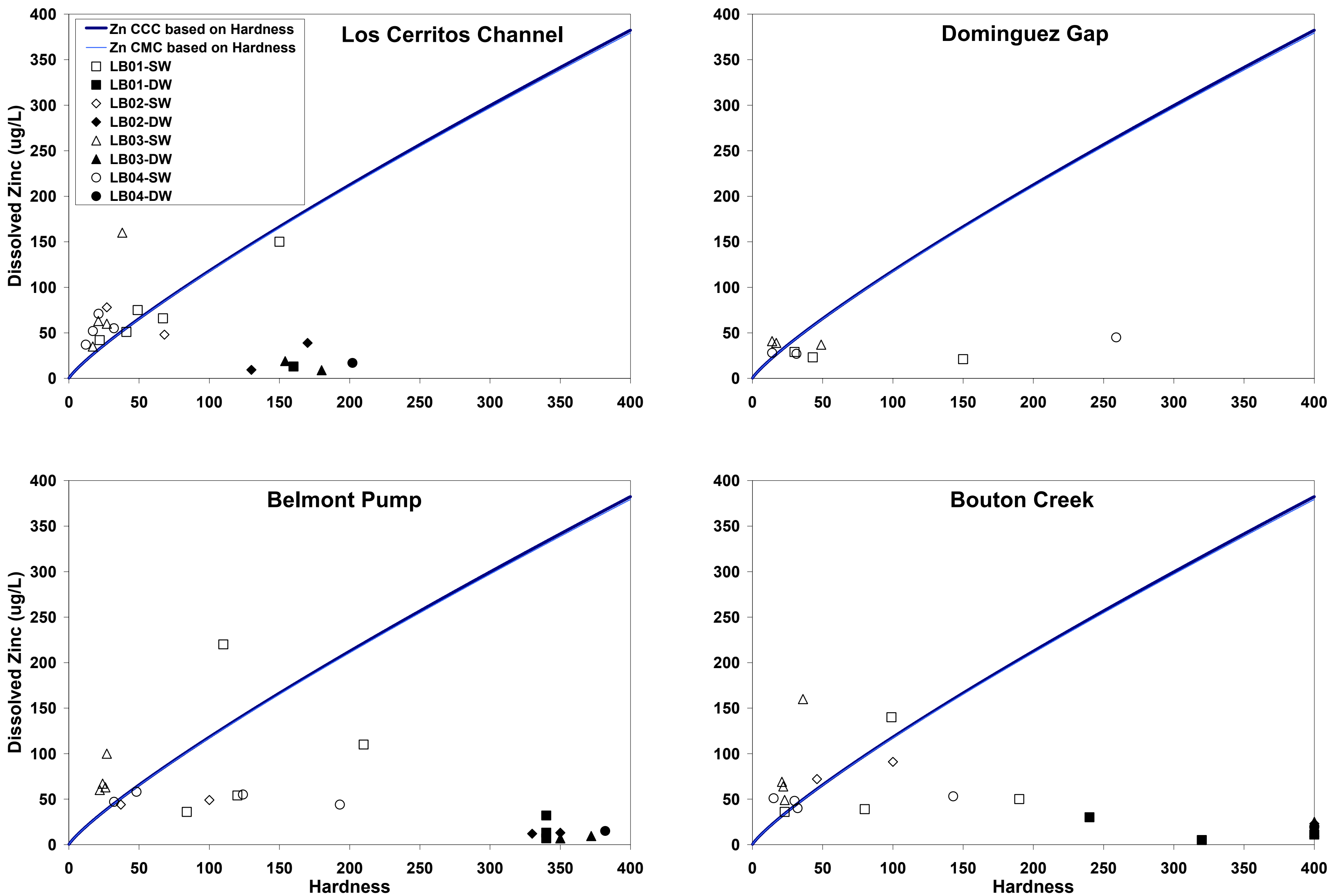


Figure 9.19. Dissolved zinc concentrations versus Hardness for 2001 through 2004. Curves depict the Hardness-dependent acute (CMC) and chronic (CCC) freshwater criteria for dissolved zinc.

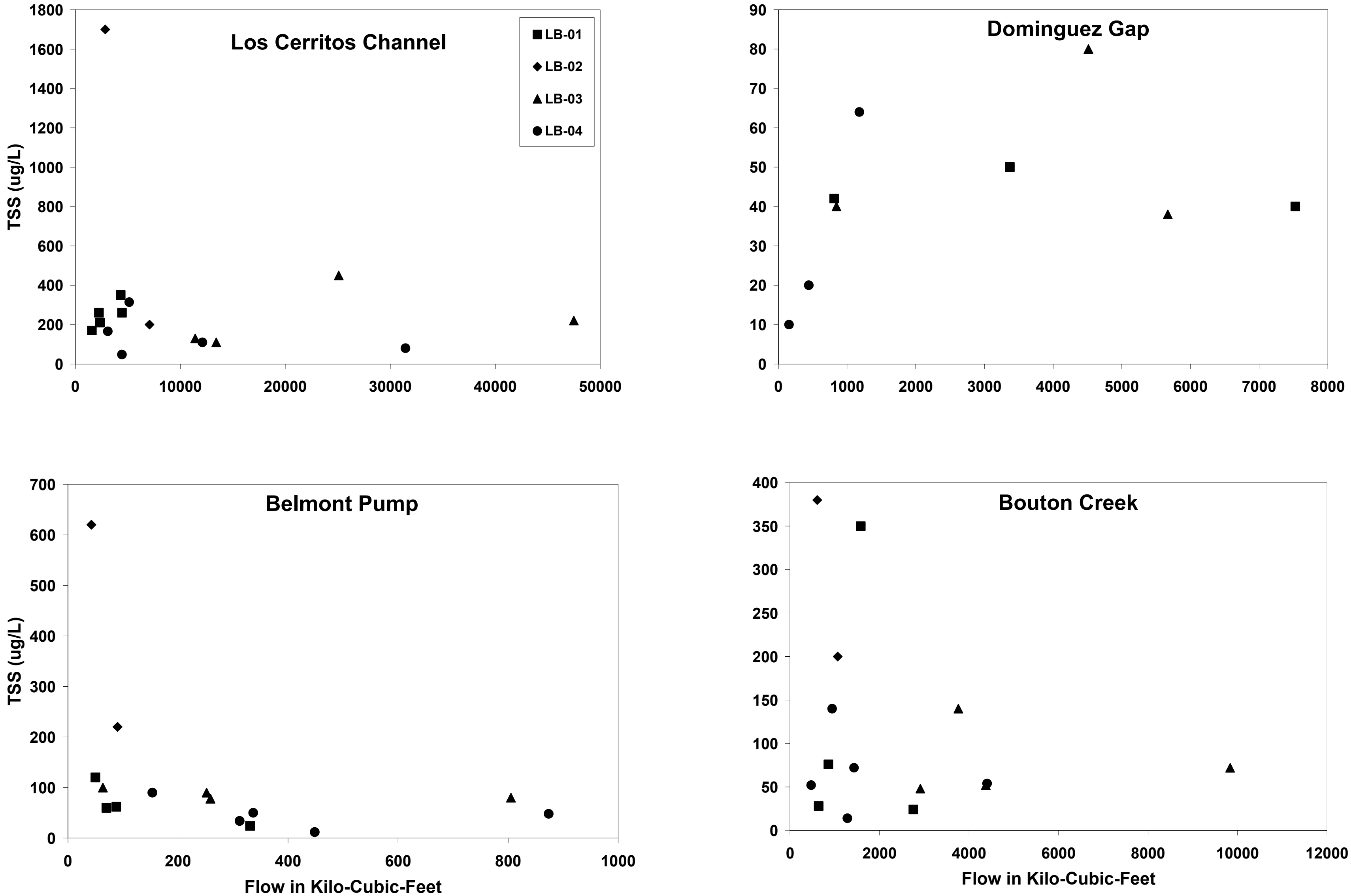


Figure 9.20. TSS concentrations versus Flow for each Monitored Storm Event, 2001-2004.

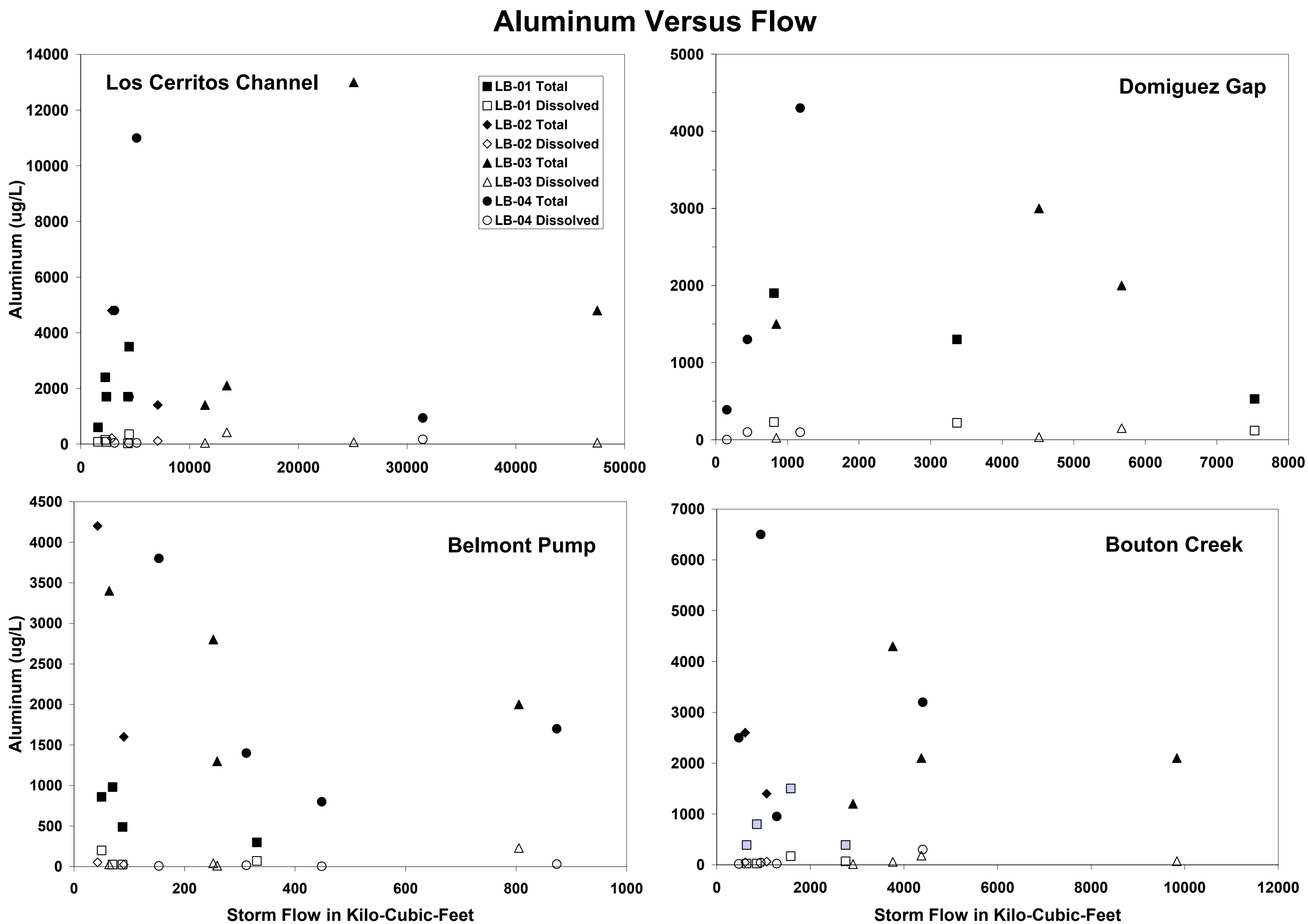


Figure 9.21. Total and Dissolved Aluminum versus Flow for each Monitored Storm Event, 2001-2004.

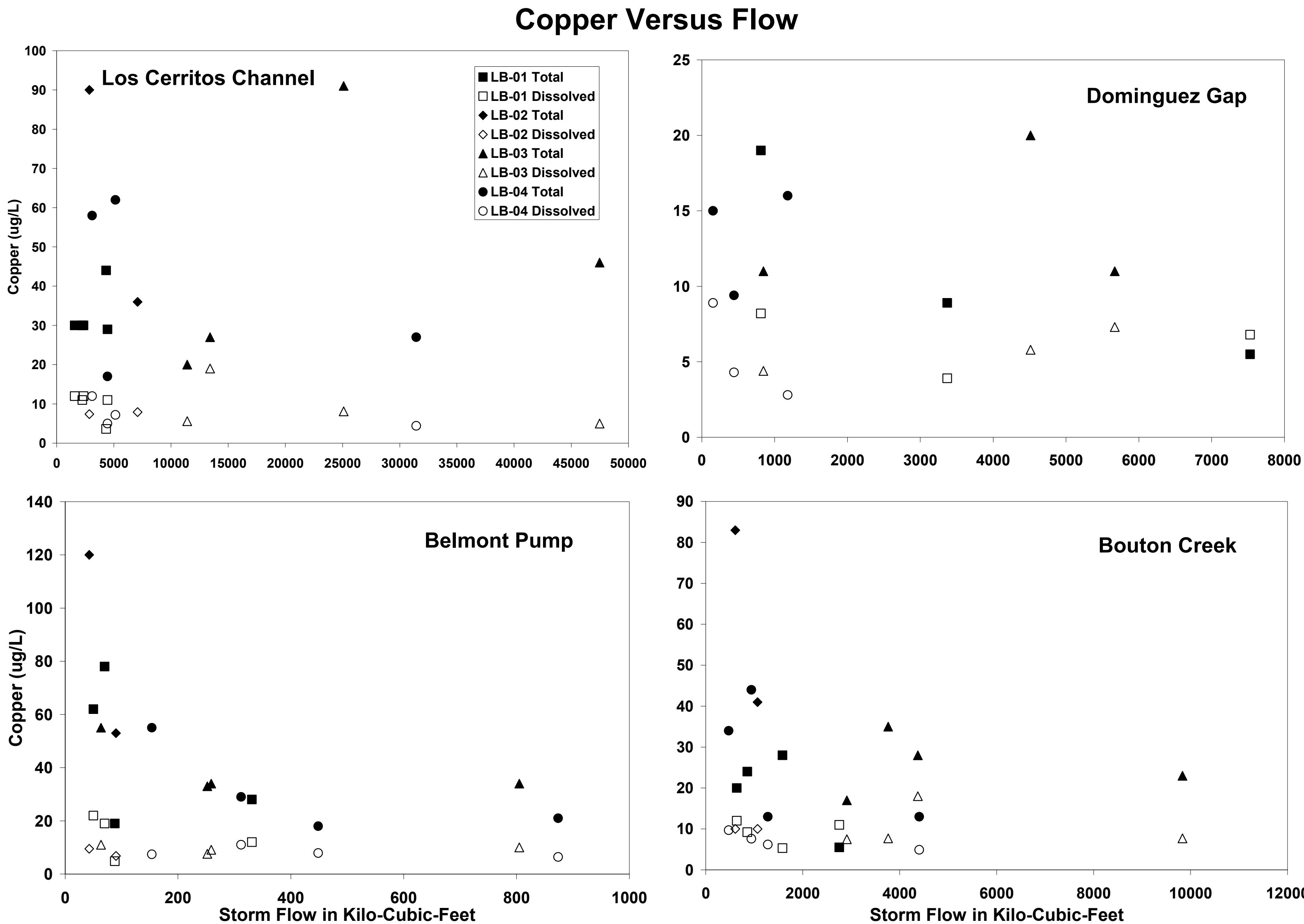


Figure 9.22. Total and Dissolved Copper versus Flow for each Monitored Storm Event, 2001-2004.

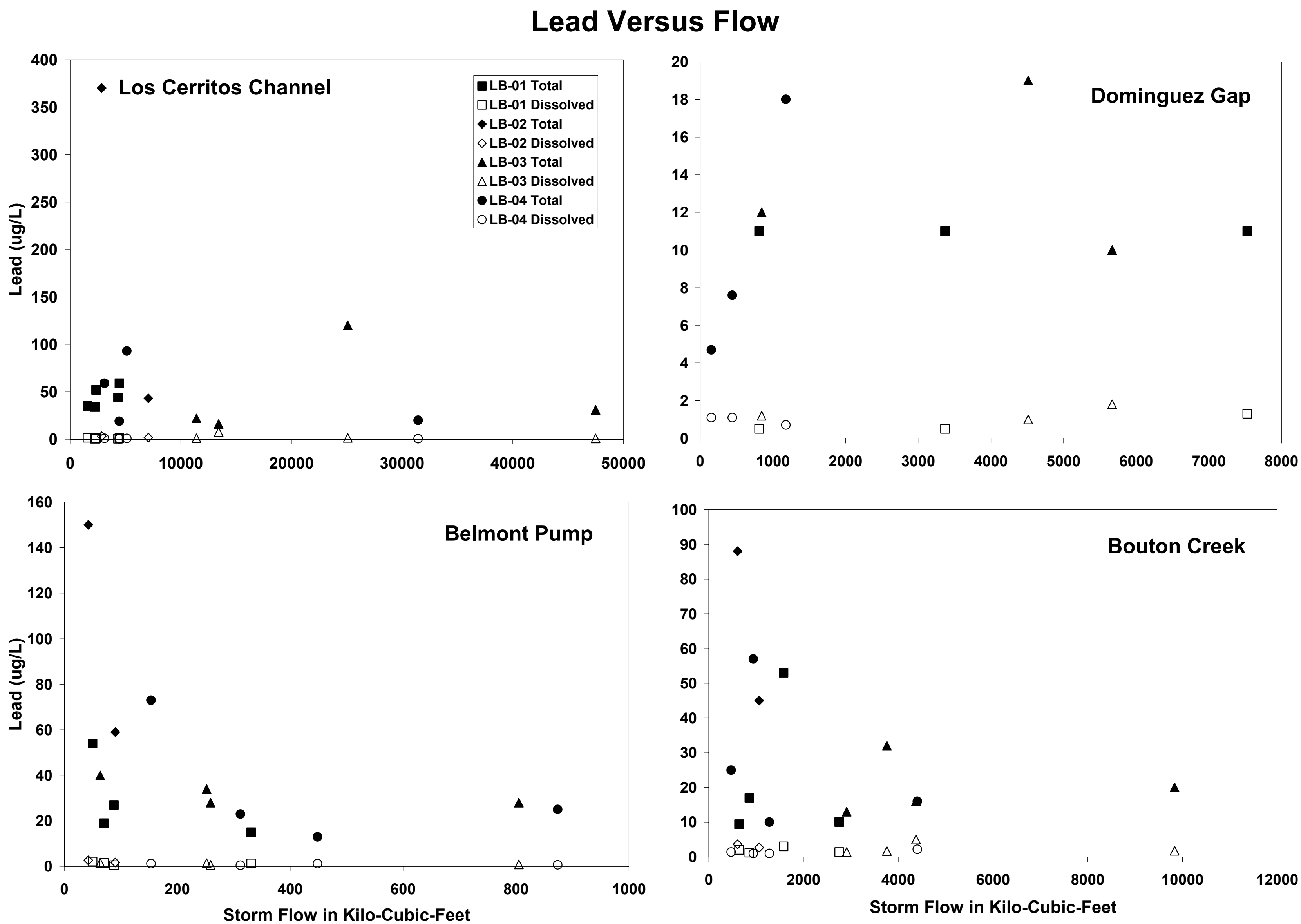


Figure 9.23. Total and Dissolved Lead versus Flow for each Monitored Storm Event, 2001-2004.

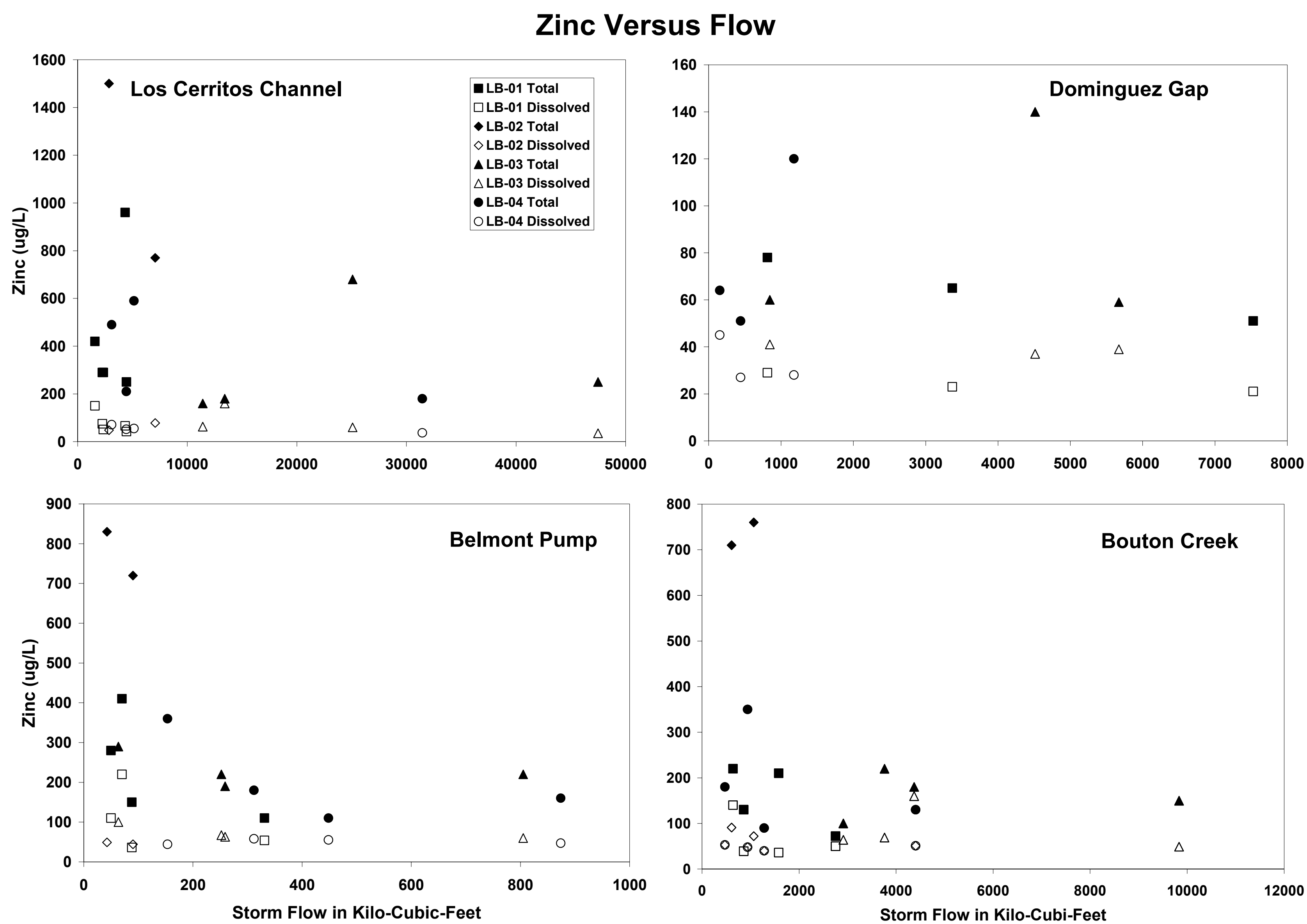


Figure 9.24. Total and Dissolved Zinc versus Flow for each Monitored Storm Event, 2001-2004.

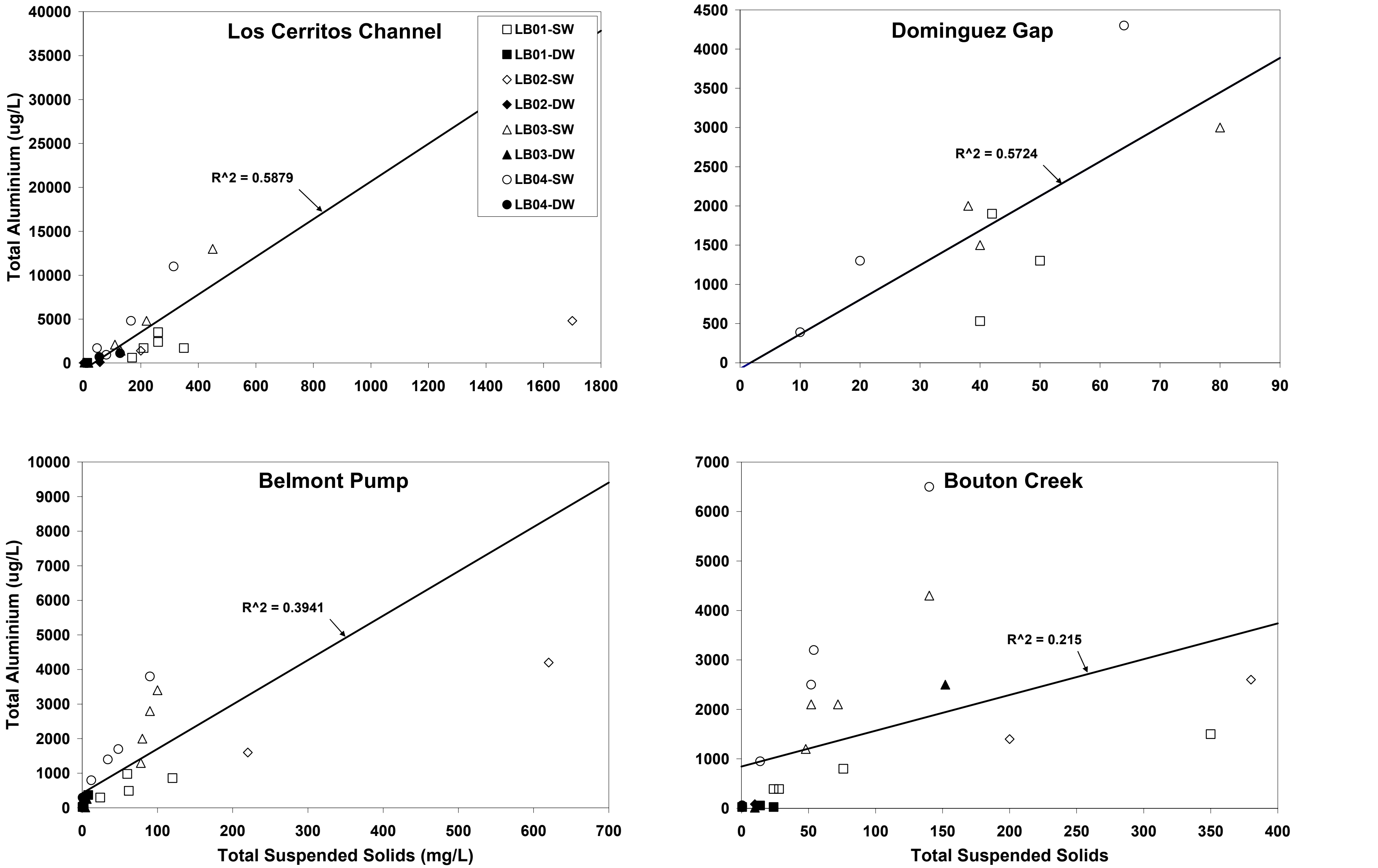


Figure 9.25. Total Aluminum concentrations versus Total Suspended Solids for all Sites during Monitoring Years 2001-2004. The lines depict a linear regression and their respective R^2 values are displayed as well. TSS value of 1650 mg/L in Los Cerritos Channel and TSS value of 650 mg/L at Bouton Creek both were treated as outliers and not included in regressions.

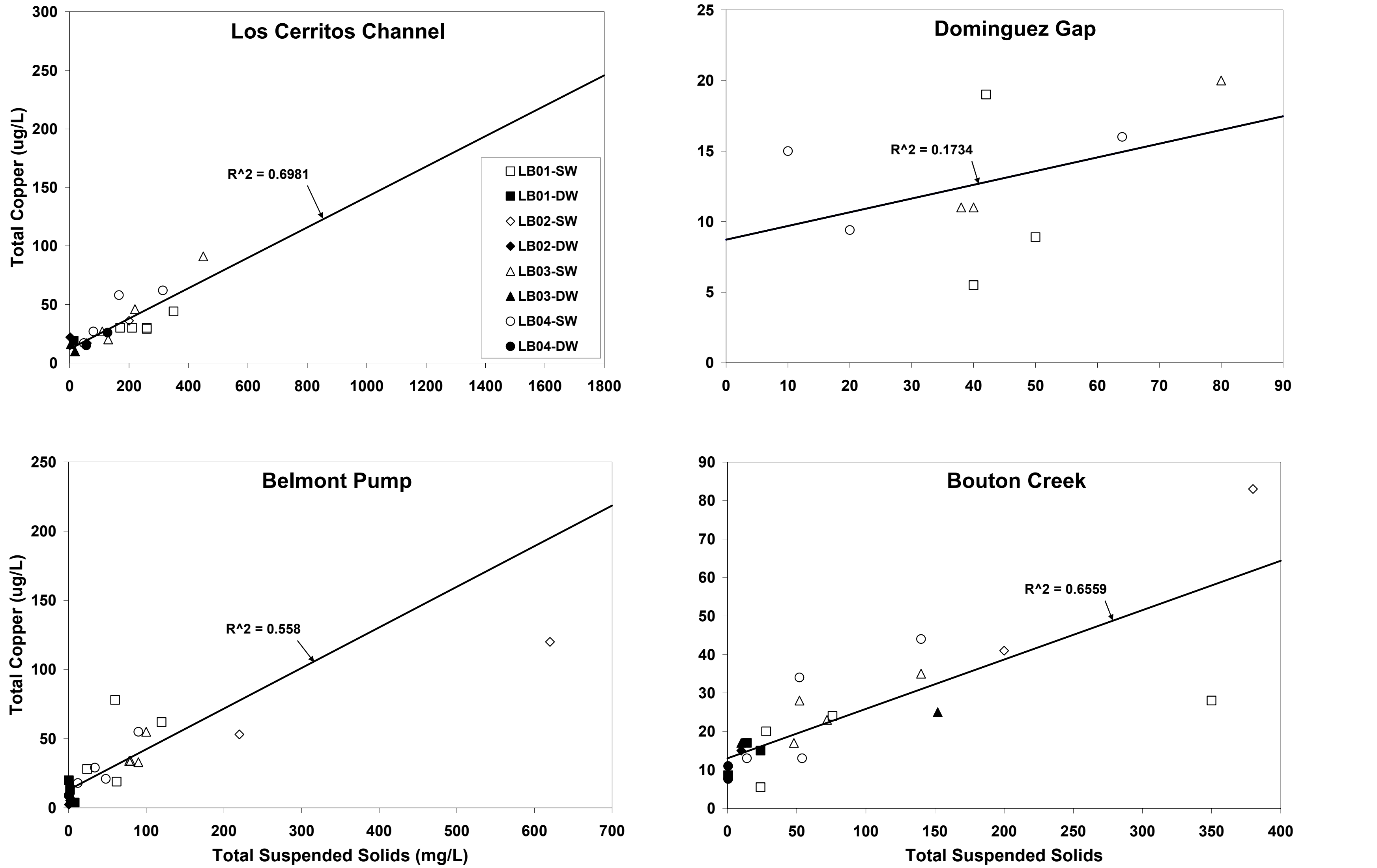


Figure 9.26. Total Copper concentrations versus Total Suspended Solids for Sites during Monitoring Years 2001-2004. The lines depict a linear regression and their respective R^2 values are displayed as well. TSS value of 1650 mg/L in Los Cerritos Channel and TSS value of 650 mg/L at Bouton Creek both were treated as outliers and not included in regressions.

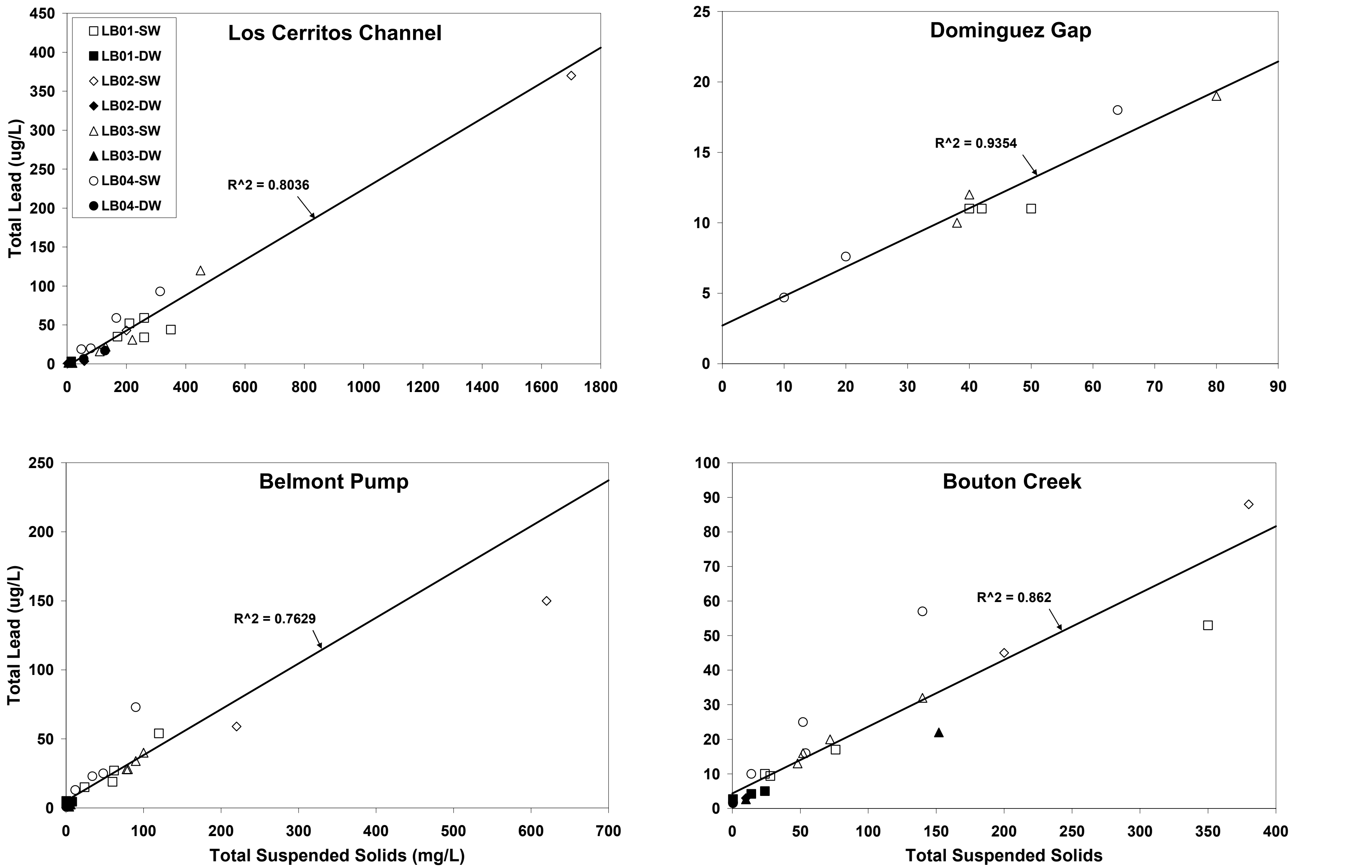


Figure 9.27. **Total Lead concentrations versus Total Suspended Solids for all Sites during Monitoring Years 2001-2004.** The lines depict a linear regression and their respective R^2 values are displayed as well. TSS value of 1650 mg/L in Los Cerritos Channel and TSS value of 650 mg/L at Bouton Creek both were treated as outliers and not included in regressions.

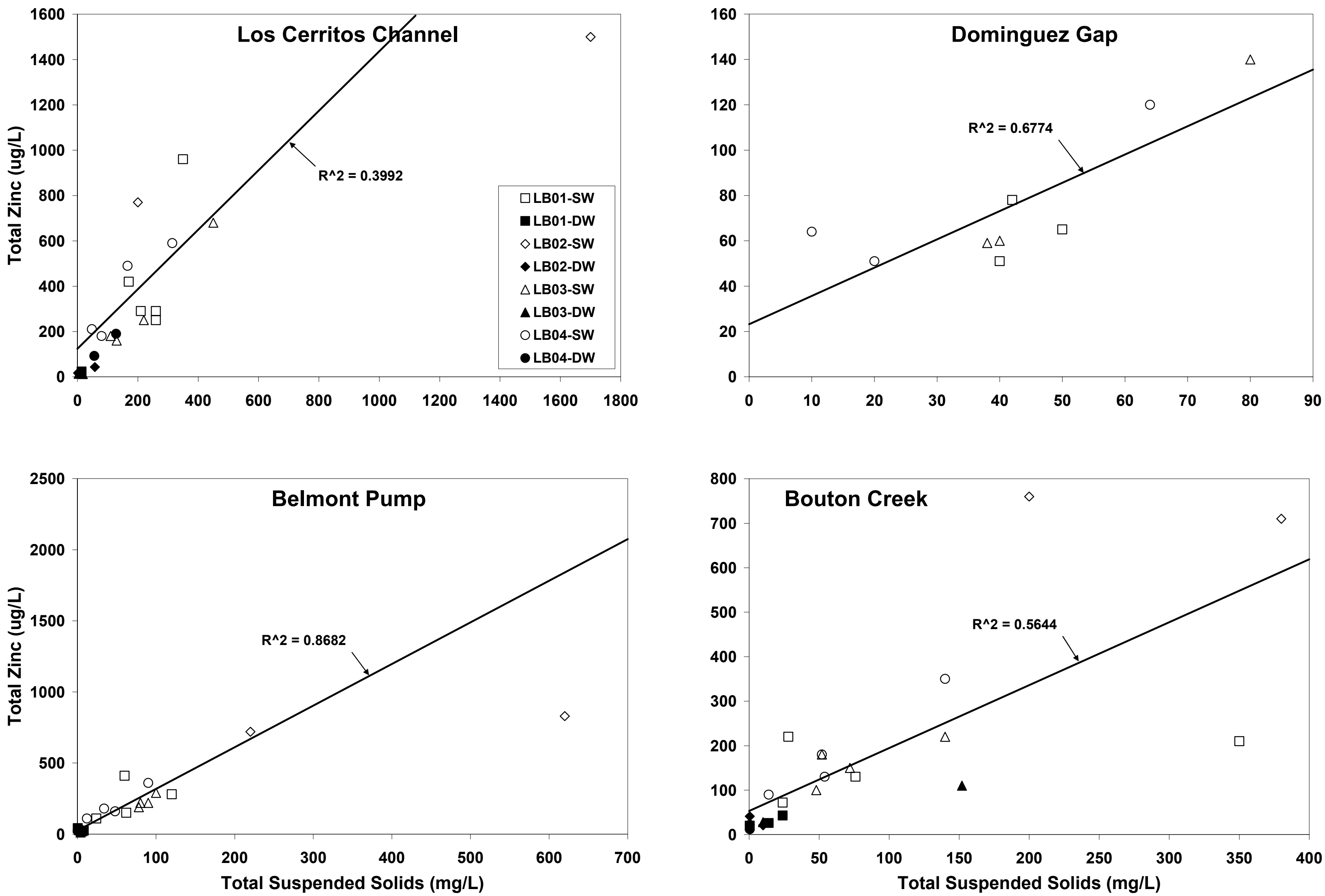


Figure 9.28. Total Zinc concentrations versus Total Suspended Solids for all Sites during Monitoring Years 2001-2004. The lines depict a linear regression and their respective R^2 values are displayed as well. TSS value of 1650 mg/L in Los Cerritos Channel and TSS value of 650 mg/L at Bouton Creek both were treated as outliers and not included in regressions.

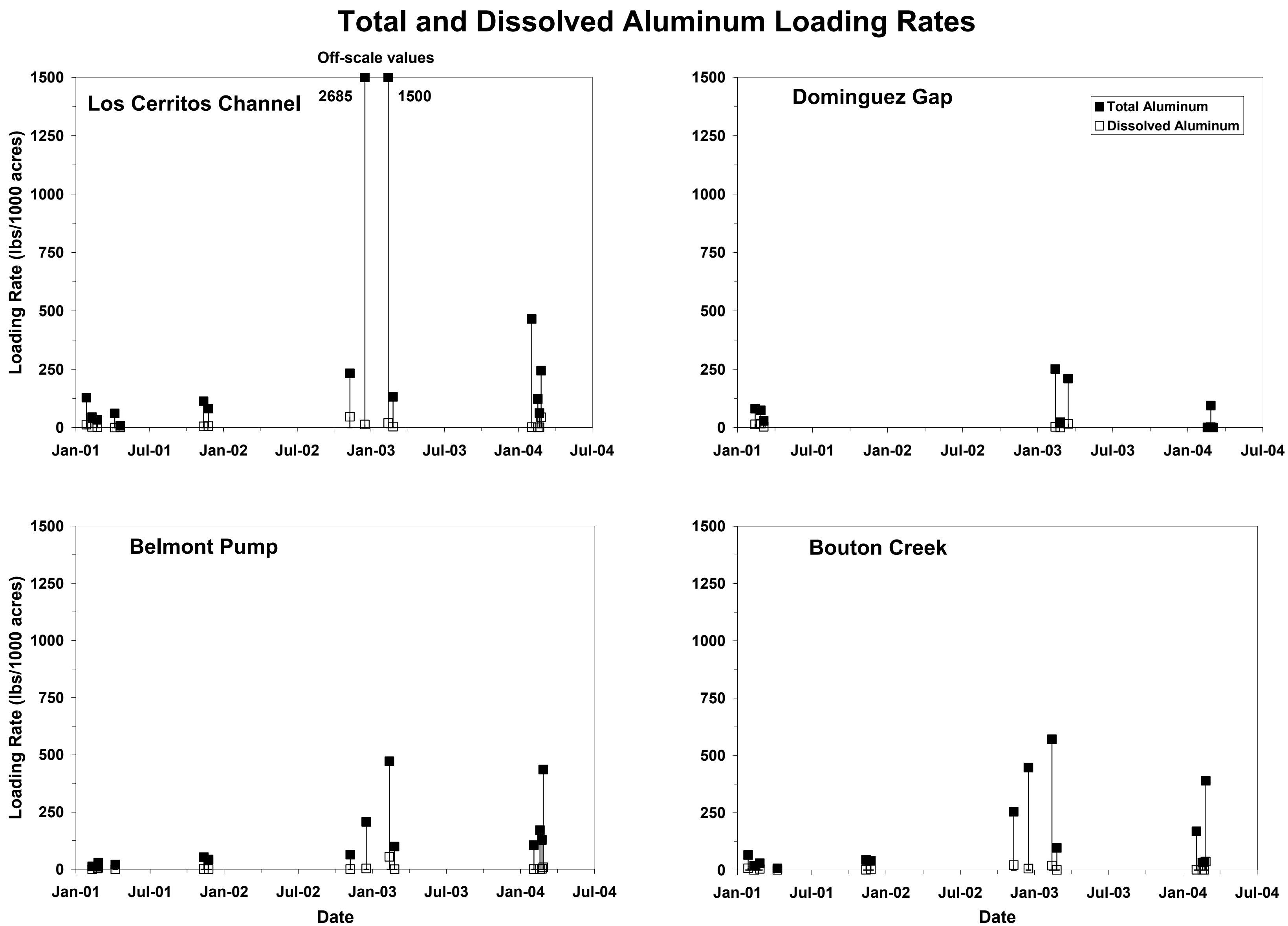


Figure 9.29. Total and Dissolved Aluminum Loading Rates calculated for all Monitored Storm Events, 2001-2004.

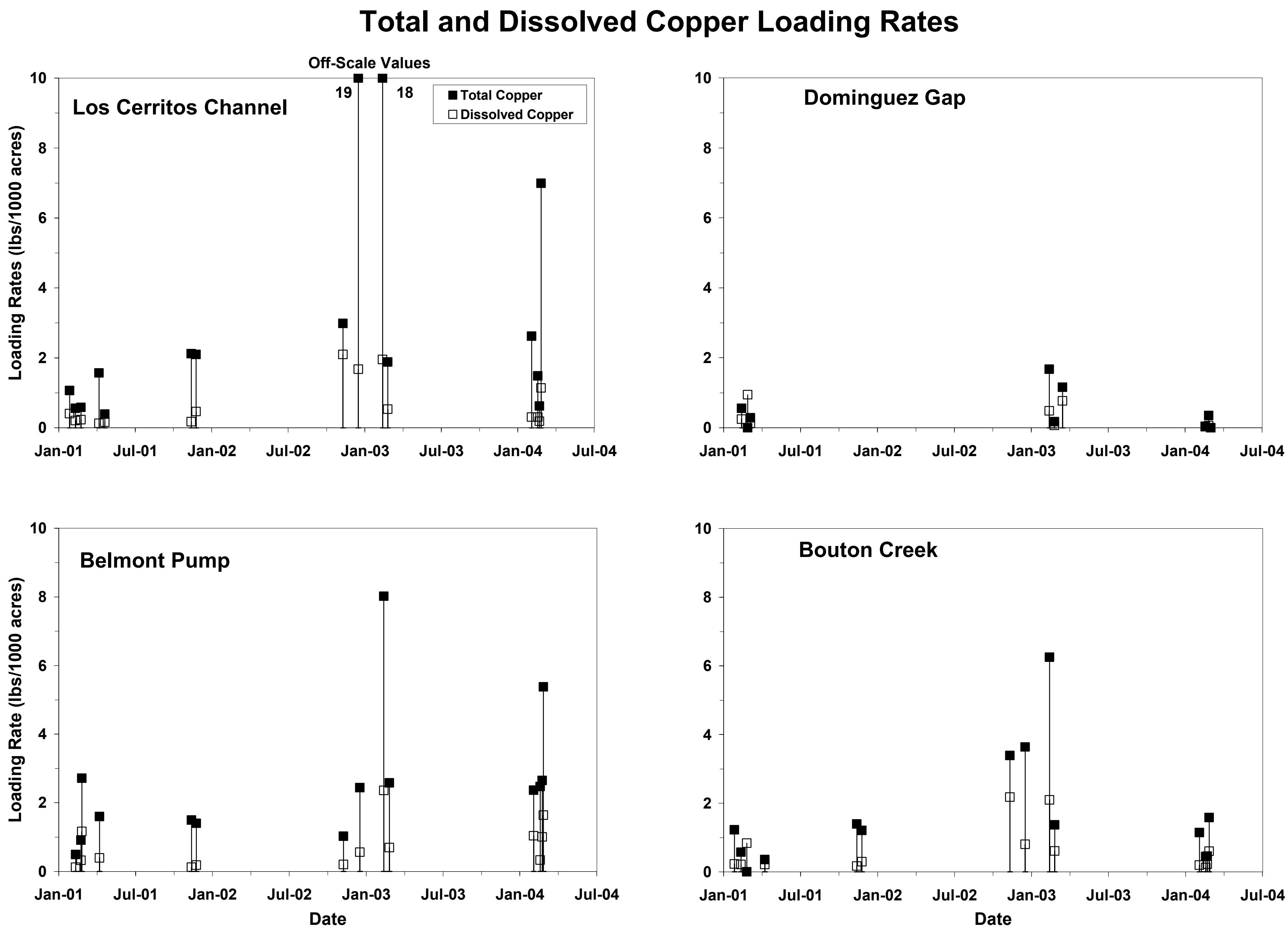


Figure 9.30. Total and Dissolved Copper Loading Rates calculated for all Monitored Storm Events, 2001-2004.

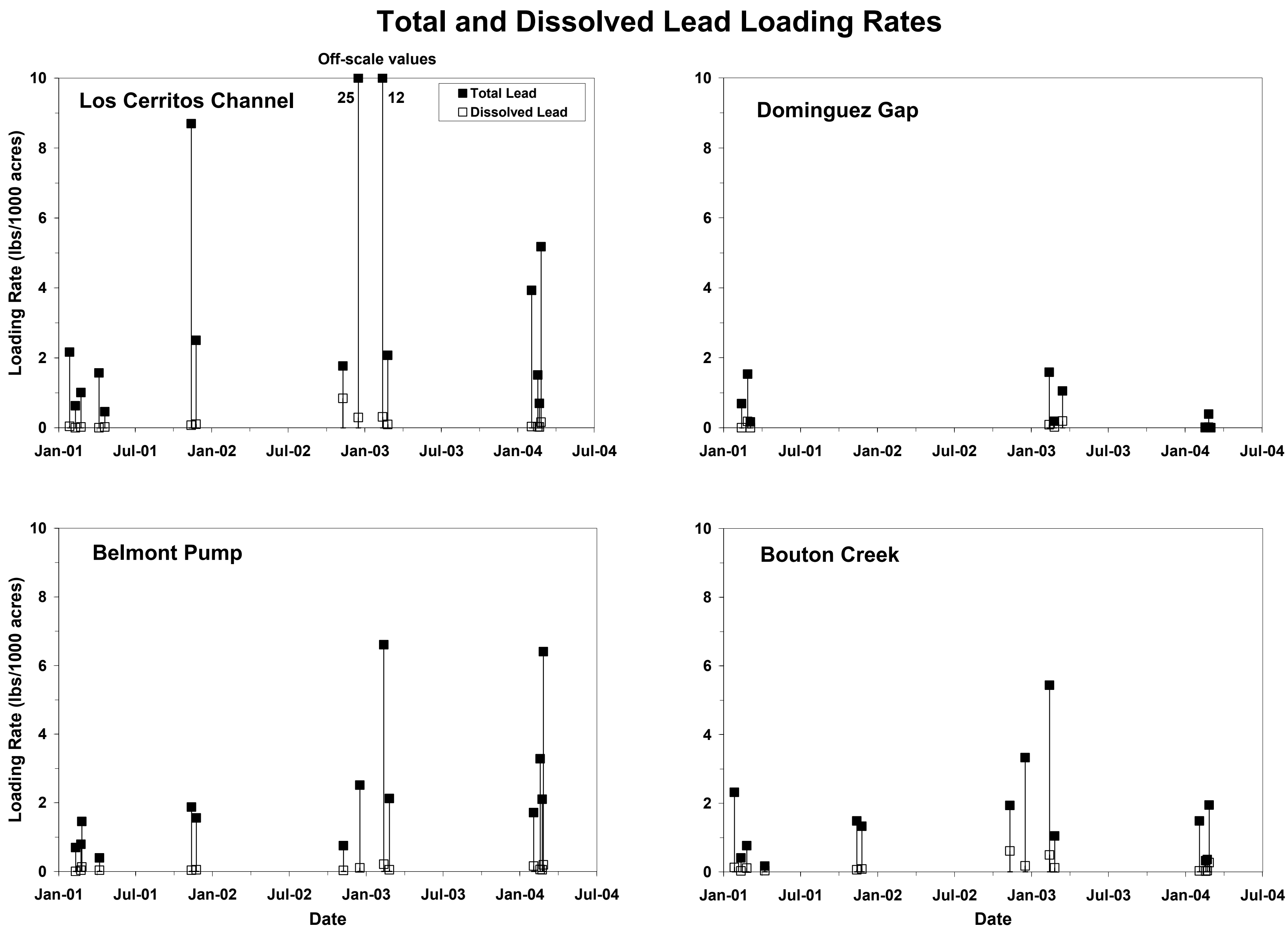


Figure 9.31. Total and Dissolved Lead Loading Rates calculated for all Monitored Storm Events, 2001-2004.

Total and Dissolved Zinc Loading Rates

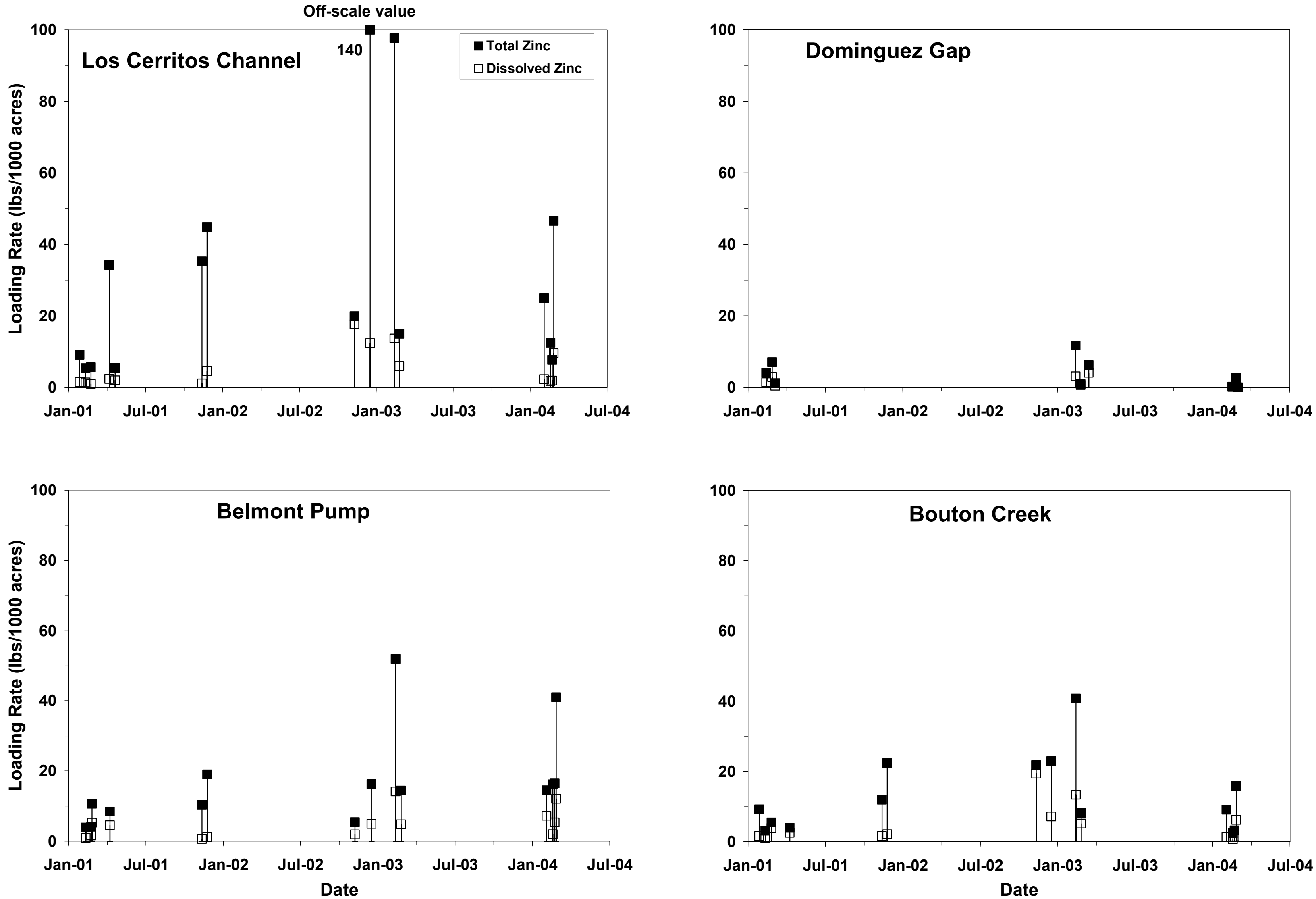


Figure 9.32. Total and Dissolved Zinc Loading Rates calculated for all Monitored Storm Events, 2001-2004.

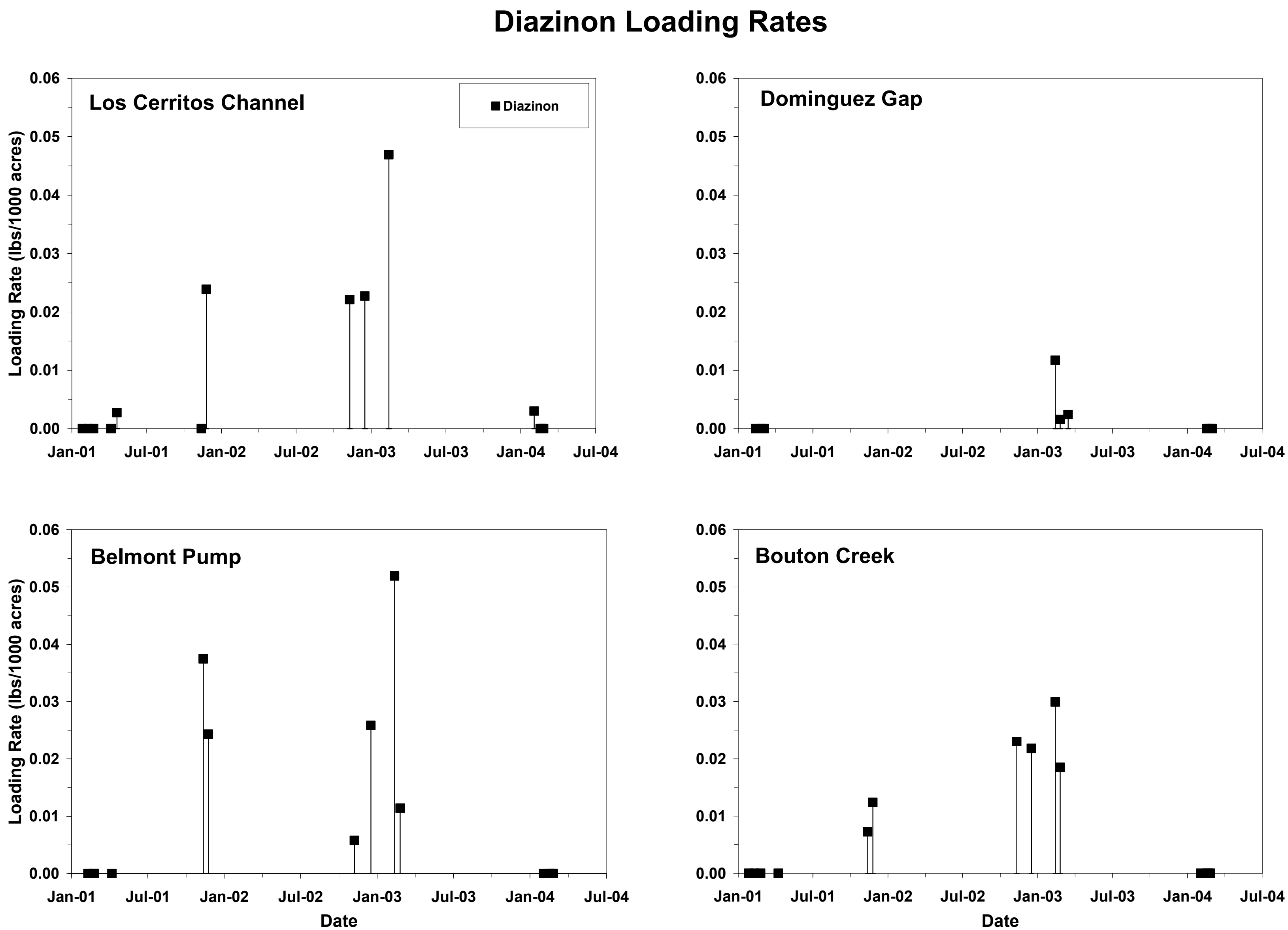


Figure 9.33. Diazinon Loading Rates calculated for all Monitored Storm Events, 2001-2004.

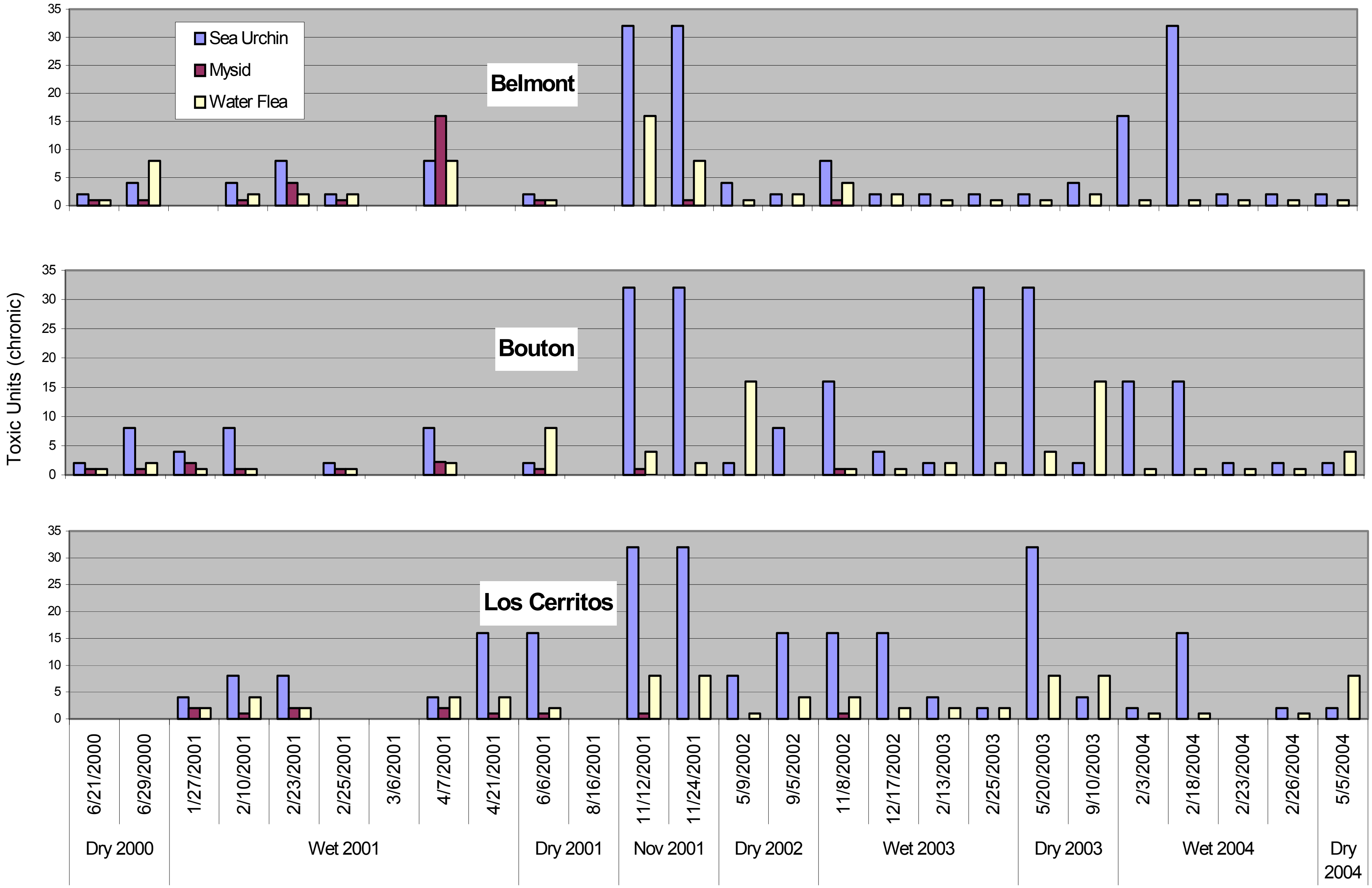
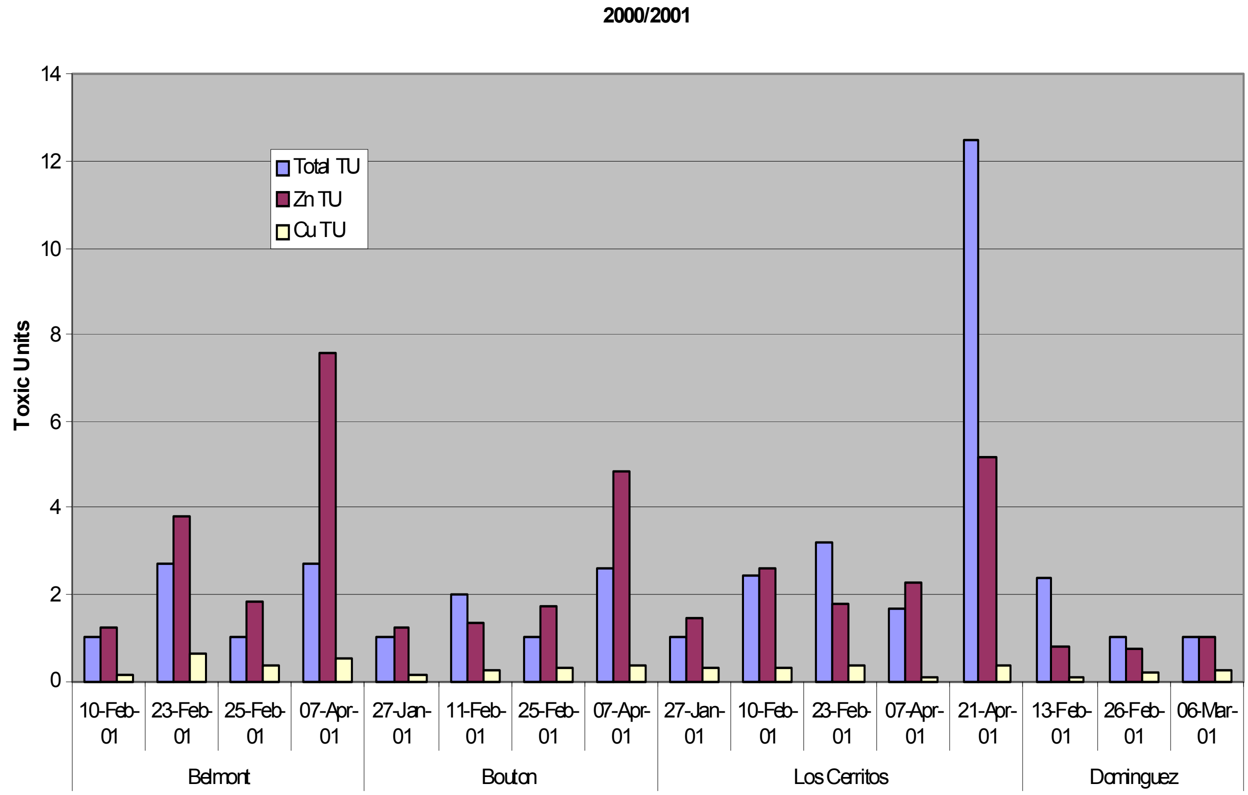


Figure 9.34. Summary of Wet and Dry Weather Toxicity Results for all Long Beach Samples.



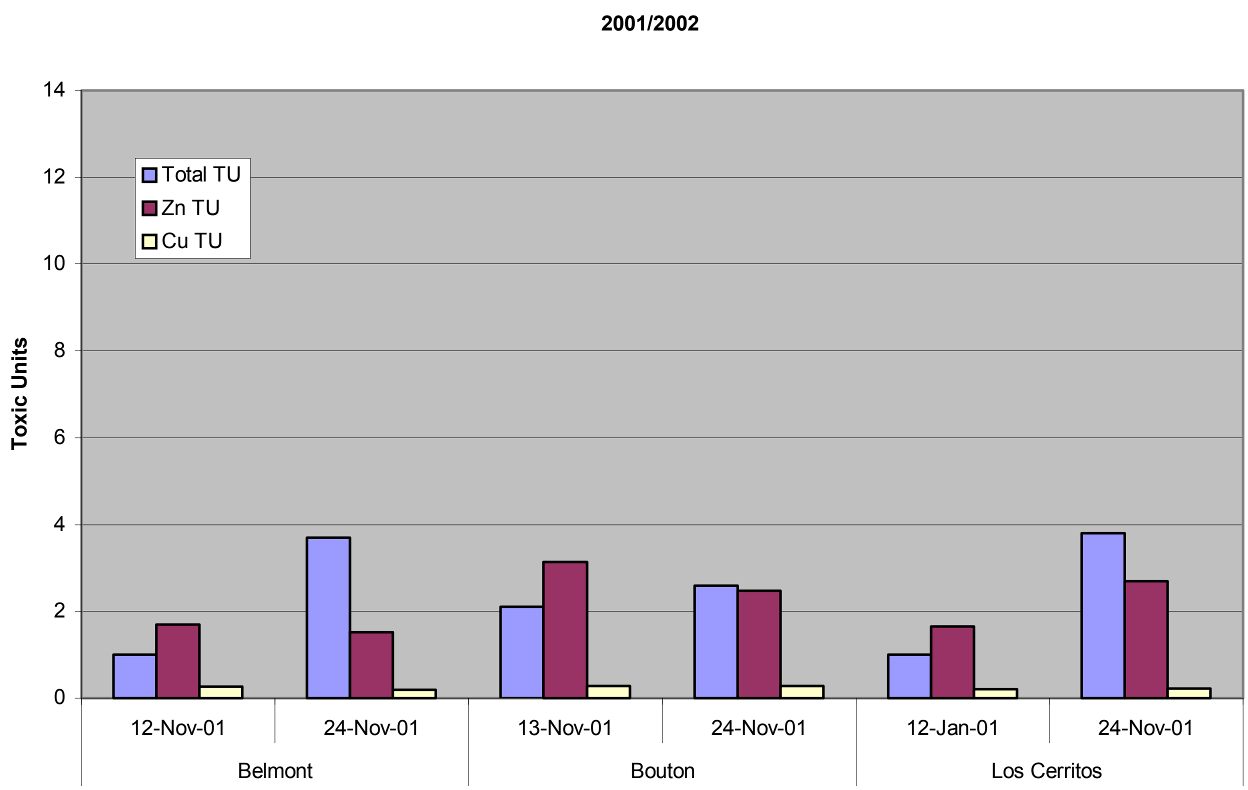
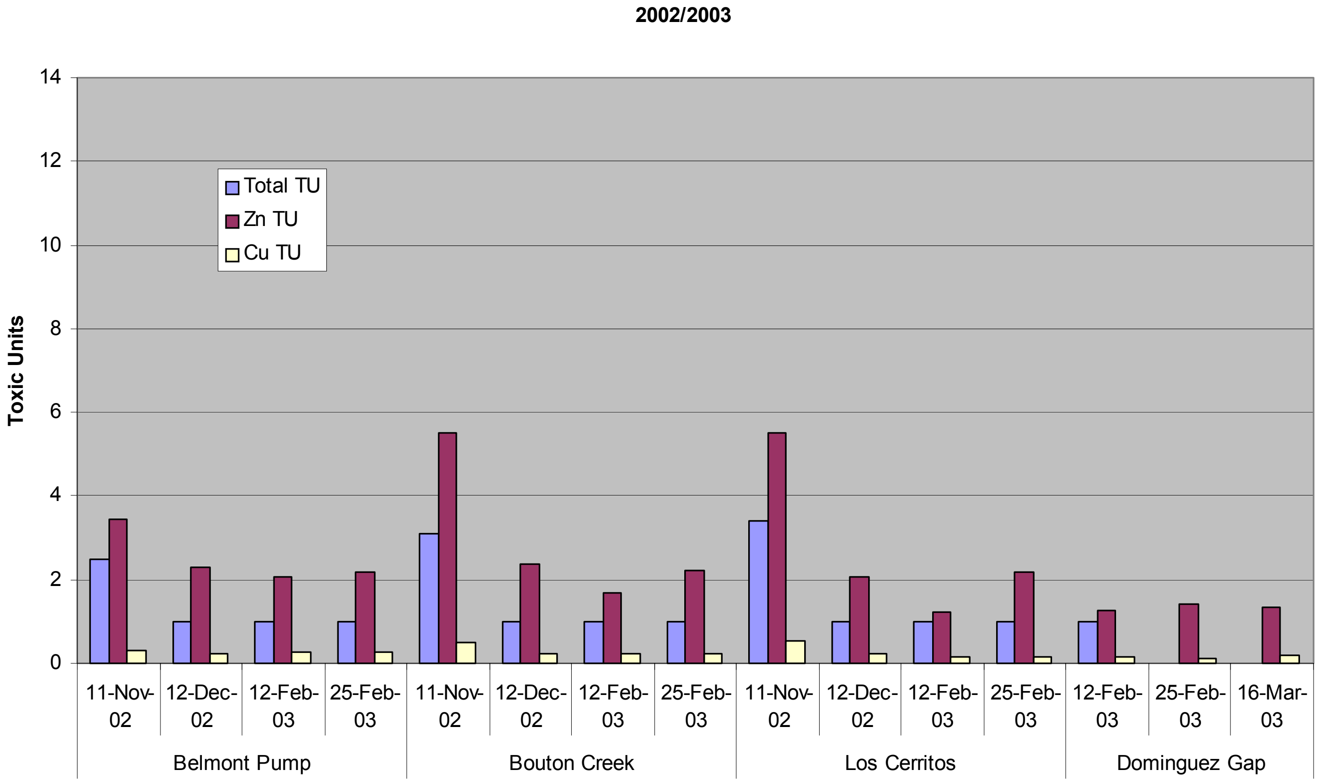


Figure 9.35a. Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated EC50>100%.



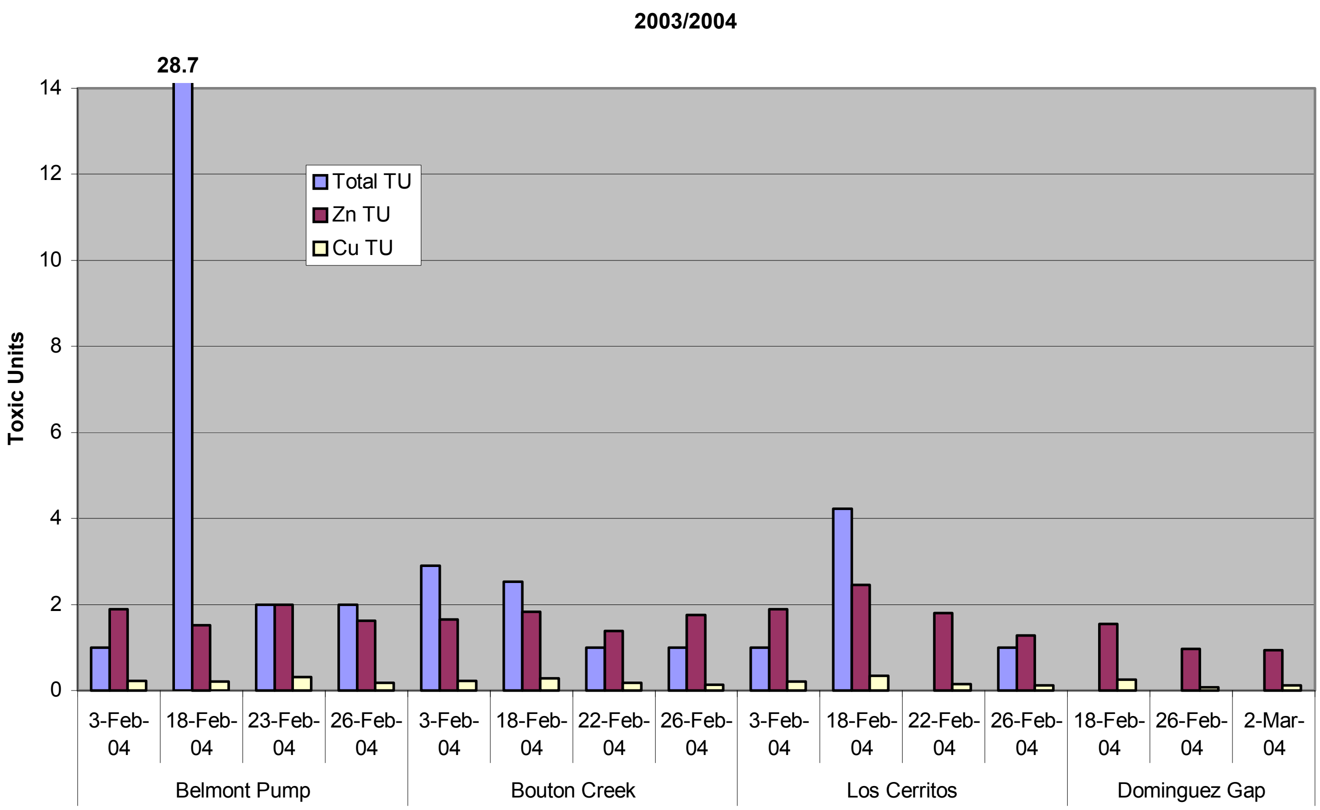


Figure 9.35b. Comparison of Measured (Total) Toxic Units for the Sea Urchin Fertilization Test and Toxic Units Predicted from the Dissolved Concentrations of Copper and Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated EC50>100%.

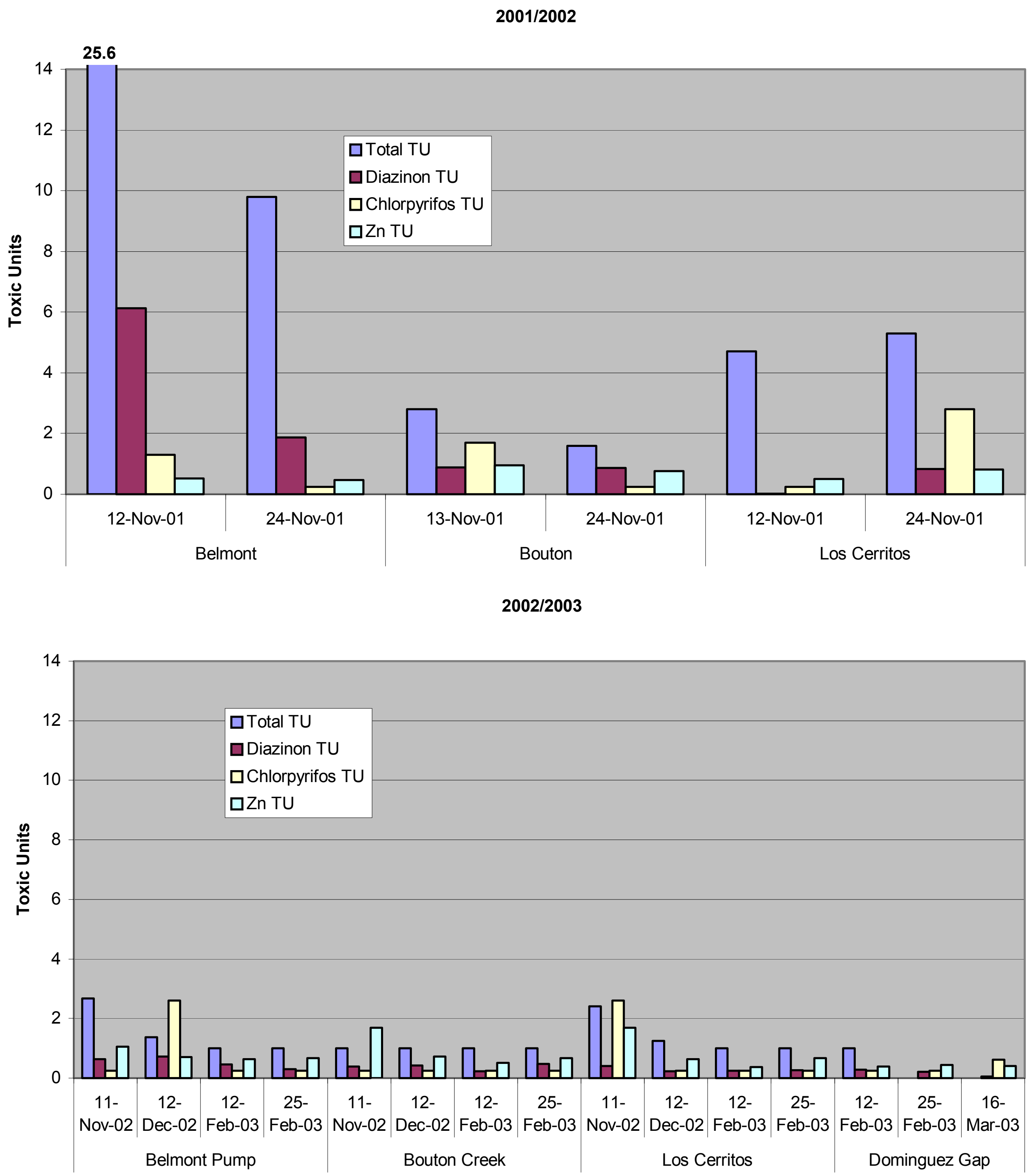


Figure 9.36a. Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zince in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated EC50>100%.

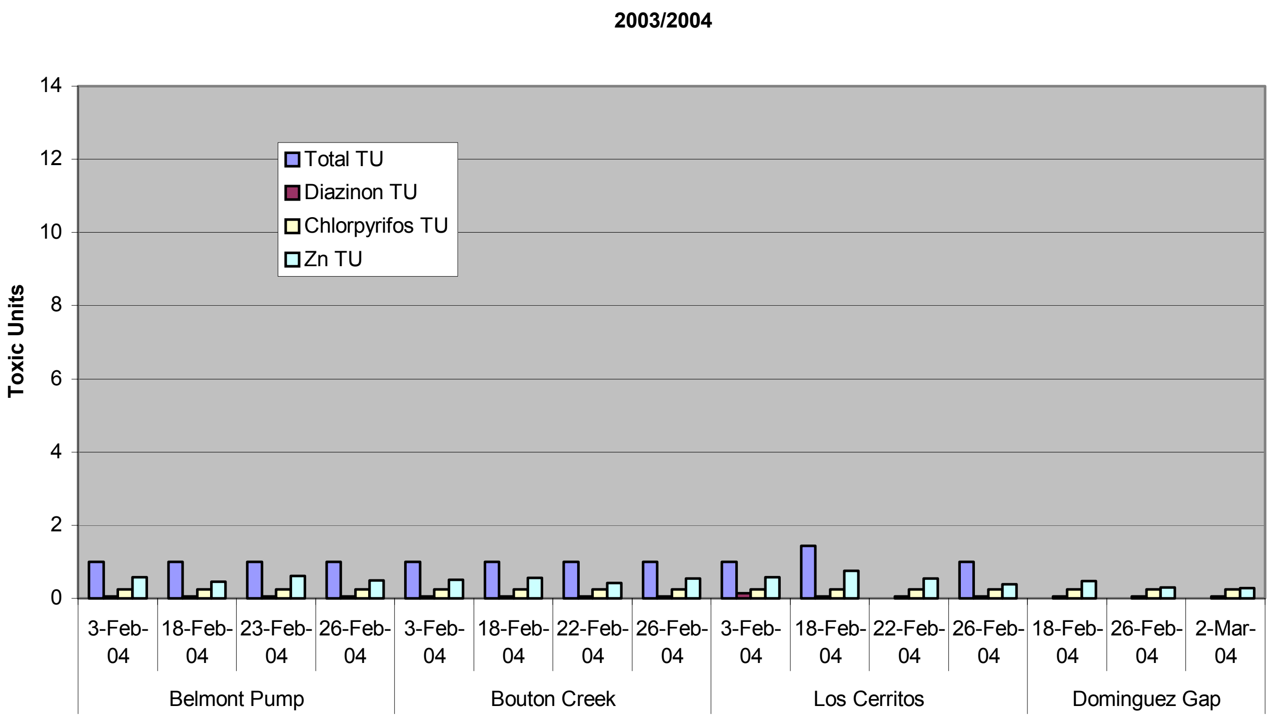


Figure 9.36b. Comparison of Measured (Total) Toxic Units for the Water Flea Survival Test and Toxic Units Predicted from the Concentrations of Chlorpyrifos, Diazinon, and Dissolved Zinc in the Test Samples. Measured toxic units are based on the EC50 (100/EC50). A value of 1 toxic unit was assigned to low/non-toxic samples have an estimated EC50>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. Summary of Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emmision Sites.

Class Constituent	Long Beach 2004 Minimum Level	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater CMC	California Fish and Game Saltwater CMC	California Toxics Rule Freshwater CCC	California Toxics Rule Saltwater CCC
Conventionals							
MBAS (Surfactants)	0.5 mg/L		0.5				
NH3-N	0.1 mg/L	2.4					
TKN	0.1 mg/L						
NO3-N (Nitrate)	0.1 mg/L						
NO2-N (Nitrite)	0.1 mg/L						
Oil & Grease	5 mg/L						
pH	1 pH Units		<[6.5-8.5]<				
Total Phenols	0.1 mg/L						
P (Total)	0.05 mg/L						
Ortho-P (Dissolved)	0.05 mg/L						
TDS	2 mg/L						
TOC	1 mg/L						
TSS	2 mg/L						
TVS	2 mg/L						
Turbidity	0.1 NTU						
Total Metals							
Al	100 ug/L		1000				
As	1 ug/L	32	50				
Cd	0.25 ug/L	4	5				
Cr	0.5 ug/L		50				
Cu	0.5 ug/L	12					
Fe	100 ug/L						
Pb	0.5 ug/L	8					
Ni	1 ug/L	20	100				
Se	1 ug/L	60	50				
Ag	0.25 ug/L	2.8					
Zn	1 ug/L	80					
Dissolved Metals							
Al	100 ug/L						
As	1 ug/L					150	36
Cd	0.25 ug/L					1.3	9.3
Cr	0.5 ug/L						
Cu	0.5 ug/L					5	3.1
Fe	100 ug/L						
Pb	0.5 ug/L					1.2	8.1
Ni	1 ug/L					29	8.2
Se	1 ug/L					5	71
Ag	0.25 ug/L					1.1	1.9
Zn	1 ug/L					66	81

Table 9.2. Summary of Available Benchmarks and Guidelines used to Evaluate Quality of Wet and Dry Season Discharges from the Mass Emission Sites. (continued)

Class Constituent	Long Beach 2004 Minimum Level	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater CMC	California Fish and Game Saltwater CMC	California Toxics Rule Freshwater CCC	California Toxics Rule Saltwater CCC
Bacteria							
Total Coliform	20 mpn/100ml	10,000	10,000				
Enterococcus	20 mpn/100ml		104				
Fecal Coliform	20 mpn/100ml	400	400				
Ratio of Fecal to Total Coliform	20 mpn/100ml		FC/TC>0.1 & TC>1000				
PCBs							
Aroclor 1016	0.5 ug/L						
Aroclor 1221	0.5 ug/L						
Aroclor 1232	0.5 ug/L						
Aroclor 1242	0.5 ug/L						
Aroclor 1248	0.5 ug/L						
Aroclor 1254	0.5 ug/L						
Aroclor 1260	0.5 ug/L						
Total PCB's	0.5 ug/L						
Organophosphates							
Atrazine	2 ug/L		3				
Chlorpyrifos	0.05 ug/L			0.02	0.02		
Cyanazine	2 ug/L						
Diazinon	0.01 ug/L			0.08			
Malathion	1 ug/L						
Prometryn	2 ug/L						
Simazine	2 ug/L		4				
Chlorinated Pesticides							
4,4'-DDD	0.05 ug/L						
4,4'-DDE	0.05 ug/L						
4,4'-DDT	0.01 ug/L					0.001	0.001
Aldrin	0.005 ug/L	0.000022				3	1.3
alpha-BHC	0.01 ug/L						
alpha-Chlordane	0.1 ug/L						
beta-BHC	0.005 ug/L						
Chlordane	0.1 ug/L						
delta-BHC	0.005 ug/L						
Dieldrin	0.01 ug/L	0.00004				0.056	0.0019
alpha-Endosulfan	0.02 ug/L					0.056	0.0087
beta-Endosulfan	0.01 ug/L					0.056	0.0087
Endosulfan sulfate	0.05 ug/L						
Endrin	0.01 ug/L	0.004	2			0.036	0.023
Endrin Aldehyde	0.01 ug/L						
Endrin ketone	0.01 ug/L						
gamma-BHC	0.02 ug/L					0.95	0.16
gamma-Chlordane	0.1 ug/L						
Heptachlor	0.01 ug/L	0.00005	0.01			0.0038	0.0036
Heptachlor epoxide	0.01 ug/L	0.00002	0.01			0.0038	0.0036
Methoxychlor	0.05 ug/L						
Toxaphene	0.5 ug/L	0.00021	2			0.0002	0.0002

Notes to Table 9.2:

General

- Minimum Level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific method. analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.
- Criteria continuous concentration (CCC) equals the highest concentration of pollutant to which aquatic life can be exposed for an extended period of time without deleterious effects.
- Criteria maximum concentration (CMC) equals the highest concentration of pollutant to which aquatic life can be exposed for a short period of time with deleterious effects.

California Toxics Rule

- CTR freshwater dissolved metals are hardness dependant. The values listed here are computed for a hardness of 50 mg/L.
- CTR freshwater dissolved cadmium and lead conversion coefficients for total to dissolved are also hardness dependent.
- CTR freshwater and saltwater dissolved metal criteria are "CCC" except for Silver which are "CMC".
- CTR freshwater and saltwater organics are "CCC" except for aldrin and gamma-BHC which are "CMC".

Ocean Plan and LA Basin Plan

- Bacteria are instantaneous or single sample criteria.

California Fish and Game

- All values are "CMC" criteria. CMCs are considered acute criteria.

Table 9.3. Comparison of Stormwater Quality Measurements from Bouton Creek with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	4	3		0				
NH3-N	4	4	0					
TKN	4	4						
NO3-N (Nitrate)	4	4						
NO2-N (Nitrite)	4	0						
Oil & Grease	4	1						
pH	4	4		0				
Total Phenols	4	0						
P (Total)	4	4						
Ortho-P (Dissolved)	4	4						
TDS	4	4						
TOC	4	4						
TSS	5	5						
TVS	4	2						
Turbidity	4	4						
Total Metals								
Al	4	4		3				
As	4	4	0	0				
Cd	4	3	0	0				
Cr	4	4		2				
Cu	4	4	4					
Fe	4	4						
Pb	4	4	4					
Ni	4	4	0	0				
Se	4	1	0	0				
Ag	4	0	0					
Zn	4	4	4					
Dissolved Metals								
Al	4	1						
As	4	3					0	0
Cd	4	0					0	0
Cr	4	4						
Cu	4	4					3	4
Fe	4	4						
Pb	4	4					2	0
Ni	4	4					0	0
Se	4	0					0	0
Ag	4	0					0	0
Zn	4	4					2	0

Table 9.3. Comparison of Stormwater Water Quality Measurements from Bouton Creek with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	4	4	3	3				
Enterococcus	4	4		4				
Fecal Coliform	4	4	3	3				
Ratio of Fecal to Total Coliform	4	4		2				
PCBs								
Aroclor 1016	4	0						
Aroclor 1221	4	0						
Aroclor 1232	4	0						
Aroclor 1242	4	0						
Aroclor 1248	4	0						
Aroclor 1254	4	0						
Aroclor 1260	4	0						
Total PCB's	4	0						
Organophosphates								
Atrazine	4	0		0				
Chlorpyrifos	4	0			0	0		
Cyanazine	4	0						
Diazinon	4	0			0			
Malathion	4	0						
Prometryn	4	0						
Simazine	4	2		1				
Chlorinated Pesticides								
4,4'-DDD	4	0						
4,4'-DDE	4	1						
4,4'-DDT	4	0					0	0
Aldrin	4	0	0				0	0
alpha-BHC	4	0						
alpha-Chlordane	4	0						
beta-BHC	4	0						
Chlordane	4	0						
delta-BHC	4	0						
Dieldrin	4	1	1				0	1
alpha-Endosulfan	4	0					0	0
beta-Endosulfan	4	0					0	0
Endosulfan sulfate	4	0						
Endrin	4	0	0	0			0	0
Endrin Aldehyde	4	0						
Endrin ketone	4	0						
gamma-BHC	4	1					0	0
gamma-Chlordane	4	0						
Heptachlor	4	0	0	0			0	0
Heptachlor epoxide	4	0	0	0			0	0
Methoxychlor	4	0						
Toxaphene	4	0	0	0			0	0

Table 9.4. Comparison of Stormwater Water Quality Measurements from Belmont Pump Station with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	4	3		0				
NH3-N	4	4	0					
TKN	4	4						
NO3-N (Nitrate)	4	4						
NO2-N (Nitrite)	4	0						
Oil & Grease	4	1						
pH	4	4		0				
Total Phenols	4	0						
P (Total)	4	4						
Ortho-P (Dissolved)	4	4						
TDS	4	4						
TOC	4	4						
TSS	4	5						
TVS	4	2						
Turbidity	4	4						
Total Metals								
Al	4	4		3				
As	4	4	0	0				
Cd	4	4	0	0				
Cr	4	4		0				
Cu	4	4	4					
Fe	4	4						
Pb	4	4	4					
Ni	4	4	0	0				
Se	4	1	0	0				
Ag	4	0	0					
Zn	4	4	4					
Dissolved Metals								
Al	4	0						
As	4	4					0	0
Cd	4	0					0	0
Cr	4	4						
Cu	4	4					2	4
Fe	4	4						
Pb	4	4					0	0
Ni	4	3					0	0
Se	4	0					0	0
Ag	4	0					0	0
Zn	4	4					1	0

Table 9.4. Comparison of Stormwater Water Quality Measurements from Belmont Pump Station with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	4	4	4	4				
Enterococcus	4	4		4				
Fecal Coliform	4	4	4	4				
Ratio of Fecal to Total Coliform	4	4		4				
PCBs								
Aroclor 1016	4	0						
Aroclor 1221	4	0						
Aroclor 1232	4	0						
Aroclor 1242	4	0						
Aroclor 1248	4	0						
Aroclor 1254	4	0						
Aroclor 1260	4	0						
Total PCB's	4	0						
Organophosphates								
Atrazine	4	0		0				
Chlorpyrifos	4	0			0	0		
Cyanazine	4	0						
Diazinon	4	0			0			
Malathion	4	0						
Prometryn	4	0						
Simazine	4	0		0				
Chlorinated Pesticides								
4,4'-DDD	4	0						
4,4'-DDE	4	1						
4,4'-DDT	4	2					2	2
Aldrin	4	0	0				0	0
alpha-BHC	4	0						
alpha-Chlordane	4	1						
beta-BHC	4	0						
Chlordane	4	1						
delta-BHC	4	0						
Dieldrin	4	0	0				0	0
alpha-Endosulfan	4	0					0	0
beta-Endosulfan	4	0					0	0
Endosulfan sulfate	4	0						
Endrin	4	0	0	0			0	0
Endrin Aldehyde	4	0						
Endrin ketone	4	0						
gamma-BHC	4	0					0	0
gamma-Chlordane	4	1						
Heptachlor	4	0	0	0			0	0
Heptachlor epoxide	4	0	0	0			0	0
Methoxychlor	4	0						
Toxaphene	4	0	0	0			0	0

Table 9.5. Comparison of Stormwater Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	4	3		0				
NH3-N	4	4	0					
TKN	4	4						
NO3-N (Nitrate)	4	4						
NO2-N (Nitrite)	4	0						
Oil & Grease	4	1						
pH	3	3		0				
Total Phenols	4	0						
P (Total)	4	4						
Ortho-P (Dissolved)	4	4						
Specific Conductance	4	4						
TDS	4	4						
TOC	4	4						
TSS	4	5						
TVS	4	2						
Turbidity	4	4						
Total Metals								
Al	4	4		3				
As	4	4	0	0				
Cd	4	4	0	0				
Cr	4	4		0				
Cu	4	4	4					
Fe	4	4						
Pb	4	4	4					
Ni	4	4	0	0				
Se	4	1	0	0				
Ag	4	1	0					
Zn	4	4	4					
Dissolved Metals								
Al	4	1						
As	4	4					0	0
Cd	4	0					0	0
Cr	4	4						
Cu	4	4					4	4
Fe	4	4						
Pb	4	3					2	0
Ni	4	2					0	0
Se	4	0					0	0
Ag	4	0					0	0
Zn	4	4					4	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 Stormwater Water Quality Measurements from Los Cerritos Channel with Guidelines and Standards. . (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	4	4	4	4				
Enterococcus	4	4		4				
Fecal Coliform	4	4	4	4				
Ratio of Fecal to Total Coliform	4	4		4				
PCBs								
Aroclor 1016	4	0						
Aroclor 1221	4	0						
Aroclor 1232	4	0						
Aroclor 1242	4	0						
Aroclor 1248	4	0						
Aroclor 1254	4	0						
Aroclor 1260	4	0						
Total PCB's	4	0						
Organophosphates								
Atrazine	4	0		0				
Chlorpyrifos	4	0			0	0		
Cyanazine	4	0						
Diazinon	4	1			0			
Malathion	4	0						
Prometryn	4	0						
Simazine	4	3		1				
Chlorinated Pesticides								
4,4'-DDD	4	0						
4,4'-DDE	4	2						
4,4'-DDT	4	1					1	1
Aldrin	4	0	0				0	0
alpha-BHC	4	0						
alpha-Chlordane	4	1						
beta-BHC	4	0						
Chlordane	4	1						
delta-BHC	4	0						
Dieldrin	4	2	2				0	2
alpha-Endosulfan	4	0					0	0
beta-Endosulfan	4	0					0	0
Endosulfan sulfate	4	0						
Endrin	4	0	0	0			0	0
Endrin Aldehyde	4	0						
Endrin ketone	4	0						
gamma-BHC	4	1					0	0
gamma-Chlordane	4	1						
Heptachlor	4	0	0	0			0	0
Heptachlor epoxide	4	0	0	0			0	0
Methoxychlor	4	0						
Toxaphene	4	0	0	0			0	0

Table 9.6. Comparison of Stormwater Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	3	0		0				
NH3-N	3	3	1					
TKN	3	3						
NO3-N (Nitrate)	3	3						
NO2-N (Nitrite)	3	0						
Oil & Grease	3	1						
pH	3	3		1				
Total Phenols	3	0						
P (Total)	3	3						
Ortho-P (Dissolved)	3	3						
Specific Conductance	3	3						
TDS	3	3						
TOC	3	3						
TSS	3	3						
TVS	3	2						
Turbidity	3	3						
Total Metals								
Al	3	3		2				
As	3	3	0	0				
Cd	3	2	0	0				
Cr	3	3		0				
Cu	3	3	2					
Fe	3	3						
Pb	3	3	1					
Ni	3	3	0	0				
Se	3	0	0	0				
Ag	3	0	0					
Zn	3	3	1					
Dissolved Metals								
Al	3	1						
As	3	3					0	0
Cd	3	1					0	1
Cr	3	3						
Cu	3	3					2	2
Fe	3	3						
Pb	3	3					2	0
Ni	3	2					0	0
Se	3	0					0	0
Ag	3	0					0	0
Zn	3	3					1	0

Table 9.6. Comparison of Stormwater Water Quality Measurements from Dominguez Pump Station with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	3	3	3	3				
Enterococcus	3	3		3				
Fecal Coliform	3	3	3	3				
Ratio of Fecal to Total Coliform	3	3		2				
PCBs								
Aroclor 1016	3	0						
Aroclor 1221	3	0						
Aroclor 1232	3	0						
Aroclor 1242	3	0						
Aroclor 1248	3	0						
Aroclor 1254	3	0						
Aroclor 1260	3	0						
Total PCB's	3	0						
Organophosphates								
Atrazine	3	0		0				
Chlorpyrifos	3	0			0	0		
Cyanazine	3	0						
Diazinon	3	0			0			
Malathion	3	0						
Prometryn	3	0						
Simazine	3	2		1				
Chlorinated Pesticides								
4,4'-DDD	3	0						
4,4'-DDE	3	0						
4,4'-DDT	3	0					0	0
Aldrin	3	0	0				0	0
alpha-BHC	3	0						
alpha-Chlordane	3	0						
beta-BHC	3	1						
Chlordane	3	0						
delta-BHC	3	0						
Dieldrin	3	0	0				0	0
alpha-Endosulfan	3	0					0	0
beta-Endosulfan	3	0					0	0
Endosulfan sulfate	3	0						
Endrin	3	0	0	0			0	0
Endrin Aldehyde	3	0						
Endrin ketone	3	0						
gamma-BHC	3	0					0	0
gamma-Chlordane	3	0						
Heptachlor	3	0	0	0			0	0
Heptachlor epoxide	3	0	0	0			0	0
Methoxychlor	3	0						
Toxaphene	3	0	0	0			0	0

Table 9.7. Comparison of Dry Weather Water Quality Measurements from Bouton Creek with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	2	1		0				
NH3-N	2	1	0					
TKN	2	2						
NO3-N (Nitrate)	2	0						
NO2-N (Nitrite)	2	0						
Oil & Grease	2	0						
pH	1	1		0				
Total Phenols	2	0						
P (Total)	2	2						
Ortho-P (Dissolved)	2	1						
Specific Conductance	2	2						
TDS	2	2						
TOC	2	2						
TSS	2	0						
TVS	2	2						
Turbidity	2	2						
Total Metals								
Al	2	0		0				
As	2	2	0	0				
Cd	2	0	0	0				
Cr	2	2		0				
Cu	2	2	0					
Fe	2	2						
Pb	2	2	0					
Ni	2	2	0	0				
Se	2	0	0	0				
Ag	2	1	0					
Zn	2	2	0					
Dissolved Metals								
Al	2	0						
As	2	1					0	0
Cd	2	0					0	0
Cr	2	2						
Cu	2	2					0	2
Fe	2	1						
Pb	2	2					0	0
Ni	2	1					0	0
Se	2	0					0	0
Ag	2	1					0	0
Zn	2	2					0	0

Table 9.7. Comparison of Dry Weather Water Quality Measurements from Bouton Creek with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	2	2	0	0				
Enterococcus	2	2		1				
Fecal Coliform	2	2	0	0				
Ratio of Fecal to Total Coliform	2	2		1				
PCBs								
Aroclor 1016	2	0						
Aroclor 1221	2	0						
Aroclor 1232	2	0						
Aroclor 1242	2	0						
Aroclor 1248	2	0						
Aroclor 1254	2	0						
Aroclor 1260	2	0						
Total PCB's	2	0						
Organophosphates								
Atrazine	2	0		0				
Chlorpyrifos	2	0			0	0		
Cyanazine	2	0						
Diazinon	2	0			0			
Malathion	2	0						
Prometryn	2	0						
Simazine	2	0		0				
Chlorinated Pesticides								
4,4'-DDD	2	0						
4,4'-DDE	2	0						
4,4'-DDT	2	0					0	0
Aldrin	2	0	0				0	0
alpha-BHC	2	0						
alpha-Chlordane	2	0						
beta-BHC	2	0						
Chlordane	2	0						
delta-BHC	2	0						
Dieldrin	2	0	0				0	0
alpha-Endosulfan	2	0					0	0
beta-Endosulfan	2	0					0	0
Endosulfan sulfate	2	0						
Endrin	2	0	0	0			0	0
Endrin Aldehyde	2	0						
Endrin ketone	2	0						
gamma-BHC	2	0					0	0
gamma-Chlordane	2	0						
Heptachlor	2	0	0	0			0	0
Heptachlor epoxide	2	0	0	0			0	0
Methoxychlor	2	0						
Toxaphene	2	0	0	0			0	0

Table 9.8. Comparison of Dry Weather Water Quality Measurements from Belmont Pump Stations with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	2	1		0				
NH3-N	2	1	0					
TKN	2	2						
NO3-N (Nitrate)	2	1						
NO2-N (Nitrite)	2	0						
Oil & Grease	2	0						
pH	1	1		0				
Total Phenols	2	0						
P (Total)	2	2						
Ortho-P (Dissolved)	2	2						
Specific Conductance	2	2						
TDS	2	2						
TOC	2	2						
TSS	2	0						
TVS	2	2						
Turbidity	2	2						
Total Metals								
Al	2	1		0				
As	2	2	0	0				
Cd	2	0	0	0				
Cr	2	2		0				
Cu	2	2	0					
Fe	2	2						
Pb	2	2	0					
Ni	2	2	0	0				
Se	2	0	0	0				
Ag	2	0	0					
Zn	2	2	0					
Dissolved Metals								
Al	2	0						
As	2	2					0	0
Cd	2	0					0	0
Cr	2	2						
Cu	2	2					0	2
Fe	2	0						
Pb	2	0					0	0
Ni	2	2					0	0
Se	2	0					0	0
Ag	2	1					0	0
Zn	2	2					0	0

Table 9.8. Comparison of Dry Weather Water Quality Measurements from Belmont Pump Stations with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	2	2	2	2				
Enterococcus	2	2		2				
Fecal Coliform	2	2	2	2				
Ratio of Fecal to Total Coliform	2	2		1				
PCBs								
Aroclor 1016	2	0						
Aroclor 1221	2	0						
Aroclor 1232	2	0						
Aroclor 1242	2	0						
Aroclor 1248	2	0						
Aroclor 1254	2	0						
Aroclor 1260	2	0						
Total PCB's	2	0						
Organophosphates								
Atrazine	2	0		0				
Chlorpyrifos	2	0			0	0		
Cyanazine	2	0						
Diazinon	2	1			1			
Malathion	2	0						
Prometryn	2	0						
Simazine	2	0		0				
Chlorinated Pesticides								
4,4'-DDD	2	0						
4,4'-DDE	2	0						
4,4'-DDT	2	0					0	0
Aldrin	2	0	0				0	0
alpha-BHC	2	0						
alpha-Chlordane	2	0						
beta-BHC	2	0						
Chlordane	2	0						
delta-BHC	2	0						
Dieldrin	2	0	0				0	0
alpha-Endosulfan	2	0					0	0
beta-Endosulfan	2	0					0	0
Endosulfan sulfate	2	0						
Endrin	2	0	0	0			0	0
Endrin Aldehyde	2	0						
Endrin ketone	2	0						
gamma-BHC	2	0					0	0
gamma-Chlordane	2	0						
Heptachlor	2	0	0	0			0	0
Heptachlor epoxide	2	0	0	0			0	0
Methoxychlor	2	0						
Toxaphene	2	0	0	0			0	0

Table 9.9. Comparison of Dry Weather Water Quality Measurements from Los Cerritos Creek with Guidelines and Standards.

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Conventionals								
MBAS (Surfactants)	2	1		0				
NH3-N	2	0	0					
TKN	2	2						
NO3-N (Nitrate)	2	0						
NO2-N (Nitrite)	2	0						
Oil & Grease	2	0						
pH	1	1		0				
Total Phenols	2	0						
P (Total)	2	2						
Ortho-P (Dissolved)	2	0						
TDS	2	2						
TOC	2	2						
TSS	2	2						
TVS	2	2						
Turbidity	2	2						
Total Metals								
Al	2	2		1				
As	2	2	0	0				
Cd	2	2	0	0				
Cr	2	2		0				
Cu	2	2	2					
Fe	2	2						
Pb	2	2	1					
Ni	2	2	0	0				
Se	2	0	0	0				
Ag	2	0	0					
Zn	2	2	2					
Dissolved Metals								
Al	2	0						
As	2	2					0	0
Cd	2	0					0	0
Cr	2	1						
Cu	2	2					0	2
Fe	2	1						
Pb	2	2					0	0
Ni	2	1					0	0
Se	2	0					0	0
Ag	2	1					0	0
Zn	2	2					0	0

Table 9.9. Comparison of Dry Weather Water Quality Measurements from Los Cerritos Creek with Guidelines and Standards. (continued)

Class Constituent	No. of Samples	No. of Detects	Ocean Plan	LA Basin Plan	California Fish and Game Freshwater	California Fish and Game Saltwater	California Toxics Rule Freshwater	California Toxics Rule Saltwater
Bacteria								
Total Coliform	2	2	2	2				
Enterococcus	2	2		2				
Fecal Coliform	2	2	2	2				
Ratio of Fecal to Total Coliform	2	2		0				
PCBs								
Aroclor 1016	2	0						
Aroclor 1221	2	0						
Aroclor 1232	2	0						
Aroclor 1242	2	0						
Aroclor 1248	2	0						
Aroclor 1254	2	0						
Aroclor 1260	2	0						
Total PCB's	2	0						
Organophosphates								
Atrazine	2	0		0				
Chlorpyrifos	2	0			0	0		
Cyanazine	2	0						
Diazinon	2	1			0			
Malathion	2	0						
Prometryn	2	0						
Simazine	2	0		0				
Chlorinated Pesticides								
4,4'-DDD	2	0						
4,4'-DDE	2	0						
4,4'-DDT	2	0					0	0
Aldrin	2	0	0				0	0
alpha-BHC	2	0						
alpha-Chlordane	2	0						
beta-BHC	2	0						
Chlordane	2	0						
delta-BHC	2	0						
Dieldrin	2	0	0				0	0
alpha-Endosulfan	2	0					0	0
beta-Endosulfan	2	0					0	0
Endosulfan sulfate	2	0						
Endrin	2	0	0	0			0	0
Endrin Aldehyde	2	0						
Endrin ketone	2	0						
gamma-BHC	2	0					0	0
gamma-Chlordane	2	0						
Heptachlor	2	0	0	0			0	0
Heptachlor epoxide	2	0	0	0			0	0
Methoxychlor	2	0						
Toxaphene	2	0	0	0			0	0

Table 9.10. Regression equations for Key Total Metals versus TSS.

	Belmont Pump Station				Bouton Creek			
Metals	**m**	**b**	**r**	**r^2**	**m**	**b**	**r**	**r^2**
Aluminum (Al)	12.831	420.16	0.6277	0.3941	7.2399	844.2	0.4636	0.215
Copper (Cu)	0.8936	12.985	0.7469	0.558	0.1283	13.018	0.8098	0.6559
Lead (Pb)	0.3314	5.1537	0.8734	0.7629	0.1933	4.34	0.9284	0.862
Zinc (Zn)	2.9279	25.185	0.9317	0.8682	1.4149	52.988	0.7512	0.5644

	Los Cerritos Channel				Dominguez Gap			
Metals	**m**	**b**	**r**	**r^2**	**m**	**b**	**r**	**r^2**
Aluminum (Al)	21.46	-793.97	0.7667	0.5879	44.047	-77.131	0.7565	0.5724
Copper (Cu)	0.1299	11.905	0.8355	0.6981	0.0972	8.7188	0.4164	0.1734
Lead (Pb)	0.227	-2.71	0.8964	0.8036	0.2082	2.7057	0.9671	0.9354
Zinc (Zn)	1.3127	123.62	0.6318	0.3992	1.2481	23.192	0.823	0.6774

Notes:

m=slope
b=intercept
r=Pearson correlation coefficient
r^2=explained variance

Table 9.11. 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	2003-2004	SF	15*	53	<2-32
Long Beach	2003-2004	DS	11	9	1-2
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

* includes 4 plume samples from Alamitos Bay

Table 9.12. 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		Sea Urchin	
		Primary Category[a]	Secondary Category[a]	Primary Category	Secondary Category
Wet Weather Event:					
2/20/04	Cerritos	--	--	Metal	NPO
Dry Weather Events:					
9/10/03	Bouton	NPO	Particle (?)	--	--
5/5/04	Cerritos	NPO			

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

Table 9.13. Nonparametric Spearman rank correlation coefficients (*r_s*) showing the Relationship among Ten Chemical Concentrations and Toxic Units for either Acute or Chronic Toxicity Tests 2003 and 2004 Wet Weather. Toxic units are based on either the median response (EC50 or LC50, acute TUa) or the NOEC (chronic TUc) concentration. Values in bold text are statistically significant at $p \leq 0.05$ and indicate that the paired rank series approach the same positive or negative order and are significantly different from an order that is random. For all constituents n=46.

		Water Flea	
	Sea Urchin Fertilization	**Survival**	**Reproduction**
Constituent	**TUa**	**TUa**	**TUc**
Conventionals			
TSS	0.160	**0.505**	**0.515**
TDS	0.210	0.224	0.129
TOC	**0.465**	**0.478**	**0.390**
Dissolved Metals			
Cadmium	0.275	**0.435**	**0.341**
Chromium	0.156	-0.158	-0.071
Copper	**0.495**	**0.424**	0.245
Lead	**0.300**	**0.380**	**0.369**
Nickel	**0.406**	**0.475**	**0.435**
Zinc	**0.450**	**0.480**	**0.424**
Organophosphate Pesticides			
Diazinon	0.074	**0.433**	**0.387**

***In bold**, significant values at the level of significance alpha=0.050 (two-tailed test).*

Notes:
If the data were '<' (U qualifiers) than the MDL, one half of the MDL was used as a substitution method for these left censored data. If the data qualifier was J or UJ, indicating that the value reported is below the MDL and an estimate, the reported value was used and not change. Fortunately no right censored data was encountered.

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 53 wet weather monitoring events have been conducted at the four Long Beach mass emission stations, along with 40 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.

A number of conclusions can be made based upon both the results of the 2003/2004 Monitoring Effort and the cumulative results of the first five years of the City of Long Beach Stormwater Monitoring Program. These include:

- Exceedances of available benchmark values based upon receiving water, ocean water, drinking water or other available comparisons are common for several metals (copper, lead and zinc). Exceedances of benchmark values are less common for diazinon and chlorpyrifos (organophosphate pesticides). Over that past two years diazinon and chlorpyrifos have been detected less frequently and at generally lower concentrations.

- With the exception of a few measurements, indicator bacterial counts tend to exceed Basin Plan single sample criteria during storm events. During dry weather investigations, indicator bacteria were typically comparable to levels reported in association with wet weather events. Total and fecal coliform concentrations in Bouton Creek are often an exception. Concentrations of total and fecal coliform are often below Basin Plan single sample criteria during dry weather discharges.

- Concentrations of dissolved cadmium, copper, nickel and lead are relatively comparable during both wet and dry weather periods compared to concentrations of the total recoverable forms. 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. Although the concentrations of many dissolved metals remain relatively consistent between storm events and dry weather flows, higher levels of hardness during dry weather conditions tend to prevent frequent exceedances of freshwater CTR water quality criteria.

- Stormwater quality of discharges from the Dominguez Gap Pump Station tend to have consistent characteristics. 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.

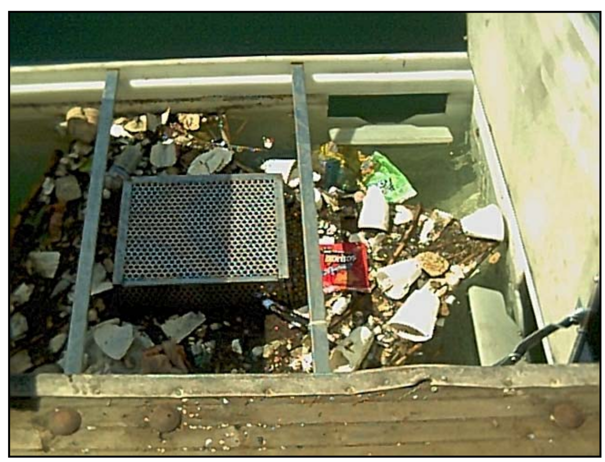
- Toxicity Identification Evaluations (TIEs) typically implicate organophosphate pesticides (diazinon and chlorpyrifos) in causing toxicity to the freshwater water flea (freshwater test). This year was an exception both in the fact that few TIEs were conducted due to lower incidence of toxicity and the fact that nonpolar organics (other than OP pesticides) and cationic metals were implicated as the most likely source of toxicity. Diazinon, the most common cause of toxicity to water fleas, was not present in

- Dissolved metals, primarily zinc and perhaps copper, have consistently been implicated in the toxicity to the purple sea urchin (marine test).

- Regression analysis demonstrated strong relationships between total recoverable metals and TSS. The explained variance was highest for total recoverable lead and TSS.

- The two surveys conducted in receiving waters have shown no evidence of wide-spread toxicity in stormwater plumes within Alamitos Bay. The initial survey was conducted in association with a brief, intense storm that 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) but no toxicity was noted. This year's survey was conducted during an event that yielded 0.67 to 0.77 inches of rain. Evidence of the plume was largely limited to the mouth of Los Cerritos Channel as it entered Marine Stadium. Although a toxicity gradient was identified, toxicity was still very low in comparison to other studies. The highest toxicity was observed in a sample containing approximately 68% stormwater. This sample had an EC_{50} of 44.7% (TU=2.2) and a NOEC of 25%. Studies in Santa Monica Bay and San Diego Bay have shown substantial toxicity in samples containing as little as 10 to 25% stormwater.

CDS Unit at 20th and Walnut being installed



Trash skimmer on the waters surface at Rainbow Harbor (Arkinstall/PRM)

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Appendix A
Quality Assurance/Quality Control Assessment

1.0 INTRODUCTION

This appendix addresses Quality Assurance and Quality Control (QA/QC) activities associated with the field sampling and laboratory analysis for the City of Long Beach 2003/2004 stormwater and dry weather monitoring programs. The field QA/QC samples were used to evaluate potential contamination and sampling error introduced prior to submittal to the analytical laboratories. Laboratory QA/QC provides information to assess potential laboratory contamination, analytical precision and accuracy and representativeness.

1.1 Precision

Precision provides an assessment of mutual agreement between repeated measurements. These measures may apply to blind field duplicates (FD), laboratory duplicates (DUP), matrix spike duplicates (MSD) and laboratory control sample duplicates (LCSD). Monitoring of precision through the process allows for the evaluation of the consistency of field sampling and laboratory analysis.

The Relative Percent Difference (RPD) is used to evaluate duplicate samples. The RPD is calculated as:

$$RPD = 100 * \left(\frac{|x_1 - x_2|}{\frac{1}{2} * (x_1 + x_2)} \right)$$

where:
x_1 = Concentration of sample 1 of the pair
x_2 = Concentration of sample 2 of the pair

1.2 Accuracy

An assessment of the accuracy of measurements is based on determining the difference between measured values and the true value and is applied to Matrix Spikes (MS), Laboratory Control Samples (LCS) and Standard Reference Material (SRM).

In general, Percent Recovery is calculated as:

$$\%Recovery = 100 * \left(\frac{Measured\_Value}{True\_Value} \right)$$

Matrix Spike recoveries take into account the concentration of the source sample.

$$\%Recovery(MS) = 100 * \left(\frac{Measured\_Value - Sample\_Value}{True\_Value} \right)$$

1.3 Representativeness, Comparability and Completeness

Representativeness is the degree to which data accurately and precisely represents the natural environment.

Comparability is the measure of confidence with which one dataset can be compared to another. The use of standardized methods of chemical analysis and field sampling and processing are ways of insuring comparability. The implementation of thorough QA/QC methods such as field duplicates and laboratory QC is essential.

Completeness is a measure of the percentage of the data judged valid after comparison with specific validation criteria. This includes data lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Implementation of standardized Chain-of-Custody procedures which track samples as they are transferred between custodians is one method of maintaining a high level of completeness.

A high level of completeness is essential to all phases of this study due to the limited number of samples. Of course, the overall goal is to obtain completeness of one hundred percent however a realistic data quality objective of 95% will insure an adequate level of data return.

Close adherence to 'Standard Operating Procedures' (SOP's) assures that the resulting data is representative, complete and comparable. The results are further assessed with a thorough validation process.

2.0 DATA QUALITY ASSESSMENT PROCESS

2.1 Verification

Data verification was the first step in the data quality assessment process. The verification process generally included checks to verify compliance with the sampling plan and with the QA/QC practices. Information contained in the laboratory reports was verified to be complete, correct and free of inconsistencies.

2.2 Validation

Data validation was performed in accordance with the National Functional Guidelines for Organic Review (EPA 540-R-99-008, October 1999), National Functional Guidelines for Low Concentration Organic Review (EPA 540-R-00-006, June 2001) and Inorganic Data Review (EPA.540-R-01-008, July 2002). All laboratory and field data generated under the program were reviewed for accuracy, precision and completeness. The review included:

- Data package completeness
- Chain-of-Custody
- Use of specified analytical methods
- Holding times for extraction and analysis
- Blanking results (equipment, bottle, filter, and method blanks) relative to the reporting limits and sample concentrations
- Field duplicate frequency and precision

- Laboratory duplicates, frequency and precision
- Laboratory Control Sample frequency, compounds and recoveries
- Surrogate standard frequency, compounds and recoveries
- Matrix spike frequency, compounds and recoveries
- Matrix spike duplicate frequency and relative percent differences
- Reporting limits and dilution factors

Completeness was assessed by comparing the Sampling and Analysis Plan to the lab reports. For the 2003/2004 storm season no samples were lost due to breakage or spoilage. Eighty-five individual analyses were requested for eight sampling events and five locations for a total of 1855 requested analyses. Only one pH field sample was missed, and seven TVS samples were rejected due to the lab using the wrong analysis method. This gives a 99.6 completeness percentage for the 2003/2004 project.

2.3 Data Qualifiers

Where appropriate, data qualifiers were associated with the results using the following standard notations from the EPA guidance documents

U	The compound was analyzed for but was not detected. The associated value is the sample reporting limit
UJ	The compound was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise
J-	The associated value is a low estimate
J	The associate value is an estimated quantity
J+	The associated value is a high estimate
R	The data are unusable. The analyte may or may not be present

3.0 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

3.1 Equipment Blanks

The results of field-related blanking activities are summarized in Table A.1. Blanks were analyzed to assess potential contamination from monitoring site intake hoses, the sub-sampling process, composite bottles and laboratory sample containers. Equipment was tested for Total Metals (Al, As, Cd, Cr. Cu, Pb, Ni, Ag, Zn) and four conventional contaminates (COD, TOC, Nitrate as N, and Total Phosphorus).

In general, if a contaminate is found in an equipment blanking study, all associated samples that have a concentration less than five times the blank hit are qualified with a 'J+' flag. Samples with relatively high concentrations are unaffected. In the blanking studies associated with the Long Beach 2003/2004 storm season no samples were qualified as a result of an equipment blanking hit.

3.1.1 Intake Hose Blanks

An intake hose is installed at each station and leads from the sample basin to the sampler. One blank analysis was performed on the set of hoses and no contaminates were detected.

3.1.2 Peristaltic Sampling Hose

Peristaltic sampling hose is the section of hose used with each station's sampler. One blank analysis was performed on the complete set of hoses and no contaminates were detected.

3.1.3 Sub-sampling Hose Blanks

Sub-sampling hoses consist of a center section of peristaltic silicon hose and two attached lengths of Teflon hose. One set of sub-sampling hoses was blanked for this study and no constituents were detected.

3.1.4 Composite Bottle Blanks

Seven batches of 20-L bottles were cleaned for the 2003/2004 storm season. There was a zinc hit of 1.4 ug/L detected in one bottle cleaned on 27-Aug-03. The associated bottles and their associated samples were identified and checked against the validation criteria. Since all associated samples had relatively large zinc values, more than five times the blank hit, the sample results were not qualified.

3.1.5 Laboratory Container Blanks

A representative bottle in the set of laboratory containers used during the 2003/2004 storm season was analyzed for contaminates. No constituents were detected.

3.2 Field Duplicates

The results of field duplicates are summarized in Tables A.2 for storm events and Table A.3 for dry weather events. Field duplicates were not collected for the last storm event at Dominguez Gap because of low sample volume.

Strict criteria are not established for the evaluation of field duplicates. Rather, samples are evaluated based upon best professional judgment. Relative percent differences were highlighted when greater than 50% and were given closer scrutiny. As a general rule, values are considered to be of concern if above 50% provided both values are greater than five times the reporting limit. In cases where one or both values are less than fives times the reporting limit then those values are considered to be of potential concern if the difference between the two values are greater than twice the reporting limit.

3.2.1 Grabs

Oil and grease and bacteria samples were collected manually as grab samples. True field duplicates were collected for these constituents. Sampling was performed sequentially maintaining a minimum period of time between each sample.

Grab Field Duplicate Locations for Long Beach 2003/2004 Project

Event	Date	Duplicated Site
Dry Weather 1	10-11-Sep-03	Bouton Creek
Storm Event 1	03-Feb-04	Los Cerritos Channel
Storm Event 2	18-Feb-04	Los Cerritos Channel
Storm Event 3	23-Feb-04	Los Cerritos Channel
Storm Event 4	26-Feb-04	Los Cerritos Channel
Dry Weather 2	05-May-04	Bouton Creek

High RPD's encountered for bacteria are typical of repeated measurements of microbial constituents in receiving waters. Out of the 18 total bacteria field duplicates 10 have RPD's less than 50%. Of the 8 remaining, both dry weather events have RPD's less than 100% as did two storm events. Three storm samples have RPD's greater than 100%. The total coliform RPD for Storm Event-1 is 116% and 164% for Storm Event 2. The fecal coliform RPD for Storm Event-2 is 177%. The total and fecal coliform samples associated with Storm Event-2 were qualified as estimates (J).

3.2.2 Composites-Sub-sampling Splits

Sub-sampling splits of the composite samples were taken at the following locations. Although not true field duplicates, these samples are assessed as field duplicates.

Composite Field Duplicate Locations for Long Beach 2003/2004 Project

Event	Date	Duplicated Site
Dry Weather 1	10-11-Sep-03	Los Cerritos Channel
Storm Event 1	03-Feb-04	Los Cerritos Channel
Storm Event 2	18-Feb-04	Belmont Pump
Storm Event 3	23-Feb-04	Belmont Pump
Storm Event 4	26-Feb-04	Los Cerritos Channel
Dry Weather 5	05-May-04	Los Cerritos Channel

Sub-sampling splits indicated that the sub-sampling process was, in most cases, able to effectively obtain representative samples from the composite containers. High variability was observed for only small number of constituents during the project year and they are shown in bold in the tables.

Total aluminum and iron have large RPD's for Dry Weather Event-1 of 75% and 130% respectively and the associated samples were qualified as estimates (J). The second dry weather event field duplicate has a large field duplicate RPD for total lead of 142%. This sample was reanalyzed by the laboratory and the results were verified. The variability is a concern. The duplicate value was compared with the TSS versus total lead regression and was found to be well outside of the normal range. Professional judgment is that the problem lies in the duplicate value and not the original and the associated sample results were not further qualified.

The RPD's from storm field duplicates are generally within range. The exceptions include fluoride and MBAS for Storm Event-1, both having an RPD of 77%. The original and duplicate values are small relative to the detection limit and so not a concern. TSS for Storm Event-2 is 73% and the associated samples were qualified as estimates (J). Results for Storm Event-3 are all within the project quality objectives. Total phosphorus for Storm Event-4 is 67% but the values and their differences are small relative to the detection limit and of no concern. The RPD for total aluminum and chromium for Storm Event-4 are 63%, and 58% respectively and their associated samples were qualified as estimates (J).

4.0 LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

This section addresses procedures and errors associated with laboratory handling and analyses. In most cases, the QA/QC data has been summarized for each type of assessment.

4.1 Reporting Limits

Achieved reporting limits were compared with target reporting limits for each laboratory report. The following cases occurred when the analytical laboratory was unable to meet the target reporting.

There are 27 results that where closely examined to verify that the minimum level was met. A reporting limit of 0.05 ug/L was reported for diazinon during the 2003/2004 project year rather than the requested 0.01 ug/L. However, since the diazinon samples were reported down to the laboratory's Method Detection Limit (MDL) of 0.01 ug/L, the lowest calibration point was set at 0.01 ug/L, and the data were qualified as estimates (J) when detected below the reporting limit, therefore the minimum level was met. Total PCBs were reported at 0.5 ug/L rather than 0.2 for the first dry weather event. The individual Aroclors were reported correctly. Also, one nitrate and two nitrites were reported at 0.5 mg/L not at 0.1 as requested for the first dry weather event.

4.2 Holding Times

A check of the holding time from sample to lab preparation and analysis was performed for each laboratory report. The following cases occurred when the lab was unable to meet the required holding time.

Bacteria grabs were analyzed two to four hours out of the six hour holding time for the first storm event, depending on the station, and the associated samples were qualified as estimates (J).

The Los Cerritos Channel Storm Event-3 (22-Feb-04) sample was received by the lab out of the 48 hour holding time for turbidity, nitrate, nitrite, dissolved orthophosphate-P, MBAS and BOD. The associated samples were qualified as estimates (J) or (UJ) for non-detects.

4.3 Method and Filter Blanks

The laboratory Method and Filter Blank results are shown in Table A.4. Only the blank hits are listed or NA to indicate a laboratory blank was not done. Overall, the analyses for the project year were free of blank contamination. There were a few exceptions. The associated samples were checked against the blank hit and those with sample results greater than the reporting limit but less than ten times (10x) the blank hit were qualified with a J+. If the sample is non-detect or if the result is greater than 10x the blank hit no additional qualification was applied.

Blank hits in the first dry weather events were in total chromium, copper and nickel. The associated samples were examined and the chromium and nickel samples were qualified with a J+ to indicate them as high estimates. The associated copper sample values were large enough to remain unaffected by the small blank hit.

The Kjeldahl nitrogen (TKN) analysis for Storm Event-2 has a small blank hit which didn't affect the relatively large sample values. Likewise, Storm Events 3, 4 and 5 have dissolved zinc filter blank hits but in each case the associated samples have relatively large zinc values and they were not qualified.

4.4 Laboratory Duplicate Samples

To evaluate precision of laboratory analyses, replicate samples were analyzed and are reported in Table A.5. Those duplicates with an RPD greater than 20% were examined more closely and those results that professional judgment determines to be affected are qualified.

Two cases cause further qualification of the associated samples. If the RPD is greater than 20% and if both the original and duplicate sample have results greater than five times the reporting limit or if the absolute value of the difference between the sample and duplicate is greater than the reporting limit the associated samples can be qualified with (J) for detects and (UJ) for non-detects.

During the 2003/2004 project year there was one case requiring qualification of the associated field sample because of laboratory duplicate QC. The duplicate analysis associated with the total chromium batch for Storm 5 has an RPD of 25% and both the lab original and duplicate values were above the reporting limit. As per the EPA guidance document, the associated Dominguez Gap field sample value was qualified as an estimated (J) value.

4.5 Matrix Spike and Laboratory Control Samples

4.5.1 Matrix Spike/ Matrix Spike Duplicate Samples

Matrix Spike and Matrix Spike Duplicates (MS/MSD) percent recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries. Precision was evaluated by calculating the RPD of the MS/MSD recovery results. QA/QC guidelines indicate that no action need be taken on MS/MSD data alone. The data reviewer may use the MS/MSD results in conjunction with other QC criteria when determining the need for further qualification. The MS/MSD results are summarized in Table A.6

During the Long Beach 2003/2004 project year the MS/MSD recoveries were low only twice. Both dry weather events yielded dissolved silver recoveries between 60 and 70% and the corresponding sample values were qualified as estimated (J-) or (UJ) for non-detects.

4.5.2 Laboratory Control Spike/Laboratory Control Spike Duplicate Samples

Laboratory Control Spikes and their duplicates (LCS/LCSD) are solutions of known compounds and selected concentrations. Precision and accuracy are evaluated as they are for MS/MSDs with the exception that there is no source sample to subtract. The LCS/LCSD results are presented in Table A.7.

The LCS/LCDS recoveries were generally in range for the Long Beach 2003/2004 project year. Across the board oil and grease recoveries were found to be between 50 and 66%, the quality objective being 78%, and all associated samples were qualified as low estimates (J-) or (UJ) for non-detects. The gamma-BHC LCS recovery was low for the second dry weather event and the associated samples were qualified (UJ) for non-detects.

4.6 Standard Reference Materials

Standard Reference Material (SRM) is analyzed to evaluate accuracy. The results are presented in Table A.8 and show that the data quality objectives were met in all cases for the Long Beach 2003/2004 project year.

4.7 Surrogate Recoveries

Surrogate analytes behave similarly to the target analytes. Surrogate spikes are introduced into samples at specific concentrations and are used to provide a measure of instrument and method performance and to indicate sample-specific matrix effects. Surrogate recovery results are summarized in Table A.9.

Surrogate recovery data quality objectives were met in all cases during the Long Beach 2003/2004 project year.

4.8 Assessment of Toxicity Analyses

The majority of toxicity tests met critical test acceptability criteria (TACs) and the results were judged to be valid. Some of the *Cerodaphnia* tests did not meet all of the TACs but were nevertheless judged to have produced valid toxicity results. A few additional tests experienced minor procedural deviations that had no significant effect on the results. All deviations are described in the following paragraphs and summarized in Table A.10.

4.8.1 Water Flea Tests

The water flea toxicity tests were conducted according to USEPA protocol guidelines, and there were no procedural problems with tests conducted on samples from the first and third storms, from Alamitos Bay Plume samples or from dry weather collections.

The bioassays conducted on all three samples collected during the second wet weather event, however, did not meet the minimum control performance standard for reproduction. Although control survival was acceptable (>90%) in each test, the controls failed to produce three broods in 60% of females or produced fewer than 15 neonates per female. Additionally, the controls showed an extremely high incidence of aborted broods during the 7-day tests. Despite this poor control performance, however, the stormwater samples showed only minor toxicity, with abundant neonate production in all test concentrations of the Belmont and Bouton samples and significantly reduced survival and reproduction in the undiluted Cerritos Channel sample. In our best professional judgment, these test results clearly showed that toxicity was absent in all but the Cerritos Channel 100% concentration, and the tests were not repeated.

Similar reproduction problems were encountered with laboratory controls during testing of samples collected from Belmont Pump and Bouton Creek during the fourth storm event. Again we saw control survival that met acceptability criteria, but low numbers of neonates and failure to produce three broods in 60% of females. Again there was a high incidence of aborted broods in the controls. Examination of the stormwater data from Belmont and Bouton showed high neonate production in all test concentrations. A slight but non-significant reduction of neonate production was noted in the 6.25% concentration (attributed to the high proportion of dilution/control water) and in the 100% concentration of each sample. Neither sample was judged to harbor significant toxicity. The Cerritos Channel sample collected during the fourth storm was tested without QC problems.

It should be noted that graphic representation of the water flea bioassays that did not meet the critical TACs as discussed in the preceding two paragraphs (Figures 7.1 through 7.3) were constructed using data from the 6.25% test exposures as the comparative data. In all other water flea tests the comparative data were from laboratory control exposures.

In all water flea bioassays, temperature, dissolved oxygen and pH measurements remained within acceptable limits. Samples were renewed each day with aliquots within the recommended pH range. All reference toxicant tests produced LC50s and EC50s that were within laboratory control chart limits.

4.8.2 Sea Urchin Tests

Sea urchin fertilization tests were conducted according to protocol guidelines. There were four samples that failed to meet TAC upon initial testing:

- The brine controls associated with the Bouton Creek dry weather sample collected on 11 September 2003 failed to achieve the required 70% minimum fertilization. The sample was retested on 16 September 2003. The brine controls run with the Belmont Pump sample from the same collection came very close to meeting minimum standards (68%), but the sample was not retested because there was no indication of toxicity in the sample.

- Both the brine and laboratory controls tested with the Cerritos Channel storm sample collected on 3 February 2004 failed to achieve the minimum fertilization requirement, and this sample was retested on 6 February 2004.

- The brine controls associated with both the Belmont and Bouton dry weather samples collected on 5 May 2004 likewise failed minimum fertilization requirements and both were retested on 7 May 2004.

With the exceptions detailed above, all sea urchin tests met TACs, all environmental monitoring values were within recommended ranges and all reference toxicant tests produced EC50s that were within laboratory control chart limits.

4.8.3 Sample Holding Times

The holding time for each sample and test is presented in Table A.11. The objective of <36 hours holding before test initiation was met for 22% of the samples; tests for 84% of the samples were started within the allowable extended holding time window of 72 hours. Most of the holding time exceedences were due to the fact that three of the four wet weather events occurred within a period of nine days, producing laboratory loading that exceeded capacity. The two longest holding times were caused by the necessity to retest samples that failed initial sea urchin TACs.

The effect of extended cold storage on stormwater toxicity is unpredictable. The 36 hr storage objective used in this program was adapted from guidance for wastewater effluent testing developed by USEPA. The same guidance allows an extension of holding time to 72 hours when required by shipping or other logistic considerations. Extended storage times may have resulted in toxicity loss due to contaminant degradation or sorption to the storage container. The impact of such potential losses in this program cannot be assessed, since toxicity was not present in samples that experienced the most extended storage.

Table A.1. Summary of Blanking Results Associated with Field Activities.

Analyte	Reporting Limit	Installed Intake Hose		Subsampling Hose		Composite Bottles		Laboratory Container Blanks		Peristaltic Hose	
		Number of Detections	Number of Analyses	Number of Detections	Number of Analyses	Number of Detections	Number of Analyses	Number of Detections	Number of Analyses	Number of Detections	Number of Analyses
CONVENTIONALS (mg/L)											
Chemical Oxygen Demand (COD)	4.0	0	1	0	1	0	7	0	1	0	1
Total Organic Carbon (TOC)	0.5-1.0	0	1	0	1	0	7	0	1	0	1
Nitrate-N	0.10	0	1	0	1	0	7	0	1	0	1
Total P	0.01-0.002	0	1	0	1	0	7	0	1	0	1
TOTAL METALS (ug/L)											
Aluminum	100	0	1	0	1	0	7	0	1	0	1
Arsenic	1.0	0	1	0	1	0	7	0	1	0	1
Cadmium	0.25	0	1	0	1	0	7	0	1	0	1
Chromium	0.50	0	1	0	1	0	7	0	1	0	1
Copper	0.50	0	1	0	1	0	7	0	1	0	1
Lead	0.50	0	1	0	1	0	7	0	1	0	1
Nickel	1.0	0	1	0	1	0	7	0	1	0	1
Silver	0.25	0	1	0	1	0	7	0	1	0	1
Zinc	1.0	0	1	0	1	**1**[1]	7	0	1	0	1

1 = Total Zinc was detected at a concentration of 1.4 ug/L on 9/04/03 in a Composite Bottle Blank.

Table A.2. Summary of Relative Percent Differences (RPD) of Field Duplicates for Storm Events (Page 1 of 2)

Analyte	Units	Event 1 03-Feb-2004			Event 2 18-Feb-2004			Event 3 23-Feb-2004			Event 4 26-Feb-2004		
		Original	Duplicate	RPD	Original	Duplicate	RPD	Original	Duplicate	RPD	Original	Duplicate	RPD
Conventionals													
BOD	mg/L	22	20	10	16	16	0	8.2	7.5	9	5	5	0
COD	mg/L	170	160	6	150	170	13	62	64	3	32	46	36
TOC	mg/L	12	12	0	16	16	0	11	10	10	5.9	6	2
EC	umhos/cm	68	69	2	1640	1600	2	289	282	2	48	47	2
Hardness	mg/L	32.1	28	14	193	191	1	48	52	8	12	13	8
Alkalinity	mg/L	21	20	5	210	210	0	43	43	0	14	14	0
pH	pH Units	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	mg/L	3.8	3.9	3	330	330	0	46	46	0	3.2	3.2	0
Fluoride	mg/L	0.062	0.14	**77** [1]	0.74J	0.75	1	0.2	0.2	0	0.1	0.1	0
TKN	mg/L	2.4	2.8	15	2.3	2.2	4	1.4	1	33	0.82	0.64	25
Ammonia as N	mg/L	0.54	0.525	3	0.64	0.67	6	0.40	0.35	12	0.23	0.22	5
Nitrate N	mg/L	0.63	0.67	6	0.84	0.88	5	0.52	0.52	0	0.26	0.25	4
Nitrite N	mg/L	0.1U	0.1U	NA	0.1U	0.1U	NA	0.1U	0.1U	NA	0.1U	0.1U	NA
Total Phosphorus	mg/L	1.2	1.1	9	0.77	0.7	10	0.36	0.37	3	0.19	0.38	**67** [1]
Ortho-P (Dissolved)	mg/L	0.18	0.18	0	0.59	0.61	3	0.29	0.28	4	0.19	0.19	0
MBAS	mg/L	0.036	0.081	**77** [1]	0.04	0.03	18	0.03	0.03	13	0.025U	0.025U	NA
Total Phenols	mg/L	0.1U	0.1U	NA	0.1U	0.1U	NA	0.1U	0.1U	NA	0.1U	0.1U	NA
Oil & Grease	mg/L	5.0U	5.0U	NA	6.05J-	5.0UJ	NA	5.0UJ	5.0UJ	NA	5.0UJ	5.0UJ	NA
TSS	mg/L	314	362	14	90	42	**73** [2]	34	36	6	80	84	5
TDS	mg/L	88	54	48	910	912	0	148	152	3	46	32	36
Turbidity	NTU	84	102	20	51	42	19	28	25	11	61	58	5
TVS	mg/L	108	128	17	1.0U	1.0U	NA	1.0U	1.0U	NA	28	32	13
Total Metals													
Aluminum	ug/L	8700	7600	13	3800	3000	24	1400	1700	19	940	1800	**63** [2]
Arsenic	ug/L	2.3	2.25	2	4.2	4.2	0	2.2	2.1	6	2.3	2.3	0
Cadmium	ug/L	2.6	2.9	11	1.1	0.81	30	0.44	0.53	19	0.66	0.69	4
Chromium	ug/L	21	18	15	9.3	7.7	19	4.7	4.8	2	2.3	4.2	**58** [2]
Copper	ug/L	62	62	0	55	40	32	29	32	10	27	22	20
Iron	ug/L	10000	9900	1	3200	3000	6	1300	1300	0	3600	3700	3
Lead	ug/L	93	94	1	73	51	35	23	26	12	20	26	26
Nickel	ug/L	18	20	11	10	8.8	13	4.8	4.9	2	3.4	4.8	34
Selenium	ug/L	1.0U	1.0U	NA	1.0U	1.0U	NA	1.2	1.4	16	1.0U	1.1	NA
Silver	ug/L	0.38	0.42	10	0.25U	0.25U	NA	0.25U	0.25U	NA	0.25U	0.25U	NA
Zinc	ug/L	590	590	0	360	280	25	180	210	15	180	190	5
Dissolved Metals													
Aluminum	ug/L	100U	100U	NA	100U	100U	NA	100U	100U	NA	170	100U	NA
Arsenic	ug/L	1.02	1.0U	NA	2.9	2.9	0	1.5	1.8	18	1.4	1.5	7
Cadmium	ug/L	0.25U	0.25U	NA	0.25U	0.25U	NA	0.25U	0.25U	NA	0.25U	0.25U	NA
Chromium	ug/L	0.94	0.98	4	4.5	4.7	4	1.9	1.9	0	1.4	0.87	47
Copper	ug/L	7.2	7.4	3	7.4	7.8	5	11	11	0	4.4	3.3	29
Iron	ug/L	150	180	18	73	76	4	47	47	0	180	190	5
Lead	ug/L	0.82	0.84	2	1.2	1.2	0	0.52	0.77	39	0.61	0.50U	NA
Nickel	ug/L	1.4	1.3	7	3	3.3	10	1.8	1.8	0	1.0U	1.0U	NA
Selenium	ug/L	1.0U	1.0U	NA	1.0U	1.0U	NA	1.0U	1.0U	NA	1.0U	1.0U	NA
Silver	ug/L	0.25U	0.25U	NA	0.25U	0.25U	NA	0.25U	0.25U	NA	0.25U	0.25U	NA
Zinc	ug/L	55	55	0	44	48	9	58	61	5	37	27	31

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Table A.2. Summary of Relative Percent Differences of Field Duplicates for Storm Events, Continued (Page 2 of 2)

Analyte	Units	Event 1 03-Feb-2004 Original	Event 1 Duplicate	Event 1 RPD	Event 2 18-Feb-2004 Original	Event 2 Duplicate	Event 2 RPD	Event 3 23-Feb-2004 Original	Event 3 Duplicate	Event 3 RPD	Event 4 26-Feb-2004 Original	Event 4 Duplicate	Event 4 RPD
Bacteriological													
Fecal Coliform	mpn/100ml	13000J	9000J	36	130000	8000	**177** [2]	8000	5000	46	3000	3000	0
Coliform, Total	mpn/100ml	24000J	90000J	**116** [3]	130000	13000	**164** [2]	30000	50000	50	13000	24000	**59** [3]
Enterococcus	cfu/100ml	24400J	38000J	44	93000	176000	**62** [3]	12800	12400	3	9650	7950	19
Polychlorinated Biphenyls (PCB's)													
PCB-1016 (Aroclor 1016)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1221 (Aroclor 1221)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1232 (Aroclor 1232)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1242 (Aroclor 1242)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1248 (Aroclor 1248)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1254 (Aroclor 1254)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1260 (Aroclor 1260)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
Total Polychlorinatedbiphenyls	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA
Organophosphate Pesticides													
Atrazine	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA
Chlorpyrifos	ug/L	0.05U	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA
Cyanazine	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA
Diazinon	ug/L	0.071	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA
Malathion	ug/L	1.0U	1.0U	NA	1.0U	1.0U	NA	1.0U	1.0U	NA	1.0U	1.0U	NA
Prometryn	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0U	2.0U	NA
Simazine	ug/L	4.4	5.4	20	2.0U	2.0U	NA	2.0U	2.0U	NA	2.0	2.0	0
Chlorinated Pesticides													
4,4'-DDD	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
4,4'-DDE	ug/L	0.013	0.013	0	0.011	0.012	9	0.01U	0.01U	NA	0.01U	0.01U	NA
4,4'-DDT	ug/L	0.01U	0.01U	NA	0.03	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Aldrin	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA
alpha-BHC	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
alpha-Chlordane	ug/L	0.01U	0.01U	NA	0.017	0.016	6	0.01U	0.01U	NA	0.01U	0.01U	NA
beta-BHC	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA
Chlordane	ug/L	0.10U	0.10U	NA	0.1	0.10U	NA	0.10U	0.10U	NA	0.10U	0.10U	NA
delta-BHC	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA	0.005U	0.005U	NA
Dieldrin	ug/L	0.010	0.012	18	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan I	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan II	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan sulfate	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin aldehyde	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin ketone	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
gamma-BHC (Lindane)	ug/L	0.021	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
gamma-Chlordane	ug/L	0.01U	0.01U	NA	0.011	0.012	9	0.01U	0.01U	NA	0.01U	0.01U	NA
Heptachlor	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Heptachlor epoxide	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA	0.01U	0.01U	NA
Methoxychlor	ug/L	0.05U	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA	0.05U	0.05U	NA
Toxaphene	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA	0.20U	0.20U	NA

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Table A.3. Summary of Relative Percent Differences (RPD) of Field Duplicates for Dry Weather Events (Page 1 of 2)

		Event 1 10-11-Sep-04			Event 2 5-May-2004		
Analyte	**Units**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Conventionals							
BOD	mg/L	16	16	0	16	21	27
COD	mg/L	48	48	0	84	100	4
TOC	mg/L	11	11	0	21	21	0
EC	umhos/cm	621	620	0	820	840	2
Hardness	mg/L	200	210	5	176	159	10
Alkalinity	mg/L	160	160	0	120	100	5
pH	pH Units	-	-	-	-	-	-
Chloride	mg/L	63	63	0	95	110	4
Fluoride	mg/L	0.49	0.49	0	0.89	0.71	23
TKN	mg/L	2.9	2.9	0	3.3	3.3	0
Ammonia as N	mg/L	0.1U	0.100U	NA	0.1U	0.1U	NA
Nitrate N	mg/L	0.1U	0.1U	NA	0.1U	0.1U	NA
Nitrite N	mg/L	0.1U	0.1U	NA	0.1U	0.1U	NA
Total Phosphorus	mg/L	0.3	0.3	0	0.62	0.86	32
Ortho-P (Dissolved)	mg/L	0.01U	0.01U	NA	0.01U	0.01U	NA
MBAS	mg/L	0.034	0.034	0	0.025U	0.025U	NA
Total Phenols	mg/L	0.1U	0.1U	NA	0.1U	0.1U	NA
Oil & Grease	mg/L	5.00U	5.00U	NA	5.00UJ	5.00UJ	NA
TSS	mg/L	56	58	4	128	140	9
TDS	mg/L	384	388	1	522	510	2
Turbidity	NTU	27	27	0	16	20	22
TVS	mg/L	95	95	0	188	144	27
Total Metals							
Aluminum	ug/L	680	310	**75** [2]	1100	870	23
Arsenic	ug/L	3.6	3.3	9	2.1	2.2	5
Cadmium	ug/L	0.27	0.26	4	0.85	0.96	12
Chromium	ug/L	1.9J+	1.7	11	3.1	2.6	18
Copper	ug/L	15	10	40	26	28	7
Iron	ug/L	440	94	**130** [2]	1500	1200	22
Lead	ug/L	6.5	6.2	5	17	100	**142** [3]
Nickel	ug/L	2.9J+	2.9J+	0	7.6	7.8	3
Selenium	ug/L	1.00U	1.00U	NA	1.00U	1.00U	NA
Silver	ug/L	0.25U	0.25U	NA	0.049J	0.25U	NA
Zinc	ug/L	92	81	13	190	220	15
Dissolved Metals							
Aluminum	ug/L	100U	1.0J	NA	100U	100U	NA
Arsenic	ug/L	3.0	3.1	3	1	1.3	26
Cadmium	ug/L	0.25U	0.25U	NA	0.23	0.22	4
Chromium	ug/L	0.50U	0.50U	NA	0.8	0.56	35
Copper	ug/L	3.4	3.4	0	7.7	7.5	3
Iron	ug/L	25U	25U	NA	27	45	50
Lead	ug/L	0.57	0.57	0	0.6	0.6	0
Nickel	ug/L	1.0U	0.21J	NA	3.2	2.9	10
Selenium	ug/L	1.00U	1.00U	NA	1.00U	1.00U	NA
Silver	ug/L	0.25UJ	0.17J	NA	0.25UJ	0.25UJ	NA
Zinc	ug/L	17	15	13	8.8	8.3	6

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Table A.3. Summary of Relative Percent Differences of Field Duplicates for Dry Weather Events, Continued (Page 2 of 2)

Analyte	Units	Event 1 10-11-Sep-2003 Original	Duplicate	RPD	Event 2 5-May-2004 Original	Duplicate	RPD
Bacteriological							
Fecal Coliform	mpn/100ml	40	80	**67** [3]	400	800	**67** [3]
Coliform, Total	mpn/100ml	1300	1700	27	2300	2300	0
Enterococcus	cfu/100ml	70	170	**83** [3]	1190	1400	16
Polychlorinated Biphenyls (PCB's)							
PCB-1016 (Aroclor 1016)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1221 (Aroclor 1221)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1232 (Aroclor 1232)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1242 (Aroclor 1242)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1248 (Aroclor 1248)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1254 (Aroclor 1254)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
PCB-1260 (Aroclor 1260)	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
Total Polychlorinatedbiphenyls	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA
Organophosphate Pesticides							
Atrazine	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA
Chlorpyrifos	ug/L	0.05U	0.05U	NA	0.05U	0.05U	NA
Cyanazine	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA
Diazinon	ug/L	0.064	0.059	8	0.05U	0.05U	NA
Malathion	ug/L	1.0U	1.0U	NA	1.0U	1.0U	NA
Prometryn	ug/L	2.0U	2.0U	NA	2.0U	2.0U	NA
Simazine	ug/L	2.0U	2.0U	NA	0.31J	0.30J	3
Chlorinated Pesticides							
4,4'-DDD	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
4,4'-DDE	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
4,4'-DDT	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Aldrin	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA
alpha-BHC	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
alpha-Chlordane	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
beta-BHC	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA
Chlordane	ug/L	0.10U	0.10U	NA	0.10U	0.10U	NA
delta-BHC	ug/L	0.005U	0.005U	NA	0.005U	0.005U	NA
Dieldrin	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan I	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan II	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endosulfan sulfate	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin aldehyde	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Endrin ketone	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
gamma-BHC (Lindane)	ug/L	0.01U	0.01U	NA	0.01UJ	0.01UJ	NA
gamma-Chlordane	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Heptachlor	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Heptachlor epoxide	ug/L	0.01U	0.01U	NA	0.01U	0.01U	NA
Methoxychlor	ug/L	0.05U	0.05U	NA	0.05U	0.05U	NA
Toxaphene	ug/L	0.20U	0.20U	NA	0.20U	0.20U	NA

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Table A.4. Summary of Lab Method and Filter Blank Hits for each Sampling Event (Page 1 of 2).

Analyte	Reporting Limit	Dry Event 1	Storm Event 1	Storm Event 2	Storm Event 3	Storm Event 4	Storm Event 5	Dry Event 2
Conventionals								
BOD	2 mg/L							
COD	20 mg/L							
TOC	1 mg/L							
EC	1 umhos/cm	-	-	-	-	-	-	-
Hardness	2 mg/L							
Alkalinity	2 mg/L							
Chloride	2 mg/L							
Fluoride	0.1 mg/L							
TKN	0.1 mg/L			0.108				
Ammonia as N	0.1 mg/L							
Nitrate N	0.1 mg/L							
Nitrite N	0.1 mg/L							
Total Phosphorus	0.05 mg/L							
Ortho-P (Dissolved)	0.05 mg/L							
MBAS	0.5 mg/L							
Total Phenols	0.1 mg/L							
Oil & Grease	5 mg/L							
TSS	2 mg/L							
TDS	2 mg/L							
Turbidity	0.1 NTU	-	-	-	-	-	-	-
TVS	2 mg/L	-	-	-	-	-	-	-
Total Metals								
Aluminum	100 ug/L							
Arsenic	1 ug/L							
Cadmium	0.25 ug/L							
Chromium	0.5 ug/L	0.595						
Copper	0.5 ug/L	0.537						
Iron	100 ug/L							
Lead	0.5 ug/L							
Nickel	1 ug/L	1.1						
Selenium	1 ug/L							
Silver	0.25 ug/L							
Zinc	1 ug/L							
Dissolved Metals								
Aluminum	100 ug/L							
Arsenic	1 ug/L							
Cadmium	0.25 ug/L							
Chromium	0.5 ug/L							
Copper	0.5 ug/L							
Iron	100 ug/L							
Lead	0.5 ug/L							
Nickel	1 ug/L							
Selenium	1 ug/L							
Silver	0.25 ug/L							
Zinc	1 ug/L				1.33	1.33	2.57	

Only laboratory blank hits are listed in this table.

- indicates Lab Blank was not analyzed

Table A.4. Summary of Lab Method and Filter Blank Hits for each Sampling Event (Page 2 of 2).

Analyte	Reporting Limit	Dry Event 1	Storm Event 1	Storm Event 2	Storm Event 3	Storm Event 4	Storm Event 5	Dry Event 2
Aroclors								
Aroclor 1016	0.5ug/L							
Aroclor 1221	0.5ug/L							
Aroclor 1232	0.5ug/L							
Aroclor 1242	0.5ug/L							
Aroclor 1248	0.5ug/L							
Aroclor 1254	0.5ug/L							
Aroclor 1260	0.5ug/L							
Total PCBs	0.5ug/L							
Chlorinated Pesticides								
4,4'-DDD	0.05ug/L							
4,4'-DDE	0.05ug/L							
4,4'-DDT	0.01ug/L							
Aldrin	0.005ug/L							
alpha-BHC	0.01ug/L							
alpha-Chlordane	0.1ug/L							
beta-BHC	0.005ug/L							
Chlordane	0.1ug/L							
delta-BHC	0.005ug/L							
Dieldrin	0.01ug/L							
Endosulfan I	0.02ug/L							
Endosulfan II	0.01ug/L							
Endosulfan sulfate	0.05ug/L							
Endrin	0.01ug/L							
Endrin aldehyde	0.01ug/L							
Endrin ketone	0.01ug/L							
gamma-BHC (Lindane)	0.02ug/L							
gamma-Chlordane	0.1ug/L							
Heptachlor	0.01ug/L							
Heptachlor epoxide	0.01ug/L							
Methoxychlor	0.5ug/L							
Toxaphene	0.5ug/L							
Organophosphates								
Atrazine	2ug/L							
Chlorpyrifos	0.05ug/L							
Cyanazine	2ug/L							
Diazinon	0.01ug/L							
Malathion	1ug/L							
Prometryn	2ug/L							
Simazine	2ug/L							

Only laboratory blank hits are listed in this table.

- indicates Lab Blank was not analyzed

Table A.5. Summary of Results and Relative Percent Differences (RPDs) of Lab Duplicates for Each Sampling Event (Page 1 of 2).

Analyte	Dry Event 1	Storm Event 1	Storm Event 2	Storm Event 3	Storm Event 4	Storm Event 5	Dry Event 2
Conventionals							
BOD	3	5	4	2	2	28 [3]	37 [3]
COD	3	19	12	1	13	NA	3
TOC	1	0	7	14	14	1	3
EC	0	0	1	1	1	0	0
Hardness	1	7	1	0	0	7	1
Alkalinity	1	1	1	3	2	2	0
Chloride	2	0	0	0	0	0	1
Fluoride	5	NA	32 [3]	7	0	7	5
TKN	3	3	5	14	14	0	6
Ammonia as N	NA	5	14	14	14	NA	NA
Nitrate N	NA	1	0	2	1	0	NA
Nitrite N	NA	NA	NA	NA	NA	NA	NA
Total Phosphorus	1	5	8	2	2	2	9
Ortho-P (Dissolved)	NA	4	0	0	1	3	1
MBAS	6	NA	8	16	NA	NA	NA
Total Phenols	NA	NA	NA	NA	NA	NA	NA
Oil & Grease	NA	NA	NA	NA	NA	NA	NA
TSS	NA	1	4	0	0	18	NA
TDS	1	8	5	5	0	6	0
Turbidity	4	0	8	4	2	1	3
TVS	8	7	NA	NA	18	4	15
Total Metals							
Aluminum	-	0	8	50 [3]	NA	16	14
Arsenic	-	-	-	-	-	-	-
Cadmium	-	6	NA	4	NA	NA	4
Chromium	-	4	3	0	1	**25 [1]**	17
Copper	-	4	0	1	25 [3]	104 [3]	5
Iron	NA	7	7	7	NA	9	5
Lead	-	1	13	1	70 [3]	NA	31 [3]
Nickel	-	13	35 [3]	2	NA	88 [3]	8
Selenium	-	-	-	-	-	-	-
Silver	-	3	NA	18	35 [3]	61 [3]	NA
Zinc	-	1	0	20	NA	2	11
Dissolved Metals							
Aluminum	-	-	15	1	1	1	NA
Arsenic	-	-	-	-	-	-	-
Cadmium	-	NA	6	0	0	2	7
Chromium	-	9	12	1	1	3	3
Copper	-	0	9	4	4	3	1
Iron	NA	7	NA	NA	5	1	NA
Lead	-	0	1	0	0	4	3
Nickel	-	37	5	2	2	6	3
Selenium	-	-	-	-	-	-	-
Silver	-	NA	NA	77 [3]	77 [3]	85 [3]	NA
Zinc	-	2	11	2	2	4	0

Bold boxed values indicate analyses that were outside the Data Quality Objectives

NA = value not calculated since one or more results were non-detect

\- = Not analyzed

1 = Both original sample and duplicate sample > 5x the Reporting Limit (RL). Associated samples were qualified as estimated (J) and non-detects as (UJ)

2 = Original sample or duplicate sample <= 5X the RL and the absolute difference between sample and duplicate > RL. Associated sample qualified as estimated (J) and non-detects as (UJ)

3 = Both original and duplicates were <5X the RL and the difference. Associated samples were not qualified

Table A.5. Summary of Results and Relative Percent Differences (RPDs) of Lab Duplicates for Each Sampling Event (Page 2 of 2).

Analyte	Dry Event 1	Storm Event 1	Storm Event 2	Storm Event 3	Storm Event 4	Storm Event 5	Dry Event 2
Aroclors							
PCB-1016 (Aroclor 1016)	NA	NA	NA	NA	NA	NA	NA
PCB-1221 (Aroclor 1221)	NA	NA	NA	NA	NA	NA	NA
PCB-1232 (Aroclor 1232)	NA	NA	NA	NA	NA	NA	NA
PCB-1242 (Aroclor 1242)	NA	NA	NA	NA	NA	NA	NA
PCB-1248 (Aroclor 1248)	NA	NA	NA	NA	NA	NA	NA
PCB-1254 (Aroclor 1254)	NA	NA	NA	NA	NA	NA	NA
PCB-1260 (Aroclor 1260)	NA	NA	NA	NA	NA	NA	NA
Total Polychlorinatedbiphenyls	NA	NA	NA	NA	NA	NA	NA
Chlorinated Pesticides							
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA
alpha-BHC	NA	NA	NA	NA	NA	NA	NA
alpha-Chlordane	NA	NA	NA	NA	NA	NA	NA
beta-BHC	NA	NA	4	4	NA	NA	NA
Chlordane	NA	NA	NA	NA	NA	NA	NA
delta-BHC	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA
Endosulfan sulfate	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA
Endrin aldehyde	NA	NA	NA	NA	NA	NA	NA
Endrin ketone	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	NA
gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA
Heptachlor epoxide	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA
Organophosphates							
Atrazine	NA	-	-	-	NA	NA	NA
Chlorpyrifos	NA	-	-	-	NA	NA	NA
Cyanazine	NA	-	-	-	NA	NA	NA
Diazinon	NA	-	-	NA	NA	NA	NA
Malathion	NA	-	-	-	13	NA	NA
Prometryn	NA	-	-	-	NA	NA	NA
Simazine	NA	-	-	-	NA	56 [3]	NA

Bold boxed values indicate analyses that were outside the Data Quality Objectives

NA = value not calculated since one or more results were non-detect

- = Not analyzed

1 = Both original sample and duplicate sample > 5x the Reporting Limit (RL). Associated samples were qualified as estimated (J) and non-detects as (UJ)

2 = Original sample or duplicate sample <= 5X the RL and the absolute difference between sample and duplicate > RL. Associated sample qualified as estimated (J) and non-detects as (UJ)

3 = Both original and duplicates were <5X the RL and the difference. Associated samples were not qualified

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 1 of 6).

Analyte	*Dry Event 1: 10 September 2003* Original	Duplicate	RPD	*Storm Event 1: 3 February 2004* Original	Duplicate	RPD	*Storm Event 2: 18 February 2004* Original	Duplicate	RPD
Conventionals									
BOD	-	-	-	-	-	-	-	-	-
COD	-	-	-	-	-	-	-	-	-
TOC	109	112	3	101	105	3	101	106	3
EC	-	-	-	-	-	-	-	-	-
Hardness	-	-	-	-	-	-	-	-	-
Alkalinity	-	-	-	-	-	-	-	-	-
Chloride	115	113	1	91	91	0	108	103	4
Fluoride	92	101	9	114	104	9	84	92	6
TKN	94	92	2	87	98	10	99	94	4
Ammonia as N	-	-	-	-	-	-	-	-	-
Nitrate N	113	115	1	111	109	2	107	103	3
Nitrite N	-	-	-	115	110	4	115	111	3
Total Phosphorus	105	107	2	103	102	1	108	104	3
Ortho-P (Dissolved)	-	-	-	100	101	1	98	98	0
MBAS	-	-	-	-	-	-	-	-	-
Total Phenols	104	101	3	84	88	4	112	107	4
Oil & Grease	-	-	-	-	-	-	-	-	-
TSS	-	-	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	-	-	-	-	-
TVS	-	-	-	-	-	-	-	-	-
Total Metals									
Aluminum	102	102	0	72	80	1	99	100	1
Arsenic	98	102	4	-	-	-	-	-	-
Cadmium	96	95	1	102	103	1	104	105	0
Chromium	97	97	0	99	99	0	100	102	1
Copper	85	91	5	93	92	1	100	100	1
Iron	96	98	1	102	101	1	93	93	0
Lead	93	95	2	101	102	1	92	93	1
Nickel	100	96	4	92	92	0	99	100	1
Selenium	-	-	-	-	-	-	-	-	-
Silver	93	90	3	99	98	1	102	102	0
Zinc	91	94	2	99	99	0	103	103	0
Dissolved Metals									
Aluminum	113	106	6	98	95	3	98	96	2
Arsenic	-	-	-	97	90	7	103	106	3
Cadmium	98	96	2	111	112	1	112	111	0
Chromium	93	95	2	103	104	1	101	103	2
Copper	90	87	3	102	102	0	103	104	1
Iron	98	98	1	103	102	1	92	92	0
Lead	90	92	2	104	105	0	100	100	0
Nickel	84	86	3	101	101	0	101	101	0
Selenium	100	100	1	117	117	0	99	100	1
Silver	**65** [1]	**66** [1]	1	97	98	1	101	101	1
Zinc	88	91	3	122	123	1	121	121	0

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 2 of 6).

	Dry Event 1: 10 September 2003			*Storm Event 1: 3 February 2004*			*Storm Event 2: 18 February 2004*		
Analyte	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Chlorinated Pesticides									
4,4'-DDD				-	-	-	-	-	-
4,4'-DDE				-	-	-	-	-	-
4,4'-DDT				84	84	0	-	-	-
Aldrin				98	93	5	-	-	-
alpha-BHC				-	-	-	-	-	-
alpha-Chlordane				-	-	-	-	-	-
beta-BHC				-	-	-	-	-	-
Chlordane				-	-	-	-	-	-
delta-BHC				-	-	-	-	-	-
Dieldrin				110	110	0	-	-	-
Endosulfan I				-	-	-	-	-	-
Endosulfan II				-	-	-	-	-	-
Endosulfan sulfate				-	-	-	-	-	-
Endrin				120	120	0	-	-	-
Endrin aldehyde				-	-	-	-	-	-
Endrin ketone				-	-	-	-	-	-
gamma-BHC (Lindane)				70	75	7	-	-	-
gamma-Chlordane				-	-	-	-	-	-
Heptachlor				95	93	3	-	-	-
Heptachlor epoxide				-	-	-	-	-	-
Methoxychlor				-	-	-	-	-	-
Toxaphene				-	-	-	-	-	-
Organophosphates									
Atrazine				-	-	-	-	-	-
Chlorpyrifos				-	-	-	-	-	-
Cyanazine				-	-	-	-	-	-
Diazinon				65	68	3	81	78	4
Malathion				64	71	10	75	71	6
Prometryn				-	-	-	-	-	-
Simazine				-	-	-	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 3 of 6).

	Storm Event 3: 22-23 February 2004			*Storm Event 4: 26 February 2004*			*Storm Event 5: 1-2 March 2004*		
Analyte	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Conventionals									
BOD	-	-	-	-	-	-	-	-	-
COD	-	-	-	-	-	-	-	-	-
TOC	95	100	4	95	100	4	100	98	2
EC	-	-	-	-	-	-	-	-	-
Hardness	-	-	-	-	-	-	-	-	-
Alkalinity	-	-	-	-	-	-	-	-	-
Chloride	103	97	5	97	93	2	99	97	2
Fluoride	92	90	2	94	92	2	96	94	2
TKN	100	107	5	100	107	5	92	94	1
Ammonia as N	-	-	-	-	-	-	-	-	-
Nitrate N	101	96	5	96	92	3	100	97	3
Nitrite N	106	103	3	107	100	7	106	109	2
Total Phosphorus	100	93	5	100	93	5	101	101	0
Ortho-P (Dissolved)	102	103	1	102	103	0	104	105	1
MBAS	-	-	-	-	-	-	-	-	-
Total Phenols	112	107	4	112	107	4	97	94	3
Oil & Grease	-	-	-	-	-	-	-	-	-
TSS	-	-	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	-	-	-	-	-
TVS	-	-	-	-	-	-	-	-	-
Total Metals									
Aluminum	91	92	1	70	72	2	102	100	2
Arsenic	-	-	-	-	-	-	-	-	-
Cadmium	96	95	1	94	93	1	103	103	0
Chromium	92	93	2	75	76	1	99	100	2
Copper	84	86	2	75	76	1	100	102	3
Iron	93	93	0	95	95	0	92	89	3
Lead	103	104	1	100	100	0	100	100	0
Nickel	85	85	0	71	72	1	98	100	2
Selenium	-	-	-	-	-	-	-	-	-
Silver	92	92	0	91	91	0	101	102	1
Zinc	87	90	2	83	83	0	105	106	1
Dissolved Metals									
Aluminum	101	96	5	101	96	5	104	105	1
Arsenic	102	101	1	100	102	2	103	106	3
Cadmium	104	105	1	104	105	1	109	109	0
Chromium	104	103	1	104	103	1	101	99	3
Copper	101	98	3	101	98	3	102	100	2
Iron	92	92	0	100	98	2	83	85	3
Lead	104	104	0	104	104	0	108	108	1
Nickel	99	98	1	99	98	1	102	98	3
Selenium	91	87	6	91	87	6	97	99	2
Silver	89	90	0	89	90	0	97	96	1
Zinc	114	114	0	114	114	0	122	116	4

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 4 of 6).

Analyte	*Storm Event 3: 22-23 February 2004*			*Storm Event 4: 26 February 2004*			*Storm Event 5: 1-2 March 2004*		
	Original	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Chlorinated Pesticides									
4,4'-DDD	-	-	-	-	-	-	-	-	-
4,4'-DDE	-	-	-	-	-	-	-	-	-
4,4'-DDT	-	-	-	-	-	-	-	-	-
Aldrin	-	-	-	-	-	-	-	-	-
alpha-BHC	-	-	-	-	-	-	-	-	-
alpha-Chlordane	-	-	-	-	-	-	-	-	-
beta-BHC	-	-	-	-	-	-	-	-	-
Chlordane	-	-	-	-	-	-	-	-	-
delta-BHC	-	-	-	-	-	-	-	-	-
Dieldrin	-	-	-	-	-	-	-	-	-
Endosulfan I	-	-	-	-	-	-	-	-	-
Endosulfan II	-	-	-	-	-	-	-	-	-
Endosulfan sulfate	-	-	-	-	-	-	-	-	-
Endrin	-	-	-	-	-	-	-	-	-
Endrin aldehyde	-	-	-	-	-	-	-	-	-
Endrin ketone	-	-	-	-	-	-	-	-	-
gamma-BHC (Lindane)	-	-	-	-	-	-	-	-	-
gamma-Chlordane	-	-	-	-	-	-	-	-	-
Heptachlor	-	-	-	-	-	-	-	-	-
Heptachlor epoxide	-	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	-	-	-	-
Toxaphene	-	-	-	-	-	-	-	-	-
Organophosphates									
Atrazine	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-
Diazinon	104	102	2	-	-	-	-	-	-
Malathion	94	94	0	-	-	-	-	-	-
Prometryn	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.

- = Not analyzed

1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 5 of 6).

Analyte	*Dry Event 2: 5 May 2004* Original	Duplicate	RPD
Conventionals			
BOD	98	-	-
COD	113	-	-
TOC	99	-	-
EC	102	-	-
Hardness	-	-	-
Alkalinity	100	-	-
Chloride	99	-	-
Fluoride	104	-	-
TKN	88	-	-
Ammonia as N	102	-	-
Nitrate N	101	-	-
Nitrite N	96	-	-
Total Phosphorus	96	-	-
Ortho-P (Dissolved)	103	-	-
MBAS	89	-	-
Total Phenols	115	-	-
Oil & Grease	-	-	-
TSS	-	-	-
TDS	-	-	-
Turbidity	-	-	-
TVS	-	-	-
Total Metals			
Aluminum	97	99	2
Arsenic	-	-	-
Cadmium	102	102	0
Chromium	92	90	3
Copper	102	102	1
Iron	99	-	-
Lead	105	103	2
Nickel	101	100	1
Selenium	-	-	-
Silver	91	91	0
Zinc	91	91	0
Dissolved Metals			
Aluminum	102	102	0
Arsenic	-	-	-
Cadmium	103	103	0
Chromium	98	96	2
Copper	101	100	1
Iron	95	-	-
Lead	104	104	0
Nickel	102	100	2
Selenium	-	-	-
Silver	**62** [1]	**62** [1]	0
Zinc	98	98	1

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.6. Summary of Matrix Spike/Matrix Spike Duplicate Results and Relative Percent Differences (RPDs) for each Sampling Event (Page 6 of 6).

Analyte	*Dry Event 2: 5 May 2004* Original	Duplicate	RPD
Chlorinated Pesticides			
4,4'-DDD	-	-	-
4,4'-DDE	-	-	-
4,4'-DDT	-	-	-
Aldrin	-	-	-
alpha-BHC	-	-	-
alpha-Chlordane	-	-	-
beta-BHC	-	-	-
Chlordane	-	-	-
delta-BHC	-	-	-
Dieldrin	-	-	-
Endosulfan I	-	-	-
Endosulfan II	-	-	-
Endosulfan sulfate	-	-	-
Endrin	-	-	-
Endrin aldehyde	-	-	-
Endrin ketone	-	-	-
gamma-BHC (Lindane)	-	-	-
gamma-Chlordane	-	-	-
Heptachlor	-	-	-
Heptachlor epoxide	-	-	-
Methoxychlor	-	-	-
Toxaphene	-	-	-
Organophosphates			
Atrazine	-	-	-
Chlorpyrifos	-	-	-
Cyanazine	-	-	-
Diazinon	-	-	-
Malathion	-	-	-
Prometryn	-	-	-
Simazine	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 1 of 6).

Analyte	*Dry Event 1: 10 September 2003*			*Storm Event 1: 3 February 2004*			*Storm Event 2: 18 February 2004*		
	Original	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Conventionals									
BOD	-	-	-	100	-	-	95	-	-
COD	-	-	-	99	-	-	113	-	-
TOC	-	-	-	106	-	-	106	-	-
EC	-	-	-	-	-	-	-	-	-
Hardness	-	-	-	-	-	-	-	-	-
Alkalinity	-	-	-	101	-	-	104	-	-
Chloride	-	-	-	101	-	-	100	-	-
Fluoride	-	-	-	106	-	-	103	-	-
TKN	-	-	-	88	-	-	88	-	-
Ammonia as N	96	100	4	94	-	-	94	-	-
Nitrate N	-	-	-	110	-	-	107	-	-
Nitrite N	-	-	-	112	-	-	105	-	-
Total Phosphorus	-	-	-	100	-	-	99	-	-
Ortho-P (Dissolved)	-	-	-	103	-	-	101	-	-
MBAS	-	-	-	91	-	-	97	-	-
Total Phenols	-	-	-	87	-	-	104	-	-
Oil & Grease	-	-	-	**68** [1]	-	-	**60** [1]	-	-
TSS	-	-	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	-	-	-	-	-
TVS	-	-	-	-	-	-	-	-	-
Total Metals									
Aluminum	126	123	3	91	87	4	96	96	0
Arsenic	-	-	-	-	-	-	-	-	-
Cadmium	103	102	1	103	103	0	104	104	0
Chromium	107	104	3	103	103	0	96	97	1
Copper	100	98	2	100	98	1	99	99	0
Iron	-	-	-	96	-	-	94	-	-
Lead	94	94	0	102	101	1	94	94	0
Nickel	108	106	2	94	94	0	98	98	0
Selenium	-	-	-	-	-	-	-	-	-
Silver	101	100	0	102	101	1	102	102	0
Zinc	102	104	2	104	104	0	99	100	1
Dissolved Metals									
Aluminum	86	84	3	101	99	2	104	101	3
Arsenic	-	-	-	-	-	-	-	-	-
Cadmium	112	111	0	103	102	0	103	103	0
Chromium	96	90	6	105	104	0	102	102	0
Copper	90	90	0	102	102	0	102	102	1
Iron	-	-	-	109	-	-	96	-	-
Lead	107	105	2	102	102	0	99	98	0
Nickel	90	92	2	101	101	0	102	102	0
Selenium	-	-	-	-	-	-	-	-	-
Silver	100	97	3	104	104	0	105	105	0
Zinc	108	110	1	103	102	1	102	102	1

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 2 of 6).

	Dry Event 1: 10 September 2003			*Storm Event 1: 3 February 2004*			*Storm Event 2: 18 February 2004*		
Analyte	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Chlorinated Pesticides									
4,4'-DDD	-	-	-	-	-	-	-	-	-
4,4'-DDE	-	-	-	-	-	-	-	-	-
4,4'-DDT	92	-	-	110	-	-	83	-	-
Aldrin	62	-	-	85	-	-	75	-	-
alpha-BHC	-	-	-	-	-	-	-	-	-
alpha-Chlordane	-	-	-	-	-	-	-	-	-
beta-BHC	-	-	-	-	-	-	-	-	-
Chlordane	-	-	-	-	-	-	-	-	-
delta-BHC	-	-	-	-	-	-	-	-	-
Dieldrin	96	-	-	110	-	-	88	-	-
Endosulfan I	-	-	-	-	-	-	-	-	-
Endosulfan II	-	-	-	-	-	-	-	-	-
Endosulfan sulfate	-	-	-	-	-	-	-	-	-
Endrin	107	-	-	120	-	-	96	-	-
Endrin aldehyde	-	-	-	-	-	-	-	-	-
Endrin ketone	-	-	-	-	-	-	-	-	-
gamma-BHC (Lindane)	79	-	-	73	-	-	58	-	-
gamma-Chlordane	-	-	-	-	-	-	-	-	-
Heptachlor	75	-	-	90	-	-	77	-	-
Heptachlor epoxide	-	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	-	-	-	-
Toxaphene	-	-	-	-	-	-	-	-	-
Organophosphates									
Atrazine	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-
Diazinon	55	-	-	80	-	-	75	-	-
Malathion	65	-	-	81	-	-	75	-	-
Prometryn	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 3 of 6).

	Storm Event 3: 22-23 February 2004			*Storm Event 4: 26 February 2004*			*Storm Event 5: 1-2 March 2004*		
Analyte	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Conventionals									
BOD	84	-	-	82	-	-	94	-	-
COD	110	-	-	112	-	-	88	-	-
TOC	99	-	-	99	-	-	100	-	-
EC	-	-	-	-	-	-	-	-	-
Hardness	-	-	-	-	-	-	-	-	-
Alkalinity	109	-	-	99	-	-	99	-	-
Chloride	99	-	-	99	-	-	95	-	-
Fluoride	88	-	-	96	-	-	87	-	-
TKN	94	-	-	94	-	-	88	-	-
Ammonia as N	94	-	-	94	-	-	-	-	-
Nitrate N	96	-	-	96	-	-	94	-	-
Nitrite N	93	-	-	92	-	-	93	-	-
Total Phosphorus	89	-	-	89	-	-	100	-	-
Ortho-P (Dissolved)	111	-	-	115	-	-	97	-	-
MBAS	90	-	-	91	-	-	86	-	-
Total Phenols	104	-	-	104	-	-	92	-	-
Oil & Grease	**61** [1]	-	-	**61** [1]	-	-	**66** [1]	-	-
TSS	-	-	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-	-	-
Turbidity	-	-	-	-	-	-	-	-	-
TVS	-	-	-	-	-	-	-	-	-
Total Metals									
Aluminum	98	99	0	94	92	1	104	105	0
Arsenic	-	-	-	-	-	-	-	-	-
Cadmium	100	101	1	100	100	0	100	100	0
Chromium	94	92	1	100	99	0	95	95	0
Copper	93	94	1	96	96	0	102	101	2
Iron	94	-	-	97	-	-	89	-	-
Lead	99	100	1	99	100	1	100	99	0
Nickel	89	90	1	92	92	0	100	97	3
Selenium	-	-	-	-	-	-	-	-	-
Silver	98	97	1	101	101	0	101	100	2
Zinc	106	109	3	101	101	0	98	99	1
Dissolved Metals									
Aluminum	101	101	0	101	101	0	97	102	4
Arsenic	-	-	-	-	-	-	-	-	-
Cadmium	100	99	0	100	99	0	101	101	0
Chromium	102	102	0	102	102	0	99	100	1
Copper	100	100	0	100	100	0	100	100	0
Iron	96	-	-	100	-	-	86	-	-
Lead	99	99	0	99	99	0	100	100	0
Nickel	98	99	1	98	99	1	101	99	2
Selenium	-	-	-	-	-	-	-	-	-
Silver	104	104	0	104	104	0	104	101	2
Zinc	98	98	0	98	98	0	98	99	1

Bold boxed values indicate analyses that were outside Data Quality Objectives.

- = Not analyzed

1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 4 of 6).

	Storm Event 3: 22-23 February 2004			*Storm Event 4: 26 February 2004*			*Storm Event 5: 1-2 March 2004*		
Analyte	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
Chlorinated Pesticides									
4,4'-DDD	-	-	-	-	-	-	-	-	-
4,4'-DDE	-	-	-	-	-	-	-	-	-
4,4'-DDT	83	-	-	81	-	-	102	-	-
Aldrin	75	-	-	78	-	-	54	-	-
alpha-BHC	-	-	-	-	-	-	-	-	-
alpha-Chlordane	-	-	-	-	-	-	-	-	-
beta-BHC	-	-	-	-	-	-	-	-	-
Chlordane	-	-	-	-	-	-	-	-	-
delta-BHC	-	-	-	-	-	-	-	-	-
Dieldrin	88	-	-	91	-	-	96	-	-
Endosulfan I	-	-	-	-	-	-	-	-	-
Endosulfan II	-	-	-	-	-	-	-	-	-
Endosulfan sulfate	-	-	-	-	-	-	-	-	-
Endrin	96	-	-	100	-	-	108	-	-
Endrin aldehyde	-	-	-	-	-	-	-	-	-
Endrin ketone	-	-	-	-	-	-	-	-	-
gamma-BHC (Lindane)	58	-	-	58	-	-	62	-	-
gamma-Chlordane	-	-	-	-	-	-	-	-	-
Heptachlor	77	-	-	80	-	-	57	-	-
Heptachlor epoxide	-	-	-	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	-	-	-	-
Toxaphene	-	-	-	-	-	-	-	-	-
Organophosphates									
Atrazine	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-
Diazinon	98	-	-	70	-	-	63	-	-
Malathion	95	-	-	76	-	-	80	-	-
Prometryn	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.

- = Not analyzed

1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 5 of 6).

	Dry Event 2: 5 May 2004		
Analyte	**Original**	**Duplicate**	**RPD**
Conventionals			
BOD	98	-	-
COD	113	-	-
TOC	99	-	-
EC	102	-	-
Hardness	-	-	-
Alkalinity	100	-	-
Chloride	99	-	-
Fluoride	104	-	-
TKN	88	-	-
Ammonia as N	102	-	-
Nitrate N	101	-	-
Nitrite N	96	-	-
Total Phosphorus	96	-	-
Ortho-P (Dissolved)	103	-	-
MBAS	89	-	-
Total Phenols	115	-	-
Oil & Grease	**50** [1]	-	-
TSS	-	-	-
TDS	-	-	-
Turbidity	-	-	-
TVS	-	-	-
Total Metals			
Aluminum	97	99	2
Arsenic	-	-	-
Cadmium	102	102	0
Chromium	92	90	3
Copper	102	102	1
Iron	99	-	-
Lead	105	103	2
Nickel	101	100	1
Selenium	-	-	-
Silver	91	91	0
Zinc	91	91	0
Dissolved Metals			
Aluminum	102	102	0
Arsenic	-	-	-
Cadmium	103	103	0
Chromium	98	96	2
Copper	101	100	1
Iron	95	-	-
Lead	104	104	0
Nickel	102	100	2
Selenium	-	-	-
Silver	96	96	0
Zinc	98	98	1

Bold boxed values indicate analyses that were outside Data Quality Objectives.

- = Not analyzed

1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.7. Summary of Laboratory Control Spike/Laboratory Control Spike Duplicate Results and Relative Percent Differences (RPDs) for Each Sampling Event (Page 6 of 6).

Analyte	*Dry Event 2: 5 May 2004*		
	Original	**Duplicate**	**RPD**
Chlorinated Pesticides			
4,4'-DDD	-	-	-
4,4'-DDE	-	-	-
4,4'-DDT	73	-	-
Aldrin	69	-	-
alpha-BHC	-	-	-
alpha-Chlordane	-	-	-
beta-BHC	-	-	-
Chlordane	-	-	-
delta-BHC	-	-	-
Dieldrin	70	-	-
Endosulfan I	-	-	-
Endosulfan II	-	-	-
Endosulfan sulfate	-	-	-
Endrin	76	-	-
Endrin aldehyde	-	-	-
Endrin ketone	-	-	-
gamma-BHC (Lindane)	**41**[1]	-	-
gamma-Chlordane		-	-
Heptachlor	60	-	-
Heptachlor epoxide	-	-	-
Methoxychlor	-	-	-
Toxaphene	-	-	-
Organophosphates			
Atrazine	-	-	-
Chlorpyrifos	-	-	-
Cyanazine	-	-	-
Diazinon	76	-	-
Malathion	80	-	-
Prometryn	-	-	-
Simazine	-	-	-

Bold boxed values indicate analyses that were outside Data Quality Objectives.
- = Not analyzed
1 = Associated sample values were qualified as low estimates (J-) or (UJ) if non-detect

Table A.8. Summary of Standard Reference Materials (SRMs) Percent Recoveries in Association with each Sampling Event.

Analyte	Dry Event 1	Storm Event 1	Storm Event 2	Storm Event 3	Storm Event 4	Storm Event 5	Dry Event 2
Conventionals							
BOD	116	-	-	-	-	-	-
COD	94	-	-	-	-	-	-
TOC	111	-	-	-	-	-	-
EC	100	97	93	93	98	97	-
Hardness	110	102	98	-	98	96	99
Alkalinity	98	-	-	-	-	-	-
Chloride	87	104	-	-	-	-	84
Fluoride	106	-	-	-	-	-	-
TKN	115	-	-	-	-	-	-
Ammonia as N	101	99	98	98	98	102	-
Nitrate N	116	-	-	-	-	-	-
Nitrite N	93	-	-	-	-	-	-
Total Phosphorus	-	-	-	-	-	-	-
Ortho-P (Dissolved)	-	-	-	-	-	-	-
MBAS	107	-	-	-	-	-	-
Total Phenols	101	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TSS	93	87	99	99	99	-	88
TDS	94	98	96	96	100	95	101
Turbidity	-	-	-	-	-	-	-
TVS	-	-	-	-	-	-	-
Total Metals							
Aluminum	105	109	97	96	96	-	107
Arsenic	-	92	97	100	101	97	94
Cadmium	101	102	104	99	99	-	105
Chromium	97	107	96	99	99	-	99
Copper	104	100	102	96	96	-	96
Iron	99	-	-	-	-	-	-
Lead	91	103	98	100	100	-	105
Nickel	105	102	98	92	92	-	97
Selenium	-	-	102	107	107	105	89
Silver	98	102	102	99	99	-	98
Zinc	116	107	103	105	105	-	101
Dissolved Metals							
Aluminum	98	109	107	105	105	100	107
Arsenic	95	-	-	-	-	-	-
Cadmium	101	102	103	102	102	101	105
Chromium	105	107	101	101	101	97	99
Copper	92	100	101	99	99	99	96
Iron	100	-	-	-	-	-	-
Lead	93	103	101	103	103	101	105
Nickel	99	102	102	99	99	98	97
Selenium	102	-	-	-	-	-	-
Silver	98	102	106	105	105	102	98
Zinc	98	107	104	102	102	102	101

- = Not analyzed

Table A.9. Summary of Results of Surrogate Recoveries for Each Sampling Event.

	Blank	LabDup	MS	MSD	LCS	Belmont	Bouton	Dominguez	Los Cerritos	Field Dup
Dry Weather Event 1										
Chlorinated Pesticides										
Tetrachloro-m-xylene	53	61	-	-	55	61	65	-	70	67
Decachlorobiphenyl	82	61	-	-	81	72	70	-	65	60
Organophosphates										
Triphenyl phosphate	56	142	-	-	116	114	131	-	100	89
Storm Event 1										
Chlorinated Pesticides										
Tetrachloro-m-xylene	58	66	61	65	63	64	72	-	73	78
Decachlorobiphenyl	95	94	101	113	105	70	64	-	63	86
Organophosphates										
Triphenyl phosphate	65	142	70	69	72	148	112	-	80	86
Storm Event 2										
Chlorinated Pesticides										
Tetrachloro-m-xylene	55	86	-	-	66	68	84	77	55	75
Decachlorobiphenyl	96	79	-	-	80	73	70	76	121	75
Organophosphates										
Triphenyl phosphate	59	-	63	62	64	72	63	75	71	94
Storm Event 3										
Chlorinated Pesticides										
Tetrachloro-m-xylene	55	86	-	-	66	80	72	-	81	84
Decachlorobiphenyl	96	79	-	-	80	72	70	-	81	75
Organophosphates										
Triphenyl phosphate	59	-	63	62	64	71	81	-	75	55
Storm Event 4										
Chlorinated Pesticides										
Tetrachloro-m-xylene	64	82	-	-	62	79	65	77	78	78
Decachlorobiphenyl	126	81	-	-	82	86	74	80	65	59
Organophosphates										
Triphenyl phosphate	67	72	-	-	82	-	-	-	-	-
Storm Event 5										
Chlorinated Pesticides										
Tetrachloro-m-xylene	74	67	-	-	52	-	-	74	-	-
Decachlorobiphenyl	111	87	-	-	83	-	-	86	-	-
Organophosphates										
Triphenyl phosphate	79	91	-	-	65	-	-	74	-	-
Dry Weather Event 2										
Chlorinated Pesticides										
Tetrachloro-m-xylene	54	54	-	-	67	61	58	-	64	62
Decachlorobiphenyl	80	72	-	-	67	69	66	-	71	67
Organophosphates										
Triphenyl phosphate	82	76	-	-	99	76	74	-	72	64

- = Not analyzed

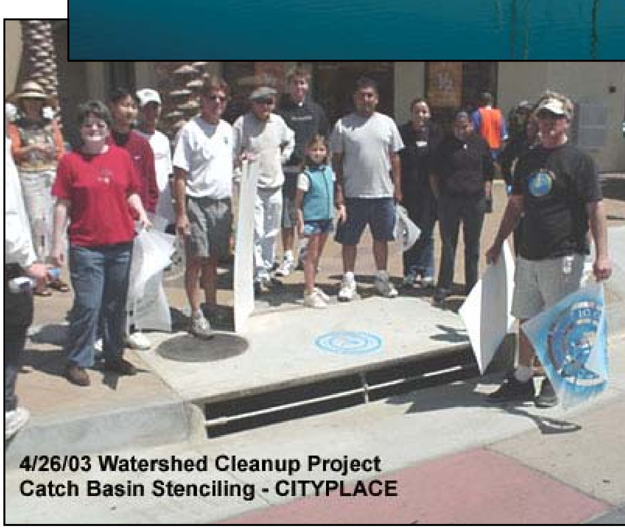
Table A.10. Long Beach Stormwater Toxicity Testing QA Exceptions.

Sample Date	Experiment	Species	Sample	Description
9/11/2003	309022	Sea Urchin	Bouton	Brine control <70% fertilization, retested outside holding time (>36 hours).
2/3/2004	402015	Sea Urchin	Cerritos	Lab and brine controls <70% fertilization, retested outside holding time (>36 hours).
2/18/2004	402059	Water Flea	Bouton, Belmont and Cerritos	Reproduction <15 neonates per female or <3 broods in 60% of females. Results judged to provide valid toxicity assessment.
2/26/2004	402073	Water Flea	Bouton, Belmont	Reproduction <15 neonates per female or <3 broods in 60% of females. Results judged to provide valid toxicity assessment.
5/5/2004	405010	Sea Urchin	Bouton, Belmont	Brine control <70% fertilization, retested outside holding time (>36 hours).

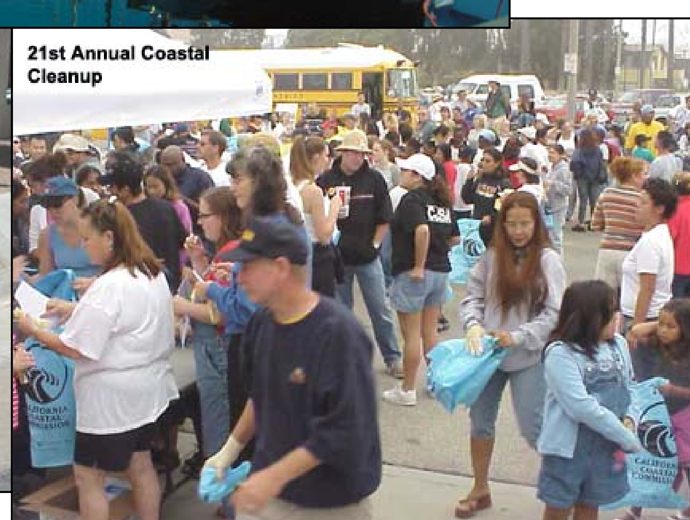
Table A.11 Sampling Holding Times Long Beach Stormwater Samples, 2003-2004.

Date Collected	Sample Location	Hours Held Before Testing	
		Water Flea	Sea Urchin
9/10/03	Belmont Pump	34	52
9/11/03	Bouton Creek	10	**125**
9/10/03	Cerritos Channel	34	51
2/3/04	Belmont Pump	38	39
2/3/04	Bouton Creek	38	38
2/3/04	Cerritos Channel	37	**83**
2/18/04	Belmont Pump	44	45
2/18/04	Bouton Creek	NA	37
2/18/04	Cerritos Channel	41	42
2/23/04	Belmont Pump	NA	34
2/23/04	Bouton Creek	40	38
2/26/04	Belmont Pump	55	**76**
2/26/04	Bouton Creek	51	**73**
2/26/04	Cerritos Channel	53	**75**
5/5/04	Belmont Pump	25	48
5/5/04	Bouton Creek	27	49
5/5/04	Cerritos Channel	26	26

Bold typeface: Test initiation exceeded 72 hour hold time.



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



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