

CHAPTER 3

MICROBIOLOGY WATER QUALITY SHORELINE AND INSHORE

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INTRODUCTION

Santa Monica Bay (SMB) plays a very important part in Southern California's recreation, tourism, and commercial economy, but for decades it has been used as a repository for point and non-point source discharges. These discharges include those from wastewater treatment plants, storm drains, and rivers and creeks. Major concerns regarding the effects of these discharges on the aquaculture, recreation, and other beneficial uses of the Bay, in addition to public health, led to the regulation of treatment plant discharges.

Because of effluent discharge from the Hyperion Treatment Plant (HTP) into Santa Monica Bay waters, the City of Los Angeles (CLA) has been monitoring Santa Monica Bay shoreline and offshore waters since the late 1940's. Initially, monitoring sites were located away from storm drains, but decades of data from both the shoreline and the offshore waters monitoring programs, along with the constantly improving quality of the discharge, indicated that Hyperion's discharge has no discernible impact on the water quality of the SMB shoreline. Instead, test results suggested that runoff to the Bay originating inland and reaching the Bay via storm drains (particularly during periods of heavy rainfall), sewage spills, and illicit discharges, was an important source of contamination (RWQCB 2005).

Runoff from approximately 1,060 square miles of developed land reaches Santa Monica and San Pedro Bays through about 60 storm drains. On an average dry day, approximately 100 million gallons of water flow through Los Angeles' storm drain system and when it rains, the volume of water reaching Santa Monica Bay can be as much as 10 billion gallons (CLA, WPD 2005). Storm drain flows originate as stormwater runoff or as urban runoff from rooftops, parking lots, freeways, industrial facilities, construction sites, residential yards, golf courses, and many other pervious and impervious surfaces. These flows pick up pollutants along the way and deposit them in Santa Monica Bay, resulting in contamination of shoreline waters. Acknowledging historical data regarding Hyperion's outfall and impact of storm drain flows on the SMB shoreline, in 1994 the California Regional Water Quality Control Board, Los Angeles Region (Regional Board) approved the relocation of CLA sampling sites to affect implementation of a region-wide shoreline-monitoring program associated with storm drain outfalls in Santa Monica Bay. Thereafter, focus of the monitoring along the shoreline became directed toward storm drains and monitoring sites were moved closer to storm drain outfalls (a distance of 50 yards).

Implementation of the Municipal Separate Stormwater Sewer System (MS4) permit began in December 2001 (RWQCB 2001). The MS4 permit requires the City of Los Angeles to monitor SMB shoreline stations to evaluate the impacts to coastal receiving waters and the loss of recreational uses resulting from urban or storm water runoff. Compliance with the MS4 permit involved monitoring eighteen shorelines stations six days per week (rather than daily as in the HTP permit) and compliance with AB411 standards. The City of Los Angeles requested that the shoreline component of the region-wide monitoring program be integrated into the MS4 and removed from the Hyperion permit. As a result of the City's request, shoreline bacterial monitoring is not required under the new Hyperion Treatment Plant permit (CRWQCB 2005).

Federal Regulations under the Clean Water Act of 1972 require States to list bodies of impaired water bodies and the pollutants for which they are listed (303(d) list). The Santa Monica Bay was listed as an impaired water body due to the excessive amounts of coliform bacteria (SWRCB 2004). Due to this listing, the States must also develop a watershed-based, pollutant-specific Total Maximum Daily Load (TMDL) to bring the impaired water body into compliance with water quality standards.

On July 15, 2003, the Santa Monica Bay Beaches Bacterial TMDLs (SMBBB TMDLs) became effective. One requirement of these TMDLs was to develop a Coordinated Shoreline Monitoring Plan (CSMP). The final draft of the CSMP was submitted to the CRWQCB in April 2004 and on April 28, 2004 the Regional Board approved the plan. The City of Los Angeles and other responsible jurisdictions implemented it on November 1, 2004. Shoreline monitoring under the CSMP is to be coordinated with similar monitoring required under the MS4 permit, and eventually will be enforced under the MS4 permit. As a result of a request by the City, some TMDL monitoring requirements were incorporated into the MS4 permit monitoring in November

2004. This was done to promote consistency of monitoring and to conserve staff, resources, and funding, while improving water quality monitoring and protecting public health.

Changes in effect (beginning November 2004):

- Sampling locations moved from 50 yards from storm drains to zero point.
- Monitoring frequency reduced from seven to six days per week.
- Frequency of Enterococcus testing changed from five times per month to six times per week.
- Enterococcus testing changed from membrane filtration to the chromogenic substrate method.

One criterion used for the determination of water quality in Santa Monica Bay is the presence of pathogenic bacteria and viruses. Pathogens are typically associated with plant effluent and storm drain runoff and are a public health risk. Because of the association of indicator bacteria with pathogens, the easier recovery of indicator bacteria in relation to the much more difficult recovery for pathogens, and the higher density of indicator bacteria to the small number of pathogens, the water quality of SMB receiving waters is monitored via indicator bacteria. Indicator bacteria include total coliform, fecal coliform, and enterococcus. Both the MS4 permit and the SMBBB TMDLs contain options for alternative methods for the detection of indicator bacteria; the conventional method of membrane filtration (MF) with which historical data had been generated or a chromogenic substrate method (CS, a relatively new method). During 2001-2002, the City of Los Angeles' Bureau of Sanitation, Environmental Monitoring Division (EMD) conducted a study assessing the comparability of these two methods on receiving waters. In addition to procedural differences between the two methods, there is a minor difference in the target organisms. The MF methods tests for total coliform, fecal coliform and enterococcus, whereas CS targets total coliform, *E. coli* (instead of fecal coliform), and enterococcus.

In terms of procedural advantages, the CS method is much easier and less cumbersome than MF and requires fewer supplies and preparation work. In addition, the former allows for a faster turnaround time in getting the samples processed and as a result, leads to earlier data submission to the Department of Health Services (DHS). Total coliform and *E. coli* results can be made available to the DHS within 18 hours instead of 24 hours, thereby, providing the public with earlier notification on the water quality of its beaches and subsequently reducing health risks.

Because the CS method tests for *E. coli* instead of fecal coliforms, one of the three bacterial indicators noted in the AB411 standards, issues regarding the validity of using *E. coli* over fecal coliforms arose. This matter was addressed in a EMD study, which concluded that *E. coli*, a subset of the fecal coliform group, should not compromise public health due to the fact that *E. coli* is the predominant organism found in this group of bacterial indicators.

In November 2002, after submittal of method comparison data, the City was granted approval by the Regional Board to use the chromogenic substrate method, with the understanding that a 1:1 relationship would be used for the fecal coliform: *E. coli* relationship and in December 2002 the City of Los Angeles began testing SMB shoreline waters using the chromogenic substrate method. This method was used for detecting total coliform and *E. coli* only. Methods comparison for enterococcus detection was addressed at a later date; therefore, the membrane filtration method continued to be used for enterococcus testing.

Since the shoreline monitoring component has been incorporated into the MS4 monitoring program and is not included in the new Hyperion NPDES Permit, Ballona Creek data, which has historically been included in the Santa Monica Bay Annual and Biennial Reports, is omitted from this biennial report, but will be incorporated in the 2004-2005 MS4 annual report.

The waters of Santa Monica Bay are routinely monitored throughout the year to assess affects of storm drain flow and Hyperion wastewater discharge on the water quality of shoreline and offshore waters. The results of bacteriological data and field observations during 2003 and 2004 are summarized below.

MATERIALS AND METHODS

SAMPLING LOCATIONS

From January 1, 2003 until October 31, 2004, water samples from 18 Santa Monica Bay shoreline locations were collected daily. To incorporate requirements of the SMBBB TMDLs program into this monitoring program, on November 1, 2004, sample locations were moved to point zero and collected six days per week, Monday through Saturday. Shoreline locations ranged southward from Surfrider Beach in Malibu to Malaga Cove in Palos Verdes Estates (Figure 3-1). All samples were collected during daylight hours. Eleven inshore stations were sampled five times a month. Ten of these inshore stations are located approximately 1000 feet offshore at the edge of kelp beds or near water contact recreation areas. Samples were collected from the monitoring vessel *La Mer* or *Marine Surveyor*. The eleventh inshore station, IS11, is located at King Harbor in Redondo Beach where samples are collected from the Harbor Patrol Dock. Surface and depth samples were taken at each of these inshore stations. Surface samples were collected 0.5 meters below the water's surface and depth samples were collected two meters above the ocean floor.

The Hyperion Treatment Plant effluent was sampled five times a month on rotating days of the week in compliance with Hyperion's National Pollutant Discharge Elimination System (NPDES) Permit. The sampling point was located at a site where the effluent is discharged through the 5-Mile effluent pipe. Sampling occurred during daytime peak plant flow hours.

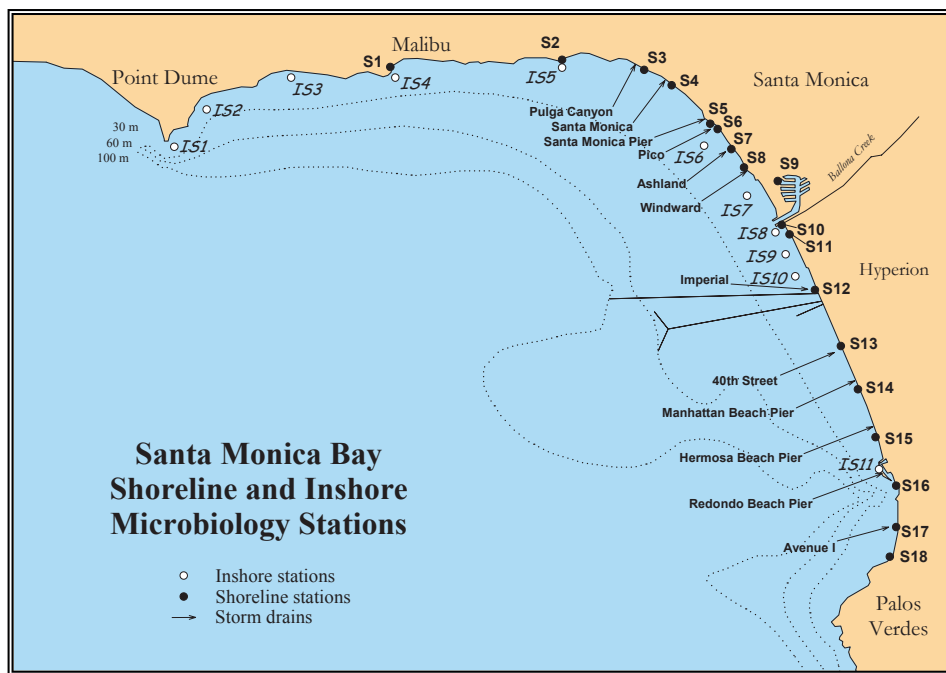


Figure 3-1. Shoreline and inshore microbiology stations in Santa Monica

METHODOLOGY

Water samples were collected and analyzed according to Standard Methods (APHA 1998). Total coliform and *E. coli* densities were determined by the chromogenic substrate method as recommended in section SM9223B. From January 1, 2003 until October 31, 2004, enterococcus densities were determined by the membrane filtration method according to Standard Methods (APHA 1998). In November of 2004, following approval by the CRWQCB, the CLA began using the chromogenic substrate method for the analysis of enterococcus bacteria on all shoreline samples. Total coliform, fecal coliform, and enterococcus densities for inshore and plant effluent samples were determined by the MF method; SM9222B, 9222D, and 9230C, respectively.

From January 1, 2003 until October 31, 2004, shoreline samples were tested daily for total coliforms and *E. coli* and five times a month for enterococcus bacteria. Starting November 1, 2004, shoreline samples were tested 6 times per

week for all indicator bacteria. Inshore and plant effluent samples were collected five times a month and tested for the three indicator bacteria. Inshore samples collected at sea were filtered and initially incubated aboard the monitoring vessel *La Mer* or *Marine Surveyor*. After the vessel docked, agar plates were transferred to the Microbiology laboratory incubators for the remainder of their incubation period.

Visual field observations for shoreline stations were made along a 20-foot stretch of shoreline to the north and south of each station. This area around each station was observed for the presence of materials of sewage and non-sewage origin, any unusual odors of sewage and non-sewage origin, plankton color, and the presence of flow from storm drains. Materials of sewage origin included plastic goods, rubber goods, and grease particles. Non-sewage origin materials included ocean debris, seaweed, refuse, tar, and dead marine animals. Station S08 was used as the shoreline weather station for observations of air and water temperature, weather conditions, wind speed and direction, wave height, and sea conditions.

Inshore stations were observed for water color, clarity, and the presence of floatable items and materials of sewage and non-sewage origin at the time of sample collection. Weather conditions were recorded every four hours while at sea. Daily rainfall data were obtained from the weather stations at the Los Angeles Airport and Downtown Los Angeles, University of Southern California.

Quality assurance and quality control procedures were conducted to confirm the validity of the

analytical data collected. All areas impacting reported data were subjected to standard microbiological quality control procedures in accordance with Standard Methods (APHA 1998). These areas included sampling techniques, sample storage and holding, facilities, personnel, equipment, supplies, media, and analytical test procedures. In addition, duplicate analyses were performed on ten percent of all samples. When quality control results were not within acceptable limits, corrective action was initiated. This quality assurance program helped ensure the production of uniformly high quality and defensible data. The Microbiology Unit participates in the performance evaluation program managed by the California State Department of Health Services (CSDHS) annually. CSDHS, as part of their Environmental Laboratory Accreditation Program (ELAP), biannually certifies the Microbiology Unit.

DATA ANALYSIS

The results obtained from microbiological samples generally are not normally distributed. To compensate for a skewed distribution and to obtain a nearly normal distribution, data must be log-normalized prior to analysis. Geometric means are the best estimate of central tendency for log-normalized data and were calculated for each bacterial indicator group. Annual geometric means were calculated for all shoreline and inshore data while monthly geometric means were calculated for Hyperion Treatment Plant effluent data.

Shoreline data were divided into periods of wet and dry weather to examine the effects of storm drain runoff on indicator bacterial concentrations. Regulatory agencies have defined wet weather as the day of rain plus the following two days. In November 2004, in coordination with the SMBBB TMDLs, the definition of wet weather was defined as the day of rain plus the succeeding three days. In accordance with Hyperion's NPDES Permit, data within 3 or 4 days (HTP NPDES Permit and SMBBB TMDLs, respectively) of a rain event are not included in calculations for compliance with NPDES bacterial water quality limits.

RESULTS

SANTA MONICA BAY SHORELINE

Rainfall

The months of rainfall in 2003 were February through May, and October through December (Figure 3-2). The greatest amount of rain fell in early 2003, with February having the most rainfall with 4.64 inches, and March with 4.59 inches. Five months of 2003 (January, June, July, August, and September) had either no rainfall or showed only trace amounts (<0.01 inches) of rain. The total rainfall for the year was 13.38 inches.

February, October, and December of 2004 were months with the greatest rainfall amounts (Figure 3-2). In contrast to 2003, the highest amount of rainfall fell in the latter part of the year, occurring in October and December (3.78 inches and 8.77inches, respectively) and only four months had either trace amounts or no rainfall (June, July, August, and September). Except for rainfall in January 2004, both years exhibited the same rainfall pattern: seven months of rain and four to five months of dry or trace amounts. The total rainfall amount in 2004 was 18.71 inches, indicating a 39.8 % increase in rainfall from 2003 to 2004.

Shoreline Stations

From January 2003 until October 2004, the SMB shoreline was monitored daily (Sunday to Saturday). However, with the implementation of the Santa Monica Bay Beaches Bacterial TMDLs Coordinated Shoreline Monitoring Plan, beginning November 1, 2004, the CLA requested and was granted approval by the Regional Board, to modify both sampling frequency and location of sites. Sampling frequency was reduced from seven to six days, Monday to Saturday, and sampling locations were moved from 50 yards of the storm drain to the zero point (point at which storm drain discharge meets, or would meet, the surf).

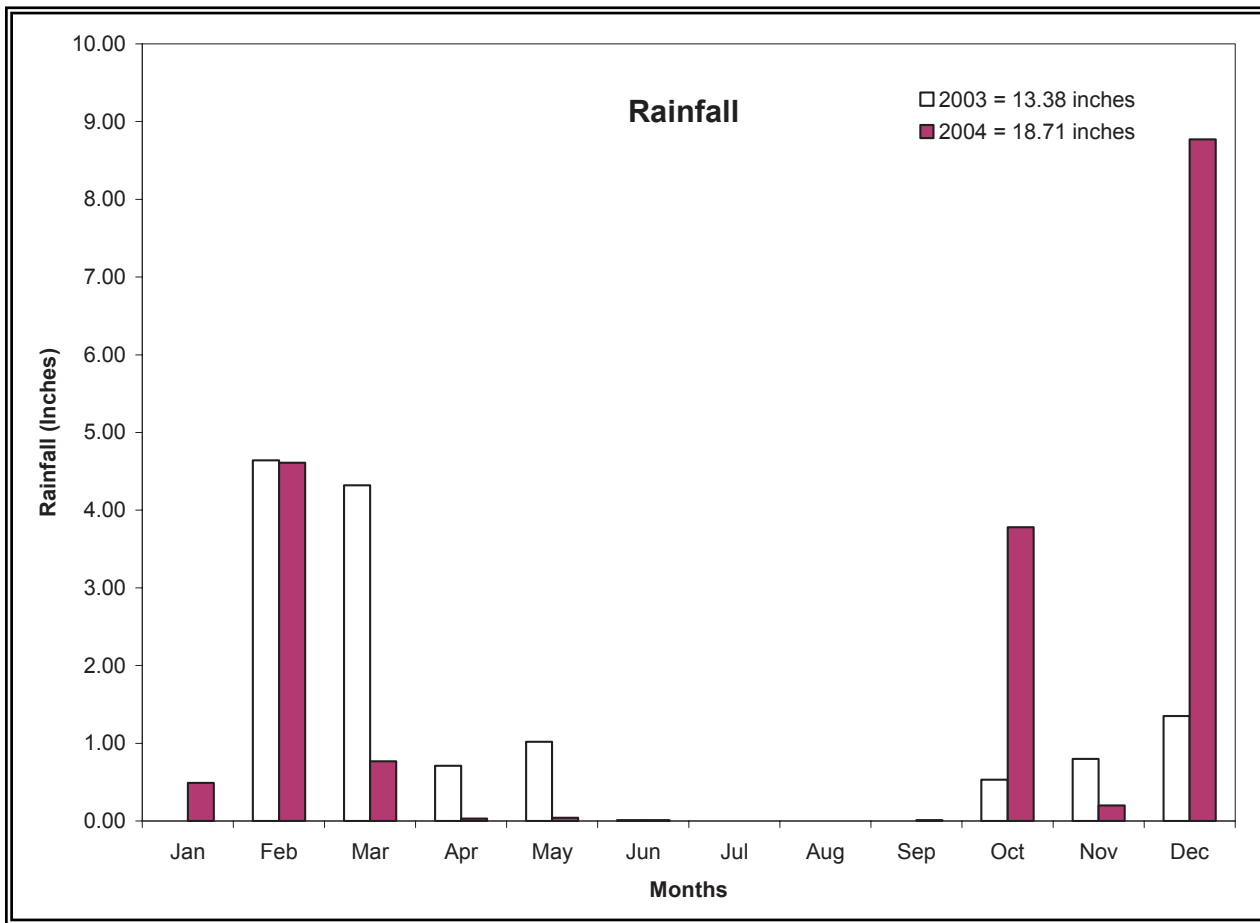


Figure 3-2. Monthly rainfall amounts, 2003 and 2004.

Normally, as seen in past data (CLA, EMD 1997-2003), dry weather indicator bacteria in SMB waters follow a hierarchical relationship. Total coliform densities are usually highest, followed by *E. coli*/fecal coliform, and, subsequently, enterococcus. While this relationship was seen for dry weather means in 2003 and 2004, (Figure 3-3) this pattern was not seen in wet weather where fecal coliform means were either less than or equal to enterococcus.

In total, dry-weather geometric means in 2003 were higher than those in 2004 for total coliforms and enterococcus; *E. coli* means were the exception, where sixteen of eighteen sites in 2004 had higher densities than their counterparts in 2003 (Figure 3-3). During the wet-weather period, total coliform and *E. coli* geometric means for 2004 were greater than those in 2003, while

2003 enterococcus means were very similar to those in 2004.

As usual, wet-weather geometric means were higher than those for dry weather among all indicators. All sites had increased geometric means during wet weather, but those sampling locations with highest counts during periods of rainfall were S01 (Malibu Lagoon), S05 (Santa Monica Pier), S06 (Pico-Kenter storm drain), S09 (Mother's Beach), S10 (Dockweiler State Beach, adjacent to Ballona Creek) and S11 (Culver Blvd) for 2003 and 2004 (Figure 3-3). It is also interesting to note that for 2003 and 2004, total coliform and *E. coli* dry weather geometric means at Station S01 were greater than 50% or more than the means at their respective wet-weather stations; this was also seen at Station S16 for dry-weather *E. coli* means. For example, Station S16 2004

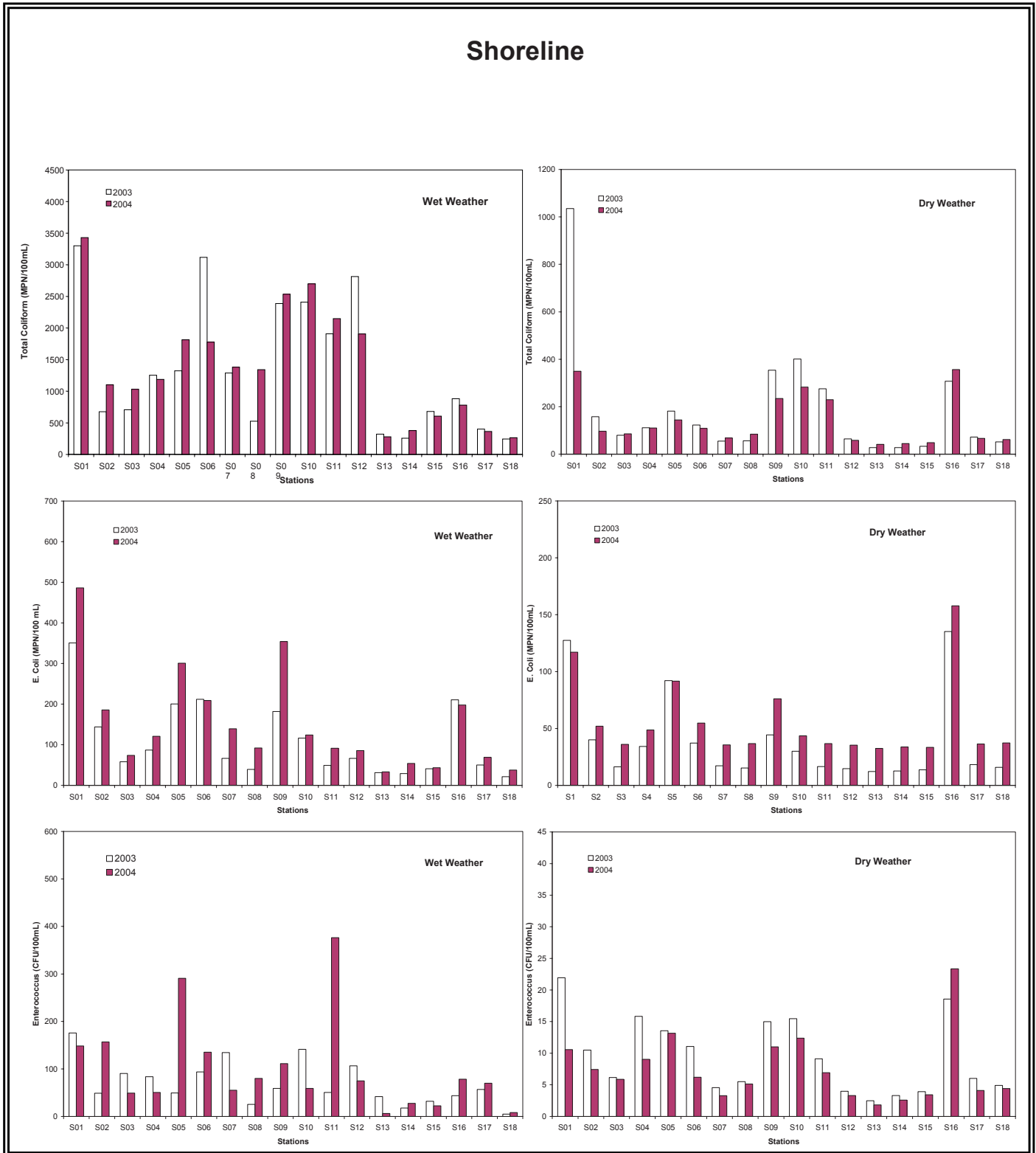


Figure 3-3. Annual geometric means for indicator bacteria at shoreline stations in Santa Monica Bay, 2003-2004.

dry-weather *E. coli* geometric means were greater than 2004 wet-weather *E. coli* means at fourteen stations.

Bacterial densities among sampling sites showed that, overall, S01 (Malibu Lagoon) generally had the highest geometric means for all indicators during both weather periods. The exceptions were geometric means for 2003 dry-weather *E. coli* (S16), 2004 dry-weather means for enterococcus (stations S05, S09, S10, and S16) and total coliform and *E. coli* (S16); and 2004 wet-weather enterococcus means at stations S02, S05, and S11. Additional sites with overall high counts through all indicators were stations S05, S06, S09, S10, and S11. Note that these sites are predominately in the northern part of the Bay, indicating that geometric means for most north Santa Monica Bay sites were greater than those from sites located in the south Bay.

The sampling locations with the lowest bacterial densities overall were stations S13 (Manhattan Beach) and S18 (Malaga Cove, Palos Verdes Estates) for 2003 and 2004, wet and dry periods. Other sites with low geometric means were stations S14 and S15.

Starting November 1 through December 31, 2004, SMB shoreline samples were collected at point zero (zone at which storm drain flow meets or would meet the surf). The majority of geometric mean densities at these sites were higher than those from samples collected earlier in the year (January through October), at 50 yards from the storm drain flow or the mouth of the drain. This pattern is seen along all indicators during wet and dry periods for 2003 and 2004 (Figure 3-4).

Hyperion Treatment Plant Effluent

Comparison of years 2003 and 2004 shows that 2004 had higher densities for all three indicators (Figure 3-5). In 2003 the highest means for total coliforms and enterococcus were in October; and the highest fecal coliform means were in May. For 2004, the highest means for both total and fecal

coliforms were in August, while the highest for enterococcus was detected in April. Although geometric means for 2003 fluctuated throughout the year with no apparent pattern, the higher means for 2004 generally occurred from April until August.

Water Quality Standards

A summary of percent compliance of water quality standards (Table 3-1) for SMB shoreline stations is given in Table 3-2. Station S01 (Surfrider Beach) was the station with the most standards exceeded and the station with lowest compliance. This station exceeded all seven Body Contact and Shellfish Harvesting standards for both years (ranging from 0 to 97% compliance). In addition to S01, stations S04 (Santa Monica storm drain), S09 (Mother's Beach, Marina Del Rey), S10 (adjacent to Ballona Creek), S11 (Culver Blvd, Playa Del Rey), and S17 (Ave I, Redondo Beach) were sites with the highest number of standards exceeded in 2003. For 2004, stations S06 (Santa Monica storm drain), S10 (Ballona Creek), S11 (Culver Blvd), and S16 (Redondo Beach pier), were sites with the highest number of standards exceeded. For 2003 and 2004, the predominate number of stations with the highest number of exceeded standards and the lowest percentage of compliance were located in the northern part of the Bay. At the other end of the spectrum, during both monitoring years, stations S13 and S14, (Manhattan Beach and Manhattan Beach Pier, respectively), were the sites with the highest compliance; all seven standards were met with 100% compliance. Also in 2004, stations S15 and S18 were 100 percent compliant. All of these high compliant stations are located in the southern portion of the Bay.

Comparing monitoring years, 2004 had higher compliance overall than did 2003 for both percentage compliance and the number of standards exceeded (Table 3-2). The standards most exceeded were #2 (Total coliform six-month median, >70 CFU/100 mL) and #5 (>10% Total Coliform exceeding 230 CFU/100 mL) for 2003 and 2004; both are Shellfish Harvesting standards. The standard least exceeded was #6 (Fecal coliform

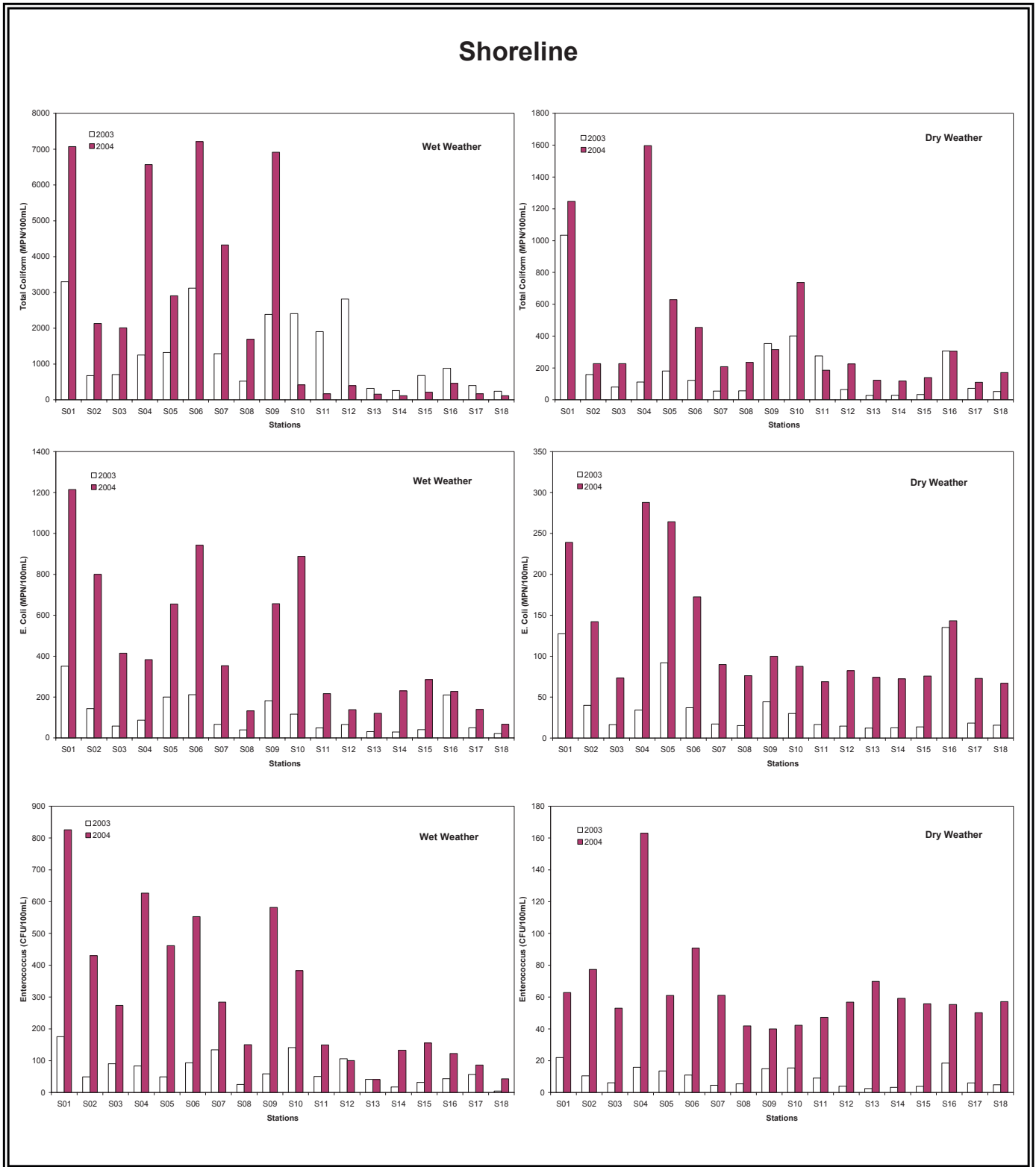


Figure 3-4. Annual geometric means for indicator bacteria at Santa Monica Bay shoreline stations, November and December, 2003 and 2004.

log-mean exceeding 200 CFU/100 mL in 30 days) during 2003 and 2004. Whereas all standards were exceeded in 2003 and 2004, in the previous

biennial reporting years (2001 and 2002), all sites were in full compliance with at least two standards; #1 (Total coliform >10,000 CFU/100 mL) and #4

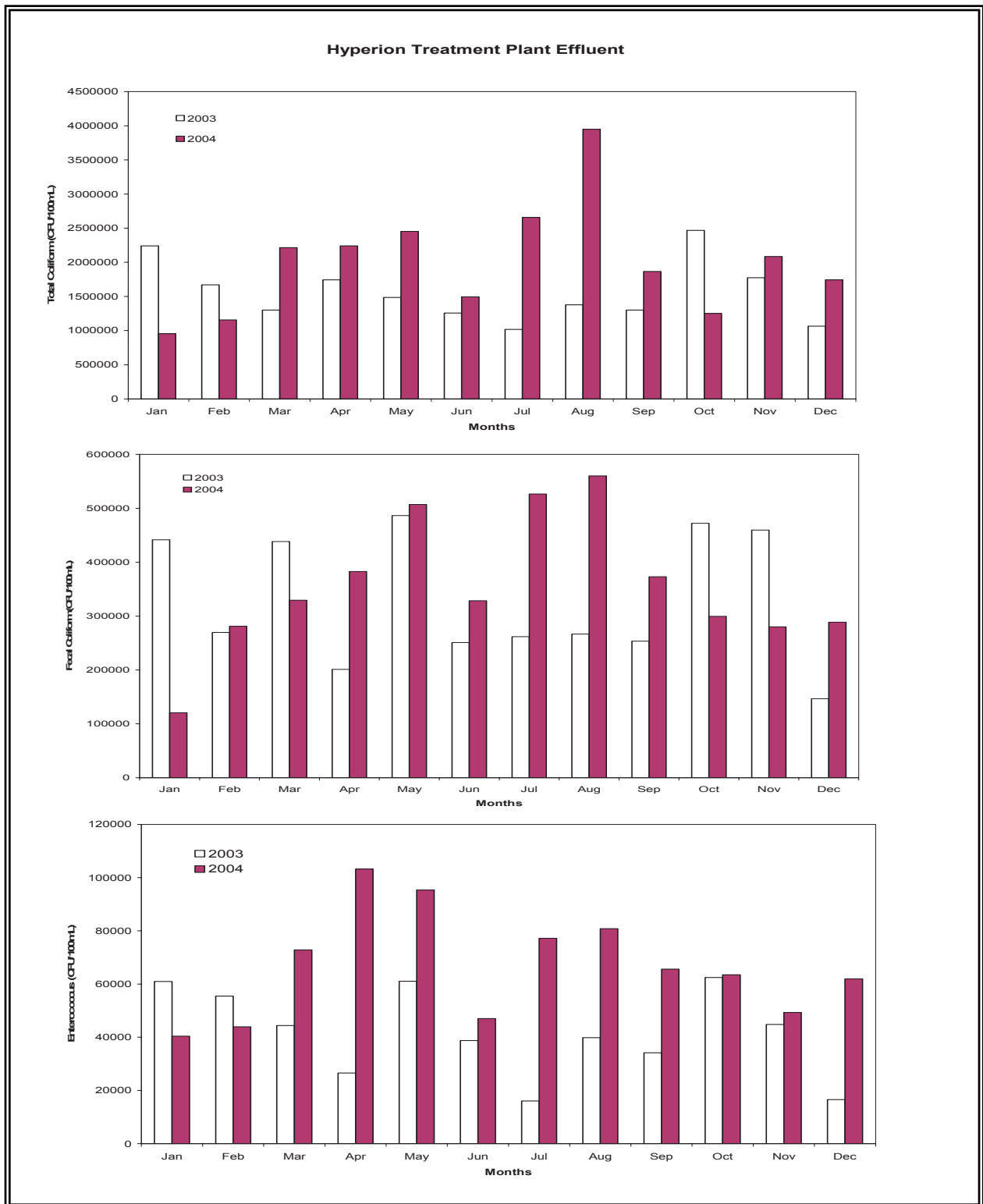


Figure 3-5. Monthly geometric means for indicator bacteria for Hyperion Treatment Plant effluent, 2003 and 2004.

Table 3-1. Summary of bacteriological standards for recreational waters from various sources. Values listed are CFU/100mL.

Standard	Period	Total Coliform	Fecal Coliform	Enterococcus
Water-Contact	Single Sample	10,000 ¹ (Unless repeat sample within 48 hours is <10,000)	-	104 ²
	30-Day	1,000 ¹ (>20% of samples shall not exceed 1,000)	200 ¹ (Geometric mean of at least 5 samples)	24 ³ 35 ²
	60-Day	-	400 ¹ (>10% of samples shall not exceed 400)	-
Shellfish Harvesting	6-Month median	70 ¹	-	12 ³
	6-Month	230 ¹ (>10% of samples shall not exceed 230)	-	-
¹ NPDES Permit No.CA109991 ² USEPA Recommended Limit ³ Sanitary Survey Limit				

(>20% total coliform exceeding 1000 CFU/100 mL in 30 days). With the exception of standard #6, the overall number of stations exceeding each standard was less for 2001/2002 (CLA, EMD 2003) than for 2003/2004.

The Santa Monica Urban Runoff Recycling Facility (SMURRF) treats dry-weather urban runoff from stations S05 and S06 (Santa Monica Pier and Pico-Kenter storm drain, respectively). An assessment was made to determine if the water quality at these sites improved as a result of the diversion. The assessment was based on percent compliance of the NPDES bacteriological standards going back to 1997 to observe if any trending could be established and if the percentages of compliance with those standards indicated improvement in water quality. The last biennial report (2001/2002) found a reduction in the number of water contact standards exceeded for both of these stations (CLA, EMD 2003). For 2003 and 2004, when compared to previous years, 1997 to 2002, there was a reduction in the number of standards exceeded at Station S05, as well as an increase in the percent compliance to Shellfish Harvesting and Water Contact standards. Station S06, however, increased in the number of

standards exceeded when compared to the previous biennial, 2001-2002, but did show a decrease in the number of standards exceeded when compared to earlier years, 1997 – 2000 and improved in percent compliance in comparison to all previous years, 1997 – 2002 (CLA, EMD 1999-2003).

Field Observations

Table 3-3 is a summary of field observations-plastic goods (tampon inserters), rubber goods (prophylactic rings), and grease particles. All are considered to be materials of sewage origin (MOSOs), which, when found, trigger an incidence of treatment plant non-compliance.

The year 2003 had three times as many incidences of non-compliance for MOSOs as 2004; thirty-three incidences in 2003 and eleven in 2004. The station with the greatest number of incidences for MOSOs in 2003 was Station S06 (Pico-Kenter storm drain) and in 2004, Station S10 (Ballona Creek). Overall, Station S10 was the site where more MOSOs were found for both years combined. Stations with the least number of incidences for both years, having no MOSOs found, were stations S01 (Malibu

Table 3-2. Percent of NPDES bacteriological standards limits compliance with total coliform standards (1-5) and E. Coli** standards (6-7) at shoreline stations, 2003-2004.

Percent Compliance														
Sta	(1)*		(2)*		(3)*		(4)*		(5)*		(6)*		(7)*	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
S01	95	97	0	33	50	42	17	42	0	0	83	75	8	25
S02	100	100	0	75	100	100	83	100	17	17	100	100	100	92
S03	100	100	17	67	100	100	100	100	25	33	100	100	100	100
S04	100	99	33	67	100	83	92	75	0	17	100	92	92	83
S05	100	100	0	17	100	100	100	92	8	0	100	92	58	83
S06	100	99	0	50	100	100	83	83	8	25	100	100	83	92
S07	99	100	75	100	100	100	100	100	50	42	100	100	100	100
S08	100	100	75	100	100	100	100	92	33	42	100	100	100	100
S09	100	100	0	0	92	100	67	100	0	0	100	100	92	92
S10	99	100	0	0	83	92	67	67	0	0	100	100	100	100
S11	100	100	0	0	92	92	75	75	0	0	100	100	100	100
S12	100	100	67	83	100	100	100	100	8	50	100	100	100	100
S13	100	100	100	100	100	100	100	100	100	100	100	100	100	100
S14	100	100	100	100	100	100	100	100	100	100	100	100	100	100
S15	100	100	75	100	100	100	100	100	67	92	100	100	100	100
S16	100	98	0	0	100	92	100	67	0	0	100	100	100	42
S17	99	100	67	92	100	100	92	100	25	42	100	100	100	100
S18	100	100	58	100	100	100	92	100	50	83	100	100	100	100

*LEGEND
 (1) Total coliform >10,000 CFU/100mL when verified within 48 hours - Water Contact Std.
 (2) Total coliform six month median >70 CFU/100mL - Shellfish Harvesting Std.
 (3) Total coliform monthly median >1,000 CFU/100mL Water - Contact Std.
 (4) >20% Total coliform exceeding 1000CFU/100mL in 30 days - Water Contact Std.
 (5) >10% Total coliform exceeding 230CFU/100mL in six months - Shellfish Harvesting Std.
 (6) Fecal coliform log-mean exceeding 200 CFU/100mL in 30 days - Water Contact Std.
 (7) Fecal coliform >10% exceeding 400 CFU/100mL in 60 days - Water Contact Std.
 ** E. Coli replaced Fecal Coliform using 1:1 ratio

Lagoon), S02 (Topanga Canyon Lagoon), and S08 (Windward Ave storm drain); all located in the north. There were no grease particles found in 2003 or 2004.

Higher quantities of MOSOs were found in the southern half of SMB than in the northern portion. In 2003, there were more occurrences of plastic and rubber goods in the southern portion of the Bay than in the northern portion, and in 2004, the number of goods found in the south was four times

more than the amount found in the north.

The occurrence of plastic and rubber goods and grease particles decreased dramatically from 1998 to 2004. In 1995 there were 548 occurrences; 1996, 351; 1997, 252; 1998, 381; 1999, 66; 2000, 51; 2001, 38; 2002, 48; 2003, 33; and 2004, 11. Following the same trend, grease particles decreased from 103 in 1995; 1996, 1; 1997, 9; 1998, 32; no grease particles have been found after 1998 (CLA, EMD 1997 - 2003).

Table 3-3. Number of visual observations of materials of sewage origin at shoreline stations, 2003-2004.

Materials of Sewage Origin													
Sta.	PG*		RG*		GP*		Sta.	PG*		RG*		GP*	
	2003	2004	2003	2004	2003	2004		2003	2004	2003	2004	2003	2004
S01	0	0	0	0	0	0	S10	1	0	4	4	0	0
S02	0	0	0	0	0	0	S11	1	0	1	2	0	0
S03	0	0	2	0	0	0	S12	1	0	1	0	0	0
S04	0	0	1	2	0	0	S13	1	0	2	0	0	0
S05	2	0	2	0	0	0	S14	1	0	0	0	0	0
S06	2	0	4	0	0	0	S15	0	0	1	0	0	0
S07	1	0	1	0	0	0	S16	0	0	2	2	0	0
S08	0	0	0	0	0	0	S17	1	0	0	0	0	0
S09	1	0	0	0	0	0	S18	0	1	0	0	0	0

*LEGEND
PG - Plastic goods
RG - Rubber goods
GP - Grease particles

INSHORE

Water quality monitoring via indicator bacteria for Santa Monica Bay inshore waters was performed at ten offshore sites and one land-based site (Fig. 3-1). With the exceptions of stations IS08 and IS11, there was no significant difference between geometric means, surface or depth, when comparing same-site counterparts for 2003 and 2004 (Figure 3-6).

At the majority of stations geometric means were so low that there was no significant difference between surface and depth geometric means, with the exception again of stations IS08 and IS11. Surface total coliform geometric means for both of these stations were slightly higher than those found at depth, for 2003 and 2004. Station IS11, located at King Harbor in Redondo Beach, and the only land-based site, had higher geometric means than IS08, located just outside of the mouth of Ballona Creek, for all indicators, surface and depth (excluding surface enterococcus), for both years.

All sites, except the two previously mentioned, were 100% compliant with Water Contact and

Shellfish Harvesting standards (Table 3-4). Stations IS08 and IS11 were 100% compliant for all NPDES Permit limits except for the total coliform six-month median (Shellfish Harvesting Standard). Station IS08 was out of compliance 50% of the time at the surface and 25% at depth in 2003; the following year it was out of compliance 42% of the time at the surface, but was 100% compliant at depth. Station IS11 was 92% compliant at surface and depth, in both 2003 and 2004. As in the previous biennial report (2001-2002), stations IS11 and IS08 were the only stations of non-compliance and the total coliform six-month median was the limit most exceeded.

DISCUSSION

SHORELINE

Rainfall

The annual total rainfall in Southern California is calculated on a yearly basis beginning July 1

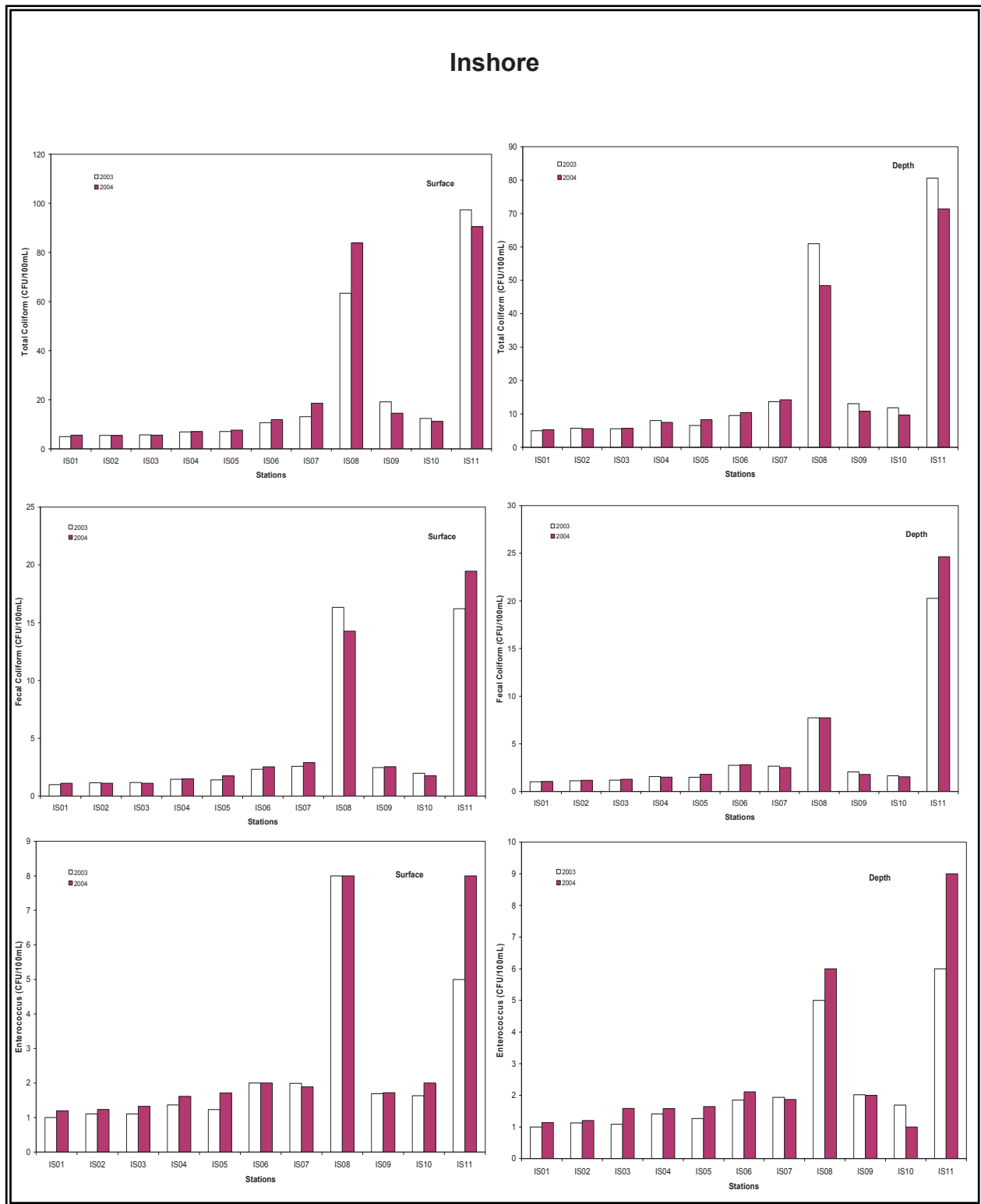


Figure 3-6. Annual geometric means for indicator bacteria at inshore (surface and depth) stations in Santa Monica Bay, 2003-2004.

Table 3-4. Percent of NPDES Permit bacteriological limits compliance with total coliform standards (1-5) and fecal coliform standards (6-7) at inshore stations in Santa Monica Bay, 2003-2004..

Percent Compliance														
	(1)*		(2)*		(3)*		(4)*		(5)*		(6)*		(7)*	
	Inshore Surface													
Sta	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
IS01	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS02	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS03	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS04	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS05	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS06	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS07	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS08	100	100	50	58	100	100	100	100	100	100	100	100	100	100
IS09	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS10	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS11	100	100	92	92	100	100	100	100	100	100	100	100	100	100
	Inshore Depth													
IS01	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS02	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS03	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS04	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS05	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS06	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS07	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS08	100	100	75	100	100	100	100	100	100	100	100	100	100	100
IS09	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS10	100	100	100	100	100	100	100	100	100	100	100	100	100	100
IS11	100	100	92	92	100	100	100	100	100	100	100	100	100	100
*LEGEND														
(1) Total coliform >10,000 CFU/100mL when verified within 48 hours - Water Contact Std.														
(2) Total coliform six month median >70 CFU/100mL - Shellfish Harvesting Std.														
(3) Total coliform monthly median >1,000 CFU/100mL - Water Contact Std.														
(4) >20% Total coliform exceeding 1000CFU/100mL in 30 days - Water Contact Std.														
(5) >10% Total coliform exceeding 230CFU/100mL in six months - Shellfish Harvesting Std.														
(6) Fecal coliform log-mean exceeding 200 CFU/100mL in 30 days - Water Contact Std.														
(7) Fecal coliform >10% exceeding 400 CFU/100mL in 60 days - Water Contact Std.														

and running through June 30, with the majority of rainfall occurring between October and April (CLA, EMD 2003). Southern California has a Mediterranean-like climate, meaning that the greatest rainfall amounts fall within five to six months of the year, and often there is no rainfall at all for several consecutive months (Kayhanian *et al.* 2003). Due to a dominant marine layer, usually from late spring to early fall, significant rainfall is rare between May and October (NWS 2005). Rainfall patterns for 2003 and 2004 followed the normal trend, with the greatest amount of rainfall occurring between October and April, a small amount recorded during May and June, and no rainfall from July through September.

For downtown Los Angeles the average annual rainfall is 14.77 inches (NWS 2005). Rainfall amounts of 13.38 inches and 18.71 inches fell in 2003 and 2004, respectively. This may partly account for 2004 geometric means being greater than those for 2003.

Shoreline Stations

Historic monitoring of Santa Monica Bay has never shown the wastewater discharge from Hyperion Treatment Plant to have a detectable affect upon water quality at CLA monitored shoreline stations. Instead, water quality data has shown that contamination originates from land via storm drain discharge during events such as rainfall, illicit discharges, and sewage spills (RWQCB 2005); data from 2003 and 2004 supports this.

Most Santa Monica Bay monitoring stations with the greatest bacterial densities are located in the northern half of the Bay where the majority of consistently flowing storm drains is found. Stations S01, S05, S06, S09 were some of the sites with the greatest densities, and each is associated with either a storm drain (or a lagoon as is S01) and/or a large heavily used pier. Station S09 (Mother's Beach, Marina Del Rey) is in an enclosed marina and is subject to low or sluggish current flows, and is associated with several small storm drains. Stations S13, S14, S15, and S18, sites with the lowest bacterial densities,

are located in the southern half of the Bay and are either associated with storm drains with the lowest number of flow days, small piers, or open beaches.

Occurrences of observable storm drain flows that reach the surf are noted in Table 3-5. Storm drain data suggests no correlation of high counts solely with the number of days storm drain flow was observed. Rather, the number of flow days in conjunction with the rate of flow (1-light, 2-moderate, 3-heavy), is more predictive of high indicator densities. For example, in 2003 and 2004, stations S01 and S10 had both high counts and a high number of observed flow days. Stations S02, S03, S04, and S12 had more observed days of storm drain flow than all stations excluding S01, S06, and S10, yet they were not the stations with the higher bacterial densities. Stations S09 and S11 had high counts, but a low number of observed storm drain flow days. It is important to note though, that the position of the mouth of the storm drain contributes to the observed number of flow days. Storm drain position (buried in sand, submerged, or extended too far in the surf) or the location of the mouth of the drain, may obscure vision or make the storm drain inaccessible. Flow observations are noted to the best of the observer's ability, but due to safety concerns, observers are not allowed under piers or to venture far into the surf to improve visibility.

Geometric mean (Figure 3-4) and percent compliance data (not shown) from point zero sampling during November to December 2004 show decreased water quality at shoreline stations compared to those stations located 50 yards from storm drain outlets. This confirms an anticipated affect of storm drain and urban runoff on shoreline waters. Studies conducted by regional agencies, academic institutions, and universities have found storm water flows and urban runoff to be major sources of pollution to the Bay (CRWQCB 2005). Test results have indicated that Hyperion's discharge does not reach the SMB shoreline and this key finding has been acknowledged by several organizations including the California Regional Water Quality Control Board, Los Angeles Region, LA County Department of Public Works, LA

Table 3-5. Storm drain flow occurrences, 2003 and 2004

Station	# Flow Days		# Flow Days Nov and Dec		Average Flow Rate*	
	2003	2004	2003	2004	2003	2004
S01	179	173	39	37	2	3
S02	99	67	1	12	2	2
S03	120	160	11	22	1	1
S04	147	138	29	35	2	2
S05	18	5	4	1	1	2
S06	86	75	22	13	2	2
S07	30	17	6	2	1	2
S08	0	0	0	0	0	0
S09	0	0	0	0	0	0
S10	365	366	61	61	3	3
S11	4	1	0	1	1	1
S12	82	47	4	1	1	1
S13	2	1	0	1	2	2
S14	4	1	0	1	2	1
S15	9	2	1	2	1	1
S16	3	0	0	0	1	0
S17	28	14	1	2	1	1
S18	0	0	0	0	0	0

*FLOW RATE
1 - Low
2 - Moderate
3 - Heavy

County Department of Health Services, Heal the Bay, educational institutions such as UCLA, and the United States Environmental Protection Agency Region IX (USEPA).

Hyperion Treatment Plant Effluent

The discharge from Hyperion Treatment Plant became 100% full secondary in November 1998. With this change in treatment, there was a significant reduction in indicator densities in treatment plant effluent (approximately a log reduction for each indicator). There has been no further decline since 1999, but rather a persistent steady state, excluding a slight increase in enterococcus densities for 2004.

Since June 1999, there has been an increase in the number of dry-weather storm drain flows diverted to sanitary sewers. At present there are thirteen storm drains diverted to sewers that feed into

Hyperion; fifteen total diversions since 1977 (two are diverted to and treated by SMURRF), with eight more at present either under construction or in design. This is part of the City's stormwater program low-flow diversion project; an on-going program geared toward increasing the number of diverted storm drains to aid in improving water quality of SMB. With the additional input of more storm drain flows to Hyperion, we may expect to see a change in plant influent, but with Hyperion already operating at full secondary treatment we anticipate very little or no further improvement in the quality of plant effluent. Recognizing that plant effluent discharge has no detectable impact on the SMB shoreline, the microbiology component for monitoring both the plant effluent and the SMB

shoreline is not included under the new Hyperion NPDES Permit, which became effective May 14, 2005. Water quality monitoring for SMB shoreline has been moved under the MS4 permit acknowledging the effects of storm drain flows and other non-point sources on the shoreline.

Water Quality Standards

Water quality standards are the basis of the water quality-based control program mandated by the Clean Water Act of 1972. These standards are important because they help to protect and restore the quality of surface waters, are consistent with the requirements of the Act, set the goals for a water-body by designating its uses, set criteria to protect those uses, and establish provisions to protect water quality from pollution. In addition, they aid in identifying water quality problems such as improperly treated wastewater discharges and polluted non-point discharges (USEPA 2005)

Overall water quality for 2003/2004 SMB shoreline showed no improvement when compared to the previous biennium based on percent compliance and the number of standards exceeded. In fact, comparison with past compliance data (CLA, EMD 1999 – 2003) suggests there was a degradation of water quality, with the exception of some improvement from 2003 to 2004. The perception of degrading water quality may be a result of the change in methodology from membrane filtration to chromogenic substrate. One of the concerns of the CS method was the high rate of false positives for total coliforms. This rate can be as high as 30% (CLA, EMD, unpublished). As previously mentioned the two standards with the highest frequency of exceedances were both total coliform standards and are most likely consequences of the method change. With the establishment of more stringent standards such as those contained in AB411 and with implementation of more TMDLs, there will, more than likely, be an impression of degrading water quality, as these changes may result in more beach closures and postings. However, that is a false impression. In truth, increased and more extensive monitoring simply allows for sharper resolution and better understanding of the problems (Stenstrom 1999).

Field Observations

After \$1.4 billion in costs and more than fifteen years of construction, Hyperion Wastewater Treatment Plant went to full secondary for the second time in its history in November 1998. The reduction in densities of indicator bacteria in plant effluent and reductions in the number of materials of sewage origin found on the SMB shoreline are concrete evidence of improved treatment and water quality. There was more than a one-log reduction in the number of occurrences of materials of sewage origin from 1998 to 2004, and no observable evidence of grease particles, which were frequently observed in the past. Impacts associated with the five-mile outfall discharge have decreased in spatial extent since the 1980's, commensurate with improved water quality (RWQCB 2005). This is especially evident with

the improved water quality brought about with the onset of full secondary.

INSHORE

“Nearshore” monitoring (stations located approximately 1000 feet offshore or at the 30 foot contour, whichever is furthest from the shoreline) was initially included in Hyperion’s NPDES Permit to help detect the movement of the plant’s effluent plume toward the shore. In 1994, this program was replaced or modified by “inshore” monitoring (stations approximately 1000 feet offshore) to detect bacterial concentrations near kelp beds or near water contact recreations areas (RWQCB 2005). As demonstrated herein, few occurrences of non-compliance were seen, with the exception of two stations. One (IS11, 92% compliant) is located at King Harbor in Redondo Beach where the sample is collected at the Harbor Patrol dock and has heavy influence from marina activity, in addition to being a site that is frequented by California sea lions. The other is station IS08, located just outside of the mouth of one of the largest storm drain flows into Santa Monica Bay, Ballona Creek. Station S10, the shoreline monitoring station adjacent to Ballona Creek, was one of the sites with the overall highest geometric means among the shoreline stations; so, it is no surprise that the counts at IS08 are elevated. These findings are in agreement with those of the Regional Board and, as a result, the “inshore” monitoring portion of the new NPDES Permit was modified, reducing the program from a monitoring frequency of five times per month to annually (during summer months).

CONCLUSION

Past and present improvements at the Hyperion Wastewater Treatment Plant have resulted in improved plant effluent, and subsequently, improved water quality in Santa Monica Bay. Studies have shown that urban runoff and storm

drain flows leading into the Bay, and not effluent discharged from Hyperion, are the chief contributors of pollution. These flows result from rainstorms, sewage spills, illicit discharges, street runoff from garden hoses, parking lots, and lawns; just about anything that is dumped or dropped on the ground can become part of stormwater pollution and urban runoff.

According to the City of Los Angeles Stormwater Program (CLA, WPD 2005), the largest source of stormwater pollution is the general public. They are contributors of trash containing fast-food wrappers, cigarette butts, styrofoam containers, motor oil, antifreeze, fertilizer, pesticides, sewage overflow, and pet waste. Plans to reduce stormwater pollution and urban runoff include educational programs, as well as structural best management practices (BMPs). There are four major educational programs geared toward the general public, businesses, City employees, and school education. These programs are expected to contribute to improving water quality along the Santa Monica Bay shoreline.

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