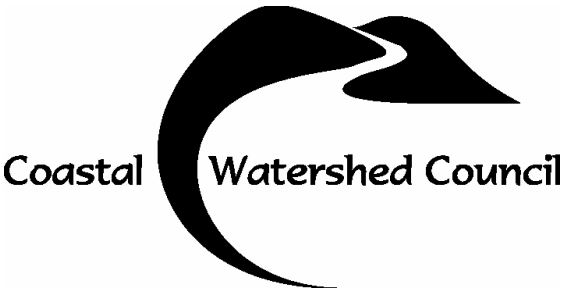


# 2003 Urban Watch Monitoring Program
City of Monterey, California

June 10, 2003 – October 29, 2003

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## PROGRAM OVERVIEW

The City of Monterey Urban Watch storm drain monitoring program was initiated in June 1997 as a collaborative effort between the Coastal Watershed Council (CWC), the City of Monterey and the Water Quality Protection Program of the Monterey Bay National Marine Sanctuary. The purpose of this project is twofold; first is to serve as a tool for education and outreach to the general community regarding the impacts that the citizens have on local water quality, and secondly, to collect useful data to support local environmental management decisions. This is accomplished through the use of trained volunteers to monitor dry-season storm drain discharges at selected outflow areas from June through November of each monitoring year.

Working with staff from the City of Monterey Public Works Department, five sampling sites were selected based on drainage basin and safe access for volunteers. Figure 1 shows the locations of these sites. The five sampling sites were referred to as: (1) *Steinbeck Plaza* located at the end of Prescott Street on Cannery Row; (2) *Twin 51* located near the recreation trail at Heritage Harbor, west of Fisherman's Warf; (3) *San Carlos* at San Carlos Beach near the Breakwater; (4) *El Dorado* on Major Sherman Lane at El Dorado Street, North of Highway 1, Del Monte Shopping Center and Don Dahvee Park; and (5) *Library*, corner of Pacific Street and Madison Street.

Each site of the 2003 Urban Watch program is characterized as follows:

| Station Name | Station ID | Drainage Area (acres) | Primary Land Use | Description | Location | Receiving Water |
|---|---|---|---|---|---|---|
| El Dorado (aka Major Sherman) (Monterey) | MSD1 | N/A | 80% residential 20% commercial | Drainage ditch | Intersection of Major Sherman Lane El Dorado Street | Lake |
| Twin's (Monterey) | MSD3 | 365 | 90% residential 10% commercial | Two 51' diameter concrete pipes | Below walking path at Heritage Harbor-adjacent to Wharf I, west ~500ft. | Ocean |
| San Carlos (Monterey) | MSD4 | 70 | 40% commercial 35% residential 25% public land | 36' diameter concrete pipe | On the beach adjacent to the west side of Coast Guard pier. | Ocean |
| Steinbeck (Monterey) | MSD5 | 37 | 90% commercial 10% residential | 36' diameter concrete pipe | At Steinbeck Plaza on Cannery Row at the end of Prescott Street | Ocean |
| Library (Monterey) | MSD6 | 467 | 100% residential | Drainage ditch | 665 Pacific Street adjacent to the Monterey Public Library on the Northeast side of Pacific Street. | Ocean |


**Figure 1**. Locations of monitoring sites in the Monterey Urban Watch Program.

## PROGRAM DESIGN

The program used the storm drain monitoring kit manufactured by the LaMotte Company (SSDK 7446) and designed in association with the City of Ft. Worth, Texas and the US EPA in 1990. The monitoring kit is designed to provide a method for volunteers to monitor dry-season storm drain discharges to identify common urban pollutants and contaminants within the study area. The kit was developed according to National Pollutant Discharge Elimination System (NPDES) Phase I dry weather monitoring requirements and is designed to detect illegal storm drain connections and discharges. To this pre-assembled kit we added the Oakton 'ECTestr' conductivity meters, and replaced the Oakton 'pHTestr' meter with pH strips for ease of use by volunteers.

Following a half-day training, volunteers were instructed to conduct sampling on a bimonthly schedule. Volunteers were divided into two teams with 3-5 members each. Samples times and dates were randomized through a flexible schedule with the volunteers. Parameters monitored included detergent surfactants, ammonia nitrogen, chlorine, turbidity, pH, conductivity, water and air temperature, odor, and color. Volunteers also noted if there was oil sheen, sewage, trash, and surface scum present. They also determined turbidity visually using a "Low-Medium-High" designation, as well as any other observations of note. Table 1 includes information on each of the parameters monitored and methods used for monitoring.

The Urban Watch Program culminates with the First Flush monitoring wherein the volunteers capture water samples from the storm drains monitored for the Urban Watch program during the first significant rain of the wet season. This rain covers the streets and flushes the gutters and storm drains of collected materials and pollutants that accumulate throughout the dry-season. Infield measurements of water temperature, conductivity, pH, and an assessment of transparency are taken by volunteers at the site, and samples are collected and sent to a professional lab where analysis for nitrate, orthophosphates, zinc, copper, lead, hardness, total coliform, *E. coli*., total dissolved solids, and total suspended solids are performed. The results are compared to the Central Coast Ambient Monitoring Program's (CCAMP) Action Levels. These action levels are not for regulatory purposes. Rather, they provide guidance on potential impacts to the health of the marine ecosystem.

## QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The Quality Assurance/Quality Control (QA/QC) program included the following components:

- Training on monitoring concepts, safety, sampling methods, and hands-on use of equipment.
- Training in use of data sheets and data entry for volunteers.
- Periodic calibration of test equipment, calibration records are available.
- Use of Instrument ID numbers to track equipment used by teams
- Monitoring of reagent stores and expiration dates, waste management.
- Periodic review of data sheets to determine inconsistency in data entry.
- Continued supervision until the trainer was confident in the volunteers' sampling and analysis skills.
- Standard Operation Procedure for volunteers to use in the field while monitoring.
- Processing and analysis of data for report.

**Table 1: Water Quality Parameters**

| Parameter | Possible Sources | Associated Problems | Method/Accuracy |
|---|---|---|---|
| Temperature | Illegal discharges, standing water, large paved surface areas | Affects rates of chemical and biochemical reactions in water. | Method - Digital thermometer<br>Accuracy ± 1% full scale |
| Turbidity | Microorganisms, sediment, erosion | Interferes with fish and other aquatic life | Method - Visual<br>Octa-Slide Viewer<br>against turbidity standard slide bar |
| pH | Aerosols and dust in air, mineral substances, soils, sewer overflows, animal wastes, pesticides & fertilizers, photosynthesis | Interferes with fish and other aquatic life | Method – MacHerey-Nagel pH-Fix 4.5-10.0 color-fixed indicator strips<br>Accuracy ± 0.25 units<br>Min detection: 4.5 |
| Detergent surfactants | Illegal or unintended discharges, car washing, cleaning of screens and grills, leaking sanitary sewers | Can be toxic to many aquatic insects, plants, and fish; can lower dissolved oxygen available to aquatic life | Method - solvent extraction/ bromphenal blue indicator<br>Accuracy ± 0.1 ppm<br>Min detection: >0.1 ppm |
| Copper | Brake pads, copper architectural elements such as roofs or gutters; Illegal discharge into the storm drain system; also can occur naturally in surface waters | Concentrations over 0.025 parts per million are toxic to most freshwater fish | Method-Diethyldithiocarbamate Octa-Slide Comparator against color standard. Accuracy± 10%.<br>Min detection: >0.0ppm |
| Chlorine | Illegal or unintended connection to a stormdrain or draining of a swimming pool; potable water line leaks | Toxic to aquatic life, can create a "sterile" environment | Method – DPD Octa-Slide Comparator against color standard. Accuracy ± 10%<br>Min detection: >0.2ppm |
| Ammonia Nitrogen | Wildlife, fertilizers, Illegal connections to stormdrain systems, poorly functioning septic systems | At certain concentrations can be toxic to aquatic organisms | LaMotte Code 5864<br>Colo-Ruler against a color standard<br>Min detection: >0.1ppm |
| E. coli bacteria | Wildlife, Illegal connections to stormdrain systems, poorly functioning septic systems, wildlife | Detrimental to human health and marine organisms. | IDEXX<br>Standard Method[1] 9223 b<br>Duplicates within 95% confidence limits |
| Conductivity | Discharges high in salts and minerals or metals, water moving through local geology | Possible agricultural, industrial or municipal wastewater runoff | Method –Electrode probe module.<br>Accuracy ± 1%<br>Min detection: 10 mS |
| Color | Tannins from plant material, soils, dyes or chemicals | Interferes with aquatic Insects | Method - Visual<br>Borger Color System |
| Odor | Product of plant decomposition; illegal discharge sources; "clean" drainage water should have no distinctive odor | Can indicate presence of contaminants | Method - Scent |
| Oil sheen | Hydrocarbons such as oil, gasoline, and grease; Decomposing plant materials (ie: eucalyptus); Leaking underground petroleum storage tanks | Toxic to aquatic organisms | Method - Visual |
| Trash, sewage, scum | Illegal discharge or illegal dumping; Scum may be result of plant material decomposition | Interferes with fish and other aquatic life | Method - Visual |

## VOLUNTEER TRAINING

Tamara Doan of the Coastal Watershed Council, Bridget Hoover of the Monterey Bay Sanctuary Citizen Monitoring Network, and Maris Sidenstecker, Water Quality Education Consultant for the City of Monterey, provided a four-hour hands-on training for volunteers on June 5, 2003. Topics included monitoring concepts, sampling procedures, the meaning of each parameter monitored, use of kits in the field, and safety protocols.

Volunteers were placed in teams according to general skill level, interest and time availability. An experienced monitor, Ms. Sidenstecker, went out with each team until staff felt that the groups had an understanding of the sampling and analytical skills outlined in the training packet given to them. Two experienced monitors were chosen as Team Leaders to help coordinate volunteer scheduling, and provide feedback to Ms. Sidenstecker.

## RESULTS

Over the period of June through October 2003, monitoring took place at the various sites 22 times and a total of 110 individual monitoring events occurred. Volunteer availability and other influencing factors were taken into consideration throughout the program and not every parameter was tested on every site visit. Of the five sites monitored throughout the duration of the program, four consistently exhibited flow to be measured. One of the monitoring sites visited, El Dorado (aka Major Sherman), had exhibited no flow in 10 of the 22 site visits, and thus measurements were recorded for only 12 samples.

The parameters listed below were analyzed in the field using the LaMotte kit described in the Program Design section of this report. The detection criteria for each parameter is based on the minimum detection limit for each respective test kit, see Table 1 (Method/Accuracy) for each parameter. If the results of the test were above the minimum detection limit, it was considered a "hit". Please see Appendix 1 for Summary Tables 1 - 5, which provide averages, minimum-maximum values, and frequency of parameters encountered. Appendix 2 presents all raw data collected in the field. Monitoring protocols are available upon request.

### I. Quantitative Parameters

**Detergent Surfactants**
There were 98 samples tested for detergent from the five sampling sites. Of those, 55 tested positive for detergent, or 56% of all samples tested. Three sites detected the highest levels of detergents: San Carlos on 9/18/03 (3.50 ppm), Steinbeck Plaza on 9/4/03 (2.70 ppm) and Twins 51 on 9/30/03 (2.30 ppm). The highest frequency of detergent detections was found at Twins 51 in 20 of 20 samples (100%), followed closely by Steinbeck Plaza, where detergents were detected in 21 of 22 samples (95%). San Carlos indicated detections in 9 of 22 samples (41%), followed by Eldorado (17%) and Library (14%). Detergents ranged between 0.05 ppm to 2.70 ppm at Steinbeck Plaza; of the 21 detections, seven were greater 1.0 ppm (33%). Detergents ranged between 0.20 ppm and 2.3 ppm at Twins 51; of the 20 detections, one was greater than 1.0 ppm (on 9/30/03). Detergents ranged between 0.20 ppm and 2.3 ppm at San Carlos; of the 9 detections, two were greater than 1.0 ppm (on 9/18/03 and 10/28/03).

**Ammonia Nitrogen**
Ammonia nitrogen was detected on 31 of 98 visits to all sites (32%). The most frequently detected value across all sites was .25 ppm, with 22 detections (43%) among all sites. The highest number of detections was found at Twin 51 (40%), followed by Steinbeck Plaza (36%), Library (32%), Eldorado (25%), and San Carlos (23%). The highest concentration reported was from Steinbeck Plaza on 7/22/03, which measured 3.0 ppm.

**Copper**
Copper was detected in 5 of 98 tests (5%) during the monitoring period. The highest concentration reported was 0.25 ppm from all sites except Twin 51, which had no detections.

**Chlorine**
Chlorine was detected in 4 of 97 tests (4%) during the monitoring period. The highest concentration reported was 0.40 ppm from all sites except Twin 51 and Steinbeck Plaza, which had no detections.

## II. Measured Values

The following parameters were measured in the field during the 110 individual monitoring events. Please see Appendix 1 for Summary Tables 1-5, which provide averages, minimum-maximum values, and frequency of parameters encountered. Appendix 2 presents all data collected in the field.

**Flow Presence**
Flow was detected in 98 of 110 observations (89%). Although the site values cannot be compared to one another, depth and width values varied a great deal between visits to a particular site. Average, min-max and frequency can be found in Appendix 1, Summary Table 1. The greatest variance in flow depth was found at the Library site, where depth ranged from 0.50 to 16.5 cm, and the greatest difference in flow width was also found at the Library site where flow width ranged between 3.0 and 90.0 cm.

**Air Temperature**
Air temperature averaged between 19.8°C (Twins 51, San Carlos) and 22°C (El Dorado) for all sites throughout the program. The lowest recorded temperature was 12.9°C at Twin 51 at 4:50 pm on 10/29/03, and the highest recorded temperature was 33.1°C at the Library site at 3:15 pm on 6/25/03.

**Water Temperature**
Water temperature averaged between 16.3°C (Library) and 19.3°C (Twin 51) for all sites throughout the program. The lowest recorded temperature was 14.5°C at the El Dorado site at 5:25 pm on 6/12/03 and at the Library site at 2:40 pm on 6/24/03. The highest recorded temperature was 22.9°C at the El Dorado site at 5:01 pm on 8/5/03.

**Conductivity**
Conductivity measurements were taken with the Oakton ECTester low range meter (0-1990 µS) and with the Oakton ECTester high range meter (0-19.90 mS) as recommended after the 2001 Urban Watch Report showed a high number of readings out of range when just the Oakton ECTester low range meter was used. Conductivity averaged between 1259 µS and 2586 µS for all sites throughout the program. The lowest recorded conductivity was 380 µS at the Twim 51 site at 5:20 pm on 9/2/03, and the highest measurable conductivity value was 8200 µS at the Steinbeck Plaza site at 4:45 pm on 8/19/03.

Sites recording the widest range of conductivity measurements were at the following: Steinbeck Plaza (1000 – 8200 µS), Twin 51 (380 – 3400 µS), and San Carlos (1100 - 3400 µS). El Dorado and Twin 51 had ranges of 1090 - 1400 µS and 2000 – 3200 µS, respectively.

**pH**
pH values throughout the entire program averaged from 7.2 to 7.5. The minimum and maximum measurements taken throughout the duration of the program was 7.0 and 7.5.

## III Qualitative Parameters

Volunteers were asked to make 'presence or absence' observations of the following parameters. More detailed descriptions were noted on the data sheet, and can be provided upon request. Site observations may have been recorded when a water sample was not collected. "Frequency" therefore is the relationship of the number of times the parameter was recorded as other than normal, out of the number of times an observation for that parameter was recorded throughout the program. Please see Appendix 1 for Summary Tables 3 and 4, which provide frequency of parameters encountered. Appendix 2 presents all data collected in the field.

**Odors**
No distinct odors were detected in 92 of 92 samples collected.

**Color**
Volunteers matched water samples to a Borger Color System (BCS) booklet used to identify colors in nature. Forty seven of 98 samples (48%) were colorless across all sites. Other noted colors varied from a drab tan (BCS-91), to a pale yellow (BCS-36) to a drab gray-tan (BCS-92). The remaining samples note water color ranging from a drab peach (BCS-58) to drab grays (BCS-120), and browns (BCS-99).

**Oil sheen**
Oil sheen was detected 6 in 95 samples (6%) during the monitoring period. Of those detected, Steinbeck Plaza noted oil sheen the most (14%).

**Sewage**
'Sewage sighted' or 'sewage smell' was noted on 5 of 96 monitoring events (5%). The highest detection was found at Steinbeck Plaza on 6/10, 7/7, 8/19, and 8/20 (4 of total 5 detections). The other detection was noted at the Library site on 7/22.

**Surface scum**
Surface scum was reported 16 times of 95 total monitored events at all sites (17%). In most cases 'bubbles,' 'soapy water' and 'foam' were reported to be a component of the surface scum. Surface scum was noted most frequently at Twin 51 (35%), followed by Eldorado (25%), Library (19%), Steinbeck Plaza (10%), and none was detected at San Carlos.

**Trash**
Trash was reported on 74 of 98 site visits (89%). Trash was noticed at all sites with great frequency: Steinbeck Plaza had trash sited in 95% of site visits, followed by Twin 51 (85%), Library (73%), San Carlos (64%), and finally Eldorado (50%) site visits. The most common trash observations included plastics, Styrofoam, aluminum, cigarette butts, and candy wrappers.

**Turbidity**
Turbidity was consistently low for all sites, with the exception of one medium turbidity measurement on 9/30/03 at the Twin 51 site.

## IV. Additional Data

**Bacteria (*E. coli*)**
Field samples were collected from each site that exhibited flow during three separate monitoring events on 6/25, 7/16, 7/23, 8/5, 8/18, 9/11, 9/22, and 10/14/2003. Once the samples were collected, they were sent to Monterey Bay Analytical Laboratories to be tested for bacteria counts (*E.coli*) and total coliform.

Results from the lab indicated the presence of *E.coli* and total coliform to be over the water quality objective in 51 of the 74 samples tested (69%). Across all sites, the values for *E.coli* ranged from 63 MPN/100ml (Eldorado on 7/16) to >141,360 MPN/100ml (Steinbeck Plaza on 10/14). The values for total coliform ranged from >2400 MPN/100ml (all sites on 6/25) to >240,000 MPN/100ml (Steinbeck Plaza on 7/23, 8/5, 9/11, 9/22, and 10/14 & Twin 51 on 7/23, 9/11, 9/22, and 10/14).

**Day of Week/Time of Day**
Volunteer monitoring occurred between Monday and Friday. No weekend data was collected for the 2003 program. The monitoring times varied; however, they were consistently in the afternoon hours for the 110 times recorded. The earliest monitoring time was 1:40 pm on 6/24/02, and the latest was 6:40pm on 7/08/03.

## V. First Flush Event

The First Flush monitoring event occurred on Wednesday, October 31, 2003 at approximately 2:00 am, and was held in the cities of Monterey, Pacific Grove, Capitola, and Santa Cruz. Storm drain outfalls were monitored for conductivity, water temperature, pH, transparency, nitrate, orthophosphate, zinc, copper, lead, total coliform, *E. coli*., total dissolved solids, and total suspended solids. The results were compared to the Central Coast Ambient Monitoring Program's (CCAMP) Action Levels. These action levels are not for regulatory purposes; rather they provide guidance on potential impacts to the health of the marine ecosystem.

A separate report has been written for the 2003 First Flush monitoring event and sent to local area governments and agencies. First Flush results illustrate the impact of non-point source pollution generated through our daily interactions in the environment. The pollutants detected, in part, are a result of the daily activities of the local population as well as the many visitors that come to this region each year - high metal concentrations can be attributed to car brake linings, high nutrient concentrations can be linked to fertilizers, and high bacteria concentrations are generated by failing sewer and septic lines, wildlife and pet waste.

Notable findings include:

Bacteria
- All of the sites exceeded the *E. coli* water quality objective of 400 MPN/100 ml.

Metals
- All of the sites, except for El Granada, exceeded the Basin Plan Water Quality Objective for copper (< 30 µg/l) and zinc (< 200 µg/l).
- Steinbeck Plaza had the highest zinc (1170 µg/l) and copper (301 µg/l) concentrations of all the sites this year and the majority of sites in previous years.
- San Carlos had high zinc (712 µg/l) and copper (193 µg/l) concentrations. These values have fluctuated over the years, but they've remained in the top third of the results reported.

Nutrients
- Nitrate concentrations were the highest in four years; yet only one site in Monterey, Steinbeck Plaza, exceeded the CCAMP Action Level of 2.25 mg-N/l.
- Orthophosphate levels were the highest ever recorded for First Flush monitoring and exceeded the CCAMP action level of 0.16 mg/l at every site in Monterey. Once again, Steinbeck Plaza had the highest orthophosphate (4.62 mg-P/l) concentration and one of the highest nitrate (3.146 mg-N/l) concentrations of all the sites.

Oil and Grease

- Oil and Grease was not detected at any site

Total Suspended Solids

- TSS was lower in Monterey than the previous year.

Toxicity

- All of the sites were considered toxic to the mussels at 50% dilution using the bay mussel (*Mytilus galloprovincialis*) 48 hour embryo-larval development test.
- At full strength (no dilution), Steinbeck Plaza was the only site to cause toxicity to topsmelt using a 7 day topsmelt (*Atherinops affinis*) survival and growth test. There was just 28% survival in the water from Steinbeck Plaza.

This data is available to interested organizations, and will be used to assess the pollutant load in the waters flowing into the Monterey Bay National Marine Sanctuary. The results of First Flush are available by contacting Bridget Hoover, Coordinator of the Monterey Bay Sanctuary Citizen Watershed Monitoring Network at (831) 883-9303. Previous First Flush reports can be downloaded from the Internet at: http://www.mbnms.nos.noaa.gov/monitoringnetwork/events.html

## DISCUSSION

Results from the 2003 Urban Watch Program data showed that detergent surfactants and ammonia nitrogen were the most common pollutants detected. Copper was detected five times, Chlorine detected four times, and turbidity was found to be above 'low' once during the 2003 program.

Detergent surfactants have consistently been detected in the storm drains monitored in this program for all monitoring years. Detergents were again found frequently throughout this year's program, and in high concentrations at the Steinbeck Plaza and Twin 51 sites. Among the different sites, detergents were found in 56% of all samples collected. However, detergents were found in 95% of samples taken from the Steinbeck site, with values from 0.10 ppm to 2.7 ppm. San Carlos detected the highest level of detergent for the program (once at 3.5 ppm), with 41% of samples taken testing positive for detergents. The Twins 51 site detergent values ranged from 0.1 ppm to 2.7 ppm with 100% of samples testing positive for detergents.

Detergents are a significant inhibitor to fish health. In concentrations as low as 2.0 ppm, detergents can cause fish to absorb double the amount of chemicals they would normally absorb. All detergents destroy the external mucus layers that protect the fish from bacteria and parasites. Detergents can also cause severe damage to fish gills. Detergent concentrations as low as 5 ppm will kill fish eggs; when detergent concentrations near 15 ppm, most fish expire.

Ammonia nitrogen was detected in 32% of the samples tested and concentrations varied from 0.0 ppm to 3.0 ppm. According to the Santa Cruz County Department of Environmental Health Services as much as 0.5 ppm of ammonium nitrogen can be expected in the native system as background levels, and detections above 0.50 should be looked at more carefully (Peters 2001).

In the 2003 Urban Watch monitoring, the conductivity values ranged from 380 µS to 8200 µS for all sites throughout the program. During the course of the 2002 Urban Watch Program, some of all readings were out of range of the Oakton ECTester low range meter used (0-1990 µS). As recommended, the Oakton ECTester high range meter (0-19.90 mS) was also utilized for the 2003 Urban Watch Program.

Although the Twin 51, San Carlos, and Steinbeck outfalls drain to the ocean, none are inundated with seawater during the dry-season monitoring period. The affect of ocean 'spray' may be a contributing factor at these locations, upstream measurements are recommended to clarify this factor. The El Dorado, and Library sites are inland a mile or more and would therefore not have any sea influence. Identifying the source(s) of water flowing through the storm drains in question and understanding the local geological and environmental influences would provide a more detailed insight to the conductivity of the water flowing at these sites to determine if this is a natural state or if some anthropogenic influence is artificially raising conductivity at these sample collection sites. In the future volunteers will be instructed in properly diluting the sample water or provided a higher range meter in order to collect more useful information.

From a qualitative observational standpoint, no distinct odor or intense color was detected in all samples. Although volunteers reported low findings of the presence of oil sheen (6%), sewage (5%), or surface scum (17%), a high frequency of trash (89%) was noted. The presence of trash can severely affect water quality as it interferes with the natural cycle of fish and other aquatic life, thereby reducing the chance of survival in a depleted habitat.

First Flush results from 2003 illustrate the impact of non-point source pollution generated through our daily interactions in the environment. The pollutants detected, in part, are a result of the daily activities of the local population as well as the many visitors that come to this region each year - high metal concentrations can be attributed to car brake linings, high nutrient concentrations can be linked to fertilizers, and high bacteria concentrations are generated by failing sewer and septic lines, wildlife and pet waste. These results also show trends that should be further studied. One sampling day is not enough to make responsible decisions about water quality, or its impacts on the Monterey Bay National Marine Sanctuary. This data is extremely useful in identifying hot spots and constituents of concern that can then be followed up with additional monitoring and source tracking of the common pollutants; metals, bacteria and orthophosphate. More toxicity analysis should be performed to prioritize problem areas and to get a better understanding of the effects of these pollutants in the marine environment.

## CONCLUSION

It is important to stress the recurrent detection of detergents and ammonia nitrogen throughout the entire program and specifically at the Steinbeck and Twin 51 sites. There should be further investigation by the City of Monterey Public Works Department with the CWC Coordinator for Monterey to strategically locate some new sites "up the watershed" so as to determine where these pollutants enter the system. With seven years of data collected, we recommend continuing to reach further into the drain system to identify more localized sources of flow. Furthermore, outreach should continue to be directed at businesses and increase in the neighborhoods that drain into this part of the storm drain system.

Modifying the current Urban Watch Program tests to include new parameters, expand the detection ranges, or to eliminate parameters that have never been detected over the six-year period, may be warranted. This could be done as the result of a six-year data review with the city of Monterey Public Works department and the Coastal Watershed Council as the first step of establishing the 2004 program.

The First Flush event proved a useful event for data collection and showed a great need to do further monitoring in the systems now looked at with the Urban Watch monitoring. The results from this year continue to reveal high concentrations of bacteria, metals, nutrients, and high toxicity levels, particularly at Steinbeck Plaza, Twin 51, and San Carlos monitoring sites.

The data results continue to show the need for a targeted public outreach program for urban runoff control within the city limits as well as in the neighborhoods that feed these drains. The city of Monterey does an

excellent job utilizing bus ads, posters, coloring books and other outreach materials as public education tools. The restaurant survey and outreach program conducted by the City of Monterey and the Sanctuary currently being repeated is another valuable outreach instrument. Other ideas include collaborating with the Chamber of Commerce and other business associations to promote clean water practices.

In conclusion, it is recommended that the City of Monterey: 1) continue the Urban Watch monitoring program for a seventh season to augment the data presented here; 2) assess upstream sources of illicit discharges and pollutant sources; 3) investigate additional parameters for study; and 4) continue outreach programs targeting local businesses, schools and residents to further reduce detergent concentrations entering the Monterey Bay National Marine Sanctuary.

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