Monterey Bay Sanctuary Citizen Watershed Monitoring Network
299 Foam Street Monterey, CA 93940 Bus. (831) 883-9303 Fax (831) 883-4748

First Flush Event Summary

October 31st and November 3rd, 2003

In the Cities of
El Granada, Half Moon Bay,
Monterey, Pacific Grove, and Santa Cruz, CA

Made Possible by:
Monterey Bay National Marine Sanctuary, Cities of Monterey, Pacific Grove, and Santa Cruz, Coastal Watershed Council, Monterey Bay Sanctuary Foundation, Monterey Regional Water Pollution Control Agency, Marine Pollution Studies Laboratory and University of California at Santa Cruz

Report Prepared by:
Bridget Hoover, Monterey Bay Sanctuary Citizen Watershed Monitoring Network Coordinator

Summary

The Monterey Bay Sanctuary Citizen Watershed Monitoring Network and the Coastal Watershed Council in collaboration with the Cities of Monterey, Pacific Grove, and Santa Cruz coordinated First Flush 2003. First Flush is the first major storm of the season in which months of accumulated contaminants are washed down the storm drain system, into the Monterey Bay National Marine Sanctuary.

This year, the storm that triggered this event in Santa Cruz, Monterey and Pacific Grove began early in the morning on October 31st. That storm did not generate enough runoff in Half Moon Bay and El Granada, so teams there did not mobilize until the early morning hours on November 3rd. Each storm did not produce a lot of rainfall (<0.5 inches in 24 hrs), however the rainfall intensity of the first hour of the storm in each city was high enough to meet the criteria to mobilize; sheeting rain and flowing water from storm drain outfall pipes. Fifty-two volunteers monitored seventeen storm drain outfalls. Most of the outfalls were monitored two to three times at approximately 30-minute intervals to determine any change in contaminants over time.

All of the sites (see Attachment 1 for more information) were monitored for the parameters listed below. Beside each parameter in parenthesis is the range of concentrations that were detected during this event.

- conductivity (170 – 1370 µS)
- water temperature (10.5°C – 19.5°C)
- pH (6.0 – 7.0)
- nitrate as N (.01 – 4.94 mg-N/l)
- orthophosphate as P (0.05 – 4.62 mg-P/l)
- total coliform (32,550 - > 241,920 MPN/100 ml)
- Escherichia coli (*E. coli)* (520 – 241,920 MPN/100ml)
- zinc (108 – 1170 µg/l)
- copper (25 – 301 µg/l)
- lead (10 – 92 µg/l)
- oil and grease (< 5 mg/l)
- total suspended solids (TSS) (25 – 1920 mg/l)
- total dissolved solids (TDS) (125 – 910 mg/l)
- toxicity

Units are represented as milligrams per liter (mg/l) , micrograms per liter (µg/l), Most Probable Number per 100 milliliters (MPN/100 ml), and micro Siemens (µS)

In order to evaluate the data collected during this event, it is customary to compare the results to benchmarks established by the Central Coast Regional Water Quality Control Board. Metal results were compared to the Central Coast Basin Plan Water Quality Objectives for the protection of marine aquatic life. Because there are no numerical water quality objectives in the Basin Plan for total coliform, *E. coli*, nitrate, orthophosphate, total suspended solids (TSS), and total dissolved solids (TDS); those results were compared with the Central Coast Ambient Monitoring Program's (CCAMP) action levels. CCAMP's action levels are benchmarks that are set at levels which may potentially impact cold water fish, and are typically either levels representing existing regulatory standards, levels derived from the literature or other agency references, or levels that are elevated relative to the data distribution for that parameter on the Central Coast. It is important to note that both Basin Plan water quality objectives and CCAMP action levels are established for receiving waters and NOT for discharge waters. A significant amount of dilution usually occurs in the receiving waters within a short distance of each outfall.

Highlights of the results include:

Bacteria

- All of the sites exceeded the *E. coli* water quality objective of 400 MPN/100 ml.
- ***E. coli*** values were much higher this year Santa Cruz than in any other city

Metals

- All of the sites, except for Pico, Half Moon Bay and El Granada, exceeded the Basin Plan Water Quality Objective for copper (< 30 µg/l) and zinc (< 200 µg/l).
- Just 2 sites exceeded the water quality objective for lead (< 30 µg/l) compared to 11 last year.

- Metal concentrations were lower than previous years at the majority of sites

Nutrients

- Nitrate concentrations were the highest in four years; yet only two sites, Steinbeck Plaza and Merced, 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 but one, Delaware.
- All of the Monterey and Pacific Grove sites have exceeded the orthophosphate action level for all four years.

Oil and Grease

- Oil and Grease was not detected at any site

Total Suspended Solids

- Half Moon Bay was the only site to exceed the action level of 500 mg/l with a concentration of 1920 mg/l.
- TSS was lower in Monterey and Pacific Grove and higher in Santa Cruz 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.

In reviewing the trends from year to year, it appears that the intensity of the storm does affect the concentration of pollutants in the discharge. In 2003, the amount of rainfall was less than 0.5 inches in 24 hours, most of it falling within the first hour. The storm in the Santa Cruz area was of greater intensity than in the other areas monitored. In 2002, the amount of accumulation was greater than 1.2 inches of rain in a 24 hr period. While the metal concentrations were lower than last year, the nutrient concentrations were higher. The total dissolved solids were higher because of less dilution and the total suspended solids lower, possibly because of less flow.

The trends between cities were also interesting to compare. Even with the difference in storm size, many of the trends between sites remain unchanged from previous years. In looking at the graphs of different parameters, the pattern is very clear which sites consistently have higher concentrations of particular pollutants.

- In Pacific Grove;
    - Asilomar continued to have one of the highest copper concentrations (128 μg/l).
    - Lover's Point again had one of the highest orthophosphate concentrations (1.75 mg-P/l).
- In Monterey;
    - 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. It also 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.
    - 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.
- In Santa Cruz;
    - Bay Street had high orthophosphate (1.99 mg-P/l) and one of the highest *E. coli*(> 241,920 MPN/100 ml) concentrations of all the sites. This was the first year for elevated concentrations of these parameters at this site. The *E. coli* concentration was 16 times higher than it had been in past years.
    - Woodrow had the highest lead concentration of 221 μg/l. This was at least five times higher than all the other sites and many times higher than previous years. Woodrow also had one of the

highest *E. coli* (> 241,920 MPN/100 ml) concentrations. This is very high compared to previous years and the other sites.
    - Delaware had very high zinc (1060 µg/l) and copper (278µg/l) concentrations in 2003. Over the years, this site has had high zinc concentrations compared to the other sites. The copper values have generally been lower than most sites.
    - Merced had the highest nitrate concentration (4.944 mg-N/l) in 2003 and has commonly had the highest nitrate over the years. However, the concentrations have been below or near the action level of 2.25 mg-N/l.
- In San Mateo:
    - El Granada had very low concentrations of every parameter measured
    - Half Moon Bay had very low concentrations of every parameter measured except for TSS, in which it had the highest concentration of all of the sites.

Conclusion

We are privileged to live in such a beautiful location of the world, an area that is mostly free from the traditional form of water quality impacts from industrial or manufacturing activities. However, 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.

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.

This year, the addition of monitoring sites in Half Moon Bay and El Granada provided a valuable comparison between more urban areas such as Monterey and Santa Cruz to the less developed and sparsely populated areas of the San Mateo coast. All of the parameters measured during the First Flush in San Mateo met the water quality objectives except for *E. coli* and total suspended solids. This contrast between the urban and rural environments suggests that management measures that mimic the natural hydrologic cycle would aid in improving water quality i.e. more permeable surfaces, vegetated buffers and biological filters. Equally important is source control - fertilizers and pesticides should be applied only when necessary and not before watering or when rain is forecasted, pet waste should be picked up and disposed of properly, and sewer systems maintained.

The cities of Monterey, Pacific Grove and Santa Cruz and the Sanctuary, not only make this event possible, but also support education programs that inform businesses, the public, and school children about storm drain pollution prevention, and work tirelessly to improve the infrastructure that has a role in water quality. Also, the volunteers that eagerly respond at any time of the day and night to capture the first storm are testimony to family and friends about the importance of clean water. Ultimately, changing human behavior through education is an important way to improve the quality of water flowing into the Monterey Bay National Marine Sanctuary.

Attachment 1

Station Name	Station ID	Drainage Area (acres)	Primary Land Use	Description	Location	Receiving Water
Eldorado (aka Major Sherman) (Monterey)	MSD1		80% residential 20% commercial	Drainage ditch	Intersection of Major Sherman Lane Eldorado 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
8th Street (Pacific Grove)	PGSD1	35	100% residential	Concrete pipe	West of Ocean View Blvd. between 7th and 8th.	Ocean
Central & 13th (aka Greenwood) (Pacific Grove)	PGSD2	250	90% residential 10% commercial	Concrete pipe	Greenwood Park at the corner of 13th and Central Ave.	Ocean
Lover's Pt (Pacific Grove)	PGSD3	222	90% residential 10% commercial	Concrete pipe	At the top of the cliff on the SE side of main beach at Lover's Pt	Ocean
Pico (Pacific Grove)	PGSD4	131	100% residential	Concrete pipe	On the W side of Sunset Drive approx. 60 ft. N of Pico St.	Ocean
Asilomar (Pacific Grove)	PGSD5	94	90% residential 10% commercial	Drainage ditch	On the W side of Sunset Drive due W of the Asilomar Convention Ctr.	Ocean

Delaware (Santa Cruz)	SCSD1	352	90% residential 5% commercial 5% open space	Concrete pipe	On S side of W. Cliff Dr. at Monterey St.	Creek
Merced Ave (Santa Cruz)	SCSD2	1289	40% residential 10% commercial 50% open space	Concrete pipe	On S. side of W. Cliff Dr. at Merced Ave.	Ocean
Bay Street (Santa Cruz)	SCSD3	285	95% commercial 5% residential	Surface drainage	On S side of W. Cliff Dr. at Bay St.	Creek
Woodrow (time series) (Santa Cruz)	SCSD4	736	80% residential 10% commercial 10% open space	Surface drainage	On S side of W. Cliff Dr. at Woodrow Ave.	Ocean
El Granada	EG 1				Major outfall at Surfers Beach along Highway 1 in El Granada	Ocean
Half Moon Bay	HMB1				Storm drain in Half Moon Bay at Main Street and Pilarcitos Creek	Creek

Attachment 2a – 1st page of Field Data Sheet

Monterey Bay National Marine Sanctuary

First Flush 2003

Field Data Sheet **Date:**

City		**Arrival Time**	
Station ID		**Departure Time**	
Time Rain Began		**Station Name**	

Team Members with phone #'s

1	4
2	5
3	6

Detailed description of weather:

Field Measurements:

Instrument ID:	**Time**

	Parameter	**Taken by:**
H20 Temp	**F or C**	
pH		
Conductivity	**µS**	
Transparency	**cm**	

Notes (include any observations from back side, ie. types of trash, biological observations, etc.

Attachment 2b – 2nd page of Field Data Sheet

Changes Over Time **Station ID**

			(answer yes or no to the observations below)					FLOW (cm)		
Time	Conductivity (µS)	Murkiness	Rain	Trash	Sewage	Oil Sheen	Bubbles/ Scum	Velocity (gpm)	Depth (cm)	Width (cm)

Sample collection for one time series:

Sample ID	Time	Collected by:	Container Type
			glass amber - O&G
			clear 100 ml - bacteria
			sq. white plastic 8 oz. - metals
			sq. white plastic32 oz. - nutrients/TDS,TSS
			clear glass wide mouth - toxicity
			clear glass wide mouth - toxicity
			clear glass wide mouth - toxicity
			clear glass wide mouth - toxicity
			clear glass wide mouth - toxicity
			clear glass wide mouth - toxicity

Duplicates or blanks collected: Yes or No

Sample Custody:

Relinquished By: **Date /Time** **Received By:** **Date/Time**

Attachment 3

METHODS USED IN THE FIRST FLUSH 2003 SAMPLING EVENT

	Constituent	Detection Limits	Units	Laboratory	Method #	Method Principles
Field Measurements						
	Conductivity	10	µS	Field		Electrodes
	Water Temp.	- 5	°C	Field		Spirit bulb
	pH	4.5		Field		Non-bleeding test strips
Nutrients						
	Nitrate as N	0.05	mg/l	Monterey Bay Analytical	EPA 300.0	
	Orthophosphate as P	0.05	mg/l	Monterey Bay Analytical	EPA 300.0	
Bacteria						
	Total coliform	1	MPN/100 ml	MRWPCA	Colilert	Chromogenic Substrate
	E. coli	1	MPN/100 ml	MRWPCA	Colilert	Chromogenic Substrate
	Total coliform	1	MPN/100 ml	SC Cty Dept of Env. Health	Colilert	Chromogenic Substrate
	E. coli	1	MPN/100 ml	SC Cty Dept of Env. Health	Colilert	Chromogenic Substrate
Total Metals						
	Zinc	20	µg/l	Monterey Bay Analytical	SM3111B[1]	acid digestion, AA flame
	Copper	20	µg/l	Monterey Bay Analytical	SM3111B[1]	acid digestion, AA flame
	Lead	10	µg/l	Monterey Bay Analytical	SM3113B[1]	acid digestion, graphite furnace
WQ parameters						
	Oil&Grease as HEM	5	mg/l	Monterey Bay Analytical	EPA 1664	Gravimetric: liquid-liquid extraction with Hexane, volatilization of solvent, weighing of residue
	total suspended solids (TSS)	10	mg/l	MRWPCA	SM2540D[1]	Gravimetric: filtration thru 1.1µm, glass fiber drying and weighing of particulates
	total dissolved solids (TDS)	10	mg/l	MRWPCA	SM2540C[1]	Gravimetric: drying and weighing of 1.1µm filtrate

[1] Standard Methods for the Examination of Water and Wastewater 20th Edition