



Monterey Bay Sanctuary Citizen Watershed Monitoring Network
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2009-2010 MRSWMP Dry Run/ First Flush Summary

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Introduction

The Monterey Bay National Marine Sanctuary (MBNMS) teamed up with the Monterey Regional Storm Water Monitoring Program (MRSWMP) and along with the help of a committed group of volunteers will monitor storm drain outfalls on four separate days:

- one dry weather event (Dry Run) prior to the first rains of the winter season
- during the first major storm of the winter season (First Flush)
- one day in the spring (Spring Run)
- one day in the summer (Summer Run)

To date there have been two monitoring days completed- the Dry Run and First Flush.

Protocols used were all from the First Flush program where volunteers take field measurements of water temperature, pH, electrical conductivity, and transparency measurements; and collect water samples for lab analysis of nutrients (nitrate, orthophosphate, urea), bacteria (*Eschericia coli* and enterococcus), metals (copper, lead and zinc), hardness, and total suspended solids.

Two more dry weather monitoring days are tentatively scheduled for April 3rd and June 26th, 2010, where volunteers will take field measurements and water samples at the same storm drain outfalls as in the previous monitoring events. If no water is flowing from the outfall, this will be noted on the field data sheet.

Programs such as these are important for their monitoring data, but also educate and inspire volunteers. These programs provide a critical link between activities on land and their impacts on the Monterey Bay National Marine Sanctuary.

Methods

This permit year (2009-2010) all MRSWMP monitoring (Dry Run, First Flush, Spring Run, Summer Run) will utilize the First Flush protocols exclusively. By standardizing the protocols, collected data is comparable between wet and dry weather events.

Dry Run and First Flush volunteers in Monterey County received classroom training on September 17th and collected Dry Run samples on September 19th, 2009. The Dry Run monitoring results are from a single sample while all First Flush results are the average of two time series samples. One site was added this year, CVSD-01 located behind the market in The Crossroads shopping center at the southeast corner of Rio Road and Highway 1. This addition brings the total number of sites monitored to 22. The geographic scope extends from the Pajaro River in the north to the Carmel River in the south (Fig. 1).

Water samples were tested for: nutrients (nitrate, orthophosphate, urea), bacteria (*Eschericia coli* and enterococcus), metals (copper, lead and zinc), hardness, and total suspended solids. All results (field and lab) are compared to receiving water standards set for particular beneficial uses in a stream, lake, or ocean—they are not meant for end-of-pipe applications like this, but lacking any other standard, they provide some means of comparison for the results. Dilution and/or mixing is expected to occur in the receiving waters within a short distance of each outfall. Metal results were compared to the Central Coast Basin Plan Water Quality Objectives (WQO) for the protection of marine aquatic life. Nitrate, orthophosphate, and total suspended solids results were compared with the Central Coast Ambient Monitoring Program's (CCAMP) attention levels (see Table 1). For all analytes Minimum Detection Limits (MDL) are noted. The MDL is the minimum concentration that a lab instrument can detect a given analyte. For sites that have a non-detect listed, it is placed on the graph at zero, however the value is not zero but instead somewhere between zero and the MDL.

2009 MRSWMP First Flush Monitoring

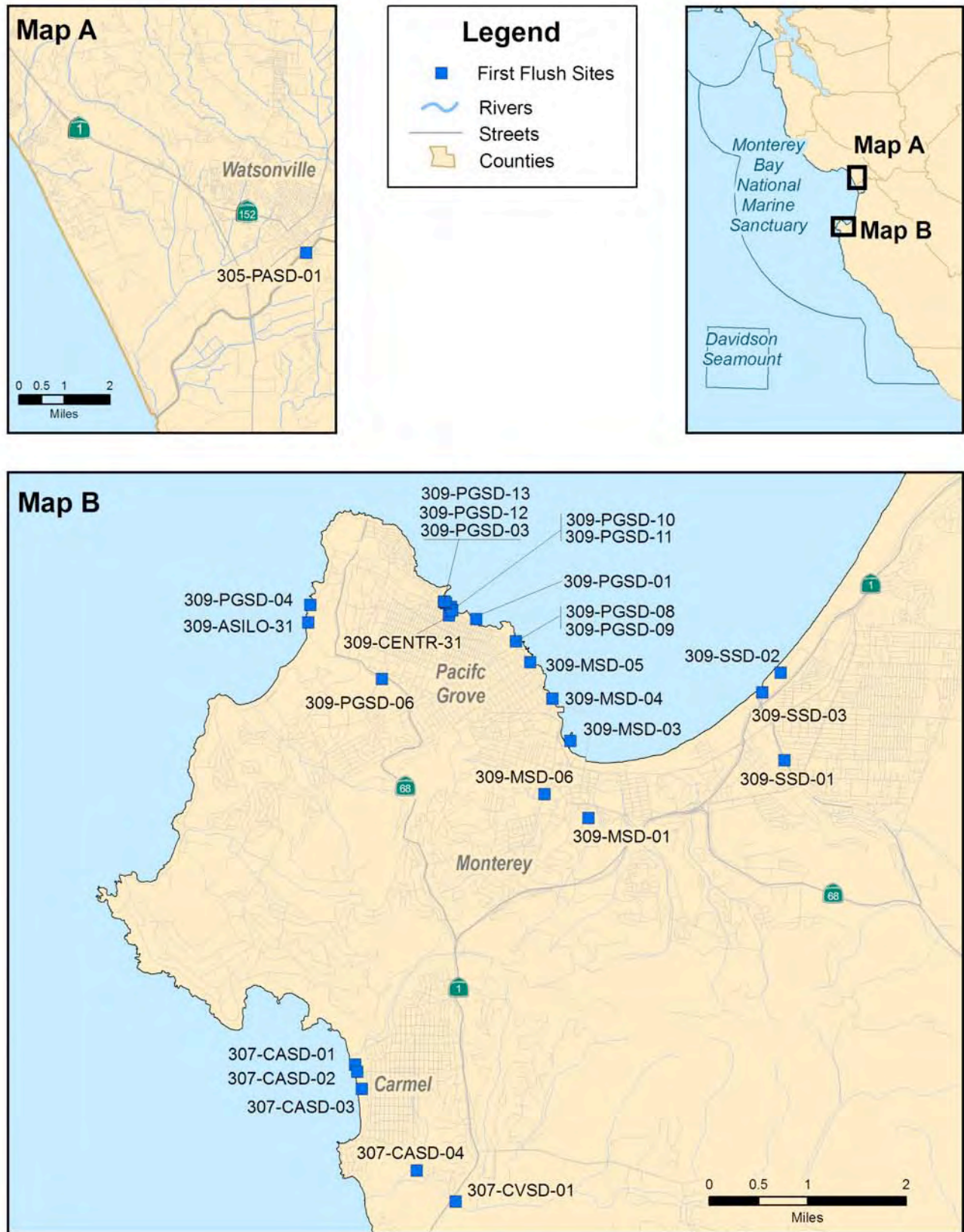


Figure 1. 2009 MRSWMP monitoring sites

Results/Discussion

Dry Run samples were collected on September 19th with the help of 42 volunteers. All sites were visited for the Dry Run but only 10 of the 22 sites had enough water flowing to be sampled. The sites with flow include:

1. Pajaro (Monterey County)
2. Twins (Monterey)
3. San Carlos Beach (Monterey)
4. Steinbeck (Monterey)
5. HopkinsMon (Monterey and Pacific Grove)
6. Greenwood Park (Pacific Grove)
7. Lover's Point (Pacific Grove)
8. Pico (Pacific Grove)
9. Asilomar (Pacific Grove)
10. 8th Avenue (Carmel)

* HopkinsMon is listed for both Monterey and Pacific Grove as the drainage originates in both cities.

The **First Flush** in Monterey County occurred on October 13th, 2009 during a major storm system that extended the length of the monitored areas and beyond- from Napa Valley to south of Big Sur. In Monterey area (measured at the Monterey airport) nearly three inches of rain fell in a 48-hour period, with the heaviest rainfall occurring on October 13th. First Flush teams mobilized and were able to conduct the First Flush monitoring for all twenty-two sites on the morning of the 13th starting at 6:30 AM. A total of 56 volunteers of assisted with the collection of field data and samples. Sites sampled were (from north to south):

1. Pajaro (Monterey County)
2. Bay Street (Seaside)
3. Hotel (Seaside)
4. Twins (Monterey)
5. San Carlos Beach (Monterey)
6. Steinbeck (Monterey)
7. HopkinsMon (Monterey and Pacific Grove)
8. HopkinsPG (Pacific Grove)
9. 8th Street (Pacific Grove)
10. Greenwood Park (Pacific Grove)
11. 15th Street (Pacific Grove)
12. Fountain Avenue (Pacific Grove)
13. Grand Avenue (Pacific Grove)
14. Forest Avenue (Pacific Grove)
15. Lover's (Pacific Grove)
16. Pico (Pacific Grove)
17. Asilomar (Pacific Grove)
18. 4th Street (Carmel by the Sea)
19. Ocean Avenue (Carmel by the Sea)
20. 8th Street (Carmel by the Sea)
21. Mission (Carmel by the Sea)
22. Crossroads (Monterey County)

Table 1: Water Quality Objectives (Urea does not have a WQO and is not listed)

<u>Parameter (reporting units)</u>	<u>Water Quality Objectives</u>	<u>Source of Objective</u>
pH	Not lower than 6.5 or greater than 8.5	General Basin Plan Objective
Water Temperature (°C)	Not more than 22	Basin Plan Objective for Cold Water Fish
Transparency (cm)	Not less than 25	Central Coast Ambient Monitoring Program (CCAMP)
Nitrate as N (ppm)	Not to exceed 2.25	Central Coast Ambient Monitoring Program (CCAMP)
Orthophosphate as P (ppm)	Not to exceed 0.12	Central Coast Ambient Monitoring Program (CCAMP)
<i>E. coli</i> (MPN/100ml)	Not to exceed 400	EPA Ambient Water Quality Criteria
Enterococcus (MPN/100ml)	Not to exceed 104	EPA Ambient Water Quality Criteria
Zinc (ppb)	Not to exceed 200	Basin Plan Objective
Copper (ppb)	Not to exceed 30	Basin Plan Objective
Lead (ppb)	Not to exceed 30	Basin Plan Objective
Total Suspended Solids (TSS) (ppm)	Not to exceed 500	Basin Plan Objective

Table 2: Range of results for Monitoring Events:

Parameter	Dry Run 2009	First Flush 2009
Conductivity	790- 1680 µS	80- 2600 µS
Transparency	12.4- 120 cm	3- 32 cm **
Water temperature	16 - 20 °C	11- 18 °C
pH	6.5- 7.5	5.0 – 7.5
Urea	ND*- 447 µg/L	ND*-1015 µg/L
Nitrate as N	ND*- 4.80 mg-N/L	ND* – 2.90 mg-N/L
Orthophosphate as P	ND*- 0.90 mg-P/L	0.20 –3.77 mg-P/L
Total Copper	ND*- 86 µg/L	10-408 µg/L
Total Zinc	ND*- 234 µg/L	15-368 µg/L
Total Lead	ND*- 10 µg/L	ND*-63 µg/L
Total Suspended Solids (TSS)	ND*- 51 mg/L	8–726 mg/L
<i>Escherichia coli</i> (<i>E. coli</i>)	104- >48,392 MPN/100ml	4681- 241,959 MPN/100ml
Enterococcus	104- 48,291 MPN/100ml	1193- >241,960 MPN/ 100ml

*ND is Non- Detect where results are below detection limits. For graphs these non-detects are given the value of the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL.

**Transparency during First Flush was not monitored at San Carlos, Steinbeck, Greenwood Park or Ocean Avenue due to darkness.

Nutrients

Nitrate

The CCAMP attention level for nitrate as N ($\text{NO}_3\text{-N}$) is 2.25 mg-N/L. The minimum detection limit (MDL) is 0.1 mg-N/L.

For the **Dry Run**, two (20%) of the ten sites monitored were above the attention level for nitrate. The highest result was in Pacific Grove (Lover's Point) with a value of 4.8 mg-N/L (Fig. 2).

During **First Flush**, one (5%) of the twenty-two monitored sites was above the attention level for nitrate. The highest concentration was in Pacific Grove (HopkinsPG) with a time series average of 2.7 mg-N/L (Fig. 2 and 3).

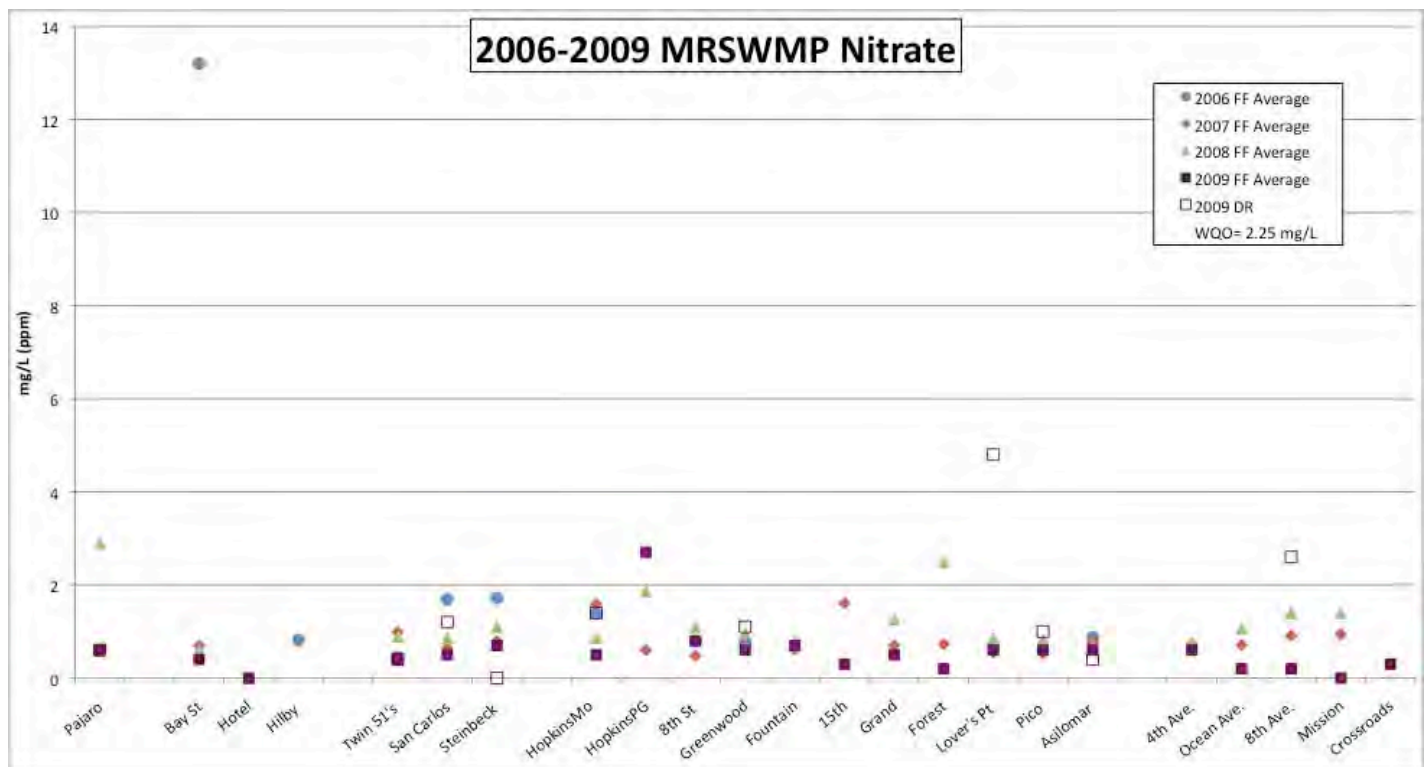


Figure 2. Results for Nitrate-N for the 2009 Dry Run and time series averages for First Flush. Sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Figure 3. Average nitrate concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Phosphate

The CCAMP attention level for orthophosphate as P ($\text{PO}_4\text{-P}$) is 0.12 mg-P/L. For the Dry Run the MDL was 0.10 mg-P/L and for the First Flush, the MDL was 0.05 mg-P/L

For the **Dry Run**, seven (70%) of the ten sites monitored were at or above the MDL. The highest result was in Monterey County (Pajaro) with a value of 0.90 mg-P/L and in Monterey (Twins, Steinbeck Plaza and HopkinsMon) with a result of 0.30 mg-P/L (Fig. 4).

During **First Flush**, twenty-one (95%) of the twenty-two sites monitored were at or above the MDL for orthophosphate. Carmel (Mission) had the highest average time series concentration for orthophosphate (2.67 mg-P/L) (Fig. 4 and 5). The next highest average time series concentration was in Monterey (Steinbeck) with a result of 2.48 mg-P/L. Pacific Grove (Asilomar) had the lowest result of all twenty-two monitored sites with an average concentration equal to the WQO, 0.12 mg-P/L.

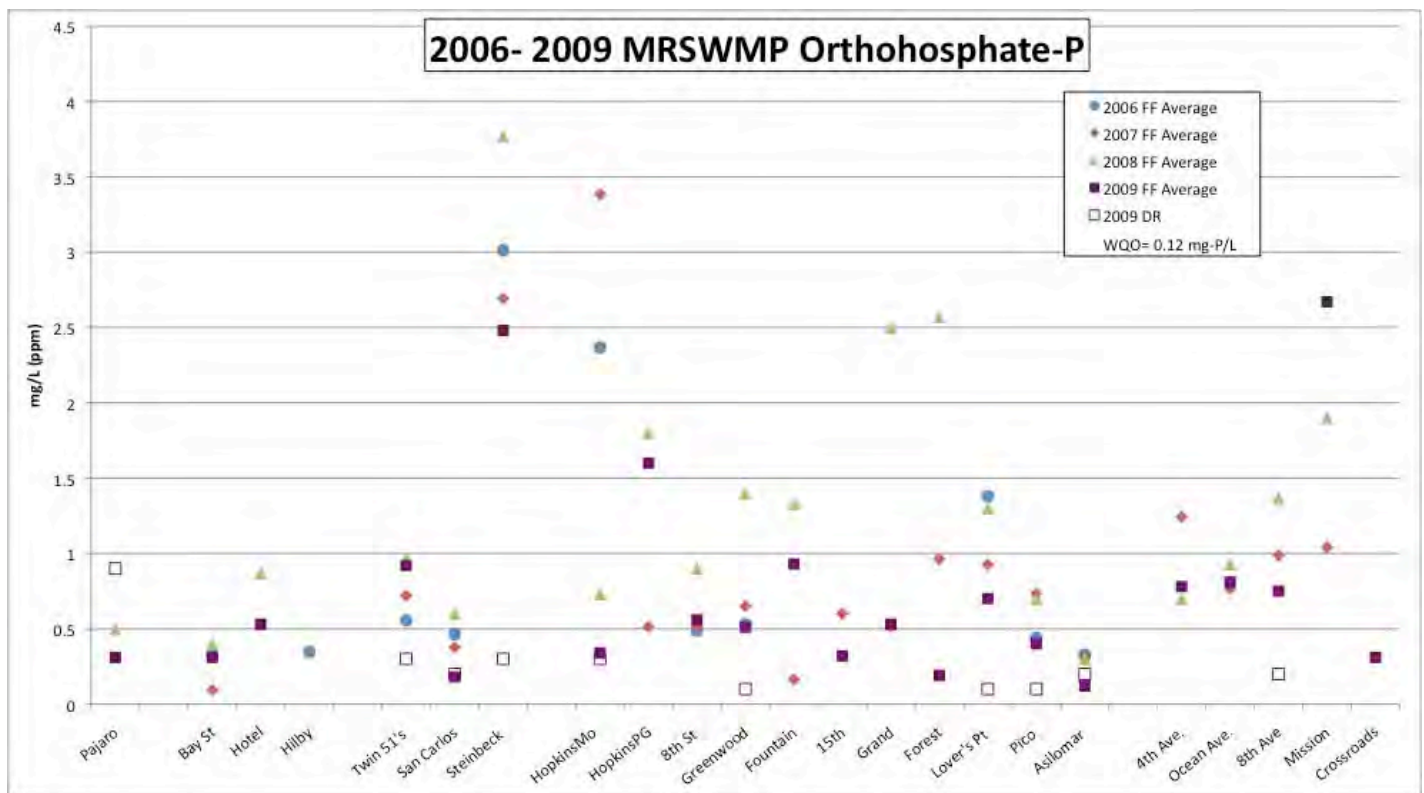


Figure 4. Results for Orthophosphate-P for the 2009 Dry Run and time series averages for First Flush. Sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

2009 MRSWMP First Flush Monitoring-Orthophosphate-P

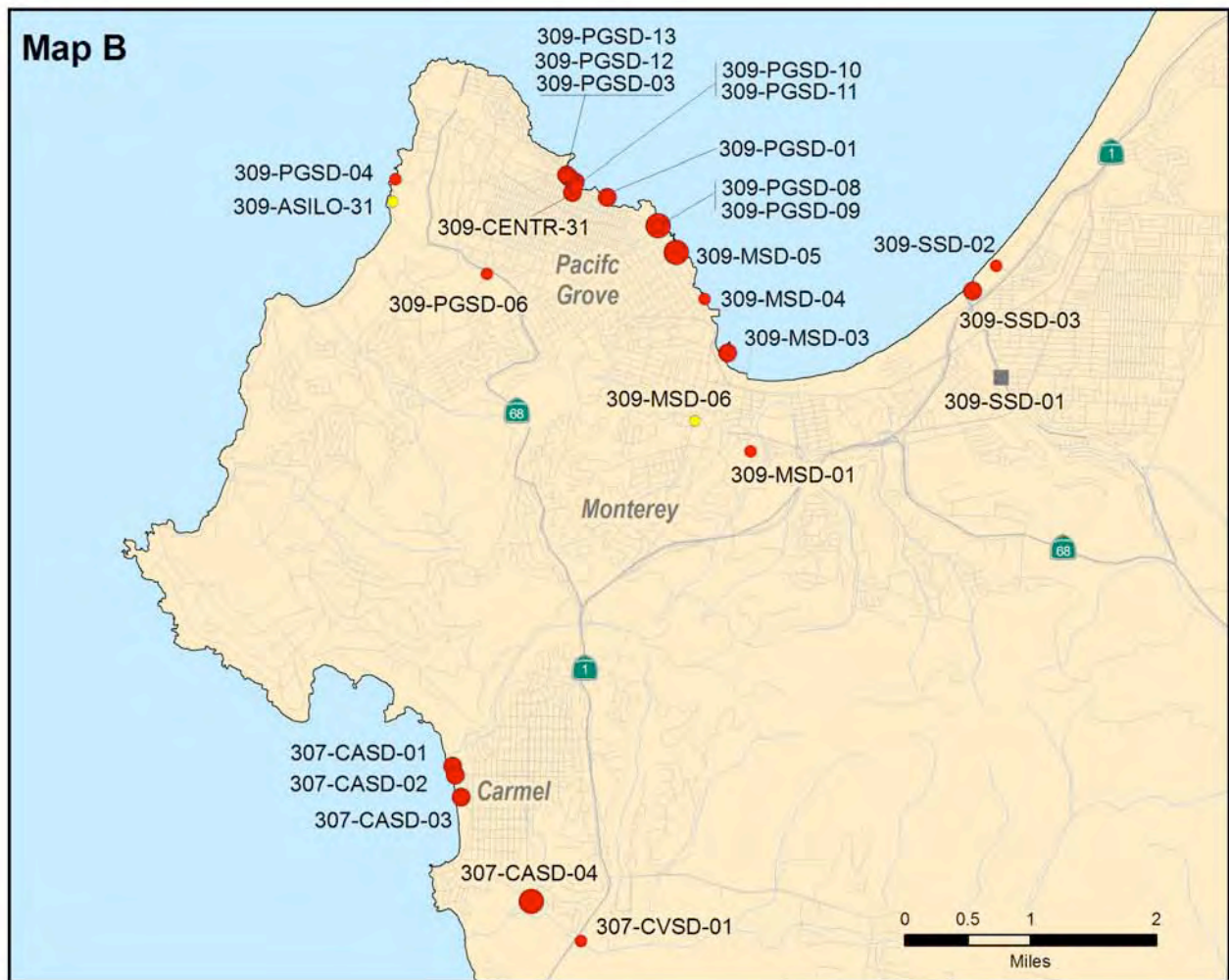
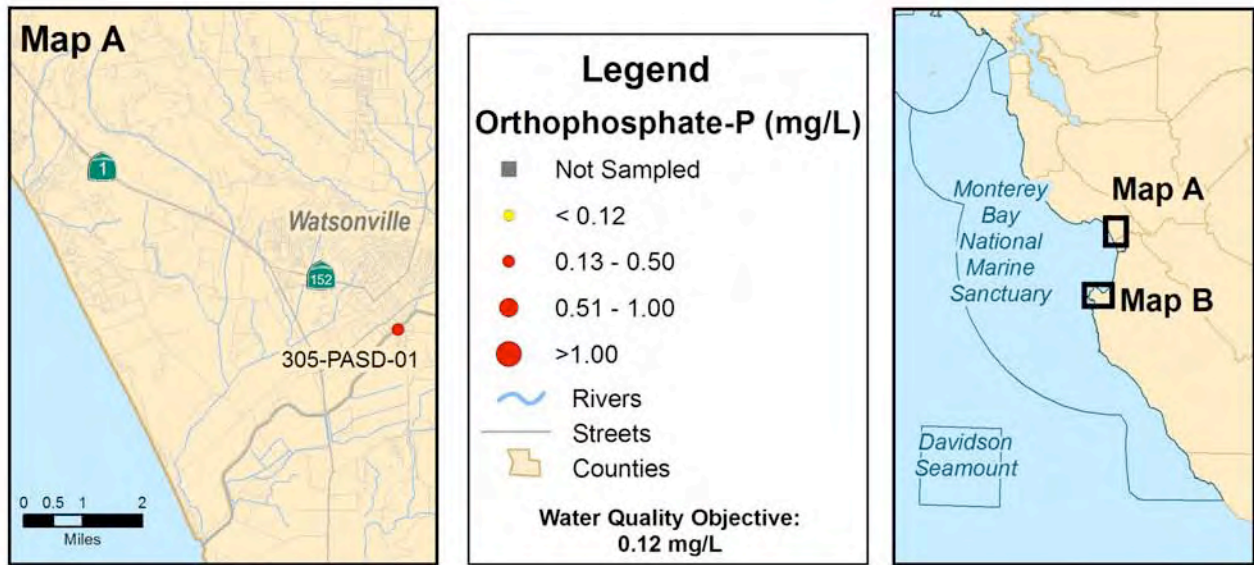


Figure 5. Average phosphate concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Urea

There is no water quality objective for urea, values are noted and compared to previous year's results in order to monitor trends. This parameter was added due to scientific research linking urea to increased toxicity in algal blooms.

For the **Dry Run**, the two highest urea results were in Monterey (Twins) with a value of 250 $\mu\text{g/L}$ and at HopkinsMon with a value of 193 $\mu\text{g/L}$ (Fig. 6). Two non-detects were noted in Carmel by the Sea (8th Avenue) and Monterey (San Carlos).

During the **First Flush**, urea was only measured during the first time series. Pacific Grove (HopkinsPG) had the highest concentration of 1671 $\mu\text{g/L}$ (Fig. 6). The lowest concentration of all sites monitored was in Pacific Grove (Pico and Asilomar) with a result of 35 $\mu\text{g/L}$.

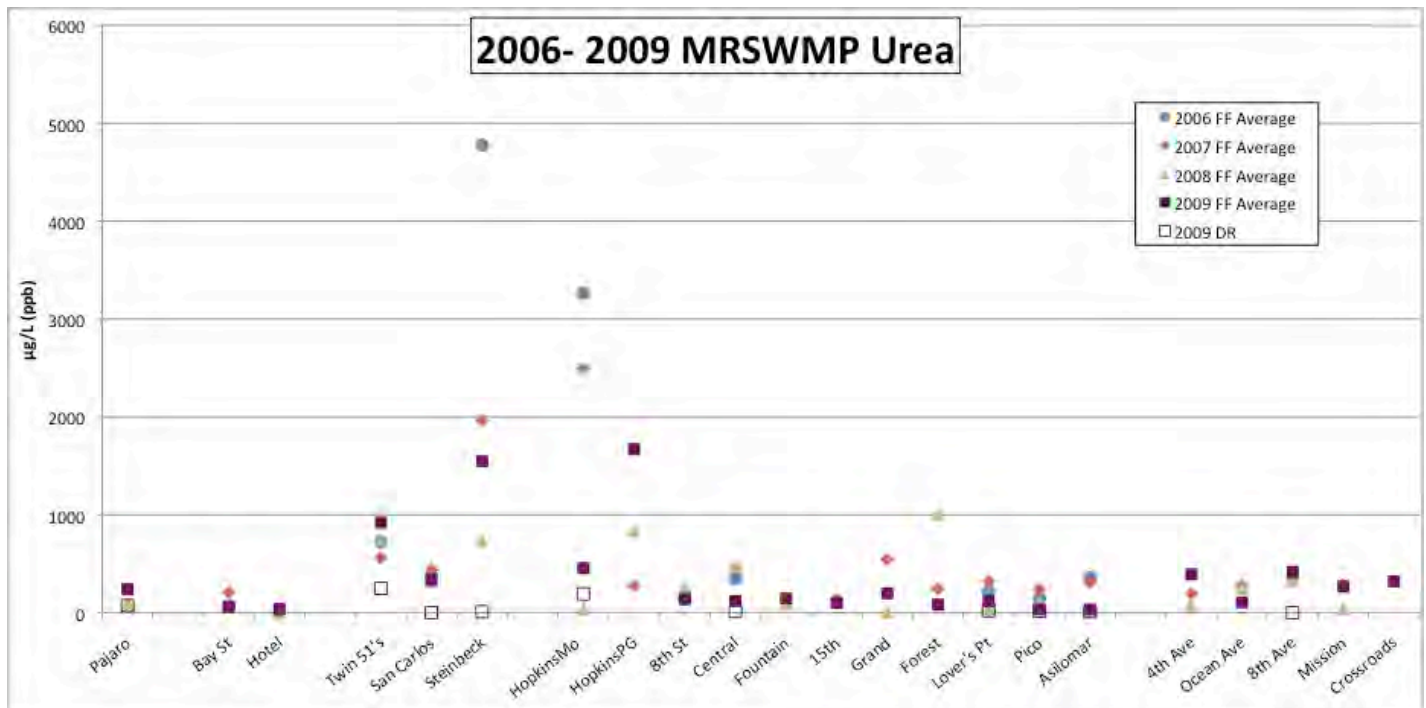


Figure 6. Urea results for the 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Bacteria

E. coli

The EPA's Ambient Water Quality Criteria for *E. coli* is 400 MPN/ 100 ml. The MDL is 20 MPN/ 100 ml.

For the **Dry Run** four (40%) of the ten sites monitored were above the Water Quality Objective (WQO) for *E. coli*. These sites were in Monterey (San Carlos Beach, Steinbeck and HopkinsMon) And in Pacific Grove (HopkinsMon and Greenwood Park). The highest *E. coli* result was >48,392 MPN/100 ml in Monterey (HopkinsMon) (Fig. 7).

During the **First Flush** *E. coli* was high in all cities; all (100%) of the twenty-two sites monitored were above the WQO for *E. coli*. The highest concentration for *E. coli* was 241,959 MPN/100 ml in Pacific Grove (Fountain) (Fig. 7 and 8). Two sites in Carmel and the Crossroads site were not analyzed due to a lab error.

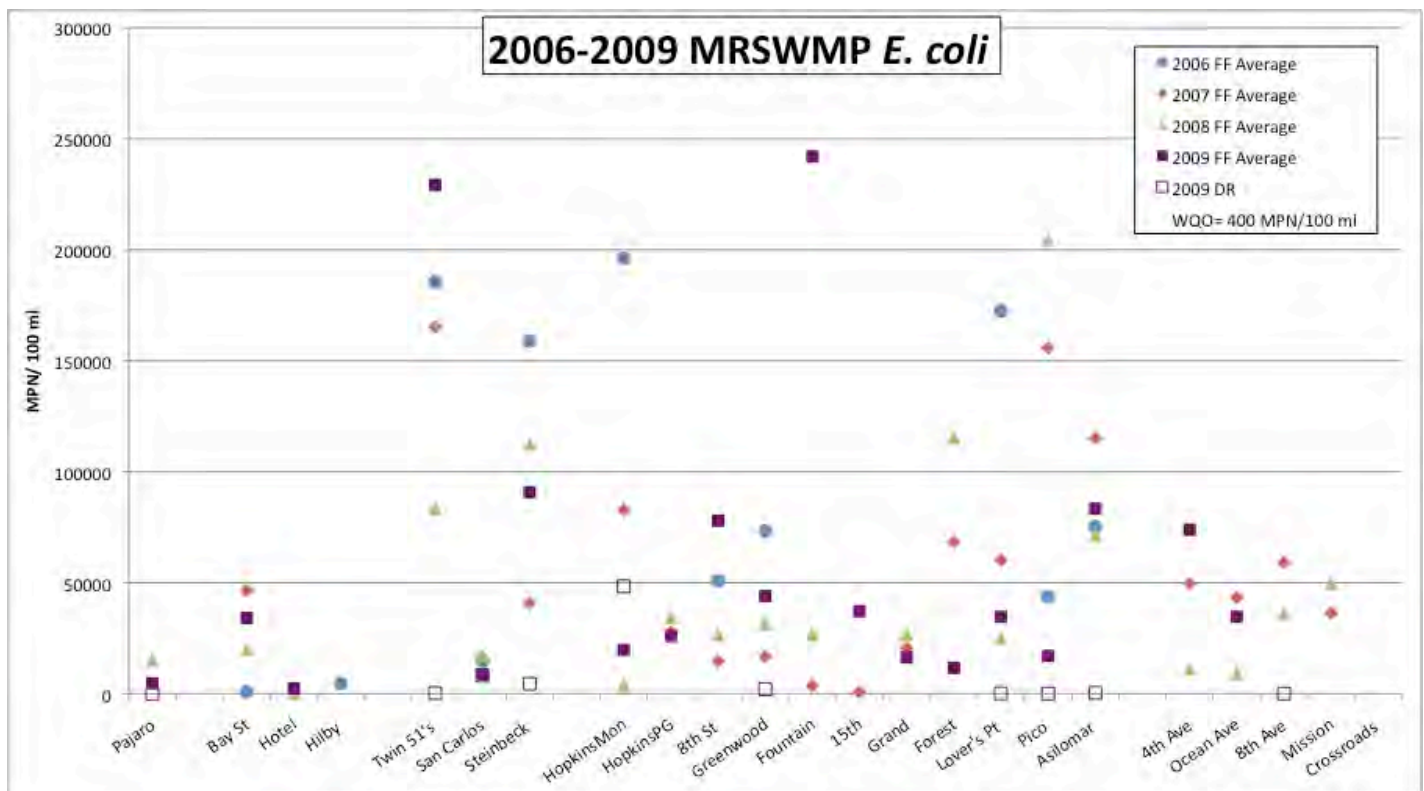


Figure 7. *E. coli* results for the 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Figure 8. Average *E. coli* concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Enterococcus

For the Dry Run only one site did not exceed the WQO of 104 MPN/100 ml and that was in Pacific Grove (Lover's) with a concentration of 104 MPN/ 100 ml. The highest enterococcus result was 48,291 MPN/ 100 ml in Monterey (HopkinsMon) (Fig. 9).

During the **First Flush** enterococcus was high in all cities; all (100%) of the twenty-two sites monitored were above the WQO. The highest concentration for enterococcus was >241,960 MPN/100 ml in Monterey (Steinbeck). Conversely the lowest concentration of enterococcus was 1193 MPN/ 100 ml in Seaside (Hotel) (Fig. 9 and 10).

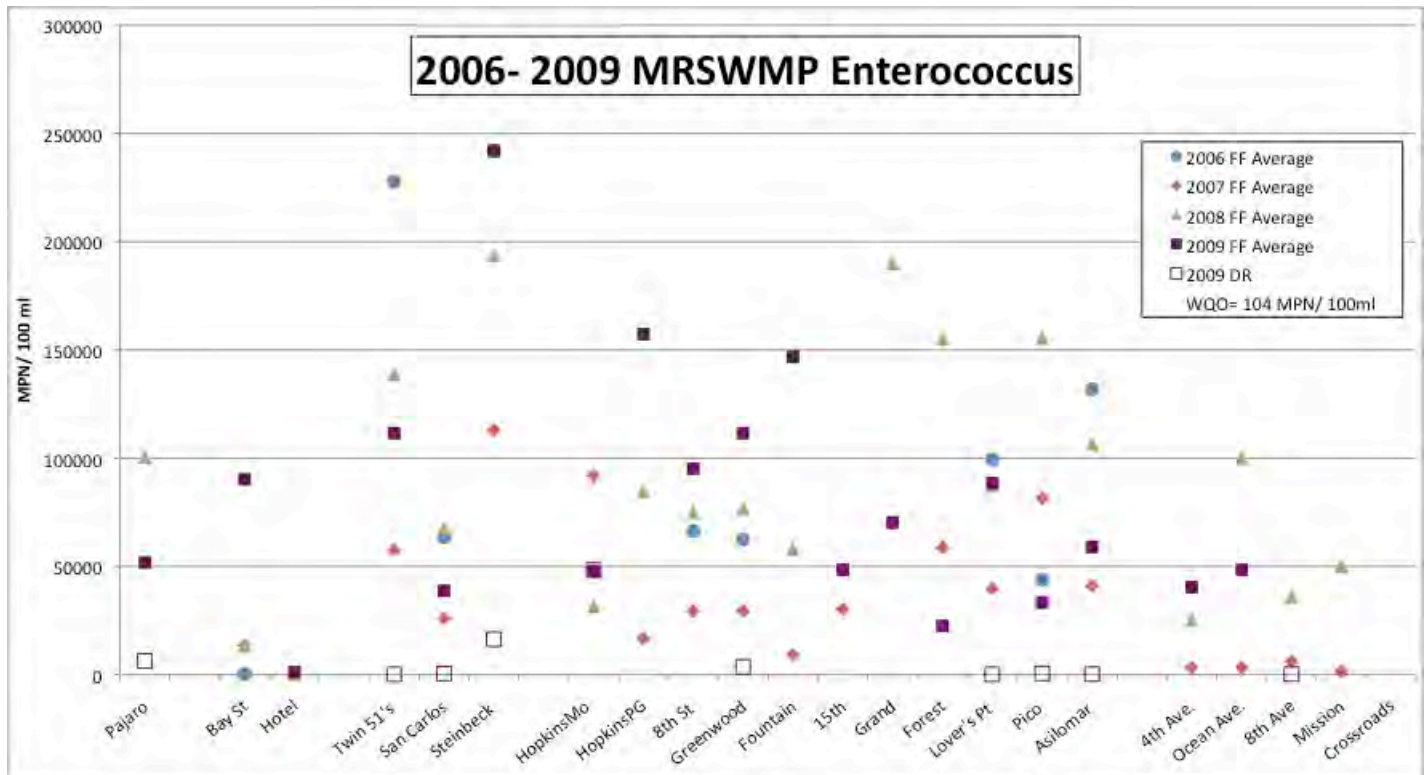


Figure 9. Results for enterococcus for the 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

2009 MRSWMP First Flush Monitoring-Enterococcus

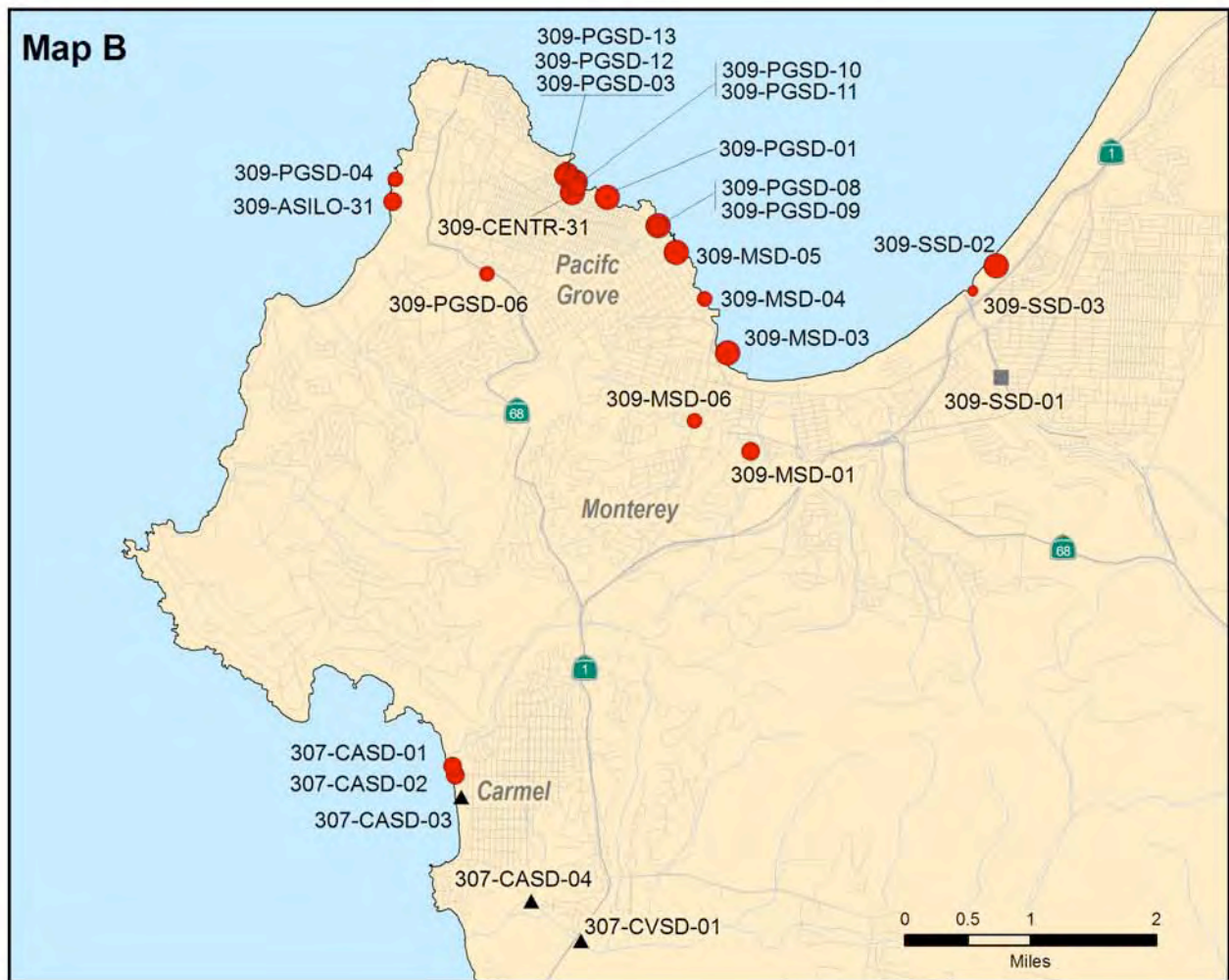
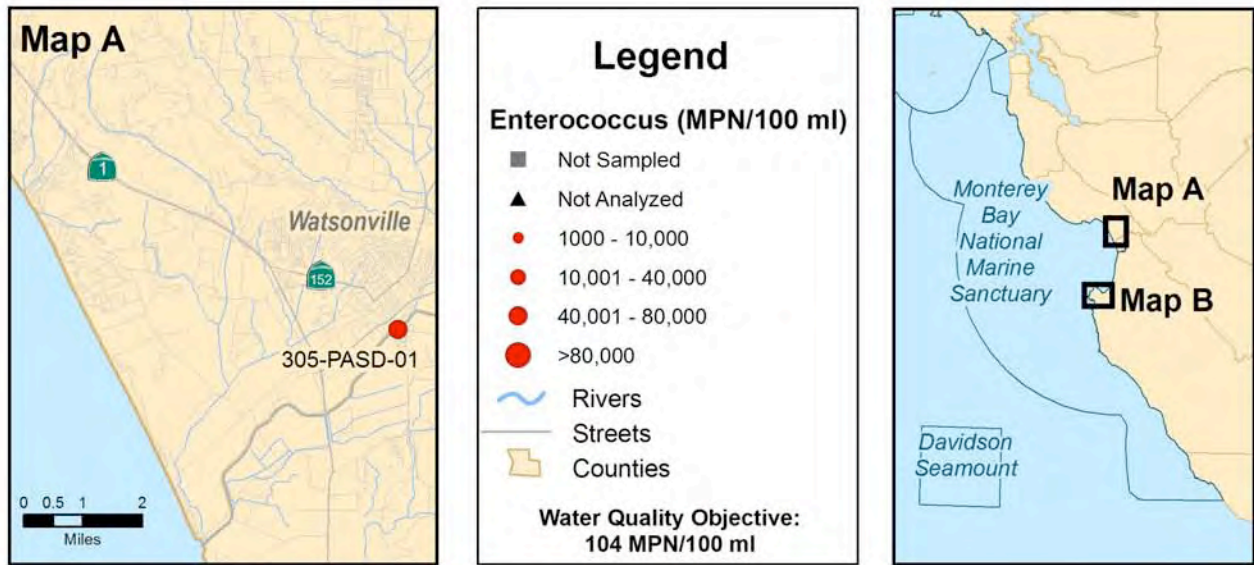


Figure 10. Average enterococcus concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Metals

Zinc

The background concentration for zinc (Zn) in seawater on the Central Coast is 8.0 micrograms per liter ($\mu\text{g/L}$); the Basin Plan Water Quality Objective (WQO) for Zn is $<200 \mu\text{g/L}$; and the MDL for zinc is $10 \mu\text{g/L}$.

For the **Dry Run**, zinc concentrations were below the WQO of $200 \mu\text{g/L}$ at all but one site: Monterey/Pacific Grove (HopkinsMon) with a result of $234 \mu\text{g/L}$ (Fig. 11).

For **First Flush**, eleven (50%) of the twenty-two sites exceeded the WQO for zinc. The highest average zinc result for 2009 was $477 \mu\text{g/L}$ in Pacific Grove (HopkinsPG). Seaside (Hotel) had the lowest concentration for zinc ($10 \mu\text{g/L}$)(Fig. 11 and 12).

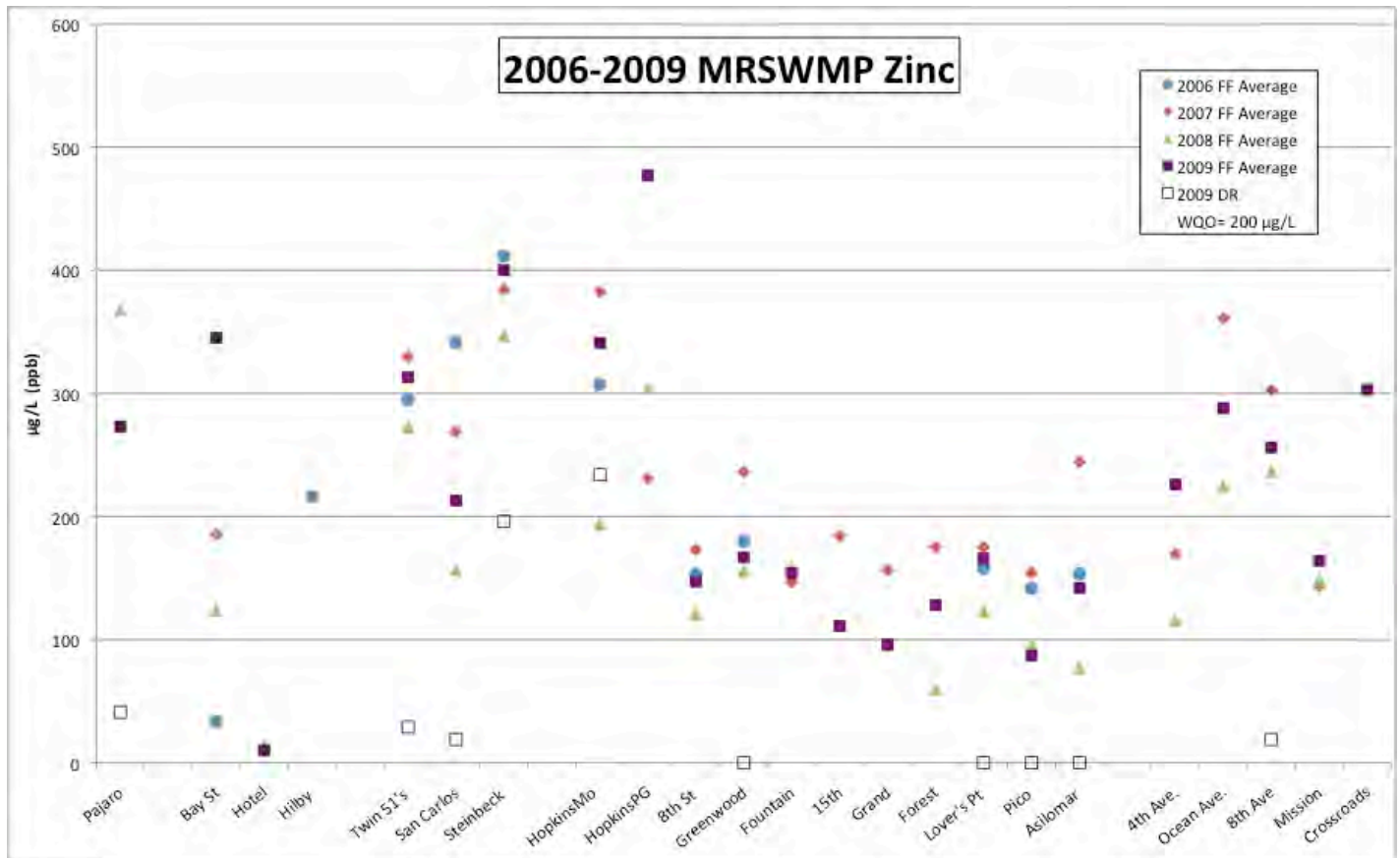


Figure 11. Zinc results for the 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Figure 12. Average zinc concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Copper

The background concentration for copper (Cu) in seawater is 2.0 µg/L; the Basin Plan Water Quality Objective (WQO) established for total Cu is 30 µg/L; the MDL for copper is 2.0 µg/L.

For the **Dry Run**, copper concentrations were all low with only one (10%) of the ten sites monitored above the WQO. The highest copper concentration was 86 µg/L in Monterey/Pacific Grove (HopkinsMon) (Fig. 13).

During **First Flush**, twenty-one (95%) of the twenty-two monitored sites exceeded the WQO. The highest copper concentration was in Carmel (Ocean Avenue) with an average of 184 µg/L. Seaside (Hotel) had the lowest result at 10 µg/L (Fig. 13 and 14).

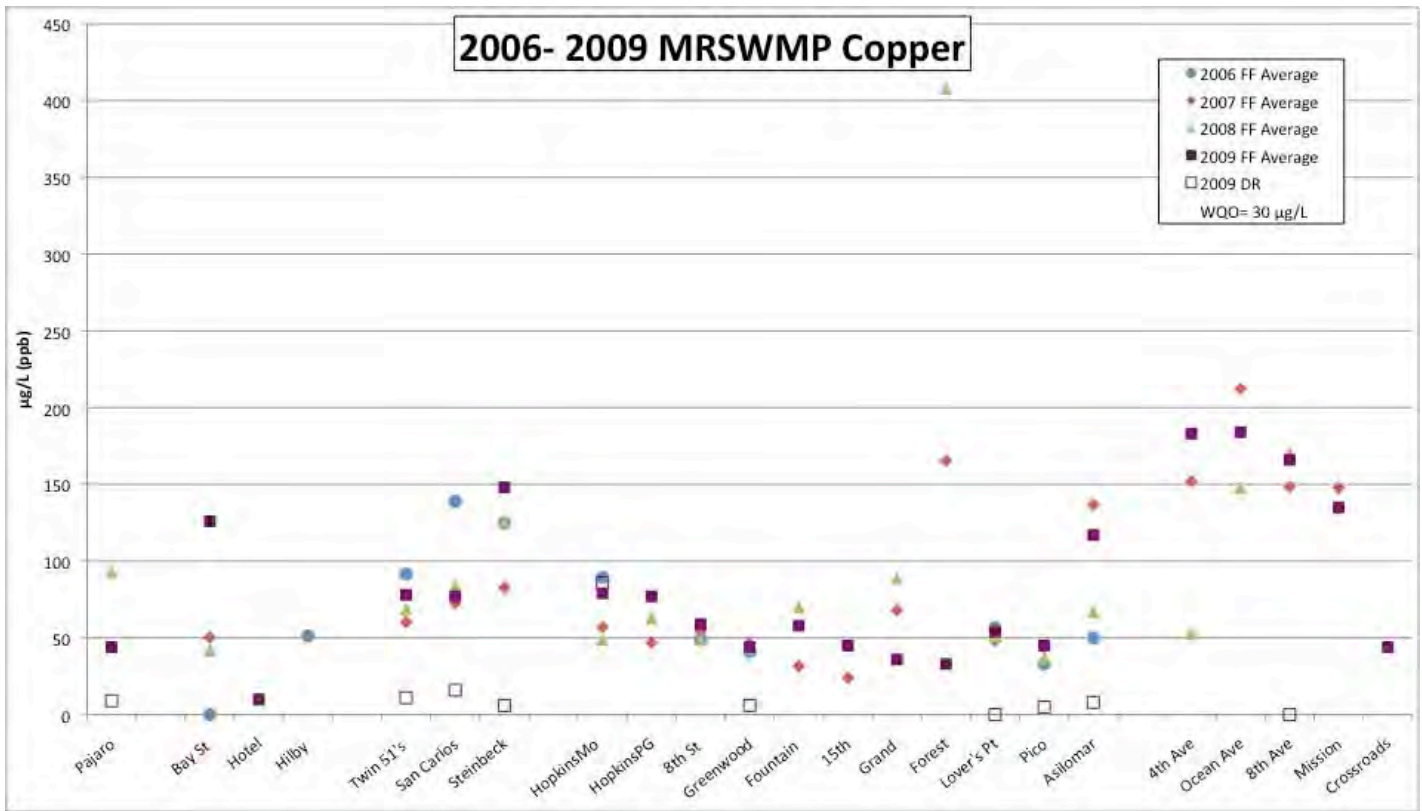


Figure 13. Total copper results for the 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Figure 14. Average copper concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Lead

The Basin Plan Water Quality Objective (WQO) for total lead (Pb) is 30 µg/L, the MDL for lead is 5 µg/L.

For the **Dry Run**, lead concentrations for all sites were below the WQO. Only one site, Monterey (HopkinsMon) had any detectable amount of lead (10 µg/L) (Fig. 15).

For **First Flush**, only one site (5%) from the twenty-two monitored exceeded the WQO: Seaside (Bay Street) with the highest average concentration of any monitored site at 33µg/L. Non-detects were noted in Seaside (Hotel), Pacific Grove (Fountain and Pico), Carmel (Ocean Avenue), and Monterey County (Crossroads) (Fig. 15 and 16).

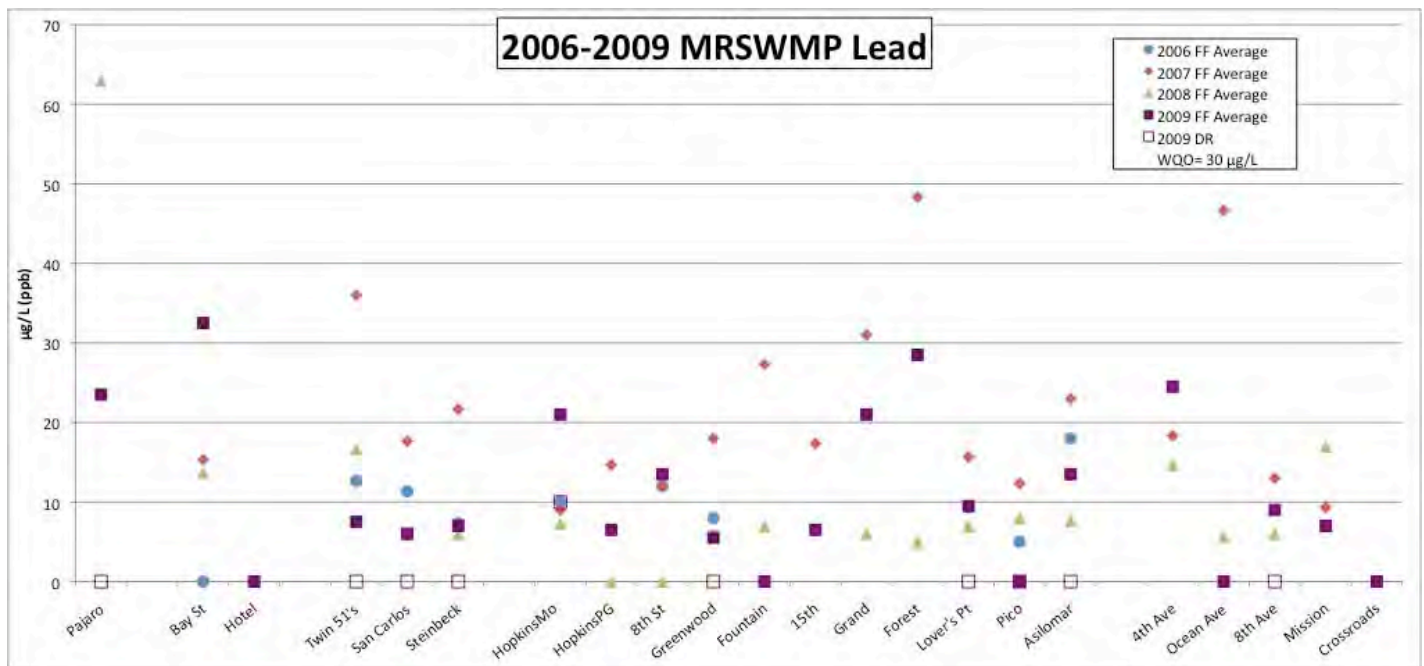


Figure 15. Total lead results for all sites for 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Figure 16. Average lead concentrations during First Flush 2009. Maps include three upstream sites: MSD-06 (Library), MSD-01 (Jack), and PGSD-06 (Congress). These sites are funded by their respective cities, not through MRSWMP.

Total Suspended Solids (TSS)

The attention level for TSS is 500 mg/L, with an MDL of 5 mg/L.

For the **Dry Run**, all sites were below the WQO (Fig. 17). Sites that had non-detects for TSS were in Monterey (San Carlos Beach), Pacific Grove (Greenwood Park, Lover's, Pico, Asilomar) and Carmel by the Sea (8th Ave.).

For the **First Flush**, no sites exceeded the attention level of the twenty-two sites monitored. There were no non-detects (Fig. 17).

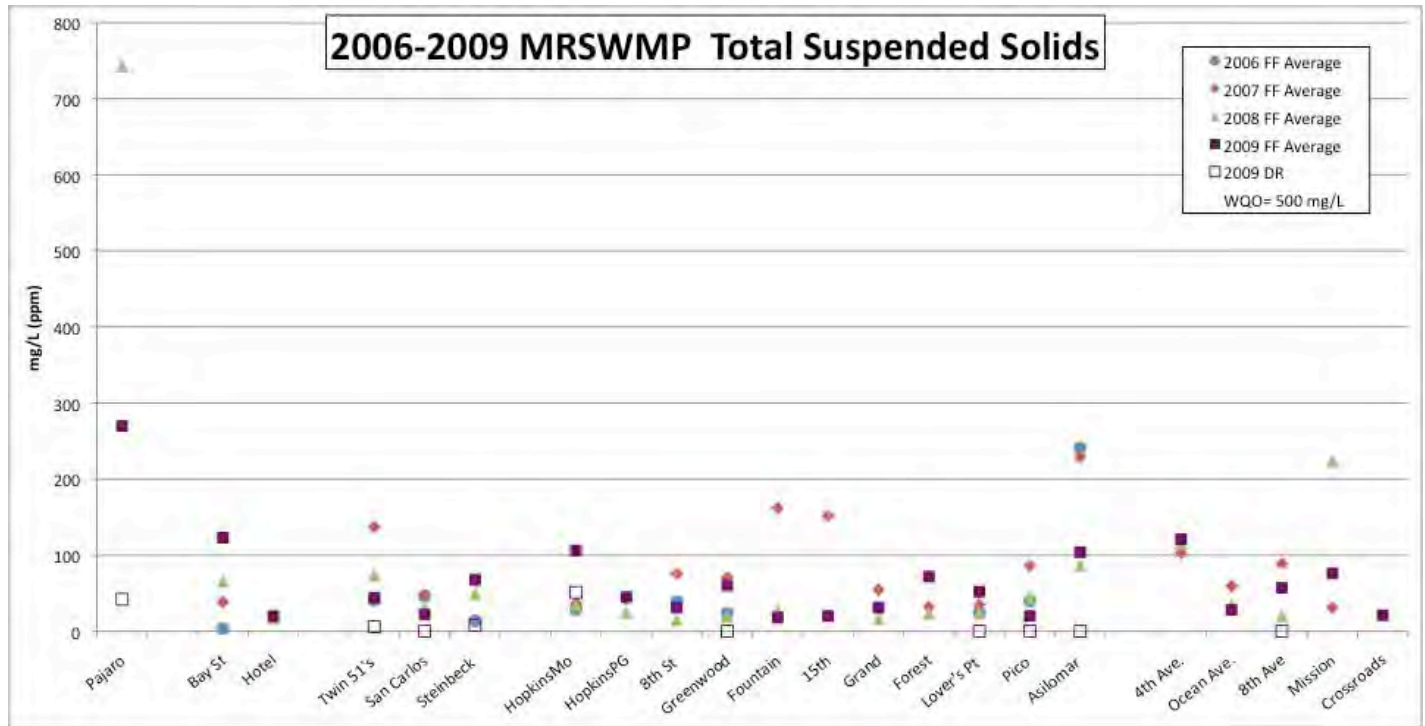


Figure 17. TSS results for all sites for 2009 Dry Run and time series averages for First Flush. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

Visual Observations

At each site during the First Flush 2009, volunteers recorded the presence of trash, sewage (sited or smelled), oil sheen, and scum.

- Trash was noted in: Monterey County (Pajaro), Seaside (Bay Street), Monterey (Twins, San Carlos Beach), Pacific Grove (Greenwood Park, Forest) and in Carmel (4th Avenue, 8th Avenue, Mission).
- Signs of sewage were noted in: Monterey County (Pajaro), Pacific Grove (Greenwood Park, 15th Street, Lover's), and Carmel (4th Avenue, Mission).
- Scum was noted in: Monterey County (Pajaro and Crossroads), Seaside (Hotel), Monterey (Twins, San Carlos Beach, Steinbeck, HopkinsMon), and Pacific Grove (HopkinsMon, HopkinsPG, Greenwood Park, Fountain, Lover's).

MRSWMP DR/FF 2009 Conclusion

This report summarizes the results from the Dry Run and First Flush events that were conducted in Fall 2009. The outfall monitoring provides information to the cities that will hopefully direct efforts to improve the water quality flowing from the outfalls into the Monterey Bay National Marine Sanctuary. These monitoring programs are not just about documenting problem areas. It is also important to document outfalls that do not flow during the dry weather as well as parameters that consistently are below established action levels. All results provide useful comparisons between outfalls as well as provide trend information over time.

During both the dry and wet weather events in 2009, there were outfalls that had quite good water quality and others that stood out from the rest with higher concentrations of pollutants. We recommend focusing some attention in those watersheds to try to determine why they are different than the others. Because it is difficult to track pollutants in wet weather events, dry weather source tracking is advised. Particular parameters such as nitrate, turbidity and lead that have historically been low during both wet and dry weather events. While it seems as though it would not be necessary to monitor for these characteristically low constituents, however all results provide valuable information to the regulatory agencies. Steinbeck Plaza continues to have high concentrations of parameters, however other sites this year had higher concentrations than Steinbeck, such as HopkinsMon and some Carmel sites.

This was the 10th Anniversary of the First Flush event in the Monterey Bay National Marine Sanctuary. We are beginning a statistical analysis of all the data to look for statistical significance in trying to answer questions and determine trends over time. A full report will be provided in Summer 2010.

Appendix 1: MRSWMP Monitoring sites- listed from north to south

City	Site ID	Site Name	Drainage Area (acres)	Primary Land Use
Monterey County	PASD-01	Pajaro		
Seaside	SSD-03	Hotel		
Seaside	SSD-01	Bay Street	1200	
Monterey	MSD-03	Twin 51's		90% residential 10% commercial
Monterey	MSD-02	San Carlos	70	40% commercial 35% residential 25% public land
Monterey	MSD-05	Steinbeck	37	90% residential 10% commercial
Pacific Grove	PGSD-08	HopkinsMon		
Pacific Grove	PGSD-09	HopkinsPG		
Pacific Grove	PGSD-01	8 th Street	35	100% residential
Pacific Grove	PGSD-11	15 th & Ocean View		
Pacific Grove	PGSD-10	Fountain Ave. & Ocean View		
Pacific Grove	CENTR-31	Greenwood Park	250	90% residential 10% commercial
Pacific Grove	PGSD-03	Lover's Point	222	90% residential 10% commercial
Pacific Grove	PGSD-12	Grand		
Pacific Grove	PGSD-13	Forest		
Pacific Grove	PGSD-04	Pico	131	100% residential
Pacific Grove	ASILO-31	Asilomar	94	90% residential 10% commercial
Carmel	CASD-01	4 th Avenue		
Carmel	CASD-02	Ocean		
Carmel	CASD-03	8 th Avenue		
Carmel	CASD-04	Mission		
Monterey County	CVSD-01	Crossroads		