



**Monterey Bay Sanctuary Citizen Watershed Monitoring Network**  
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# Dry Run & First Flush 2014 Monitoring Report

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## **Acknowledgements**

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## **Introduction**

Urban pollutants that are deposited on hard surfaces during dry weather are then washed away during winter rainstorms into rivers, storm drains and the ocean. The first winter rainstorm can have the highest concentration of pollutants because it is flushing months of built up pollutants that accumulate during the dry weather. These pollutants can be from sources such as brake dust, emissions from cars, animal waste, detergents from car washing, pesticides and fertilizers, among other chemicals commonly found in and around homes and businesses. By monitoring the water quality of the first rain event, it can give an indication of pollution sources and pollution loads going into the ocean.

Monterey Bay National Marine Sanctuary (MBNMS), San Mateo County Resource Conservation District (SMCRCD) and Coastal Watershed Council (CWC) monitor storm drain outfalls prior to and during the first major rainstorm to determine the concentrations of pollutants entering MBNMS. By monitoring prior to the first rainstorm, during dry weather, a comparison of dry and wet weather flows and pollutant concentration and load can be accomplished. MBNMS, CWC and SMCRCD teamed up with volunteers to monitor during dry weather, called the Dry Run and the water flowing into the ocean during the first major rain storm called the First Flush.

The geographic scope of this program extends from the City of Montara in San Mateo County at the north end, to the Carmel River in Monterey County in the south (Figure 1). Monterey Bay National Marine Sanctuary (MBNMS) was responsible for monitoring sites for the Monterey Regional Storm Water Monitoring Program (MRSWMP) in Monterey County which include areas in Pajaro, City of Seaside, City of Monterey, City of Pacific Grove, and Carmel Valley. The Coastal Watershed Council (CWC) coordinated monitoring sites in the City of Capitola. The San Mateo County Resource Conservation District (SMCRCD) was responsible for sampling all sites in the Cities of El Granada, Moss Beach, Montara and in Pillar Point Harbor.

For the past fifteen years, volunteers have braved winter weather and early morning hours to collect samples of water at storm drain outfalls in cities on the central California coast. Volunteers are on call twenty-four hours a day seven days a week. Having willing and trained volunteers is critical for a program with this range and scope. Samples are analyzed for common urban pollutants: bacteria (*Escherichia coli* (*E. coli*) and enterococcus), nutrients (nitrate, phosphate and urea), metals (total copper, total lead, total zinc), and total suspended solids.

The Dry Run was conducted on September 13<sup>th</sup> in Santa Cruz and Monterey counties and on October 1<sup>st</sup> in San Mateo County. The First Flush for the City of Capitola sites occurred in the morning on September 25<sup>th</sup>. Not enough rain fell in the other areas to collect samples at any other sites in San Mateo or Monterey counties. The next rain storm, with enough moisture to be able to sample at any sites, occurred mid-morning on October 25<sup>th</sup> in Monterey County. Only three of the nine Monterey County sites were sampled during this brief storm, and no sites in San Mateo County were sampled. One week later, another storm passed over the central California coastline on October 31<sup>st</sup> and dropped enough moisture to sample the remaining sites in Monterey and all the sites in San Mateo County. In all, twenty-five storm drain outfalls were monitored by seventy extraordinary volunteers.

# First Flush Sites 2014



Figure 1. 2014 Dry Run and First Flush Sites

## Methods

In early September volunteers were trained to follow standardized procedures for field measurements and to collect water samples for laboratory analysis. Following the classroom training, field training was conducted at a local outfall focusing on a demonstration of field measurements and sample collection. This day is known as the Dry Run and is conducted on a weekend day after the classroom training. After sample collections and field measurement demonstrations, teams of volunteers went to their respective sites for area familiarization, took field measurements, and collected water samples. The Dry Run is conducted well ahead of any predicted rain and provides the volunteers with a chance to test equipment at their specific sites and provides water quality information for dry weather runoff. The same analytes that are measured for the First Flush program were measured during the Dry Run. They include: nutrients (nitrate, orthophosphate, urea), bacteria (*E. coli* and enterococcus), metals (copper, lead and zinc), hardness, and total suspended solids. Field measurements were taken for water temperature, pH, electrical conductivity, and transparency.

Mobilization criteria for First Flush volunteers includes rain of at least 0.1", sheeting water on roadways, heavy flow through the storm drain system and conductivity levels less than 1000 micro Siemens ( $\mu\text{S}$ ) and declining. For the San Mateo County sites only one sample and one set of field measurements are taken at each outfall for First Flush. In Santa Cruz County, samples are collected twice at each outfall, at the beginning of sampling and after 60 minutes, while field measurements are collected at 0, 30 and 60 minutes. In Monterey County samples and field measurements are collected twice per outfall at 0 and 30 minutes.

Conductivity was measured using an Oakton EC Tester. Water temperature was measured using a digital thermometer. Transparency was measured using a transparency tube and pH was measured using Macherey-Nagel test strips. Physical observations such as trash, odor, bubbles, scum, and oil sheen were also recorded on the data sheet.

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 discharges. However, lacking any other effluent standard, they provide some context for the results. Dilution and/or mixing is expected to occur in the receiving waters within a short distance of each outfall. Metal results are compared to the Central Coast Basin Plan's Water Quality Objectives (WQO) for the protection of marine aquatic life. Nitrate, orthophosphate, and total suspended solids results are compared with the Central Coast Ambient Monitoring Program's (CCAMP) Action Levels. Bacteria (*E. coli* and enterococcus) is compared to the EPA's Ambient Water Quality Criteria (see Table 1). For all analytes, Minimum Detection Limits (MDL) are noted. The MDL is the minimum concentration that a lab instrument can detect for a given analyte. For sites that have a non-detect listed, it is placed on the graph at half the MDL, however the value is somewhere between zero and the MDL.

**Table 1: Water Quality Objectives (Urea is not listed because it does not have an objective)**

<b><u>Parameter (reporting units)</u></b>	<b><u>Water Quality Criterion</u></b>	<b><u>Source of criterion</u></b>
<b>Copper (ppb)</b>	<b>Not to exceed 30<sup>7</sup></b>	<b>Basin Plan Objective</b>
<b><i>E. coli</i> (MPN/100ml)</b>	<b>Not to exceed 235<sup>1</sup></b>	<b>EPA Ambient Water Quality Criteria</b>
<b>Enterococcus (MPN/100ml)</b>	<b>Not to exceed 104</b>	<b>EPA Ambient Water Quality Criteria</b>
<b>Lead (ppb)</b>	<b>Not to exceed 30<sup>7</sup></b>	<b>Basin Plan Objective</b>
<b>Nitrate as N (ppm)</b>	<b>Not to exceed 2.25<sup>2</sup></b>	<b>Central Coast Water Board</b>
<b>Orthophosphate as P (ppm)</b>	<b>Not to exceed 0.12<sup>3</sup></b>	<b>Central Coast Water Board</b>
<b>pH</b>	<b>Not lower than 6.5 or greater than 8.5</b>	<b>Basin Plan Objectives</b>
<b>Total Suspended Solids (TSS) (ppm)</b>	<b>Not to exceed 500<sup>8</sup></b>	<b>Central Coast Water Board</b>
<b>Transparency (cm)</b>	<b>Not less than 20<sup>4</sup></b>	<b>Central Coast Water Board</b>
<b>Water Temperature (°C)</b>	<b>Not more than 21<sup>5</sup></b>	<b>Central Coast Water Board</b>
<b>Zinc (ppb)</b>	<b>Not to exceed 200<sup>6</sup></b>	<b>Basin Plan Objective</b>

<sup>1</sup> Environmental Protection Agency, Updated WQO.

<sup>6</sup> Williamson, "The Establishment of Nutrient Objectives, Sources, Impacts and Best Management Practices for the Pajaro River and Llagas Creek", 1994.

<sup>4</sup> Based on equivalent turbidity guideline value used for 303(d) Listing Guideline Value (Sigler et al., 1985) ([http://www.secchidipin.org/Transparency\\_Tube.htm](http://www.secchidipin.org/Transparency_Tube.htm))

<sup>4</sup> 303(d) Listing guideline value, based on Sigler et al., 1985

<sup>5</sup> 303(d) Listing guideline value, based on Moyle, P. 1976. Inland Fisheries of California. Univ. of California Press.

<sup>6</sup> Basin Plan Cold Water Objective for hard water.

<sup>8</sup> Central Coast Ambient Monitoring Program, Salinas River Watershed Characterization Report 1999, rev. 2000.

## Results/Discussion

Dry Run samples were collected in Santa Cruz and Monterey counties on September 13<sup>th</sup> when all sites were visited but only 10 of the 25 sites had enough flow to be sampled. Dry Run samples were collected in San Mateo County on October 1<sup>st</sup> when one site was sampled.

Dry Run monitoring results are from a single sample in comparison to First Flush sampling results, which are either one single sample (El Granada, Moss Beach, Montara, Princeton, and Soquel Creek (Capitola)), two time series samples separated by 30 minutes (Monterey County, Seaside, Monterey, and Pacific Grove), or two time series samples separated by 60 minutes (remaining Capitola sites).

After the Dry Run and leading up to the First Flush event, the coordinators from SMCRCDC, CWC and MBNMS closely monitored the weather, notifying volunteers of approaching storms. When a storm had the potential to generate enough rainfall for First Flush mobilization, the coordinators placed the volunteers on standby until established criteria were met.

This year was particularly difficult to anticipate mobilization as the storms that hit the central coast in late 2014 were from the south and directly hitting Santa Cruz while bypassing both the Monterey Peninsula and San Mateo County. The Coastal Watershed Council was able to mobilize for all sites in Capitola on September 25<sup>th</sup> starting in the early morning after sunrise when 0.35” of rain fell. Unfortunately no sites north or south of Santa Cruz had enough runoff to mobilize for this late September storm. Another storm occurred on October 25<sup>th</sup>, which allowed for only three sites in Monterey County and Pacific Grove to be sampled: Pajaro (Monterey County), Pico (Pacific Grove) and Crossroads (Monterey County). The third storm to hit the central coast was on October 31<sup>st</sup>. This storm had broad coverage averaging 0.5 ” of precipitation in San Mateo County and 1.0-2.0” of precipitation in Monterey County. The October 31<sup>st</sup> storm enabled the remaining Monterey area sites and all of the sites on the San Mateo County coastline to be sampled.

**Table 2: Range of results for Dry Run and First Flush 2014**

<b>Parameter</b>	<b>Dry Run 2014</b>	<b>First Flush 2014</b>
Conductivity	750 - 4600 $\mu$ S	100 - 810 $\mu$ S
Copper- total	ND - 11 $\mu$ g/L	ND - 374 $\mu$ g/L
Escherichia coli ( <i>E. coli</i> )	149 – 6867 MPN/100ml	1460 – 199,000 MPN/100ml
Enterococcus	<20 – 4962 MPN/100ml	435 – 155,000 MPN/ 100ml
Lead- total	All results were ND	ND - 45 $\mu$ g/L
Nitrate as N	ND – 3.6 mg-N/L	0.3 – 1.4 mg-N/L
Orthophosphate as P	ND – 0.2 mg-P/L	ND – 2.8 mg-P/L
pH	6.75 - 7.74	6.25 – 7.5
Total Suspended Solids (TSS)	ND - 8 mg/L	2 - 378 mg/L
Transparency	100 - >120 cm	4.6 – 112 cm
Urea	10 - 45 $\mu$ g/L	24 - 4490 $\mu$ g/L
Water temperature	16.7 – 20.2 °C	16.5 – 19.7 °C
Zinc- total	14 - 313 $\mu$ g/L	27 - 941 $\mu$ g/L

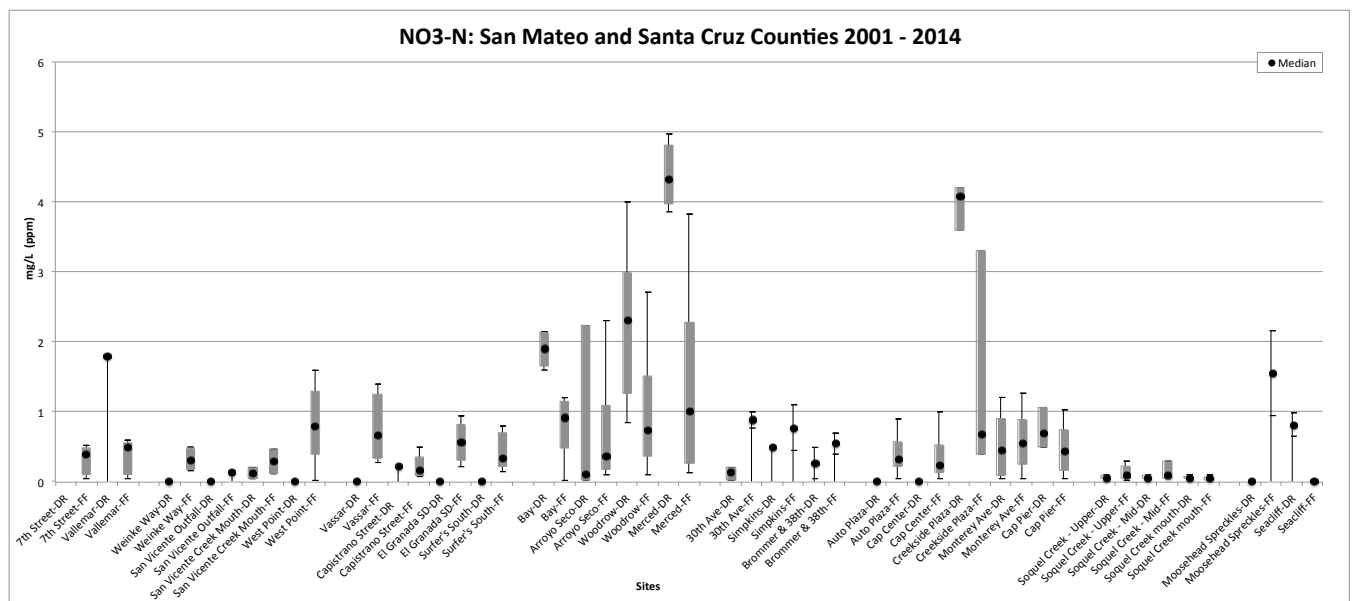
# Nutrients

## Nitrate

Although nitrate and orthophosphate are needed for plant growth, they are not normally found in elevated concentrations in aquatic systems. Nitrate as with other nutrients, can lead to algal blooms that degrade water quality as those plants die off and consume oxygen in their decomposition. Nitrate sources include runoff from fertilized lawns, agricultural and pasture lands, construction sites, and septic/sewer systems. The CCAMP Action Level for nitrate as N ( $\text{NO}_3\text{-N}$ ) is 2.25 mg-N/L. The minimum detection limit (MDL) was 0.1 mg-N/L for both the Dry Run and First Flush.

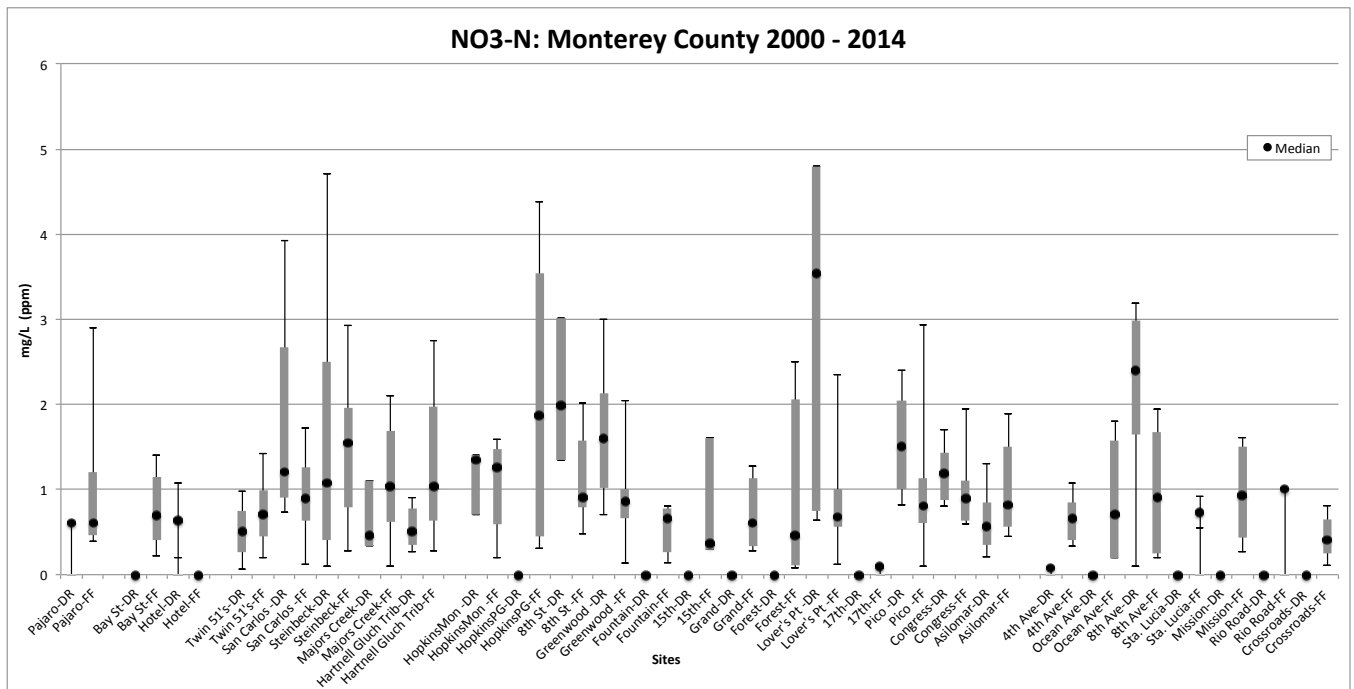
For the **Dry Run**, two of the eleven sites sampled (18%) were above the Action Level for nitrate. The highest result was from Creekside Plaza (Capitola) with a value of 3.6 mg-N/L (Figures 2 and 3). Three sites in Capitola had non-detects: Soquel Creek- Upper, Soquel Creek - Mid, and Soquel Creek - Mouth.

During the **First Flush**, none of the twenty-five monitored sites had a concentration above the Action Level for nitrate. The highest average or single sample concentration was from Vassar Avenue (El Granada) with a single sample result of 1.4 mg-N/L (Figures 2 and 3). The only site with a non-detect was the Soquel Creek - Mouth (Capitola).



**Figure 2.** Nitrate-N for the Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.





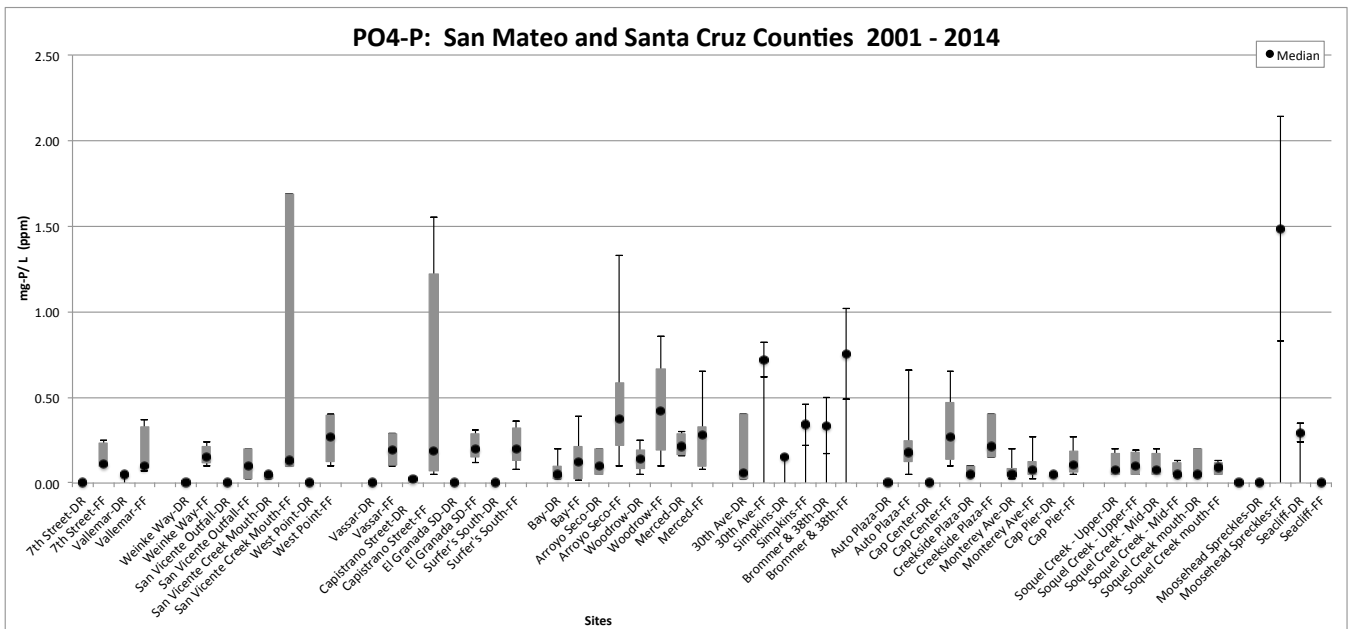
**Figure 3.** Nitrate-N for the Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

### Orthophosphate

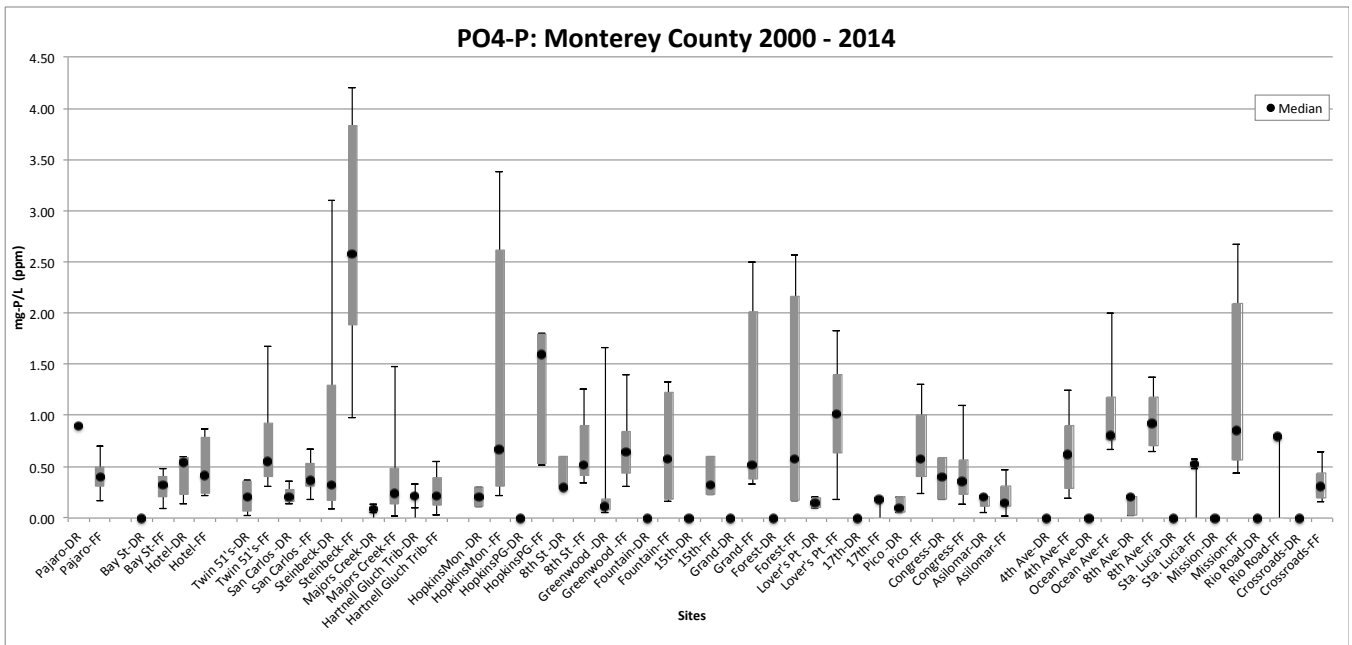
Orthophosphate, like nitrate, is also necessary for plant growth. As with nitrate, orthophosphate can lead to degradation of water as plants grow uncontrolled, complete their life cycle, and decompose, taking up oxygen in the process. Sources of orthophosphate are similar to those for nitrate: leaks in sewer or septic systems, excess fertilizers from urban or agricultural areas, and detergents. The CCAMP Action Level for orthophosphate ( $PO_4\text{-P}$ ) is 0.12 mg-P/L. The MDL was 0.10 mg-P/L for both the Dry Run and First Flush.

For the **Dry Run**, all but one of the sampled sites had non-detectable levels of orthophosphate. The one site with any detectable level of orthophosphate was Steinbeck (Monterey) with a result of 0.2 mg-P/L and over the CCAMP Action Level.

During the **First Flush**, twenty-two (88%) of the sites monitored were above the Action Level for orthophosphate. The highest average time series or single sample concentration for orthophosphate was at Steinbeck (Monterey) with an average result of 2.8 mg-P/L (Figures 4 and 5). Non-detects were noted for two sites across the region: Monterey Avenue (Capitola) and Soquel Creek - Mouth (Capitola).



**Figure 4.** Orthophosphate-P for the Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



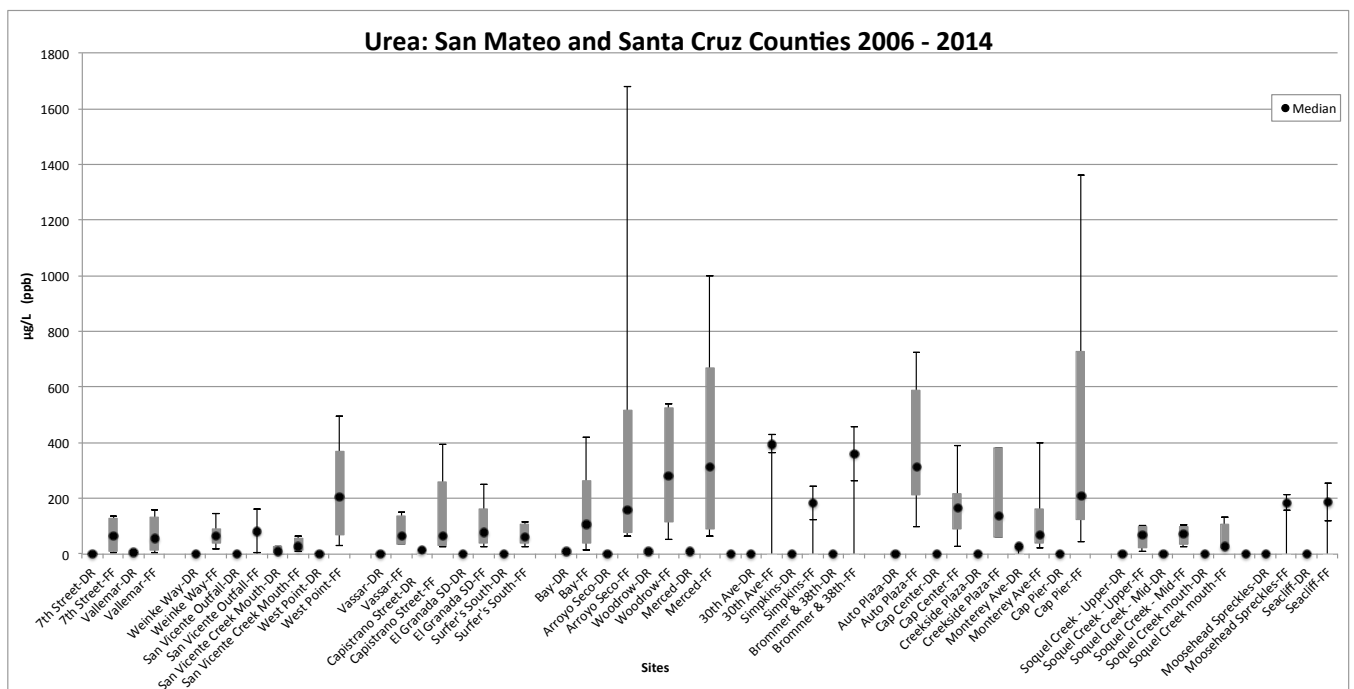
**Figure 5.** Orthophosphate-P for the Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Urea

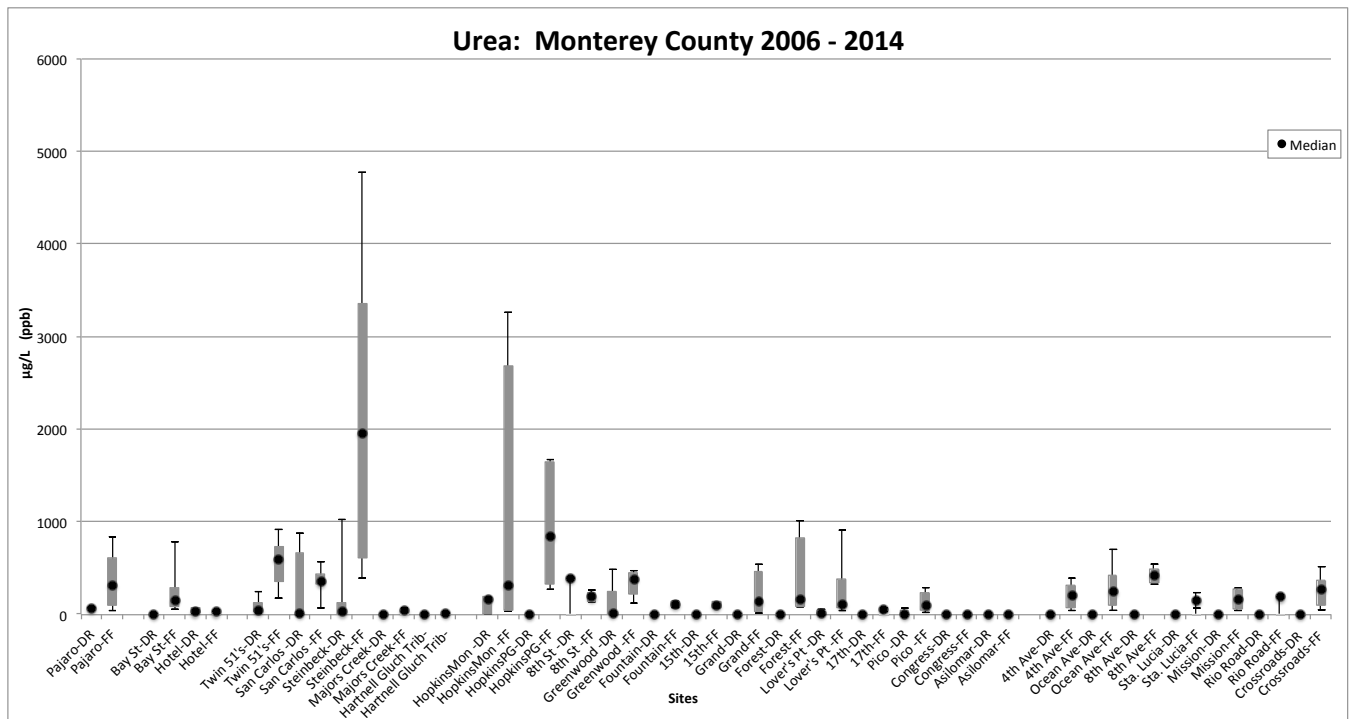
Urea is an organic compound that is soluble in water; it is an excellent fertilizer and is often used for agricultural applications. There are many sources of urea including fire retardants, cigarettes, fertilizers, animal feeds, detergents, and mammalian urine. While there is no water quality objective for urea, values are noted and compared to previous year's results in order to monitor trends. The MDL was 10 µg/L for both the Dry Run and First Flush.

For the **Dry Run**, only sites in San Mateo and Monterey Counties were monitored for urea. The highest urea result was from Twins (Monterey) with a concentration of 45 µg/L (Figures 6 and 7).

During the **First Flush**, urea was only measured during the first time series at all sites. Steinbeck (Monterey) had the highest result of 4490 µg/L (Figures 6 and 7).



**Figure 6.** Urea results for the Dry Run (DR) and First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



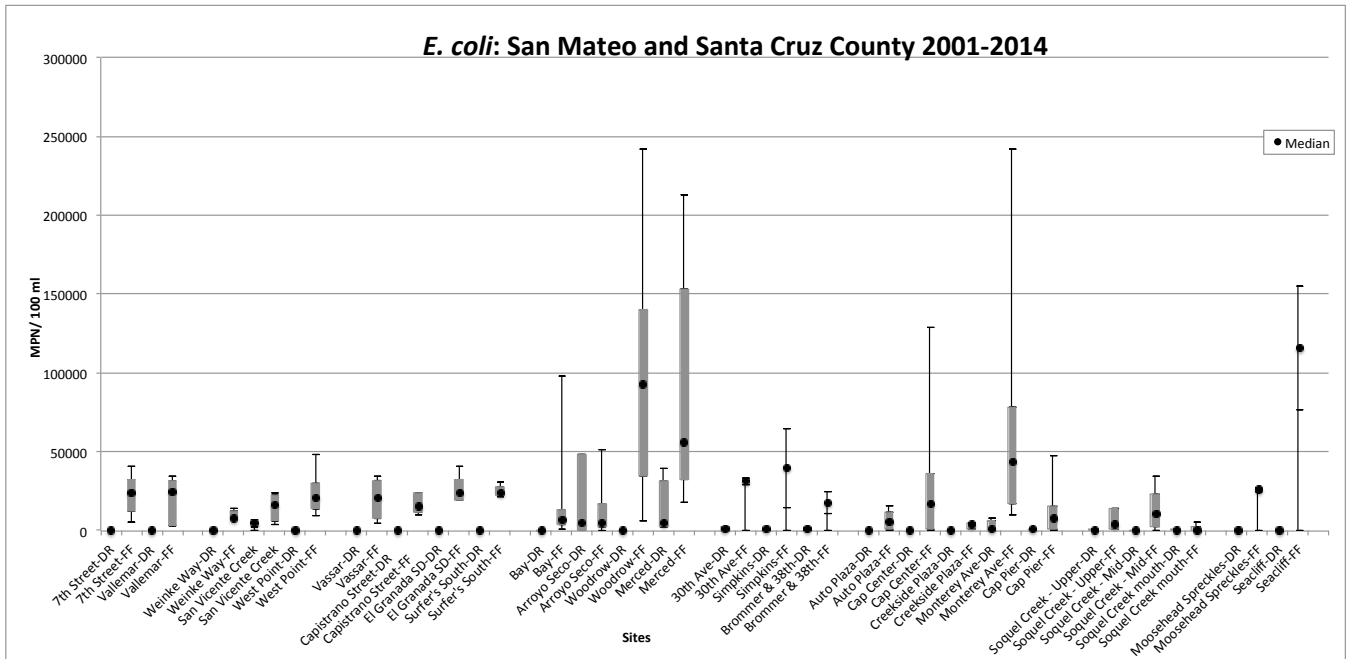
**Figure 7.** Urea results for the Dry Run (DR) and First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Bacteria

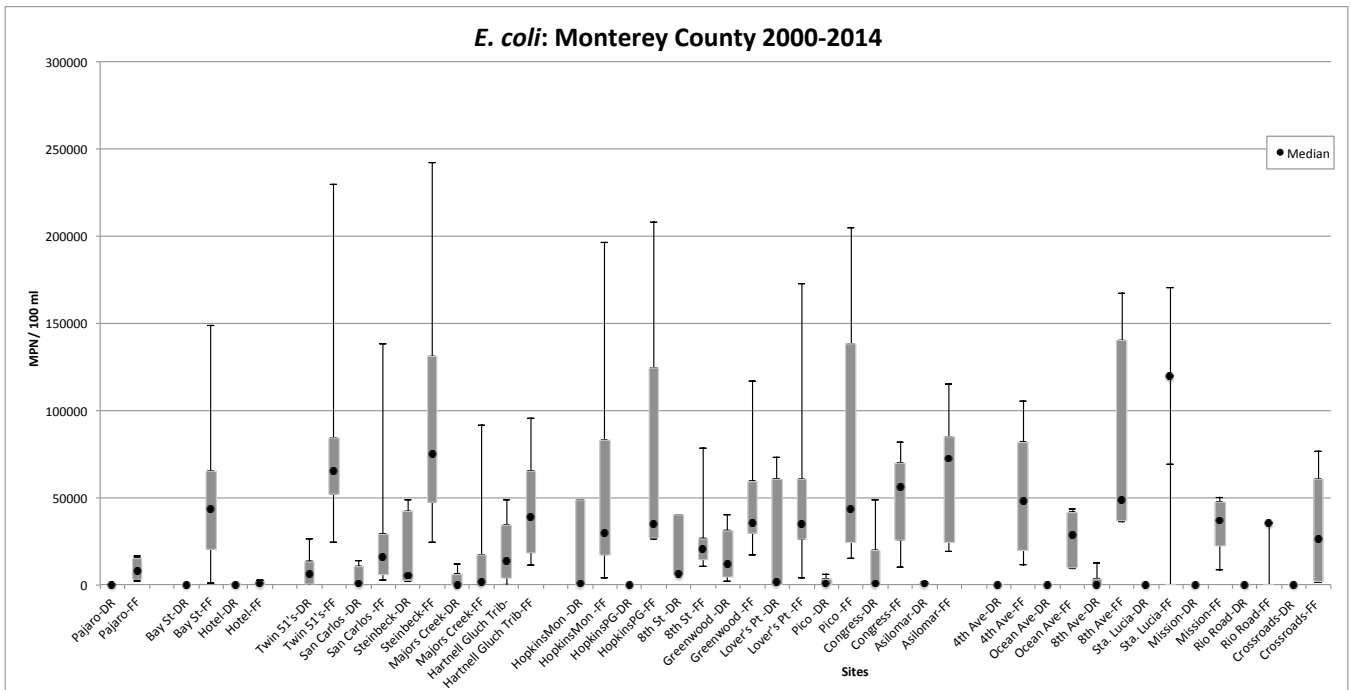
*Escherichia coli* (*E. coli*) and enterococcus are two types of fecal indicator bacteria. *E. coli* and enterococcus, found in the intestines of warm blooded animals, make their way into waterways and the ocean from wildlife populations, through improper domestic animal waste disposal, as well as sewer or septic systems. While these bacteria don't necessarily cause disease in humans, their presence does indicate the potential for other human specific pathogens to be present. The U.S. Environmental Protection Agency water quality criterion for grab samples for *E. coli* is 235 MPN/100 ml and for enterococcus, 104 MPN/100 ml. The MDL for both *E. coli* and enterococcus was 20 MPN/100ml for the Dry Run, 100 MPN/ 100 ml for the First Flush on 9-25-14 in Santa Cruz County and 10-25-14 in Monterey County, 1 MPN/ 100 ml for the First Flush on 10-31-14 in Monterey County.

For the **Dry Run**, eight (73%) of the eleven sites sampled were above the WQO for *E. coli* and enterococcus. The highest *E. coli* result was 6867 MPN/100 ml from the San Vicente Creek Mouth (Moss Beach) (Figures 8 and 9). The highest enterococcus result was 4962 MPN/ 100 ml in Steinbeck (Monterey) (Figures 10 and 11).

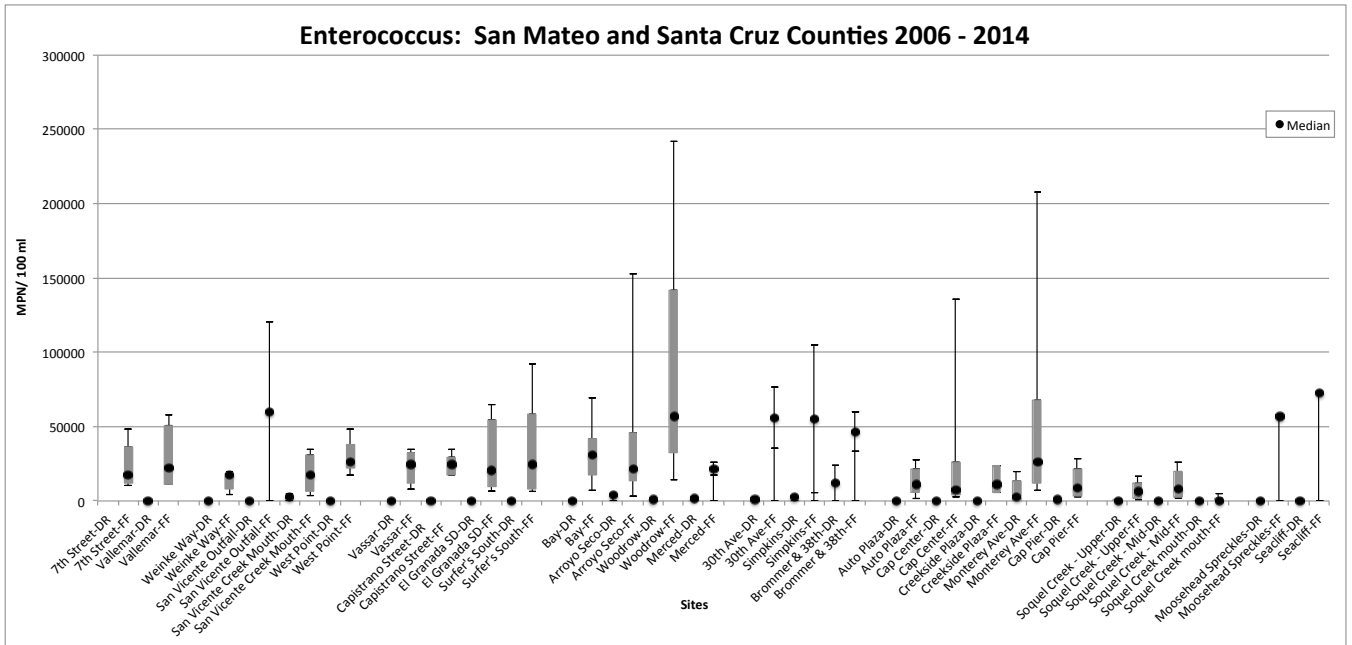
During the **First Flush** all twenty-five (100%) of the sites monitored were above the WQO for both *E. coli* and enterococcus. The highest average or single result for *E. coli* was at San Carlos (Monterey) with an average of 138,000 MPN/100 ml (Figures 8 and 9). The highest result for enterococcus was at Bay Street (Seaside) with an average of 126,500 MPN/100 ml (Figures 10 and 11). During the First Flush one of the bacteria bottles from Capitola Center (Capitola) leaked and the first time series sample was lost.



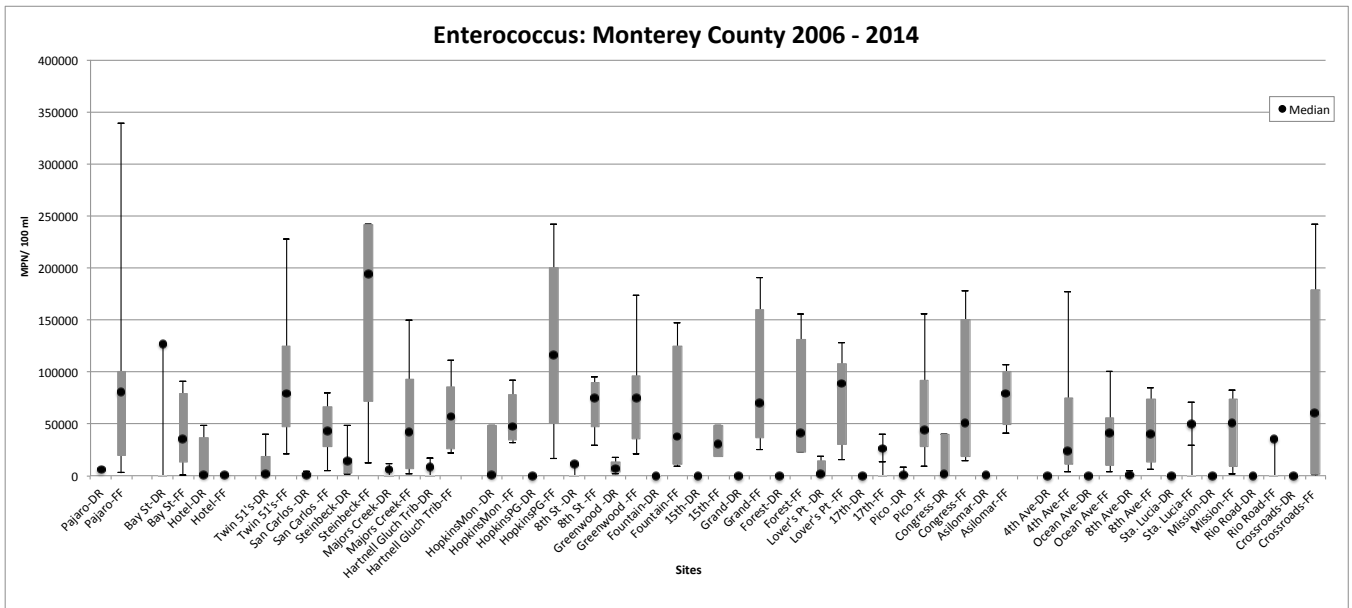
**Figure 8.** *E. coli* results for the Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



**Figure 9.** *E. coli* results for the Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.



**Figure 10.** Results for enterococcus for the Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



**Figure 11.** Results for enterococcus for the Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

## Metals

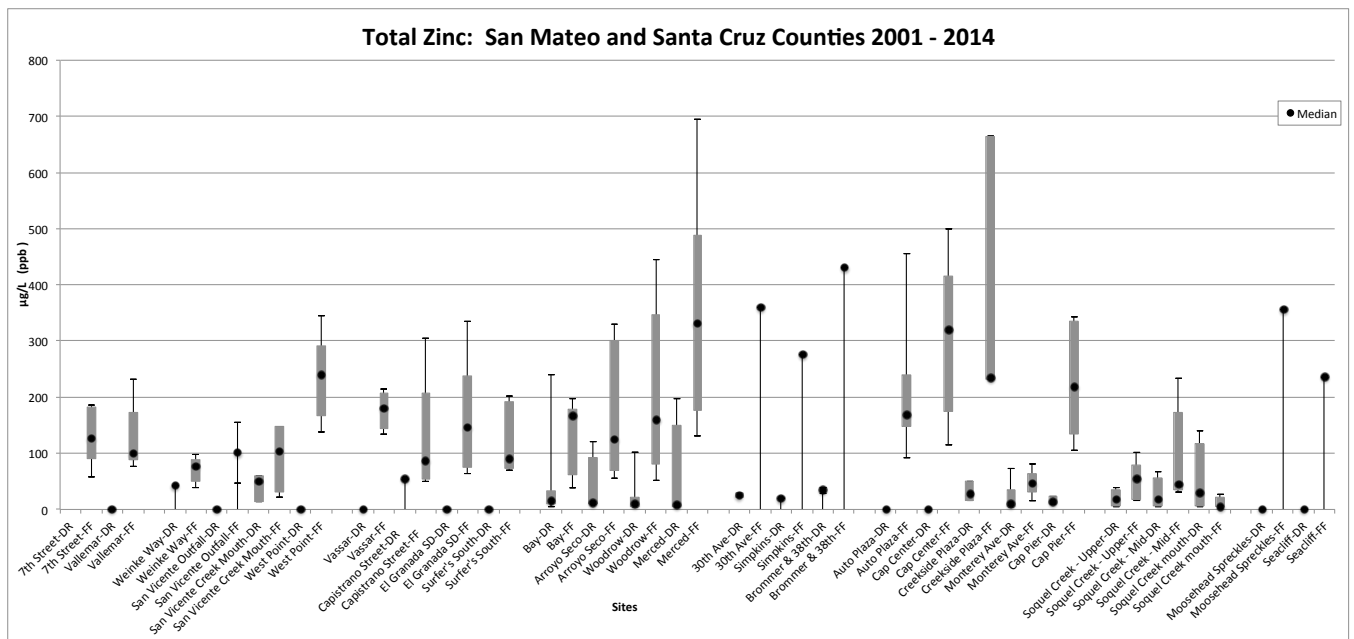
Storm water runoff in coastal urban areas is known to contain trace metals from sources such as automobile brake pads, tires, and industrial waste. Very low concentrations in the marine environment can cause reduced reproduction, developmental deformities, and mortality. For the Dry Run and First Flush, samples were analyzed for total zinc (Zn), total copper (Cu), and total lead (Pb).

### Zinc

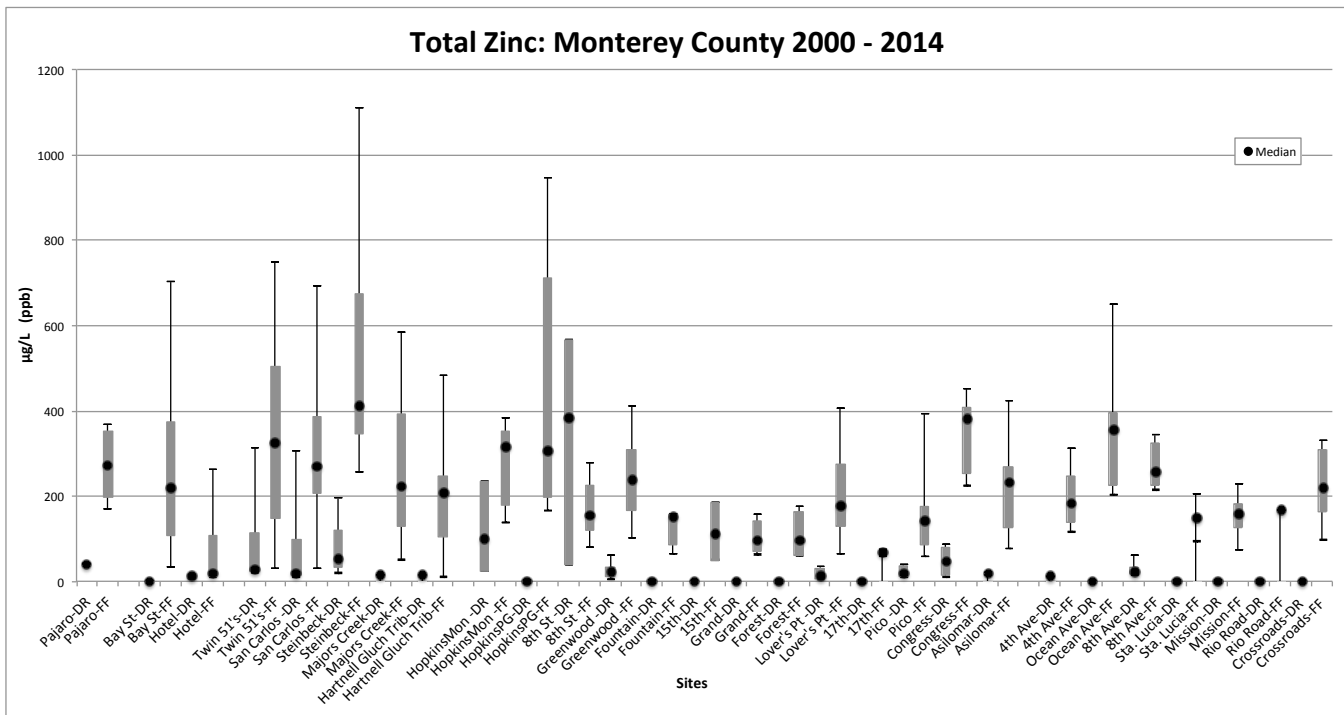
The Basin Plan WQO for Zn is <200 µg/L; and the MDL for zinc was 10 µg/L for the Dry Run and First Flush.

For the **Dry Run**, zinc concentrations were below the WQO for all but one site, Twins (Monterey) that had a concentration of 313 µg/L (Figures 12 and 13).

For the **First Flush**, twelve (48%) of the twenty-five sites were above the WQO for zinc. The highest average or single sample zinc concentration was at Steinbeck (Monterey) with an average of 764 µg/L (Figures 12 and 13).



**Figure 12.** Total zinc results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



**Figure 13.** Total zinc results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

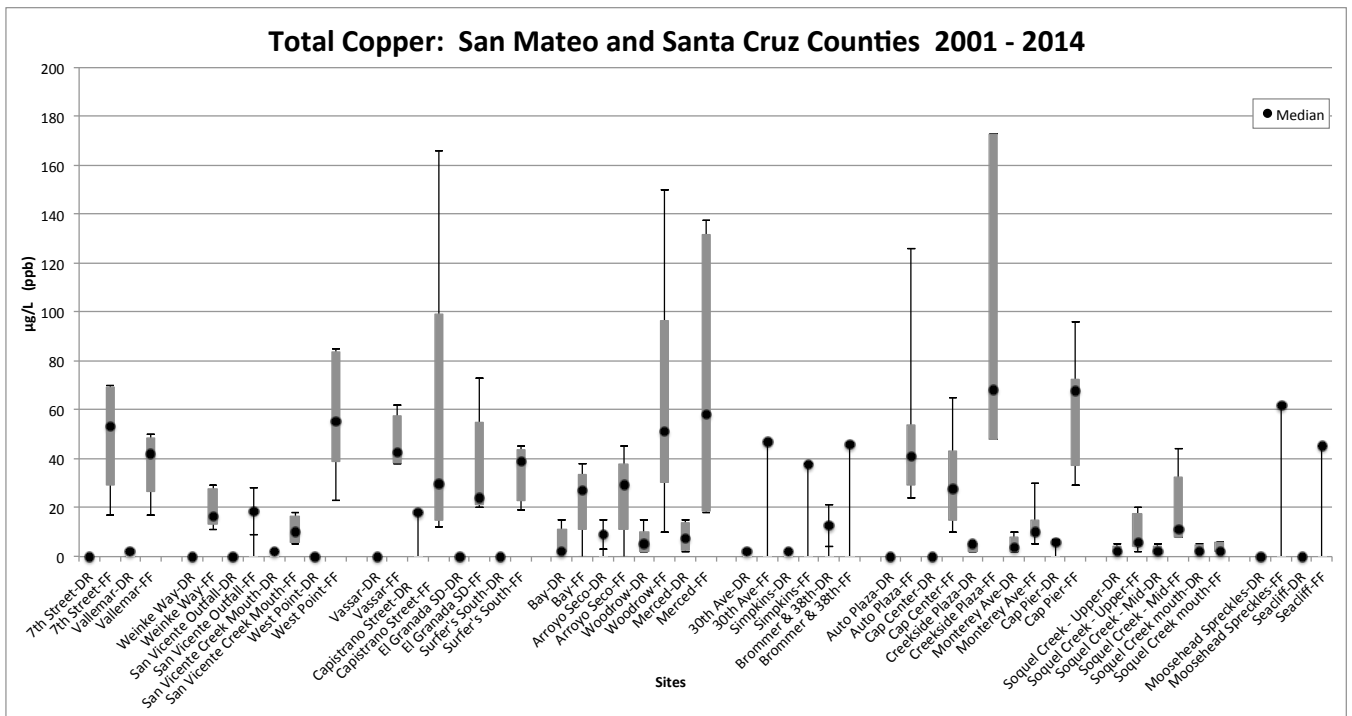
## Copper

The Basin Plan WQO established for total Cu is 30 µg/L; the MDL for copper was 4.0 µg/L for the Dry Run and the First Flush.

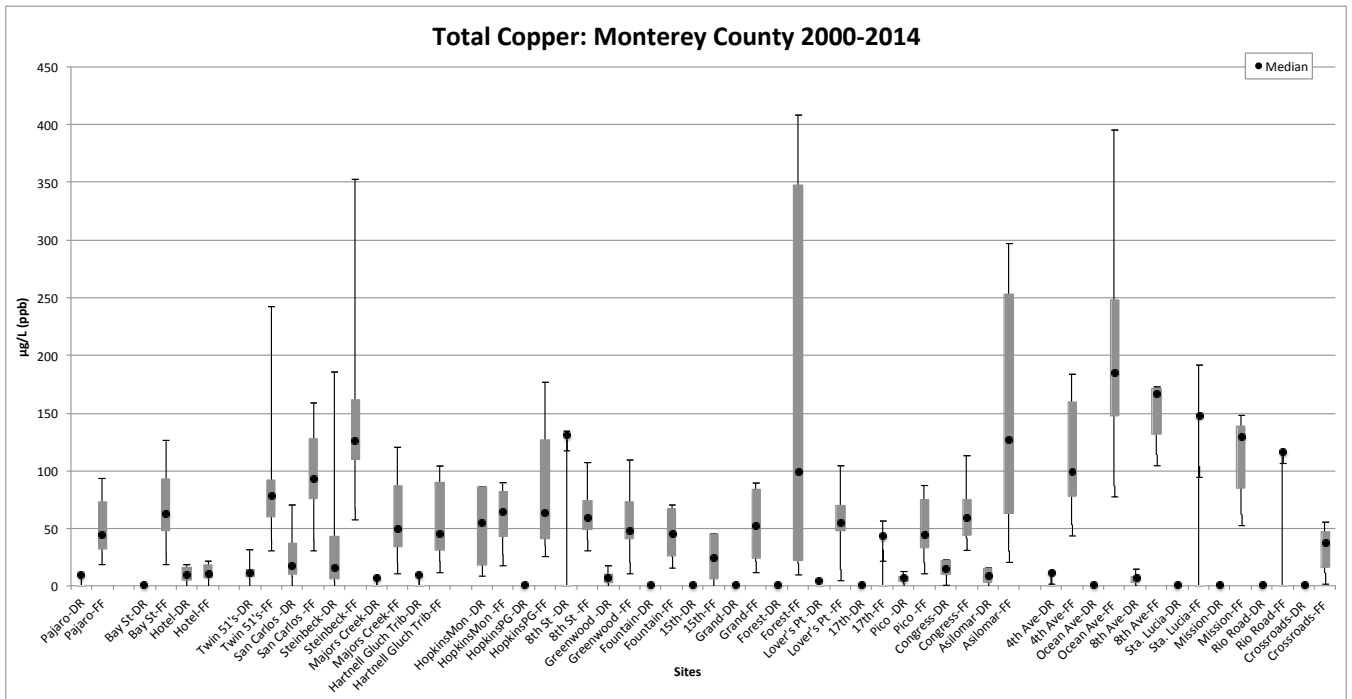
For the **Dry Run**, copper concentrations were all below the WQO. Seven sites had non-detects: San Vicente Creek Mouth (Moss Beach); Monterey Avenue, Creekside, , Soquel Creek – Upper, Soquel Creek - Mid, and Soquel Creek - Mouth (Capitola); Greenwood Park, and Pico (Pacific Grove) (Figures 14 and 15).

During the **First Flush**, twelve (48%) of the twenty-five monitored sites were above the WQO. The highest average or single sample copper concentration was at Steinbeck (Monterey) with an average of 248 µg/L (Figures 14 and 15). One site had a non-detect: Soquel Creek - Mouth (Capitola).





**Figure 14.** Total copper results for the Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



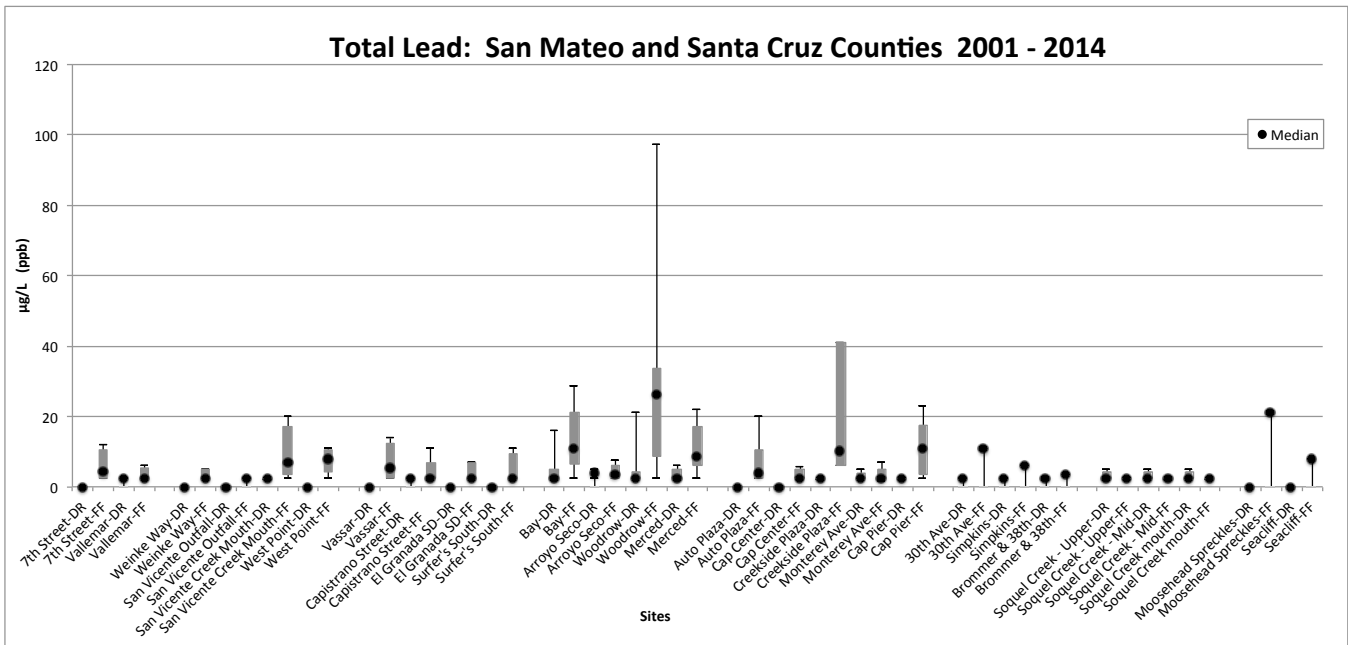
**Figure 15.** Total copper results for the Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

**Lead**

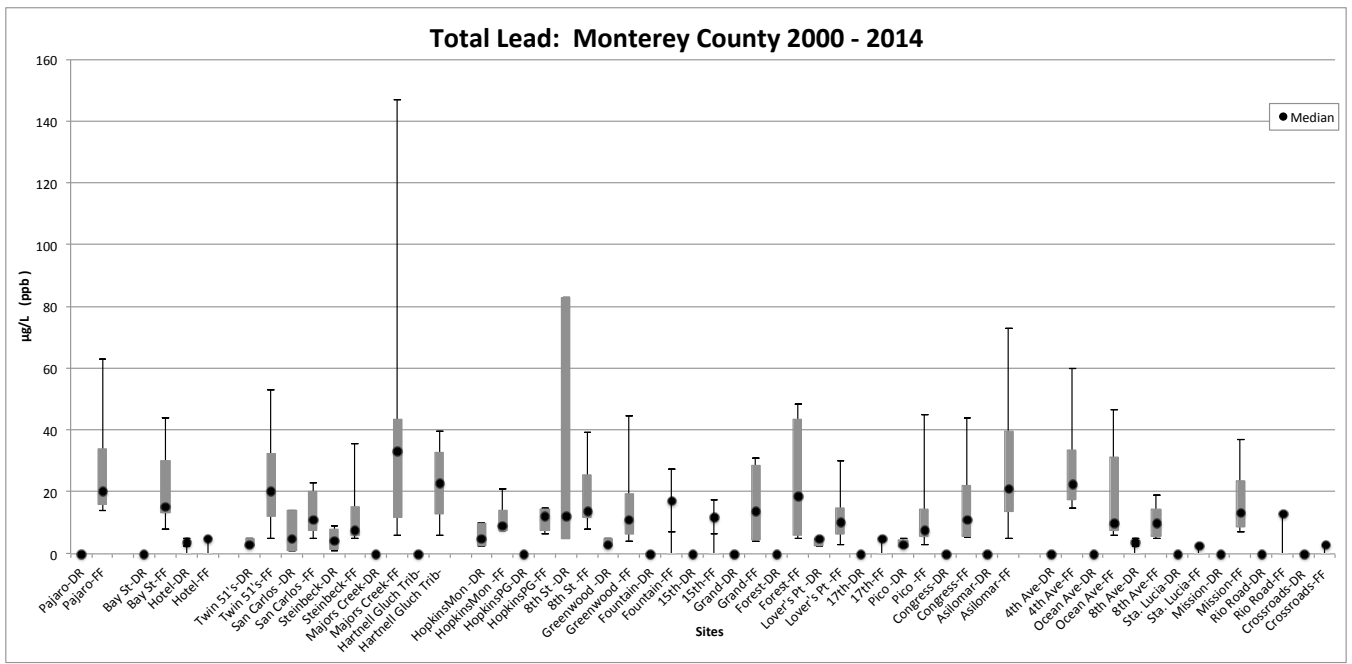
The Basin Plan WQO for total lead (Pb) is 30 µg/L. The MDL for lead was 5 µg/L for both the Dry Run and First Flush.

For the **Dry Run**, all sites had non-detects for lead (Figures 16 and 17).

For the **First Flush**, one (4%) of the twenty-five monitored sites was above the WQO. The highest average or single sample result was from Bay Street (Seaside) with an average of 41 µg/L. Thirteen sites had non-detects for all samples: El Granada Storm Drain, Surfers Storm Drain south, Capistrano Street, Vassar Avenue (El Granada); Auto Plaza, Capitola Center, Monterey Avenue, Creekside, Soquel Creek - Upper, Soquel Creek - Mid and Soquel Creek - Mouth (Capitola); Crossroads (Monterey County); Pico (Pacific Grove) (Figures 16 and 17).



**Figure 16.** Total lead results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



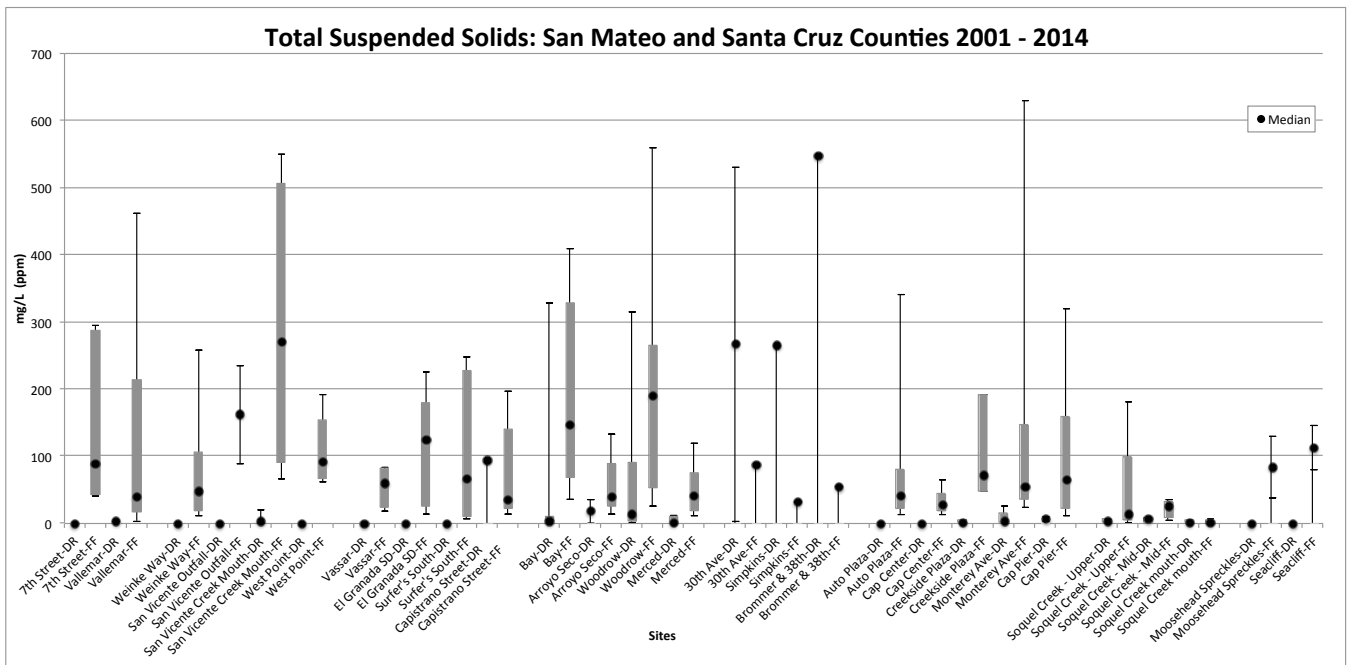
**Figure 17.** Total lead results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

**Total Suspended Solids (TSS)**

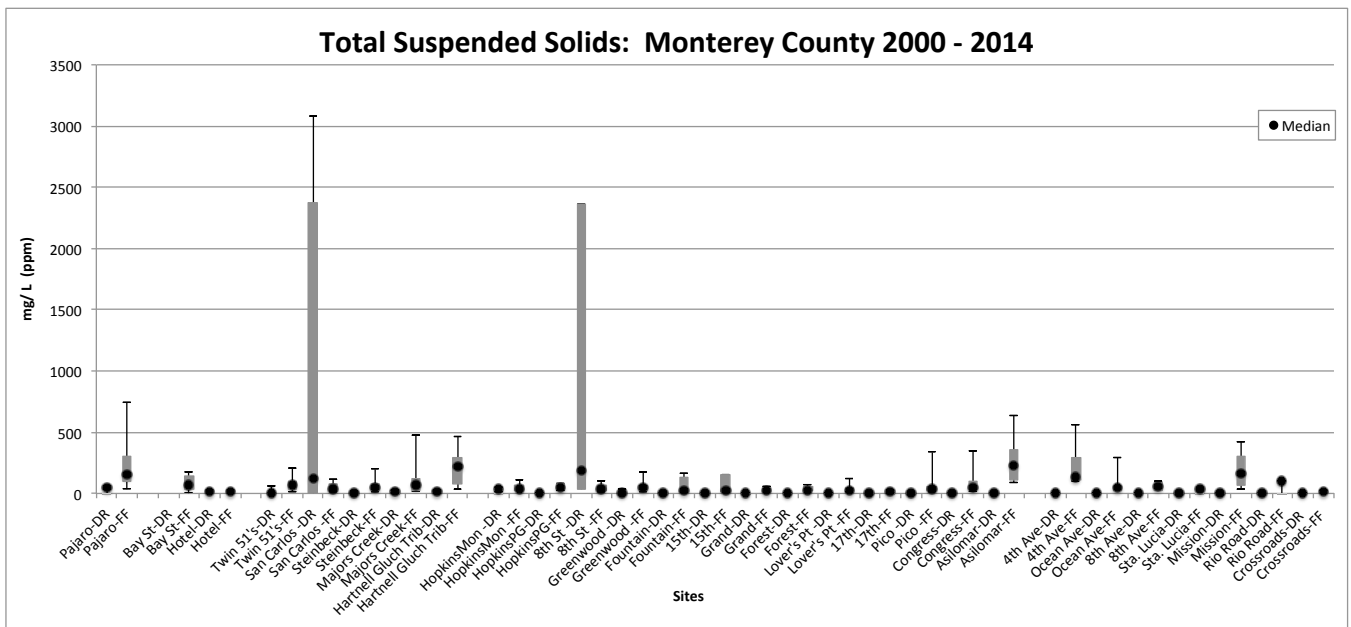
TSS are particulate matter in water that attracts charged particles which can often be pesticides and metals. TSS can additionally impact the environment through sedimentation and reduction in the ability of marine organisms to respire. Some sources of TSS are construction sites with improper sediment control, bank erosion from rivers or streams, runoff from agricultural fields, and over irrigation in urban areas. The Action Level for TSS is 500 mg/L, with an MDL of 2 mg/L for both the Dry Run and First Flush.

For the **Dry Run**, none of the sites were above the WQO. Four sites had non detects: Soquel Creek - Upper (Capitola), Twins and Steinbeck (Monterey), Pico (Pacific Grove) (Figures 18 and 19).

For the **First Flush**, none of the sites were above the WQO (Figures 18 and 19).



**Figure 18.** TSS results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in San Mateo and Santa Cruz counties. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Montara, Moss Beach, El Granada, Santa Cruz, Capitola, Aptos.



**Figure 19.** TSS results for all sites for Dry Run (DR) and time series averages for First Flush (FF) in Monterey County. Non-detects were given the value of half the Minimum Detection Limit (MDL) but their true value lies between the zero and the MDL. All sites grouped by city from north to south- Pajaro (Monterey County), Seaside, Monterey, Pacific Grove and Carmel.

At each site during the Dry Run and First Flush 2014, volunteers recorded the presence of trash, sewage (smelled), oil sheen, and bubbles and/or scum (Table 3).

**Table 3: Visual Observations**

	Trash-DR	Trash-FF	Oil Sheen-DR	Oil Sheen-FF	Smells of Sewage-DR	Smells of Sewage-FF	Scum and /or Bubbles-DR	Scum and/or Bubbles-FF
Vallemar (Montara)	NS	X	NS		NS		NS	
Weinke Way (Montara)	NS		NS		NS	X	NS	X
San Vicente Creek Mouth (Moss Beach)								
West Point (Moss Beach)	NS		NS	X	NS		NS	X
Vassar Drive (El Granada)	NS	X	NS		NS		NS	
Capistrano Street (El Granada)	NS	X	NS		NS	X	NS	
El Granada (El Granada)	NS	X	NS		NS		NS	
Surfer's South (El Granada)	NS		NS		NS		NS	X
Auto Plaza (Capitola)	NS	X	NS		NS		NS	X
Capitola Center (Capitola)	NS		NS		NS		NS	
Creskide Plaza (Capitola)						X		
Monterey Ave (Capitola)							X	X
Capitola Pier (Capitola)		X						X
Soquel Creek - Upper (Capitola)	X	NR		NR		NR		NR
Soquel Creek- Mid (Capitola)	X	NR		NR		NR		NR
Soquel Creek Mouth (Capitola)		X		X				X
Pajaro (Monterey County)		X		X	NR			X
Bay Street (Seaside)		X				X		
Twins (Monterey)	X	X		X		X	X	X
San Carlos (Monterey)		X				X		
Steinbeck (Monterey)	X	X			X	X		
Greenwood Park (Pacific Grove)								X
Lovers (Pacific Grove)						X		X
Pico (Pacific Grove)								X
Crossroads (Monterey County)		NR		NR		NR		NR

**X= found at the site; NR= not recorded; NS= not sampled**

## Conclusion

For the past fifteen years, the Dry Run and First Flush have provided Central California coastal area residents and municipalities with valuable information about the quality of water running from the storm drains to the ocean. Results from this and other Dry Run/First Flush events provide managers and researchers with pollutant concentrations during two critical times: late season dry weather and the initial flushing events when the most polluted water is expected. Results from the 2014 events show that:

- Nitrate concentrations are generally higher during the dry weather monitoring, yet 80% are still below the Action Level for dry weather and 100% are below the Action Level for wet weather.
- Dry Run results for orthophosphate were below the WQO for 90% of the sites monitored. However, orthophosphate results continue to be above the Action Level for many sites during the First Flush. In San Mateo and Monterey County 100% of the sites were over the Action Level and in Santa Cruz County 25% of sites were over the Action Level.
- Copper concentrations appear to be consistently higher at sites in the southern half of the Monterey Bay region. In Monterey County, 100% of the sites were above the Action Level for copper while 13% of the sites were in Santa Cruz County and 25% in San Mateo County.
- Zinc concentrations appear to be consistently higher at sites in the southern half of the Monterey Bay region. For sites in San Mateo and Santa Cruz Counties, zinc results were over the WQO at 25% of sites and in Monterey County were over the WQO at 89% of sites.
- Lead concentrations were below the WQO during dry weather events at all sites and over the WQO at one site for wet weather.
- As in previous years, *E. coli* and enterococcus results during First Flush were all above the WQO. In 2014, 80% of the sites exceeded the WQO for both *E. coli* and enterococcus during dry weather and 100% during wet weather.

First Flush data helps us to better understand what *our* pollutants of concern are over a very large area and help to identify where concentrations are highest. Our hope is that this informs the placement of target projects and Best Management Practices (BMPs) to address those specific contaminants. First Flush does not necessarily inform us as to whether our efforts are improving water quality; that requires a different monitoring design but with the information provided by the First Flush event a prioritization of problem watersheds can be accomplished. Local cities have used First Flush information and addressed pollutant concentrations by cleaning out storm drains prior to the rains, installing dry weather diversions and CDS units (litter/debris removal systems) as well as identifying opportunities to slow down runoff through vegetation and permeable surfaces. By addressing these issues on a watershed level more water quality improvements may be achieved.