Summary Report:
Humboldt Bay First Flush 2004

Produced for the City of Eureka
by

Community Clean Water Institute

June 2005

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This is the Summary Report of the Humboldt Bay First Flush Study. The entire Humboldt Bay First Flush Report is available at http://www.ccwi.org/issues/firstflush.htm:

Acknowledgements:

Thank you to the volunteers who made this project possible. Also to the interns, technical advisors, City of Eureka Public Works Department and everyone else who helped with the project. We hope you find this report useful, and thank you for your interest in clean water and healthy watersheds. -CCWI Staff

Funding for this project was provided by the City of Eureka.
For more information on this report, or how to protect your watershed, contact:

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1.0 Introduction

Community Clean Water Institute (CCWI), a non-profit organization which conducts water quality monitoring, has concluded a study on water quality in Humboldt Bay. **The 2004 Humboldt Bay First Flush Report describes the results from testing stormwater runoff at 10 sites around Humboldt Bay** on a rainy day on October 17, 2004.

"First Flush" refers to the first significant rain event ("First Flush") of the season. During First Flush, contaminants which accumulate over the dry summer are washed down the storm drains and carried into waterways. First Flush provides a potential "worst case" scenario for waterways near urban areas due to **urban stormwater runoff which may contain metals, oil and grease, nutrients and bacteria**.

Pollutants run off our roads and into Humboldt Bay when it rains. This type of study helps us understand the water quality of the Bay, and how our activities impact the Bay. Then we can encourage policy makers to protect the Bay.

2.0 Study plan and logistics

CCWI trained about 20 volunteers from Eureka and Arcata to become citizen water quality monitors for the First Flush. Two interns from Humboldt State University assisted with the writing of the report. Several citizen's groups, governments, and agencies participated.

The First Flush storm event took place on Sunday, October 17, 2004. 10 sites were monitored on Humboldt Bay, ranging from the south part of Eureka (near the Municipal Golf Course) to the northern part of Humboldt Bay (Jolly Giant Creek in Arcata).

In Eureka, the stream sites were Cooper Gulch and 14th Street, and Martin Slough, upstream of the golf course. The Eureka stormdrain sites were Waterfront Drive at the intersections of P St., L St., C St., Commercial Blvd., Truesdale and Christie, and McCullens Ave. There were two stream sites in the City of Arcata, Jolly Giant Creek at Samoa Crossing, and Grotzman Creek near Bayside Road and Crescent Street.

Site information:

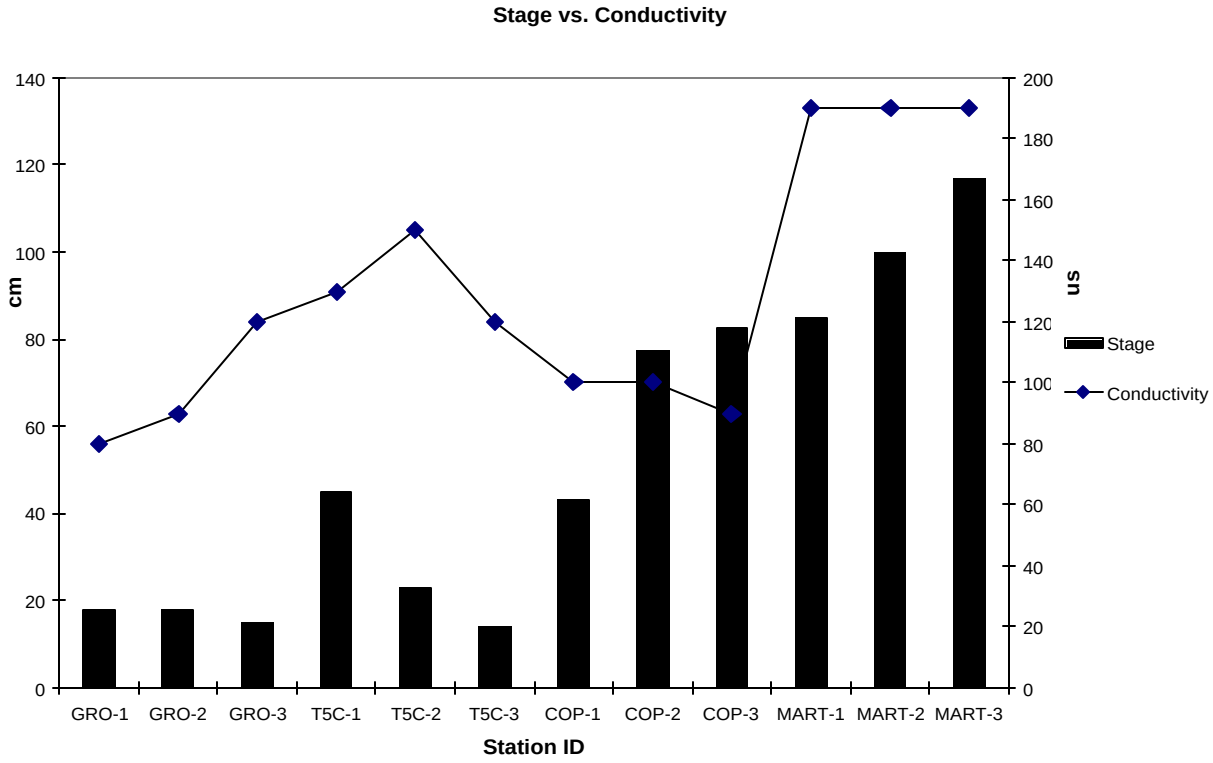
Site Name	Site Description	GPS Points	Datum
	Eureka sites		
Cooper Gulch and 14th Street (COP)	Cooper Gulch and 14th Street	-124.15343, 40.79597	WGS84
Martin Slough (MART)	Just upstream of Eureka golf course by Fairway Dr.	-124.16422, 40.76114	WGS84
	Eureka storm drains/manhole sites		
T13B	Waterfront Drive at P St.	-124.15912, 40.80611	NAD27
T13C	Waterfront Drive at L St.	-124.15908, 40.80606	NAD27
T13E	Waterfront Drive at C St.	-124.16884, 40.80500	NAD27
T13F	Waterfront Drive at Commercial St.	-124.17309, 40.80416	NAD27
T13N	Truesdale/ Christie	-124.19296, 40.77647	NAD27
T130	McCullens Ave.	-124.19069, 40.77444	NAD27
	Arcata Sites		
Jolly Giant (T5C)	Jolly Giant Creek at H St. and Samoa	124.08894, 40.86530	WGS84
Grotzman Creek (GRO)	Grotzman Creek near Bayside Road and Crescent Street	124.07250, 40.85647	WGS84

Approximately 15 volunteers collected samples which were analyzed by CCWI and North Coast Laboratories. Samples were analyzed for the following parameters: conductivity, pH, stage height, water temperature, turbidity, Nitrogen/Nitrate, Phosphorous/Phosphate, total coliform, E. coli, metals (cadmium, chromium, lead, nickel, and zinc), oil and grease (HEM-SG), and total suspended solids (TSS).

A dry run sampling event was held on Sunday, October 10 in order to capture measurements of water quality under dry conditions so as to have a source of comparison to First Flush results.

Composite samples were collected from the manhole sites with a bucket.

Conductivity and stage height were measured every half-hour at all stations. When conductivity decreased by 200 uS or there was a 20% increase in stage height, the first round of testing and sample collection was performed. Surface water sampling teams waited 30 minutes between each sampling round to obtain three sets of samples. The manhole storm drain sampling teams performed two rounds of sampling at each site with an average of 1 hour elapsing between rounds.



Conductivity and stage were used as indicators to determine the arrival of stormwater runoff. Upon arriving at their sites, monitors repeatedly measured both parameters, watching for either a 200 uS decline in conductivity or a 20% increase in stage height.

CCWI set up a temporary lab to test samples for turbidity, total coliform, and E. coli. The lab was located in a private meeting room at the Red Lion Inn of Eureka.

Laboratory volunteers. Above left: preparing a sample for turbidity. Above right: with Quantitray sealer for total coliform and E. coli.

3.0 Results and interpretation

Twenty-four field samples were collected. Surface water sites (COP, MART, GRO, & T5C) completed three rounds of sampling, while manhole sites (T13B, T13N, T13O, T13E, T13C & T13F) completed two rounds. This study includes six quality control samples and ten dry run samples in addition to the 24 field samples for a total of forty samples. Quality control samples consisted of two field blanks, three field duplicates, and one lab replicate.

Stormwater Benchmarks:
TSS: 100 mg/L
Oil and Grease: 15 mg/L
Lead: 816 ug/L
Chromium: 50 ug/L
Zinc: 117 ug/L
Nickel: 1417 ug/L
Nitrate: 0.68 mg/L

The Total Coliform and E. coli graphs include California Department of Health draft guidelines for recreational waters which are also not enforceable.
CA Department of Health Guidelines:
Total Coliform: 10,000 MPN/100mL
E. coli: 235 MPN/100mL

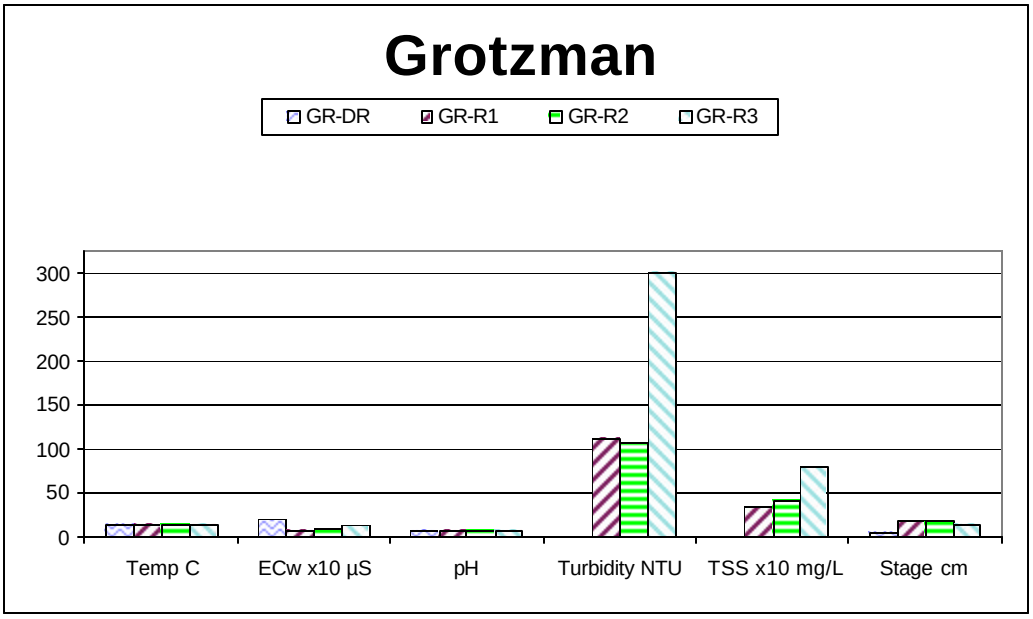
Notes about the chart on the following page:
R1, R2, R3= Rounds of sampling in order sampled.
ND= non-detect. For more information on detection limits, see the full First Flush Report.
OR= Over Range.

Station ID	Station visit ID	Collection Date	Collection Time	Conductivity (uS)	pH (pH)	Stage (cm)	Water Temperature (C)	Turbidity (NTU)	Cadmium (ug/L)	Chromium (ug/L)	Lead (ug/L)	Nickel (ug/L)	Nitrate as N (mg/L)	TSS (mg/L)	HEM-SG (mg/L)	Orthophosphate as P (mg/L)	Zinc (ug/L)
COP-Dry Run	Dry Run	10/10/2004	1:40 PM	190	7	12	13.5										
COP-1	R1	10/17/2004	11:45	100	7	43.1	14	184	ND	12	23	ND	0.72	180	ND	0.017	59
COP-2	R2	10/17/2004	12:20	100	7	77.5	14	55.1	ND	ND	17	ND	0.7	96	ND	0.041	52
COP-3	R3	10/17/2004	12:50	90	7	82.6	14	47.2	ND	ND	14	ND	0.71	57	ND	0.038	44
GRO-Dry Run	Dry Run	10/10/2004	6:05 PM	200	8	6	14										
GRO-1	R1	10/17/2004	12:30PM	80	7.5	17.78	14	112	ND	26	11	28	1.1	350	ND	0.057	77
GRO-2	R2	10/17/2004	1:00PM	90	7	17.78	14	107	ND	27	ND	29	1.1	410	ND	0.038	78
GRO-3	R3	10/17/2004	1:30PM	120	7	15.24	14	302	ND	61	17	74	1.2	800	ND	0.025	130
GRO-2 Dup	R2	10/17/2004	1:00PM					94					1.1	410	6.2	0.038	
GRO-3 Dup	R3	10/17/2004	1:30PM						ND	63	18	75					130
MAR-Dry Run	Dry Run	10/10/2004	2:45 PM	210	8	30	15.5										
MAR-01	R1	10/17/2004	1:50PM	190	8	85	14	66.3	ND	ND	ND	ND	1	67	ND	0.076	21
MAR-02	R2	10/17/2004	2:25PM	190	7	100	14	64.1	ND	ND	ND	ND	0.95	61	ND	0.06	ND
MAR-03	R3	10/17/2004	2:58PM	190	7	117	13	95.3	ND	11	ND	ND	0.93	92	ND	0.046	21
T13B-Dry Run	Dry Run	10/11/2004	8:30 AM	OR	8		17		ND	30	ND	46					330
T13B-1	R1	10/17/2004	12:35PM	0	8		16	18.1	ND	ND	ND	ND	0.29	36	ND	0.06	42
T13B-2	R2	10/17/2004	2:50PM	70	8		16	16.2	ND	ND	ND	ND	0.28	14	ND	0.062	45
T13C-Dry Run	Dry Run	10/11/2004	8:35 AM	OR	7		17		ND	ND	ND	ND					29
T13C-1	R1	10/17/2004	12:15PM	0.3	8		16	13	ND	ND	29	ND	0.56	14	ND	0.09	62
T13C-2	R2	10/17/2004	2:30PM	0	7		15	11.8	ND	ND	25	ND	0.88	14	ND	0.094	57
T13E-Dry Run	Dry Run	10/11/2004	9:00 AM	OR	8		17		ND	ND	ND	ND	3.4	27	ND	0.041	ND
T13E-1	R1	10/17/2004	1:00PM	0	8		15	17.8	ND	ND	74	ND	0.23	140	ND	0.13	440
T13E-2	R2	10/17/2004	3:10PM	0	8		18	20.6	ND	ND	22	ND	0.21	50	ND	0.071	110
T13F-Dry Run	Dry Run	10/11/2004	9:15 AM	OR	7		17		ND	ND	ND	ND	ND	7.6	ND	0.15	ND
T13F-1	R1	10/17/2004	1:15PM	100	9		16	16.8	ND	ND	ND	ND	ND	51	ND	0.063	67
T13F-2	R2	10/17/2004	3:15PM	110	8		16	15.5	ND	ND	ND	ND	0.11	19	ND	0.095	280
T13N-Dry Run	Dry Run	10/11/2004	9:40 AM	OR	8		17		ND	ND	ND	ND	3.4	21	ND	0.024	22
T13N-1	R1	10/17/2004	1:35PM	0	7		15.5	17.7	ND	14	69	35	0.24	98	ND	0.057	570
T13N-2	R2	10/17/2004	3:40PM	0.3	7		15	18.9	ND	ND	ND	ND	0.32	28	ND	0.047	100
T13O-Dry Run	Dry Run	10/11/2004	10:00 AM	OR	8		18		ND	ND	ND	ND	4.2	76	ND	0.016	ND
T13O-1	R1	10/17/2004	1:40PM	70	8		16	39.6	ND	ND	10	ND	0.64	1100	9.1	0.11	86
T13O-2	R2	10/17/2004	3:50PM	80	8		17	20.1	ND	ND	ND	ND	0.76	170	ND	0.14	45
T13O-1 Dup	R1	10/17/2004	1:40 PM					36.5	ND	ND	ND	ND	0.65	66	8.3	0.14	58
T5C-Dry Run	Dry Run	10/11/2004	4:00 PM	220	7	17	15										
T5C-1	R1	10/17/2004	12:15PM	130	8	45	14	85.8	ND	12	26	ND	0.52	110	ND	0.088	97
T5C-2	R2	10/17/2004	12:45PM	150	8	23	14	48	ND	42	84	55	0.71	220	ND	0.015	350
T5C-3	R3	10/17/2004	1:15PM	120	8	14	14	59	ND	13	21	ND	0.58	150	ND	0.012	79
Trip Blank		10/17/2004	2:30 PM					0.71									
Trip Blank		10/17/2004	2:35 PM					0.58									
Trip Blank-Dup		10/17/2004	2:35 PM					0.35									

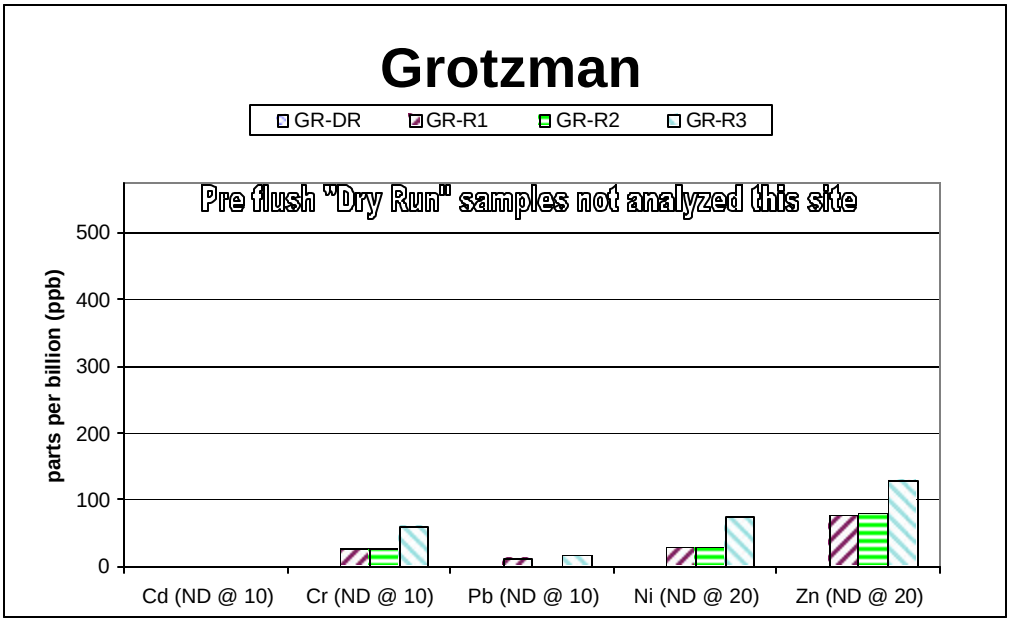
Sample ID	Date Collected	Time Collected	Set up Date	Set up Time	Reading Date	Reading Time	MPN Total Coliform in tray	MPN Total coliform in sample	MPN E.coli in tray	MPN E.coli in sample	Result Unit	Dilution Factor
Cooper Gulch 14th St	10/17/2004	11:45AM	10/17/2004	11:00PM	10/18/2004	11:00PM	1011.1	>101110	214.2	21420	MPN/100	100
Cooper Gulch 14th St	10/17/2004	12:30PM	10/17/2004	11:00PM	10/18/2004	11:45PM	913.9	91390	184.2	18420	MPN/100	100
Cooper Gulch 14th St	10/17/2004	12:50PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	191.8	19180	MPN/100	100
Grotzman	10/17/2004	1:00PM	10/17/2004	11:00PM	10/18/2004	11:00PM	960.6	96060	360.9	36090	MPN/100	100
Grotzman	10/17/2004	1:30PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	141.4	14140	MPN/100	100
Grotzman	10/17/2004	12:30PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	416	41600	MPN/100	100
Grotzman Dup	10/17/2004	1:00PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	238.2	23820	MPN/100	100
Grotzman Rep	10/17/2004	1:00PM	10/17/2004	11:00PM	10/18/2004	11:45PM	829.7	82970	248.9	24890	MPN/100	100
Martin	10/17/2004	1:50PM	10/17/2004	11:00PM	10/18/2004	11:45PM	960.6	96060	75.4	7540	MPN/100	100
Martin	10/17/2004	2:25PM	10/17/2004	11:00PM	10/18/2004	11:45PM	629.4	62940	42.6	4260	MPN/100	100
Martin	10/17/2004	2:58PM	10/17/2004	11:00PM	10/18/2004	11:00PM	829.7	82970	41.6	4160	MPN/100	100
T13B	10/17/2004	12:35PM	10/17/2004	11:00PM	10/18/2004	11:00PM	791.5	79150	160.7	16070	MPN/100	100
T13B	10/17/2004	2:50PM	10/17/2004	11:00PM	10/18/2004	11:00PM	689.3	68930	249.5	24950	MPN/100	100
T13C	10/17/2004	12:15PM	10/17/2004	11:00PM	10/18/2004	11:45PM	272.3	108920	12.2	4880	MPN/100	400
T13C	10/17/2004	12:15PM	10/17/2004	11:00PM	10/18/2004	11:00PM	791.5	79150	52.1	5210	MPN/100	100
T13C	10/17/2004	2:30PM	10/17/2004	11:00PM	10/18/2004	11:00PM	829.7	82970	41.9	4190	MPN/100	100
T13E	10/17/2004	1:00PM	10/17/2004	11:00PM	10/18/2004	11:00PM	913.9	91390	67.7	6770	MPN/100	100
T13E	10/17/2004	3:10PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	95	9500	MPN/100	100
T13F	10/17/2004	1:15PM	10/17/2004	11:00PM	10/18/2004	11:00PM	601.5	60150	11	1100	MPN/100	100
T13F	10/17/2004	unlabelled	10/17/2004	11:00PM	10/18/2004	11:00PM	658.6	65860	8.6	860	MPN/100	100
T13N	10/17/2004	1:35PM	10/17/2004	11:00PM	10/18/2004	11:45PM	755.5	75550	124	12400	MPN/100	100
T13N	10/17/2004	3:40PM	10/17/2004	11:00PM	10/18/2004	11:00PM	913.9	91390	151.5	15150	MPN/100	100
T13O	10/17/2004	1:40PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	85	8500	MPN/100	100
T13O	10/17/2004	1:40PM	10/17/2004	11:00PM	10/18/2004	11:00PM	524.7	209880	8.6	3440	MPN/100	400
T13O	10/17/2004	12:50PM	10/17/2004	11:00PM	10/18/2004	11:45PM	960.6	96060	72.3	7230	MPN/100	100
T13O Dup	10/17/2004	1:40PM	10/17/2004	11:00PM	10/18/2004	11:00PM	689.3	68930	45.5	4550	MPN/100	100
T5C	10/17/2004	1:15PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	142.1	14210	MPN/100	100
T5C	10/17/2004	12:15PM	10/17/2004	11:00PM	10/18/2004	11:00PM	665.3	66530	343.6	34360	MPN/100	100
T5C	10/17/2004	12:45PM	10/17/2004	11:00PM	10/18/2004	11:45PM	1011.1	>101110	658.6	65860	MPN/100	100
Trip Blank	10/17/2004	2:30PM	10/17/2004	11:00PM	10/18/2004	11:45PM			<1	<100	MPN/100	
Trip Blank	10/17/2004	2:35PM	10/17/2004	11:00PM	10/18/2004	11:00PM			<1	<100	MPN/100	100

Selected Graphs: These graphs were chosen as examples for analysis. For more graphs, see the entire First Flush Report, available at http://www.ccwi.org/issues/firstflush.htm:

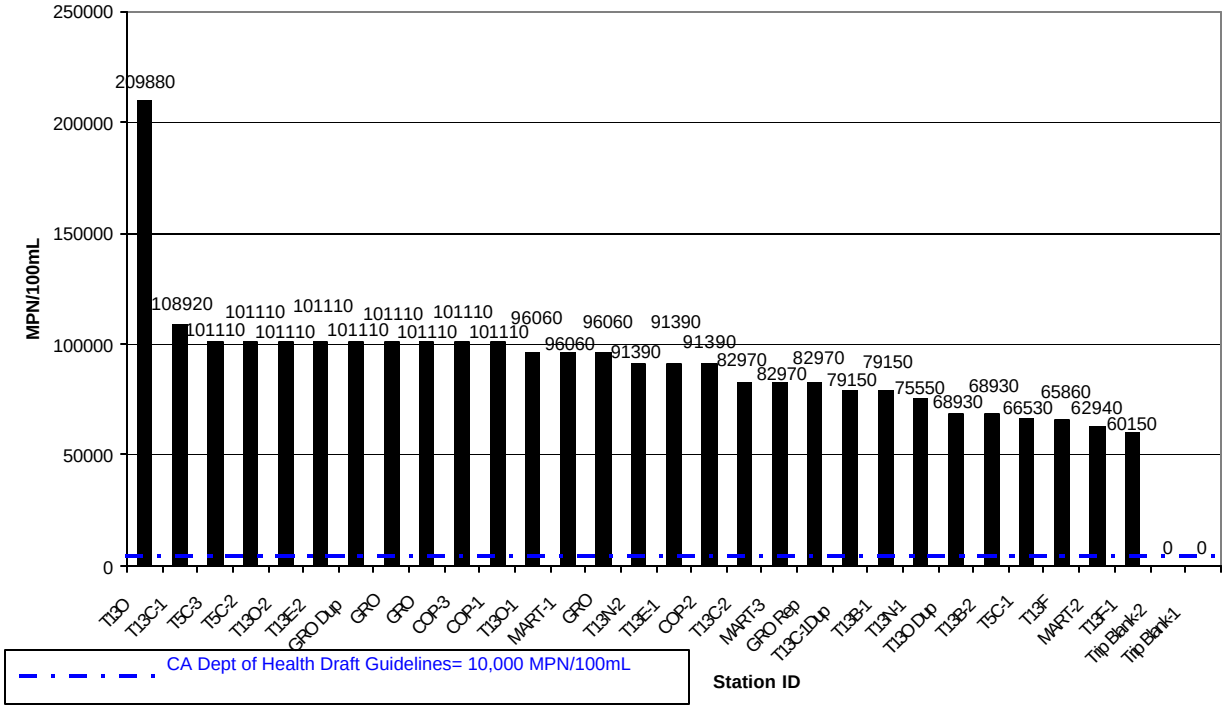
Physical



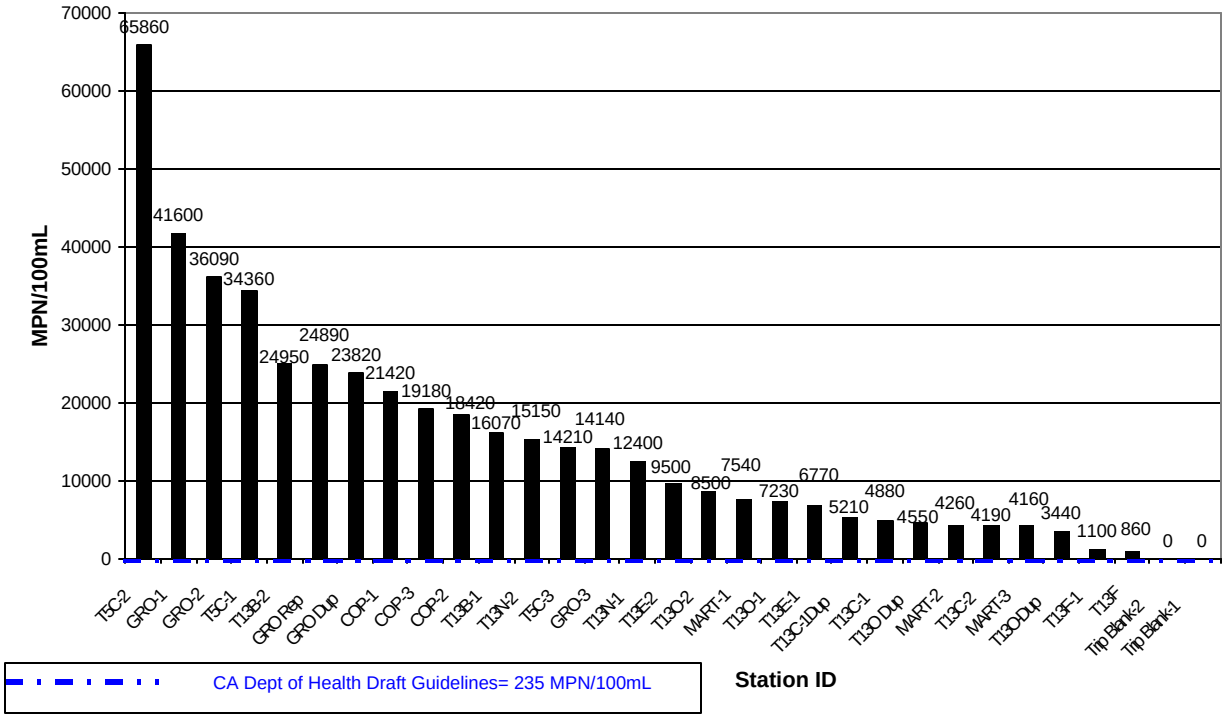
Metals



Total Coliform MPN/100mL
1:100 dilution



e.Coli MPN/100mL
1:100 dilution



Results Summary:
Sites with the highest number of highest readings were **Grotzman Creek in Arcata**, and **the storm drain at McCullens Ave. in Eureka**.

Grotzman Creek in Arcata had the highest readings of the sites monitored for: Nitrogen/Nitrate, turbidity, chromium, and nickel.

The storm drain at McCullens Ave. in Eureka had the highest readings for: Total Suspended Solids, Phosphorous/Phosphate, oil and grease, and total coliform. **McCullens had a reading for Total Coliform of 209,880 MPN/100mL.** The California Department of Health Services (DHS) draft guideline for Total Coliform is 10,000 MPN per 100 ml. So that sample at McCullens measured at 20 times higher than the State guideline.

Also in Eureka, the storm drain at Truesdale and Christie Street in Eureka had the highest reading for Zinc at 570 ug/L.

In Arcata, Jolly Giant Creek in Arcata had the highest readings for Lead at 84 parts per billion.

Total Coliform and E. coli were the parameters with the highest number of exceedences of standards. CCWI used a 1:100 dilution to test for coliform, meaning that 1 milliliter of sample water was placed in a 100mL container before the test was run. Some tests were performed at a 1:400 dilution (which uses 1/4 milliliter of sample water and 99.75 milliliters of distilled water).

Jolly Giant Creek had readings of E. coli measured at 65,860 MPN/100mL.

The California Department of Health Services (DHS) draft guideline for E. coli is 235 per 100 ml. The measurement at Jolly Giant was 250 times the guideline.

Coliform is a heading that describes a type of bacteria, which includes E. coli. It is found within the intestines of warm blooded animals, though most water contamination comes from cattle and people. Sources of bacteria include the natural environment (soils and decaying vegetation), stormwater, urban runoff, animal wastes (both wildlife and domestic animals), and human sewage. Analysis for total coliform and E. coli bacteria is widely used as an indicator test.

There are, of course, limitations to the conclusions that can be drawn from this single study. Additional ongoing studies will provide the data needed for a more thorough analysis of water quality and stormwater characterization in Humboldt Bay.

4.0 Data quality overview

Quality Assurance: Field blanks and duplicates are quality control samples to provide quality assurance information of this sampling event. **Blanks:** The CCWI staff team carried two field blanks of deionized water throughout the duration of the sampling period. Field blanks were analyzed with the same lab equipment for bacteria and turbidity in the CCWI lab to measure the level of background contamination from sampling containers or handling procedures. **Dups:** Several sites were also assigned duplicate containers that were collected in the same manner as regular samples and marked "DUP." Out of 30 field samples, 3 duplicates were collected in the field. Duplicate samples were collected at Grotzman (Rounds 2 & 3)

and T13O (Round 1) at the same time as the initial sample and were subjected to identical handling and analysis. Grotzman-2 duplicate was tested for turbidity, oil and grease, TSS, Nitrate-N, Phosphate-P, and coliform bacteria. Grotzman-3 duplicate was tested for metals. T13O-1 duplicate was tested for turbidity, coliform bacteria, oil and grease, Nitrate-N, Phosphate-P, TSS, and metals. **Reps:** In the CCWI lab, one replicate from Grotzman-2 was analyzed for bacteria. CCWI only uses reportable data for Quality Assurance analysis. The relative percent difference (RPD) between the sample and duplicate sample result is calculated with the following formula:

$$RPD = \frac{(\text{Sample Value}) - (\text{Duplicate Value})}{(\text{Sample Value} + \text{Duplicate Value})/2} \times 100$$

Relative Percent Difference

Site Name-Round	Turbidity	TSS	Nitrate -N	Phosphate -P	Total Coliform	E. coli
GRO-2	12.94	0	0	0	-5.12	40.96
GRO-3						
T13O-1	8.15	177	-1.55	-24	37.85	60.77

Site Name-Round	Cadmium	Chromium	Nickel	Lead	Oil & Grease	Zinc
GRO-2						
GRO-3	0	-3.23	-1.34	-5.71		0
T13O-1	NA	NA	NA		9.2	38.89

Precision assessment is performed on reportable data only. Zeros can occur when the initial and the duplicate results are the same (High Precision). Precision assessment is Not Applicable (NA) when results are Non Detect (ND).

5.0 Summary and recommendations

CCWI recommends a community-wide effort to continue First Flush studies on an annual basis. We also encourage local and regional jurisdictions and agencies to collaborate in funding on-going citizen monitoring which will serve to educate the public and collect valuable water quality data.

3 factors: climate, population growth, and land use

The information provided by the First Flush study combined with future studies may help to model and predict how other factors such as climate, population growth, and land use in Humboldt County will affect both the quantity and quality of the stormwater discharge entering Humboldt Bay.

Climate variability may greatly influence the characteristics of any future stormwater flushes. Depending on seasonal shifts, annual precipitation, and duration of precipitation, stormwater runoff events may exhibit changes in quantity, quality, duration, and timing. Shifts in the area's climate over time, including those

predicted by global climate change such as increased probability of severe drought years, may also affect stormwater runoff events over time.

Population growth and land use practices may influence the results of future flushes. Increases in population around the Bay may increase the quantity of stormwater runoff if the growth takes place on the outskirts of the Cities and results in increased impervious surface (pavement which does not allow rainfall to seep into the ground). However, if population growth occurs in downtown Eureka's redevelopment area, or areas which do not result in additional impervious surface (growing the town vertically, not horizontally), or if best management practices such as stormwater catchment with bioswales and pervious pavement are implemented, stormwater runoff may be less affected. The Cities of Eureka and Arcata can exercise discretion over land use policy, and can encourage practices which minimize the environmental impact of stormwater runoff.

One example of a best practice is the City of Arcata's GIS-based Stormwater Drainage Master Plan. The Plan is an example of how a city in Humboldt Bay can set policies to discourage the creation of impervious surface. The City implemented a utility fee which is calculated based upon actual square footage of impervious surface for each parcel. Billing based upon impervious surface area provides a means to more equitably distribute the costs according to how runoff is generated, and it further encourages minimal paving. Taxing the source of pollution to pay for its cleanup is known as "polluter pays." There are many well-known Best Management Practices which can mitigate the impacts of stormwater runoff, available from the EPA, State Water Resources Control Board, and from numerous agencies, conservation districts, and non-profits which work on water quality.

For non-point source pollution, unfortunately, the polluter is all of us. Each of us can do something about stormwater runoff. This study is meant to encourage citizens to become involved in the protection of Humboldt Bay. Every resident can become an active steward of this valuable resource which supports our economy, community, and environment, and we can make a healthier Humboldt Bay.

CCWI encourages continued community collaboration to support citizen monitoring which will serve to educate the public and collect valuable water quality data.

Humboldt Bay First Flush Report is available at http://www.ccwi.org/issues/firstflush.htm or by contacting CCWI at (707) 824-4370.

6.0 References

Geist, Jill K. *Final Comment Report: Humboldt Bay and Watershed Fecal Coliform Study*. Humboldt Bay Shellfish Advisory Committee. Arcata, CA. February 2003.

National Weather Service Website
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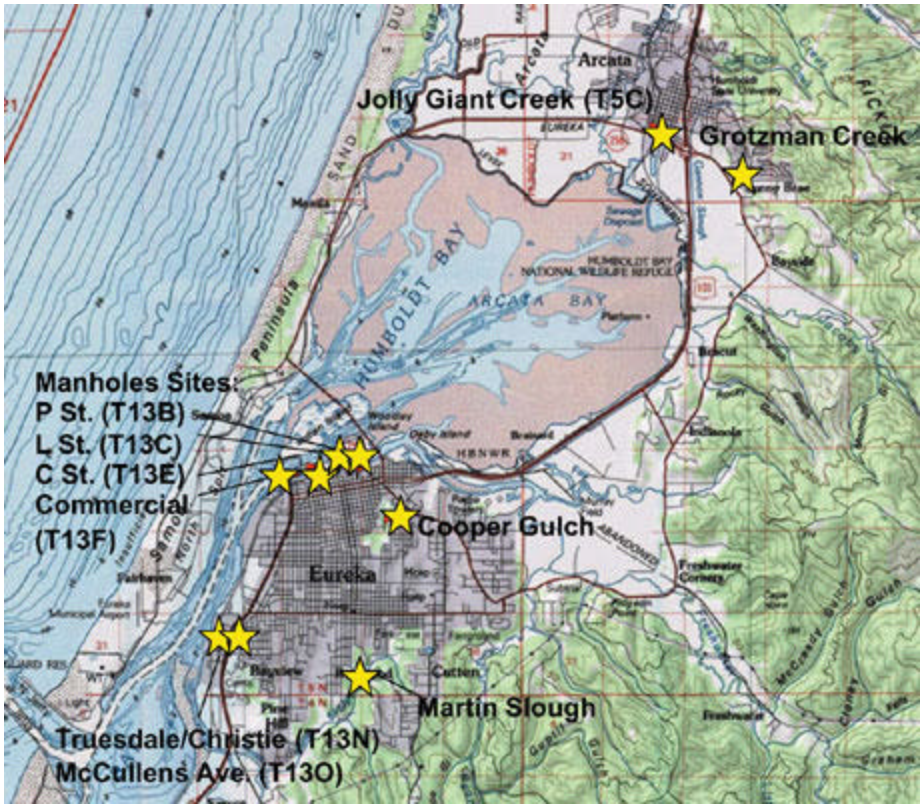
EPA Office of Water: *Volunteer Stream Monitoring: A Methods Manual.*

Humboldt Bay First Flush 2004- Site Map
Community Clean Water Institute



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