Clean Charles 2005 Water Quality Report
1998 Core Sampling Program
July 1999

Prepared By

US EPA
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1.0 BACKGROUND

The Charles River watershed is located in eastern Massachusetts and drains 311 square miles from a total of 24 cities and towns. The Charles River, designated as a Massachusetts class B water, is the longest river in Massachusetts and meanders 80 miles from its headwaters at Echo Lake in Hopkinton to the outlet in the Boston Harbor. From Echo Lake to the Watertown Dam the river flows over many dams and drops approximately 340 feet. From the Watertown Dam to the New Charles River Dam/boat locks in Boston the river is primarily flat water (EPA 1997). This section, referred to as "the Basin", is the most urbanized part of the river and is extensively used by rowers, sailors and anglers. Parkland of the Metropolitan District Commission (MDC) encompasses the banks of the river, creating excellent recreational opportunities with their open space and bicycle paths.

The lower basin (defined as the section between Boston University Bridge and the New Charles River Dam), once a tidal estuary, is now a large impoundment. A major portion of the banks and shoreline of this area is defined by sea walls.

The Charles River has been polluted and physically altered for more than a century. The Basin is influenced by point sources, storm water runoff and Combined Sewer Overflows (CSOs). An EPA survey, conducted in 1996, identified over 100 outfall pipes in the Basin (EPA 1996).

In 1995, EPA established the Clean Charles 2005 initiative to restore the Charles River to a swimmable and fishable condition by Earth Day in 2005. The initiative has a strategy to provide a comprehensive approach for improving water quality through CSO controls, illicit sanitary connection removal, stormwater management planning and implementation, public outreach, education, enforcement and technical assistance.

2.0 INTRODUCTION

In 1998, EPA's Office of Environmental Measurement and Evaluation (OEME) implemented a water quality monitoring program for the Charles River that will continue until at least 2005. EPA and it's partners in the Clean Charles 2005 Water Quality Subcommittee developed the study design in order to track improvements in the Charles River Basin and to identify where further pollution reductions or remediation actions were necessary in order to meet the swimmable and fishable goals. Members of the subcommittee include EPA-New England, U.S. Geological Survey (USGS), U.S. Army Corps of Engineers - New England District (ACE), Massachusetts Executive Office of Environmental Affairs (EOEA), Massachusetts Department of Environmental Protection (DEP), Massachusetts Department of Environmental Management (DEM), Massachusetts Water Resources Authority (MWRA), Boston Water and Sewer Commission (BWS), Charles River Watershed Association (CRWA) and the MDC. EPA and it's partners are supporting several other water quality studies in the Charles River to further identify impairment areas and to evaluate storm water management

techniques.

OEME's basic sampling program was designed to monitor twelve fixed stations during three dry weather sampling events and six of the twelve stations during a maximum of three wet weather sampling events. The sampling was to be conducted during peak recreational usage in July, August and September. To establish boundary conditions, one station was located immediately downstream from the South Natick Dam or 30.5 miles upstream of the Watertown Dam. The other eleven stations were located in the Basin. Five of these eleven sampling stations were located in priority resource areas which were identified as potential wading and swimming locations. The project map in Figure 1 shows the dry and wet weather fixed sampling stations, the priority resource areas, CSO locations, and discharge pipes locations. Table 1 describes all the sampling stations monitored in 1998 and shows the priority resource areas in bold text.

The program included measurements of dissolved oxygen (DO), temperature, pH, specific conductance, chlorophyll a, total organic carbon (TOC), total suspended solids (TSS), apparent color, clarity, turbidity, nutrients, metals and bacteria. In addition, chronic toxicity was tested during the August sampling event. For more project design information refer to the Project Work/QA Plan for the Clean Charles 2005 Water Quality Study in Appendix B.

Table 1: Sampling Station Description

PRIMARY STATIONS DESCRIPTION	STATION #
Downstream of S. Natick Dam	CRBL01
Upstream of Watertown Dam	CRBL02
Daly Field, 10 m off south bank	**CRBL03**
Herter East Park, 10 m off south bank	**CRBL04**
Magazine Beach, 10 m off north bank	**CRBL05**
Downstream of BU bridge, main stem	CRBL06
Downstream of Stony Brook & Mass Ave, 10 m off S. shore	CRBL07
Pond at Esplanade	**CRBL08**
Upstream of Longfellow bridge, Cam. side	CRBL09
Community boating Area	**CRBL10**
Between Longfellow bridge & Old Dam	CRBL11
Upstream of railroad bridge	CRBL12
SUPPLEMENTAL SAMPLING STATIONS USED	
Downstream of BOS 032 (mid stream)	CRBL3A
500 meters downstream of Arsenal St (at town line)	CRBL3B
500 meters downstream of Arsenal St (at town line on north side)	CRBL3C
Herter East Park (north side of river)	CRBL4N
Upstream of Northeastern U. boathouse (north side)	CRBL4A
South side of river opposite Magazine Beach	CRBL5S
600 meters Upstream from Mass Ave bridge (south side)	CRBL6A
600 meters Upstream from Mass Ave bridge (midstream)	CRBL6B
600 meters Upstream from Mass Ave bridge (north side)	CRBL6C
Downstream of Stony Brook and Mass Ave bridge (north side)	CRBL7N
Downstream of Stony Brook and Mass Ave bridge (mid stream)	CRBL7M
Mouth of Cheesecake Brook	CHEZ01
Charles River upstream of Cheesecake Brook	CRBL0A
Mouth of Laundry Brook	LA4N01

Bold = Priority resource area sites

3.0 PROJECT DESCRIPTION

In 1998, OEME conducted the first (baseline) year of the clean 2005 sampling program. Because of unpredictability of the rain storms that met the established criteria, no intensive wet weather sampling was conducted during 1998. However, post storm sampling was conducted after two rain events. On August 18, after 2.10 inches of rain fell in Boston during August 17 and 18, bacteria and basic water chemistry were analyzed at the 12 fixed stations and at 10 supplemental stations. On October 15, 1998, after 0.89 inches of rain fell in Boston on October 14, bacteria was measured at

one fixed station and three supplemental stations[1].

Intensive dry weather sampling was conducted on July 15, August 11, September 1 and October 20, 1998. The original plan called for sampling three times during dry weather, however, since no intensive wet weather sampling was conducted, an extra dry weather sampling event was added in October. Continuous monitoring was conducted during July 10 - 15 and August 13 - 18, for DO, temperature, pH and specific conductance. On August 13, field measurements were made at the fixed stations. Table 2 shows the parameters analyzed for the intensive sampling events.

Table 2: Parameters Analyzed During the 1998 Intensive Sampling Events

Field Measurements	Bacteria	Nutrients	Total Metals	Ambient Toxicity	Other Parameters
dissolved oxygen, temperature, pH, specific conductance, turbidity, Secchi disk	*E.coli*, fecal coliform	total phosphorus, ortho-phosphorus, nitrate + nitrite, ammonia	Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Sb, Se, Tl, V, Zn, Hg	7-day chronic (Only conducted during August event)	TSS, chlorophyll a, TOC, apparent color

The 7-day chronic toxicity tests were conducted on the samples collected August 11. Renewal samples were collected on August 13 and 16. In addition to the parameters listed above, Enterococci samples were collected during the August and September intensive sampling events. Metals, ammonia and Enterococci were analyzed by contract laboratories. The EPA OEME Laboratory and field staff analyzed all other parameters.

4.0 DATA ANALYSIS

The data collected in 1998 will serve as baseline information, to which data from future years will be compared. As illicit sewer connections are eliminated, as stormwater best management practices (BMPs) are implemented and CSO discharges reduced, water quality data will be used to assess the combined effect of these controls. Since no baseline data was available from past years, the collected data was evaluated in terms of relevant water quality criteria and compared among stations.

During the July and October sampling events the flow in the river was approximately

[1] Precipitation data collected from the National Weather Service Preliminary Climate Data Worksheet (http://www.nws.noaa.gov/er/box/).

double the flows during the August and September sampling events[1]. However, there were no correlations detected between water quality and flow. Figure A6 is a graph of the flow at the Waltham gaging station during the summer sampling period. In general, the worst water quality was in the Pond at the Esplanade (CRBL08) and improved water quality was observed at the outlet of the basin near the New Charles River Dam. Appendix B contains all the validated data for this report.

4.1 Clarity, Chloropyll a, TSS, Turbidity, TOC and Apparent Color

A Secchi disk was used to measure clarity (transparency). The Massachusetts Department of Health has established minimum standards for bathing beaches (105 CMR 445.00) which require that a clarity disk be readily visible at 4 feet.

Clarity was not measured at the South Natick Dam (CRBL01) and Watertown Dam (CRBL02) due to shallow water at these stations. Stations located at the end of the Basin, near the New Dam, had the best clarity. Secchi disk readings at the Community Boating area (CRBL10), between the Longfellow bridge and old Dam (CRBL11), and Upstream of the railroad bridge (CRBL12) exceeded 4 feet 60% of the time. The five stations from Herter East Park (CRBL04) through the Pond at the Esplanade (CRBL08) had Secchi disk readings less than 4 feet during all sampling events. See Figure 2 for a graph of the clarity results.

Some stations in the basin recorded good clarity and relatively high chlorophyll a (an indicator of algal bio-mass) concentrations, while other stations had poor clarity and relatively low chlorophyll a concentrations. This may indicate that algae is not the sole source of impaired clarity. The Pond at the Esplanade (CRBL08) recorded the lowest average clarity values and the highest average Chlorophyl a concentrations during the study period. At this site, the increased algal bio-mass appears to contribute to the reduced clarity.

The TSS concentrations met the Massachusetts water quality guidelines (Table 3) during all sampling events. In general, TSS and turbidity concentrations were slightly lower near the inlet at Watertown Dam and the outlet near the New Dam. TSS and turbidity concentrations were highest in the Pond at the Esplanade (CRBL08). No trends were noticed with TOC or apparent color measurements.

Table 3: Massachusetts Class B Warm Water Surface Water Quality Standards and

[1] Flow data collected form USGS Waltham gaging station and is reported as preliminary data.

Guidelines

Parameter	MA Surface Water Quality Standards (314 CMR 4.00) and Guidelines
Dissolved Oxygen	$\geq$ 5 mg/l and $\geq$ 60% (for Class B warm water fisheries)
pH	Between 6.5 and 8.3 (for Class B waters)
Fecal coliform	See Table 4
Solids	TSS $\leq$ 25.o mg/l
Color and Turbidity	Narrative Standard
Nutrients	Narrative “Control of Eutrophication” Site Specific

4.2 Bacteria

During the four intensive dry weather sampling events, EPA collected fecal coliform and *E.coli* samples. Enterococci samples were collected during the August and September sampling events.

The Massachusetts Department of Public Health (DPH) Minimum Standards for Bathing Beaches and the DEP Surface Water Quality Standards (314 CMR 4.00) establish maximum bacteria criteria. These are summarized in Table 4.

Table 4: Massachusetts Freshwater Bacteria Criteria

Bacteria	MA DPH Minimum Criteria for Bathing Beaches (105 CMR 445.00)	MA DEP Surface Water Quality Standards (314 CMR 4.00) and water quality guidelines	
	Bathing beaches	Primary contact	Secondary contact
Total coliform (guideline)	≤1000 colonies/100ml	NA	NA
Fecal coliform	NA	a geometric mean ≤200 col/100ml for ≥5 samples ≤400/100ml for not more than 10 % of the samples	a geometric mean ≤1000 col/100ml for ≥5 samples ≤2000/100ml for not more than 10 % of the samples
		≤400 col/100ml for <5 samples	≤2000 col/100ml for <5 samples
Enterococci (proposed)	5 sample geometric mean ≥ 33 colonies/100ml (chronic) Public Bathing Beach immediate closure ≥61 colonies/100ml (acute)	NA	NA
E. coli	NA	NA	NA

NA = not applicable

For the purpose of this report, the fecal coliform counts of individual samples will be compared to the more stringent criteria of less than or equal to 200 colonies/100ml for primary contact recreation (swimming) and less than or equal to 1000 colonies/100ml for secondary contact recreation (boating). The dry weather fecal coliform counts were all less than the 1000 colonies/100ml criteria and 83% of the sample counts met the 200 colonies/100ml criteria. All the dry and post storm samples collected at the two most downstream stations (CRBL11 and CRBL12) had fecal coliform counts less than the 200 colonies/100 ml criteria.

Post storm fecal coliform counts collected on August 18,1998, after two inches of rain fell on the Boston area, revealed that five of the eleven stations sampled exceeded 1000 colonies/100ml while seven of the eleven stations were above the 200 colonies/100ml. The highest concentration (90,000 colonies/100ml) was found downstream of Stony Brook and Mass Ave. Bridge (CRBL07). Upstream of the Mass Ave. Bridge (CRBL6A) also had elevated fecal counts of 33,000 colonies/100ml. These elevated concentrations indicate the impact of Stony Brook, Muddy River and other discharges on this south side of the River. Fecal coliform concentrations collected at the 12 fixed stations are presented in Figure 3.

As part of the CRWA Environmental Monitoring for Public Access and Community Tracking (EMPACT) project grant, Enterococci samples were analyzed using the standard method along with EPA's new method (EPA1600). Only dry weather samples were collected and all counts were less than the proposed standard of 61colonies/100ml for immediate closure of public bathing beaches (Table 4).

4.3 Dissolved Oxygen and pH

Dissolved oxygen was measured at each station during every sampling event. It was measured continuously by automated instruments during the periods of July 10 -15 and August 13 - 20 at stations CRBL3C, CRBL06, CRBL07, and CRBL09. Massachusetts Water Quality Standards establish a minimum DO concentration of 5 mg/l or 60% saturation for Class B warm water fisheries (Table 3), which is the criteria for the Charles River. Stations between the BU and Mass Ave bridges (CRBL06 and CRBL6C) were the only stations to record DO concentrations less than 5 mg/l. The continuous monitor at station CRBL06 recorded concentrations below 5 mg/l on August 14, 15, 18 and 19. Some of the lower concentrations occurred in the early morning hours, which would be characteristic of a DO sag associated with algal respiration. Other low DO values were recorded in the afternoon and the causes, at this time, are unknown (Figure A2 and A4). At station CRBL6C, the one measurement taken on August 18, at 1230 hours was 4.85mg/l (Table A8). Continuous monitoring will be conducted in ongoing years to further identify DO problems.

Hydrogen ion (pH) was measured at the same stations and with the same frequency as DO. Massachusetts Water Quality Standards establishes a pH range of 6.5 through 8.3 for Class B water (Table 3). On two occasions in August the pH concentrations exceeded 8.3 in the Pond at the Esplanade (CRBL08) (Table A5 & A7). A pH of 8.51 was recorded at Magazine Beach (CR9905) on September 1 (Table A9). The cause of these elevated pH levels are unexplainable at this time.

4.4 Nutrients

Nutrient analyses included measurement of total phosphorus, ortho-phosphorus, nitrate+nitrite and ammonia. Except for a single concentration of 0.33 mg/l at the Watertown Dam (CRBL02) on September 1, total phosphorus concentrations ranged from 0.06 to 0.2 mg/l, with an average concentration of 0.12mg/l. In general, the total and ortho-phosphorus concentrations at the South Natick Dam (CRBL01) were as high or higher than the rest of the stations in the Basin. This indicates that a significant amount of phosphorus may be coming from upstream sources. These sources include the five wastewater treatment plants (WWTP) located upstream of the South Natick Dam. These are the Charles River Pollution Control District, Massachusetts Correctional Institute (MCI) in Norfolk, Wrentham State School, the towns of Medfield and Milford.

Massachusetts does not have numeric standards for phosphorus but rather a narrative

site specific criteria. When comparing total phosphorus concentrations to Connecticut's lakes trophic classifications, all locations would be considered highly eutrophic[1]. Figure 4 shows the total phosphorus concentrations.

Nitrate+nitrite, measured as the total of nitrate and nitrite, concentrations ranged from not detected above a reporting limit of 0.113 mg/l to 0.784 mg/l reported as nitrogen. Ammonium concentrations ranged from not detected above a reporting limit of 0.05 mg/l to 0.20 mg/l reported as nitrogen. No spacial trends were observed for nitrate+nitrite or ammonia.

4.5 Metals

The relevant metals concentrations were compared to the Ambient Water Quality Criteria (AWQC). The criteria are not intended to be predictive of aquatic life toxicity but protective of aquatic life. For this report the AWQC was calculated for total metals using the hardness of the water at each station. The metals data and the associated AWQC are presented in Table 5. The concentration of all the metals analyzed are presented in Appendix A. In general, metals concentrations were higher in the Basin than upstream at the Watertown and South Natick Dams. No metal concentrations exceeded the acute AWQC. Lead and copper concentrations were the only metals that exceeded the chronic AWQC. Copper concentrations exceeded the chronic criteria approximately 20% of the time and 80% of these exceedences occurred during the October sampling event. The Pond at the Esplanade (CRBL08) exceeded the copper AWQC during three of the four sampling events. For all stations, lead concentrations exceeded the chronic AWQC 96% of the time. Station CRBL08 had the highest lead concentrations and was associated with other elevated metals. Lead and copper concentrations are presented in Figure 5 and 6, respectively.

4.6 Toxicity

A two-species, seven-day, ambient, aquatic toxicity test was performed on the samples collected on August 11. Test replenishment samples were collected at the same stations on August 13 and 16. The two species used for testing were the cladoceran, *Ceriodaphnia dubia* and fathead minnow, *Pimephales promelas* . The only station with a chronic toxic response for cladoceran was the Herter East Park (CRBL04). This station showed a 60% mortality. The chemistry data at this location did not provide an explanation for this toxic response. No toxic response was observed at any station for fathead minnows.

4.7 Data Usability

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[1]The Connecticut Water Quality Lake Trophic Classification Criteria during the spring and summer conditions for total phosphorus are: Oligotrophic (0 - 0.010 mg/l), Mesotrophic (0.010 - 0.030 mg/l), Eutrophic (0.030 - 0.050 mg/l), and Highly Eutrophic (>0.050 mg/l).

All chemistry samples, except the ortho-phosphorus samples collected on July 15, and August 11, were analyzed within the required holding times. The July 15 and August 11 ortho-phosphorus samples were analyzed one day and two days, respectively, past the two day holding time. The ortho-phosphorus data collected on October 20, was rejected because of problems that occurred during the analysis. Turbidity data was rejected for the September 1 sampling event because of poor instrument performance. Rejected data are not presented in this report.

For the low level metals analysis, a trip blank was used to evaluate any contamination that may exist from preservation, sample container, sampling method, and/or during transport. This bottle was collected prior to sampling and brought on the sampling trip. Because of an elevated trip blank, the mercury data reported for the August 11 sampling event are reported as maximum values. No trip blank was collected on the September 1, sampling event. Because of the missing trip blank all metals data has been qualified as estimates. However, the low mercury concentrations reported on September 1, and the consistent metal concentrations trends among stations for different sampling events give credence to this data. It should be noted, with the exception of the mercury blank results on August 11, there were no other problems with elevated trip blanks for the other sampling events.

Of the total 133 duplicate parameters analyzed during the four intensive sampling events, 11 analytes did not meet the precision quality control goal of less than 35 relative percent difference established in the Quality Assurance Project Plan (Appendix B). Seven of these analytes were associated with low concentrations near the reporting limit where more instrument drift occurs. Laboratory and field quality control data were reviewed for the other four analytes, which include chlorophyll a, nitrate+nitrite, mercury, and *E. coli.* No abnormalities were noted and therefore, the use of this data is not limited.

5.0 1999 FUTURE STUDY DESIGN

Several changes are proposed for the 1999 sampling program. In addition to apparent color, true color will be analyzed at all main stem stations to gather more information on the cause of reduced clarity. In the fall of 1999, a basin wide survey will be initiated to look at sources of reduced clarity. EPA will work with USGS to design this survey to mesh with current work being conducted by USGS. EPA's survey will continue into the summer of 2000. Since the AWQC is actually based on dissolved metals, both total and dissolved metals will be analyzed in 1999. Some of the continuous DO monitoring will be focused near the BU Bridge (CRBL06), where low values were recorded in 1998. Enterococci will be analyzed during all intensive sampling events. *E. coli* analysis will be discontinued in 1999, since the state does not have water quality criteria for *E. coli*. In the fall of 1999, fish will be collected at multiple stations in the basin for assemblage and fish tissue analysis. Fish assemblage will be used to evaluate the type and abundance of fish species in the basin. Fish tissue analysis will be used to evaluate

potential consumption health risks. One of these stations will be located at the Herter East Park station (CRBL04) as follow up to the toxicity measured at this site during the August sampling event. Other sites will be chosen near recreational fishing areas.

Figure 2: Secchi Disk Measurements at Stations CRBL03 -CRBL12

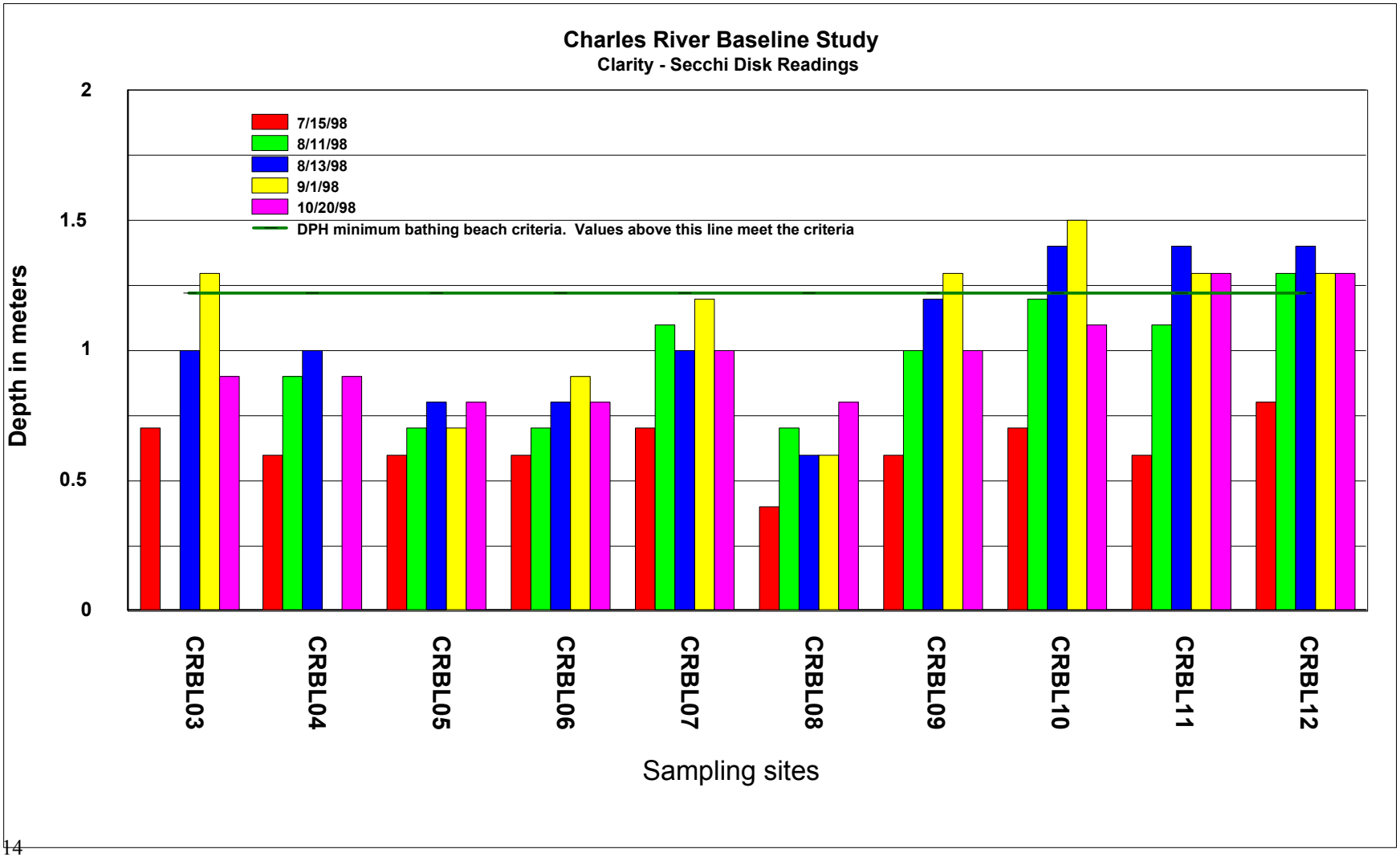
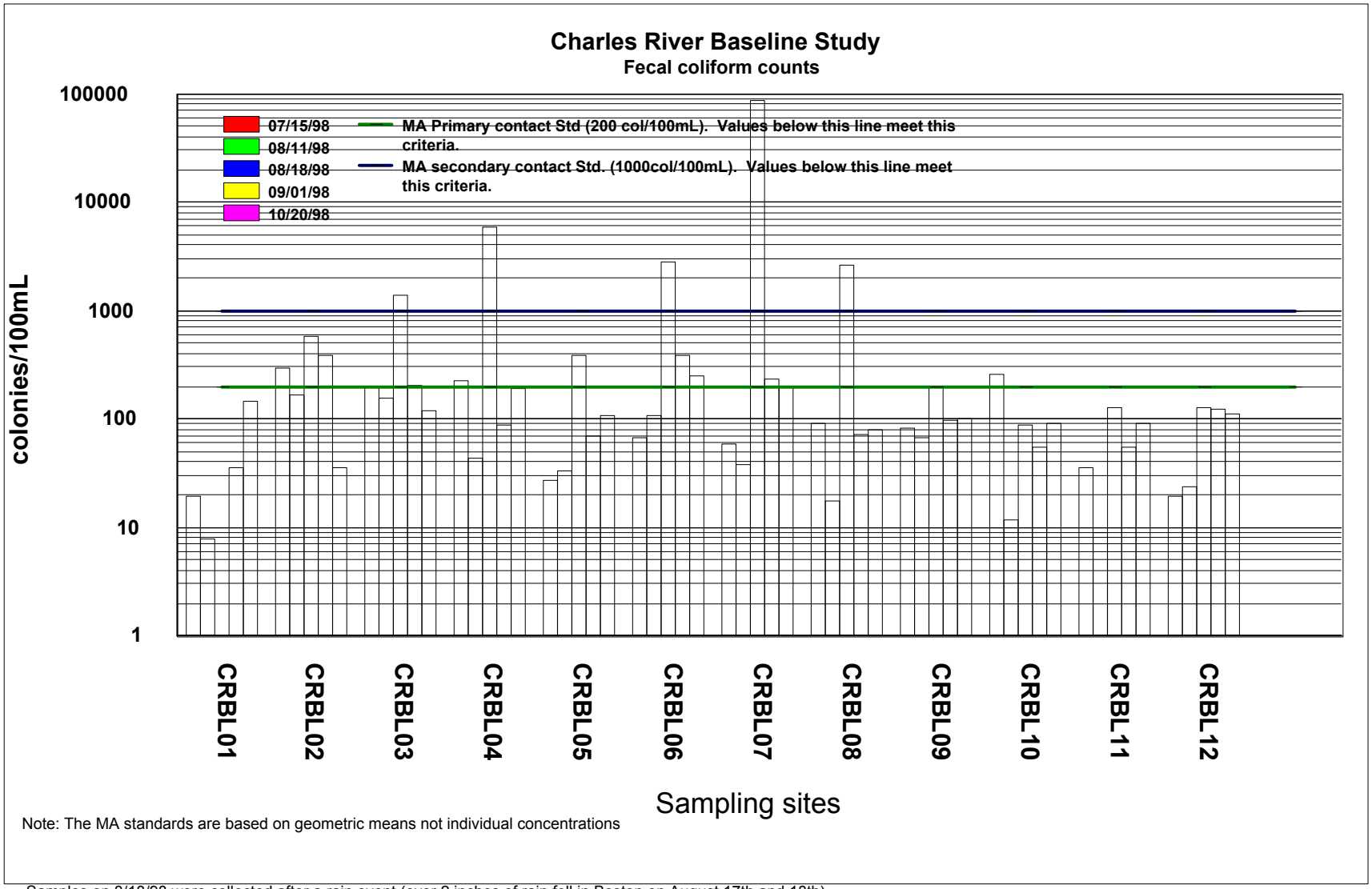


Figure 3: Fecal Coliform Concentrations at the 12 Fixed Stations



15 Samples on 8/18/98 were collected after a rain event (over 2 inches of rain fell in Boston on August 17th and 18th)

Figure 4: Total Phosphorus Concentrations at the 12 Fixed Stations

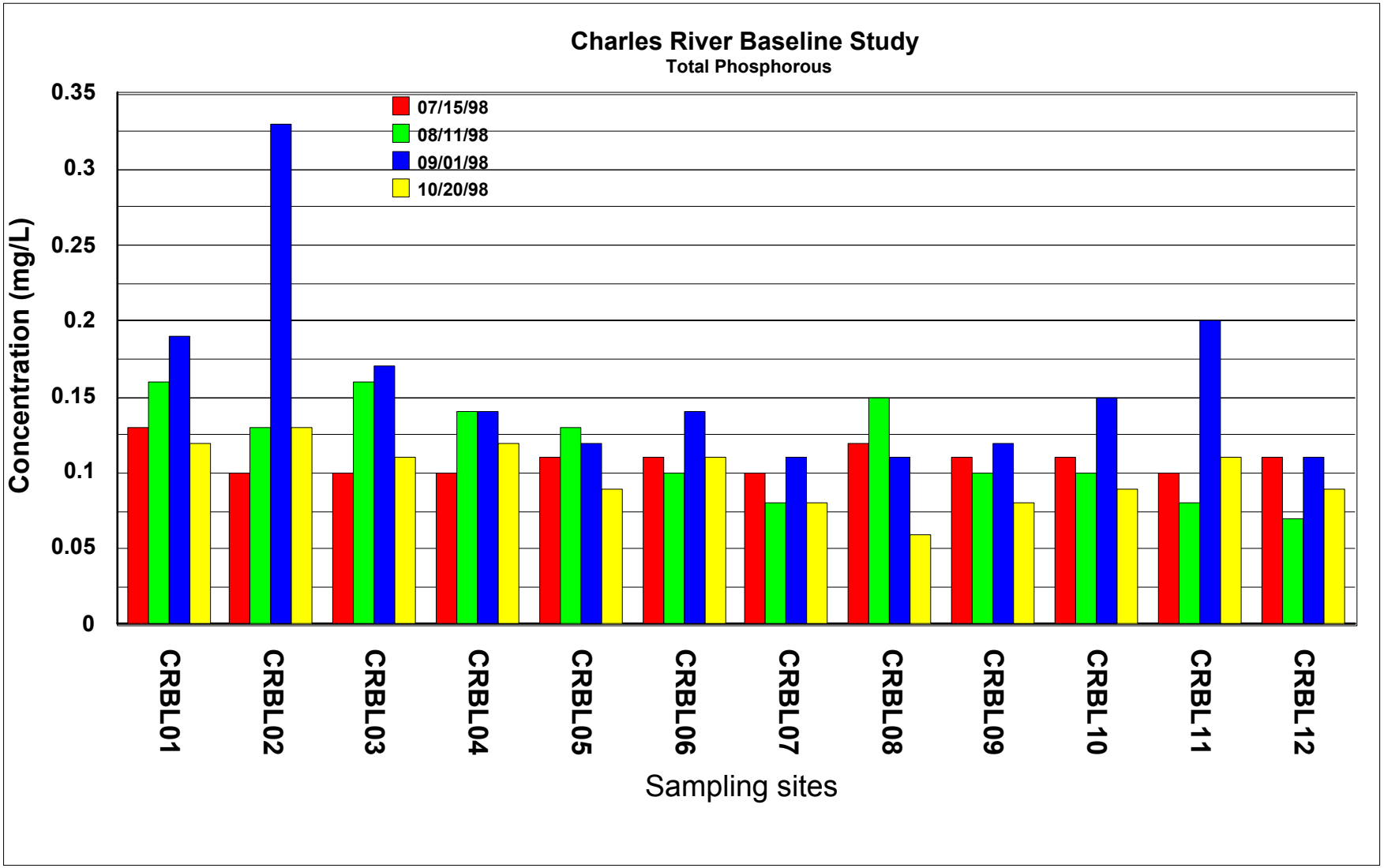


Figure 5: Lead Concentrations at the 12 Fixed Stations

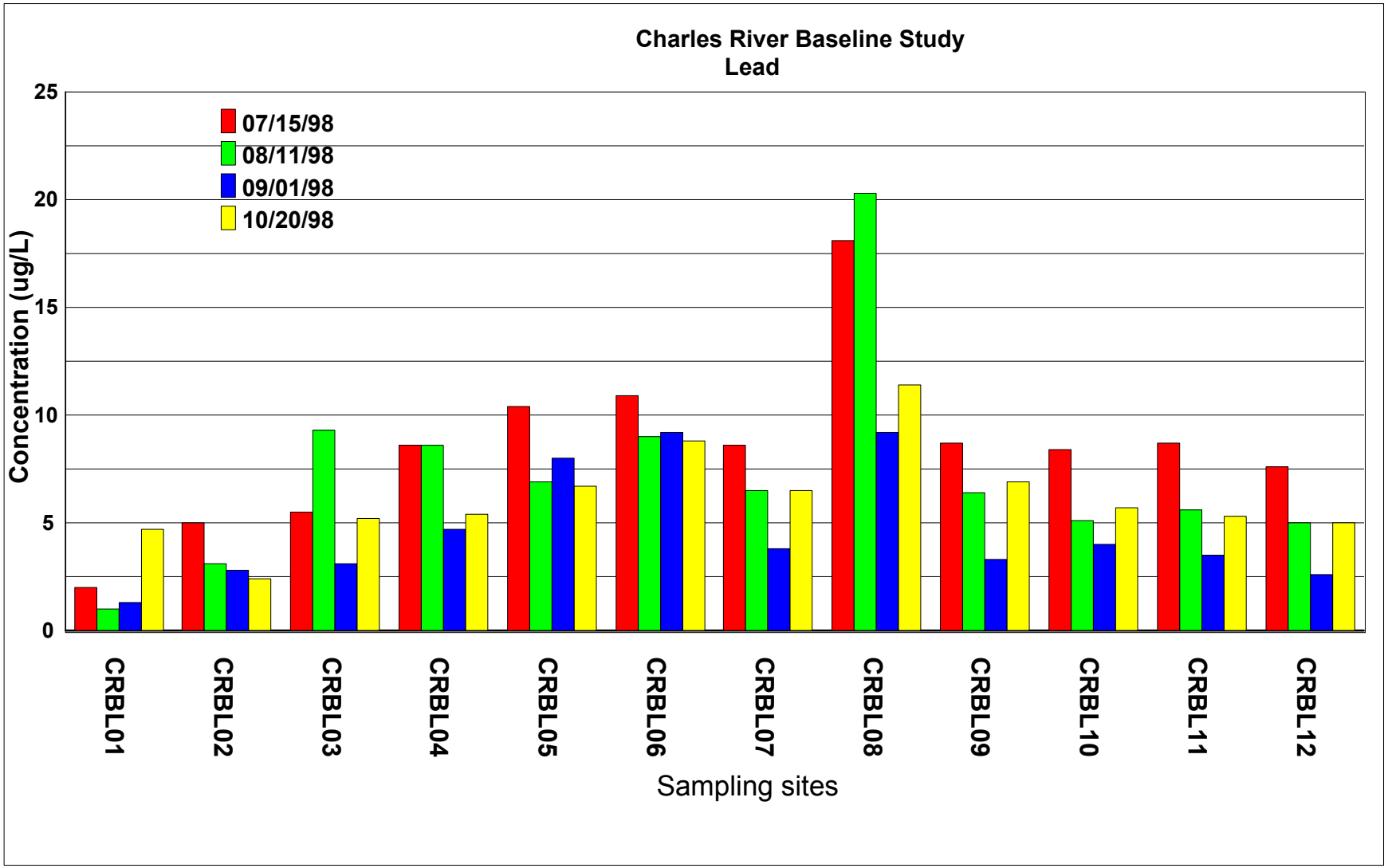


Figure 6: Copper Concentrations at the 12 Fixed Stations

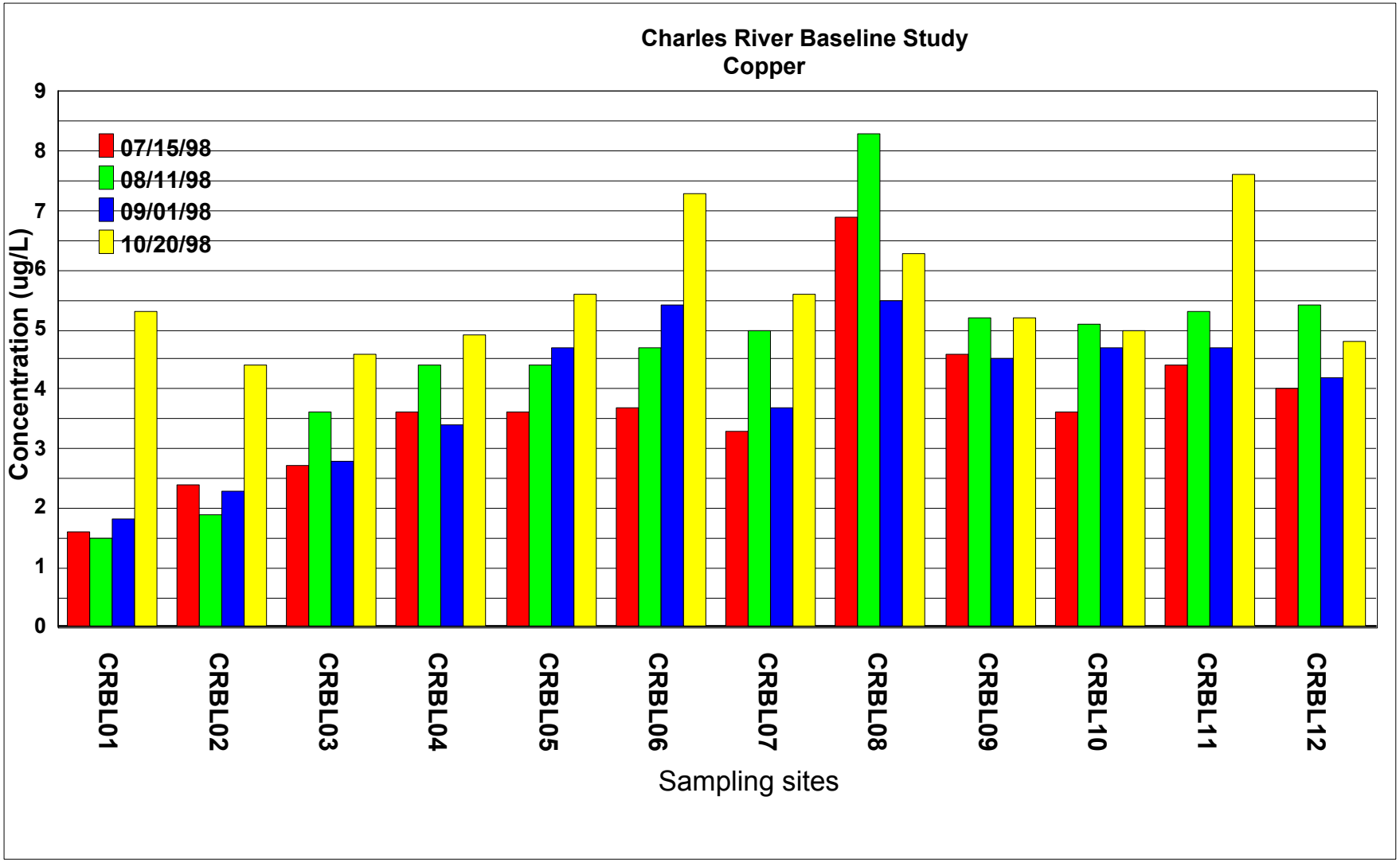


Table 5: Priority Pollutant Metals Concentrations and the Ambient Water Quality Criteria (converted for total metals)

STATION	Arsenic Conc. (ug/L)	Arsenic AWQC Acute (ug/L)	(ug/L) AWQC Chronic	Cadmium Conc. (ug/L)	Cadmium AWQC Acute (ug/L)	Cadmium AWQC Chronic (ug/L)	Chromium Conc (ug/L)	Chromium AWQC Acute (ug/L)	Chromium AWQC Chronic (ug/L)	Copper Conc (ug/L)	Copper AWQC Acute (ug/L)	Copper AWQC Chronic (ug/L)	Lead Conc. (ug/L)	Lead AWQC Acute (ug/L)	Lead AWQC Chronic (ug/L)
Sampling was conducted on 7/15/98															
CRBL01	0.9	340	150	0.03	1.5	1.1	0.9	803	38	1.6	6	4	2.09	23	0.9
CRBL02	1.1	340	150	0.06	1.8	1.3	1.1	916	44	2.4	6	5	5.04	28	1.1
CRBL03	1.2	340	150	0.08	1.8	1.3	1.2	924	44	2.7	6	5	5.51	29	1.1
CRBL04	1.0	340	150	0.14	1.9	1.3	1.4	945	45	3.6	7	5	8.64	30	1.2
CRBL05	1.2	340	150	0.13	1.8	1.3	1.3	915	44	3.6	6	5	10.4	28	1.1
CRBL06	1.2	340	150	0.1	1.8	1.3	1.2	927	44	3.7	7	5	10.9	29	1.1
CRBL07	1.2	340	150	0.09	1.8	1.3	1.1	942	45	3.3	7	5	8.68	30	1.2
CRBL08	1.6	340	150	0.15	1.8	1.3	1.8	934	45	6.9	7	5	18.2	29	1.1
CRBL09	1.5	340	150	0.05	1.9	1.4	1	965	46	4.6	7	5	8.78	31	1.2
CRBL10	1.4	340	150	0.06	1.8	1.3	1.1	921	44	3.6	6	5	8.43	29	1.1
CRBL11	1.4	340	150	0.08	1.9	1.3	1	962	46	4.4	7	5	8.72	31	1.2
CRBL12	1.6	340	150	0.07	2.6	1.7	0.9	1197	57	4.0	9	6	7.61	43	1.7
Sampling was conducted on 8/11/98															
CRBL01	ND(0.5)	340	150	0.03	1.9	1.3	0.6	948	45	1.5	7	5	1.09	30	1.2
CRBL02	0.8	340	150	0.04	2.3	1.5	0.5	1108	53	1.9	8	6	3.18	38	1.5
CRBL03	1.1	340	150	0.14	2.5	1.6	0.9	1160	55	3.6	8	6	9.38	41	1.6
CRBL04	1.1	340	150	0.14	2.4	1.6	0.9	1133	54	4.4	8	6	8.7	40	1.5
CRBL05	1.1	340	150	0.09	2.6	1.7	0.8	1193	57	4.4	9	6	6.99	43	1.7
CRBL06	1.3	340	150	0.11	2.7	1.7	1.1	1228	59	4.7	9	6	9	45	1.8
CRBL07	1.2	340	150	0.17	3.1	1.9	0.8	1371	66	5.0	10	7	6.58	53	2.1
CRBL08	1.6	340	150	0.15	3.0	1.9	1.8	1346	64	8.3	10	7	20.4	52	2.0
CRBL09	1.4	340	150	0.07	3.2	2.0	1	1416	68	5.2	11	7	6.43	56	2.2
CRBL10	1.4	340	150	0.07	3.3	2.0	0.9	1431	68	5.1	11	7	5.19	57	2.2
CRBL11	1.6	340	150	0.06	3.3	2.0	1	1432	68	5.3	11	7	5.62	57	2.2
CRBL12	1.6	340	150	0.11	4.2	2.3	0.8	1702	81	5.4	13	9	5.04	75	2.9
Sampling was conducted on 9/1/98 (No trip blank was collected on this sampling event)															
CRBL01	0.7	340	150	0.07	2.0	1.4	1.6	1015	48	1.8	7	5	1.40	33	1.3
CRBL02	1.3	340	150	0.08	2.2	1.5	1.4	1082	52	2.3	8	5	2.84	37	1.4
CRBL03	1.2	340	150	0.12	2.3	1.5	1.5	1090	52	2.8	8	6	3.12	37	1.5
CRBL04	1.4	340	150	0.14	2.3	1.6	1.7	1120	54	3.4	8	6	4.76	39	1.5
CRBL05	1.4	340	150	0.15	2.3	1.5	1.7	1103	53	4.7	8	6	8.02	38	1.5
CRBL06	1.6	340	150	0.16	2.7	1.7	1.8	1224	59	5.4	9	6	9.25	45	1.7
CRBL07	1.5	340	150	0.16	2.6	1.7	1.4	1217	58	3.7	9	6	3.83	44	1.7
CRBL08	1.7	340	150	0.14	2.8	1.8	1.9	1274	61	5.5	9	6	9.21	48	1.9
CRBL09	1.6	340	150	0.11	2.8	1.8	1.5	1272	61	4.5	9	6	3.36	47	1.8
CRBL10	1.8	340	150	0.10	3.2	1.9	1.4	1396	67	4.7	10	7	4.04	55	2.1
CRBL11	1.8	340	150	0.09	3.2	1.9	1.3	1405	67	4.7	11	7	3.54	55	2.2
CRBL12	2.0	340	150	0.09	4.2	2.4	1.2	1723	82	4.2	13	9	2.69	76	3.0
Sampling was conducted on 10/20/98															
CRBL01	0.8	340	150	0.04	1.7	1.2	1.1	889	42	5.3	6	4	4.74	27	1.1
CRBL02	0.7	340	150	0.03	1.5	1.2	1	825	39	4.4	6	4	2.47	24	0.9
CRBL03	0.8	340	150	0.04	1.8	1.3	1.1	906	43	4.6	6	5	5.26	28	1.1
CRBL04	0.8	340	150	0.06	1.8	1.3	1.1	907	43	4.9	6	5	5.45	28	1.1
CRBL05	0.9	340	150	0.08	1.7	1.3	1.2	890	43	5.6	6	4	6.75	27	1.1
CRBL06	0.9	340	150	0.1	1.7	1.3	1.5	897	43	7.3	6	5	8.85	28	1.1
CRBL07	0.9	340	150	0.05	2.1	1.4	1	1026	49	5.6	7	5	6.6	34	1.3
CRBL08	0.8	340	150	0.12	2.3	1.6	1.2	1120	54	6.3	8	6	11.4	39	1.5
CRBL09	1.0	340	150	0.05	2.1	1.4	0.9	1026	49	5.2	7	5	6.9	34	1.3
CRBL10	0.8	340	150	0.05	2.1	1.5	0.8	1042	50	5.0	7	5	5.72	35	1.4
CRBL11	0.9	340	150	0.05	2.3	1.5	0.8	1105	53	7.6	8	6	5.32	38	1.5
CRBL12	0.9	340	150	0.05	2.7	1.7	0.7	1242	59	4.8	9	6	5	46	1

Note:

ND = Not detected above the associated detection limit

~ = Because of an elevated trip blank, mercury data is reported as maximum values

= Above Chronic Criteria

Table 5 (Continued): Priority Pollutant Metals Concentrations and the Ambient Water Quality Criteria (converted for total metals) Cont.

STATION	Mercury Conc. (ug/L)	Mercury AWQC Acute (ug/L)	Mercury AWQC Chronic (ug/L)	Nickel Conc. (ug/L)	Nickel AWQC Acute (ug/L)	Nickel AWQC Chronic (ug/L)	Selenium Conc. (ug/L)	Selenium AWQC Chronic (ug/L)	Silver Conc. (ug/L)	Silver AWQC Acute (ug/L)	Zinc Conc. (ug/L)	Zinc AWQC Acute (ug/L)	Zinc AWQC Chronic (ug/L)
Sampling was conducted on 7/15/98													
CRBL01	0.0114	1.7	0.91	2	203	23	ND(1)	5	ND(0.02)	0.7	4.3	52	52
CRBL02	0.0138	1.7	0.91	2.2	233	26	ND(1)	5	ND(0.02)	1.0	6	59	59
CRBL03	0.00967	1.7	0.91	2	235	26	ND(1)	5	ND(0.02)	1.0	6.6	60	60
CRBL04	0.0187	1.7	0.91	2.2	241	27	ND(1)	5	0.02	1	7.6	61	61
CRBL05	0.0178	1.7	0.91	2.2	233	26	ND(1)	5	0.03	1	7.8	59	59
CRBL06	0.0212	1.7	0.91	2.1	236	26	ND(1)	5	0.02	1.0	8.1	60	60
CRBL07	0.0128	1.7	0.91	2.1	240	27	ND(1)	5	0.02	1.0	7.5	61	61
CRBL08	0.0263	1.7	0.91	2.7	238	26	ND(1)	5	0.04	1.0	12.9	61	61
CRBL09	0.0128	1.7	0.91	2.3	246	27	1	5	ND(0.02)	1.1	8.1	63	63
CRBL10	0.0118	1.7	0.91	2.2	234	26	ND(1)	5	ND(0.02)	1.0	7.3	60	60
CRBL11	0.0157	1.7	0.91	2.1	245	27	ND(1)	5	ND(0.02)	1.1	8	63	63
CRBL12	0.0112	1.7	0.91	2.1	307	34	2	5	ND(0.02)	1.7	8.5	78	78
Sampling was conducted on 8/11/98													
CRBL01	~.0141	1.7	0.91	1.1	241	27	ND(1)	5	ND(0.02)	1.1	3.1	62	62
CRBL02	~.0129	1.7	0.91	1.3	284	32	ND(1)	5	ND(0.02)	1.5	4.6	72	72
CRBL03	~.0273	1.7	0.91	1.6	298	33	ND(1)	5	ND(0.02)	1.6	10	76	76
CRBL04	~.0194	1.7	0.91	1.7	290	32	ND(1)	5	ND(0.02)	1.5	9	74	74
CRBL05	~.0161	1.7	0.91	1.7	306	34	ND(1)	5	ND(0.02)	1.7	6.5	78	78
CRBL06	~.0177	1.7	0.91	1.9	316	35	ND(1)	5	ND(0.02)	1.8	7.6	81	81
CRBL07	~.0160	1.7	0.91	1.9	353	39	1	5	0.02	2.3	7.6	90	90
CRBL08	~.0299	1.7	0.91	2.5	347	39	1	5	0.03	2.2	11.8	89	89
CRBL09	~.0232	1.7	0.91	1.9	366	41	ND(1)	5	ND(0.02)	2.4	7.1	93	93
CRBL10	~.0195	1.7	0.91	1.9	370	41	1	5	ND(0.02)	2.5	6.1	94	94
CRBL11	~.0156	1.7	0.91	1.8	370	41	2	5	ND(0.02)	2.5	6.8	94	94
CRBL12	~.0195	1.7	0.91	1.8	442	49	3	5	ND(0.02)	3.6	6.1	113	113
Sampling was conducted on 9/1/98 (No trip blank was collected on this sampling event)													
CRBL01	0.0060	1.7	0.91	1.2	259	29	ND(1)	5	ND(0.02)	1.2	4.2	66	66
CRBL02	0.0076	1.7	0.91	1.3	277	31	ND(1)	5	ND(0.02)	1.4	5.0	71	71
CRBL03	0.0047	1.7	0.91	1.2	279	31	ND(1)	5	ND(0.02)	1.4	6.0	71	71
CRBL04	0.0089	1.7	0.91	1.4	287	32	ND(1)	5	ND(0.02)	1.5	8.0	73	73
CRBL05	0.0100	1.7	0.91	1.5	283	31	ND(1)	5	ND(0.02)	1.4	9.0	72	72
CRBL06	0.0138	1.7	0.91	1.7	315	35	ND(1)	5	0.04	1.8	10.0	80	80
CRBL07	0.0062	1.7	0.91	1.5	313	35	ND(1)	5	ND(0.02)	1.8	5.6	80	80
CRBL08	0.0069	1.7	0.91	1.7	328	36	ND(1)	5	0.03	2.0	7.9	84	84
CRBL09	0.0088	1.7	0.91	1.5	327	36	ND(1)	5	ND(0.02)	2.0	9.8	83	83
CRBL10	0.0073	1.7	0.91	1.6	360	40	ND(1)	5	ND(0.02)	2.4	6.5	92	92
CRBL11	0.0123	1.7	0.91	1.5	363	40	ND(1)	5	ND(0.02)	2.4	5.8	93	93
CRBL12	0.0045	1.7	0.91	1.4	448	50	ND(1)	5	0.02	3.7	5.3	114	114
Sampling was conducted on 10/20/98													
CRBL01	0.0120	1.7	0.91	1.4	226	25	ND(1)	5	0.04	0.9	10.6	58	58
CRBL02	0.0130	1.7	0.91	1.4	209	23	ND(1)	5	0.03	0.8	11.7	53	53
CRBL03	0.0110	1.7	0.91	1.5	230	26	ND(1)	5	0.02	1.0	11.7	59	59
CRBL04	0.0120	1.7	0.91	1.5	231	26	ND(1)	5	0.03	1.0	11.3	59	59
CRBL05	0.0120	1.7	0.91	1.5	226	25	ND(1)	5	0.03	0.9	12.1	58	58
CRBL06	0.0160	1.7	0.91	1.7	228	25	ND(1)	5	0.05	0.9	15	58	58
CRBL07	0.0090	1.7	0.91	1.5	262	29	ND(1)	5	0.02	1.2	11.4	67	67
CRBL08	0.0140	1.7	0.91	1.8	287	32	ND(1)	5	0.05	1.5	11.7	73	73
CRBL09	0.0190	1.7	0.91	1.5	262	29	ND(1)	5	0.03	1.2	11.3	67	67
CRBL10	0.0090	1.7	0.91	1.5	266	30	ND(1)	5	0.03	1.3	10.4	68	68
CRBL11	0.0070	1.7	0.91	1.5	283	31	ND(1)	5	0.04	1.5	10.4	72	72
CRBL12	0.0070	1.7	0.91	1.4	319	36	ND(1)	5	0.03	1.9	10.4	81	81

Note:
ND = Not detected above the associated detection limit
~ = Because of an elevated trip blank, mercury data is reported as maximum values
= Above Chronic Criteria

6.0 REFERENCES

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Attachment A

Charles River 1998 Baseline Data Report

Attachment B

Project Work/QA Plan
Clean Charles 2005 Water Quality Study

Charles River Data Report

In 1995, EPA established the Clean Charles 2005 initiative to restore the Charles River to a swimmable and fishable condition by Earth Day in 2005. The initiative has a developing strategy to provide a comprehensive approach for improving water quality through: Combined Sewer Overflow (CSO) controls, illicit sanitary connection removal, stormwater management planning and implementation, public outreach, education, enforcement and technical assistance.

EPA's Office of Environmental Measurement and Evaluation (OEME) has initiated a water quality study that will continue until 2005. EPA and it's partners in the Clean 2005 Water Quality subcommittee developed the study design in order to track improvements in the Charles River Basin (defined as the section between the Watertown Dam and the New Charles River Dam) and to identify where further pollution reductions or remediation actions are necessary in order to meet the swimmable and fishable goals. In order to further identify impairment areas, and to evaluate storm water management techniques, EPA is supporting several other water quality studies in the Charles River.

In 1998, OEME conducted the first (baseline) year of the water quality study. Twelve stations were monitored on 4 different occasions in the watershed. Eleven of these stations were located in the Basin. The study included measurements of dissolved oxygen, temperature, pH, specific conductance, apparent color, clarity, turbidity, nutrients, metals and bacteria. In addition chronic toxicity was also tested.

Summary of Findings

The continuous dissolved oxygen data was collected during a 6 - day period in July and for an 8 - day period in August. At station CRBL06, (located downstream of the BU bridge) the dissolved oxygen dropped below the 5mg/l standard for periods of time during the August sampling event. In general, sampling stations toward the outlet of the Basin had better clarity and lower fecal coliform concentrations. Station CRBL08 (located in the Pond at the Esplanade) had lower clarity, higher chlorophyll a and higher metals concentrations than other stations.

Station Descriptions

Primary Stations	Station #
Downstream of S. Natick Dam	CRBL01
Upstream of Watertown Dam	CRBL02
Daly Field, 10 m off south bank	CRBL03
Herter East Park, 10 m off south bank	CRBL04
Magazine Beach, 10 m off north bank	CRBL05
Downstream of BU bridge, main stem	CRBL06
Downstream of Stony Brook & Mass Ave, 10 m off S. shore	CRBL07
Pond at Esplanade	CRBL08
Upstream of Longfellow bridge, Cam. side	CRBL09
Community boating Area	CRBL10
Between Longfellow bridge & Old Dam	CRBL11
Upstream of railroad bridge	CRBL12
Supplemental sa mpling stations used	
Downstream of BOS 032 (mid stream)	CRBL3A
500 meters downstream from Arsenal St (at town line)	CRBL3B
500 meters downstream from Arsenal St (on north side)	CRBL3C
Herter East Park (north side of river)	CRBL4N
Upstream of Northeastern U. boathouse (north side)	CRBL4A
South side of river opposite Magazine Beach	CRBL5S
600 meters Upstream from MA Ave bridge (south side)	CRBL6A
600 meters Upstream from MA Ave bridge (midstream)	CRBL6B
600 meters Upstream from MA Ave bridge (North side)	CRBL6C
Downstream of Stony Brook and MA Ave bridge (north side)	CRBL7N
Downstream of Stony Brook and MA Ave bridge (mid stream)	CRBL7M
Mouth of Cheesecake Brook	CHEZ01
Charles River upstream of Cheesecake Brook	CRBL0A
Mouth of Laundry Brook	LAUN01