ICR Treatment Study Summary Report

Evaluation of GAC Technology Using Pilot – Scale Testing for Compliance with the Information Collection Rule

This study was conducted from April 21, 1998 through January 12, 1999

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Quittacas Water Filtration Plant, ICR # 403

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Section 1

I. Conclusions and Recommendations

The Granular Activated Carbon (GAC) Pilot Study conducted at the Quittacas Water Treatment Plant (QWTP) in New Bedford, MA showed that a significant reduction in disinfection byproduct (DBP) production can be achieved over the existing filtration process. The highest concentration of total trihalomethanes (THM4) reported from the plant's filtered water (source water for GAC pilot plant) was 93 ug/l; a level just below the current THM regulation of 100 ug/l and above the future stage 1 regulation of 80 ug/l. The highest THM4 concentration reported for the GAC 20-minute empty bed contact time (EBCT) was 38.4 ug/l, a concentration that would likely meet future Stage 2 EPA THM4 regulations. A similar trend was found with haloacetic acids (HAAs). When compared to the source water, the effluent samples from the GAC columns show up to a 58% reduction in THM4 and up to a 53% reduction of HAA6. According to the pilot study conducted at the QWTP, GAC filtration is an effective method for reducing DBPs in finished drinking water.

A concern, however, is the ability to implement GAC filtration post conventional filtration. The addition of a second Stage 2 filters containing GAC at the QWTP would require a significant amount of planning, re-designing and funding. Although GAC filters would reduce the levels of DBPs to meet future regulations, adding these filters to the existing plant would be costly, and re-pumping would be required. As an alternative to reduce the production of DBPs the plant may decide to use different chemicals for disinfection, such as chloramines,. This option may be more cost effective and feasible for the city.

II. Background

Water Quality History

The QWTP has provided the City of New Bedford with reliable, high quality drinking water since it was placed in service in 1977. The plant, which employs a conventional treatment process, has been able to continually meet new and more stringent drinking water regulations over 22 years with little or no modification. Most notably, the standard for filtered water turbidity was 1.0 NTU when the facility began operation in 1977, but was lowered to 0.5 NTU in 1989 with the promulgation of the Surface Water Treatment Rule (SWTR). The Quittacas plant has consistently produced filtered water exceeding these requirements—typically 0.1 NTU. This will also ensure compliance with the new lower turbidity standard of 0.3 NTU recently promulgated under the Interim Enhanced Surface Water Treatment Rule (IESWTR).

The plant has also optimized its corrosion control treatment under the Lead and Copper Rule, and is in compliance with all other drinking water regulations. However, the recently promulgated Stage 1 Disinfectants/Disinfection By-Products Regulation (D/DBPR) will present a treatment and compliance challenge for the plant. The current total trihalomethane (TTHM) levels in the system are 89 ppb (running annual average, RAA), and the highest individual quarterly value has been 95 ppb (September 1997). The elevated TTHM levels are a result of the city's need to comply with the Lead and Copper Rule. Implementation of a higher pH/alkalinity level in the finished water to control lead solubility has resulted in increased THMs (THM formation increases at higher pH levels). The plant currently meets the TOC removal requirements under the Enhanced Coagulation provisions of the Stage 1 D/DBPR.

The plant is planning to convert to chloramine residual disinfection to address the TTHM issue, and also to increase the level of safety for plant employees and the general public by replacing gas chlorination systems with liquid hypochlorite systems.

Existing Treatment Plant

The existing QWTP is shown in Figure 1. Raw water from Long Pond, Assawampset, Pocksha, Great-Quittacas and Little Quittacas Pond is pumped into the plant via an influent channel where lime is added to achieve a target alkalinity of 10-12 mg/l as CaCO3. After the influent channel, the flow enters 16 rapid mix tanks (4 trains of 4 basins) where alum is added to the tanks as the primary coagulant at an average dose of 18 to 20 milligrams per liter (mg/L). Following rapid mix, the dosed water enters flocculation basins. Flocculated water then enters four sedimentation basins in parallel. Settled water enters the filter influent channel and is filtered through six gravity filters. The filters contain dual media consisting of 30 inches of anthracite coal (ES = 1.2-1.5) over 9 inches of fine sand (ES = 0.50) and 10 inches of coarse sand/gravel for a total bed depth of 49 inches.

Chlorine is added as the primary disinfectant as the flow enters a 2 million gallon clearwell. As flow exits the clearwell, soda ash is added for pH and alkalinity adjustment for corrosion control. The water is carried to a 78 million gallon reservoir known as High Hill Reservoir. As the water exits High Hill Reservoir, it is re-chlorinated for maintenance of a residual throughout the distribution system.

Basic Engineering

The basic process for conventional treatment at the Quittacas Water Treatment Plant can be found in Appendix A, ICR monitoring reports A.2 Design Plant Parameters and A.3 Design Plant Chemical Parameters.

1998 Source and Finished Water Quality

A summary of the source and finished water quality is presented in Tables 1 and 2. The information represents data collected for monthly ICR monitoring reports for the City of New Bedford from January 1998 through December 1998.

Table 1: Full-Scale Source Water Quality Data

Item	Units	Average	Std Dev	Min	Max	Count
Temperature	°C	14.25	7.99	3.00	25.00	12
pH	units	6.55	0.21	6.06	6.84	12
Turbidity	NTU	0.99	0.29	0.63	1.38	12
Alkalinity	mg/L as $CaCO_3$	7	1	5	8	12
Total Hardness	mg/L as $CaCO_3$	10.2	1.53	8.00	14.0	12
Calcium Hardness	mg/L as $CaCO_3$	17.1	1.06	14.0	20.0	12
TOC	mg/L	4.34	0.65	3.7	5.8	12
UV_{254}	cm^{-1}	0.170	0.027	0.123	0.211	12
Bromide	µg/L	22	.02	N.D.	25	12

Table 2: Full-Scale Finished Water Quality Data

Item	Units	Average	Std Dev	Min	Max	Count
Temperature	°C	13.83	8.56	2	26	12
pH	units	9.38	0.26	9	9.86	12
Turbidity	NTU	0.07	0.02	0.05	0.12	12
TOC	mg/L	2.04	0.27	1.7	2.5	12
UV_{254}	cm^{-1}	0.037	0.0005	0.028	0.049	12
SDS-THM4	µg/L	69.99	30.86	42.04	104.3	4
SDS-HAA5	µg/L	19.94	0.52	19.2	20.34	4

III. Materials and Methods

Pretreatment and Design Information

Figure 2 illustrates the full-scale treatment process at QWTP. The sampling point for ICR GAC testing is located immediately after the water exits the filters and prior to the addition of chlorine. After full-scale filtration, there was no additional pretreatment prior to the pilot plant's GAC filters. Figure 3 details the flow through the pilot plant. The equipment used is listed in Table 3.

Table 3: Equipment Used in the Pilot-Scale Study

Quantity	Item
1	½" Flexible Hose
1	100-gallon High Density Polyethylene Influent Water Equalization Tank
3	Rotary Gear Positive Displacement Pumps
2	4" -inch diameter PVC Filter Columns (77-inches in height to influent tap; 89 inches overall height)
3	Flow Meters (rotameters)
2	On-line Process Turbidimeters (Hach 1720 B)

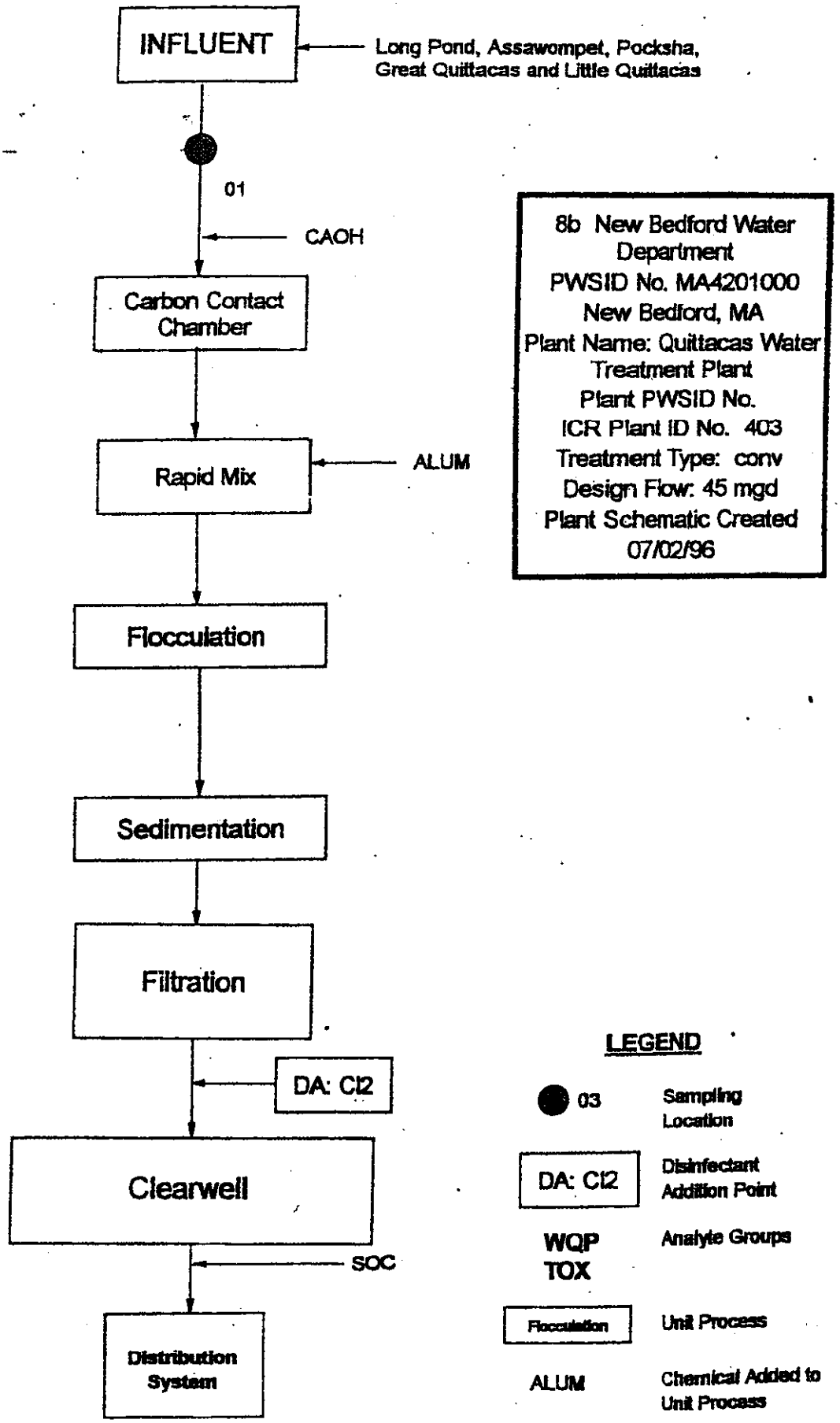
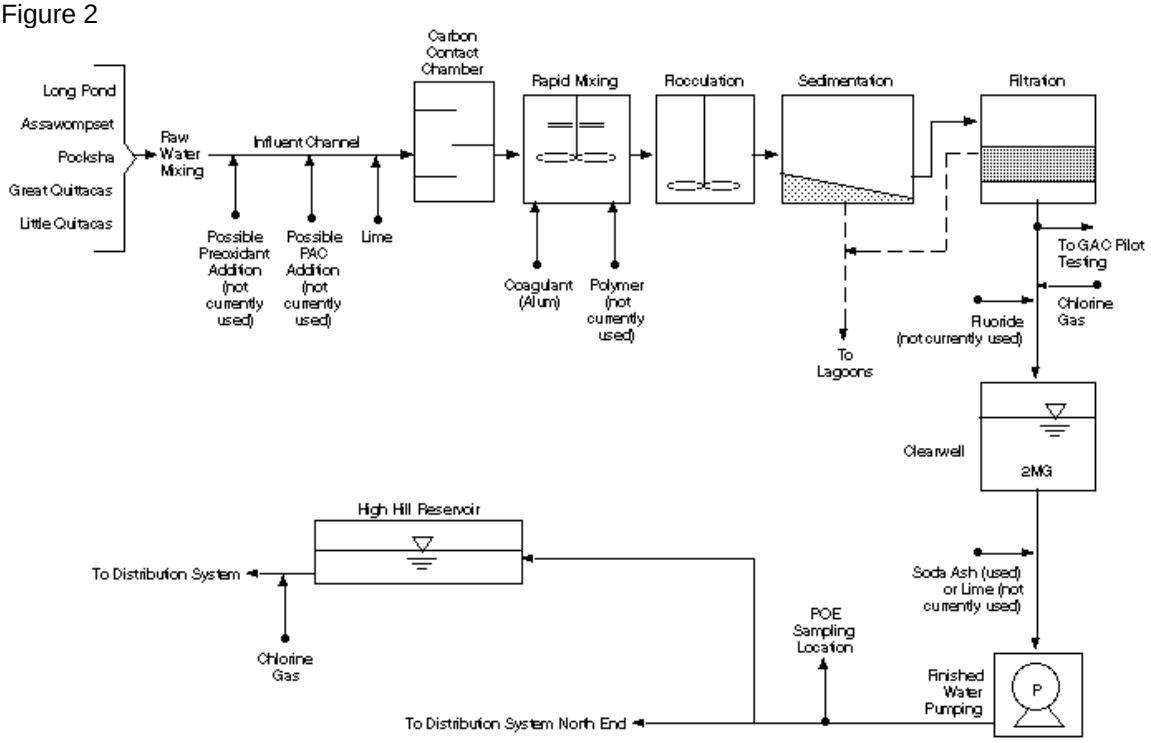


Figure 1
New Bedford Existing Full Scale Plant

Figure 2



¡ **CDM** Camp Dresser & McKee

Figure 2
Existing New Bedford Full-Scale Plant Schematic

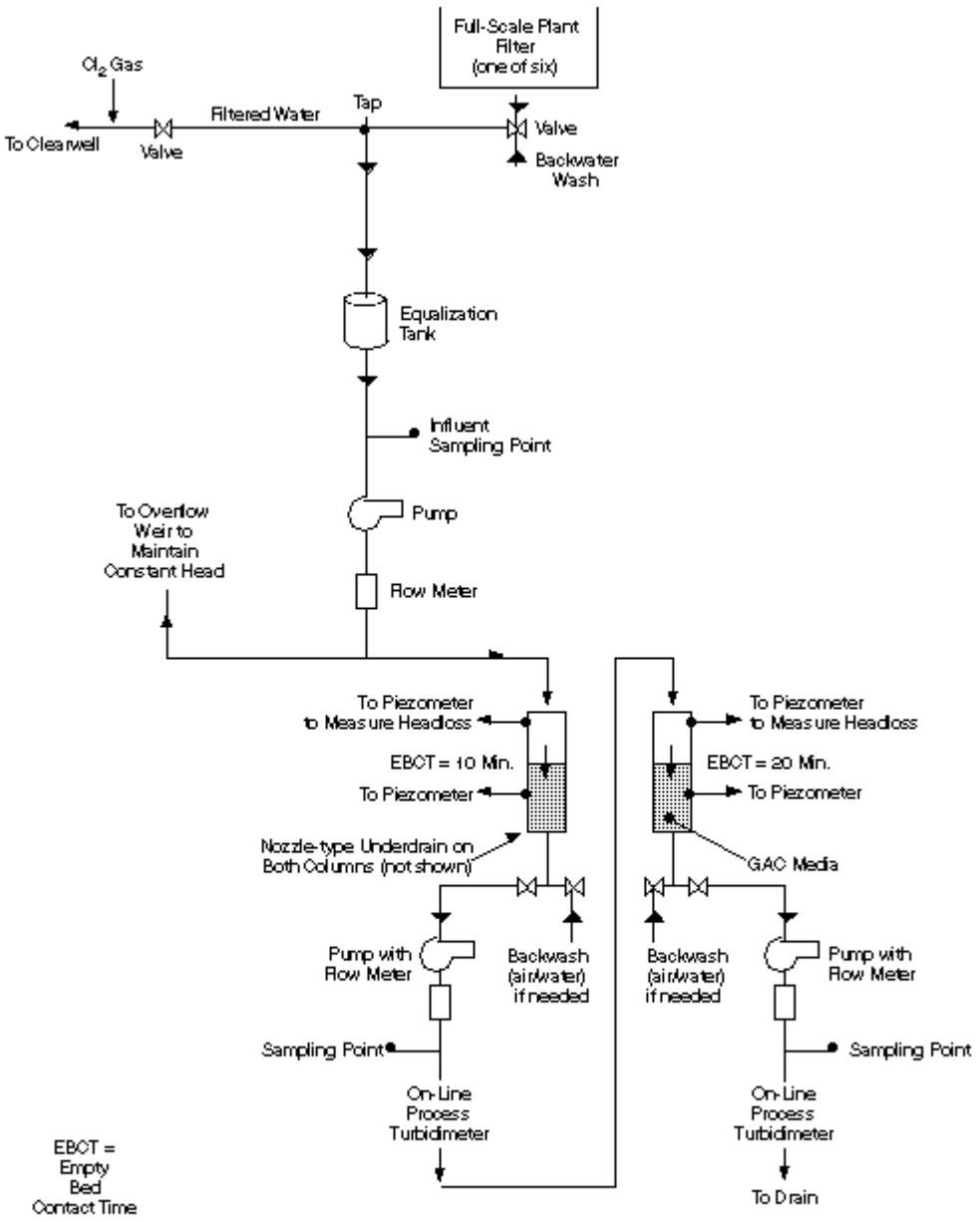


Figure 3 **CDM** Camp Dresser & McKee

Figure 3
GAC Pilot Plant Study Schematic

Procedures

A 50-pound sample of GAC was obtained from a manufacturer, Calgon Carbon Corporation. The GAC was transferred to a large container, and samples were collected according to the quartering procedure described in Appendix 2-A of the EPA Treatment Studies Guidance Manual. An amount equal to the bed volume in each column plus 25% of dry GAC was measured and water (unchlorinated, but filtered) was added to this batch to soak the carbon. The carbon soaked for 8 hours. Each pilot column was filled with unchlorinated, filtered water, and the wetted carbon was added in batches, backwashing slowly to remove the fines after each batch was added. After all the carbon was added, each column was backwashed at approximately 30 to 40 percent expansion for 15-20 minutes. The backwash procedure was carefully controlled to ensure that only fines were removed. Following the backwash the GAC media settled to a depth 5% greater than the desired EBCT calculated depth, allowing for future settling of the media during operation. Pilot operations began the following day, after backwashing for 5-10 minutes.

At the start of the pilot runs, the filter effluent valves were opened and the filter effluent pumps were increased gradually in speed until the desired effluent flow rate was achieved to reach the required EBCT for each column. The columns are open to the atmosphere to allow entrained air to escape. The filters were checked every hour for the first two days of operation to verify that the flow rate remained consistently within 5 percent of target flow.

A blank water sample was taken from for each column prior to the addition of GAC to ensure no that the column material did not leach impurities to the water.

Experimental Design

The primary variable for this pilot study was temperature and the two different EBCTs. In order to study seasonal temperature variation, the pilot plant operated over a 9-month period. Temperature ranged from 24°C in the summer to 3°C in the winter. Table 4 lists the empty bed contact times (EBCT) and the sampling dates for each season.

Table 4: Experimental Design for Pilot-Scale GAC Study

Season	Pretreatment	EBCT
Spring (4/22/98 – 6/8/98)	Conventional filtration (see Appendix A)	10 minutes and 20 minutes
Summer (6/17/98 – 8/26/98)	Conventional filtration	10 minutes and 20 minutes
Autumn (9/9/98 – 11/4/98)	Conventional filtration	10 minutes and 20 minutes
Winter (11/18/98 – 1/12/99)	Conventional filtration	10 minutes and 20 minutes

The City of New Bedford has met the requirements of the ICR with this GAC pilot plant study. Two empty-bed contact times (EBCTs) were evaluated over all four seasons to fully capture temperature variations.

Analytical Information

There were four laboratories used throughout the duration of the pilot study. Table 5 lists the analytes tested by each lab as well as the method used and the minimum reporting level (MRL) for each method. Table 6 provides the full name, address and contact information for each of the four laboratories.

Table 5: List of Analytical Methods Used During GAC Pilot Study

Analyte	Method	MRL	Laboratory	Dates of Service
Alkalinity	2320 B	5 mg/l as CaCO3	QTPU	4/21/98 – 1/12/99
Ammonia	SM 4500-NH3-F 350.1	0.10 mg/L 0.07 mg/L	CDM ALPHA	4/21/98 – 1/5/99 1/12/99 – 1/17/99
Bromide	EPA 300A 300.0 300.0	20 µg/L 50 µg/L 50 µg/L	CDM EHL ALPHA	4/22/98 – 9/4/98 9/10/98 – 12/30/98 1/12/99 – 1/17/99
Calcium Hardness	3500 Ca D	3 mg/l	QTPU	4/21/98 – 1/12/99
Chlorine Residual	4500-Cl G	0.1 mg/l	CDM ALPHA	4/21/98 – 1/8/99 1/12/99 - 1/17/99
BCAA, DBAA, DCAA, MBAA, MCAA, TCAA	SM 6251B 552.2	1.0µg/L for each analyte 1.0µg/L for each analyte	CDM EHL	4/23/98-12/30/98 1/12/98 – 1/17/98
pH	4500-H B	Not Applicable	QTPU	4/21/98 – 1/12/99
Temperature	2550 B	Not Applicable	QTPU	4/21/98 – 1/12/99
CHCL3, BDCM, DBCM, CHBR3	EPA 551.1 551.1	1.0 µg/L for each analyte 1.0 µg/L for each analyte	CDM EHL	4/23/98-12/30/98 1/12/98 – 1/17/98
Total hardness	2340 B		QTPU	4/21/98 – 1/12/99
TOC	SM 5310C 415.1	0.50 mg/L 0.10 mg/L	CDM ALPHA	4/21/98 – 12/23/98 12/28/98 – 1/17/99
TOX	5320B	25 µg/L	EHL	4/21/98 – 1/12/99
Turbidity	2130 B		QTPU	4/21/98 – 1/12/99
UV 254	SM 5910 SM5910B	0.005 cm^{-1} 0.005 cm^{-1}	CDM ALPHA	4/21/98- 12/31/98 1/12/99 – 1/17/99

Table 6: Laboratory Information

Abbrevi-ation	Laboratory Name	Address	Contact	Phone	Fax
CDM	Camp Dresser & McKee Laboratory (MA001)	CLOSED 1/15/99	Peter Maynard	(617) 252-8823	(617) 621-2565
QTPU	Quittacas Treatment Plant Utility Lab	238 Middleboro Rd. East Freetown, MA 02717	Steuart Bailey	(508) 763-2231	(508) 763-4494
EHL	Environmental Health Laboratories	110 S.Hill Street South Bend, IN 46617	Richard Radcliff	(219) 233-4777	(219) 233-8207
ALPHA	Alpha Analytical Laboratory	8 Walkup Drive Westborough, MA 01581	Jim Occhialini	(508) 898-9220	(508) 898-9193

IV. Results and Discussion

Study Observations

The following observations were made during the course of the pilot study:

- Backwashing occurred three times, each for a 10 minute duration on:
  - 5/20/98 (672 operating hours)
  - 8/10/98 (2,663 operating hours)
  - 10/9/98 (4,103 operating hours).
- Prior to the first backwashing, an air bubble was found in the 20-minute column. No other such occurrences were noted.
- A small leak was found in the piping of the 20-minute column and was repaired.
- During backwashing, the amount of GAC lost was negligible.
- A power failure occurred on 9/1/98. The plant was shut down for 30 minutes.
- Once every month, the generator is tested at QWTP. Power is cut for 15 seconds.
- The plant was shut down on 9/15/98 for 6 hours.
- No major operational difficulties were reported by the operator for the duration the study.

Source Water Quality

Table 7 summarizes the average influent water quality during the study. The value in parentheses represents the standard deviation over the course of the study. Refer to Table 4 for a breakdown of dates for each season.

Table 7: Summary of Source Water Quality

Water Quality Parameter	**Spring Average**	**Summer Average**	**Autumn Average**	**Winter Average**
Temperature (°C)	17.5 (2.8)	23.7 (1.9)	17.0 (5.29)	5.4 (2.07)
pH	5.81 (0.22)	5.65 (0.12)	5.59 (0.09)	5.62 (0.07)
Turbidity (NTU)	0.13 (0.02)	0.13 (0.04)	0.10 (0.02)	0.09 (0.02)
Alkalinity (mg/L as $CaCO_3$)	2.58 (0.38)	3.07 (0.67)	2.60 (0.89)	3.00 (0.00)
Calcium Hardness (mg/L as $CaCO_3$)	18.0 (2.5)	18.0 (2.0)	11.6 (2.6)	14.8 (3.6)
Total Hardness (mg/L as $CaCO_3$)	22.7 (1.6)	21.7 (2.1)	18.8 (2.3)	21.6 (3.3)
Bromide (µg/L)	BMRL	BMRL	23.0 (0.0)	21.0 (1.0)
TOC (mg/L)	2.21 (0.22)	2.32 (0.24)	2.48 (0.08)	2.38 (0.13)
UV 254 (cm^{-1})	0.04 (0.01)	0.05 (0.0)	0.05 (0.0)	0.05 (0.0)
SDS-THM4 (µg/L)	50.6 (28.0)	79.2 (11.9)	63.5 (13.4)	50.9 (28.4)
SDS-HAA5 (µg/L)	38.3 (19.8)	42.0 (18.7)	46.1 (8.6)	40.3 (10.9)
SDS-HAA6 (µg/L)	40.6 (20.1)	45.6 (18.8)	50.4 (8.9)	43.0 (12.4)
TOX (µg/L)	217 (29.9)	291 (91.8)	408 (87.0)	412 (160.2)
Chlorine Demand (mg/L)	2.21 (0.22)	2.63 (0.56)	2.46 (0.68)	2.70 (0.30)

Note: BMRL: Below Minimum Reporting Limit

Effluent Water Quality

Graphical representations of the pilot study results can be found at the end of this section. These graphs were generated by the EPA for the final review of the Data Collection Sheets. Comments to the initial submittal of these sheets can be found in Section3, along with responses from Steve Allgeier, EPA Cincinnati.

Analytes shown include TOC, UV254, THM4, HAA6 and TOX. Also, graphs of each of the four THMs and six HAAs are shown for the respective EBCTs. Each analyte is plotted against operation time to show the breakthrough curve. As anticipated, the concentration of all parameters sampled increases with time.

Additional information concerning breakthrough and run times can be generated using the Data Collection Spreadsheets, included as a diskette with this report. As discussed with Steve Allgeier, this information was not necessary to compile for this report.

Seasonal Variation

The temperature of the source water during this pilot study ranged from 3°C to 24°C. Figure 4 illustrates the temperature trend for the source water during this pilot study.
The following analysis compares the temperature variation with the breakthrough curves found at the end of this section.

- During the spring (water sample temperature of 17.5 °C), there was a slight increase in TOC, THMs and HAAs in the 20-minute EBCT and a more noticeable increase in these parameters in the 10-minute EBCT samples. Although the 10-minute EBCT exhibited an increase in TOC, THMs and HAAs in the spring, the increase is not as severe as in the summer.

- As water temperature increased during the summer months (6/17/98 – 8/26/98 or 67 to 141 operating hours) the greatest increases of TOC, THMs and HAAs occurred for both the 20 -minute and 10-minute EBCT samples. The 10-minute EBCT column had reached 70% breakthrough on 8/26/98 and again on 9/9/98. This column was taken off-line at this time.

- During autumn (9/9/98 – 11/4/98), TOC, THMs and HAAs in the 20-minute column seem to level off until the winter (11/18/98 – 1/12/99) when little increase in all analytes occurred.

The results indicate a correlation between the temperature of the influent and the DBP removal effectiveness of the GAC columns. The graphs produced by the EPA display a definitive trend toward seasonal variation, showing the largest variation from start to finish in the summer. The GAC is least efficient when water temperatures are high during the summer and the most efficient when water temperatures are slightly above freezing. Table 8 lists the standard deviations for TOC, THM4 and HAA5 for both 10 minute and 20 minute EBCT column water samples over the four seasons. Notice that for each analyte and both EBCT column samples, the summer standard deviations are the highest.

Table 8: Standard Deviations By Seasonal Variation

Season	**TOC**	**THM4**	**HAA5**
Spring			
10-min	0.26	7.69	3.05
20-min	0	2.91	0.65
Summer			
10-min	**0.31**	**12.71**	**8.24**
20-min	**0.23**	**7.24**	**14.24**
Autumn			
20-min	0.08	4.22	3.42
Winter			
20-min	0.15	3.91	5.88

The properties of the carbon could also have an effect on the trends shown in this study. This analysis was not conducted as part of the ICR.

V. QA/QC Summary

As stated in the *EPA HELP PACKET,* only calibration procedures are required in addition to the Treatment Summary Sheets. The calibrations for each laboratory can be found in Section 2. Also, electronic copies of the *Data Collection Sheets* and *Treatment Study Sheets* are included in Section 2.

Quittacas Water Treatment Plant
New Bedford, MA
GAC Pilot Study
Source Water Temperature

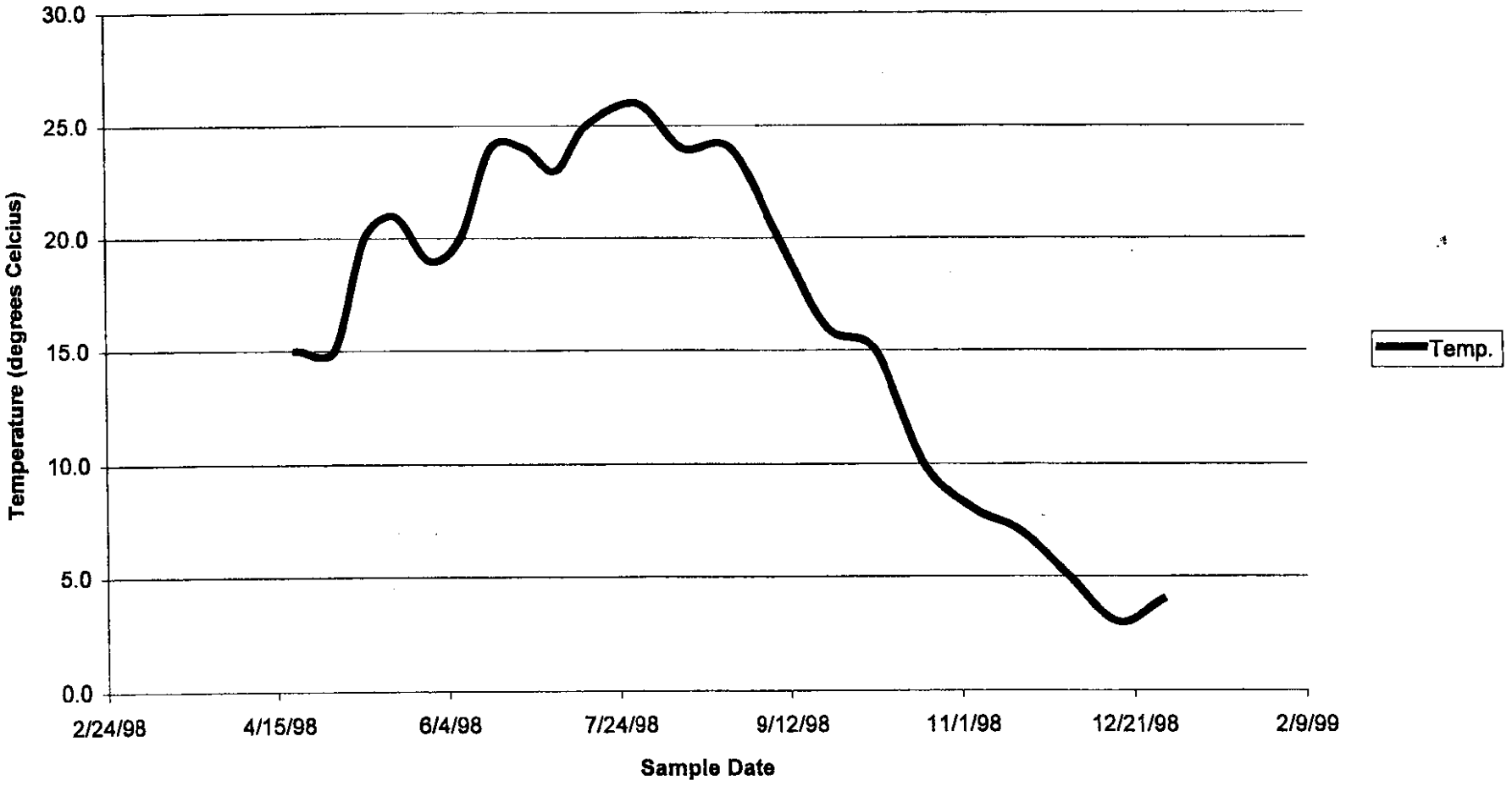


Figure 4

City of New Bedford Water Department — **Pilot-Scale GAC Treatment Study Summary** — Session: 1

ICR Information

ID / ICR#: MA4201000 / 403
ICR Contact: Mr. Charles Kennedy
Phone No.: (508) 763-5771
Period: 4/21/98 - 10/7/98 (169 days)

Design Information

Design TOC: 2.7 mg/L
Col Diameter: 101.6 mm
Full-Scale GAC Size: 8x40 US Std Mesh
Full-Scale particle dia.: 1.393 mm
Meas Dry Bed Density: 465.5 kg/m3

Water Quality Summary

	Influent							
Influent	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
TOC	2.3	0.2	22	1.9 - 2.8				
pH	5.7	0.2	23	5.4 - 6.1				
UV254	0.050	0.008	22	0.038 - 0.066				
SUVA	2.14	0.24	21	1.7 - 2.7				
Bromide	3.92	8.50	22	0.0 - 23.0				
SDS-TOX	320	142	21	13 - 570				
SDS-THM4	68	14	21	46 - 92				
SDS-HAA6	50	8	20	35 - 67				
Ammonia	0.02	0.06	22	0.00 - 0.20				
Effluent	**10 Min EBCT**			(140 days)	**20 Min EBCT**			(266 days)
Effluent pH	5.9	1.1	19	5.3 - 10.3	5.9	0.9	23	5.5 - 10.1
Effluent Temp	20.3	3.9	19	14.0 - 26.0	16.8	7.3	23	3.0 - 26.0

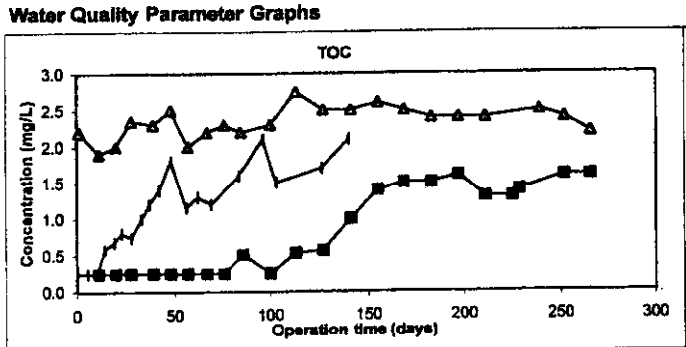
Cumulative SDS Conditions

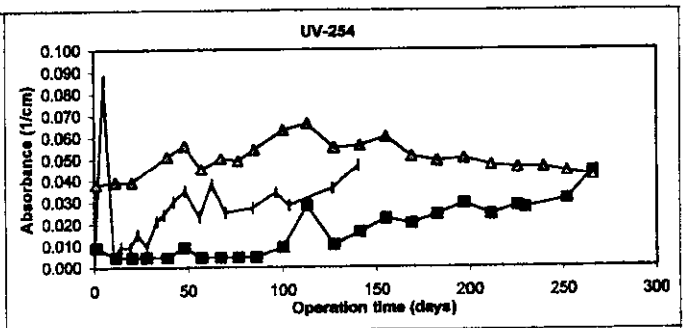
	Mean	SD	Count	Min/Max
Res (2)	0.88	0.35	51	0.05 - 2.06
Temp	13.0	0.0	52	13.0 - 13.0
pH	9.1	0.0	52	9.1 - 9.1
Time	99.7	7.7	52	50.0 - 116.0

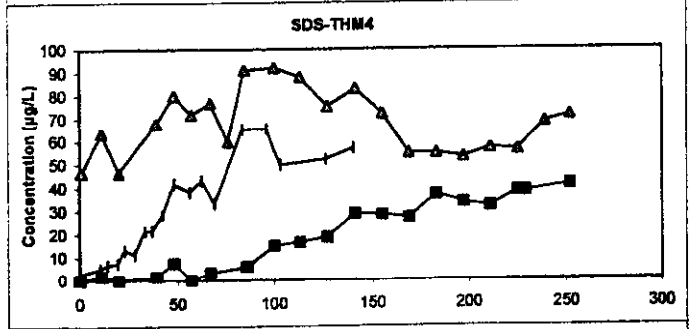
Comments:

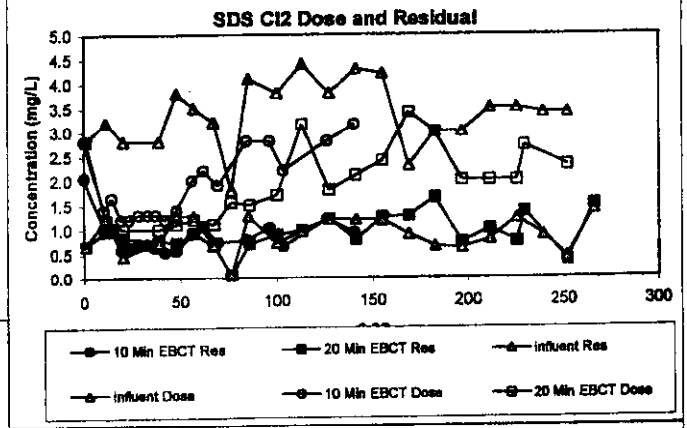
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent

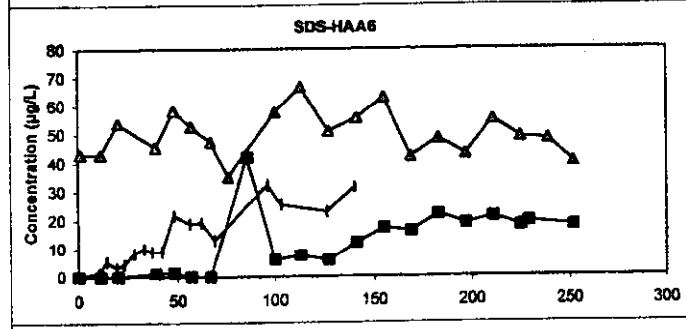
Water Quality Parameter Graphs

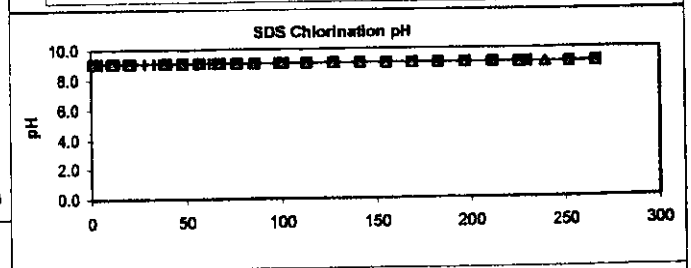


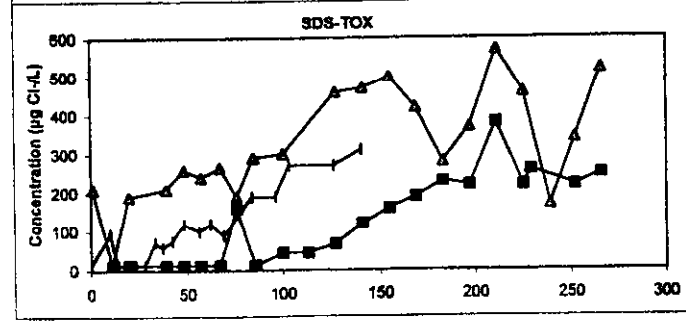


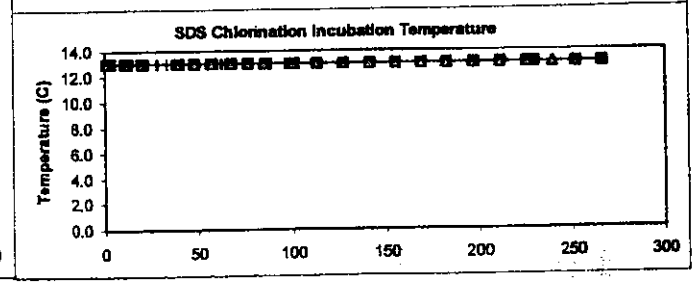




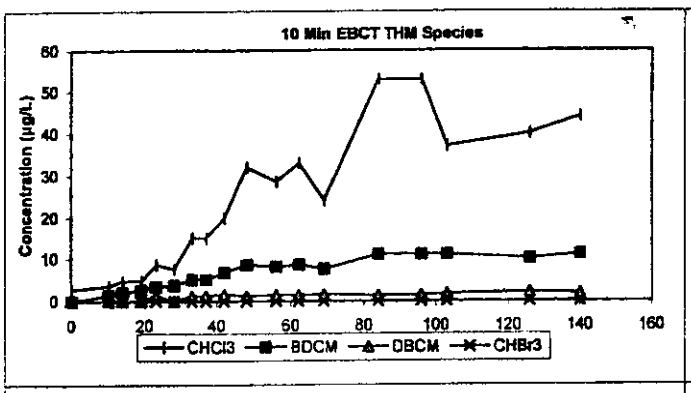


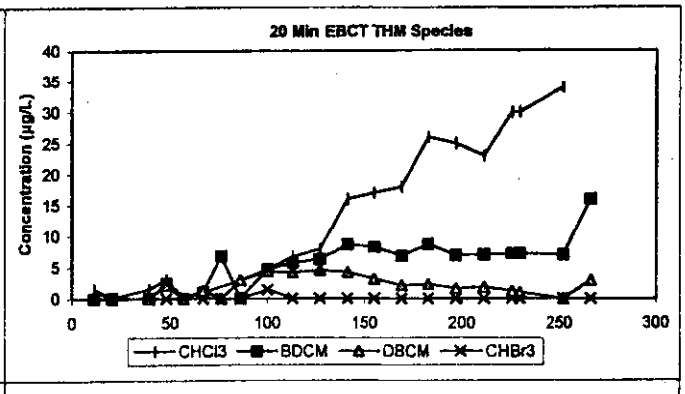


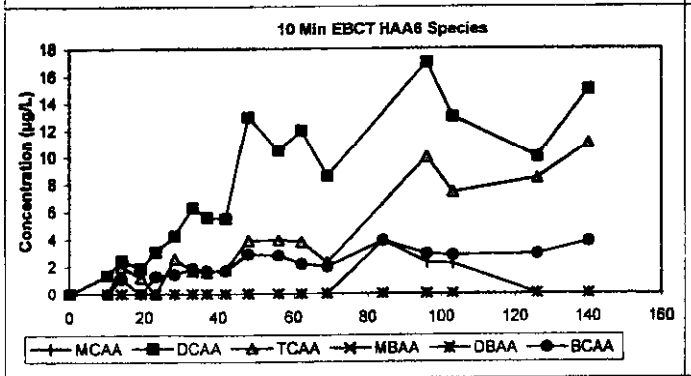


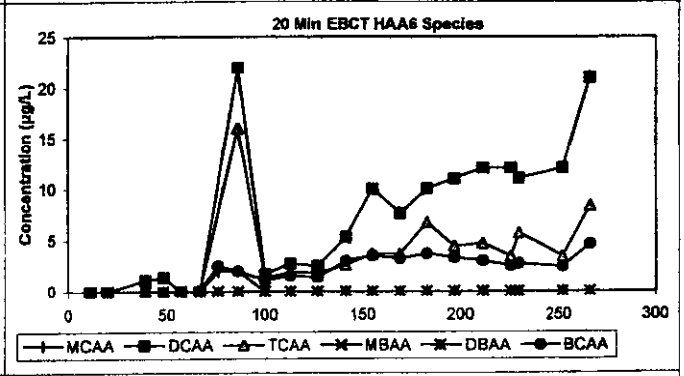


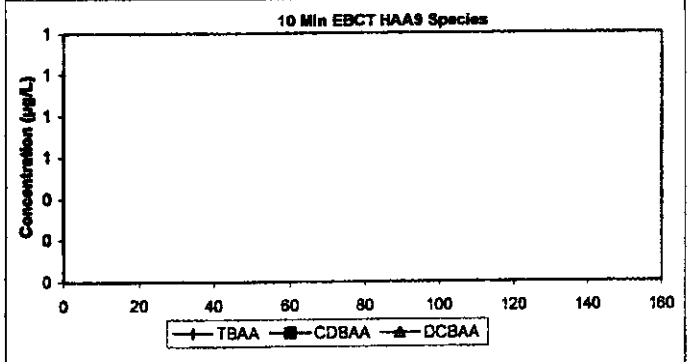
Water Quality Parameter Graphs (Continued)

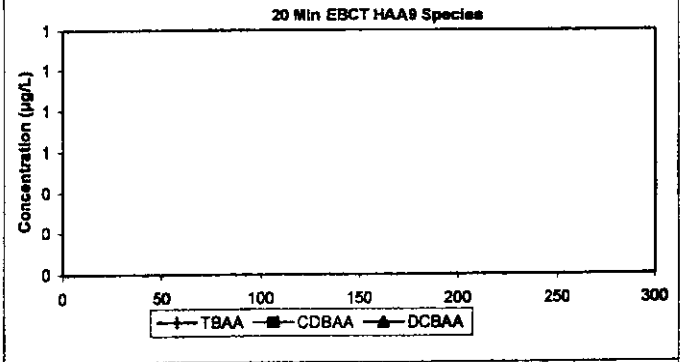


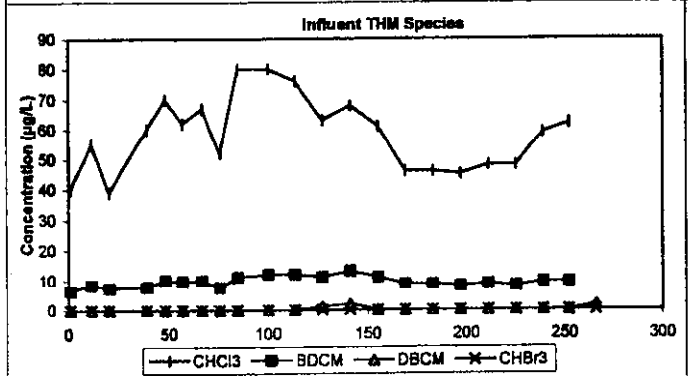


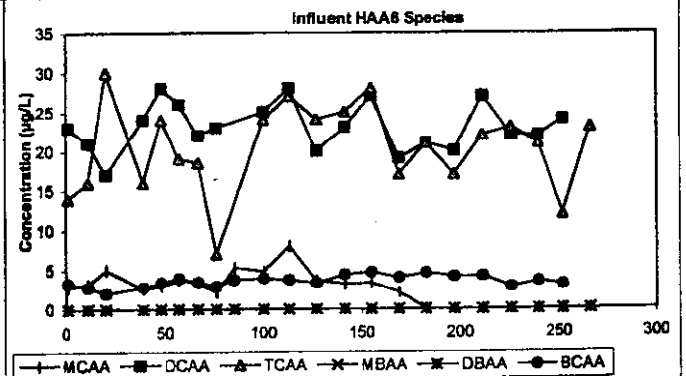


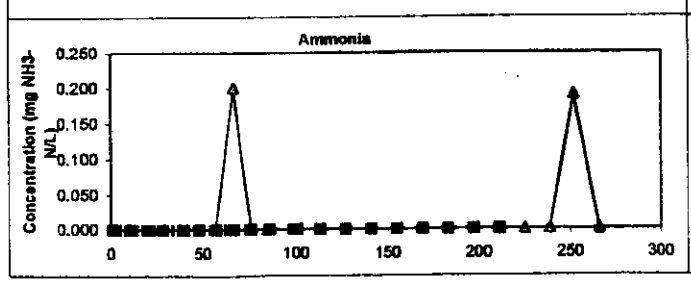


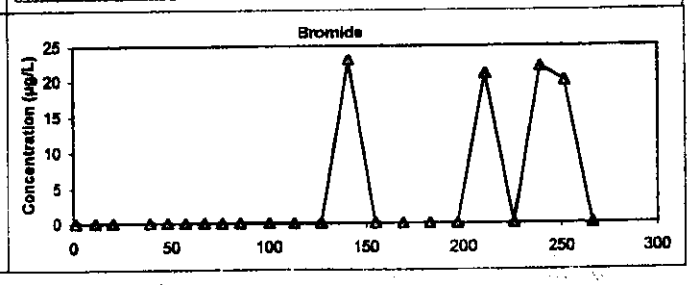












Section 2

Calibration Procedures

Alpha Analytical Labs
Eight Walkup Drive
Westborough, MA 01581

UV_{254}

Calibration as per Method 5910 B with DBP/ICR Analytical Methods Manual Modifications

TOC

Calibration as per Method 5310 C with DBP/ICR Analytical Methods Manual Modifications

THM

Calibration as per Method 551.1 with DBP/ICR Analytical Methods Manual Modifications

Calibration as per Method 524.2

HAA

Calibration as per Method 6251 B with DBP/ICR Analytical Methods Manual Modifications

CDM Camp Dresser & McKee Inc.

consulting
engineering
construction
operations

Ten Cambridge Center
Cambridge, Massachusetts 02142
Tel: 617 252-8000 Fax: 617 621-2565

MEMORANDUM

To: Lisa Sorgini

From: Peter Maynard PM

Re: ICR Bench Study: Analytical Calibration Protocol

Date: 11 June 1999

Calibration for analysis of samples submitted to the CDM laboratory under ICR Bench Study programs were performed in accordance to the protocols given in the DBP/ICR Analytical Methods Manual [EPA 814-B-96-002] Section 9.0.

Environmental
Health Laboratories

110 S. Hill Street
South Bend, IN 46617-2702
(219) 233-4777
(219) 233-3272
FAX (219) 233-8207

Calibration Procedures:

EHL followed standard calibration procedures as indicated bythe Standard Methods and EPA Methods listed below:

5320B
300.0
551.1
552.2

If you have any further questions, please contact us at 1-800-332-4345.

Section 3

EPA response and graphs are included on the diskette.

New Bedford, Massachusetts
ICR Monitoring
Data Collection Sheets - Comment Responses

General Comments:

All averages for duplicate samples have been reported in Groups A,B and C as they appear in Group D. Also, all results reported below the MRL have been changed to BMRL.

I. ***Missing Data*** – Note changes / additions on DCS
II. ***Corrections/Errors***

Field 1-4

1. ***Data reported as NR***. – Much of the data for samples A-4, A-4 DUP, C-4 and C-4 DUP is reported as NR because the sample bottles were broken in transport. The following is a list of samples that were not analyzed:

A-4	SDS- THM/HAA/TOX
A-4	Bromide
A-4	UV 254
A-4 Dup	SDS- THM/HAA/TOX
A-4 Dup	NH3
A-4 Dup	UV 254
A-4 Dup	Bromide

2. ***Verify Duplicate analysis of UV, CL2 dose/residual, and MCAA. –***
UV 254 – Sample A-12 Dup was reported correctly. The laboratory noted that this sample did not follow the trend for this analyte but no QA/QC error were found. However, this sample was reported as an outlier (NR) due to the high concentration which was not attained by any other sample.

Cl2 Dose/Residual – correct. No lab error were detected.

MCAA – correct. No lab errors were detected.

Field 1-5

1. ***Verify duplicate THM/HAA.*** Two corrections made – typographical error. The remaining information did not change.
   HAA – DCAA – Correct. All lab QA/QC checks
   THM - Chloroform- Correct. All lab QA/QC checks
   BDCM – Correct. All lab QA/QC checks

2. Delete Column
3. Report Average
4. ***Reported as NR? See comment 1 in Field 1-4. The following is a list of samples that were not analyzed:***

C-4	SDS – THM/HAA/TOX
C-4	Bromide
C-4 DUP	SDS – THM/HAA/TOX
C-4 DUP	UV254
C-4 DUP	Bromide

III QA/QC Info

1. Incubation time, pH and temperature

Time- 50 hours – typographical error by laboratory. 116 hours – correct. The samples that were incubating for 116 hours were in over a weekend. They were removed on Monday morning. The start time was 14:00 on 7/10 and 10:00 on 7/15.

Temp – According to the CDM laboratory, the temperature was recorded at the start of the incubation. Measures were taken to ensure that the temperature remained constant for the duration the sample was heated. The error that may have occurred was ± 2degrees. The final temp was not recorded by the lab.

pH – Like temperature, pH was recorded at the start of the incubation. The final pH was not recorded in the laboratory report.

2. ***Detectable residual?*** No.

3-5. ***Influent analysis with STD > 20% and High/Low spikes***

Bromide – Detection limit for bromide is 20 ug/l. The highest sample recorded in this pilot testing was 23.0 ug/l. Using the range of 0-23 would produce a large differential, however the actual difference between detectable and the result is small and should not be listed with a high std.
Ammonia – The MRL for ammonia is 0.10 mg/l. Only two samples were above the MRL, the highest at 0.2 mg/l. Once again, using a range of 0- 0.2 mg/l does not give a correct standard deviation. Both of these parameters should be acceptable.

UV254(Influent) – Typographical error. Refer to DCS. Low spikes are attributed to "NR"s.
10 Minute – Sample B-2 result is correct. No laboratory errors can be found.
20-minute - Typographical error. Refer to DCS.

TOX– All laboratory QA/QC information checks. No typographical errors were found. From laboratory analysis, we can not explain the high and low spikes for this analyte.

HAA6 (Influent) – Low spikes and the high standard deviations are due to samples recorded as 'NR'. Sample A-24 was uncommonly high for DCAA and BCAA, but undetectable for MCAA. This lone sample was sent to a different laboratory for HAA analysis. The laboratory data checks, however, the sample may not have been quenched. Therfore, the results are reported as 'NR'

HAA6 (20-Minute) – Due to DCAA and TCAA. See response #6.

THM4- The largest differentials for THMs are a result of the wide range of TOX results. The three other analytes stay within acceptable ranges. Once again, sample 24 has unexplainably high results. The laboratory data checks, however, the sample may not have been quenched. Therfore, the results are reported as 'NR'

CHBR3 (Influent) – Typographical error. Refer to DCS.

TOC – All TOC data is correct and accurate.

6. ***High DCAA and TCAA concentrations for C-9 and C-10.***
Results for both samples and analytes are correct, as the QA/QC data checks. However, because sample C-9 had a different incubation time, those samples have been listed as NR

Appendix A

A.2 -- Design Plant Parameters

Date: 4/30/99

PWS Name: City of New Bedford Water Department
PWS ID: MA4201000
WIDB:
ICR Contact Person: Mr. Charles F. Kennedy

Sampling Period: Design
Design Sampling Start Date: 7/22/97
Design Sampling End Date: 1/15/99

Treatment Plant Name: Quittacas Water Treatment Plant
ICR Treatment Plant ID: 403
Treatment Plant PWS ID: MA4201000
Treatment Plant Category: CONV

State Approved Plant Capacity (MGD): 45.0
Historical Min. Water Temperature (deg C): 1.0
Installed Sludge Handling Capacity (WTD): 53.75
Blending Indicator: N

Water Resource Name: Little Quittacas Pond
Water Resource Type: Reservoir/lake
Average Residence Time (Days): 28
Intake Name: Little Quittacas Pond Short Intake
Watershed Control: Y

Hydrologic Unit Code:
River Reach:
Latitude (degrees, minutes, seconds): +41°47'.222"
Longitude (degrees, minutes, seconds): -70°54'.826"
River Reach Miles:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
	Influent	INF	1

Process Train Name: Quittacas Water Treatment Plant
Process Train Category: CONV

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
1	Carbon Contact	Other Treatment Process		Surface Area (ft2): 6,724 Liquid Volume (gal): 528,103 Short Circuiting Factor:
2	Rapid Mix	Rapid Mix	2	Type of Mixer: ME Baffling Type: PR Liquid Volume (gal): 119,459 Short Circuiting Factor: Mean Velocity Gradient (sec-1): 220.0
3	Floc. Basin A	Flocculation Basin		Type of Mixer: ME Liquid Volume (gal): 477,459 Short Circuiting Factor: Baffling Type: PR Stage Sequence Number: 1 Stage Mean Velocity Gradient (sec-1): 45 Stage Liquid Volume (gal): 477,459
4	Floc. Basin B	Flocculation Basin		Type of Mixer: ME Liquid Volume (gal): 477,459 Short Circuiting Factor: Baffling Type: PR Stage Sequence Number: 2 Stage Mean Velocity Gradient (sec-1): 25

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Stage Liquid Volume (gal): 477,459
5	Sedimentation	Sedimentation	4	Surface Area (ft2): 24,804 Liquid Volume (gal): 3,054,167 Baffling Type: PR Short Circuiting Factor: Plate Settler Surface Area (ft2): Plate Settler Brand Name: Tube Settler Surface Area (ft2): Tube Settler Brand Name:
6	Filtration	Filtration	5	Surface Area (ft2): 5,225 Liquid Volume (gal): 371,322 Total Media Depth (in): 39 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 5.6 Depth From Top of Media to Top of Backwash Trough (ft): 3.6
7	Chlorine gas	Disinfectant Addition		Chemical Code: CL2 Measurement Formula: Cl2 Dose Rate (mg/L): 1.75
8	Clearwell	Clearwell		Surface Area (ft2): 22,282 Liquid Volume (gal): 2,000,000

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
				Minimum Liquid Volume (gal): 1,500,000 Baffling Type: PR Short Circuiting Factor: Covered Indicator Code: Y
9	Chem. Addtion	Other Treatment Process	11	Surface Area (ft2): Liquid Volume (gal): Short Circuiting Factor:
	Finished Water	FIN	7	

End of Report A.2 -Design Plant Parameters

A.3 -- Design Plant Chemical Parameters

Date: 4/30/99

PWS Name: City of New Bedford Water Department
PWS ID: MA4201000
WIDB:
ICR Contact Person: Mr. Charles F. Kennedy

Sampling Period: Design
Sampling Start Date: 7/22/97
Sampling End Date: 1/15/99

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
Treatment Plant Name: Quittacas Water Treatment Plant **ICR Treatment Plant ID No:** 403 **Treatment Plant Category:** CONV						
Process Train Name: Quittacas Water Treatment Plant **Process Train Category:** CONV						
1	Carbon Contact	Other Treatment Process				
				Calcium hydroxide	Ca(OH)2	3.04
2	Rapid Mix	Rapid Mix	2			
				Aluminum sulfate (Alum)	Al2(SO4) x H2O	17.26
3	Floc. Basin A	Flocculation Basin				
4	Floc. Basin B	Flocculation Basin				
5	Sedimentation	Sedimentation	4			
6	Filtration	Filtration	5			

Sep. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
7	Chlorine gas	Disinfectant Addition				
				Chlorine gas	Cl2	1.75
8	Clearwell	Clearwell				
9	Chem. Addtion	Other Treatment Process	11			
				Sodium carbonate	Na2CO3	27.00

End of Report A.3 --Design Plant Chemical Parameters

A.1 -- Initial Sampling Plan by Location

Date: 4/30/99

PWS Name: City of New Bedford Water Department
PWS ID: MA4201000
WIDB:
ICR Contact Person: Mr. Charles F. Kennedy

Sampling Period: Design
Design Sampling Start Date: 7/22/97
Design Sampling End Date: 1/15/99

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Treatment Plant Name: Quittacas Water Treatment Plant **ICR Treatment Plant ID No:** 403 **Treatment Plant Category:** CONV						
	Influent	INF	1	403009701BACT 403009701Br 403009701NH3 403009701PROT 403009701TOC 403009701UV-254 403009701VIRU 403009701WQP		
Process Train Name: Quittacas Water Treatment Plant **Process Train Category:** CONV						
1	Carbon Contact	Other Treatment Process				

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
2	Rapid Mix	Rapid Mix	2			
3	Floc. Basin A	Flocculation Basin				
4	Floc. Basin B	Flocculation Basin				
5	Sedimentation	Sedimentation	4			
				403009704TOC		
				403009704UV-254		
				403009704WQP		
6	Filtration	Filtration	5			
				403009705CLD		
				403009705TOC		
				403009705UV-254		
				403009705WQP		
7	Chlorine gas	Disinfectant Addition				
8	Clearwell	Clearwell				
9	Chem. Addtion	Other Treatment Process	11			
	Finished Water	FIN	7			
				403009707BACT		
				403009707CL2		
				403009707PROT		
				403009707TOC		

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
				403009707UV-254		
				403009707VIRU		
				403009707WQP		

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	Sample ID Number	Laboratory Name	Laboratory ICR ID
Distribution System Samples for Non-Blending Plants						
Treatment Plant Name: Quittacas Water Treatment Plant						
ICR Treament Plant ID No: 403						
	Quittacas SDS	SDS	3			
	Crapo Hill Land Fill	DSE	6			
	129 Ashley Blvd.	AVG	8			
	133 Williams St.	AVG	9			
	754 Brock Ave.	MAX	10			

End of Report A.1 --Initial Sampling Plan By Location