

**Hap Cremean Water Plant  
ICR Treatment Study  
Summary Report**

**Evaluation of GAC Technology for Compliance  
with the Information Collection Rule**

Conducted during the period of April 1998 through October 1998

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ICR # 527

July 1999

**Attachments:**

1 diskette containing the *ICR Treatment Study Summary Report Spreadsheet*  
and the *ICR Treatment Study Data Collection Spreadsheet*.

# **Outline For The Treatment Study Summary Report**

## **I. Conclusions**

## **II. Background Information**

- A. Treatment plant description
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- B. Tabular summary of source/finished water quality

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- A. Pretreatment processes to the advanced treatment process
  - 1. Schematics of pretreatment processes
  - 2. Design data for each pretreatment process
- B. Advanced treatment process information
  - 1. Schematics and descriptions of the process equipment used to investigate the advanced treatment process
  - 2. Design data for the advanced treatment process
  - 3. Procedures specific to the treatment study
- C. Experimental Design
- D. Analytical Methods

## **IV. Results and Discussion**

- A. Problems encountered
- B. Water quality data
  - 1. Water quality of pretreated influent
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- C. Impact of specific variables on performance
- D. Summary of significant results

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## **Appendix A**

## **I. Conclusions**

- Recarbonated lime-softened water from the plant processes was used as feed water for the pilot study.
- The feed to the pilot GAC column was pretreated via sand filtration.
- No significant problems were encountered during the study.
- Pilot column was operated for 4000 hours without experiencing breakthrough of TOC.
- THM<sub>4</sub> breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule occurred at approximately 36 days for EBCT<sub>10</sub>.
- THM<sub>4</sub> breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule occurred at approximately 117 days for EBCT<sub>20</sub>.
- HAA<sub>5</sub> breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule occurred at approximately 41 days for EBCT<sub>10</sub>.
- HAA<sub>5</sub> breakthrough for Stage 2 levels of the Disinfectant/Disinfection By-Product Rule did not occur during the study period for EBCT<sub>20</sub>.
- No cost analyses were performed as a part of this work.

## **II. Background Information**

### **A. Treatment Plant Description**

The Hap Cremean Water Treatment Plant is a lime softening plant that is rated to produce 100 mgd. See Figure 1 for a schematic of the plant processes.

Treatment Plant Design Information: Reports G.1 and G.2 from the ICR Water Utility Database System are attached.

### **B. Tabular summary of source and finished water quality: Tables 1 and 2 contain the summary of source and finished water quality provided by the water treatment plant.**

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (°C)	13.0	7.0	22.0	3.0
pH	7.9	0.2	8.2	7.6
Turbidity (ntu)	11	7	29	5
Alkalinity (mg/L as CaCO <sub>3</sub> )	110	2	114	108
Calcium Hardness (mg/L CaCO <sub>3</sub> )	109.0	7.9	122.5	95.0
Total Hardness (mg/L CaCO <sub>3</sub> )	162	8	174	148
TOC (mg/L)	5.58	0.46	6.26	4.77
UV <sub>254</sub> (cm <sup>-1</sup> )	0.144	0.017	0.172	0.121
Bromide (µg/L)	0.011	0.005	0.019	0.000

**Table 1 - Source Water Quality for Hap Cremean Water Treatment Plant**

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
pH	7.7	0.1	7.8	7.6
Turbidity (ntu)	0.09	0.01	0.11	0.07
TOC (mg/L)	2.84	0.35	3.60	2.32
Distribution System THM <sub>4</sub> (µg/L)	54.4	15.4	81.0	37.4

**Table 2 - Finished Water Quality for Hap Cremean Water Treatment Plant**

### **III. Materials and Methods**

#### **A. Pretreatment Processes to the Advanced Treatment Process**

Figure 1 outlines the full-scale processes used in the plant prior to the sampling point. Design data for each pretreatment process is shown in reports G.1 and G.2 from the ICR Water Utility Database System attached.

#### **B. Advanced Treatment Process Information**

Figure 2 is a schematic of the of the process equipment used to investigate the advanced treatment process. Table 3 provides a description of the process equipment used for the study. Table 4 discusses the design data used to for the GAC study.

The procedures outlined in the *ICR Manual for Bench- and Pilot-Scale Studies* were followed. Only stainless steel and teflon tubing were used in the apparatus to minimize contamination.

GAC Type	Calgon F-300 (8 x 30 U.S. Mesh)
GAC Column Type	Glass, 3 inch diameter
GAC Amount	1800 g / Column (3600 mL), 2 columns
Empty Bed Contact Time (each)	10 min
Empty Bed Contact Time (total)	20 min
Influent Sample Point	After Dual Media Filter
EBCT 10 Sample Point	After First GAC Column
EBCT 20 Sample Point	After Second GAC Column

**Table 3: GAC Column Design Used During GAC Study**

Design Data for GAC Treatment Process	
Loading	2.0 gpm/ft <sup>2</sup>
Superficial Velocity	4.9 M/hr
Surface Area of Pilot Column	6.85 in <sup>2</sup>
GAC Bed Depth for 10 min.	32 in.
Volumetric Flow Rate	5.72 gal/hr
10 min. EBCT Volume of GAC	220 in <sup>3</sup>

**Table 4 - Design Data for GAC Pilot-Scale Treatment Study**

C. Experimental Design

The experimental design was to look at the effect of Empty Bed Contact Time and bed volumes contacted on removal of DBP precursors with GAC.

D. Analytical Methods

Table 5 outlines the analytical methods used during the treatment study as well as the minimum reporting level (MRL) for each analyte. Table 6 lists the laboratories involved in the treatment study and the analyses performed. There were no deviations from the QA/QC procedures outlined in the *DBP/ICR Analytical Methods Manual*.

Analyte	Method	Minimum Reporting Level
pH	SM4500-H+	NA
Temperature	SM2550B	NA
Alkalinity	SM2320B	5 mg/L as CaCO <sub>3</sub>
Ammonia	SM4500-NH3G	0.1 mg/L NH <sub>3</sub> -N
Calcium Hardness	SM3500CaD	5 mg/L as CaCO <sub>3</sub>
Cl <sub>2</sub> Residual	SM4500-ClD	0.2 mg/L
Total Hardness	SM2340C	5 mg/L as CaCO <sub>3</sub>
Turbidity	SM2130B	0.03 ntu
Bromide	EPA300	0.02 µg/L
UV <sub>254</sub>	SM5910	0.009 cm <sup>-1</sup>
TOC	SM310C	0.5 mg/L
TOX	SM5320B	25 µg/L
CHCl <sub>3</sub> , BDCM, DBCM, CHBr <sub>3</sub>	EPA551	1 µg/L
MCAA, DCAA, TCAA, MBAA, DBAA, BCAA	EPA522.2	2 µg/L for MCAA 1 µg/L for other analytes

**Table 5 -Summary of Analytical Methods and MRLs Used During GAC Study**

Laboratory	Dates of Service	Analyses Performed
Water Quality Assurance Lab ICROH003 910 Dublin Road Columbus, OH 43215 Mr. Kenneth S. Button (614) 645-7691 (614) 645-3819 FAX	2/16/98 - 10/26/98	Alkalinity, Ammonia, Calcium Hardness, Cl <sub>2</sub> Residual, pH, Temperature, Total Hardness, Turbidity, UV <sub>254</sub> , Bromide, TOC, TOX, THM <sub>4</sub> , HAA <sub>6</sub>

**Table 6 - Summary of Laboratories Conducting Analyses During GAC Study**

#### **IV. Results and Discussions**

##### **A. Problems Encountered**

There were no significant problems encountered in this study. Some operational problems were encountered, but none resulted in the plant being non-operational for more than seven (7) days. They are as follows:

- May 15, 1998 - Plant pump providing influent flow to pilot-plant failed
- July 13, 1998 - Plant pump providing influent flow to pilot-plant failed
- July 31, 1998 - Plant pump providing influent flow to pilot-plant failed, plant down for 5 days

B. Water Quality Data

Table 7 outlines the water quality of the pretreated influent to the advanced treatment process.

Water Quality Parameter	Average	Standard Deviation
Temperature (°C)	20.1	3.8
pH	7.30	0.80
Turbidity (ntu)	0.15	0.15
Alkalinity (mg/L as CaCO <sub>3</sub> )	33	4
Calcium Hardness (mg/L CaCO <sub>3</sub> )	62	8
Total Hardness (mg/L CaCO <sub>3</sub> )	102	7
TOC (mg/L)	2.75	0.21
UV <sub>254</sub> (cm <sup>-1</sup> )	0.06	0.007
Bromide (µg/L)	14	5
SDS-THM <sub>4</sub> (µg/L)	85.9	20.8
SDS-HAA <sub>5</sub> (µg/L)	53.4	10.1
SDS-HAA <sub>6</sub> (µg/L)	57.5	10.5
SDS-TOX (µg Cl-/L)	270	35
SDS-Chlorine Demand (mg/L)	2.5	0.3

**Table 7 - Average Pretreated Feed Water Quality for Hap Cremean Water Treatment Plant During GAC Study**



Table 8 outlines the DBP data collected during the study.

Break-through Criterion	Value of Listed Parameter When Breakthrough Criterion is Met						
	Run Time (days)	Throughput (Bed Vol.)	TOC (mg/L)	SDS -THM4 (ug/L)	SDS-HAA5 (ug/L)	SDS-HAA6 (ug/L)	SDS-TOX (ug Cl-/L)
SDS-THM4 = 90 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-THM4 = 72 ug/L	114	16416	2.3	72	38	44	190
SDS-THM4 = 54 ug/L	96	13824	2.3	54	33	37	140
SDS-THM4 = 36 ug/L	35	5040	1.4	36	14	19	78
SDS-HAA5 = 54 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-HAA5 = 27 ug/L	40	5760	1.9	52	27	28	127
SDS-HAA6 = 54 ug/L	NA	NA	NA	NA	NA	NA	NA
SDS-HAA6 = 27 ug/L	39	5616	1.8	50	23	27	115

**Table 8 - Summary of Times to Reach Various Breakthrough Criteria for the Hap Cremean Water Treatment Plant and The Water Quality of the GAC Effluent When Those Criteria Are Met**

### C. Impact of Specific Variables on Performance

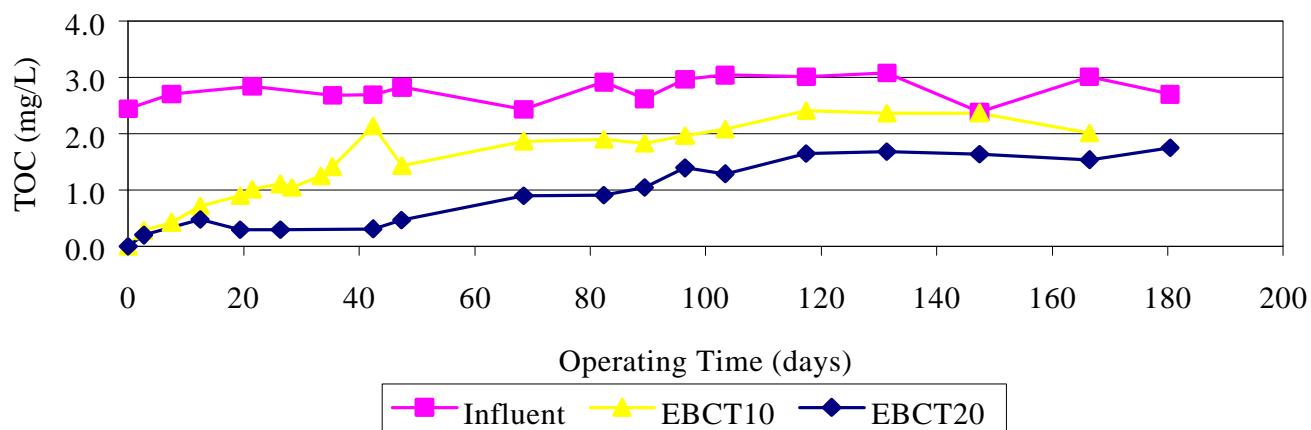
Included in this final report are several tables and graphs that illustrate important aspects of the study. They are as follows:

#### 1. Breakthrough curves for TOC and UV<sub>254</sub>

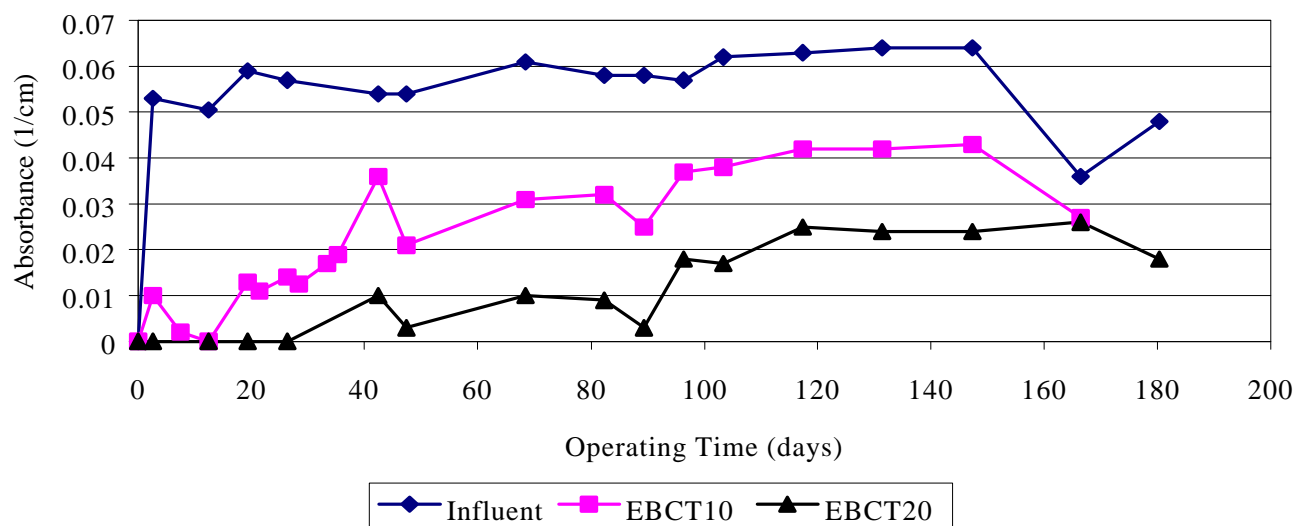
Figure 3: TOC concentration as a function of operation time

Figure 4: UV<sub>254</sub> absorption as a function of operating time

**Figure 3**  
**Hap Cremean Water Treatment Plant**  
**TOC Breakthrough Curve For GAC Study**



**Figure 4**  
**Hap Cremean Water Treatment Plant**  
**UV<sub>254</sub> Curve for GAC Study**



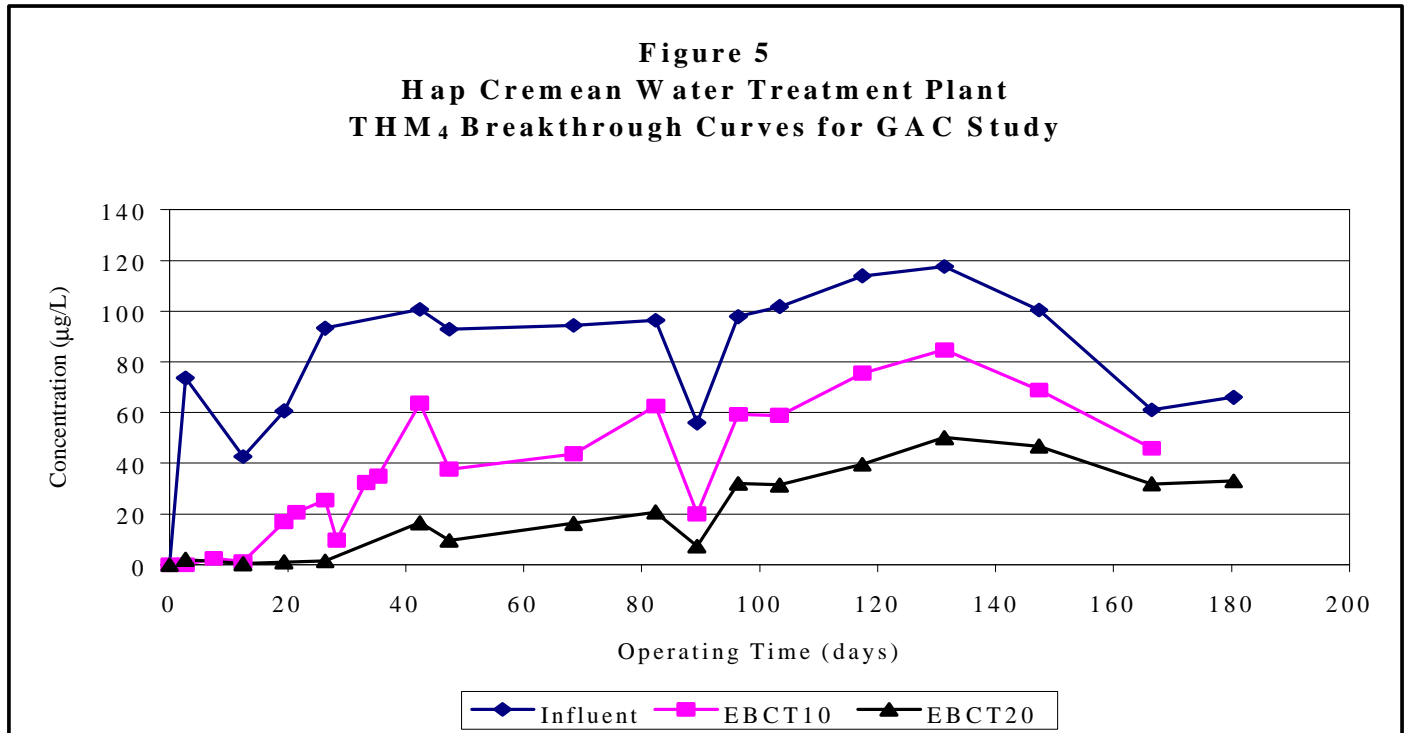
## 2. SDS Breakthrough curves analysis

Figure 5: THM<sub>4</sub> concentration as a function of operating time

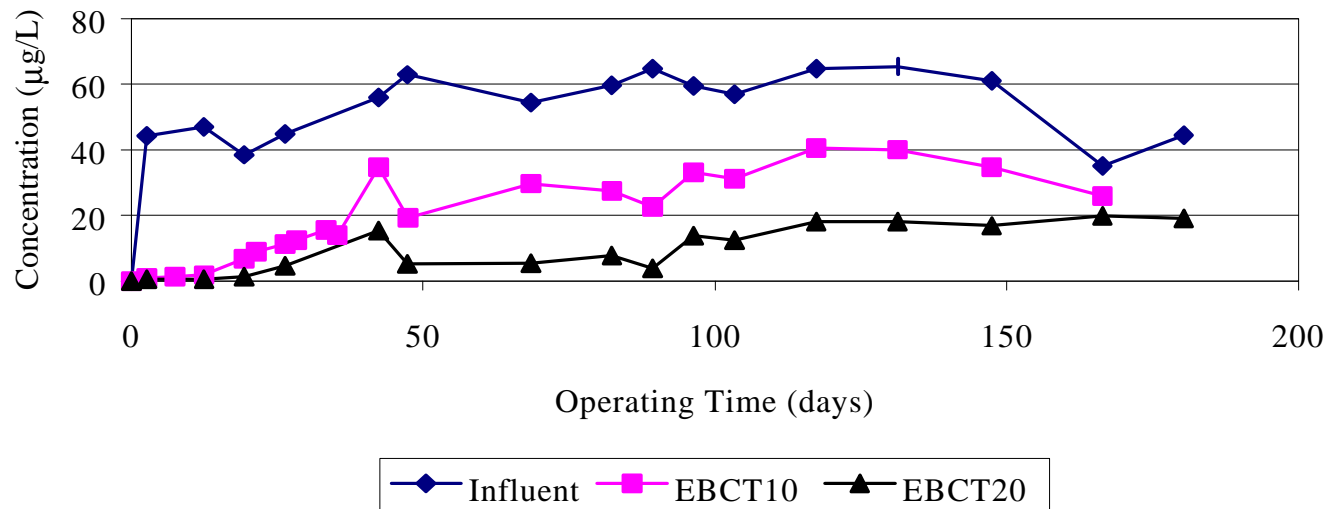
Figure 6: HAA<sub>5</sub> concentration as a function of operating time

Figure 7: HAA<sub>6</sub> concentration as a function of operating time

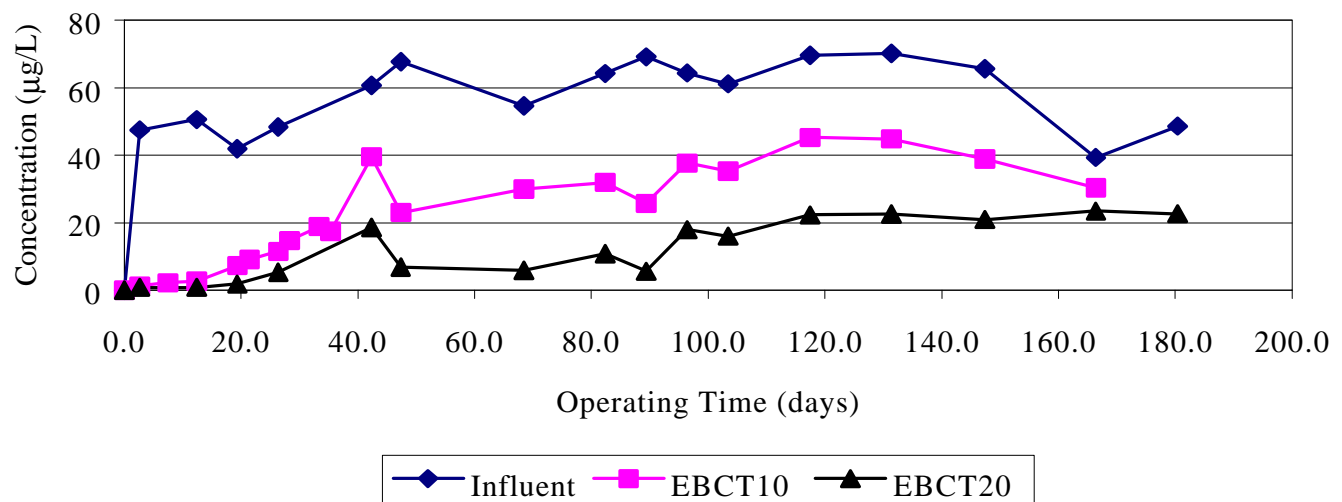
Figure 8: TOX concentration as a function of operating time



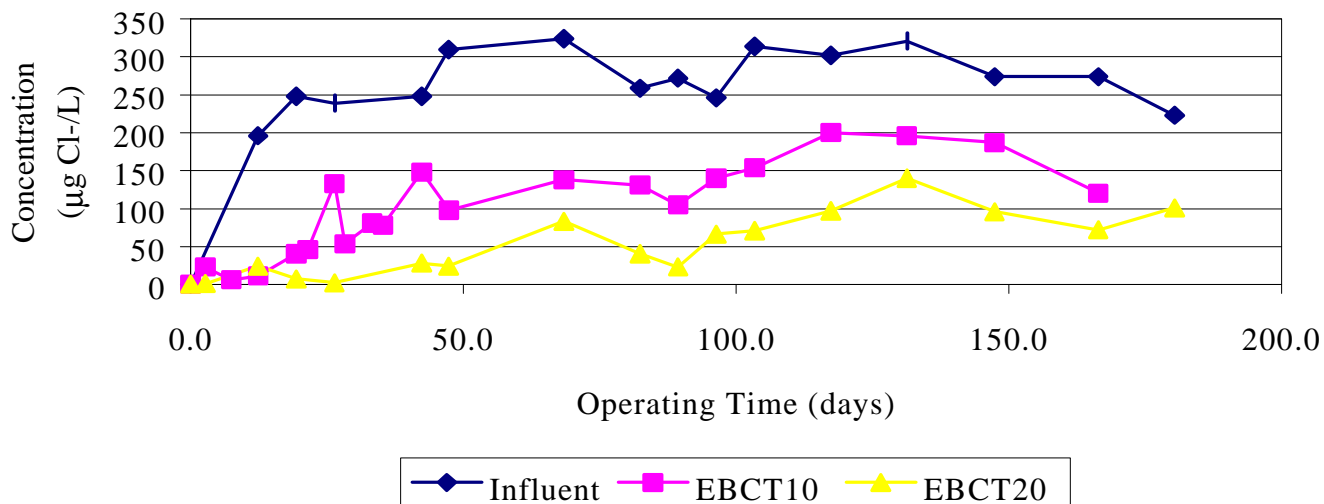
**Figure 6**  
**Hap Cremean Water Treatment Plant**  
**HAA<sub>5</sub> Breakthrough Curves for GAC Study**



**Figure 7**  
**Hap Cremean Water Treatment Plant**  
**HAA<sub>6</sub> Breakthrough Curves for GAC Study**



**Figure 8**  
**Hap Cremean Water Treatment Plant**  
**TOX Curves for GAC Study**



#### D. Summary of Significant Results

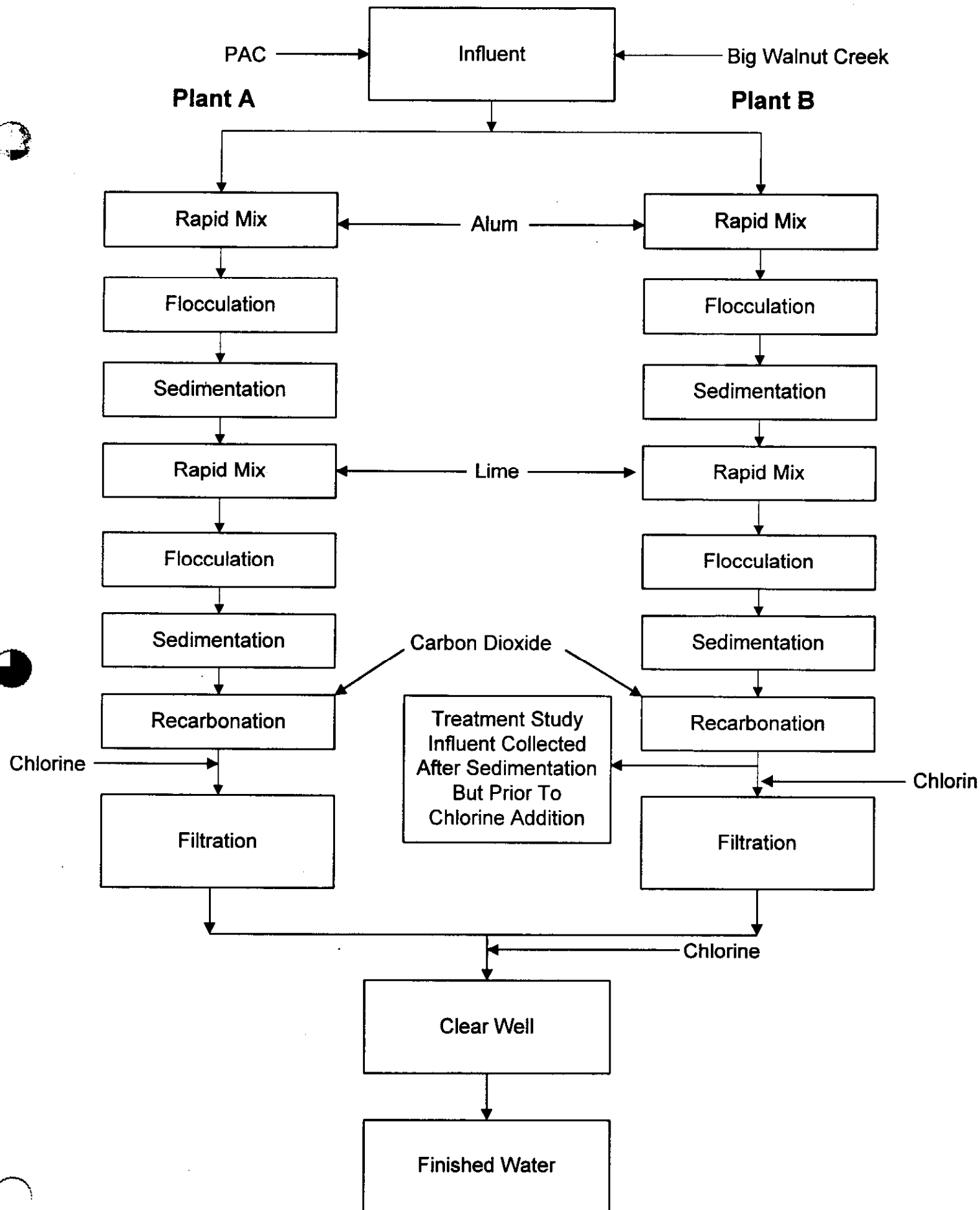
- Sustained THM<sub>4</sub> breakthrough to > 80 % of the Second Stage Placeholders was at a runtime of about 800 hours for the EBCT<sub>10</sub> column; HAA<sub>5</sub> and HAA<sub>6</sub> breakthroughs were longer.
- Sustained THM<sub>4</sub> breakthrough to > 80 % of the Second Stage Placeholders was at a runtime of between 2400 and 4000 hours for the EBCT<sub>20</sub> column; HAA<sub>5</sub> and HAA<sub>6</sub> breakthroughs did not occur.

#### V. QA/QC Summary

All QA/QC procedures and requirements were followed as described in the *DBP/ICR Analytical Methods Manual*. All of the data collected was used to generate the graphs, even if it was measured below the stated MRL. In the Data Collection Spreadsheets these samples were marked BMRL.

The calibration procedures used during the study are consistent with those outlined in the *DBP/ICR Analytical Methods Manual*. Appendix A contains a listing of the procedures and calibration curves used by the laboratory during this study.

## **Appendix A**



**Figure 1: Hap Cremean Water Treatment Plant  
Full Scale Treatment Plant Schematic**

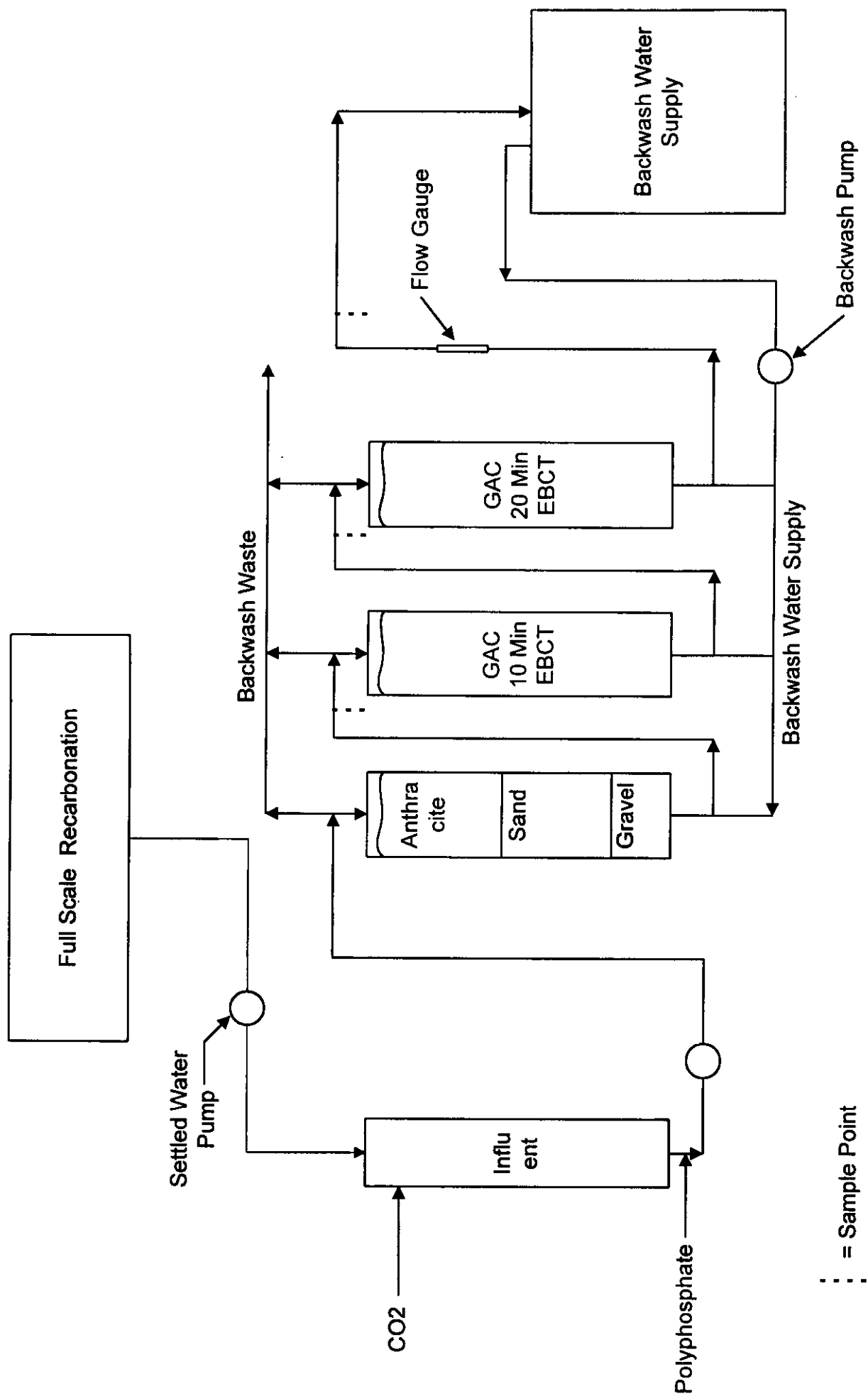


Figure 2 - Schematic of Pilot-Scale GAC Testing System



# G.1 -- Final Design Plant Parameters

Date: 4/27/99

PWS Name: City of Columbus, Dept. Public Utilities

PWS ID: OH2500411

WIDB:

ICR Contact Person: Dr. Kenneth S. Button

Sampling Period: Final

Design Sampling Start Date: 7/7/97

Design Sampling End Date: 12/31/98

Treatment Plant Name: Hap Cremean Water Plant

ICR Treatment Plant ID: 527

Treatment Plant PWS ID: OH2500421

Treatment Plant Type: CS/SOFT

State Approved Plant Capacity (MGD): 100

Historical Min. Water Temperature (deg C): 0.1

Installed Sludge Handling Capacity (GPD): 1,500,000.00

Blending Indicator: N

Water Resource Name: Hoover Reservoir

Water Resource Type: Reservoir/lake

Average Residence Time (Days): 177

Intake Name: Big Walnut Creek

Watershed Control: N

Hydrologic Unit Code:

River Reach:

Latitude (degrees, minutes, seconds): +40°3'43"

Longitude (degrees, minutes, seconds): -82°53'21"

River Reach Miles:

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

INF

1

Process Train Name: Hap Cremean Process Train

Process Train Category: CS/SOFT

1 HC WW Return

Washwater Return

7

Washwater Treated: N

Seq. Sample  
No. Location  
Name

Sample  
Location  
Type

Sample  
Loc.  
No.

Coagulation/Sedimentation: N

Filtration: N

Disinfectant Addition: N

Plain Sedimentation: N

Other Treatment:

24 hr average Water flow Returned (MGD): 25.12

2 Rapid Mix

Rapid Mix

Type of Mixer: ME

Baffling Type: UN

Liquid Volume (gal): 26,611

Short Circuiting Factor: 0.0

Mean Velocity Gradient (sec-1): 30.0

3 Flocculation

Flocculation Basin

Type of Mixer: ME

Liquid Volume (gal): 1,500,000

Short Circuiting Factor:

Baffling Type: PR

Stage Sequence Number: 1

Stage Mean Velocity Gradient (sec-1): 30

Stage Liquid Volume (gal): 750,000

4 Sedimentation-2

Sedimentation

Surface Area (ft<sup>2</sup>): 41,064

Liquid Volume (gal): 4,600,000

Baffling Type: PR

Short Circuiting Factor:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Plate Settler Surface Area (ft<sup>2</sup>):  
 Plate Settler Brand Name:  
 Tube Settler Surface Area (ft<sup>2</sup>):  
 Tube Settler Brand Name:

Type of Mixer: ME  
 Liquid Volume (gal): 1,500,000  
 Short Circuiting Factor: 0.0  
 Baffling Type: PR

Stage Sequence Number: 1  
 Stage Mean Velocity Gradient (sec-1): 30  
 Stage Liquid Volume (gal): 1,500,000

Surface Area (ft<sup>2</sup>): 69,600  
 Liquid Volume (gal): 7,809,120  
 Baffling Type: PR  
 Short Circuiting Factor:  
 Plate Settler Surface Area (ft<sup>2</sup>):  
 Plate Settler Brand Name:  
 Tube Settler Surface Area (ft<sup>2</sup>):  
 Tube Settler Brand Name:

Surface Area (ft<sup>2</sup>): 34,800  
 Liquid Volume (gal): 3,900,000  
 Baffling Type: PR

5 Flocculation

6 Sediment-5,6

7 HC Recarbon-7

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.	
8	Inter Chlorine	Disinfectant Addition		Short Circuiting Factor: 0.0
				Chemical Code: CL2
				Measurement Formula: cl2
				Dose Rate (mg/L): 2.33
9	Filtration	Filtration	4	Surface Area (ft2): 16,920
				Liquid Volume (gal): 621,417
				Total Media Depth (in): 42
				Depth of GAC (in):
				Media Type: DUAL
				Type of Activated Carbon:
				Minimum Water Depth To Top of Media (ft): 4.5
				Depth From Top of Media to Top of Backwash Trough (ft): 2.7
10	Post Chlorine	Disinfectant Addition		Chemical Code: CL2
				Measurement Formula: cl2
				Dose Rate (mg/L): 1.17
11	Clearwells, 1-6	Clearwell		Surface Area (ft2): 309,072
				Liquid Volume (gal): 40,920,000
				Minimum Liquid Volume (gal): 18,495,000
				Baffling Type: AV
				Short Circuiting Factor:
				Covered Indicator Code: N

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Finished Water	FIN	5
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Treatment Plant Name: Dublin Road Water Plant  
ICR Treatment Plant ID: 528  
Treatment Plant PWS ID: OH2500411  
Treatment Plant Type: CS/SOFT

State Approved Plant Capacity (MGD): 65  
Historical Min. Water Temperature (deg C): 0.5  
Installed Sludge Handling Capacity (GPD): 3,168,000.00  
Blending Indicator: N

Water Resource Name: Scioto River  
Water Resource Type: Flowing stream  
Intake Name: Scioto River Intake Structure  
Watershed Control: N  
Hydrologic Unit Code: 0506001

On River Reach Code:  
Latitude (degrees, minutes, seconds): +39°58'5"  
Longitude (degrees, minutes, seconds): -83°2'5"  
River Reach Miles:

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Influent	INF	1
Process Train Name:	Dublin Road Process Train	
Process Train Category:	CS/SOFT	
1 DR WW Return	Washwater Return	7
	Washwater Treated: N	
	Coagulation/Sedimentation: N	
	Filtration: N	
	Disinfectant Addition: N	
	Plain Sedimentation: N	
	Other Treatment:	
	24 hr average Water flow Returned (MGD): 0.42	

2 Rapid Mix-RAW	Rapid Mix	
	Type of Mixer: ME	
	Baffling Type: UN	
	Liquid Volume (gal): 1,197	

Seq. No. Sample Location Name

Sample Location Type

Sample Loc. No.

Short Circuiting Factor: 0.0  
Mean Velocity Gradient (sec-1): 1,200.0

3 COAG

Flocculation Basin

Type of Mixer: ME

Liquid Volume (gal): 2,000,000

Short Circuiting Factor:

Baffling Type: AV

Stage Sequence Number: 1

Stage Mean Velocity Gradient (sec-1): 70

Stage Liquid Volume (gal): 2,000,000

4 Coagulated

Sedimentation

Surface Area (ft2): 44,415

Liquid Volume (gal): 5,000,000

Baffling Type: PR

Short Circuiting Factor:

Plate Settler Surface Area (ft2):

Plate Settler Brand Name:

Tube Settler Surface Area (ft2):

Tube Settler Brand Name:

5 Rapid Mix-SOFT

Rapid Mix

Type of Mixer: ME

Baffling Type: UN

Liquid Volume (gal): 6,754

Short Circuiting Factor: 0.0

Mean Velocity Gradient (sec-1): 714.0

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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6	SOFT	Flocculation Basin	Type of Mixer: ME Liquid Volume (gal): 2,000,000 Short Circuiting Factor: 0.0 Baffling Type: AV  Stage Sequence Number: 1 Stage Mean Velocity Gradient (sec-1): 70 Stage Liquid Volume (gal): 2,000,000  Surface Area (ft2): 88,830 Liquid Volume (gal): 10,000,000 Baffling Type: PR Short Circuiting Factor: Plate Settler Surface Area (ft2): Plate Settler Brand Name: Tube Settler Surface Area (ft2): Tube Settler Brand Name:
7	Softened	Sedimentation	
8	DR Recarbon	Recarbonation Basin	3 Surface Area (ft2): 44,415 Liquid Volume (gal): 5,000,000 Baffling Type: AV Short Circuiting Factor: 0.0
9	Chlorine gas 1	Disinfectant Addition	Chemical Code: CL2 Measurement Formula: cl2



Treatment Plant Name: Parsons Avenue Water Plant  
ICR Treatment Plant ID: 529  
Treatment Plant PWS ID: OH2500442  
Treatment Plant Type: SPLIT/SOFT

State Approved Plant Capacity (MGD): 50  
Historical Min. Water Temperature (deg C): 12.0  
Installed Sludge Handling Capacity (GPD): 4,320,000.00  
Blending Indicator: N

Water Resource Name: South Wellfield 4  
Water Resource Type: Ground water  
Intake Name: Collector Well 115  
Wellhead Protection: Y

Hydrologic Unit Code:  
Latitude (degrees, minutes, seconds): +39°50'30"  
Longitude (degrees, minutes, seconds): -82°59'1"

Water Resource Name: South Wellfield 3  
Water Resource Type: Ground water  
Intake Name: Collector Well 104  
Wellhead Protection: Y

Hydrologic Unit Code:  
Latitude (degrees, minutes, seconds): +39°50'23"  
Longitude (degrees, minutes, seconds): -83°0'32"

Water Resource Name: South Wellfield 2  
Water Resource Type: Ground water  
Intake Name: Collector Well 103  
Wellhead Protection: Y

Hydrologic Unit Code:  
Latitude (degrees, minutes, seconds): +39°50'46"  
Longitude (degrees, minutes, seconds): -83°0'31"

Water Resource Name: South Wellfield 1  
Water Resource Type: Ground water  
Intake Name: Collector Well 101  
Wellhead Protection: Y

Hydrologic Unit Code:  
Latitude (degrees, minutes, seconds): +39°51'11"  
Longitude (degrees, minutes, seconds): -83°0'16"

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Influent	INF		1
Process Train Name: Parsons Avenue Process Train			
Process Train Category: SOFT			
1	PA WW Return	Washwater Return	8
			Washwater Treated: N
			Coagulation/Sedimentation: N
			Filtration: N
			Disinfectant Addition: N
			Plain Sedimentation: N
			Other Treatment:
			24 hr average Water flow Returned (MGD): 0.4
2	Rapid Mix	Rapid Mix	
			Type of Mixer: ME
			Baffling Type: PR
			Liquid Volume (gal): 25,700
			Short Circuiting Factor:
			Mean Velocity Gradient (sec-1): 350.0
3	Primary	Solids Contact Clarifier	
			Clarifier Type: Not specified
			Brand Name: Peabody-Wells
			Surface Area (ft <sup>2</sup> ): 16,238
			Liquid Volume (gal): 2,451,000
			Short Circuiting Factor:
			Baffling Type: UN
			Plate Settler Surface Area (ft <sup>2</sup> ):
			Tube Settler Surface Area (ft <sup>2</sup> ):

Seq. No. Sample Location Name

Sample Location Type

Sample Loc. No.

4 Secondary

Solids Contact Clarifier

Plate Settler Brand Name:  
Tube Settler Brand Name:

Clarifier Type: Not specified  
Brand Name: Peabody Wells  
Surface Area (ft<sup>2</sup>): 16,238  
Liquid Volume (gal): 2,451,000  
Short Circuiting Factor:  
Baffling Type: UN  
Plate Settler Surface Area (ft<sup>2</sup>):  
Tube Settler Surface Area (ft<sup>2</sup>):  
Plate Settler Brand Name:  
Tube Settler Brand Name:

5 CO2 Feed

Other Treatment Process

7

Surface Area (ft<sup>2</sup>): 300  
Liquid Volume (gal): 31,236  
Short Circuiting Factor:

6 Chlorine gas

Disinfectant Addition

Chemical Code: CL2  
Measurement Formula: cl2  
Dose Rate (mg/L): 1.45

7 Filtration

Filtration

4

Surface Area (ft<sup>2</sup>): 6,564  
Liquid Volume (gal): 736,000  
Total Media Depth (in): 36  
Depth of GAC (in):

Seq. Sample  
No. Location  
Name

Sample  
Location  
Type

Sample  
Loc.  
No.

Media Type: DUAL  
Type of Activated Carbon:  
Minimum Water Depth To Top of Media (ft): 2.3  
Depth From Top of Media to Top of Backwash Trough (ft): 3.3

8 Chlorine gas Disinfectant Addition

Chemical Code: CL2  
Measurement Formula: cl2  
Dose Rate (mg/L): 0.84

9 Main Clearwell Clearwell

Surface Area (ft2): 112,500  
Liquid Volume (gal): 12,400,000  
Minimum Liquid Volume (gal): 6,000,000  
Baffling Type: PR  
Short Circuiting Factor:  
Covered Indicator Code: Y

Process Train Name: Bypass

Process Train Category: CONV

1 Secondary t2

Solids Contact Clarifier

Clarifier Type: Not specified  
Brand Name: Peabody Wells  
Surface Area (ft2): 16,238  
Liquid Volume (gal): 2,451,000  
Short Circuiting Factor:  
Baffling Type: UN  
Plate Settler Surface Area (ft2):  
Tube Settler Surface Area (ft2):

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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2	CO2 Feed t2	Other Treatment Process	Plate Settler Brand Name: Tube Settler Brand Name: Surface Area (ft2): 300 Liquid Volume (gal): 31,236 Short Circuiting Factor: Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 1.45
3	Chlorine gas t2	Disinfectant Addition	Surface Area (ft2): 8,752 Liquid Volume (gal): 736,000 Total Media Depth (in): 36 Depth of GAC (in): Media Type: DUAL Type of Activated Carbon: Minimum Water Depth To Top of Media (ft): 2.3 Depth From Top of Media to Top of Backwash Trough (ft): 3.3
4	Filtration t2	Filtration	Chemical Code: CL2 Measurement Formula: cl2 Dose Rate (mg/L): 0.84
5	Chlorine gas t3	Disinfectant Addition	Surface Area (ft2): 112,500 Liquid Volume (gal): 12,400,000
6	Main Clearwell t2	Clearwell	

Seq. No.	Sample Location Name	Sample Location Type	Sample Loc. No.
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Minimum Liquid Volume (gal): 6,000,000  
 Baffling Type: PR  
 Short Circuiting Factor:  
 Covered Indicator Code: Y

Finished Water	FIN	5
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End of Report G.1 -- Final Design Plant Parameters

# G.2 -- Final Design Plant Chemical Parameters

Date: 10/28/99

PWS Name: City of Columbus, Dept. Public Utilities

PWS ID: OH2500411

WIDB:

ICR Contact Person: Dr. Kenneth S. Button

Sampling Period: Final

Sampling Start Date: 7/7/97

Sampling End Date: 12/31/98

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Hap Cremean Water Plant

ICR Treatment Plant ID No: 527

Treatment Plant Category: CS/SOFT

Process Train Name: Hap Cremean Process Train

Process Train Category: CS/SOFT

1	HC WW Return	Washwater Return	7	Ferric chloride	fec13	0.00
2	Rapid Mix	Rapid Mix		Potassium permanganate	ppm	0.00
				Powdered activated carbon	pac	0.00
				Aluminum sulfate (Alum)	Al2(so4)3	42.00
3	Flocculation	Flocculation Basin				
4	Sedimentation-2	Sedimentation				
5	Flocculation	Flocculation Basin				
6	Sediment-5,6	Sedimentation				
7	HC Recarbon-7	Recarbonation Basin	3	Carbon dioxide	co2	17.00
				Calcium hydroxide	caoh	81.00

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
8	Inter Chlorine	Disinfectant Addition				
9	Filtration	Filtration	4	Chlorine gas	cl2	2.33
10	Post Chlorine	Disinfectant Addition				
11	Clearwells, 1-6	Clearwell		Chlorine gas	cl2	1.17
				Zinc orthophosphate	Zn	0.30
				Hydrofluorosilicic acid	F	0.90



Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Dublin Road Water Plant

ICR Treatment Plant ID No: 528

Treatment Plant Category: CS/SOFT

Process Train Name: Dublin Road Process Train

Process Train Category: CS/SOFT

1	DR WW Return	Washwater Return	7			
2	Rapid Mix-RAW	Rapid Mix		Ferric chloride	fecl3	59.20
				Aluminum sulfate (Alum)	Al2(so4)3	0.00
				Calcium oxide	CAO	0.00
				Sodium hydroxide	naoh	0.00
				Sodium carbonate	Na2(CO3)	0.00
				Potassium permanganate	ppm	0.50
				Powdered activated carbon	pac	0.00
3	COAG	Flocculation Basin				
4	Coagulated	Sedimentation				
5	Rapid Mix-SOFT	Rapid Mix		Ferric chloride	fecl3	226.58
				Calcium oxide	CAO	18.70
				Aluminum sulfate (Alum)	Al2(so4)3	0.00
				Powdered activated carbon	pac	97.20
				Sodium carbonate	Na2(CO3)	0.00
				Calcium hydroxide	caoh	0.00
				Sodium hydroxide	naoh	0.00
6	SOFT	Flocculation Basin				
7	Softened	Sedimentation				

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
8	DR Recarbon	Recarbonation Basin	3	Carbon dioxide	co2	43.67
9	Chlorine gas 1	Disinfectant Addition	4	Chlorine gas	cl2	2.29
10	Filtration	Filtration		Hydrofluorosilic acid	F	0.61
11	Chlorine gas 2	Disinfectant Addition		Chlorine gas	cl2	0.98
12	Dublin Rd WP	Clearwell		Zinc orthophosphate	Zn	0.31

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
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Treatment Plant Name: Parsons Avenue Water Plant  
 ICR Treatment Plant ID No: 529  
 Treatment Plant Category: SPLIT/SOFT

Process Train Name: Parsons Avenue Process Train  
 Process Train Category: SOFT

1	PA WW Return	Washwater Return	8			
2	Rapid Mix	Rapid Mix				
3	Primary	Solids Contact Clarifier		Sodium carbonate	Na2(CO3)	89.00
4	Secondary	Solids Contact Clarifier		Sodium hydroxide	naoh	0.00
				Calcium hydroxide	caoh	278.00
5	CO2 Feed	Other Treatment Process	7			
6	Chlorine gas	Disinfectant Addition		Carbon dioxide	co2	2.90
7	Filtration	Filtration	4	Chlorine gas	cl2	1.45
8	Chlorine gas	Disinfectant Addition				
9	Main Clearwell	Clearwell		Chlorine gas	cl2	0.84
				Hydrofluorosilic acid	F	0.80
				Zinc orthophosphate	Zn	0.29

Process Train Name: Bypass  
 Process Train Category: CONV

1	Secondary t2	Solids Contact Clarifier				
2	CO2 Feed t2	Other Treatment Process				

Seq. No.	Sample Location Name	Sample Location Type	Sample Location Number	Chemical Name	Measurement Formula	Dose (mg/L)
3	Chlorine gas t2	Disinfectant Addition		Carbon dioxide	co2	2.90
4	Filtration t2	Filtration		Chlorine gas	cl2	1.45
5	Chlorine gas t3	Disinfectant Addition				
6	Main Clearwell t2	Clearwell		Chlorine gas	cl2	0.84
				Hydrofluorosilic acid	F	0.80
				Zinc orthophosphate	Zn	0.29

End of Report G.2 -- Final Design Plant Chemical Parameters

*Cost Parameters  
Eval of*

October 29, 1999

Mr. Steve Allgeier  
ICR Treatment Study Coordinator  
US EPA Office of Ground Water and Drinking Water  
26 W. MLK Drive  
Cincinnati, Ohio 45268

Re: City of Columbus ICR Treatability Study – Hap Cremean Water Treatment Plant

Dear Mr. Allgeier:

This letter is in response to the preliminary review of the ICR Treatment Study Data Collection Spreadsheet and the ICR Treatment Study Summary Report Spreadsheet conducted by the EPA. We have reviewed the comments and addressed them as follows:

**ICR Treatment Study Summary Report Spreadsheet**

File Name: 1009-527\_srss.xls

Full-Scale Water Quality (FS WQ) Data Sheet:

- SUVA data from the ICR monitoring database was collected and inserted into the spreadsheet.
- Bromide values were changed to  $\mu\text{g/L}$ . ✓
- Temperature data from the ICR monitoring database was collected and inserted into the spreadsheet. ✓
- HAA<sub>6</sub> data from the ICR monitoring database was collected and inserted into the spreadsheet. ?

QA and QC Data Sheet 1:

- MRLs for Alkalinity, Ammonia, Calcium Hardness, SDS-Cl<sub>2</sub> Residual, Total Hardness, and Turbidity have been reported. ✓
- Bromide values were changed to  $\mu\text{g/L}$ . ✓
- MRL for TOC was changed to 0.5 mg/L ✓
- MRL for TOX was changed to 25 mg Cl-/L ✓
- MRL for CHCL<sub>3</sub> was changed to 1.0  $\mu\text{g/L}$  ✓

Check on QC Analyses:

- Verified for all RPE QC results that only results above MRL have been reported in the summary statistics
- UV RPE values verified as entered in spreadsheet. The count was misreported and has been corrected.
- The count was misreported and has been corrected.
- The count was misreported and has been corrected.
- CHBr<sub>3</sub> RPE values verified as entered in spreadsheet.

**ICR Treatment Study Data Collection Spreadsheet**

File Name: 1009-528\_dcsc.xls

I. Missing Data

- NA has been entered in all blank fields
- Cover page has been corrected with the correct plant ID number
- Pretreatment processes have been matched between the DCSS and the summary report
- BMRL has been entered for any results below the minimum reporting level
- "Y" or "N" has been reported in the "Sample Duplicate ?" column for all of the samples.
- The 3<sup>rd</sup> duplicate was inadvertently missed.
- Data or NA has been entered into all of the cells for Field 1-4
- Data or NA has been entered into all of the cells for Field 1-5
- Data or NA has been entered into all of the cells for Field 1-6
- NA has been placed in the cell for the fuel oil rate because the plant does not use fuel oil

II. Corrections/Errors

- The entry in cell E16 has been corrected
- TOX results in cells BW46-7 were verified as entered in spreadsheet
- TOC and UV results in cells BN50 and BO51 were ~~verified as entered in the spreadsheet~~ *corrected*
- TOC results were verified as entered in spreadsheet

III. QA/QC Information

- Records indicate that the plant pump providing water to the pilot-plant failed on day 89, so the entire sample will be reported as NR
- The TOC and UV spike in the 10-minute column are due to a recarbonation failure in the pilot-plant resulting in a very high influent pH
- The pilot-plant was not operated to 70% breakthrough because it had reached steady-state removal.
- Operation records show no operational problems during the time period the spike early in the 10-minute EBCT CHCl<sub>3</sub> occurred.

Every effort has been made to address the comments on the ICR Treatment Study Data Collection Spreadsheet and the ICR Treatment Study Summary Report Spreadsheet as completely and accurately as possible. If you have any questions regarding the above information please call me at (614) 430-2639.

Very truly yours,

MALCOLM PIRNIE, INC.

*Kristin D. Knight*

Kristin Knight  
Engineer

ksk

0228-713