

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1063
Study Protocol	GAC bench-scale treatment study
Plant ICR Number	455
PWS Name	City of Lincoln Water System
City, State, Zip	Lincoln, NE 68503

These are general comments that do not need to be responded to directly.

Major comments:

1. The source water for this treatment study is a groundwater under the direct influence of a surface water. This study was performed in addition to a treatment study that evaluated four GACs based on West plant pretreatment (1061). This study utilized water pretreated by the East plant. Note that only two quarters of testing (two RSSCTs during each quarter) are included in this treatment study. The same SDS chlorination conditions were utilized during all runs.
2. All RSSCTs were designed based on literature values of the GAC dry bed density to yield full-scale EBCTs of 10 and 20 minutes. The measured dry bed density was used to determine the reported full-scale EBCTs. These values ranged from 84 to 98 percent of the target EBCTs. Table III-4 in the Summary Report summarizes the actual EBCTs obtained during the study.

General Comments:

1. Quarter 1: Breakthrough of SDS-DCAA was relatively early, and a peak curve occurred for both EBCT runs.
2. Note that the average GAC influent bromide concentration during the two runs differed by 44 percent (75 and 117 µg/L). The GAC influent TOC concentrations were very similar for both runs. The change in the bromide to TOC ratio in both the GAC influent and effluent may impact DBP speciation, making it more difficult to directly compare the results of the two runs, which evaluated two GAC types.
3. This study also evaluated the breakthrough of the herbicides atrazine, diethylatrazine, and di-isopropylatrazine. Results are summarized in Table IV-3 of the Summary Report. Although

GAC influent levels were measured above detection limits, all GAC effluent concentrations were below detection limits. Both runs were evaluated. The runs were monitored for herbicides until the run was completed based on TOC breakthrough.

4. Missing GAC Cost Parameters include: Special Sitework Factor and Labor Overhead Factor. Utility was unable to provide this data. With regard to Modifications to Existing Plant, EPA Treatment Studies Coordinator estimated a value based on discussions with the utility.

Outlier Data:

No outliers were removed.

Cell: A1

Comment: 1063-SAS.xls 2/17/00 13:48

All curve fits reviewed and approved. See below for log of refit datasets.

Cell: C2

Comment: 1063-084-01 - Run 1 (BCAA) 2/17/00 11:46
Original value (CoefA0) = 0.1204 New value = -0.9874
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D2

Comment: 1063-084-01 - Run 1 (BCAA) 2/17/00 11:46
Original value (CoefAf) = 3.8164 New value = 17.9041
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E2

Comment: 1063-084-01 - Run 1 (BCAA) 2/17/00 11:46
Original value (CoefB) = 31.2752 New value = 30.7108
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F2

Comment: 1063-084-01 - Run 1 (BCAA) 2/17/00 11:46
Original value (CoefD) = 0.1871 New value = 0.1028
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J2

Comment: 1063-084-01 - Run 1 (BCAA) 2/17/00 11:46
Original value (S) = -0.0437 New value = -0.0787
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C6

Comment: 1063-084-01 - Run 1 (CHCl3) 2/17/00 11:43
Original value (CoefA0) = 0 New value = -0.0534
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: D6

Comment: 1063-084-01 - Run 1 (CHCl3) 2/17/00 11:43
Original value (CoefAf) = 0 New value = 1.5854
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: E6

Comment: 1063-084-01 - Run 1 (CHCl3) 2/17/00 11:43
Original value (CoefB) = 0 New value = 2008.2559
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: F6

Comment: 1063-084-01 - Run 1 (CHCl3) 2/17/00 11:43
Original value (CoefD) = 0 New value = 0.2415
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: J6

Comment: 1063-084-01 - Run 1 (CHCl3) 2/17/00 11:43
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: C8

Comment: 1063-084-01 - Run 1 (DBAA) 2/17/00 11:49
Original value (CoefA0) = -0.473 New value = -1.8478
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D8

Comment: 1063-084-01 - Run 1 (DBAA) 2/17/00 11:49
Original value (CoefAf) = 4.7568 New value = 7.3667
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E8

Comment: 1063-084-01 - Run 1 (DBAA) 2/17/00 11:49
Original value (CoefB) = 5.7695 New value = 3.2633
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F8

Comment: 1063-084-01 - Run 1 (DBAA) 2/17/00 11:49
Original value (CoefD) = 0.0847 New value = 0.0635
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J8

Comment: 1063-084-01 - Run 1 (DBAA) 2/17/00 11:49
Original value (S) = 0 New value = -0.0444
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C10

Comment: 1063-084-01 - Run 1 (DCAA) 2/17/00 11:45
Original value (CoefA0) = 0.1289 New value = -0.0774
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D10

Comment: 1063-084-01 - Run 1 (DCAA) 2/17/00 11:45
Original value (CoefAf) = 2.0868 New value = 3.1453
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E10

Comment: 1063-084-01 - Run 1 (DCAA) 2/17/00 11:45
Original value (CoefB) = 12.1908 New value = 328.1658
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F10

Comment: 1063-084-01 - Run 1 (DCAA) 2/17/00 11:45
Original value (CoefD) = 0.1771 New value = 0.5177
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J10

Comment: 1063-084-01 - Run 1 (DCAA) 2/17/00 11:45
Original value (S) = -0.0322 New value = -0.0627
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C13

Comment: 1063-084-01 - Run 1 (HAA6) 2/17/00 11:51
Original value (CoefA0) = 0.1947 New value = -0.946
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D13

Comment: 1063-084-01 - Run 1 (HAA6) 2/17/00 11:51
Original value (CoefAf) = 9.0065 New value = 12.0821
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E13

Comment: 1063-084-01 - Run 1 (HAA6) 2/17/00 11:51
Original value (CoefB) = 13.0787 New value = 22.0111
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F13

Comment: 1063-084-01 - Run 1 (HAA6) 2/17/00 11:51
Original value (CoefD) = 0.1773 New value = 0.2049
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J13

Comment: 1063-084-01 - Run 1 (HAA6) 2/17/00 11:51
Original value (S) = -0.0499 New value = -0.0891
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48
Original value (CoefA0) = 0 New value = 1.575
Fewer than 6 points above MRL. Step function applied.

Cell: D18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48

Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K18

Comment: 1063-084-01 - Run 1 (TCAA) 2/17/00 11:48
Original value (t0) = 0 New value = 51.3651
Fewer than 6 points above MRL. Step function applied.

Cell: C28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (CoefA0) = 0 New value = 1.35
Fewer than 6 points above MRL. Step function applied.

Cell: D28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K28

Comment: 1063-10-02 - Run 3 (CHCl3) 2/17/00 12:02
Original value (t0) = 0 New value = 121.128
Fewer than 6 points above MRL. Step function applied.

Cell: C90

Comment: 1063-167-01 - Run 2 (BCAA) 2/17/00 12:01
Original value (CoefA0) = 0.0127 New value = -0.8776
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D90

Comment: 1063-167-01 - Run 2 (BCAA) 2/17/00 12:01
Original value (CoefAf) = 2.83 New value = 51.6984
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E90

Comment: 1063-167-01 - Run 2 (BCAA) 2/17/00 12:01
Original value (CoefB) = 46.6739 New value = 119.1729

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F90

Comment: 1063-167-01 - Run 2 (BCAA) 2/17/00 12:01

Original value (CoefD) = 0.0953 New value = 0.0463

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J90

Comment: 1063-167-01 - Run 2 (BCAA) 2/17/00 12:01

Original value (S) = -0.0039 New value = -0.0123

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C94

Comment: 1063-167-01 - Run 2 (CHCl3) 2/17/00 11:52

Original value (CoefA0) = 0 New value = -0.1672

Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: D94

Comment: 1063-167-01 - Run 2 (CHCl3) 2/17/00 11:52

Original value (CoefAf) = 0 New value = 79.0638

Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: E94

Comment: 1063-167-01 - Run 2 (CHCl3) 2/17/00 11:52

Original value (CoefB) = 0 New value = 1953.7975

Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: F94

Comment: 1063-167-01 - Run 2 (CHCl3) 2/17/00 11:52

Original value (CoefD) = 0 New value = 0.0252

Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: J94

Comment: 1063-167-01 - Run 2 (CHCl3) 2/17/00 11:52

Original value (S) = 0 New value = 0

Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: C98

Comment: 1063-167-01 - Run 2 (DCAA) 2/17/00 11:59

Original value (CoefA0) = 0.0181 New value = -0.8084

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D98

Comment: 1063-167-01 - Run 2 (DCAA) 2/17/00 11:59

Original value (CoefAf) = 2.2155 New value = 149.5179

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E98

Comment: 1063-167-01 - Run 2 (DCAA) 2/17/00 12:00

Original value (CoefB) = 19.1367 New value = 333.6561

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F98

Comment: 1063-167-01 - Run 2 (DCAA) 2/17/00 12:00
Original value (CoefD) = 0.0761 New value = 0.0601
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J98

Comment: 1063-167-01 - Run 2 (DCAA) 2/17/00 12:00
Original value (S) = -0.0038 New value = -0.1086
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C112

Comment: 1063-20-02 - Run 4 (BCAA) 2/17/00 12:06
Original value (CoefA0) = 0 New value = -0.2365
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: D112

Comment: 1063-20-02 - Run 4 (BCAA) 2/17/00 12:06
Original value (CoefAf) = 0 New value = 2.8321
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: E112

Comment: 1063-20-02 - Run 4 (BCAA) 2/17/00 12:06
Original value (CoefB) = 0 New value = 38.7511
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: F112

Comment: 1063-20-02 - Run 4 (BCAA) 2/17/00 12:06
Original value (CoefD) = 0 New value = 0.0224
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: J112

Comment: 1063-20-02 - Run 4 (BCAA) 2/17/00 12:06
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: C116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (CoefA0) = 0 New value = 1.75
Fewer than 6 points above MRL. Step function applied.

Cell: D116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K116

Comment: 1063-20-02 - Run 4 (CHCl3) 2/17/00 12:03
Original value (t0) = 0 New value = 279.0756
Fewer than 6 points above MRL. Step function applied.

Cell: C120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (CoefA0) = 0 New value = 1.35
Fewer than 6 points above MRL. Step function applied.

Cell: D120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K120

Comment: 1063-20-02 - Run 4 (DCAA) 2/17/00 12:04
Original value (t0) = 0 New value = 279.0756
Fewer than 6 points above MRL. Step function applied.

ICR Information

ID / ICR#: NE3110926 / ICR455
 ICR Contact: Jerry Obrist
 Phone No.: (402)441-7571
 Period: 12/30/98 - 1/12/99 (13 B-S days)

Design Information

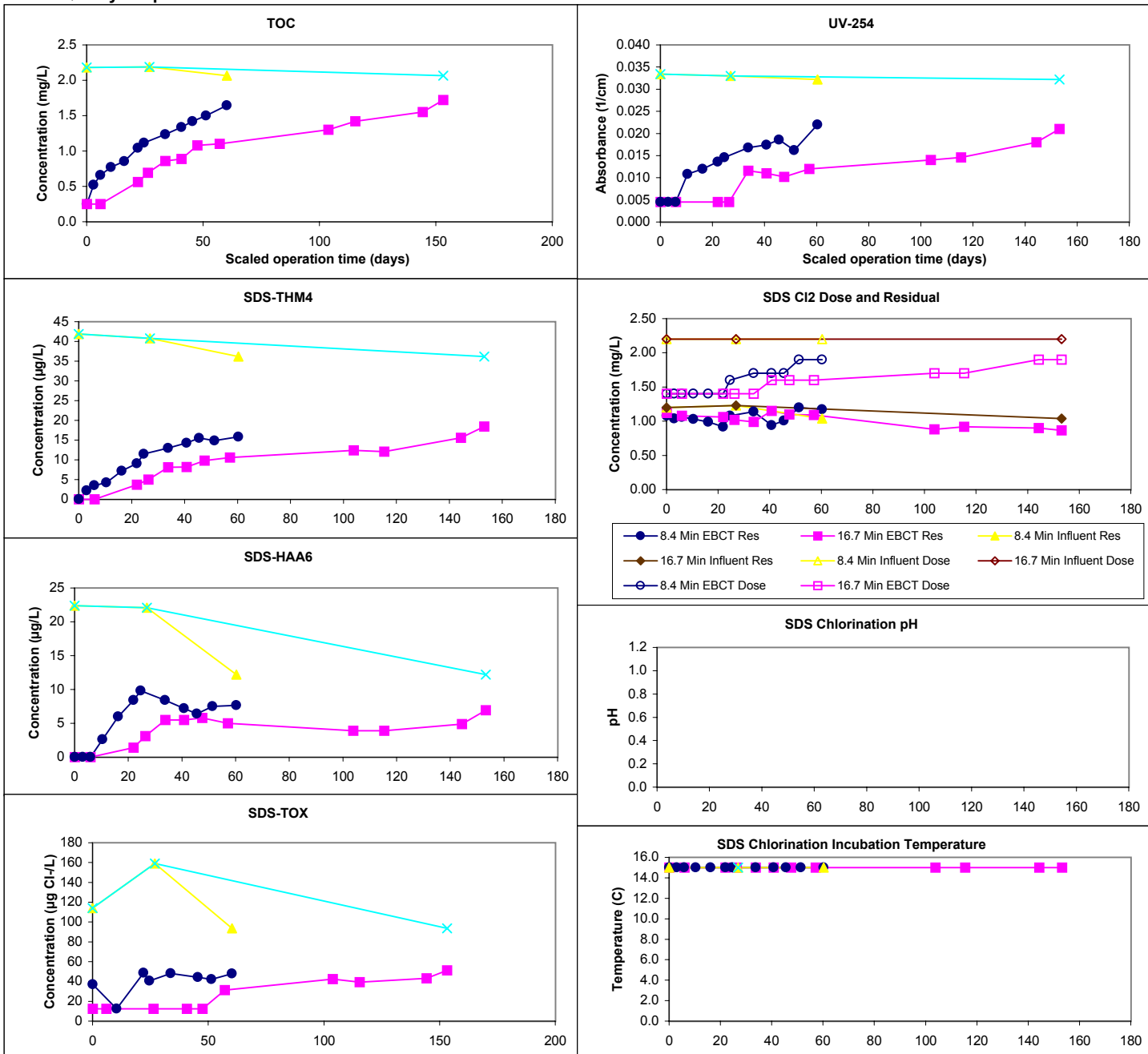
Design TOC: 2.0 mg/L
 Col Diameter: 11.0 mm
 Min Reynolds#: 0.48
 Full-Scale Temp: 13.6 C

Full-Scale GAC Size: 12x40 Bituminous
 Bench-Scale GAC Size: 140x200
 Scaling Factor: 11.63
 Meas Dry Bed Density: 0.54 g/cm3

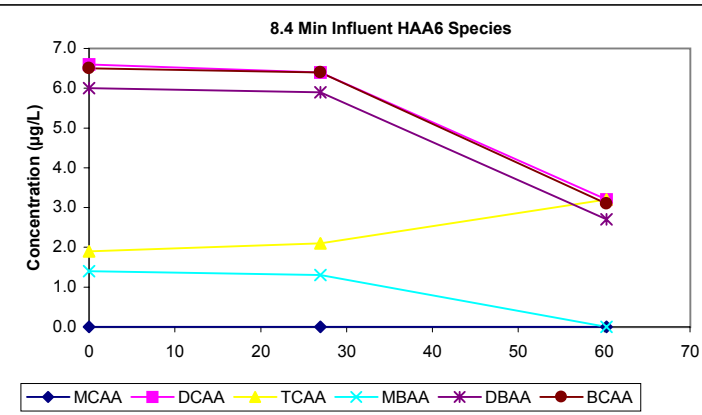
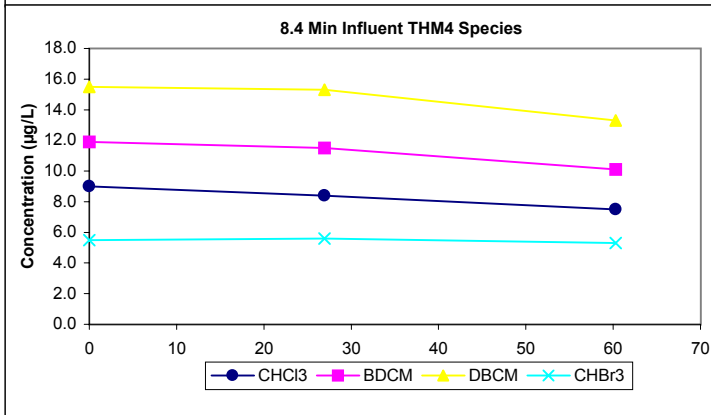
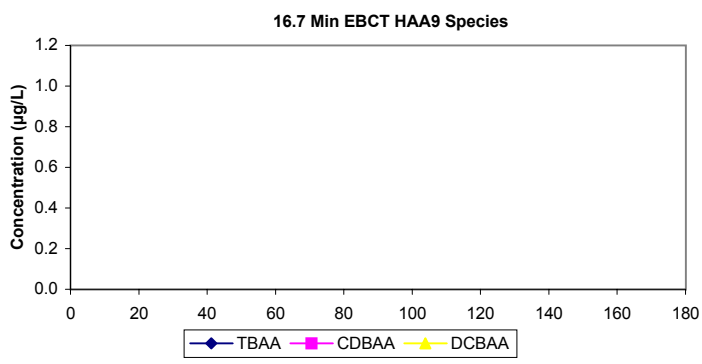
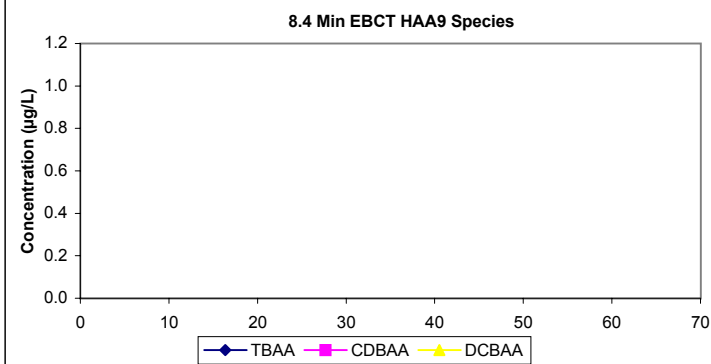
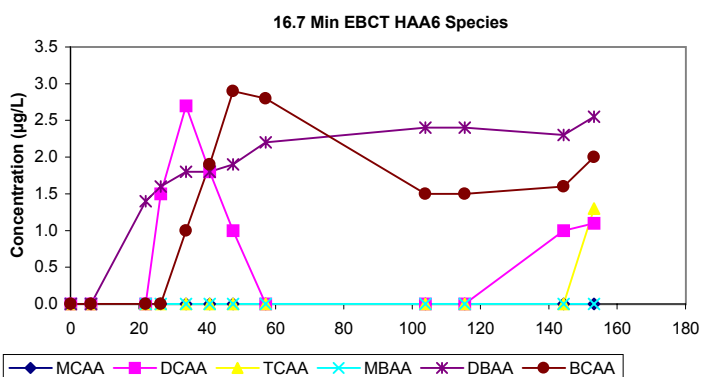
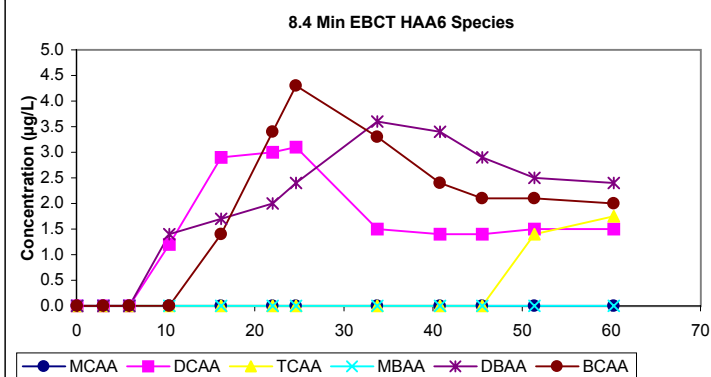
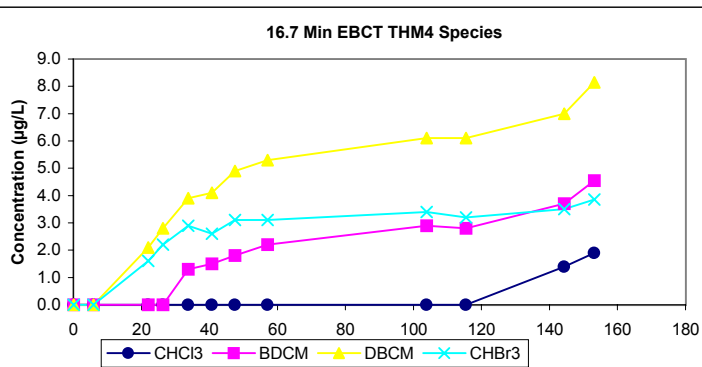
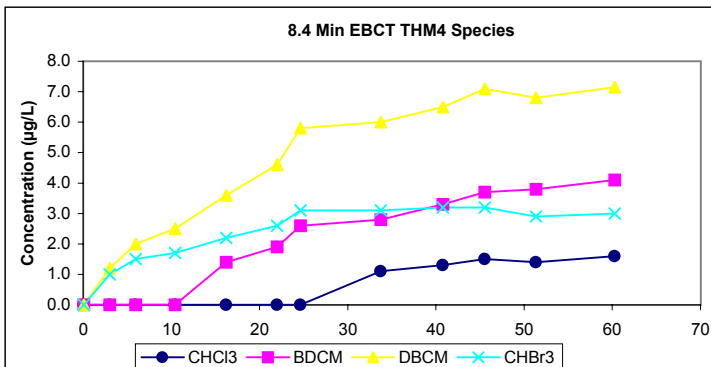
Water Quality Summary

Influent	8.4 Min Influent				16.7 Min Influent				Res (0)	Mean	SD	Count	Min/Max
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max					
TOC	2.1	0.1	3	2.1 - 2.2	2.1	0.1	3	2.1 - 2.2		1.06	0.10	30	0.87 - 1.23
pH	7.7	0.1	3	7.6 - 7.8	7.7	0.1	3	7.6 - 7.8	Temp	15.0	0.0	28	15.0 - 15.0
UV254	0.033	0.001	3	0.032 - 0.033	0.033	0.001	3	0.032 - 0.033	pH	NA	NA	0	0.0 - 0.0
SUVA	1.53	0.03	3	1.51 - 1.56	1.53	0.03	3	1.51 - 1.56	Time	16.5	0.0	28	16.5 - 16.5
Bromide	75	18	2	66 - 84	75	18	2	66 - 84	Comments:				
SDS-TOX	122	34	3	94 - 159	122	34	3	94 - 159					
SDS-THM4	40	3	3	36 - 42	40	3	3	36 - 42					
SDS-HAA6	19	6	3	12 - 22	19	6	3	12 - 22					
Effluent	8.4 Min EBCT (5 B-S days)				16.7 Min EBCT (13 B-S days)				Chart Legend:	<div><div></div>8.4 Min EBCT</div> <div><div></div>16.7 Min EBCT</div> <div><div></div>8.4 Min Influent</div> <div><div></div>16.7 Min Influent</div>			
Effluent pH	7.8	0.0	12	7.7 - 7.8	7.8	0.1	11	7.7 - 7.9					
Effluent Temp	20.8	0.6	12	19.8 - 21.7	21.2	1.3	12	17.9 - 22.9					

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: NE3110926 / ICR455
 ICR Contact: Jerry Obrist
 Phone No.: (402)441-7571
 Period: 1/20/99 - 2/18/99 (29 B-S days)

Design Information

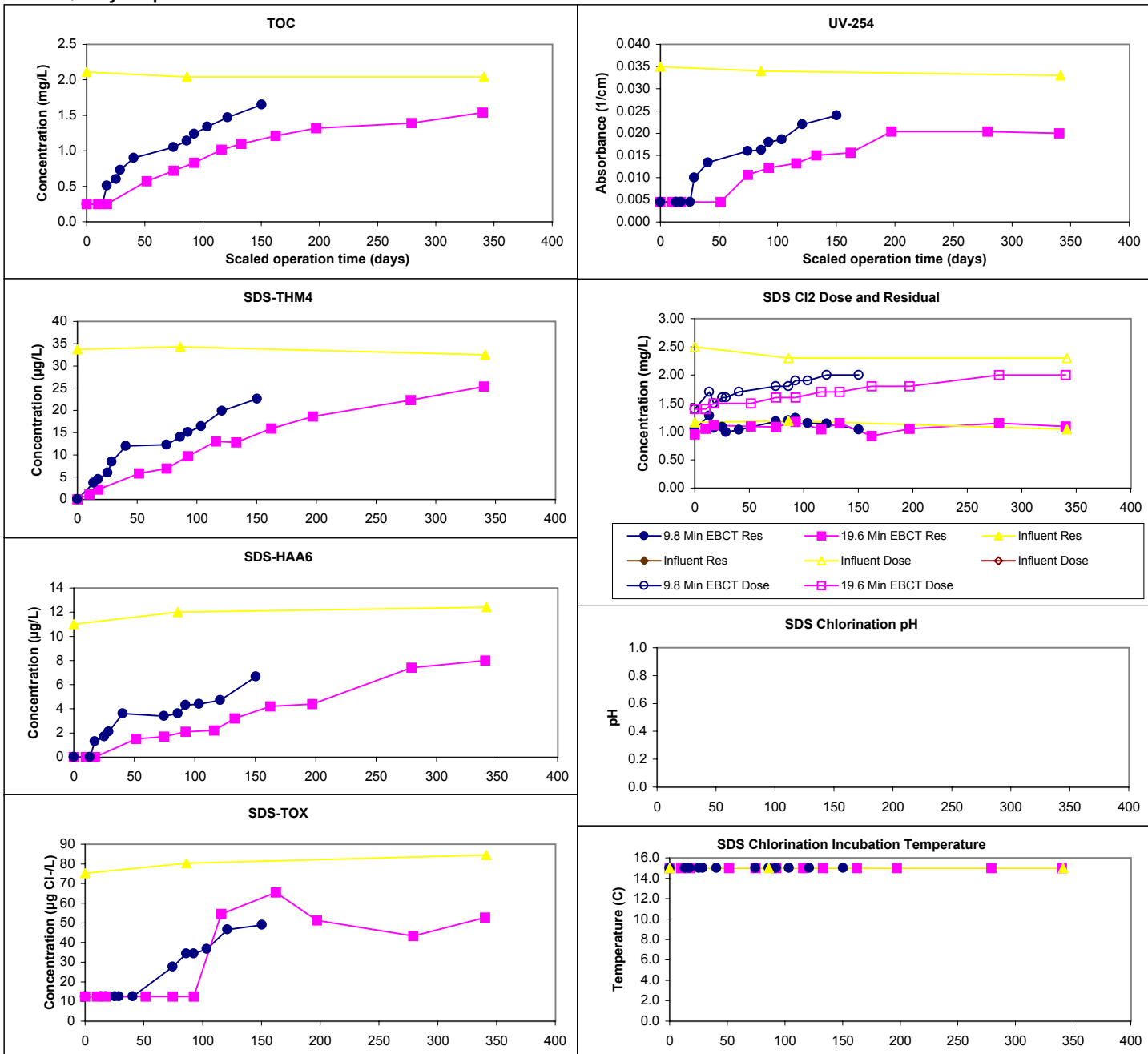
Design TOC: 2.0 mg/L
 Col Diameter: 11.0 mm
 Min Reynolds#: 0.49
 Full-Scale Temp: 11.3 C

Full-Scale GAC Size: 12x40 Bituminous
 Bench-Scale GAC Size: 140x200
 Scaling Factor: 11.63
 Meas Dry Bed Density: 0.46 g/cm3

Water Quality Summary

Influent	Influent				Influent	Mean	SD/RD	Count	Min/Max	Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max						Mean	SD	Count	Min/Max
TOC	2.1	0.0	3	2.0 - 2.1						Res (0)	1.10	0.08	27 0.92 - 1.28
pH	7.6	0.3	3	7.4 - 7.9						Temp	15.0	0.0	27 15.0 - 15.0
UV254	0.034	0.001	3	0.033 - 0.035						pH	NA	NA	0 0.0 - 0.0
SUVA	1.65	0.03	3	1.62 - 1.67						Time	16.5	0.0	27 16.5 - 16.5
Bromide	117	7	2	113 - 120						Comments:			
SDS-TOX	80	5	3	75 - 85									
SDS-THM4	34	1	3	33 - 34						Chart Legend:			
SDS-HAA6	12	1	3	11 - 12									
Effluent	9.8 Min EBCT				19.6 Min EBCT					Legend: ● 9.8 Min EBCT ■ 19.6 Min EBCT ▲ Influent × Influent			
Effluent pH	7.8	0.1	12	7.6 - 8.0	7.8	0.1	12	7.5 - 7.9					
Effluent Temp	22.6	0.6	12	21.5 - 23.4	22.3	1.0	12	19.8 - 23.3					

Water Quality Graphs



Water Quality Graphs (Continued)

