

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1079
Study Protocol	Membrane 2- and 3-Stage Pilot-Scale
Plant ICR Number	305
PWS Name	City of North Miami Beach
City, State, Zip	North Miami Beach, FL 33162

General Comments:

1. This study was done according to the Experimental Design Summary (Table 3.3) in the Summary Report. However, the data from Runs 2 and 3 with the TriSep membranes were entered into one worksheet in the DCS file. Also, the TriSep membranes were not operated between 8/11/98 and 9/18/98 as originally reported in Table 3.3.
2. One-half of the TriSep membranes were replaced after cleaning on 7/16/98 due to irreversible membrane fouling; before cleaning antiscalent and acid pretreatment were used (this was designated as Run 2 in Table 3.3), while after cleaning sulfuric acid was the only pretreatment used (Run 3 in Table 3.3).
3. Significant operational events, results, and timelines are provided in Section 4.0 of the Summary Report.
4. Autopsy reports for the fouled TriSep membranes are provided in Appendix B of the Summary Report.
5. Conceptual estimates of full-scale costs are provided in Section 4.5 in the Summary Report.

Water Quality Comments:

1. Four water quality outliers were identified and removed prior to base analysis.
2. Reported feed alkalinity values were sampled prior to sulfuric acid pretreatment; thus the pretreated membrane feed would have lower alkalinities than reported here. Feed TDS values may have also been sampled at this point – if this is true, the actual TDS concentration in the membrane feed stream would be higher than reported.

3. In general the SDS permeate and feed samples were dosed to achieve a free chlorine residual between 0.5 and 1.0 mg/L after 6 hours of incubation at 25 to 27°C, at a pH ranging from 8.6 to 9.0.

Productivity Comments:

1. Seven productivity outliers were identified and removed prior to base analysis.
2. On 10/18/98, during operation of the 3-stage pilot system with TriSep membranes, the system valving was reconfigured resulting in increased back-pressure and reduced, but more stable, MTC_w .
3. Many operational changes were made during the run with the TriSep membrane. These changes include replacement of half of the membranes in the system, adding a third stage and modifying the back-pressure system. These changes resulted in very erratic productivity trends as seen in Figure 4.17 of the Summary Report. Analysis of the productivity data was limited to data between the time at which the membranes were replaced and the time at which the third stage was added.
4. The membrane systems were cleaned with either low pH solutions (for metallic scale removal) or alkaline solutions (for biological and organic fouling). Additional information about the membrane cleaning procedures is given in Section 3.4.5 of the Summary Report.
5. During EPA data analysis the projected cleaning intervals (and slopes) for the Fluid Systems, Trisep and Hydranautics membrane were 68 days (-3.84×10^{-4} gfd/psi/day), 63 days (-8.96×10^{-4} gfd/psi/day), and 73 (-6.70×10^{-4} gfd/psi/day), respectively. The Trisep productivity projections are only based on the data collected from 7/17 through 9/18/98, due to operational complications during the other cycles. The productivity projections for all three membranes are similar to those made by the consultant.

ICR Information

ID / ICR#: FL4131618 / 305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 4/24/98 - 5/21/98 (27 days)

Membrane Information

Manufacturer: Fluid Systems
 Trade Name: Fluid Systems
 Membrane Model: 4040-TFC 4821 ULP
 MWCO: NA Daltons
 Element Size: 4" x 40"
 Element Area: 80.0 ft²
 Design Flux: 20.5 gfd
 Mfr. NDP: 75.0 psi
 Mfr. MTC_w: 0.270 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 10.0 gpm
 Minimum Flow: 4.0 gpm
 Total Width : 14.0 ft
 Feed Spacer Thickness: 0.0027 ft
 840 Element Area 330.0 ft²
 840 Purchase Price: \$790

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.270 TavGC
 Design Recovery: 0.65
 Avg Sys Flux F_w: 9.5 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: NA
 Design Flux: 9.5 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 1.3 psi
 Osmotic P Stage 2: 1.5 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	7.3	NA	1	7.3 - 7.3	7.1	NA	1	7.1 - 7.1	7.4	NA	1	7.4 - 7.4
Temp	26.4	NA	1	26.4 - 26.4	26.0	NA	1	26.0 - 26.0	26.0	NA	1	26.0 - 26.0
Alk	NA	NA	0	0 - 0	50	NA	1	50 - 50	120	NA	1	120 - 120
TDS	260	NA	1	260 - 260	95	NA	1	95 - 95	400	NA	1	400 - 400
TotHard	200	NA	1	200 - 200	42	NA	1	42 - 42	600	NA	1	600 - 600
CaHard	190	NA	1	190 - 190	40	NA	1	40 - 40	620	NA	1	620 - 620
Turb	1.60	NA	1	1.60 - 1.60	0.72	NA	1	0.72 - 0.72	2.20	NA	1	2.20 - 2.20
Amm	0.07	NA	1	0.07 - 0.07	0.15	NA	1	0.15 - 0.15	NA	NA	0	0.0 - 0.0
TOC	8.1	NA	1	8.1 - 8.1	0.3	NA	1	0.3 - 0.3	NA	NA	0	0.0 - 0.0
UV254	0.246	NA	1	0.246 - 0.246	0.005	NA	1	0.005 - 0.005	NA	NA	0	0.000 - 0.000
SUVA	3.04	NA	1	3.04 - 3.04	1.80	NA	1	1.80 - 1.80	NA	NA	0	NA
Bromide	10	NA	1	10 - 10	NA	NA	0	0 - 0				
TOX	580	NA	1	580 - 580	13	NA	1	13 - 13				
CHCl3	200.0	NA	1	200.0 - 200.0	3.1	NA	1	3.1 - 3.1	Mass Balance Closure Errors (%)			
BDCM	34.0	NA	1	34.0 - 34.0	0.0	NA	1	0.0 - 0.0				
DBCM	4.1	NA	1	4.1 - 4.1	0.0	NA	1	0.0 - 0.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	Alk	0	n/a	n/a
THM4	238.1	NA	1	238.1 - 238.1	3.1	NA	1	3.1 - 3.1	TDS	1	0	n/a
MCAA	3.7	NA	1	3.7 - 3.7	0.0	NA	1	0.0 - 0.0	TotHard	1	0	n/a
DCAA	46.0	NA	1	46.0 - 46.0	0.0	NA	1	0.0 - 0.0	CaHard	1	0	n/a
TCAA	41.0	NA	1	41.0 - 41.0	0.0	NA	1	0.0 - 0.0	Turb	1	0	n/a
MBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	TOC	0	n/a	n/a
BCAA	8.4	NA	1	8.4 - 8.4	0.0	NA	1	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0				
CDBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	TDS _t	76	10	5
DCBAA	7.8	NA	1	7.8 - 7.8	0.0	NA	1	0.0 - 0.0	Comments:			
HAA5	90.7	NA	1	90.7 - 90.7	0.0	NA	1	0.0 - 0.0				
HAA6	99.1	NA	1	99.1 - 99.1	0.0	NA	1	0.0 - 0.0				
HAA9	106.9	NA	1	106.9 - 106.9	0.0	NA	1	0.0 - 0.0				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description			Scale		
Res (0)	0.60	0.00	2	0.60 - 0.60	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal			Full-Scale		
Temp (°C)	25.0	0.0	2	25.0 - 25.0	Scale Inhibitor		BF Goodrich AF 600, AF 1000, 5 ppm , typical			Full-Scale		
pH (unit)	8.7	0.0	2	8.7 - 8.8								
Time (hr)	6.0	0.0	2	6.0 - 6.0								

Mass Balance Errors

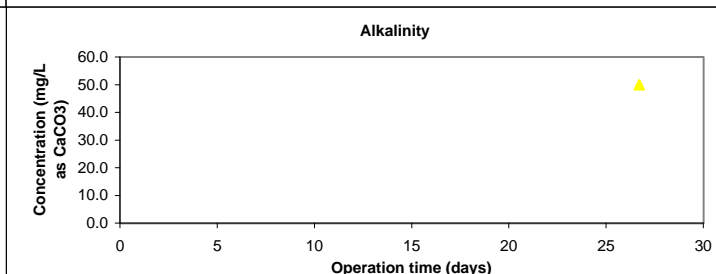
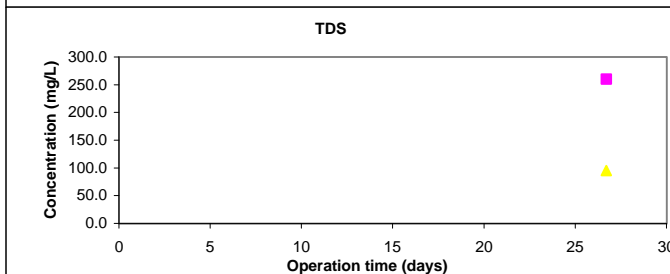
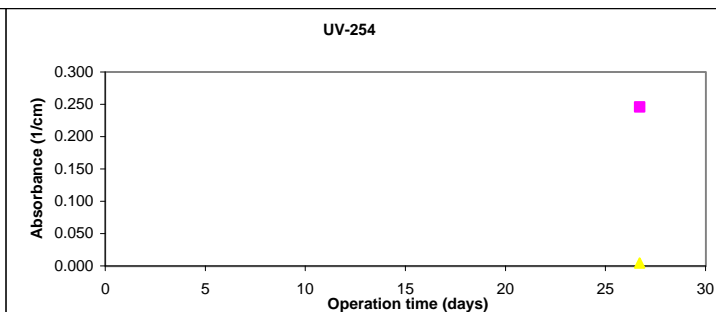
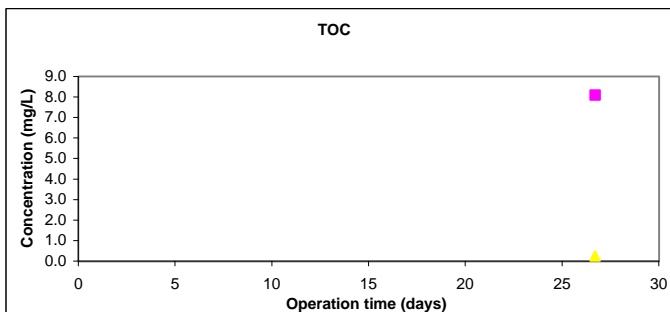
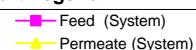
Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	#DIV/0!	#DIV/0!
Sys Conc - Stg 2 Conc	0.0%	0.0%	Sys Conc - Stg 2 Conc	-0.2%	1.2%	Sys Conc - Stg 2 Conc	-0.1%	0.9%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	#DIV/0!	#DIV/0!
Sys Perm - Avg Stg Perr	0.0%	0.0%	Sys Perm - Sum Stg Per	0.1%	0.7%	Sys Perm - Avg Stg Perm	-7.7%	12.3%

Stage Summary

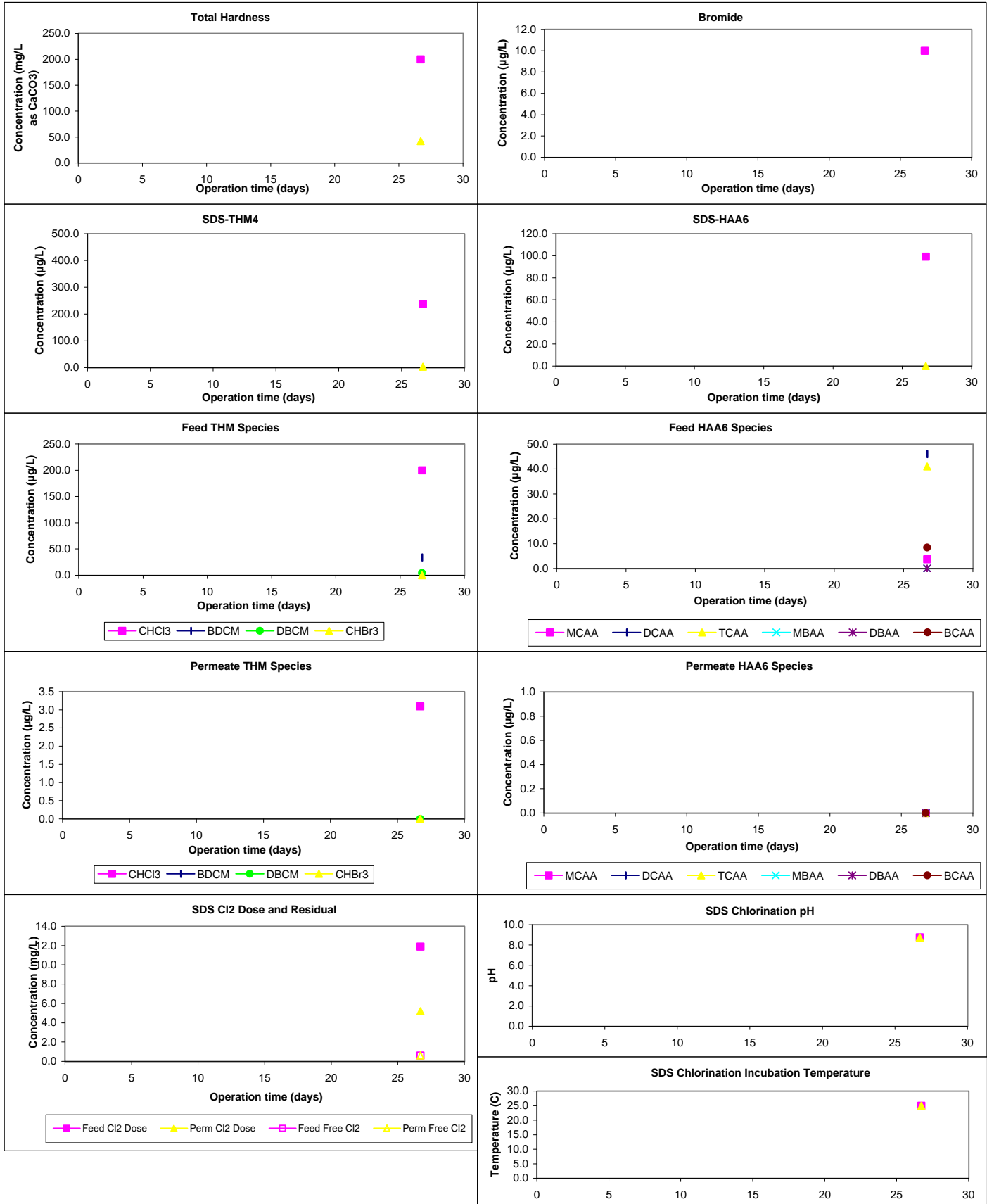
WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.44	NA	1	0.44 - 0.44					
pH	7.3	7.4	7.3	NA	1	7.3 - 7.3	7.1	7.0	NA	1	7.0 - 7.0
Temp	26.4	26.0	26.4	NA	1	26.4 - 26.4	26.0	26.0	NA	1	26.0 - 26.0
Alk	NA	120	NA	NA	0	0 - 0	50	32	NA	1	32 - 32
TDS	260	400	260	NA	1	260 - 260	95	85	NA	1	85 - 85
TotHard	200	600	200	NA	1	200 - 200	42	26	NA	1	26 - 26
CaHard	190	620	190	NA	1	190 - 190	40	24	NA	1	24 - 24
Turb	1.60	2.20	1.60	NA	1	1.60 - 1.60	0.72	0.48	NA	1	0 - 0
TOC	8.1	NA	8.1	NA	1	8.1 - 8.1	0.3	NA	NA	0	0.0 - 0.0
UV254	0.246	NA	0.246	NA	1	0.246 - 0.246	0.005	NA	NA	0	0.000 - 0.000
SUVA	3.04	NA	3.04	NA	1	3.04 - 3.04	1.80	NA	NA	0	0.00 - 0.00
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.36	NA	1	0.36 - 0.36					
pH	7.3	7.4	7.5	NA	1	7.5 - 7.5	7.1	7.1	NA	1	7.1 - 7.1
Temp	26.4	26.0	26.0	NA	1	26.0 - 26.0	26.0	26.0	NA	1	26.0 - 26.0
Alk	NA	120	150	NA	1	150 - 150	50	84	NA	1	84 - 84
TDS	260	400	345	NA	1	345 - 345	95	145	NA	1	145 - 145
TotHard	200	600	280	NA	1	280 - 280	42	56	NA	1	56 - 56
CaHard	190	620	262	NA	1	262 - 262	40	58	NA	1	58 - 58
Turb	1.60	2.20	0.60	NA	1	0.60 - 0.60	0.72	0.80	NA	1	1 - 1
TOC	8.1	NA	NA	NA	0	0.0 - 0.0	0.3	NA	NA	0	0.0 - 0.0
UV254	0.246	NA	NA	NA	0	0.000 - 0.000	0.005	NA	NA	0	0.000 - 0.000
SUVA	3.04	NA	NA	NA	0.00	0.00 - 0.00	1.80	NA	NA	0.00	0.00 - 0.00
WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

Water Quality Parameter Graphs

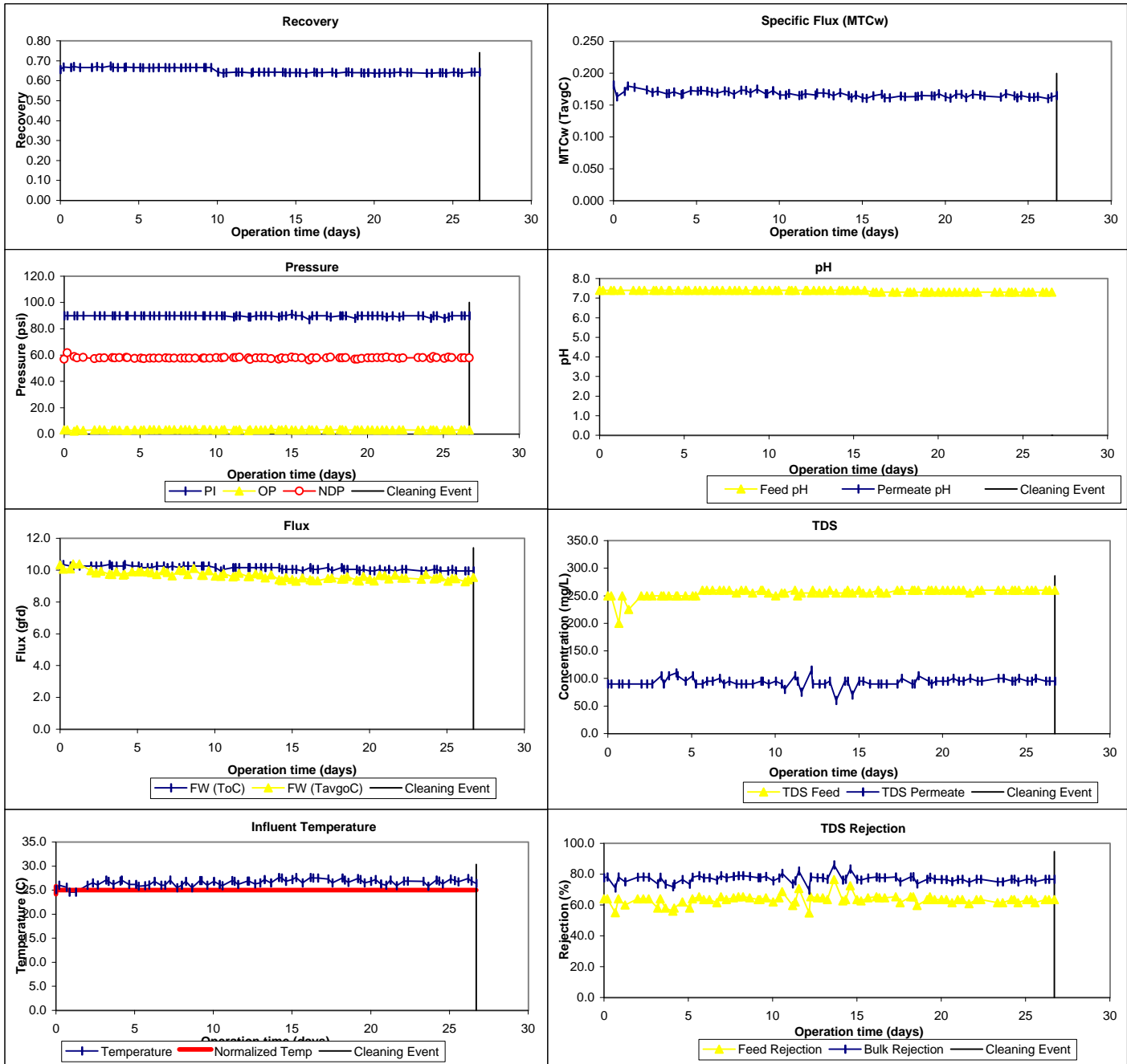
Chart Legend:



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / 305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 5/21/98 - 7/19/98 (59 days)

Membrane Information

Manufacturer: TriSep Corporation
 Trade Name: TriSep
 Membrane Model: 4040-TS80-TSA
 MWCO: 150-300 Daltons
 Element Size: 4-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 22.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTC_w: 0.210 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 20.0 gpm
 Minimum Flow: 5.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 360.0 ft²
 840 Purchase Price: \$850

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.210 TavGC
 Design Recovery: 0.75
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: 0
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 1.2 psi
 Osmotic P Stage 2: 1.5 psi
 Osmotic P Stage 3: 0.0 psi

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	7.1	0.2	4	6.8 - 7.2	6.8	0.3	4	6.4 - 7.0	7.0	0.4	4	6.6 - 7.4
Temp	26.9	0.7	4	26.0 - 27.7	26.9	0.3	4	26.5 - 27.0	27.1	0.6	4	26.5 - 28.0
Alk	167	9	4	160 - 180	88	6	4	80 - 92	185	17	3	166 - 200
TDS	247	5	4	240 - 250	162	22	4	140 - 185	440	58	4	360 - 500
TotHard	212	7	4	204 - 220	131	29	4	106 - 160	540	NA	1	540 - 540
CaHard	208	5	4	202 - 212	124	20	4	102 - 144	442	139	2	344 - 540
Turb	0.51	0.1	4	0.42 - 0.60	0.31	0.1	4	0.25 - 0.40	0.81	0.1	4	0.70 - 1.00
Amm	0.39	0.06	4	0.32 - 0.45	0.29	0.07	4	0.20 - 0.37	NA	NA	0	0.0 - 0.0
TOC	8.1	0.3	4	7.8 - 8.4	0.3	0.1	4	0.3 - 0.5	NA	NA	0	0.0 - 0.0
UV254	0.355	0.0	4	0.348 - 0.366	0.012	0.0	4	0.005 - 0.023	NA	NA	0	0.000 - 0.000
SUVA	4.42	0.18	4	4.19 - 4.63	4.20	3.49	4	1.80 - 9.20	NA	NA	0	NA
Bromide	82	10	4	72 - 95	67	7	4	60 - 76				
TOX	620	139	4	505 - 800	13	0	4	13 - 13				
CHCl3	190.0	34.6	4	160.0 - 240.0	4.0	1.7	4	2.6 - 6.3	Mass Balance			
BDCM	23.3	4.1	4	18.0 - 28.0	3.4	0.2	4	3.1 - 3.6	Closure Errors (%)			
DBCM	3.1	0.5	4	2.6 - 3.5	4.4	1.4	4	2.4 - 5.3	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	4	0.0 - 0.0	3.4	2.3	4	0.0 - 5.1	Alk	3	-93	68
THM4	216.4	38.8	4	180.6 - 271.5	15.2	2.2	4	12.2 - 17.5	TDS	4	3	5
MCAA	4.1	1.1	4	3.3 - 5.6	0.0	0.0	4	0.0 - 0.0	TotHard	1	16	n/a
DCAA	51.0	6.7	4	42.0 - 57.0	1.2	0.3	4	1.0 - 1.6	CaHard	2	12	4
TCAA	43.5	6.5	4	38.0 - 52.0	1.8	0.6	4	1.3 - 2.7	Turb	4	-21	49
MBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	0.0	0.0	4	0.0 - 0.0	1.3	0.9	4	0.0 - 1.9	TOC	0	n/a	n/a
BCAA	7.5	0.7	4	6.7 - 8.2	0.5	0.6	4	0.0 - 1.1	UV254	0	n/a	n/a
TBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0				
CDBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	TDS	99	7	11
DCBAA	6.3	1.5	4	5.0 - 8.2	0.3	0.5	4	0.0 - 1.0	Comments:			
HAA5	98.6	12.9	4	83.3 - 112.6	4.3	0.1	4	4.1 - 4.4				
HAA6	106.1	13.7	4	90.0 - 120.8	4.8	0.6	4	4.3 - 5.5				
HAA9	112.4	15.0	4	95.3 - 129.0	5.1	1.0	4	4.3 - 6.5				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description			Scale		
Res (0)	0.85	0.16	8	0.50 - 1.00	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal			Pilot-Scale		
Temp (°C)	26.3	0.5	8	26.0 - 27.0	Scale Inhibitor		BF Goodrich AF 600, AF 1000, 5 ppm , typical			Pilot-Scale		
pH (unit)	8.8	0.1	8	8.6 - 8.9	Sulfuric Acid		93% to adjust pH to 5.8 - 6.2: biological fouling			Pilot-Scale		
Time (hr)	6.0	0.0	8	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	-0.1%	1.0%
Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!	Stg 2 Conc - Stg 3 Inf	200.0%	0.0%	Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!
Sys Perm - Avg Stg Perm	-8.8%	10.9%	Sys Perm - Sum Stg Per	0.0%	0.3%	Sys Perm - Avg Stg Perm	-14.2%	9.3%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.50	0.10	4	0.35 - 0.56					
pH	7.1	7.0	7.1	0.2	4	6.8 - 7.2	6.8	6.7	0.3	4	6.4 - 7.0
Temp	26.9	27.1	26.9	0.7	4	26.0 - 27.7	26.9	26.9	0.3	4	26.5 - 27.0
Alk	167	185	167	9	4	160 - 180	88	70	9	4	60 - 80
TDS	247	440	247	5	4	240 - 250	162	147	27	4	120 - 175
TotHard	212	540	212	7	4	204 - 220	131	113	22	4	87 - 134
CaHard	208	442	208	5	4	202 - 212	124	106	25	4	76 - 130
Turb	0.51	0.81	0.51	0	4	0.42 - 0.60	0.31	0.36	0.17	4	0 - 1
TOC	8.1	NA	8.1	0.3	4	7.8 - 8.4	0.3	0.3	0.0	4	0.3 - 0.3
UV254	0.355	NA	0.355	0.008	4	0.348 - 0.366	0.012	0.005	0.000	4	0.005 - 0.005
SUVA	4.42	NA	4.42	0.18	4	4.19 - 4.63	4.20	1.80	0.00	4	1.80 - 1.80

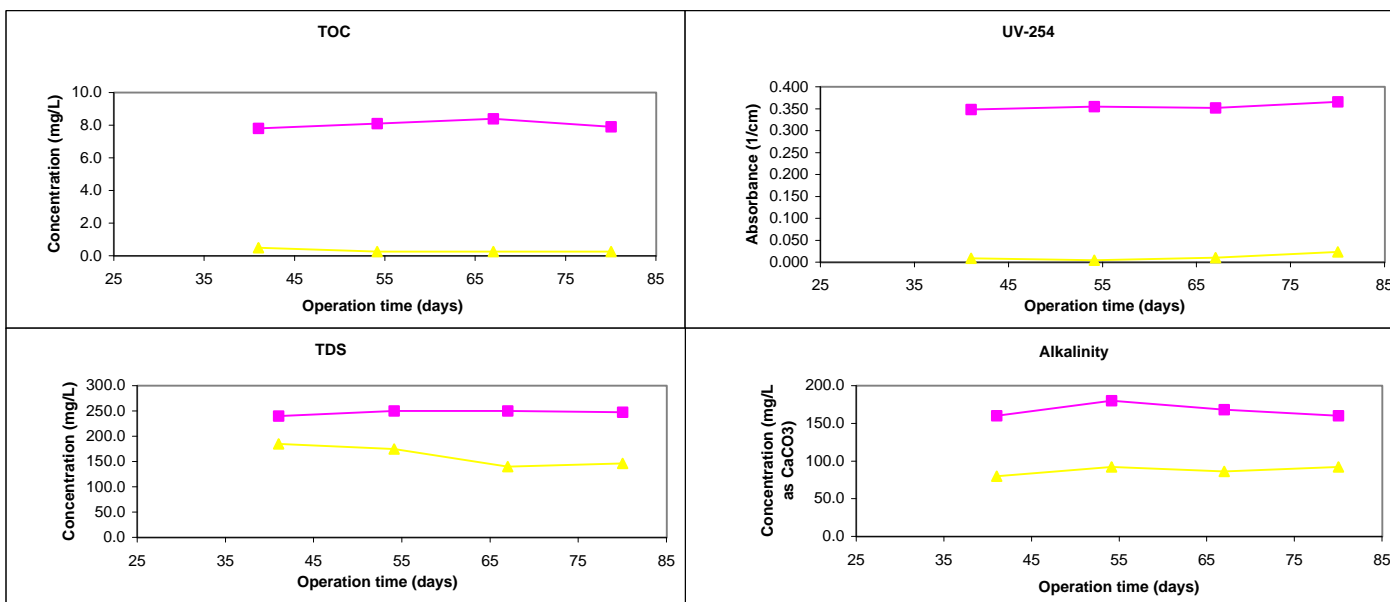
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.35	0.09	4	0.25 - 0.46					
pH	7.1	7.0	7.0	0.3	4	6.7 - 7.4	6.8	6.9	0.4	4	6.6 - 7.4
Temp	26.9	27.1	26.9	0.3	4	26.5 - 27.0	26.9	26.9	0.3	4	26.5 - 27.0
Alk	167	185	176	NA	1	176 - 176	88	167	31	4	122 - 190
TDS	247	440	368	59	4	310 - 450	162	211	32	4	175 - 245
TotHard	212	540	364	68	4	300 - 460	131	175	48	4	122 - 220
CaHard	208	442	344	44	4	292 - 400	124	187	31	4	148 - 214
Turb	0.51	0.81	0.64	0	4	0.58 - 0.70	0.31	0.88	0.66	4	0 - 2
TOC	8.1	NA	18.2	2.9	4	14.1 - 20.8	0.3	1.2	0.1	4	1.0 - 1.3
UV254	0.355	NA	0.695	0.170	4	0.493 - 0.848	0.012	0.050	0.010	4	0.036 - 0.060
SUVA	4.42	NA	3.90	1.02	4.00	2.37 - 4.44	4.20	4.13	0.61	4.00	3.60 - 5.00

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

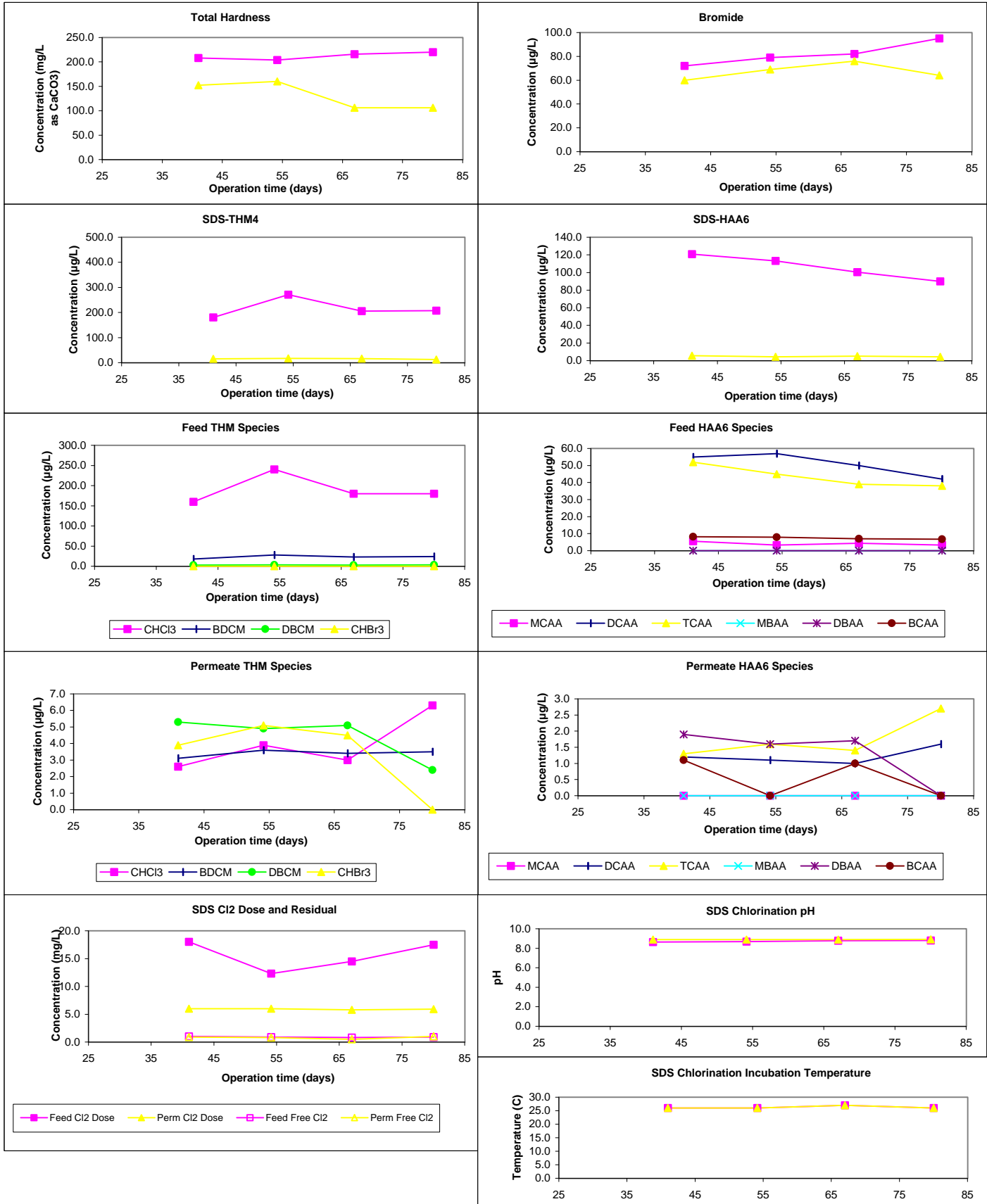
Water Quality Parameter Graphs

Chart Legend:

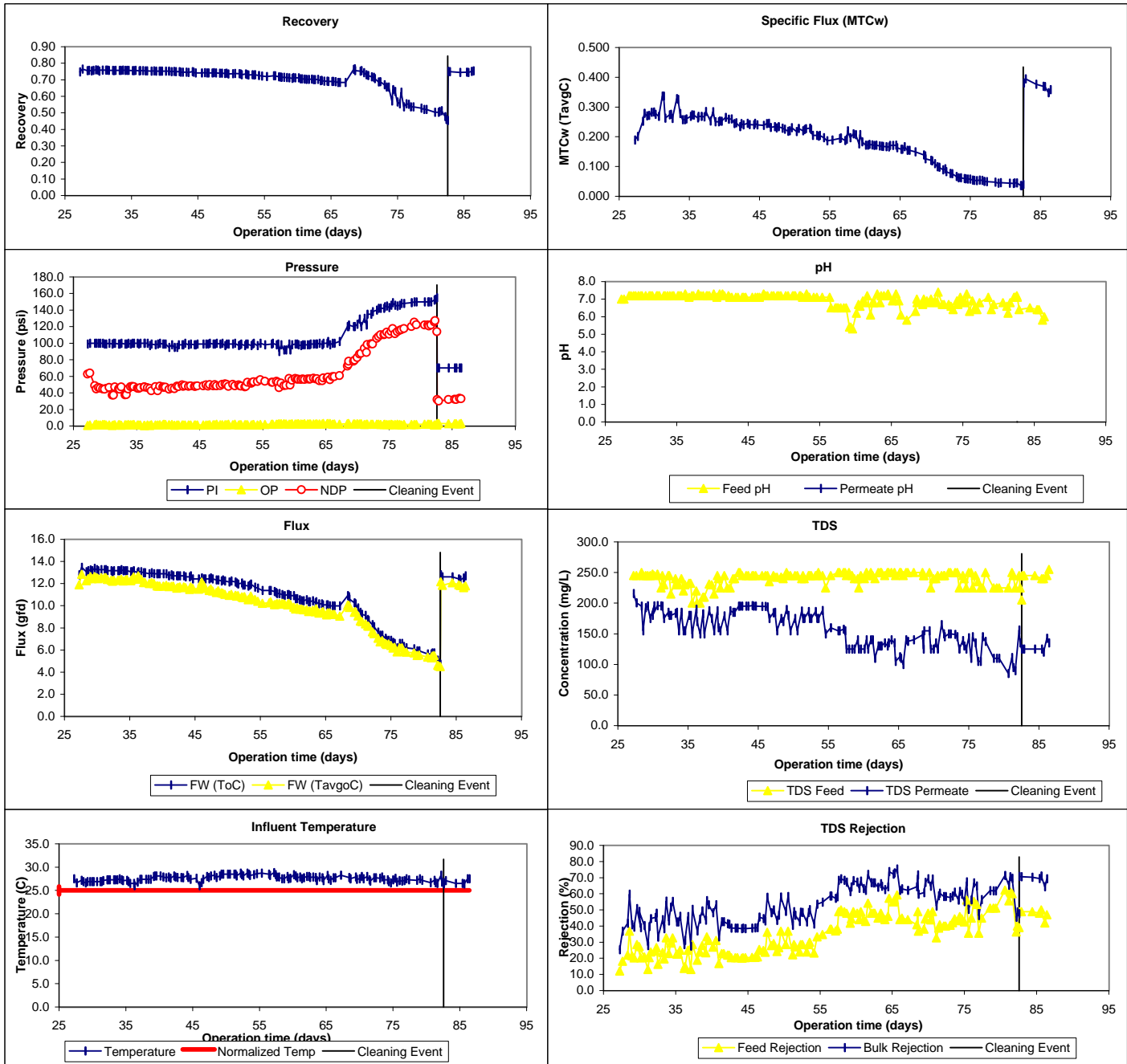
■ Feed (System)
▲ Permeate (System)



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / 305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 7/20/98 - 9/18/98 (60 days)

Membrane Information

Manufacturer: TriSep Corporation
 Trade Name: TriSep
 Membrane Model: 4040-TS80-TSA
 MWCO: 150-300 Daltons
 Element Size: 4-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 22.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTC_w: 0.210 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 20.0 gpm
 Minimum Flow: 5.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 360.0 ft²
 840 Purchase Price: \$850

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.210 TavGC
 Design Recovery: 0.75
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: 0
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 1.2 psi
 Osmotic P Stage 2: 1.5 psi
 Osmotic P Stage 3: 0.0 psi

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.9	0.7	4	5.9 - 7.3	6.0	0.1	4	5.8 - 6.1	6.0	0.1	4	5.9 - 6.1
Temp	27.0	1.4	4	26.0 - 29.0	26.9	1.4	4	26.0 - 29.0	27.0	1.4	4	26.0 - 29.0
Alk	210	54	3	164 - 270	52	13	4	44 - 71	NA	NA	0	0 - 0
TDS	253	5	4	250 - 260	101	3	4	98 - 105	631	50	4	559 - 675
TotHard	230	41	4	200 - 290	69	24	4	52 - 102	683	62	4	600 - 740
CaHard	189	53	4	114 - 240	64	27	4	46 - 104	671	78	4	575 - 760
Turb	0.48	0.1	4	0.40 - 0.52	0.25	0.1	4	0.15 - 0.30	0.58	0.1	4	0.50 - 0.70
Amm	0.34	0.22	4	0.00 - 0.46	0.27	0.05	4	0.24 - 0.34	NA	NA	0	0.0 - 0.0
TOC	8.1	1.0	4	7.2 - 9.4	0.8	0.4	4	0.3 - 1.1	NA	NA	0	0.0 - 0.0
UV254	0.355	0.0	4	0.320 - 0.385	0.005	0.0	4	0.005 - 0.005	NA	NA	0	0.000 - 0.000
SUVA	4.49	0.84	4	3.40 - 5.35	0.78	0.68	4	0.41 - 1.80	NA	NA	0	NA
Bromide	103	6	3	99 - 110	90	6	4	86 - 99				
TOX	643	160	3	470 - 785	20	12	3	13 - 34				
CHCl3	152.5	23.6	4	120.0 - 170.0	2.4	1.7	4	1.1 - 4.8	Mass Balance			
BDCM	24.5	3.9	4	19.0 - 28.0	2.1	1.3	3	1.0 - 3.5	Closure Errors (%)			
DBCM	3.8	0.3	4	3.4 - 4.2	2.7	1.8	4	1.2 - 5.1	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	3	0.0 - 0.0	2.1	1.4	4	1.0 - 4.2	Alk	0	n/a	n/a
THM4	174.8	30.2	3	142.4 - 202.2	10.6	6.4	3	5.2 - 17.6	TDS	4	-15	5
MCAA	3.2	0.4	4	2.6 - 3.6	0.0	0.0	4	0.0 - 0.0	TotHard	4	-6	28
DCAA	44.5	11.4	4	30.0 - 57.0	0.4	0.8	4	0.0 - 1.5	CaHard	4	16	39
TCAA	45.3	15.1	4	27.0 - 62.0	0.9	1.8	4	0.0 - 3.5	Turb	4	-113	48
MBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	0.8	0.5	4	0.0 - 1.0	0.7	0.9	4	0.0 - 1.8	TOC	0	n/a	n/a
BCAA	7.6	1.4	4	5.8 - 9.2	0.3	0.5	4	0.0 - 1.0	UV254	0	n/a	n/a
TBAA	0.0	0.0	2	0.0 - 0.0	0.0	0.0	3	0.0 - 0.0				
CDBAA	1.1	1.3	4	0.0 - 2.3	0.0	0.0	4	0.0 - 0.0	TDS _t	99	-11	11
DCBAA	7.1	2.2	4	4.2 - 9.2	0.0	0.0	4	0.0 - 0.0	Comments:			
HAA5	93.7	26.8	4	60.2 - 122.6	2.0	3.3	4	0.0 - 6.8				
HAA6	101.3	28.2	4	66.0 - 131.8	2.2	3.8	4	0.0 - 7.8				
HAA9	85.4	21.4	2	70.2 - 100.5	2.9	4.2	3	0.0 - 7.8				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.78	0.24	8	0.50 - 1.00	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal		Pilot-Scale			
Temp (°C)	25.8	0.5	8	25.0 - 26.5	Scale Inhibitor		BF Goodrich AF 600, AF 1000, 5 ppm , typical		Pilot-Scale			
pH (unit)	8.7	0.2	8	8.4 - 8.9	Sulfuric Acid		93% to adjust pH to 5.8 - 6.2: biological fouling		Pilot-Scale			
Time (hr)	6.0	0.0	8	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.3%	3.7%
Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!	Stg 2 Conc - Stg 3 Inf	200.0%	0.0%	Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!
Sys Perm - Avg Stg Perm	-26.3%	15.5%	Sys Perm - Sum Stg Per	0.1%	0.6%	Sys Perm - Avg Stg Perm	-16.9%	12.0%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.51	0.02	4	0.48 - 0.52					
pH	6.9	6.0	6.9	0.7	4	5.9 - 7.3	6.0	5.8	0.2	4	5.7 - 6.1
Temp	27.0	27.0	27.0	1.4	4	26.0 - 29.0	26.9	25.9	0.6	4	25.0 - 26.5
Alk	210	NA	210	54	3	164 - 270	52	38	7	4	30 - 46
TDS	253	631	253	5	4	250 - 260	101	84	26	4	68 - 123
TotHard	230	683	230	41	4	200 - 290	69	53	24	4	36 - 88
CaHard	189	671	189	53	4	114 - 240	64	45	17	4	34 - 70
Turb	0.48	0.58	0.48	0	4	0.40 - 0.52	0.25	0.34	0.14	4	0 - 1
TOC	8.1	NA	8.1	1.0	4	7.2 - 9.4	0.8	0.4	0.4	4	0.3 - 1.0
UV254	0.355	NA	0.355	0.027	4	0.320 - 0.385	0.005	0.005	0.000	4	0.005 - 0.005
SUVA	4.49	NA	4.49	0.84	4	3.40 - 5.35	0.78	1.46	0.68	4	0.45 - 1.80

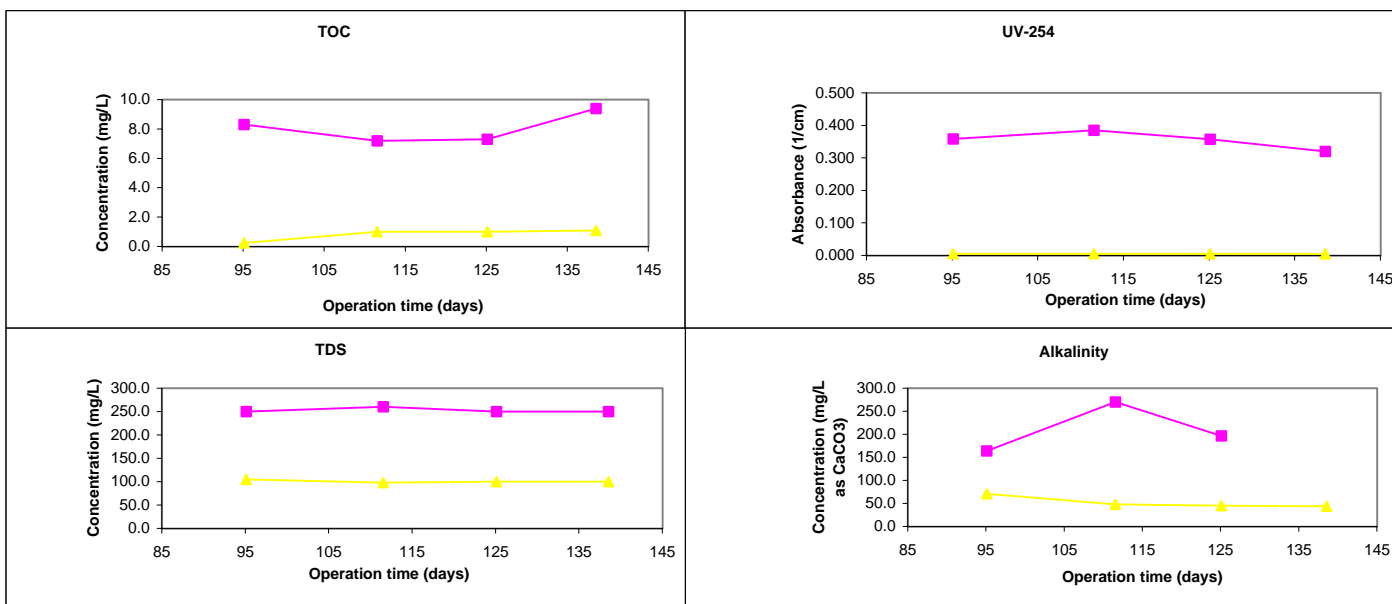
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.50	0.01	4	0.49 - 0.51					
pH	6.9	6.0	6.2	0.1	4	6.0 - 6.3	6.0	6.1	0.1	4	5.9 - 6.2
Temp	27.0	27.0	26.3	1.0	4	25.0 - 27.0	26.9	26.0	0.8	4	25.0 - 27.0
Alk	210	NA	92	28	4	62 - 127	52	72	15	4	58 - 85
TDS	253	631	433	25	4	400 - 455	101	147	38	4	95 - 185
TotHard	230	683	405	63	4	324 - 460	69	113	3	4	108 - 116
CaHard	189	671	347	59	4	280 - 410	64	107	4	4	104 - 112
Turb	0.48	0.58	0.49	0	4	0.47 - 0.50	0.25	0.29	0.07	4	0 - 0
TOC	8.1	NA	16.5	1.0	4	15.1 - 17.6	0.8	0.7	0.5	4	0.3 - 1.2
UV254	0.355	NA	0.698	0.010	4	0.686 - 0.710	0.005	0.008	0.007	4	0.005 - 0.019
SUVA	4.49	NA	4.25	0.21	4.00	4.03 - 4.54	0.78	1.47	0.73	4.00	0.38 - 1.90

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH	This was only a two stage study										
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

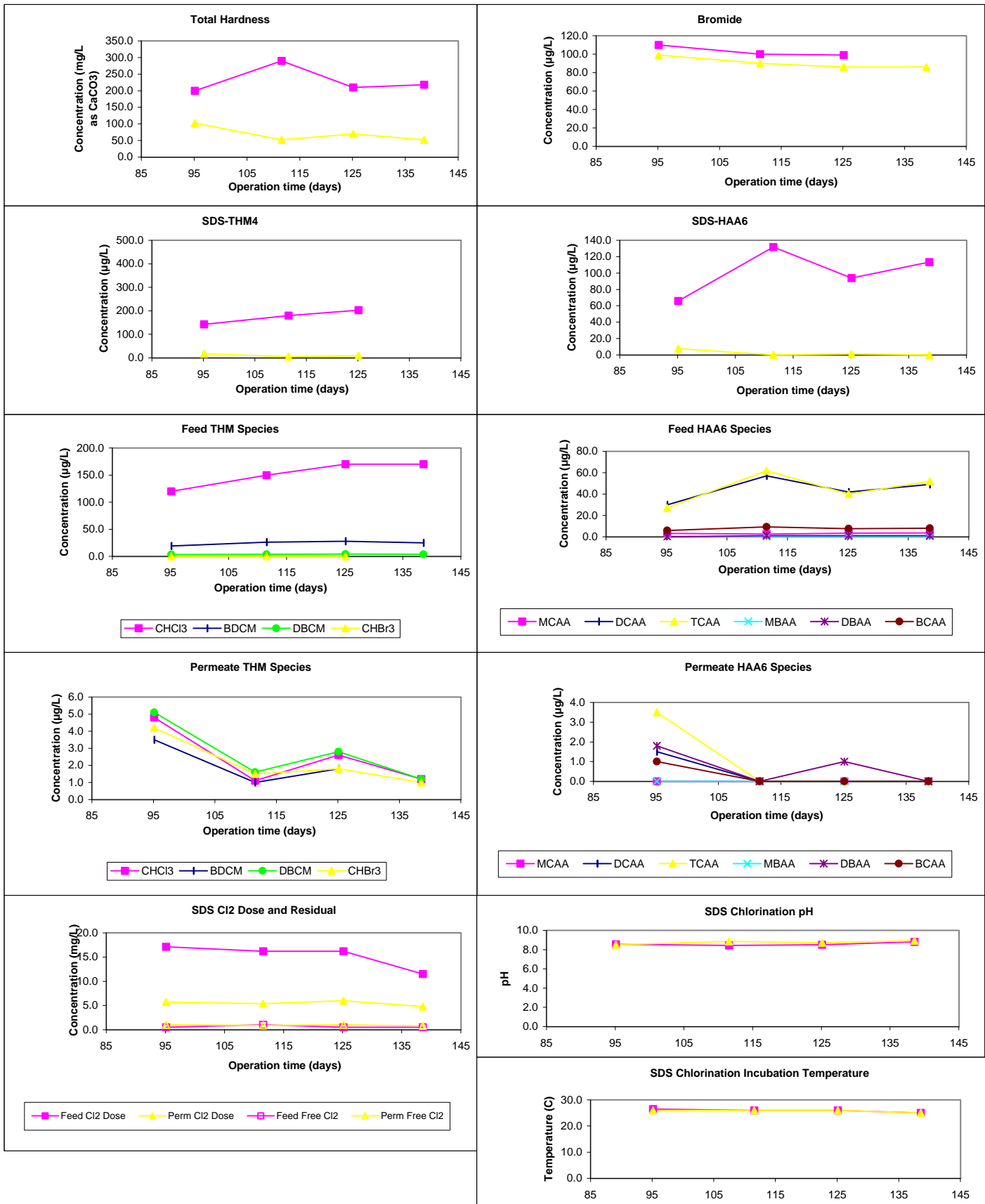
Chart Legend:

■ Feed (System)
▲ Permeate (System)

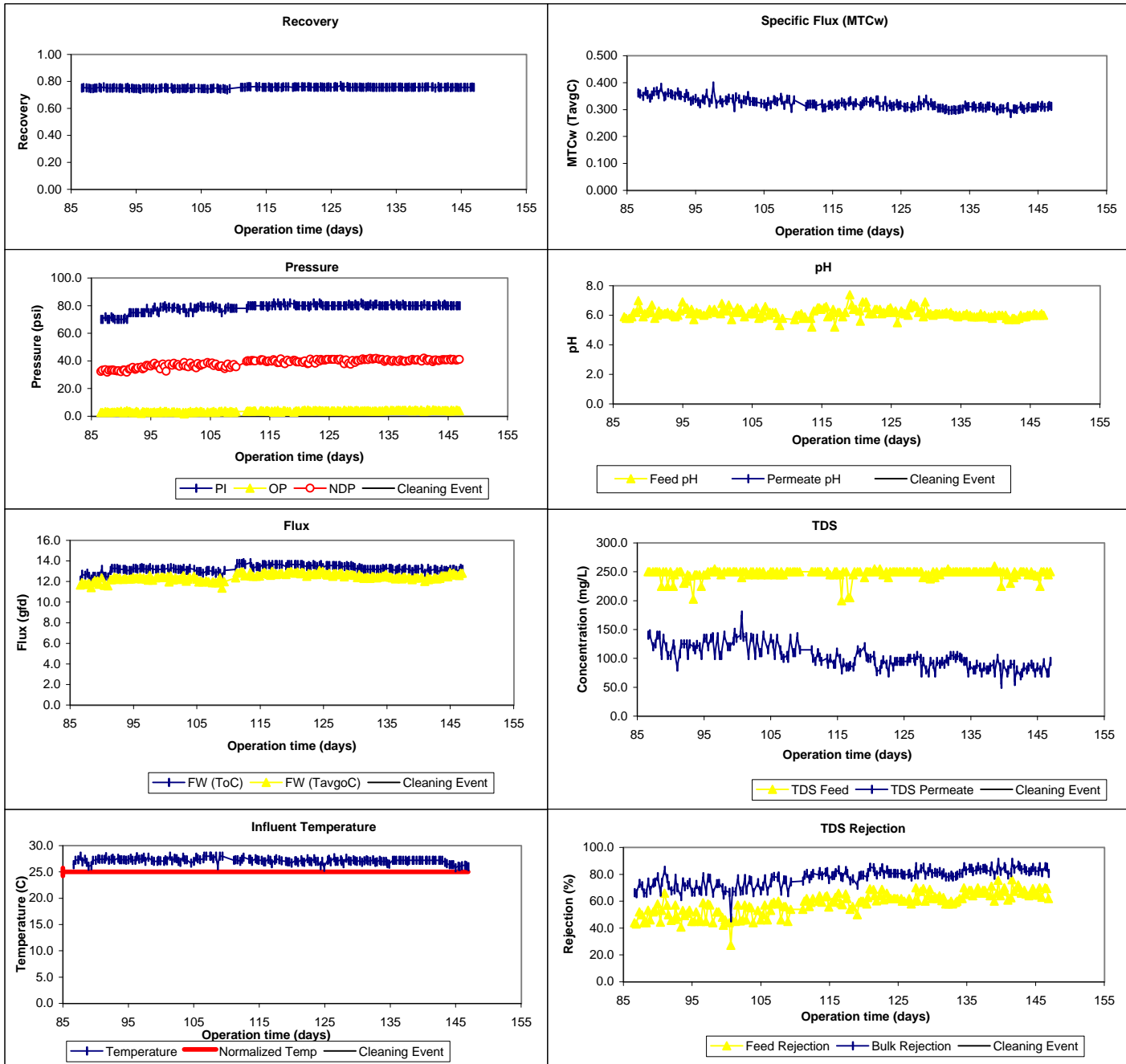
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / #305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 9/18/98 - 11/12/98 (55 days)

Membrane Information

Manufacturer: TriSep Corporation
 Trade Name: TriSep
 Membrane Model: 4040-TS80-TSA
 MWCO: 150-300 Daltons
 Element Size: 4-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 22.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTC_w: 0.210 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 20.0 gpm
 Minimum Flow: 5.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 360.0 ft²
 840 Purchase Price: \$850

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.210 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: 2
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 3.2 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 10.5 psi

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.3	0.6	4	5.7 - 7.2	5.9	0.2	4	5.7 - 6.1	6.1	0.4	4	5.5 - 6.4
Temp	24.9	1.0	4	23.5 - 26.0	24.9	1.0	4	23.5 - 26.0	24.9	1.0	4	23.5 - 26.0
Alk	192	NA	1	192 - 192	49	12	3	36 - 60	170	70	3	120 - 250
TDS	239	20	4	210 - 250	90	21	4	75 - 120	1085	100	4	1000 - 1230
TotHard	220	16	4	200 - 240	68	12	4	52 - 80	760	480	3	380 - 1300
CaHard	201	8	4	190 - 208	62	12	4	46 - 76	730	464	3	360 - 1250
Turb	0.87	0.6	4	0.40 - 1.80	0.51	0.3	4	0.18 - 0.72	1.46	0.7	4	0.45 - 2.00
Amm	0.48	0.15	4	0.38 - 0.69	0.28	0.03	4	0.24 - 0.30	NA	NA	0	0.0 - 0.0
TOC	7.8	0.7	4	7.0 - 8.6	0.3	0.0	4	0.3 - 0.3	NA	NA	0	0.0 - 0.0
UV254	0.324	0.0	4	0.285 - 0.348	0.005	0.0	4	0.005 - 0.005	NA	NA	0	0.000 - 0.000
SUVA	4.15	0.46	4	3.80 - 4.83	1.80	0.00	4	1.80 - 1.80	NA	NA	0	NA
Bromide	92	9	4	78 - 98	84	11	4	69 - 95				
TOX	548	287	4	250 - 940	17	9	4	13 - 31				
CHCl3	135.3	51.5	4	61.0 - 180.0	1.0	0.8	4	0.0 - 1.8	Mass Balance Closure Errors (%)			
BDCM	18.7	9.1	4	6.8 - 28.0	0.3	0.6	4	0.0 - 1.2				
DBCM	2.3	1.6	4	0.0 - 3.4	0.5	1.0	4	0.0 - 2.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	4	0.0 - 0.0	0.5	1.0	4	0.0 - 1.9	Alk	1	-535	n/a
THM4	156.2	61.7	4	67.8 - 211.4	2.3	2.7	4	0.0 - 6.2	TDS	4	-58	28
MCAA	2.2	1.7	4	0.0 - 4.1	0.0	0.0	4	0.0 - 0.0	TotHard	3	-155	143
DCAA	38.0	19.7	4	23.0 - 67.0	0.0	0.0	4	0.0 - 0.0	CaHard	3	-152	157
TCAA	51.5	59.4	4	14.0 - 140.0	0.4	0.8	4	0.0 - 1.5	Turb	4	-214	269
MBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	2.5	5.0	4	0.0 - 10.0	0.3	0.6	4	0.0 - 1.1	TOC	0	n/a	n/a
BCAA	5.9	3.8	4	2.2 - 11.0	0.0	0.0	4	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	0.0	0.0	2	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0				
CDBAA	15.8	25.3	3	0.0 - 45.0	0.0	0.0	4	0.0 - 0.0	TDS	99	-61	29
DCBAA	8.3	9.9	4	2.1 - 23.0	0.0	0.0	4	0.0 - 0.0	Comments:			
HAA5	94.2	82.6	4	39.5 - 217.0	0.7	1.3	4	0.0 - 2.6				
HAA6	100.1	86.2	4	41.7 - 228.0	0.7	1.3	4	0.0 - 2.6				
HAA9	186.8	154.4	2	77.6 - 296.0	0.7	1.3	4	0.0 - 2.6				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.74	0.24	8	0.50 - 1.00	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal		Pilot-Scale			
Temp (°C)	24.9	0.2	8	24.5 - 25.0	Sulfuric Acid		93% to adjust pH to 5.8 - 6.2: biological fouling		Pilot-Scale			
pH (unit)	8.8	0.1	8	8.7 - 9.0								
Time (hr)	6.0	0.0	8	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	0.3%	1.9%	Sys Conc - Stg 3 Conc	-0.9%	7.5%	Sys Conc - Stg 3 Conc	-0.1%	1.7%
Stg 1 Conc - Stg 2 Inf	-0.1%	1.4%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.5%	7.5%
Stg 2 Conc - Stg 3 Inf	-0.2%	2.2%	Stg 2 Conc - Stg 3 Inf	-3.0%	11.7%	Stg 2 Conc - Stg 3 Inf	0.0%	0.3%
Sys Perm - Avg Stg Perm	-35.8%	10.4%	Sys Perm - Sum Stg Per	-10.2%	2.1%	Sys Perm - Avg Stg Perm	-19.1%	11.6%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.58	0.02	4	0.55 - 0.59					
pH	6.3	6.1	6.3	0.6	4	5.7 - 7.2	5.9	5.8	0.2	4	5.6 - 5.9
Temp	24.9	24.9	24.9	1.0	4	23.5 - 26.0	24.9	24.8	1.1	4	23.3 - 26.0
Alk	192	170	192	NA	1	192 - 192	49	209	354	4	28 - 740
TDS	239	1085	239	20	4	210 - 250	90	65	11	4	55 - 80
TotHard	220	760	220	16	4	200 - 240	68	67	30	4	50 - 112
CaHard	201	730	201	8	4	190 - 208	62	53	29	4	34 - 96
Turb	0.87	1.46	0.87	1	4	0.40 - 1.80	0.51	0.37	0.19	4	0 - 1
TOC	7.8	NA	7.8	0.7	4	7.0 - 8.6	0.3	0.5	0.4	4	0.3 - 1.1
UV254	0.324	NA	0.324	0.028	4	0.285 - 0.348	0.005	0.005	0.000	4	0.005 - 0.005
SUVA	4.15	NA	4.15	0.46	4	3.80 - 4.83	1.80	1.45	0.70	4	0.41 - 1.80

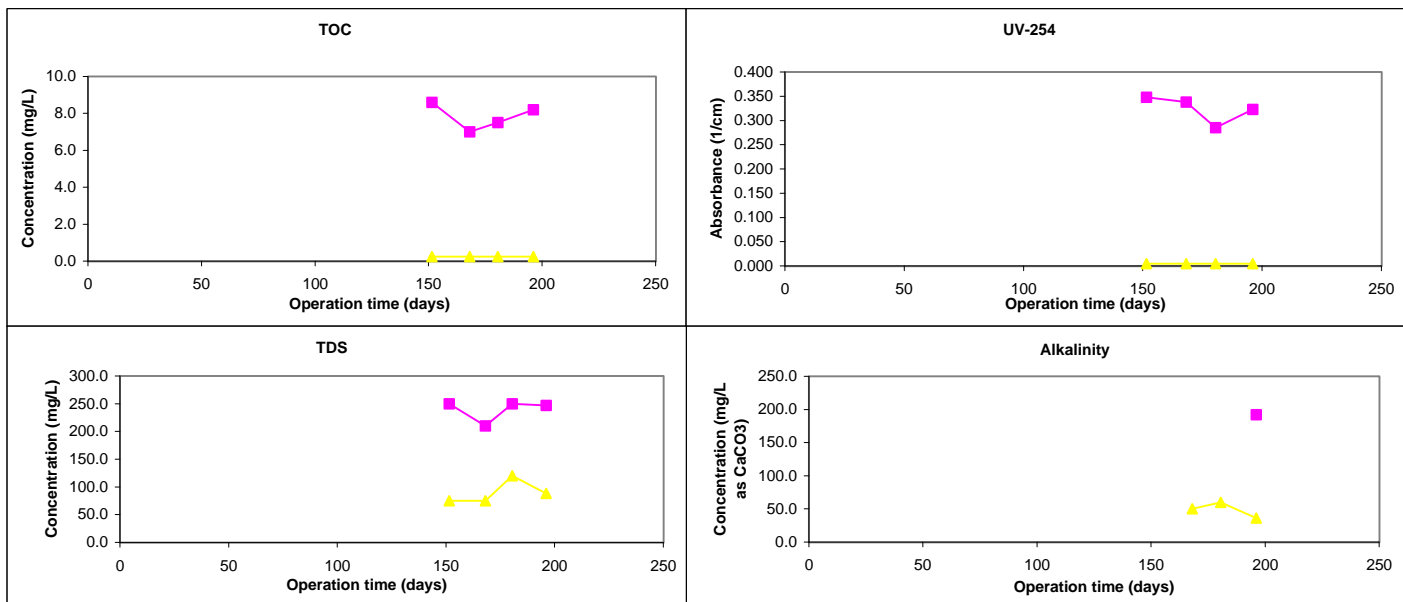
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.64	0.08	4	0.60 - 0.76					
pH	6.3	6.1	6.1	0.3	4	5.7 - 6.4	5.9	6.0	0.3	4	5.7 - 6.2
Temp	24.9	24.9	24.9	1.1	4	23.4 - 26.0	24.9	24.9	1.0	4	23.5 - 26.0
Alk	192	170	185	104	4	120 - 340	49	149	156	4	38 - 380
TDS	239	1085	477	23	4	445 - 500	90	155	31	4	120 - 195
TotHard	220	760	478	120	4	300 - 550	68	108	24	4	80 - 134
CaHard	201	730	380	92	4	260 - 470	62	93	26	4	70 - 124
Turb	0.87	1.46	0.49	0	4	0.30 - 0.62	0.51	0.48	0.23	4	0 - 1
TOC	7.8	NA	23.7	8.3	4	19.1 - 36.1	0.3	0.4	0.4	4	0.3 - 1.0
UV254	0.324	NA	0.865	0.044	4	0.808 - 0.915	0.005	0.005	0.000	4	0.005 - 0.005
SUVA	4.15	NA	3.90	1.00	4.00	2.42 - 4.62	1.80	1.46	0.68	4.00	0.45 - 1.80

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.37	0.04	4	0.31 - 0.38					
pH	6.3	6.1	6.3	0.0	3	6.3 - 6.3	5.9	4.1	3.5	3.0	0.0 - 6.2
Temp	24.9	24.9	24.5	0.9	3	23.5 - 25.0	24.9	24.5	0.9	3	23.4 - 25.0
Alk	192	170	121	2	3	120 - 124	49	85	2	3	82 - 86
TDS	239	1085	681	68	3	605 - 737	90	137	28	3	110 - 165
TotHard	220	760	723	75	3	680 - 810	68	97	12	3	90 - 110
CaHard	201	730	657	98	3	600 - 770	62	80	17	3	70 - 100
Turb	0.87	1.46	4.32	3	3	0.55 - 6.20	0.51	0.24	0.00	3	0 - 0
TOC	7.8	NA	36.3	2.6	3	33.8 - 39.0	0.3	0.3	0.0	3	0.3 - 0.3
UV254	0.324	NA	1.555	0.106	2	1.480 - 1.630	0.005	0.005	0.000	3	0.005 - 0.005
SUVA	4.15	NA	NA	NA	2.00	NA	1.80	1.80	0.00	3.00	1.80 - 1.80

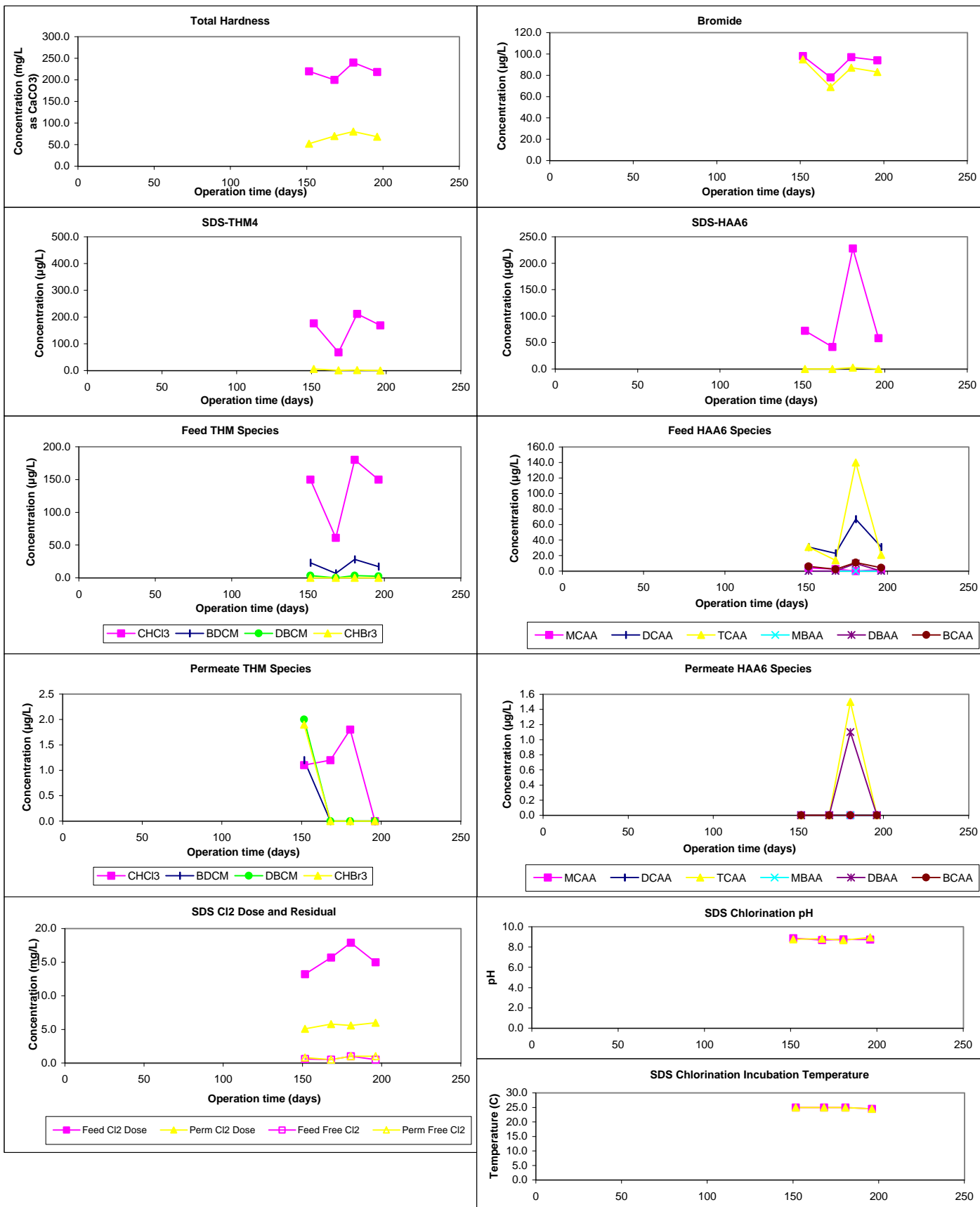
Chart Legend:

- Feed (System)
- Permeate (System)

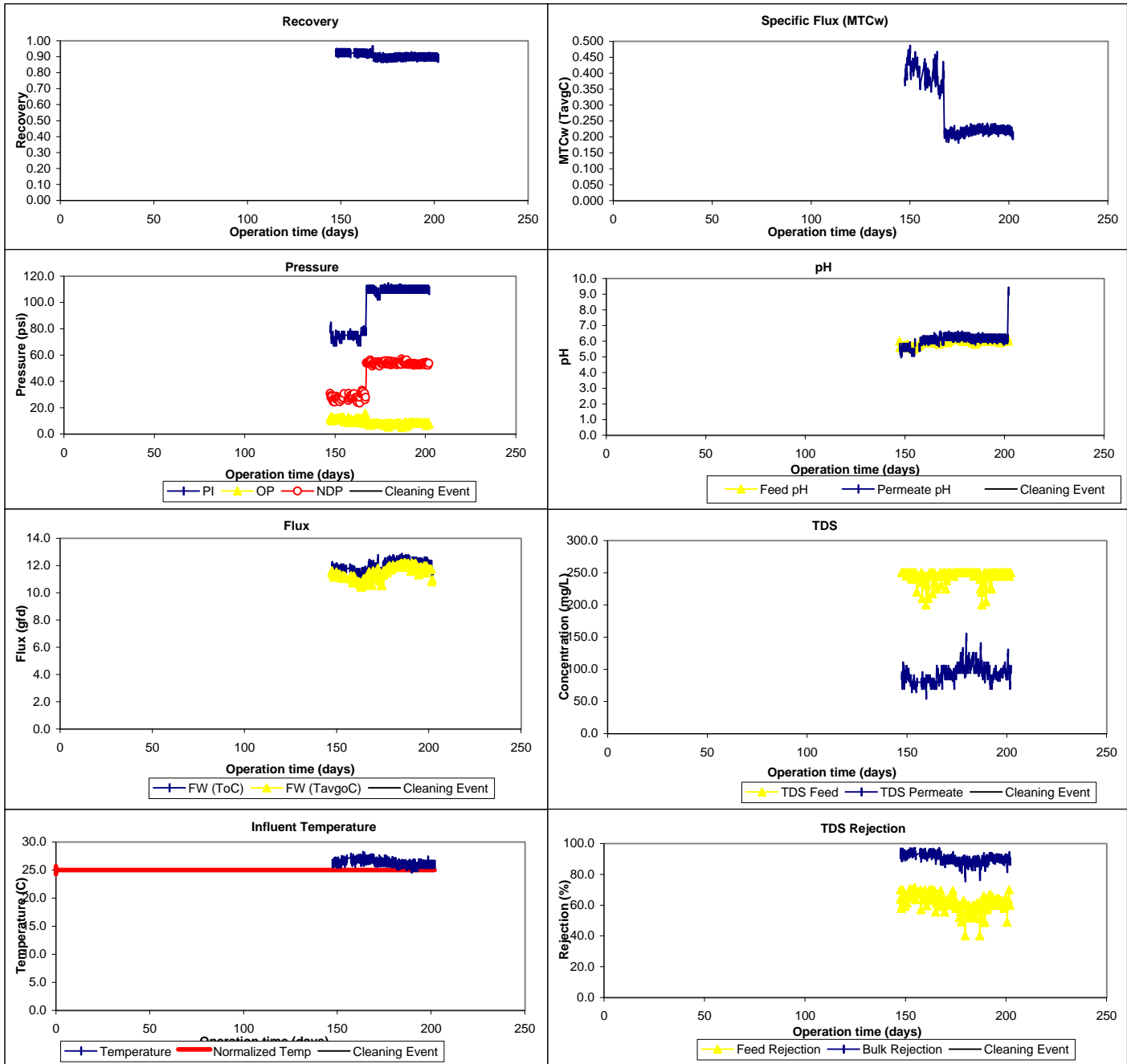
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / #305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 11/13/98 - 12/2/98 (19 days)

Membrane Information

Manufacturer: TriSep Corporation
 Trade Name: TriSep
 Membrane Model: 4040-TS80-TSA
 MWCO: 150-300 Daltons
 Element Size: 4-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 22.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTC_w: 0.210 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 20.0 gpm
 Minimum Flow: 5.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 360.0 ft²
 840 Purchase Price: \$850

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.210 TavGC
 Design Recovery: 0.85
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: 0
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 3.0 psi
 Osmotic P Stage 2: 6.5 psi
 Osmotic P Stage 3: 0.0 psi

Water Quality Summary

	Feed (System)				Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	7.2	NA	1	7.2 - 7.2	5.9	NA	1	5.9 - 5.9	6.3	NA	1	6.3 - 6.3
Temp	26.0	NA	1	26.0 - 26.0	26.0	NA	1	26.0 - 26.0	26.0	NA	1	26.0 - 26.0
Alk	168	NA	1	168 - 168	30	NA	1	30 - 30	NA	NA	0	0 - 0
TDS	250	NA	1	250 - 250	88	NA	1	88 - 88	817	NA	1	817 - 817
TotHard	216	NA	1	216 - 216	62	NA	1	62 - 62	366	NA	1	366 - 366
CaHard	208	NA	1	208 - 208	56	NA	1	56 - 56	338	NA	1	338 - 338
Turb	0.60	NA	1	0.60 - 0.60	0.40	NA	1	0.40 - 0.40	0.70	NA	1	0.70 - 0.70
Amm	0.35	NA	1	0.35 - 0.35	0.23	NA	1	0.23 - 0.23	NA	NA	0	0.0 - 0.0
TOC	7.9	NA	1	7.9 - 7.9	0.3	NA	1	0.3 - 0.3	NA	NA	0	0.0 - 0.0
UV254	0.344	NA	1	0.344 - 0.344	0.005	NA	1	0.005 - 0.005	NA	NA	0	0.000 - 0.000
SUVA	4.35	NA	1	4.35 - 4.35	1.80	NA	1	1.80 - 1.80	NA	NA	0	NA
Bromide	95	NA	1	95 - 95	85	NA	1	85 - 85				
TOX	900	NA	1	900 - 900	13	NA	1	13 - 13				
CHCl3	220.0	NA	1	220.0 - 220.0	2.4	NA	1	2.4 - 2.4	Mass Balance			
BDCM	30.0	NA	1	30.0 - 30.0	0.0	NA	1	0.0 - 0.0	Closure Errors (%)			
DBCM	3.8	NA	1	3.8 - 3.8	0.0	NA	1	0.0 - 0.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	Alk	0	n/a	n/a
THM4	253.8	NA	1	253.8 - 253.8	2.4	NA	1	2.4 - 2.4	TDS	1	-42	n/a
MCAA	3.8	NA	1	3.8 - 3.8	0.0	NA	1	0.0 - 0.0	TotHard	1	-196	n/a
DCAA	61.0	NA	1	61.0 - 61.0	0.0	NA	1	0.0 - 0.0	CaHard	1	-214	n/a
TCAA	110.0	NA	1	110.0 - 110.0	0.0	NA	1	0.0 - 0.0	Turb	1	-146	n/a
MBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	1.0	NA	1	1.0 - 1.0	0.0	NA	1	0.0 - 0.0	TOC	0	n/a	n/a
BCAA	9.6	NA	1	9.6 - 9.6	0.0	NA	1	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	0.0	NA	1	0.0 - 0.0	0.0	NA	1	0.0 - 0.0				
CDBAA	2.8	NA	1	2.8 - 2.8	0.0	NA	1	0.0 - 0.0	TDS _t	53	-42	12
DCBAA	17.0	NA	1	17.0 - 17.0	0.0	NA	1	0.0 - 0.0	Comments:			
HAA5	175.8	NA	1	175.8 - 175.8	0.0	NA	1	0.0 - 0.0				
HAA6	185.4	NA	1	185.4 - 185.4	0.0	NA	1	0.0 - 0.0				
HAA9	205.2	NA	1	205.2 - 205.2	0.0	NA	1	0.0 - 0.0				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.90	0.14	2	0.80 - 1.00	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal		Pilot-Scale			
Temp (°C)	25.0	0.0	2	25.0 - 25.0	Sulfuric Acid		93% to adjust pH to 5.8 - 6.2: biological fouling		Pilot-Scale			
pH (unit)	8.8	0.1	2	8.7 - 8.8								
Time (hr)	6.0	0.0	2	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!	Sys Conc - Stg 3 Conc	#DIV/0!	#DIV/0!
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!	Stg 2 Conc - Stg 3 Inf	200.0%	0.0%	Stg 2 Conc - Stg 3 Inf	#DIV/0!	#DIV/0!
Sys Perm - Avg Stg Perm	-10.7%	5.3%	Sys Perm - Sum Stg Per	-0.1%	0.6%	Sys Perm - Avg Stg Perm	-24.0%	9.2%

Stage Summary

	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.57	NA	1	0.57 - 0.57					
pH	7.2	6.3	7.2	NA	1	7.2 - 7.2	5.9	5.8	NA	1	5.8 - 5.8
Temp	26.0	26.0	26.0	NA	1	26.0 - 26.0	26.0	26.0	NA	1	26.0 - 26.0
Alk	168	NA	168	NA	1	168 - 168	30	20	NA	1	20 - 20
TDS	250	817	250	NA	1	250 - 250	88	66	NA	1	66 - 66
TotHard	216	366	216	NA	1	216 - 216	62	40	NA	1	40 - 40
CaHard	208	338	208	NA	1	208 - 208	56	36	NA	1	36 - 36
Turb	0.60	0.70	0.60	NA	1	0.60 - 0.60	0.40	0.20	NA	1	0 - 0
TOC	7.9	NA	7.9	NA	1	7.9 - 7.9	0.3	0.3	NA	1	0.3 - 0.3
UV254	0.344	NA	0.344	NA	1	0.344 - 0.344	0.005	0.005	NA	1	0.005 - 0.005
SUVA	4.35	NA	4.35	NA	1	4.35 - 4.35	1.80	1.80	NA	1	1.80 - 1.80

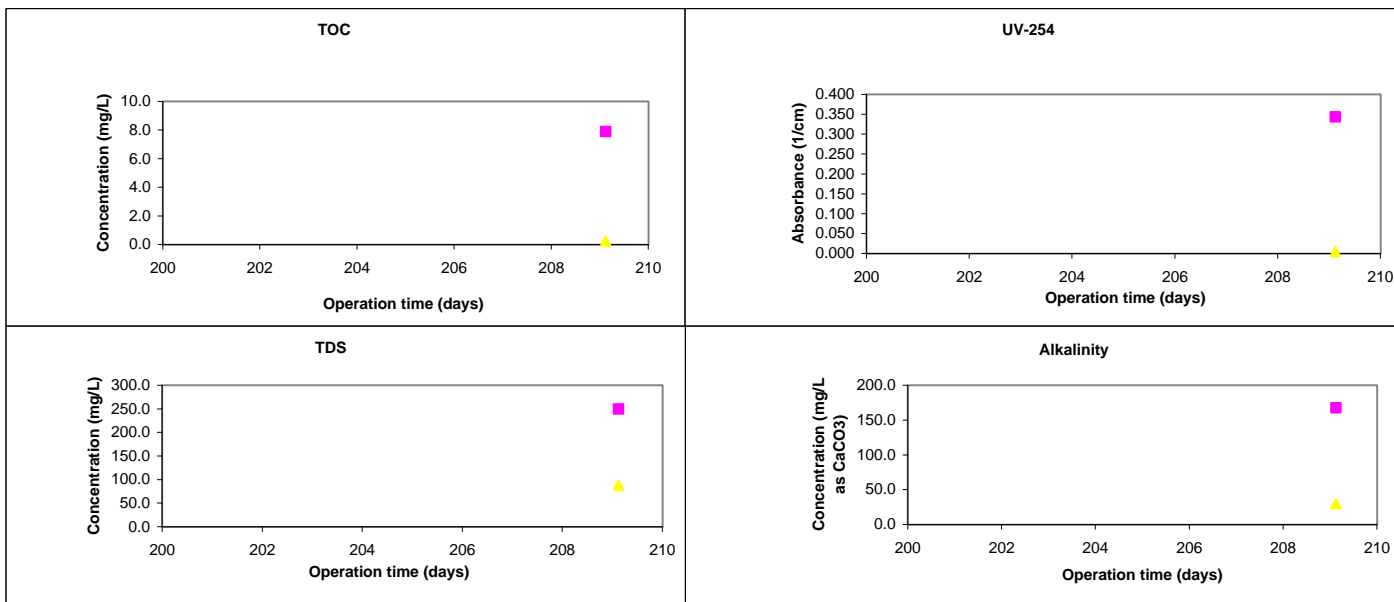
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.65	NA	1	0.65 - 0.65					
pH	7.2	6.3	6.3	NA	1	6.3 - 6.3	5.9	6.0	NA	1	6.0 - 6.0
Temp	26.0	26.0	26.0	NA	1	26.0 - 26.0	26.0	26.0	NA	1	26.0 - 26.0
Alk	168	NA	56	NA	1	56 - 56	30	52	NA	1	52 - 52
TDS	250	817	500	NA	1	500 - 500	88	152	NA	1	152 - 152
TotHard	216	366	380	NA	1	380 - 380	62	98	NA	1	98 - 98
CaHard	208	338	360	NA	1	360 - 360	56	92	NA	1	92 - 92
Turb	0.60	0.70	0.55	NA	1	0.55 - 0.55	0.40	0.25	NA	1	0 - 0
TOC	7.9	NA	19.1	NA	1	19.1 - 19.1	0.3	1.2	NA	1	1.2 - 1.2
UV254	0.344	NA	0.824	NA	1	0.824 - 0.824	0.005	0.005	NA	1	0.005 - 0.005
SUVA	4.35	NA	4.31	NA	1.00	4.31 - 4.31	1.80	0.38	NA	1.00	0.38 - 0.38

	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

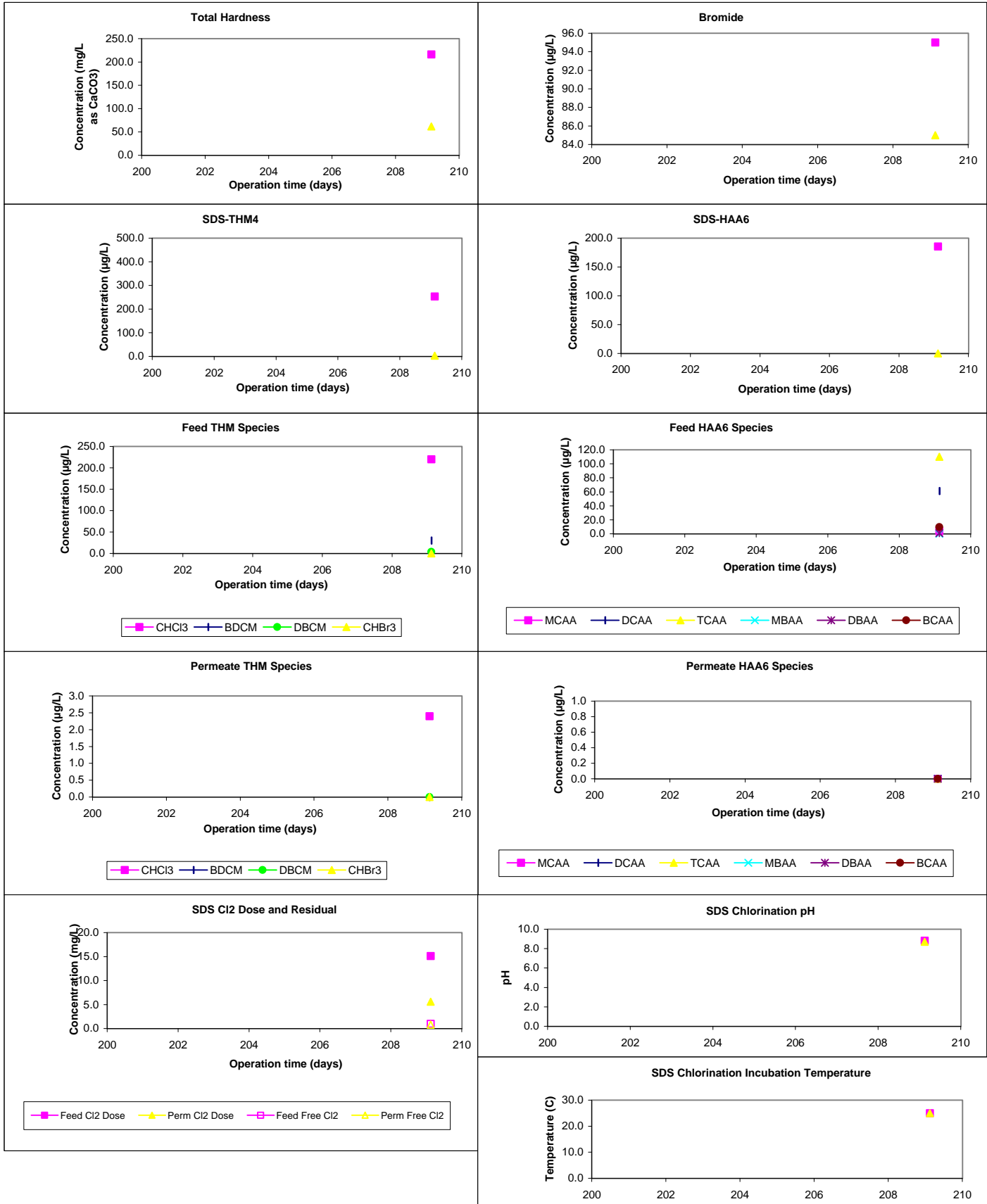
Water Quality Parameter Graphs

Chart Legend:

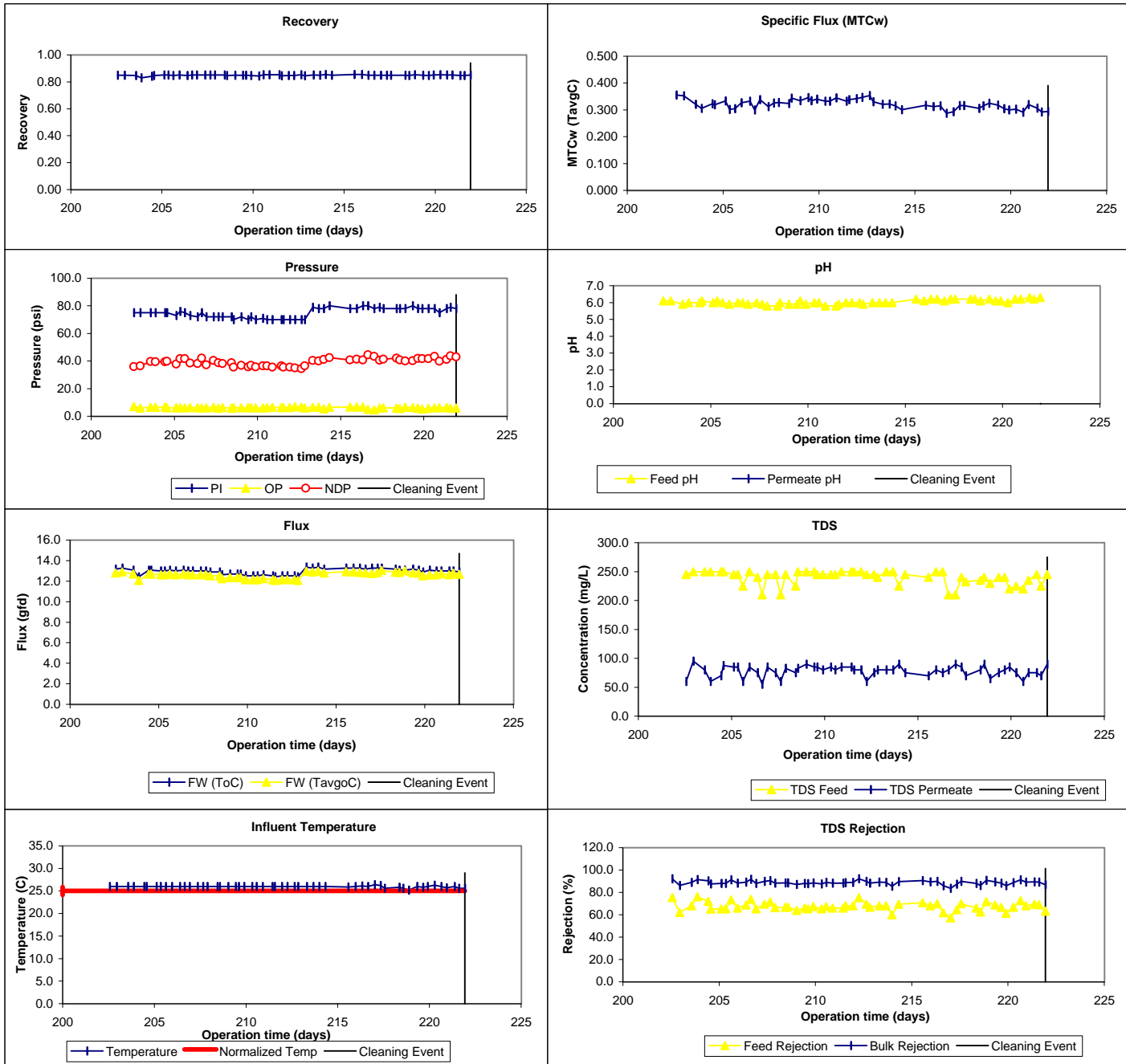
■ Feed (System)
▲ Permeate (System)



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / #305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 12/2/98 - 1/30/99 (59 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: ESNA-1
 Membrane Model: ESNA-1-4040
 MWCO: 180 Daltons
 Element Size: 4.0-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 27.0 gfd
 Mfr. NDP: 75.0 psi
 Mfr. MTC_w: 0.360 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 16.0 gpm
 Minimum Flow: 3.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$900

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.360 TavGC
 Design Recovery: 0.75
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: NA
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 2.5 psi
 Osmotic P Stage 2: 3.5 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	7.2	0.0	5	7.1 - 7.2	6.0	0.0	5	6.0 - 6.1	6.3	0.2	5	6.1 - 6.5
Temp	25.0	0.0	5	25.0 - 25.0	25.0	0.0	5	25.0 - 25.0	25.0	0.0	5	25.0 - 25.0
Alk	163	10	5	156 - 178	29	6	5	20 - 36	170	NA	1	170 - 170
TDS	209	19	5	190 - 240	59	11	5	49 - 75	531	60	5	475 - 610
TotHard	210	4	5	204 - 216	55	13	5	38 - 70	376	18	5	350 - 400
CaHard	204	7	5	192 - 210	52	7	5	46 - 60	352	18	5	340 - 380
Turb	0.42	0.1	5	0.32 - 0.62	0.23	0.1	5	0.11 - 0.34	0.68	0.3	4	0.35 - 0.95
Amm	0.25	0.10	5	0.10 - 0.37	0.16	0.07	5	0.05 - 0.22	1.00	NA	1	1.0 - 1.0
TOC	8.1	1.0	5	7.0 - 9.1	0.6	0.4	5	0.3 - 1.2	28.4	NA	1	28.4 - 28.4
UV254	0.321	0.0	5	0.300 - 0.338	0.011	0.0	5	0.005 - 0.022	1.210	NA	1	1.210 - 1.210
SUVA	4.02	0.34	5	3.71 - 4.56	1.74	0.67	5	0.92 - 2.75	NA	NA	1	NA
Bromide	86	8	5	78 - 98	47	13	5	40 - 70				
TOX	608	433	5	125 - 1290	13	0	5	13 - 13				
CHCl3	185.0	19.4	5	165.0 - 210.0	2.3	1.6	5	0.0 - 3.6	Mass Balance Closure Errors (%)			
BDCM	30.9	2.4	5	28.0 - 34.0	2.3	1.4	5	0.0 - 3.6				
DBCM	4.1	0.9	5	2.9 - 5.5	2.7	1.7	5	0.0 - 4.5	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	5	0.0 - 0.0	1.3	1.0	5	0.0 - 2.6	Alk	1	-190	n/a
THM4	220.0	21.4	5	197.0 - 249.5	8.6	5.6	5	0.0 - 14.2	TDS	5	-23	26
MCAA	2.6	1.5	5	0.0 - 3.7	0.0	0.0	5	0.0 - 0.0	TotHard	5	-73	8
DCAA	43.8	4.5	5	40.0 - 50.5	0.2	0.5	5	0.0 - 1.2	CaHard	5	-81	10
TCAA	35.6	8.2	5	28.0 - 49.5	0.0	0.0	5	0.0 - 0.0	Turb	4	-39	76
MBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Amm	1	18	n/a
DBAA	0.2	0.5	5	0.0 - 1.1	0.3	0.7	5	0.0 - 1.6	TOC	1	3	n/a
BCAA	7.2	0.7	5	6.5 - 8.2	0.2	0.5	5	0.0 - 1.1	UV254	1	-1	n/a
TBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0				
CDBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	TDS	99	-15	7
DCBAA	5.7	1.3	5	3.9 - 7.1	0.0	0.0	5	0.0 - 0.0	Comments:			
HAA5	82.3	13.0	5	68.0 - 103.4	0.6	1.2	5	0.0 - 2.8				
HAA6	89.4	13.4	5	74.5 - 111.0	0.8	1.7	5	0.0 - 3.9				
HAA9	95.1	14.5	5	78.4 - 118.1	0.8	1.7	5	0.0 - 3.9				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.77	0.19	10	0.50 - 1.00	Cartridge Filtration		Hytrex II GX 05-9, 5 micron: colloidal removal		Pilot-Scale			
Temp (°C)	25.0	0.0	10	25.0 - 25.0	Sulfuric Acid		93% to adjust pH to 5.8 - 6.2: biological fouling		Pilot-Scale			
pH (unit)	8.8	0.1	10	8.6 - 9.1								
Time (hr)	6.0	0.0	10	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.1%	1.2%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 2 Conc	0.0%	0.0%	Sys Conc - Stg 2 Conc	-0.3%	2.8%	Sys Conc - Stg 2 Conc	-0.2%	1.4%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.1%	1.0%
Sys Perm - Avg Stg Perm	-10.2%	4.0%	Sys Perm - Sum Stg Per	0.1%	1.1%	Sys Perm - Avg Stg Perm	-20.1%	10.2%

Stage Summary

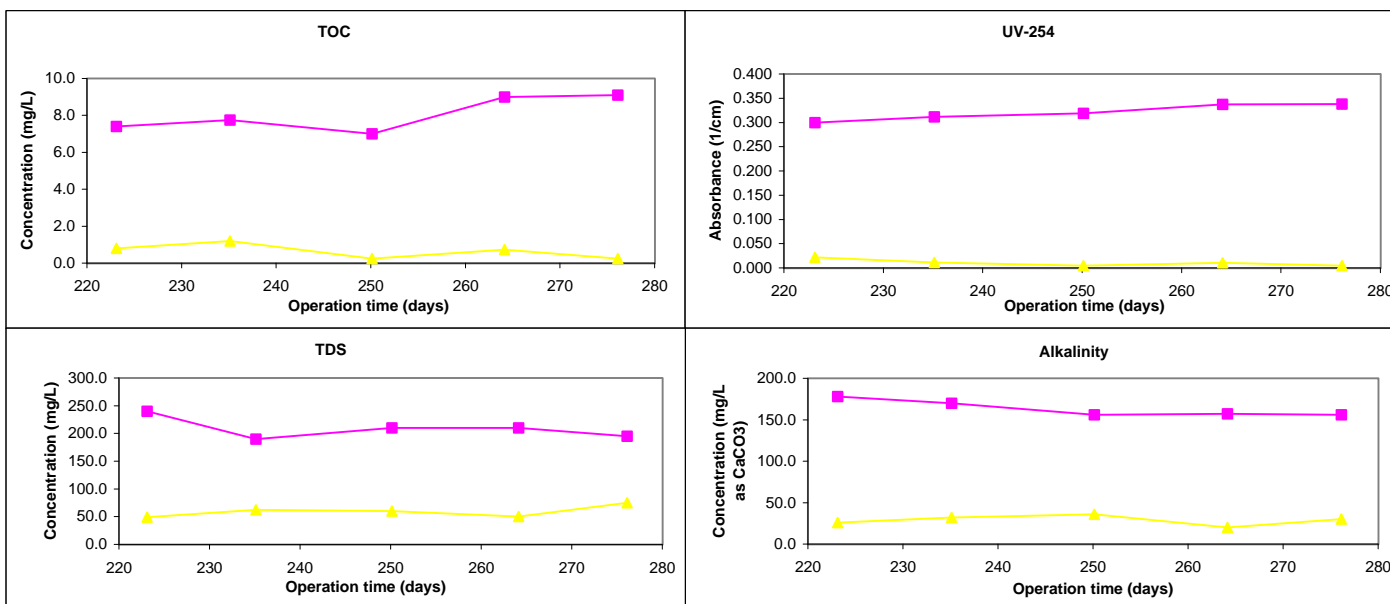
	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.52	0.01	5	0.51 - 0.52					
pH	7.2	6.3	7.2	0.0	5	7.1 - 7.2	6.0	5.9	0.1	5	5.8 - 6.0
Temp	25.0	25.0	25.0	0.0	5	25.0 - 25.0	25.0	25.0	0.0	5	25.0 - 25.0
Alk	163	170	164	10	5	156 - 178	29	20	9	5	12 - 34
TDS	209	531	212	21	5	190 - 240	59	50	0	5	50 - 50
TotHard	210	376	210	4	5	204 - 216	55	44	8	5	36 - 58
CaHard	204	352	204	7	5	192 - 210	52	35	7	5	26 - 44
Turb	0.42	0.68	0.44	0	5	0.32 - 0.62	0.23	0.41	0.61	5	0 - 2
TOC	8.1	28.4	8.0	0.9	5	7.0 - 9.1	0.6	0.6	0.4	5	0.3 - 1.1
UV254	0.321	1.210	0.321	0.016	5	0.300 - 0.338	0.011	0.009	0.004	5	0.005 - 0.014
SUVA	4.02	NA	4.03	0.33	5	3.71 - 4.56	1.74	1.60	0.23	5	1.27 - 1.80
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.46	0.02	5	0.44 - 0.48					
pH	7.2	6.3	6.3	0.1	5	6.2 - 6.5	6.0	6.0	0.0	5	6.0 - 6.1
Temp	25.0	25.0	25.0	0.0	5	25.0 - 25.0	25.0	25.0	0.0	5	25.0 - 25.0
Alk	163	170	NA	NA	0	0 - 0	29	37	12	5	24 - 54
TDS	209	531	387	24	5	350 - 410	59	103	25	5	70 - 140
TotHard	210	376	311	79	4	225 - 400	55	92	18	5	70 - 110
CaHard	204	352	273	64	5	215 - 380	52	75	25	5	44 - 100
Turb	0.42	0.68	0.48	0	5	0.30 - 0.85	0.23	0.21	0.08	5	0 - 0
TOC	8.1	28.4	14.1	6.2	5	3.2 - 17.7	0.6	0.8	0.7	5	0.3 - 2.0
UV254	0.321	1.210	0.739	0.058	5	0.677 - 0.801	0.011	0.023	0.009	5	0.016 - 0.037
SUVA	4.02	NA	8.06	8.13	5.00	4.03 - 22.59	1.74	4.00	2.23	5.00	1.85 - 6.40
	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

This was only a two stage study.

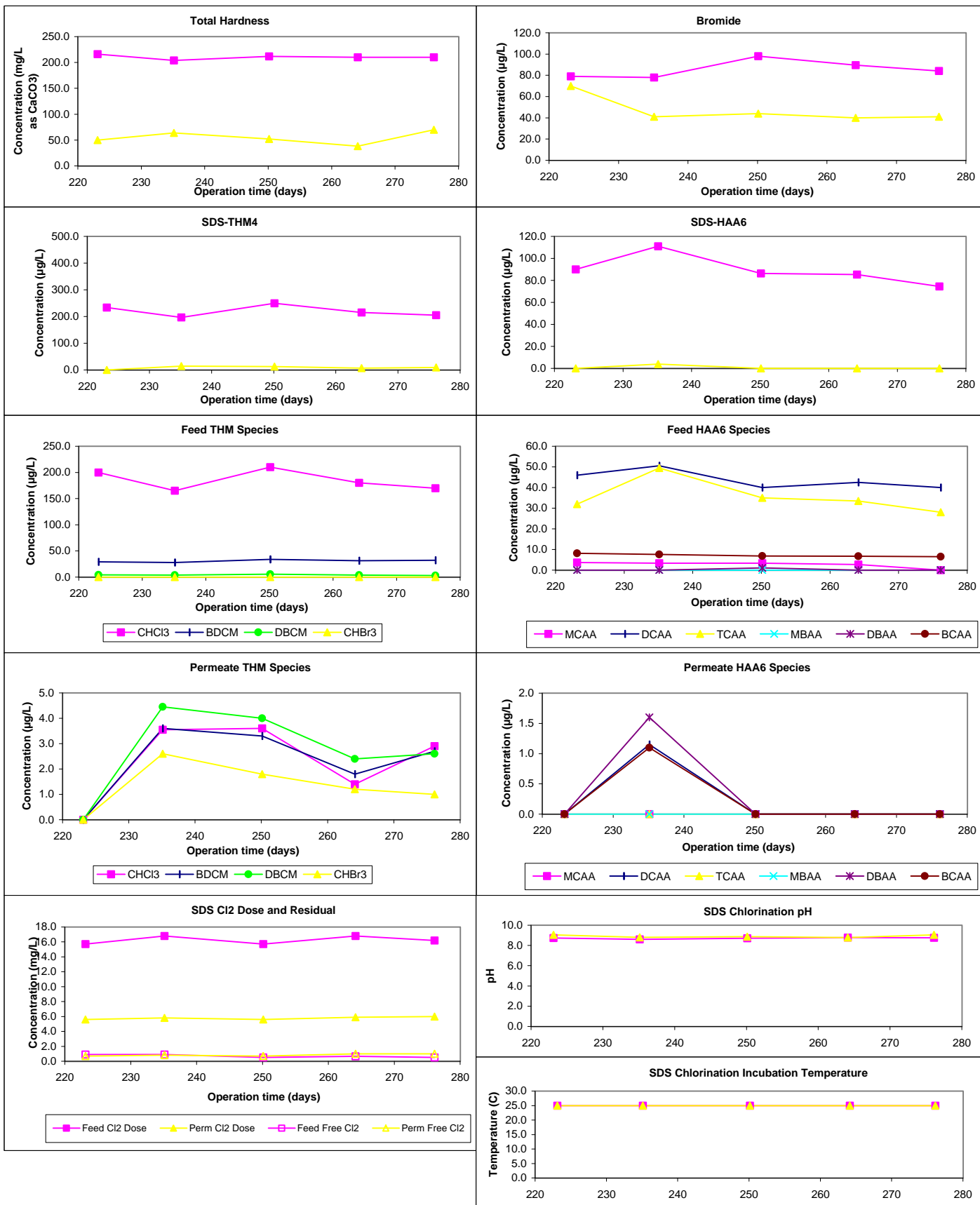
Chart Legend:

- Feed (System)
- Permeate (System)

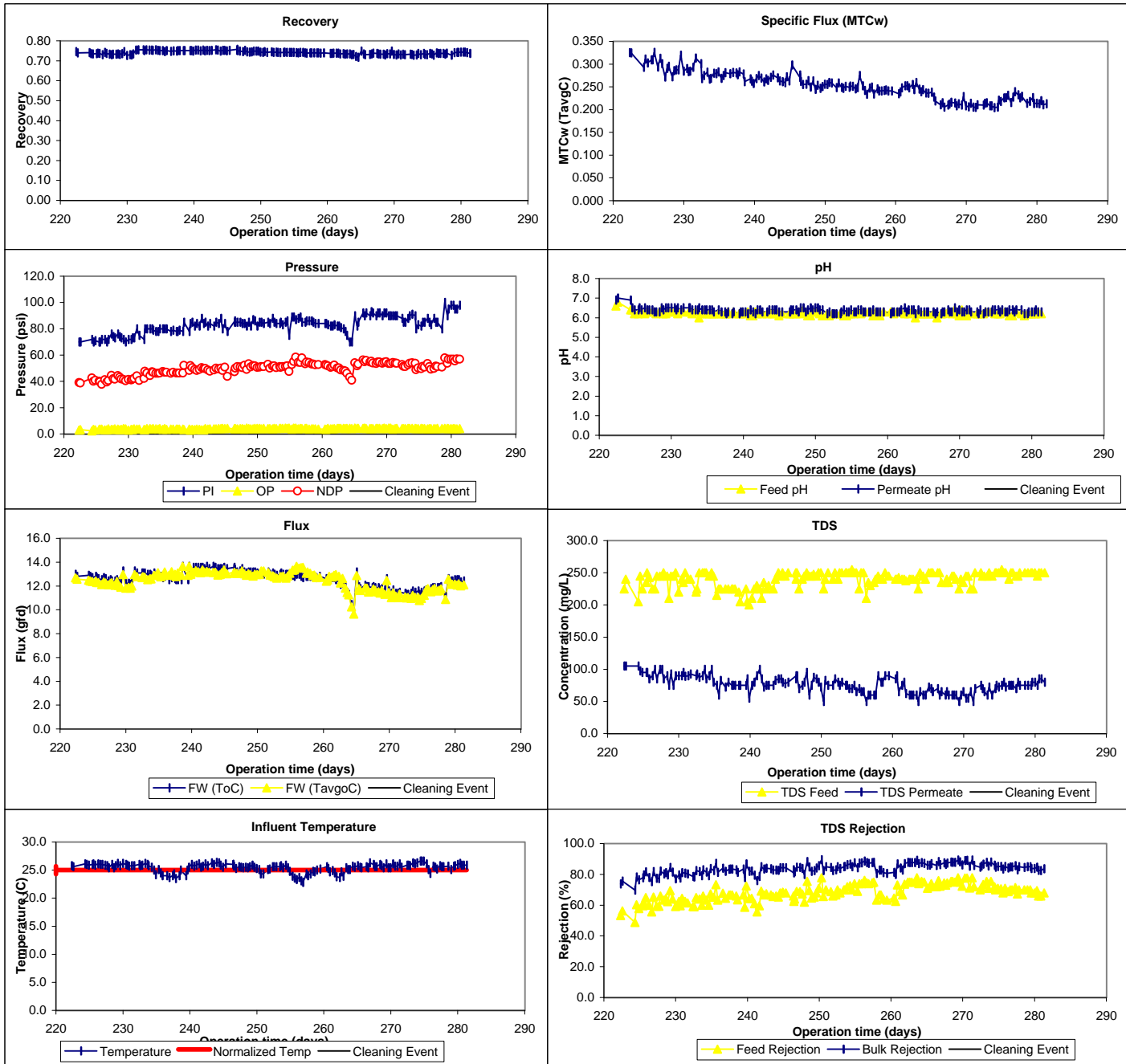
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL4131618 / #305
 ICR Contact: Joseph Arena
 Phone No.: (305) 651-8520
 Period: 2/1/99 - 4/18/99 (76 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: ESNA-1
 Membrane Model: ESNA-1-4040
 MWCO: 180 Daltons
 Element Size: 4.0-inch x 40-inch
 Element Area: 85.0 ft²
 Design Flux: 27.0 gfd
 Mfr. NDP: 75.0 psi
 Mfr. MTC_w: 0.360 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 16.0 gpm
 Minimum Flow: 3.0 gpm
 Total Width: 15.0 ft
 Feed Spacer Thickness: 0.0024 ft
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$900

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.360 TavGC
 Design Recovery: 0.75
 Avg Sys Flux F_w: 12.0 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 4
 # Pres Ves in Stg 2: 2
 Pres Ves in Stg 3: NA
 Design Flux: 12.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 2.5 psi
 Osmotic P Stage 2: 3.5 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	7.2	0.1	3	7.2 - 7.3	5.9	0.1	3	5.8 - 6.0	6.4	0.2	3	6.2 - 6.6
Temp	25.2	0.3	3	25.0 - 25.5	25.5	0.5	3	25.0 - 26.0	25.5	0.5	3	25.0 - 26.0
Alk	183	36	3	142 - 210	44	14	3	34 - 60	172	NA	1	172 - 172
TDS	215	5	3	210 - 220	62	3	3	60 - 65	595	82	3	500 - 645
TotHard	213	4	3	210 - 218	61	6	3	56 - 68	363	32	3	340 - 400
CaHard	208	3	3	206 - 212	57	5	3	52 - 62	330	17	3	310 - 340
Turb	0.75	0.7	3	0.34 - 1.50	0.13	0.0	3	0.13 - 0.14	0.78	0.7	3	0.35 - 1.60
Amm	0.22	0.09	3	0.12 - 0.27	0.18	0.05	3	0.14 - 0.23	NA	NA	0	0.0 - 0.0
TOC	8.0	0.8	3	7.3 - 8.8	0.3	0.0	3	0.3 - 0.3	NA	NA	0	0.0 - 0.0
UV254	0.341	0.0	3	0.336 - 0.349	0.013	0.0	3	0.010 - 0.018	NA	NA	0	0.000 - 0.000
SUVA	4.30	0.32	3	3.97 - 4.60	5.20	1.74	3	4.00 - 7.20	NA	NA	0	NA
Bromide	88	4	3	84 - 91	40	10	3	29 - 48				
TOX	705	28	3	680 - 735	22	8	3	13 - 28				
CHCl3	196.7	23.1	3	170.0 - 210.0	6.0	1.3	3	4.7 - 7.3	Mass Balance			
BDCM	25.7	2.5	3	23.0 - 28.0	3.4	0.6	3	2.8 - 4.0	Closure Errors (%)			
DBCM	3.3	0.4	3	3.1 - 3.8	2.6	0.8	3	1.8 - 3.4	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	3	0.0 - 0.0	0.9	0.8	3	0.0 - 1.5	Alk	0	n/a	n/a
THM4	225.7	25.6	3	196.1 - 241.8	12.9	1.7	3	11.5 - 14.8	TDS	0	n/a	n/a
MCAA	3.8	0.6	3	3.1 - 4.2	0.0	0.0	3	0.0 - 0.0	TotHard	0	n/a	n/a
DCAA	50.0	3.6	3	47.0 - 54.0	1.3	1.2	3	0.0 - 2.2	CaHard	0	n/a	n/a
TCAA	38.7	9.1	3	29.0 - 47.0	0.4	0.6	3	0.0 - 1.1	Turb	0	n/a	n/a
MBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	3	0.0 - 0.0	Amm	0	n/a	n/a
DBAA	0.0	0.0	3	0.0 - 0.0	0.7	0.6	3	0.0 - 1.1	TOC	0	n/a	n/a
BCAA	6.9	1.1	3	5.9 - 8.0	0.0	0.0	3	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	3	0.0 - 0.0				
CDBAA	0.7	1.2	3	0.0 - 2.0	0.0	0.0	3	0.0 - 0.0	TDS	99	-15	5
DCBAA	5.2	2.8	3	2.4 - 7.9	0.0	0.0	3	0.0 - 0.0	Comments:			
HAA5	92.5	12.1	3	81.1 - 105.1	2.4	1.5	3	1.0 - 4.0				
HAA6	99.3	13.1	3	87.0 - 113.1	2.4	1.5	3	1.0 - 4.0				
HAA9	105.2	16.9	3	89.4 - 123.0	2.4	1.5	3	1.0 - 4.0				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (0)	0.77	0.21	6	0.50 - 1.00	Cartridge Filtration	Hytrex II GX 05-9, 5 micron: colloidal removal						Pilot-Scale
Temp (°C)	25.0	0.0	6	25.0 - 25.0	Sulfuric Acid	93% to adjust pH to 5.8 - 6.2: biological fouling						Pilot-Scale
pH (unit)	8.9	0.1	6	8.7 - 9.0								
Time (hr)	6.0	0.0	6	6.0 - 6.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.2%
Sys Conc - Stg 2 Conc	0.0%	0.1%	Sys Conc - Stg 2 Conc	-0.1%	2.6%	Sys Conc - Stg 2 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.6%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	-11.1%	3.9%	Sys Perm - Sum Stg Per	0.0%	0.9%	Sys Perm - Avg Stg Perm	-22.8%	13.8%

Stage Summary

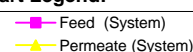
WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.52	0.00	3	0.51 - 0.52					
pH	7.2	6.4	7.2	0.1	3	7.2 - 7.3	5.9	5.9	0.2	3	5.7 - 6.1
Temp	25.2	25.5	25.2	0.3	3	25.0 - 25.5	25.5	25.5	0.5	3	25.0 - 26.0
Alk	183	172	183	36	3	142 - 210	44	40	17	3	30 - 60
TDS	215	595	215	5	3	210 - 220	62	50	5	3	45 - 55
TotHard	213	363	213	4	3	210 - 218	61	58	12	3	48 - 72
CaHard	208	330	208	3	3	206 - 212	57	53	15	3	44 - 70
Turb	0.75	0.78	0.75	1	3	0.34 - 1.50	0.13	1.96	3.16	3	0 - 6
TOC	8.0	NA	8.0	0.8	3	7.3 - 8.8	0.3	0.3	0.0	3	0.3 - 0.3
UV254	0.341	NA	0.341	0.007	3	0.336 - 0.349	0.013	0.005	0.000	3	0.005 - 0.005
SUVA	4.30	NA	4.30	0.32	3	3.97 - 4.60	5.20	1.80	0.00	3	1.80 - 1.80

WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.46	0.01	3	0.45 - 0.48					
pH	7.2	6.4	6.4	0.3	3	6.1 - 6.7	5.9	6.0	0.2	3	5.8 - 6.2
Temp	25.2	25.5	25.5	0.5	3	25.0 - 26.0	25.5	25.5	0.5	3	25.0 - 26.0
Alk	183	172	NA	NA	0	0 - 0	44	49	10	3	38 - 58
TDS	215	595	438	29	3	405 - 460	62	117	21	3	100 - 140
TotHard	213	363	273	12	3	260 - 280	61	104	6	3	98 - 110
CaHard	208	330	240	0	2	240 - 240	57	98	4	3	94 - 102
Turb	0.75	0.78	0.47	0	3	0.32 - 0.78	0.13	0.19	0.11	3	0 - 0
TOC	8.0	NA	16.6	1.7	3	14.7 - 18.0	0.3	1.2	0.7	3	0.7 - 2.0
UV254	0.341	NA	0.750	0.063	3	0.677 - 0.789	0.013	0.027	0.009	3	0.020 - 0.037
SUVA	4.30	NA	4.53	0.16	3.00	4.36 - 4.64	5.20	2.57	0.63	3.00	1.85 - 3.00

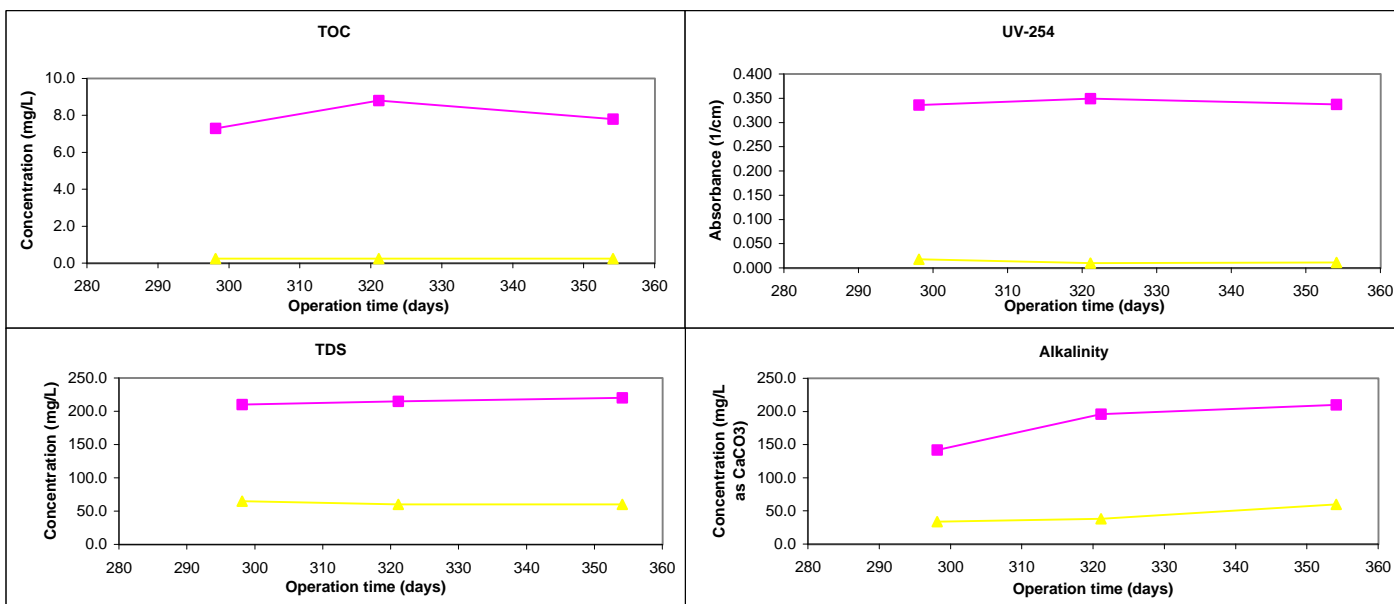
WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

This was only a two stage study.

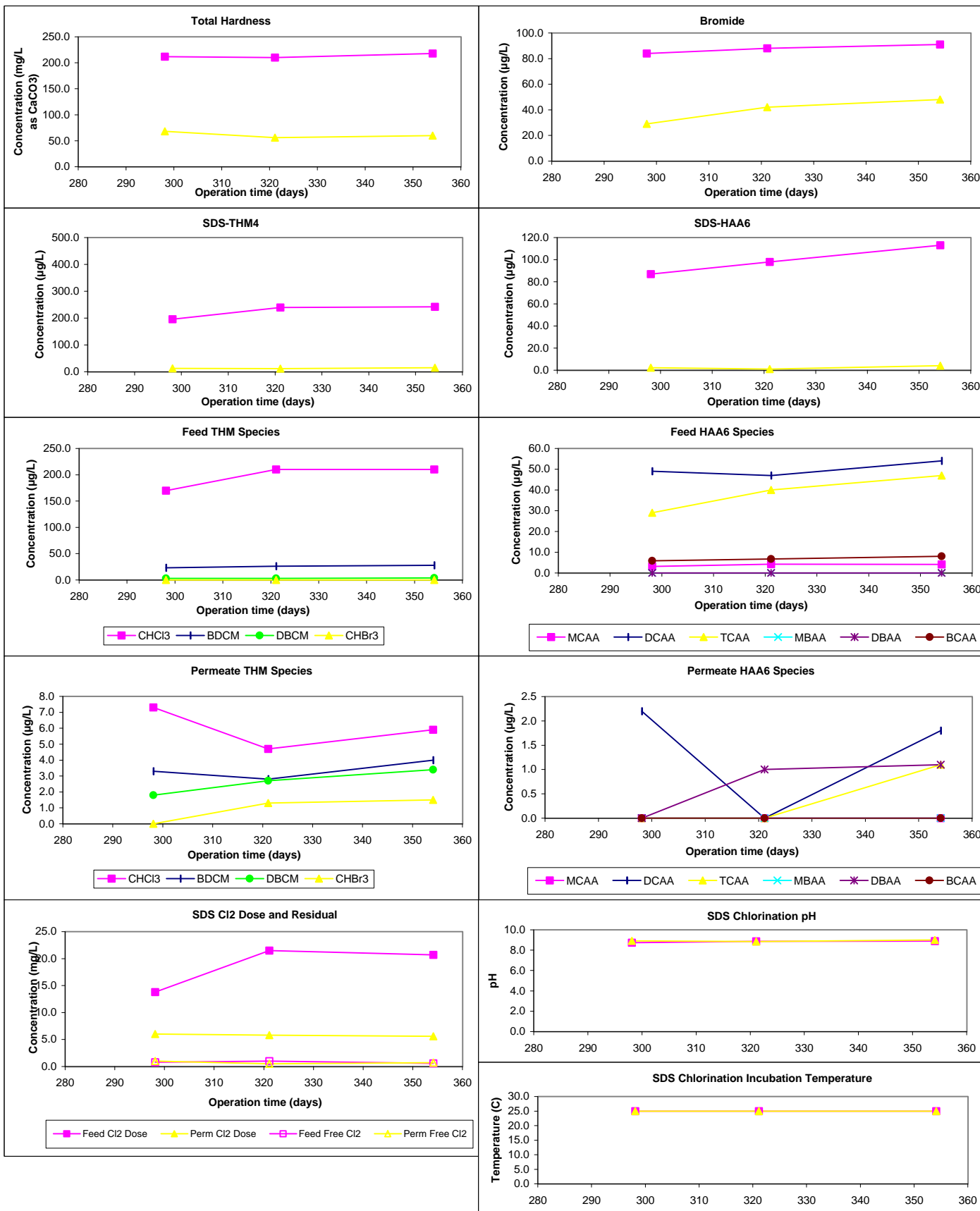
Chart Legend:



Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs

