

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1051
Study Protocol	Membrane RBSMT treatment study
Plant ICR Number	636
PWS Name	City of Beaumont
City, State, Zip	Beaumont, TX 77703

General Comments:

1. During this bench-scale study, two membranes were evaluated: the FilmTec BW30-XLE and the FilmTec NF200. Each membrane was tested during four quarters over a one-year period.
2. The influent to the study was collected from the pulsator clarifier effluent after a chlorine addition point. However, the Summary Report (Figure 1) indicates that the sample was collected after the chlorinator was turned off and no chlorine residual was present at the time of collection.
3. During data analysis, temperatures of 16°C, 24°C, 29°C, and 24°C for Winter, Spring, Summer and Autumn, were used, respectively. This was necessary to estimate the range of pressures required to maintain a constant production rate over the course of a calendar year. The temperatures were estimated using the range of full-scale influent water temperatures reported in the Summary Report. The temperatures in the Data Collection Spreadsheets are indicative of lab conditions.
4. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 2 water quality outliers were identified and removed prior to base analysis.
2. SDS conditions are summarized in Table 6 of the Summary Report. The pH and incubation time were relatively constant, pH ranged from 7.7 to 8.1 and time ranged from 6.0 to 6.43 hours. Temperature and residual were varied over the four quarters, temperature ranged from 11 to 30 °C and residual ranged from 0.5 – 1.0 to 2.2 mg/L.

Productivity Comments:

1. 1 productivity outlier was identified and removed prior to base analysis.
2. During the 1st quarter for both membranes, the temperature gauges were found to be inaccurate. A NIST calibrate thermometer was used during the last three quarters.
3. Significant membrane fouling was observed for both membranes. During the 4th quarter, higher antiscalant doses were used along with a slightly lower flux, and these changes reduced the rate of flux loss.
4. The cleaning procedure utilized both phosphoric acid and sodium hydroxide solutions. Additional information is provided in Section 3B of the Summary Report.

ICR Information

ID / ICR#: TX1230001 / 636
ICR Contact: Bob Burrows, R.S.
Phone No.: 409-838-3524
Period: 4/9/98 - 4/18/98 (9 days)

Membrane Information

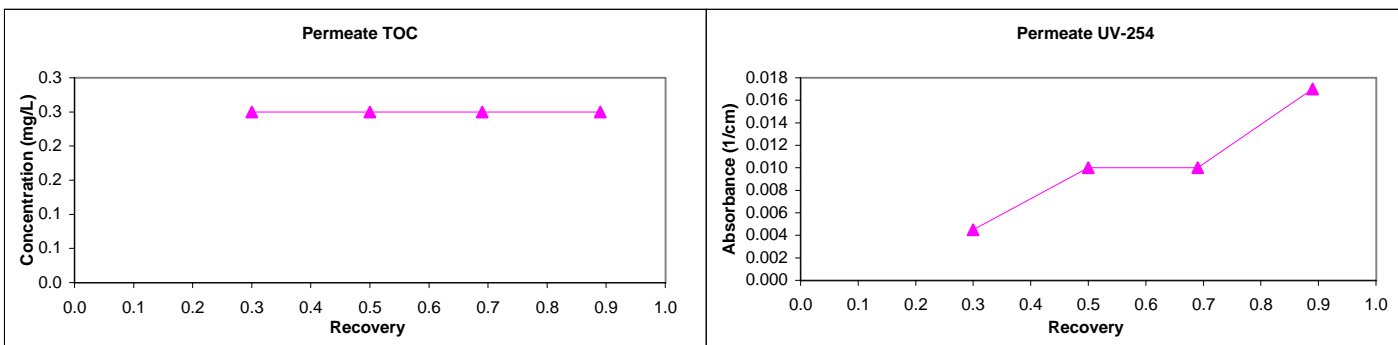
Manufacturer: FilmTec Corporation
Trade Name: NF200B-4040
MWCO: 400 Daltons
Mfr. Flux: 16.5 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.235 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: \$700
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 34.0 gpm
840 Total Width: 70.7 ft
840 Feed Spacer Thickness: 0.0023 ft

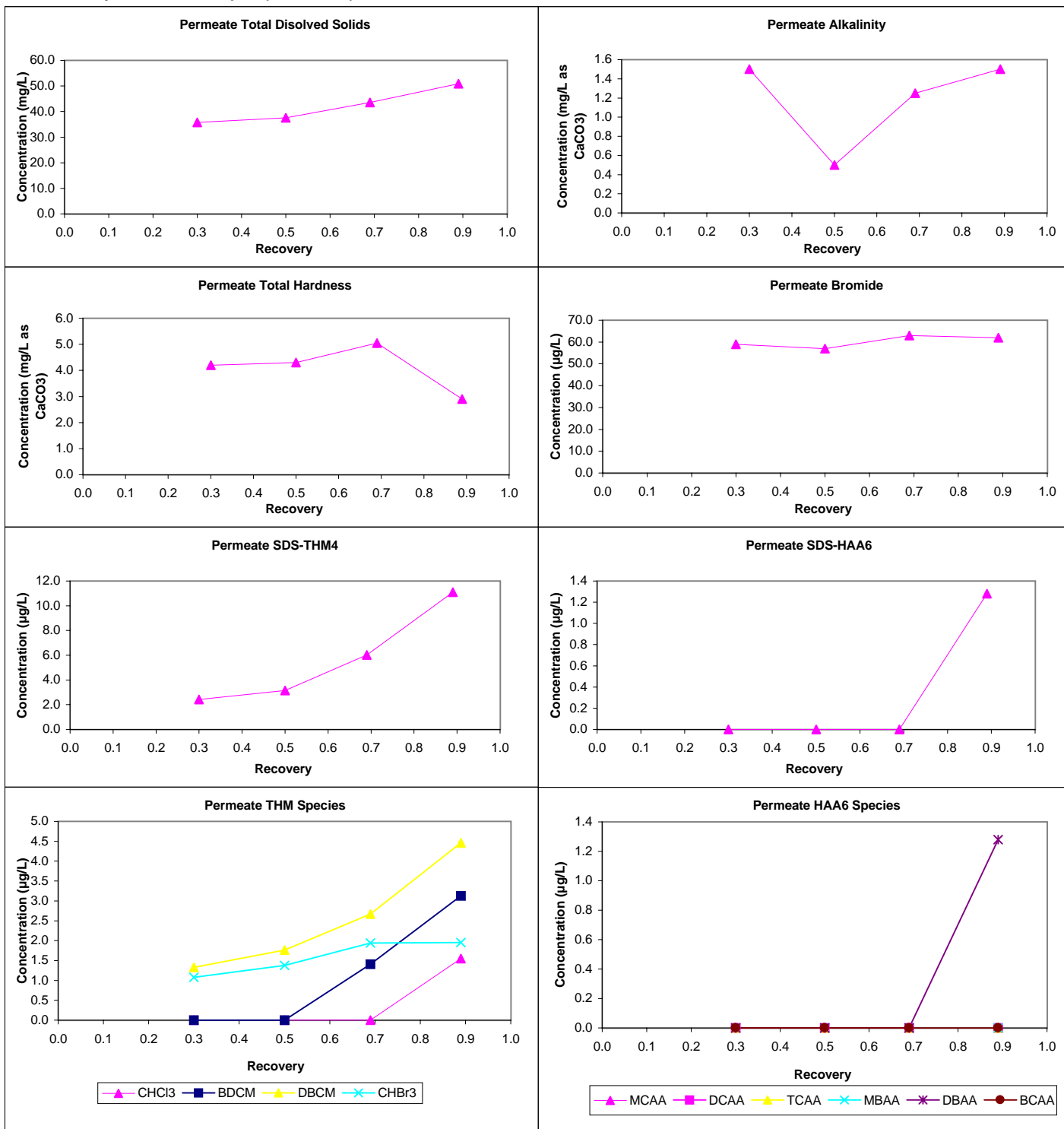
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.50	0.69	0.89	0.30	0.50	0.69	0.89	WQP	Count	Avg	SD
pH	6.1	0.2	6.1	6.0	6.5	6.6	5.9	6.4	6.5	6.6	TDS	7	-14	21
Temp	20.5	0.5	21.0	21.0	23.0	21.0	21.0	21.0	23.0	21.0	Alk	4	-51	17
Alk	2	0	2	1	1	2	2	3	3	5	TDS	4	-20	13
TDS	112	1	36	38	44	51	138	157	195	504	TotHard	4	-17	28
TotHard	25	2	4	4	5	3	37	51	48	156	CaHard	4	27	21
CaHard	13	2	2	2	3	2	19	28	79	136	Turb	4	-289	229
Turb	0.34	0.11	0.12	0.13	0.11	0.10	0.21	0.22	0.22	0.32	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a
TOC	3.8	0.1	0.3	0.3	0.3	0.3	5.0	7.2	12.0	33.0	UV254	4	-5	8
UV254	0.071	0.002	0.005	0.010	0.010	0.017	0.091	0.117	0.208	0.527	Pretreatment Information			
SUVA	1.89	0.08	1.80	4.00	4.00	6.80	1.82	1.63	1.73	1.60				
Bromide	60	2	59	57	63	62	ProcessDescriptionScale							
TOX	418	193	13	13	13	13								
CHCl3	46.0	4.6	0.0	0.0	0.0	1.6	Rapid Mix µm: Al2(SO4)3 18H2O, 58 ppm Full-scale Pulsator ClarifierNA Full-scale FiltrationAnthracite Sand Full-scale Filtration1 um exclusion Bench-scale Antiscalant Addition 3 mg/L Hypersperse AF200ul Bench-scale							
BDCM	20.1	1.3	0.0	0.0	1.4	3.1								
DBCM	5.0	0.3	1.3	1.8	2.7	4.5								
CHBr3	0.0	0.0	1.1	1.4	1.9	2.0								
THM4	71.1	6.2	2.4	3.1	6.0	11.1								
MCAA	1.0	1.0	0.0	0.0	0.0	0.0	Design Parameters							
DCAA	20.1	0.3	0.0	0.0	0.0	0.0								
TCAA	19.5	3.2	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	0.5	0.5	0.0	0.0	0.0	1.3								
BCAA	5.9	0.4	0.0	0.0	0.0	0.0								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	41.2	3.0	0.0	0.0	0.0	1.3								
HAA6	47.1	2.6	0.0	0.0	0.0	1.3								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions							Active memb area: 0.167 ft² Active width: 0.333 ft Norm Temp: 22.3 °C Feed TDS: 112.0 mg/L Manuf rep TDS rej: 96% Temp Norm MTC-w: 0.217 gfd/psi							
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.12	0.69	6	0.71 - 2.50										
Temp (°C)	20.9	0.0	6	20.9 - 20.9										
pH (unit)	7.7	0.1	6	7.6 - 7.9										
Time (hr)	6.8	0.0	6	6.8 - 6.8										
Comments:														

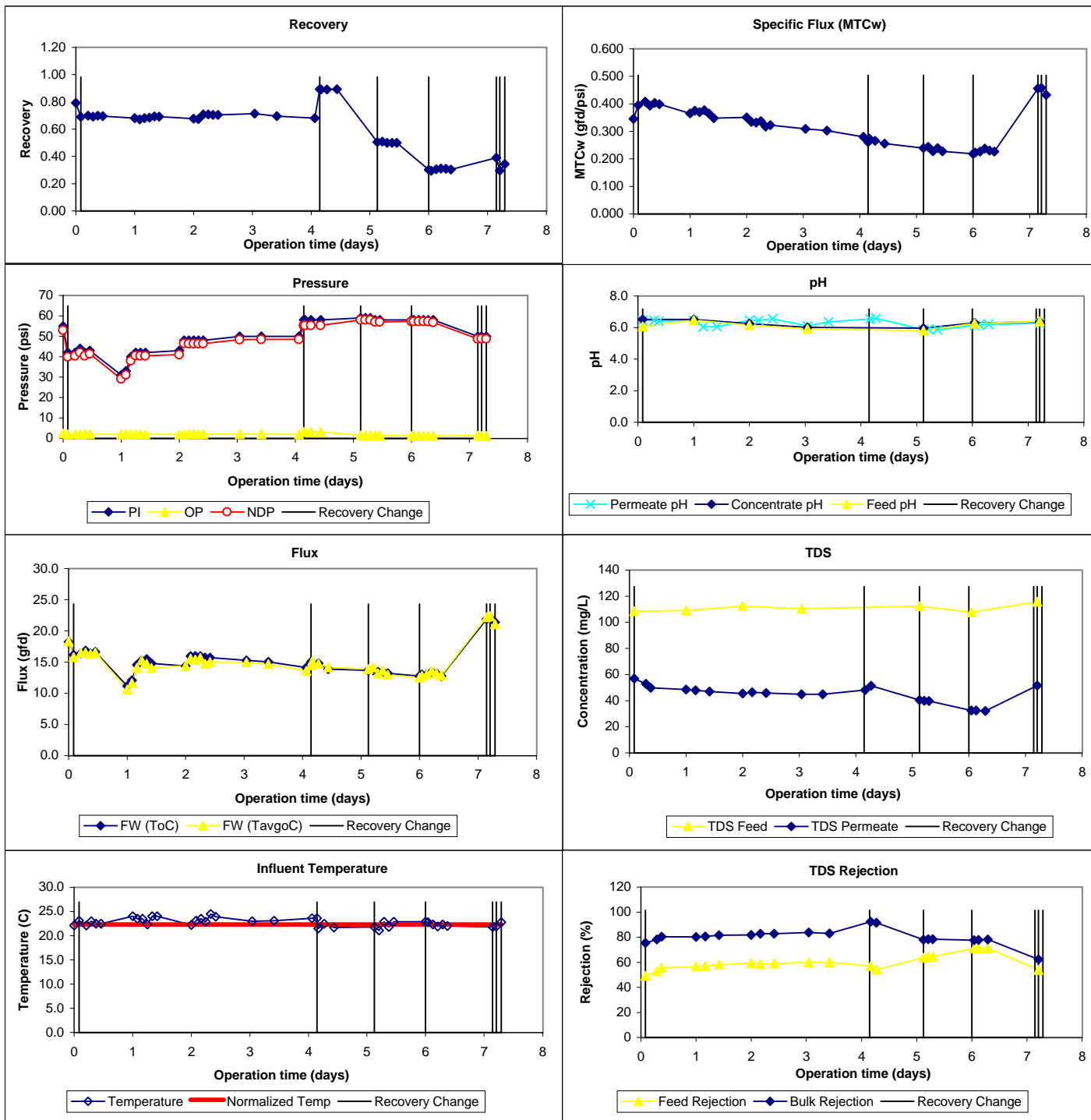
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
 ICR Contact: Bob Burrows, R.S.
 Phone No.: 409-838-3524
 Period: 7/8/98 - 7/16/98 (8 days)

Membrane Information

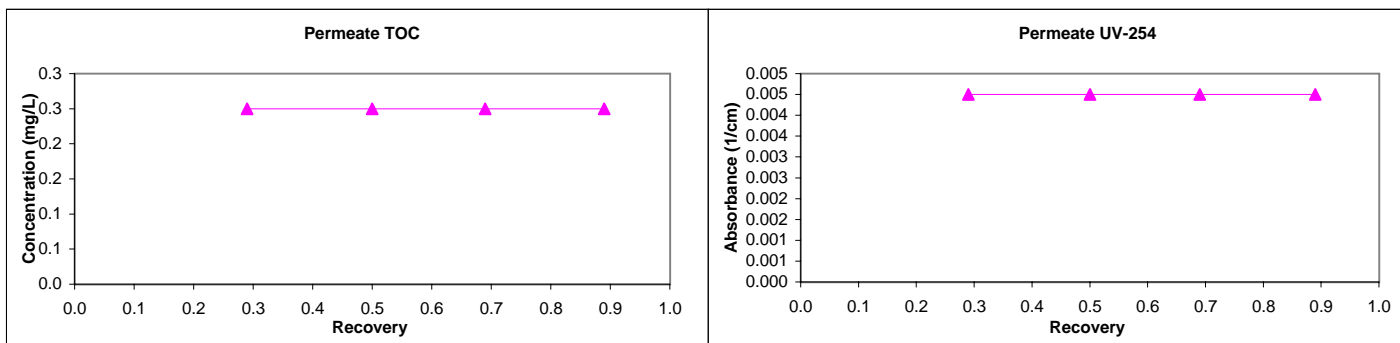
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-4040
 MWCO: 400 Daltons
 Mfr. Flux: 16.5 gfd
 Mfr. NDP: 70.0 psi
 Mfr. MTCw: 0.235 gfd/psi

Mfr. Temp: 25.0 °C
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$700
 840 Maximum Flow: 70.0 gpm
 840 Minimum Flow: 34.0 gpm
 840 Total Width: 70.7 ft
 840 Feed Spacer Thickness: 0.0023 ft

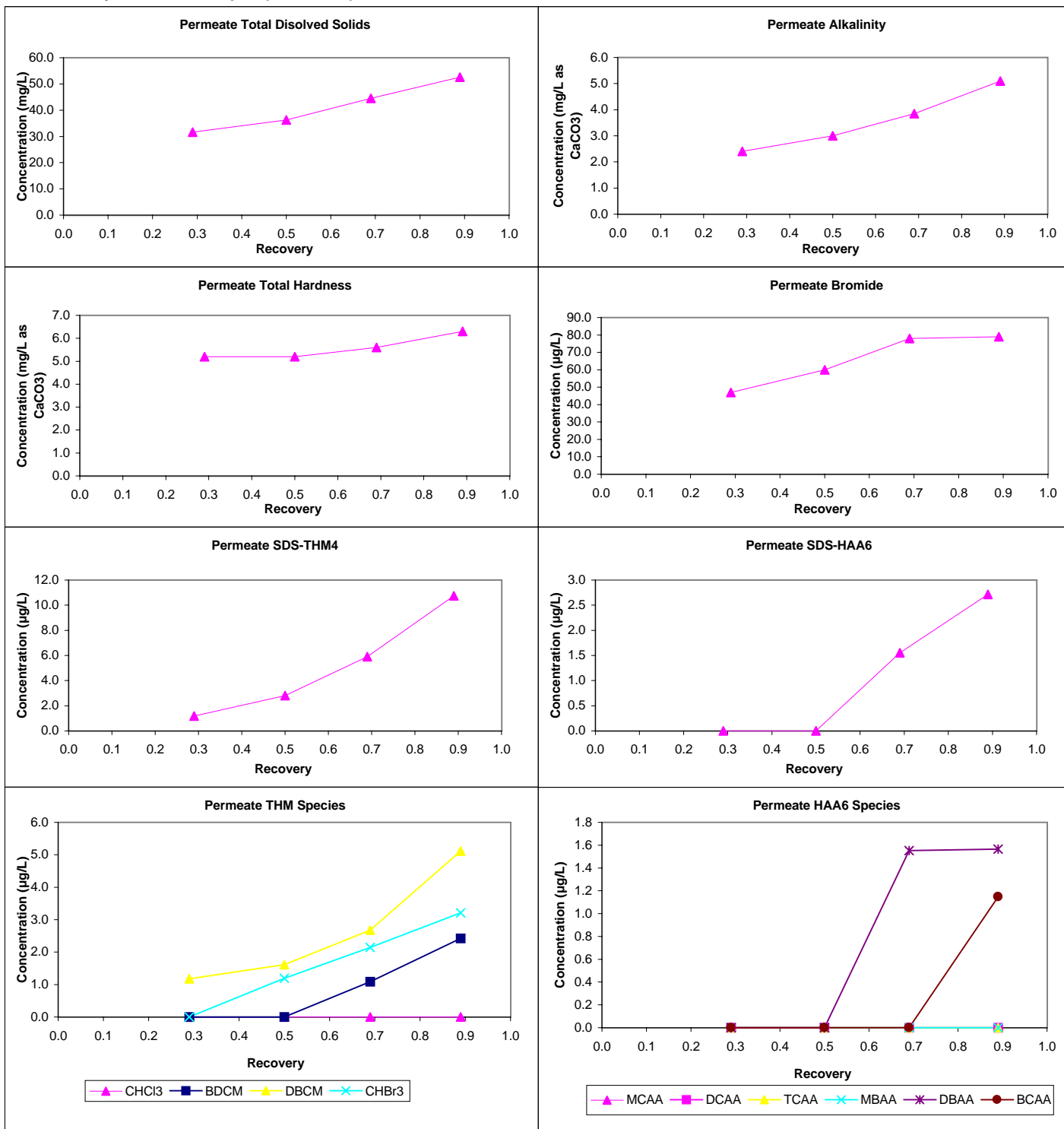
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.29	0.50	0.69	0.89	0.29	0.50	0.69	0.89	WQP	Count	Avg	SD
pH	6.1	0.2	6.5	6.6	6.8	6.6	7.0	6.6	6.8	7.1	TDS	8	-14	16
Temp	21.5	1.5	23.7	23.7	23.2	23.2	23.7	23.7	22.0	23.2				
Alk	6	1	2	3	4	5	8	9	11	12	Alk	4	4	6
TDS	112	2	32	36	45	53	143	166	267	490	TDS	4	-9	11
TotHard	30	1	5	5	6	6	42	55	84	197	TotHard	4	-2	7
CaHard	20	0	4	4	4	5	28	33	53	123	CaHard	4	-6	9
Turb	0.17	0.01	0.07	0.11	0.10	0.08	0.14	0.16	0.19	0.23	Turb	4	-106	111
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	3.7	0.0	0.3	0.3	0.3	0.3	5.2	7.3	13.0	29.5	TOC	0	n/a	n/a
UV254	0.074	0.002	0.005	0.005	0.005	0.005	0.103	0.145	0.237	0.546	UV254	4	-2	7
SUVA	2.03	0.03	1.80	1.80	1.80	1.80	1.98	1.99	1.82	1.85				
Bromide	61	3	47	60	78	79					Pretreatment Information			
TOX	273	3	13	13	13	13					Process	Description	Scale	
CHCl3	62.8	9.4	0.0	0.0	0.0	0.0					Rapid Mix	Al ₂ (SO ₄) ₃ 18H ₂ O, 58 ppm	Full-scale	
BDCM	21.1	2.0	0.0	0.0	1.1	2.4					Pulsator Clarifier	NA	Full-scale	
DBCM	5.3	0.4	1.2	1.6	2.7	5.1					Filtration	Anthracite Sand	Full-scale	
CHBr3	0.0	0.0	0.0	1.2	2.1	3.2					Filtration	1 um exclusion	Bench-scale	
THM4	89.3	11.8	1.2	2.8	5.9	10.7					Antiscalant Addition	3 mg/L Hypersperse AF200ul	Bench-scale	
MCAA	1.3	1.3	0.0	0.0	0.0	0.0					Design Parameters			
DCAA	20.4	1.4	0.0	0.0	0.0	0.0					Active memb area:	0.167 ft ²		
TCAA	17.3	1.2	0.0	0.0	0.0	0.0					Active width:	0.333 ft		
MBAA	0.0	0.0	0.0	0.0	0.0	0.0					Norm Temp:	22.3 °C		
DBAA	1.2	0.1	0.0	0.0	1.6	1.6					Feed TDS:	112.0 mg/L		
BCAA	5.8	0.4	0.0	0.0	0.0	1.1					Manuf rep TDS rej:	96%		
TBAA	NA	NA	NA	NA	NA	NA					Temp Norm MTC-w:	0.217 gfd/psi		
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	40.2	1.0	0.0	0.0	1.6	1.6								
HAA6	45.9	0.6	0.0	0.0	1.6	2.7								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.98	0.33	6	0.80 - 1.66										
Temp (°C)	30.3	0.1	6	30.0 - 30.3										
pH (unit)	8.1	0.0	6	8.0 - 8.1										
Time (hr)	6.4	0.0	6	6.3 - 6.4										

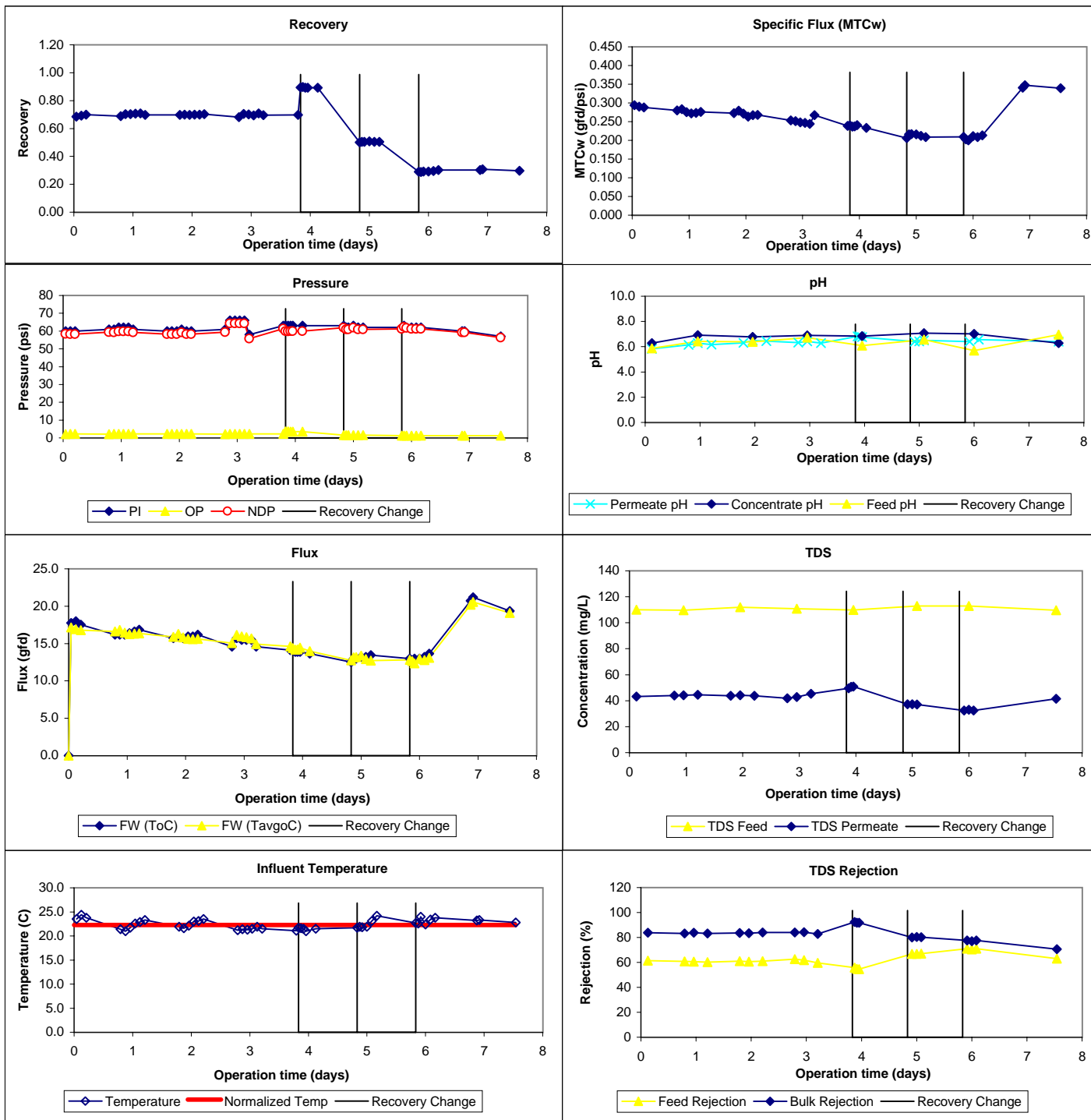
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
ICR Contact: Bob Burrows, R.S.
Phone No.: 409-838-3524
Period: 10/7/98 - 10/15/98 (8 days)

Membrane Information

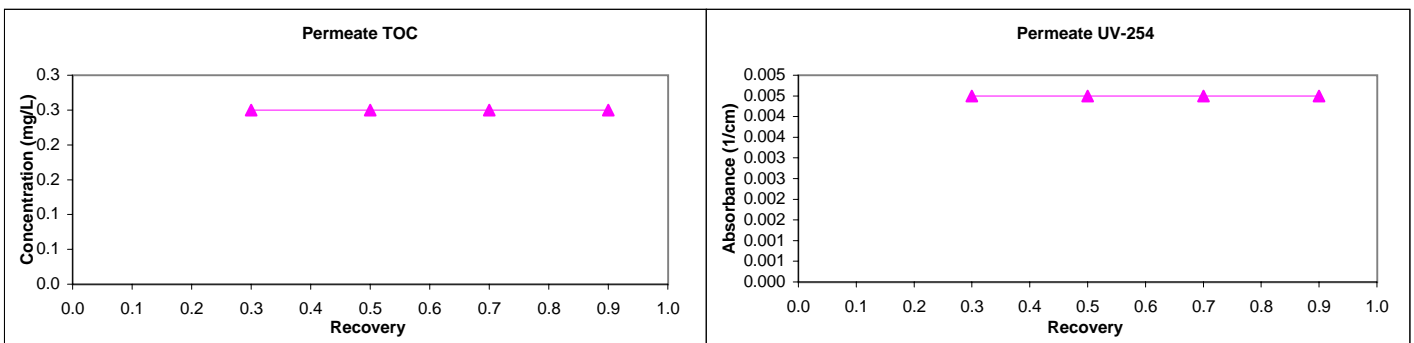
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Trade Name: NF200B-4040
MWCO: 400 Daltons
Mfr. Flux: 16.5 gfd
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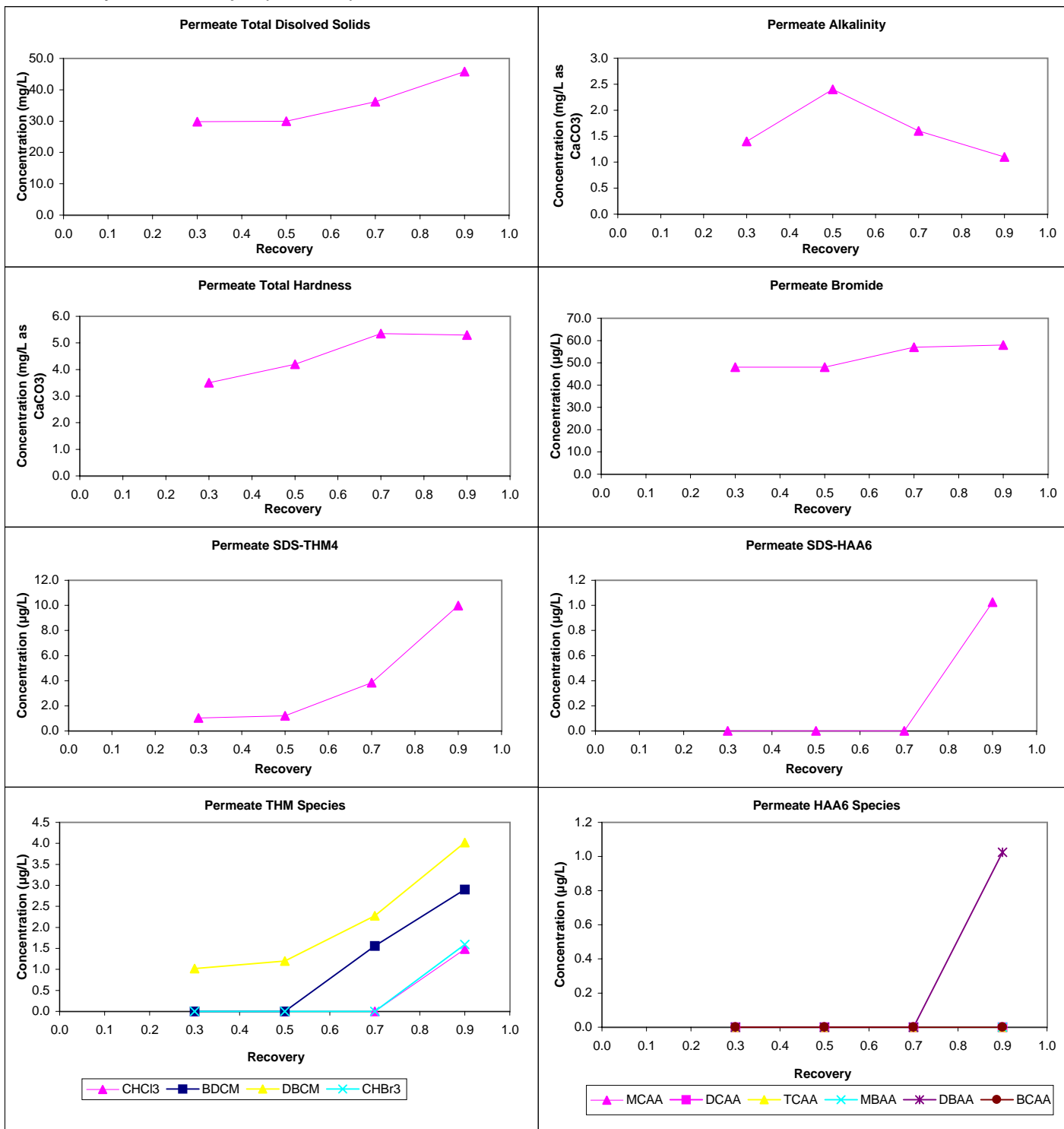
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																																																
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90	WQP	Count	Avg	SD																																													
pH	5.7	0.3	6.2	6.6	5.8	5.7	6.5	6.7	6.1	6.4	TDS	8	-26	18																																													
Temp	22.5	NA	22.5	22.8	21.1	21.2	22.5	22.8	21.1	21.2	Alk	4	-67	112																																													
Alk	3	0	1	2	2	1	2	4	4	5	TDS	4	-21	17																																													
TDS	105	0	30	30	36	46	135	160	194	479	TotHard	4	2	9																																													
TotHard	29	1	4	4	5	5	41	60	87	216	CaHard	4	5	7																																													
CaHard	16	1	2	2	3	3	23	34	51	130	Turb	4	-60	145																																													
Turb	0.16	0.00	0.37	0.15	0.11	0.10	0.75	0.17	0.16	0.20	Amm	0	n/a	n/a																																													
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a																																													
TOC	3.5	0.1	0.3	0.3	0.3	0.3	5.0	6.9	12.0	31.0	UV254	4	-16	23																																													
UV254	0.074	0.001	0.005	0.005	0.005	0.005	0.097	0.136	0.231	0.465	<div>Pretreatment Information</div> <table><thead><tr><th>Process</th><th>Description</th><th>Scale</th></tr></thead><tbody><tr><td>Rapid Mix</td><td>Al2(SO4)3 18H2O, 58 ppm</td><td>Full-scale</td></tr><tr><td>Pulsator Clarifier</td><td>NA</td><td>Full-scale</td></tr><tr><td>Filtration</td><td>Anthracite Sand</td><td>Full-scale</td></tr><tr><td>Filtration</td><td>1 um exclusion</td><td>Bench-scale</td></tr><tr><td>Antiscalant Addition</td><td>3 mg/L Hypersperse AF200ul</td><td>Bench-scale</td></tr></tbody></table> <div>Design Parameters</div> <table><tbody><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F_{W-des} (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>22.3 °C</td><td>1</td><td>0.70</td><td>16.5</td></tr><tr><td>Feed TDS:</td><td>112.0 mg/L</td><td>2</td><td>0.90</td><td>16.5</td></tr><tr><td>Manuf rep TDS rej:</td><td>96%</td><td>3</td><td>0.50</td><td>16.5</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.217 gfd/psi</td><td>4</td><td>0.30</td><td>16.5</td></tr></tbody></table> <div>Comments:</div>				Process	Description	Scale	Rapid Mix	Al2(SO4)3 18H2O, 58 ppm	Full-scale	Pulsator Clarifier	NA	Full-scale	Filtration	Anthracite Sand	Full-scale	Filtration	1 um exclusion	Bench-scale	Antiscalant Addition	3 mg/L Hypersperse AF200ul	Bench-scale	Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)	Active width:	0.333 ft	Norm Temp:	22.3 °C	1	0.70	16.5	Feed TDS:	112.0 mg/L	2	0.90	16.5	Manuf rep TDS rej:	96%	3	0.50	16.5	Temp Norm MTC-w:	0.217 gfd/psi	4	0.30	16.5
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SUVA	2.09	0.03	1.80	1.80	1.80	1.80	1.94	1.97	1.93	1.50																																																	
Bromide	56	3	48	48	57	58	<div>Design Parameters</div> <table><tbody><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F_{W-des} (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>22.3 °C</td><td>1</td><td>0.70</td><td>16.5</td></tr><tr><td>Feed TDS:</td><td>112.0 mg/L</td><td>2</td><td>0.90</td><td>16.5</td></tr><tr><td>Manuf rep TDS rej:</td><td>96%</td><td>3</td><td>0.50</td><td>16.5</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.217 gfd/psi</td><td>4</td><td>0.30</td><td>16.5</td></tr></tbody></table> <div>Comments:</div>								Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)	Active width:	0.333 ft	Norm Temp:	22.3 °C	1	0.70	16.5	Feed TDS:	112.0 mg/L	2	0.90	16.5	Manuf rep TDS rej:	96%	3	0.50	16.5	Temp Norm MTC-w:	0.217 gfd/psi	4	0.30	16.5																		
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TOX	268	3	13	13	13	13																																																					
CHCl3	56.8	6.4	0.0	0.0	0.0	1.5									<div>Design Parameters</div> <table><tbody><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F_{W-des} (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>22.3 °C</td><td>1</td><td>0.70</td><td>16.5</td></tr><tr><td>Feed TDS:</td><td>112.0 mg/L</td><td>2</td><td>0.90</td><td>16.5</td></tr><tr><td>Manuf rep TDS rej:</td><td>96%</td><td>3</td><td>0.50</td><td>16.5</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.217 gfd/psi</td><td>4</td><td>0.30</td><td>16.5</td></tr></tbody></table> <div>Comments:</div>								Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)	Active width:	0.333 ft	Norm Temp:	22.3 °C	1	0.70	16.5	Feed TDS:	112.0 mg/L	2	0.90	16.5	Manuf rep TDS rej:	96%	3	0.50	16.5	Temp Norm MTC-w:	0.217 gfd/psi	4	0.30	16.5										
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DBCM	3.8	0.4	1.0	1.2	2.3	4.0																																																					
CHBr3	0.0	0.0	0.0	0.0	0.0	1.6																																																					
THM4	79.5	8.8	1.0	1.2	3.8	10.0																																																					
MCAA	0.0	0.0	0.0	0.0	0.0	0.0																																																					
DCAA	27.7	2.6	0.0	0.0	0.0	0.0																																																					
TCAA	28.6	3.1	0.0	0.0	0.0	0.0																																																					
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																																																					
DBAA	0.5	0.5	0.0	0.0	0.0	1.0																																																					
BCAA	7.2	1.4	0.0	0.0	0.0	0.0																																																					
TBAA	NA	NA	NA	NA	NA	NA																																																					
CDBAA	NA	NA	NA	NA	NA	NA																																																					
DCBAA	NA	NA	NA	NA	NA	NA																																																					
HAA5	56.9	6.3	0.0	0.0	0.0	1.0																																																					
HAA6	64.0	7.7	0.0	0.0	0.0	1.0																																																					
HAA9	NA	NA	NA	NA	NA	NA																																																					
SDS Conditions							<div>Design Parameters</div> <table><tbody><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F_{W-des} (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>22.3 °C</td><td>1</td><td>0.70</td><td>16.5</td></tr><tr><td>Feed TDS:</td><td>112.0 mg/L</td><td>2</td><td>0.90</td><td>16.5</td></tr><tr><td>Manuf rep TDS rej:</td><td>96%</td><td>3</td><td>0.50</td><td>16.5</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.217 gfd/psi</td><td>4</td><td>0.30</td><td>16.5</td></tr></tbody></table> <div>Comments:</div>								Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)	Active width:	0.333 ft	Norm Temp:	22.3 °C	1	0.70	16.5	Feed TDS:	112.0 mg/L	2	0.90	16.5	Manuf rep TDS rej:	96%	3	0.50	16.5	Temp Norm MTC-w:	0.217 gfd/psi	4	0.30	16.5																		
Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)																																																							
Active width:	0.333 ft																																																										
Norm Temp:	22.3 °C	1	0.70	16.5																																																							
Feed TDS:	112.0 mg/L	2	0.90	16.5																																																							
Manuf rep TDS rej:	96%	3	0.50	16.5																																																							
Temp Norm MTC-w:	0.217 gfd/psi	4	0.30	16.5																																																							
WQP	Avg	SD	Count	Min - Max																																																							
Res (mg/L) (0)	2.18	0.08	6	2.07 - 2.28																																																							
Temp (°C)	30.3	0.0	6	30.3 - 30.4																																																							
pH (unit)	7.8	0.0	6	7.8 - 7.8																																																							
Time (hr)	6.0	0.0	6	6.0 - 6.0																																																							

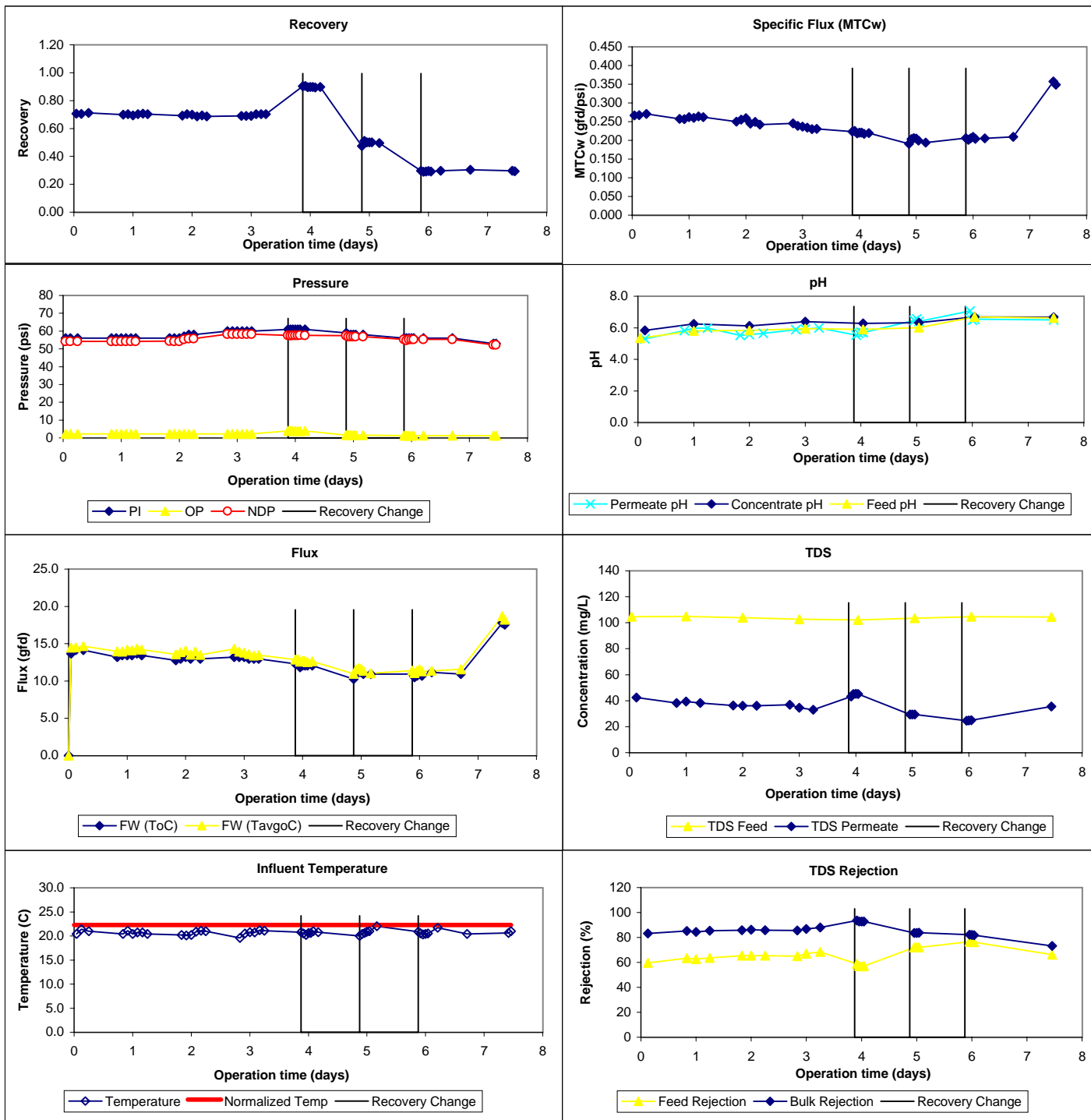
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
ICR Contact: Bob Burrows, R.S.
Phone No.: 409-838-3524
Period: 1/14/99 - 1/22/99 (8 days)

Membrane Information

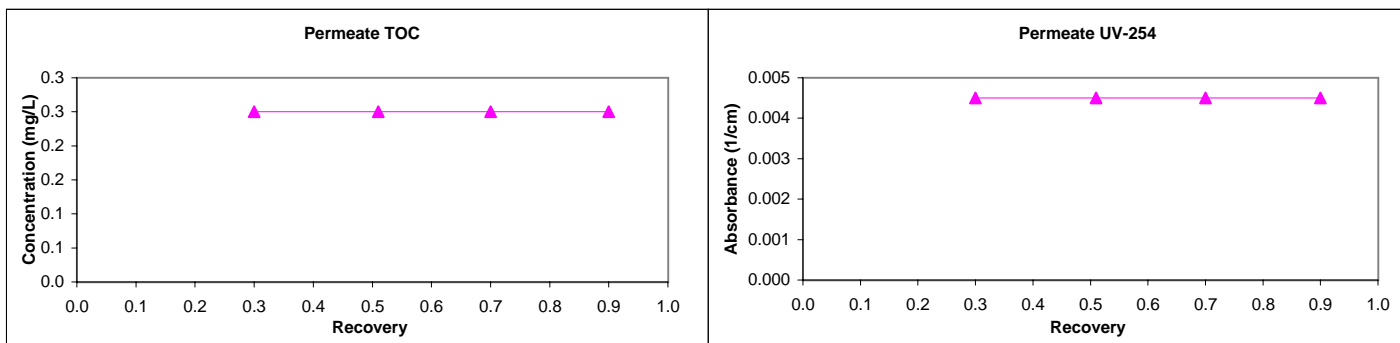
Manufacturer: FilmTec Corporation
Trade Name: NF200B-4040
MWCO: 400 Daltons
Mfr. Flux: 16.5 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.235 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: \$700
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 34.0 gpm
840 Total Width: 70.7 ft
840 Feed Spacer Thickness: 0.0023 ft

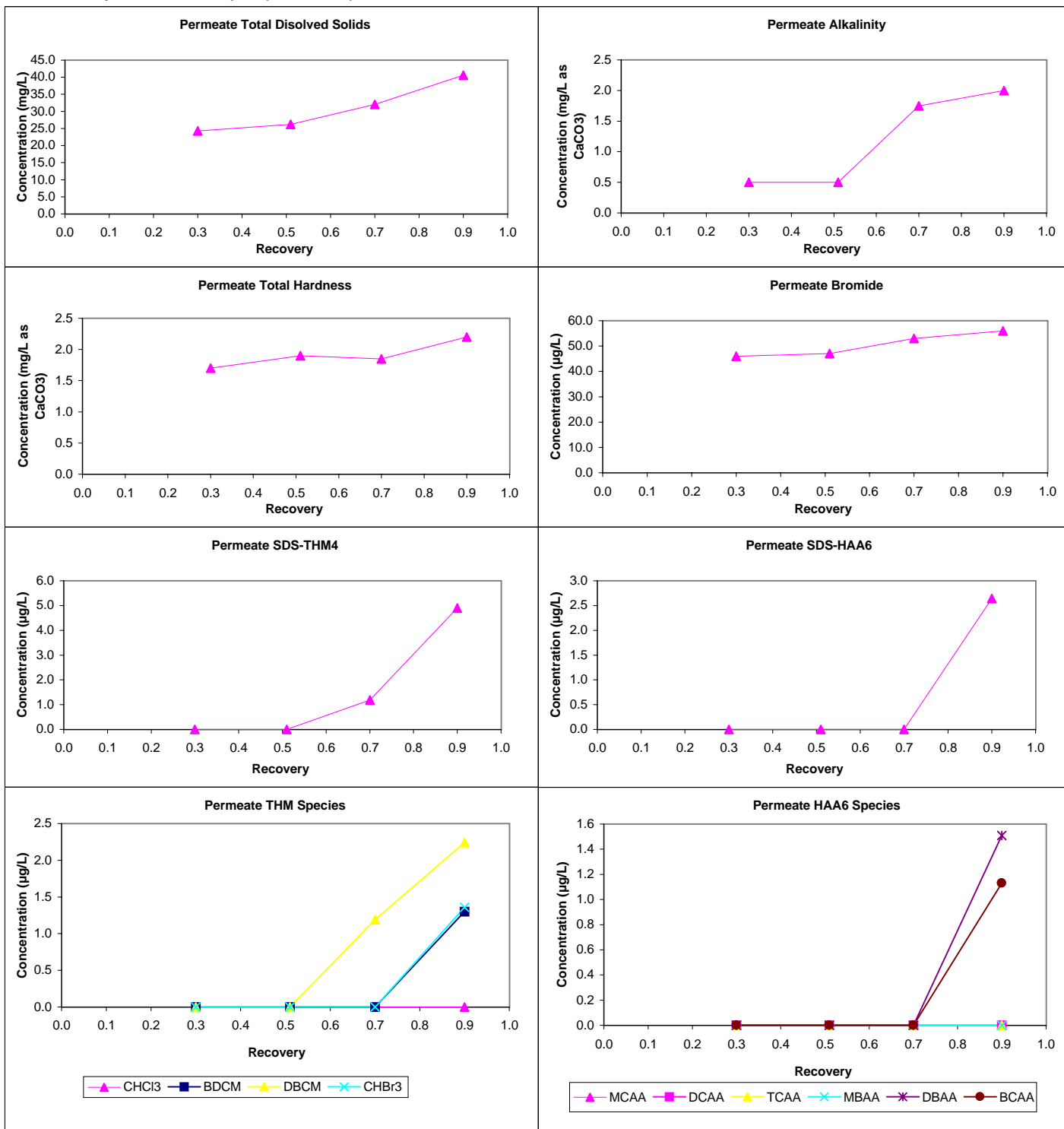
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)											
Recovery ->	Avg	Diff	0.30	0.51	0.70	0.90	0.30	0.51	0.70	0.90	WQP	Count	Avg	SD								
pH	5.7	0.1	5.8	6.2	6.3	6.2	6.2	6.3	6.4	6.6	TDS	8	-11	14								
Temp	22.0	0.3	21.5	22.1	22.2	20.9	21.7	22.3	21.8	20.4	Alk	4	-1	21								
Alk	2	0	1	1	2	2	3	4	5	5	TDS	4	-11	10								
TDS	106	0	24	26	32	41	136	181	257	560	TotHard	4	-1	5								
TotHard	24	1	2	2	2	2	31	47	73	225	CaHard	4	-1	6								
CaHard	15	0	1	1	1	1	21	30	44	146	Turb	4	-126	136								
Turb	0.12	0.02	0.10	0.08	0.07	0.06	0.12	0.11	0.10	0.16	Amm	0	n/a	n/a								
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a								
TOC	3.2	0.0	0.3	0.3	0.3	0.3	4.4	6.2	10.0	14.5	UV254	4	-2	3								
UV254	0.055	0.000	0.005	0.005	0.005	0.005	0.078	0.109	0.177	0.482	Pretreatment Information											
SUVA	1.72	0.00	1.80	1.80	1.80	1.80	1.79	1.76	1.77	3.32												
Bromide	53	1	46	47	53	56	ProcessDescriptionScale															
TOX	173	13	56	13	13	13																
CHCl3	31.7	2.4	0.0	0.0	0.0	0.0	Rapid Mix µm: Al2(SO4)3 18H2O, 58 ppm Full-scale Pulsator ClarifierNA Full-scale FiltrationAnthracite Sand Full-scale Filtration1 µm exclusion Bench-scale Antiscalant Addition 3 mg/L Hypersperse AF200ul Bench-scale															
BDCM	12.7	0.7	0.0	0.0	0.0	1.3																
DBCM	3.4	0.4	0.0	0.0	1.2	2.2																
CHBr3	0.0	0.0	0.0	0.0	0.0	1.4																
THM4	47.7	1.3	0.0	0.0	1.2	4.9																
MCAA	0.0	0.0	0.0	0.0	0.0	0.0	Design Parameters															
DCAA	16.6	0.9	0.0	0.0	0.0	0.0																
TCAA	13.5	1.2	0.0	0.0	0.0	0.0																
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																
DBAA	1.3	0.1	0.0	0.0	0.0	1.5																
BCAA	5.6	0.7	0.0	0.0	0.0	1.1																
TBAA	NA	NA	NA	NA	NA	NA																
CDBAA	NA	NA	NA	NA	NA	NA																
DCBAA	NA	NA	NA	NA	NA	NA																
HAA5	31.4	2.3	0.0	0.0	0.0	1.5																
HAA6	37.0	3.0	0.0	0.0	0.0	2.6																
HAA9	NA	NA	NA	NA	NA	NA	Active memb area: 0.167 ft² Active width: 0.333 ft Norm Temp: 22.3 °C Feed TDS: 106.0 mg/L Manuf rep TDS rej: 96% Temp Norm MTC-w: 0.217 gfd/psi															
SDS Conditions															ID#Recov (dec.)Fw-des (gfd) 10.7016.5 20.9016.5 30.5016.5 40.3016.5							
WQP	Avg	SD	Count	Min - Max																		
Res (mg/L) (0)	1.92	0.29	6	1.73 - 2.50																		
Temp (°C)	11.6	0.0	6	11.6 - 11.6																		
pH (unit)	8.1	0.0	6	8.0 - 8.1																		
Time (hr)	6.0	0.0	6	6.0 - 6.0		Comments:																

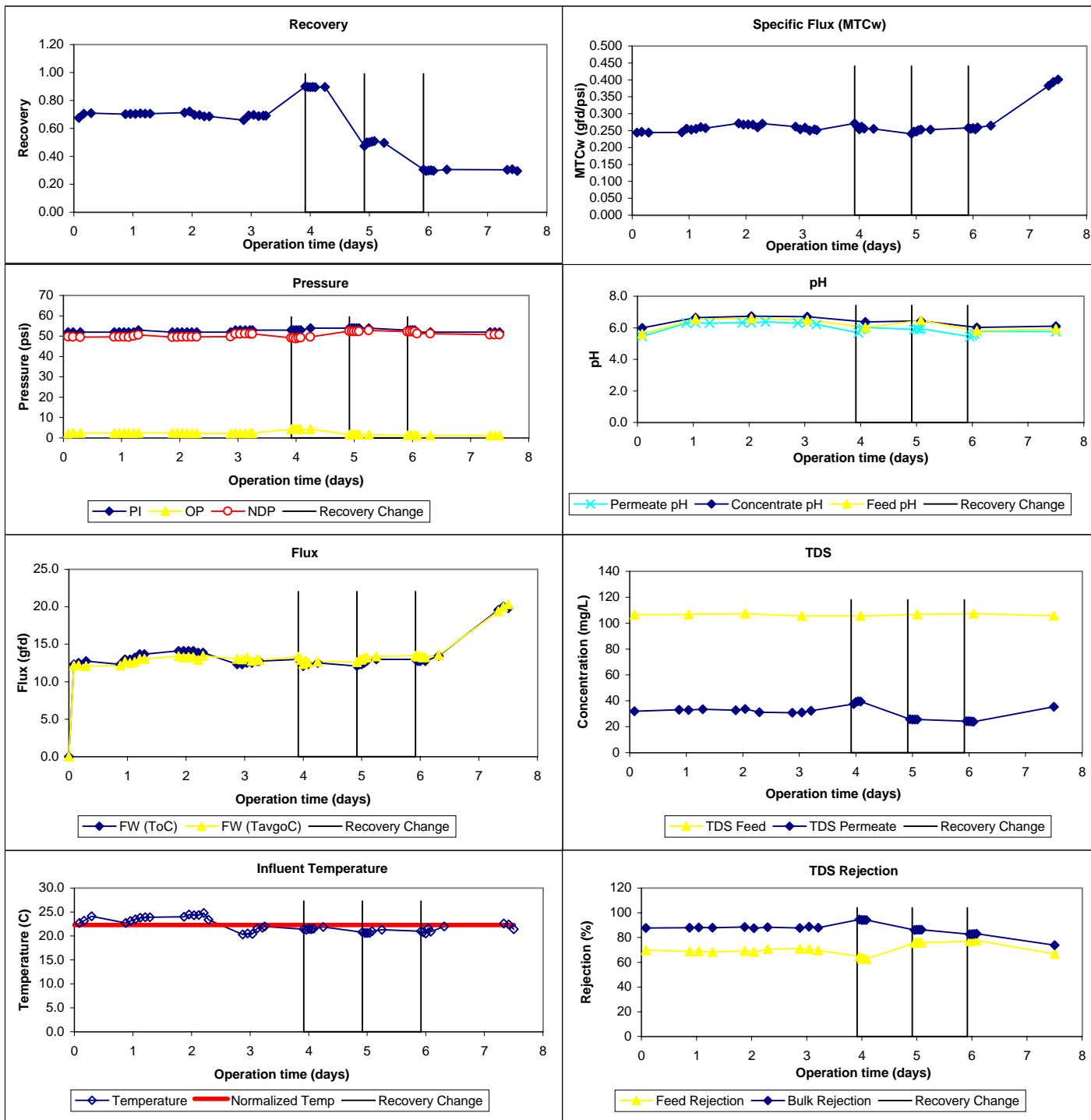
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
 ICR Contact: Bob Burrows, R.S.
 Phone No.: 409-838-3524
 Period: 4/9/98 - 4/18/98 (9 days)

Membrane Information

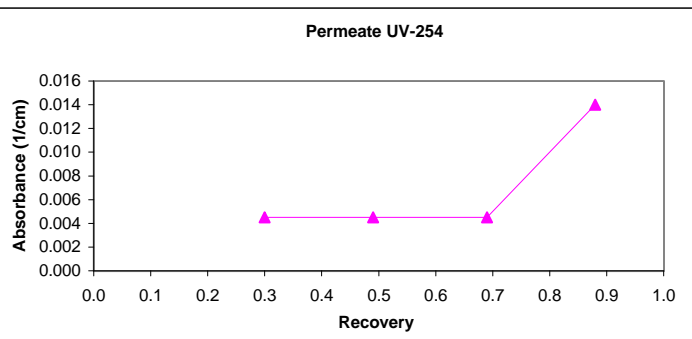
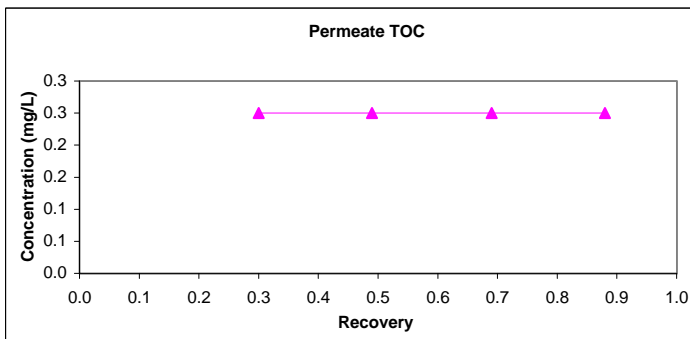
Manufacturer: Dow-Filmtec
 Trade Name: BW30-XLE
 MWCO: 100 Daltons
 Mfr. Flux: 30(15 av gfd)
 Mfr. NDP: 130.0 psi
 Mfr. MTCw: 0.231 gfd/psi

Mfr. Temp: 25.0 °C
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$700
 840 Maximum Flow: 70.0 gpm
 840 Minimum Flow: 18.8 gpm
 840 Total Width: 70.6 ft
 840 Feed Spacer Thickness: 0.0026 ft

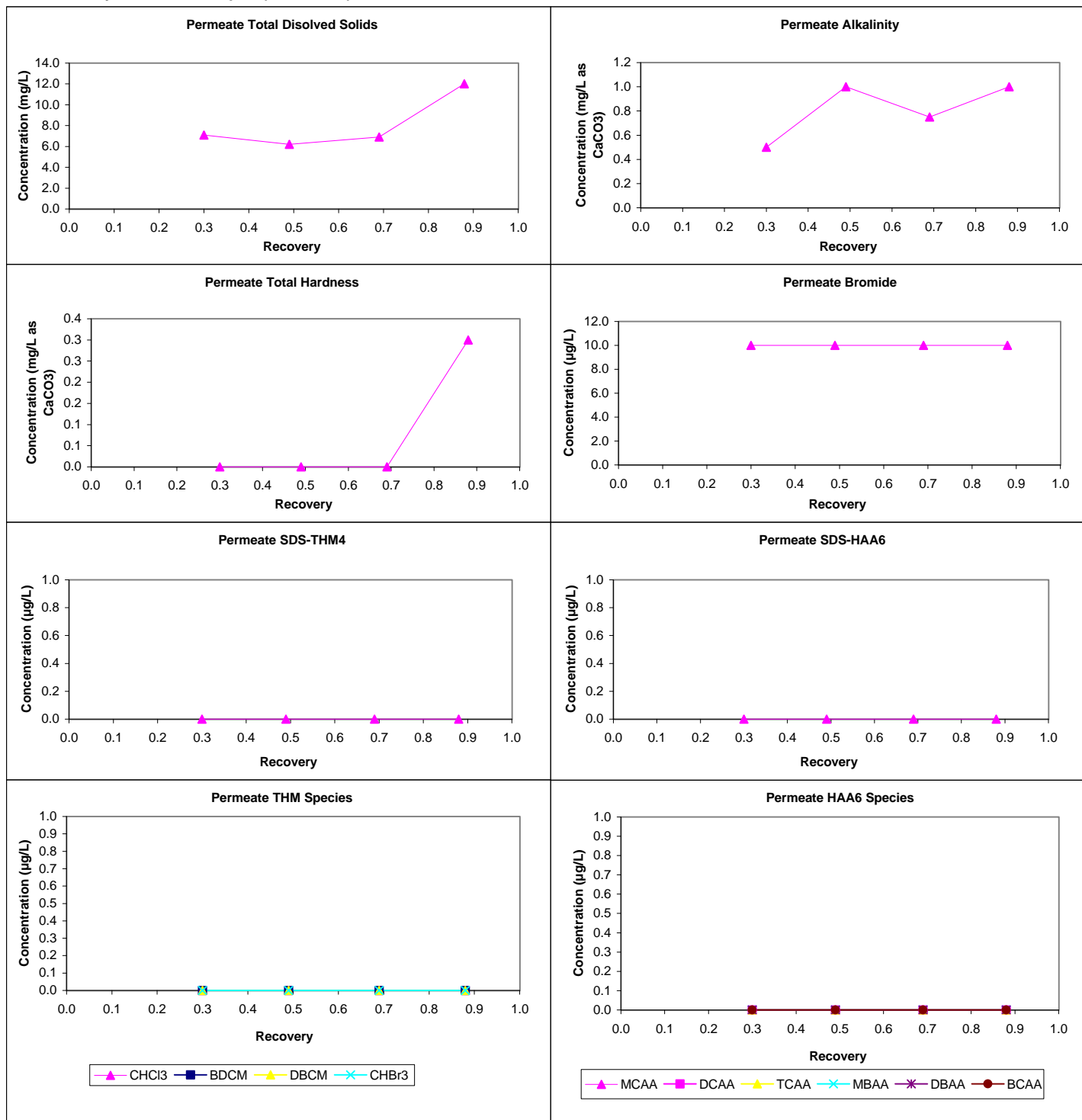
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																	
Recovery ->	Avg	Diff	0.30	0.49	0.69	0.88	0.30	0.49	0.69	0.88	WQP	Count	Avg	SD														
pH	6.1	0.2	5.6	5.9	5.9	6.2	6.0	6.5	6.7	7.1	TDS	7	-14	31														
Temp	20.5	0.5	21.0	21.0	24.2	21.0	22.0	21.0	22.3	21.0	Alk	4	8	11														
Alk	2	0	1	1	1	1	3	5	6	12	TDS	4	-17	8														
TDS	112	1	7	6	7	12	144	176	302	671	TotHard	1	17	n/a														
TotHard	25	2	0	0	0	0	35	54	94	253	CaHard	0	n/a	n/a														
CaHard	13	2	0	0	0	0	18	30	52	145	Turb	4	-265	187														
Turb	0.34	0.11	0.13	0.12	0.12	0.11	0.22	0.22	0.21	0.33	Amm	0	n/a	n/a														
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a														
TOC	3.8	0.1	0.3	0.3	0.3	0.3	5.2	7.3	12.0	30.0	UV254	4	17	8														
UV254	0.060	0.013	0.005	0.005	0.005	0.014	0.098	0.129	0.213	0.555	Pretreatment Information Process Description Scale Rapid Mix um: Al2(SO4)3 18H2O, 58 ppm Full-scale Pulsator Clarifier NA Full-scale Filtration Anthracite Sand Full-scale Filtration 1 um exclusion Bench-scale Antiscalant Addition 3 mg/L Hypersperse AF200ul Bench-scale																	
SUVA	1.60	0.37	1.80	1.80	1.80	5.60	1.88	1.77	1.78	1.85																		
Bromide	60	2	10	10	10	10	Design Parameters Active memb area: 0.167 ft ² Active width: 0.333 ft Norm Temp: 22.3 °C Feed TDS: 112.0 mg/L Manuf rep TDS rej: 98% Temp Norm MTC-w: 0.213 gfd/psi																					
TOX	418	193	13	13	13	13																						
CHCl3	46.0	4.6	0.0	0.0	0.0	0.0																						
BDCM	20.1	1.3	0.0	0.0	0.0	0.0																						
DBC	5.0	0.3	0.0	0.0	0.0	0.0																						
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0																						
THM4	71.1	6.2	0.0	0.0	0.0	0.0																						
MCAA	1.0	1.0	0.0	0.0	0.0	0.0																						
DCAA	20.1	0.3	0.0	0.0	0.0	0.0																						
TCAA	19.5	3.2	0.0	0.0	0.0	0.0																						
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																						
DBAA	0.5	0.5	0.0	0.0	0.0	0.0																						
BCAA	5.9	0.4	0.0	0.0	0.0	0.0																						
TBAA	NA	NA	NA	NA	NA	NA																						
CDBAA	NA	NA	NA	NA	NA	NA																						
DCBAA	NA	NA	NA	NA	NA	NA																						
HAA5	41.2	3.0	0.0	0.0	0.0	0.0																						
HAA6	47.1	2.6	0.0	0.0	0.0	0.0																						
HAA9	NA	NA	NA	NA	NA	NA																						
SDS Conditions							Comments:																					
WQP	Avg	SD	Count	Min - Max																								
Res (mg/L) (0)	1.18	0.65	6	0.82 - 2.50																								
Temp (°C)	20.9	0.0	6	20.9 - 20.9																								
pH (unit)	7.7	0.0	6	7.6 - 7.7																								
Time (hr)	6.8	0.0	6	6.8 - 6.8																								

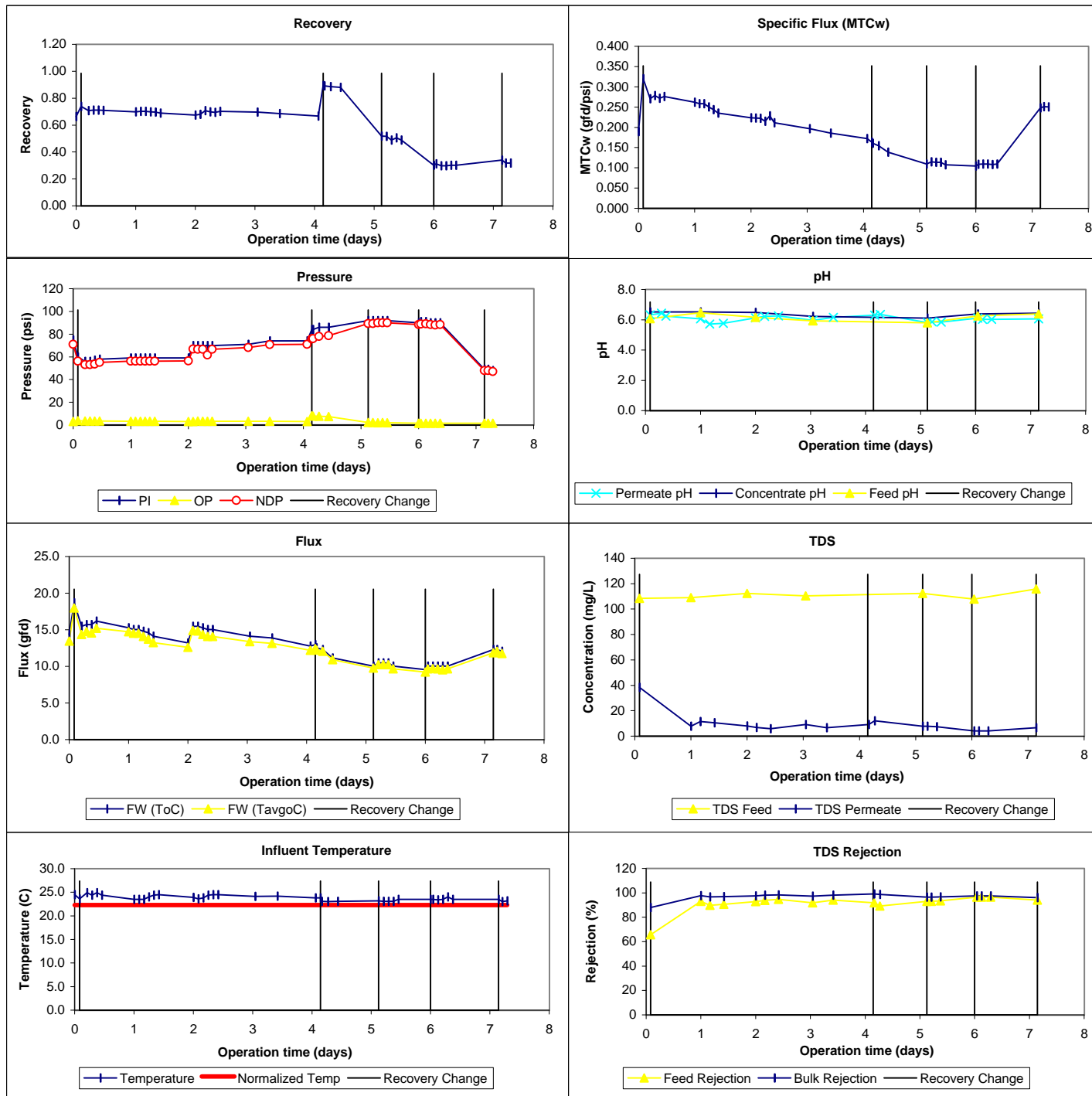
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
 ICR Contact: Bob Burrows, R.S.
 Phone No.: 409-838-3524
 Period: 7/8/98 - 7/16/98 (8 days)

Membrane Information

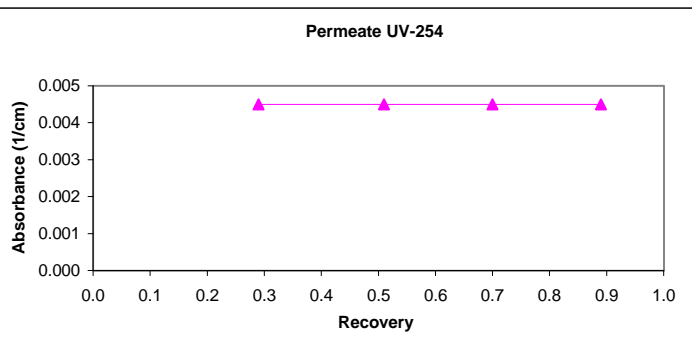
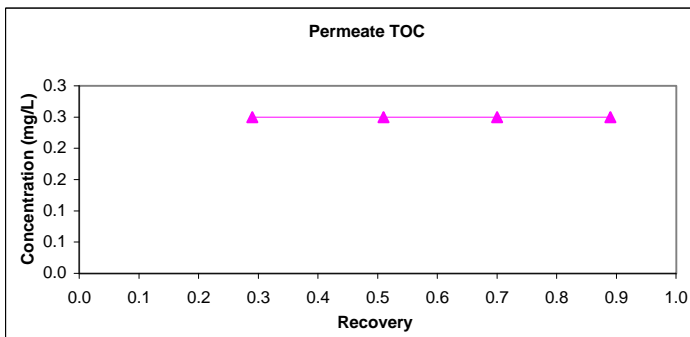
Manufacturer: Dow-Filmtec
 Trade Name: BW30-XLE
 MWCO: 100 Daltons
 Mfr. Flux: 30(15 av gfd)
 Mfr. NDP: 130.0 psi
 Mfr. MTCw: 0.231 gfd/psi

Mfr. Temp: 25.0 °C
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$700
 840 Maximum Flow: 70.0 gpm
 840 Minimum Flow: 18.8 gpm
 840 Total Width: 70.6 ft
 840 Feed Spacer Thickness: 0.0026 ft

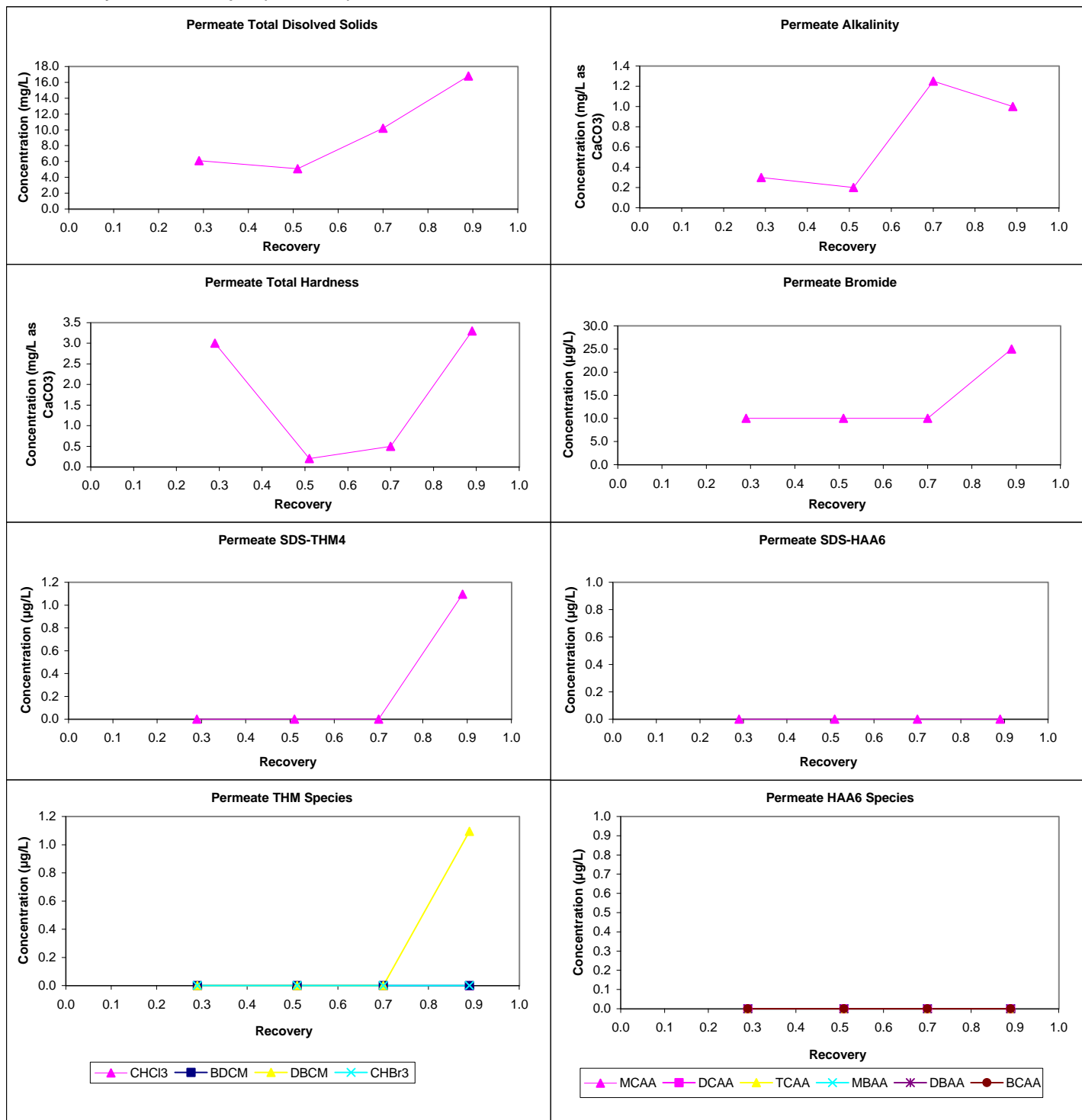
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)					
Recovery ->	Avg	Diff	0.29	0.51	0.70	0.89	0.29	0.51	0.70	0.89	WQP	Count	Avg	SD		
pH	6.1	0.2	6.1	6.8	6.4	6.8	7.0	6.8	7.0	7.7	TDS	8	-12	12		
Temp	21.5	1.5	24.0	23.7	23.2	23.2	24.0	23.7	23.2	23.2						
Alk	6	1	0	0	1	1	9	11	18	41	Alk	4	-1	9		
TDS	112	2	6	5	10	17	149	179	331	714	TDS	4	-15	11		
TotHard	30	1	3	0	1	3	46	59	89	205	TotHard	4	-6	13		
CaHard	20	0	3	0	0	3	30	37	53	115	CaHard	4	-15	20		
Turb	0.17	0.01	0.08	0.13	0.12	0.08	0.12	0.21	0.20	0.23	Turb	4	-93	122		
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a		
TOC	3.7	0.0	0.3	0.3	0.3	0.3	5.2	7.3	12.0	29.5	TOC	0	n/a	n/a		
UV254	0.074	0.002	0.005	0.005	0.005	0.005	0.105	0.145	0.232	0.567	UV254	4	-4	7		
SUVA	2.03	0.03	1.80	1.80	1.80	1.80	2.01	1.99	1.93	1.92						
Bromide	61	3	10	10	10	25	Pretreatment Information									
TOX	273	3	13	13	13	13									Process	Description
CHCl3	62.8	9.4	0.0	0.0	0.0	0.0	Rapid Mix um: Al2(SO4)3 18H2O, 58 ppm Full-scale Pulsator Clarifier NA Full-scale Filtration Anthracite Sand Full-scale Filtration 1 um exclusion Bench-scale Antiscalant Addition 3 mg/L Hypersperse AF200ul Bench-scale									
BDCM	21.1	2.0	0.0	0.0	0.0	0.0										
DBC	5.3	0.4	0.0	0.0	0.0	1.1										
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0										
THM4	89.3	11.8	0.0	0.0	0.0	1.1										
MCAA	1.3	1.3	0.0	0.0	0.0	0.0	Design Parameters									
DCAA	20.4	1.4	0.0	0.0	0.0	0.0										
TCAA	17.3	1.2	0.0	0.0	0.0	0.0										
MBAA	0.0	0.0	0.0	0.0	0.0	0.0										
DBAA	1.2	0.1	0.0	0.0	0.0	0.0										
BCAA	5.8	0.4	0.0	0.0	0.0	0.0										
TBAA	NA	NA	NA	NA	NA	NA										
CDBAA	NA	NA	NA	NA	NA	NA										
DCBAA	NA	NA	NA	NA	NA	NA										
HAA5	40.2	1.0	0.0	0.0	0.0	0.0										
HAA6	45.9	0.6	0.0	0.0	0.0	0.0										
HAA9	NA	NA	NA	NA	NA	NA										
SDS Conditions							Active memb area: 0.167 ft ² Active width: 0.333 ft Norm Temp: 22.3 °C Feed TDS: 112.0 mg/L Manuf rep TDS rej: 98% Temp Norm MTC-w: 0.213 gfd/psi									
WQP	Avg	SD	Count	Min - Max		ID#									Recov (dec.)	F _{W-des} (gfd)
Res (mg/L) (0)	1.08	0.29	6	0.86 - 1.66		1									0.70	15.0
Temp (°C)	30.3	0.1	6	30.0 - 30.3		2									0.90	15.0
pH (unit)	8.1	0.0	6	8.0 - 8.1		3									0.50	15.0
Time (hr)	6.4	0.0	6	6.3 - 6.4		4									0.30	15.0
Comments:																

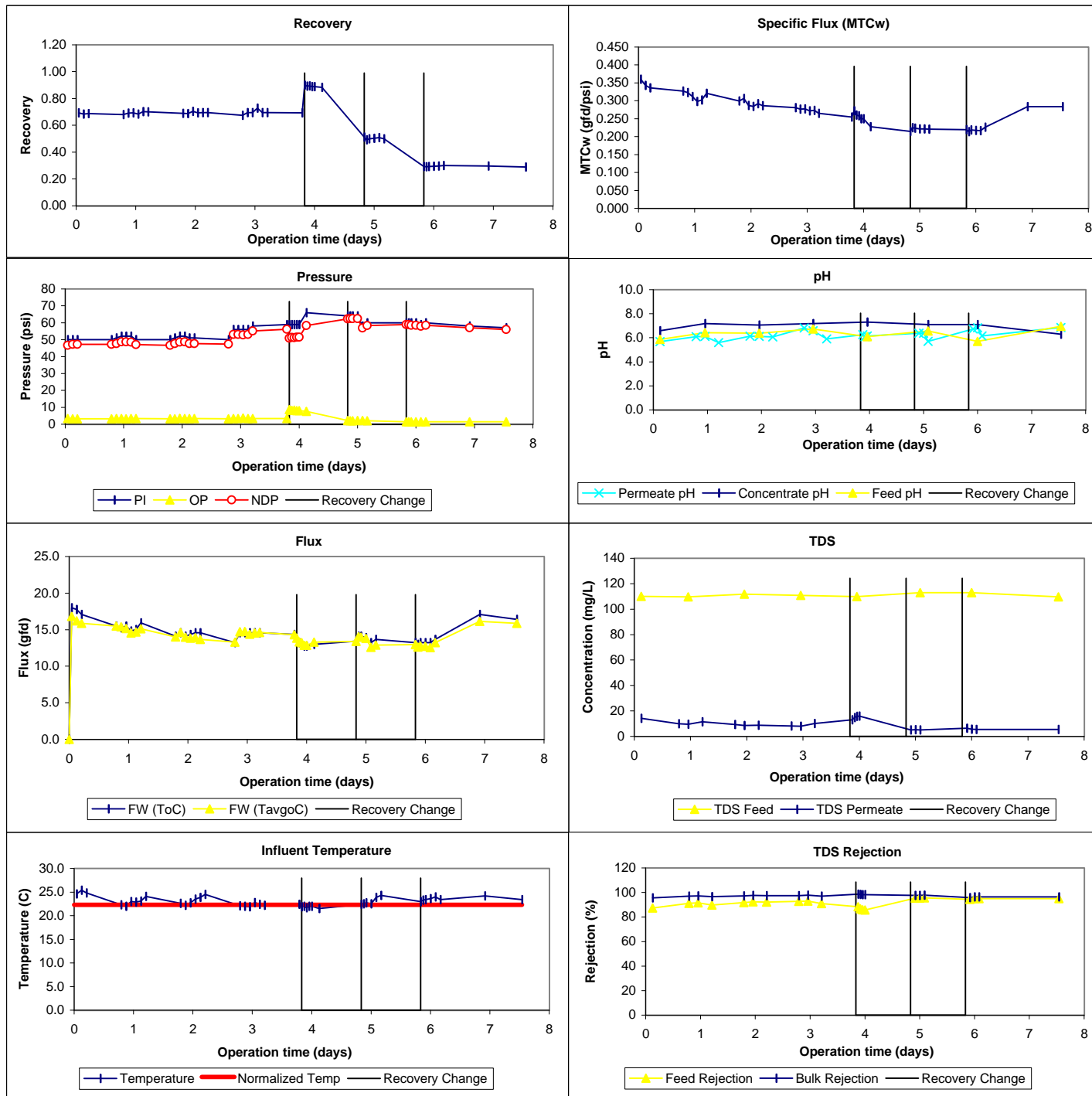
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
 ICR Contact: Bob Burrows, R.S.
 Phone No.: 409-838-3524
 Period: 10/7/98 - 10/15/98 (8 days)

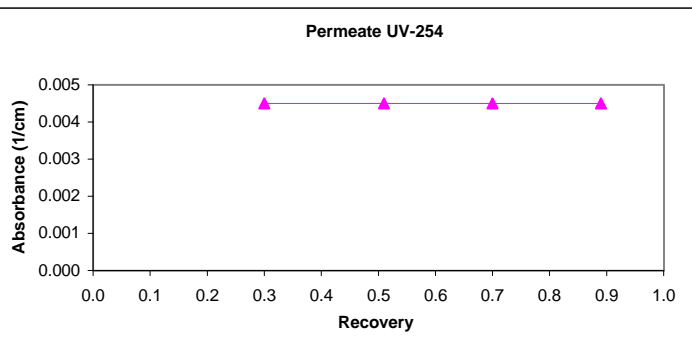
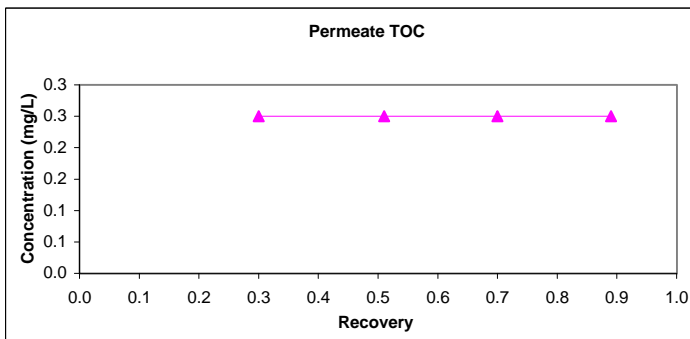
Membrane Information

Manufacturer: Dow-Filmtec
 Trade Name: BW30-XLE
 MWCO: 100 Daltons
 Mfr. Flux: 30(15 av gfd)
 Mfr. NDP: 130.0 psi
 Mfr. MTCw: 0.231 gfd/psi
 Mfr. Temp: 25.0 °C
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$700
 840 Maximum Flow: 70.0 gpm
 840 Minimum Flow: 18.8 gpm
 840 Total Width: 70.6 ft
 840 Feed Spacer Thickness: 0.0026 ft

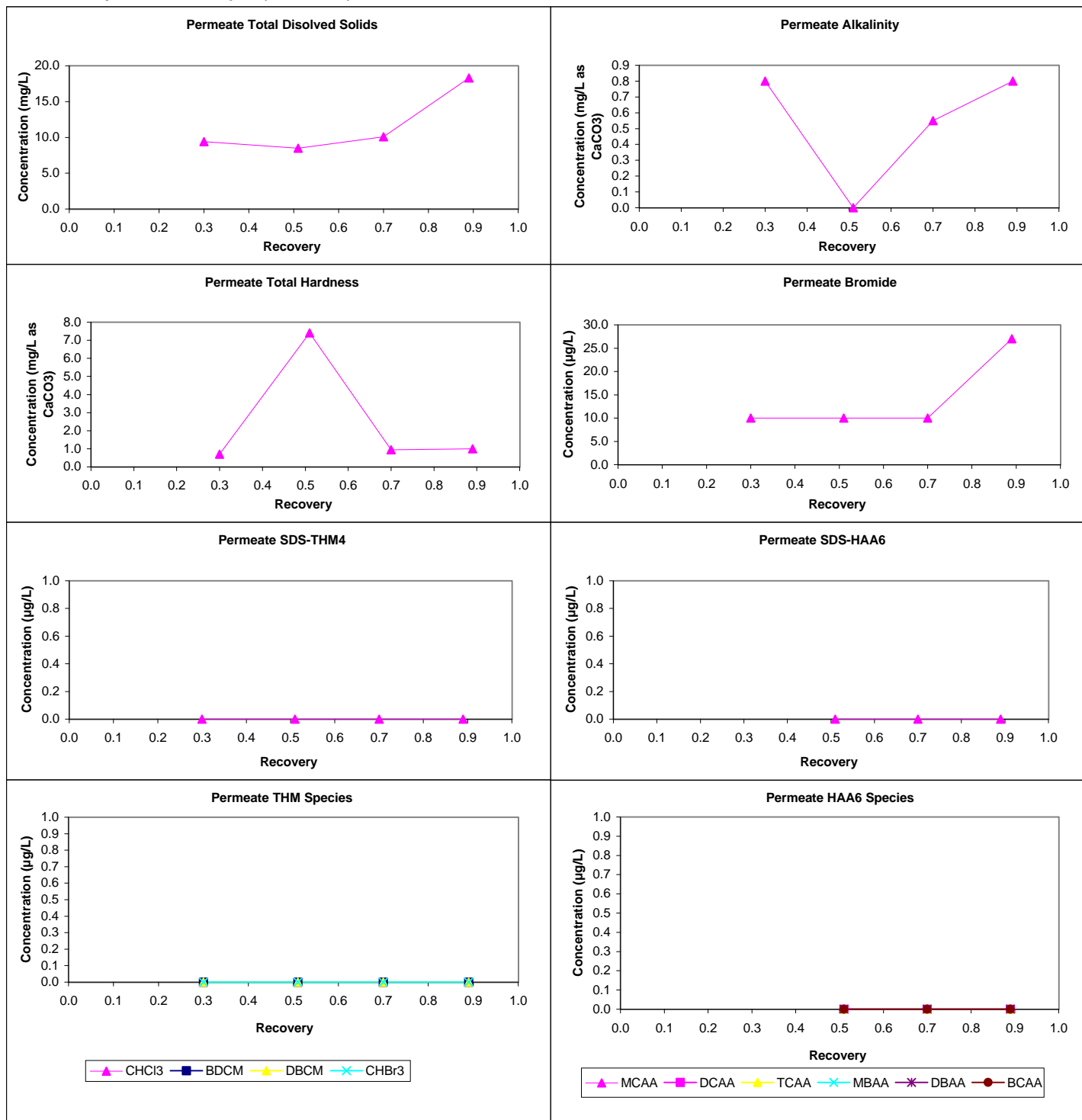
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.51	0.70	0.89	0.30	0.51	0.70	0.89	WQP	Count	Avg	SD
pH	5.7	0.3	6.2	6.1	5.7	5.7	6.5	6.8	6.3	6.7	TDS _t	8	-14	15
Temp	22.5	NA	22.5	22.8	21.1	21.2	22.5	22.8	21.1	21.2				
Alk	3	0	1	0	1	1	3	4	5	10	Alk	3	-43	18
TDS	105	0	9	9	10	18	142	174	216	599	TDS	4	-26	21
TotHard	29	1	1	7	1	1	39	63	85	216	TotHard	4	-3	16
CaHard	16	1	0	7	1	1	22	36	48	131	CaHard	4	3	18
Turb	0.16	0.00	0.45	0.15	0.13	0.10	0.60	0.17	0.17	0.19	Turb	4	-45	141
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	3.5	0.1	0.3	0.3	0.3	0.3	5.0	7.1	11.0	29.0	TOC	0	n/a	n/a
UV254	0.074	0.001	0.005	0.005	0.005	0.005	0.099	0.148	0.231	0.452	UV254	4	-15	22
SUVA	2.09	0.03	1.80	1.80	1.80	1.80	2.00	2.08	2.10	1.56				
Bromide	56	3	10	10	10	27								
TOX	268	3	13	13	38	13								
CHCl3	56.8	6.4	0.0	0.0	0.0	0.0								
BDCM	18.9	2.1	0.0	0.0	0.0	0.0								
DBC	3.8	0.4	0.0	0.0	0.0	0.0								
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0								
THM4	79.5	8.8	0.0	0.0	0.0	0.0								
MCAA	0.0	0.0	NR	0.0	0.0	0.0								
DCAA	27.7	2.6	NR	0.0	0.0	0.0								
TCAA	28.6	3.1	NR	0.0	0.0	0.0								
MBAA	0.0	0.0	NR	0.0	0.0	0.0								
DBAA	0.5	0.5	NR	0.0	0.0	0.0								
BCAA	7.2	1.4	NR	0.0	0.0	0.0								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	56.9	6.3	NR	0.0	0.0	0.0								
HAA6	64.0	7.7	NR	0.0	0.0	0.0								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	2.24	0.08	6	2.14 - 2.34										
Temp (°C)	30.3	0.0	6	30.3 - 30.4										
pH (unit)	7.8	0.0	6	7.8 - 7.8										
Time (hr)	6.0	0.0	6	6.0 - 6.0										
Pretreatment Information														
	Process	Description	Scale											
	Rapid Mix	um: Al2(SO4)3 18H2O, 58 ppm	Full-scale											
	Pulsator Clarifier	NA	Full-scale											
	Filtration	Anthracite Sand	Full-scale											
	Filtration	1 um exclusion	Bench-scale											
	Antiscalant Addition	3 mg/L Hypersperse AF200ul	Bench-scale											
Design Parameters														
	Active memb area:	0.167 ft ²									ID#	Recov (dec.)	F _{W-des} (gfd)	
	Active width:	0.333 ft									1	0.70	15.0	
	Norm Temp:	22.3 °C									2	0.90	15.0	
	Feed TDS:	112.0 mg/L									3	0.50	15.0	
	Manuf rep TDS rej:	98%									4	0.30	15.0	
	Temp Norm MTC-w:	0.213 gfd/psi												
Comments:														

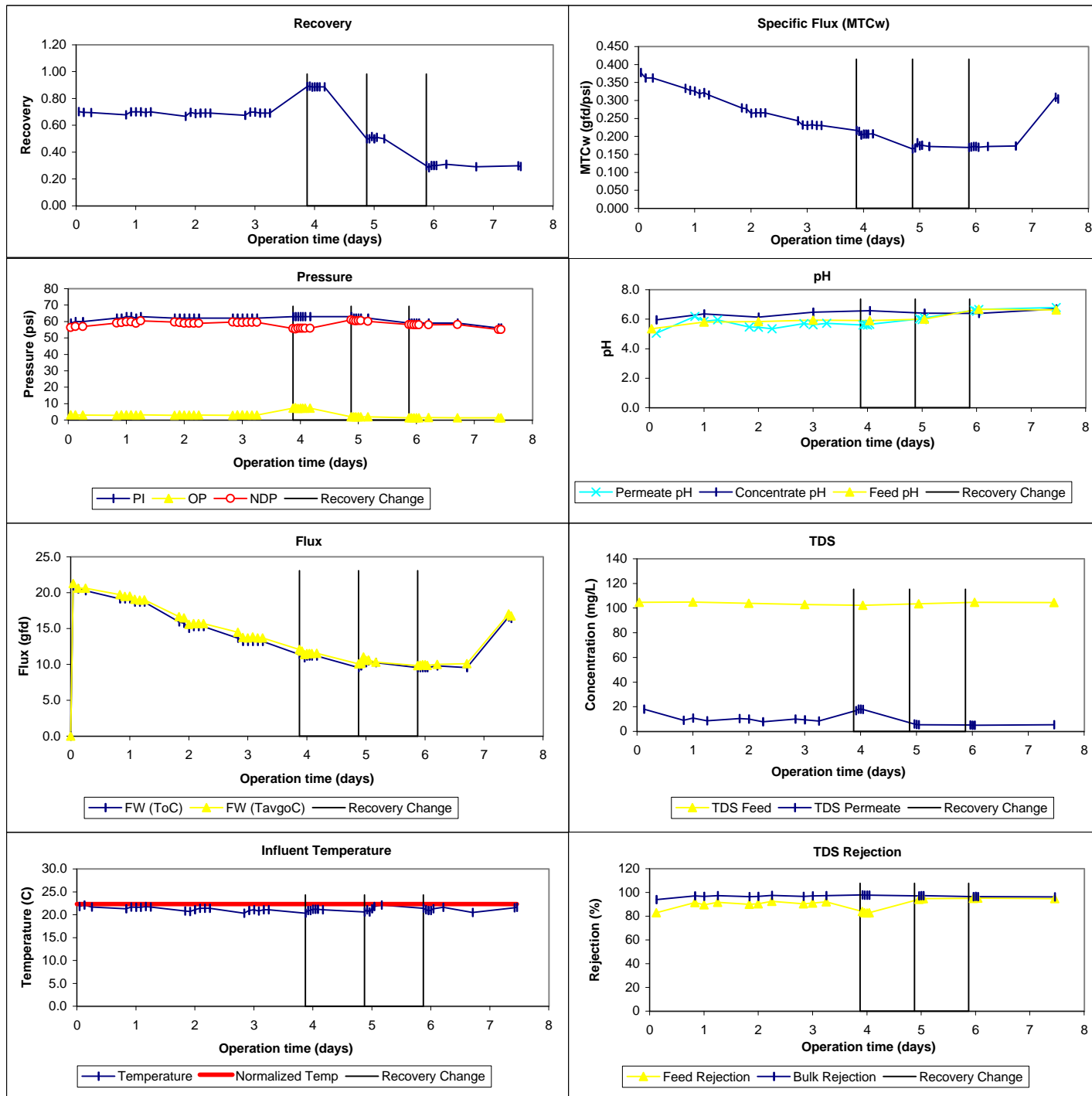
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX1230001 / 636
 ICR Contact: Bob Burrows, R.S.
 Phone No.: 409-838-3524
 Period: 1/14/99 - 1/22/99 (8 days)

Membrane Information

Manufacturer: Dow-Filmtec
 Trade Name: BW30-XLE
 MWCO: 100 Daltons
 Mfr. Flux: 30(15 av gfd)
 Mfr. NDP: 130.0 psi
 Mfr. MTCw: 0.231 gfd/psi
 Mfr. Temp: 25.0 °C
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$700
 840 Maximum Flow: 70.0 gpm
 840 Minimum Flow: 18.8 gpm
 840 Total Width: 70.6 ft
 840 Feed Spacer Thickness: 0.0026 ft

Water Quality Summary

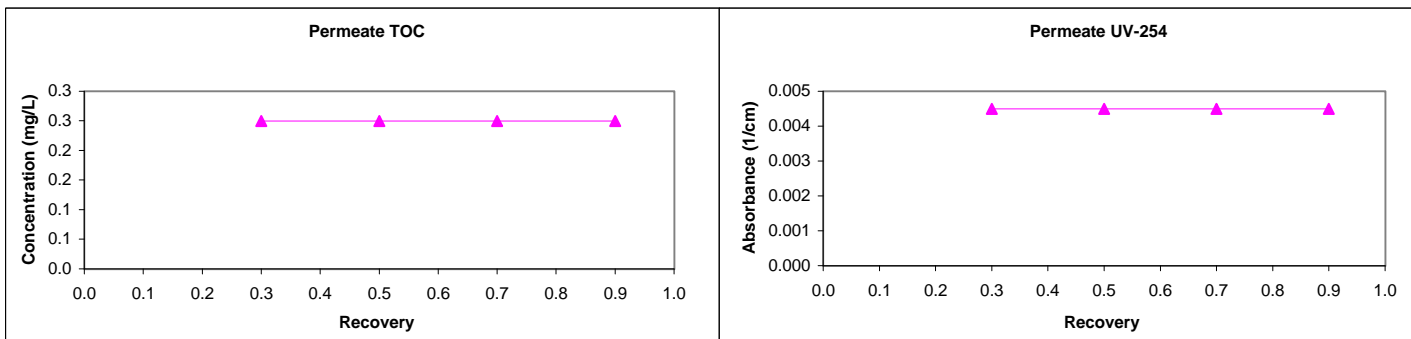
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90	WQP	Count	Avg	SD
pH	5.7	0.1	5.6	6.3	6.4	6.0	6.1	6.6	6.7	6.9	TDS _t	8	-11	13
Temp	22.0	0.3	21.2	22.4	22.1	20.8	21.6	22.4	21.6	20.4				
Alk	2	0	1	0	1	0	3	4	5	14	Alk	2	-2	2
TDS	106	0	7	6	11	21	143	200	320	744	TDS	4	-7	7
TotHard	24	1	0	0	0	1	32	49	86	238	TotHard	2	5	2
CaHard	15	0	0	0	0	0	22	31	55	154	CaHard	1	3	n/a
Turb	0.12	0.02	0.10	0.08	0.07	0.06	0.12	0.13	0.13	0.17	Turb	4	-100	129
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	3.2	0.0	0.3	0.3	0.3	0.3	4.6	6.2	11.0	15.5	TOC	0	n/a	n/a
UV254	0.055	0.000	0.005	0.005	0.005	0.005	0.079	0.109	0.190	0.524	UV254	4	1	2
SUVA	1.72	0.00	1.80	1.80	1.80	1.80	1.72	1.76	1.73	3.38				
Bromide	53	1	10	10	10	31					Pretreatment Information			
TOX	173	13	13	13	13	13					Process	Description	Scale	
CHCl3	31.7	2.4	0.0	0.0	0.0	0.0					Rapid Mix um: Al2(SO4)3 18H2O, 58 ppm	Full-scale		
BDCM	12.7	0.7	0.0	0.0	0.0	0.0					Pulsator Clarifier	NA	Full-scale	
DBC	3.4	0.4	0.0	0.0	0.0	0.0					Filtration	Anthracite Sand	Full-scale	
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0					Filtration	1 um exclusion	Bench-scale	
THM4	47.7	1.3	0.0	0.0	0.0	1.1					Antiscalant Addition 4 mg/L Hypersperse AF200ul	Bench-scale		
MCAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCAA	16.6	0.9	0.0	0.0	0.0	0.0								
TCAA	13.5	1.2	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	1.3	0.1	0.0	0.0	0.0	0.0								
BCAA	5.6	0.7	0.0	0.0	0.0	0.0								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	31.4	2.3	0.0	0.0	0.0	0.0								
HAA6	37.0	3.0	0.0	0.0	0.0	0.0								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.97	0.26	6	1.82 - 2.50										
Temp (°C)	11.6	0.0	6	11.6 - 11.6										
pH (unit)	8.1	0.0	6	8.0 - 8.1										
Time (hr)	6.0	0.0	6	6.0 - 6.0										

Design Parameters

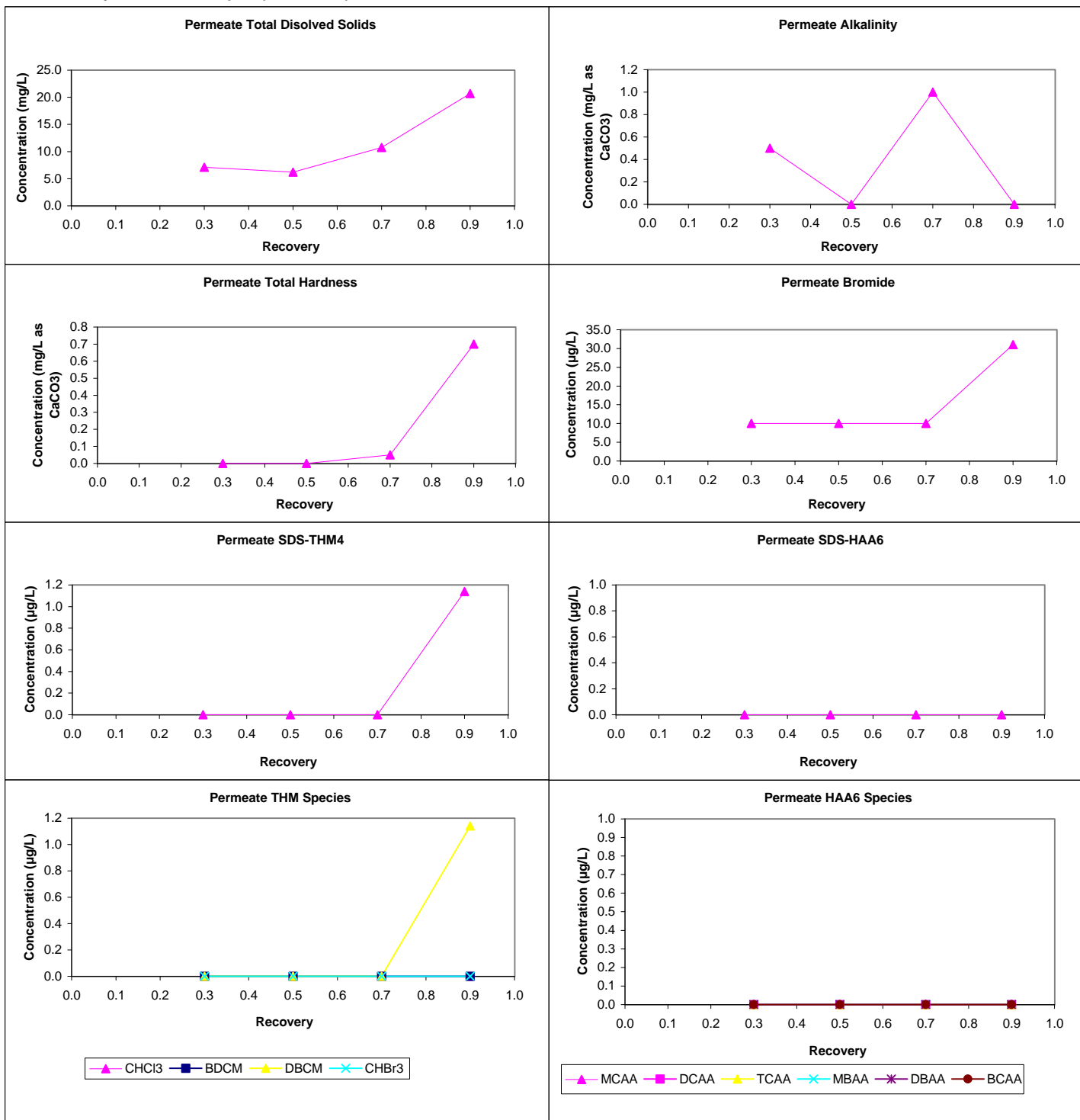
Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)
Active width:	0.333 ft	1	0.70	15.0
Norm Temp:	22.3 °C	2	0.90	15.0
Feed TDS:	106.0 mg/L	3	0.50	15.0
Manuf rep TDS rej:	98%	4	0.30	15.0
Temp Norm MTC-w:	0.213 gfd/psi			

Comments:

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs

