ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 1035

Study Protocol RBSMT

Plant ICR Number 1077

PWS Name City of Margate

City, State, Zip Margate, FL 33063

General Comments:

1. During this bench-scale study, four membranes were evaluated: the FilmTec NF70, the FilmTec NF200B, the Hydranautics ESNA1 and the Fluid Systems TFC-S. Each membrane was evaluated two times, from 11/17/98 to 5/8/99. The experimental design is listed in Table 4 of the Summary Report.

2. The influent to the treatment study was collected prior to any full-scale treatment (i.e., untreated groundwater from the Floridian Aquifer). Bench-scale pretreatment included scale control and cartridge filtration.

3. During analysis, a water temperature of 25^{o}C was used for all four quarters. Since this is a Florida groundwater source, little variability in temperature would be expected over the course of a year. It was necessary to use a temperature representative of full-scale conditions to develop estimates of pressure requirements. The temperatures reported in the Data Collection Spreadsheets are indicative of lab conditions.

4. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 50 water quality outliers were removed from this study.

2. Many outliers were identified at the 70% recovery run. Since this is the first run conducted during each session, it is possible that membrane performance was not stable.

3. SDS conditions are summarized in Table 9 of the Summary Report. Constant target SDS conditions were used for the entire study: temperature 22^{o}C, pH 7.5, incubation time 24 hours and free residual 1 mg/L.

4. Some difficulty in controlling the waste flow rate at 90% recovery was encountered during the experiments. This impacted the composite permeate and concentrate samples collected at 90% recovery and most likely resulted in correspondingly high mass balance closure. During the second round of testing with the four membranes, a positive-displacement pump was substituted for the waste control valve and used for the high recovery runs (70% and 90%). This pump provided better control of the concentrate waste flow rate.

5. For all four membranes, the permeate water quality results for the two sessions of testing are inconsistent. It is possible that significant membrane variability was encountered during this study. The consultant briefly discusses some problems encountered with respect to membrane variability in section 4.1 of "Results and Discussion" in the Summary Report.

Productivity Comments:

1. 13 productivity outliers were removed from this study.

2. During the productivity data analyses the calculated slopes of the system flux decline curves were positive for the 1035-1-TFC-S and 1035-2-NF200B runs. A positive flux decline slope is physically impossible; therefore it was replaced by zero. Consequently, the projected cleaning interval exceeded one year; therefore, an upper-bound of 365 days was used as the cleaning interval for these two runs.

3. The membrane cleaning procedure included the use of a citric acid solution (pH > 2, heated to 30 – 35 ^{o}C), and a sodium hydroxide/surfactant solution (pH < 11, heated to 30 – 35 ^{o}C). It is not clear in Section 4.3.5 in the Summary Report whether both solutions were used sequentially during each cleaning event, or whether different cleaning solutions were used based on the suspected membrane foulant.

City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (NF70)** | **Quarter:** 1

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 11/23/98 - 12/16 (23 days)

Membrane Information

Manufacturer: Film Tec
Trade Name: NF70
MWCO: 200 Daltons
Mfr. Flux: 25.0 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.357 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $600
840 Maximum Flow: 75.0 gpm
840 Minimum Flow: 24.7 gpm
840 Total Width: 58.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.30	0.47	0.69	0.88	0.30	0.47	0.69	0.88
pH	6.7	0.1	6.0	6.4	7.5	7.3	7.0	6.9	8.0	8.0
Temp	21.5	0.0	23.2	26.3	24.4	24.5	23.2	26.3	24.4	24.5
Alk	148	1	19	29	131	66	197	263	577	1080
TDS	**474**	**5**	**52**	**87**	**338**	**260**	**NR**	**NA**	**1826**	**NA**
TotHard	295	0	22	46	218	121	378	512	1010	2160
CaHard	279	0	20	43	210	115	357	484	958	2040
Turb	0.38	0.02	0.00	0.01	0.04	0.17	0.28	0.32	0.23	3.00
Amm	0.64	0.00	0.19	0.24	0.60	0.43	0.44	NA	1.20	NA
TOC	**9.7**	**0.0**	**0.6**	**0.5**	**0.8**	**1.1**	**12.8**	**19.5**	**36.4**	**53.5**
UV254	0.279	0.001	0.005	0.012	0.010	0.025	0.381	0.559	1.116	3.325
SUVA	2.88	0.00	0.75	2.31	1.32	2.19	2.98	2.87	3.07	6.21
Bromide	**185**	**1**	**38**	**50**	**171**	**137**				
TOX	**722**	**9**	**13**	**30**	**32**	**69**				
CHCl3	166.4	0.7	2.2	3.3	1.7	7.3				
BDCM	49.9	2.2	2.9	4.6	3.9	11.6				
DBCM	10.2	0.4	2.2	4.4	7.8	12.0				
CHBr3	0.0	0.0	0.0	0.0	5.0	1.9				
THM4	**226.5**	**3.2**	**7.3**	**12.3**	**18.4**	**32.9**				
MCAA	4.3	1.6	0.0	0.0	0.0	0.0				
DCAA	36.2	2.6	0.0	1.4	0.0	2.3				
TCAA	74.3	1.8	0.0	1.2	0.0	2.4				
MBAA	0.6	0.6	0.0	0.0	0.0	0.0				
DBAA	1.4	0.0	0.0	1.1	2.3	2.0				
BCAA	8.3	0.1	0.0	1.5	1.5	2.5				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**116.9**	**1.4**	**0.0**	**3.7**	**2.3**	**6.6**				
HAA6	**125.2**	**1.3**	**0.0**	**5.3**	**3.8**	**9.2**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	1.03	0.32	6	0.61 - 1.33
Temp (°C)	23.0	0.0	6	23.0 - 23.0
pH (unit)	7.5	0.0	6	7.5 - 7.5
Time (hr)	23.6	0.0	6	23.6 - 23.6

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	12	40	19
Alk	4	25	32
TDS	1	58	n/a
TotHard	4	18	28
CaHard	4	18	29
Turb	3	-160	216
Amm	2	-24	63
TOC	4	-4	25
UV254	3	21	13

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

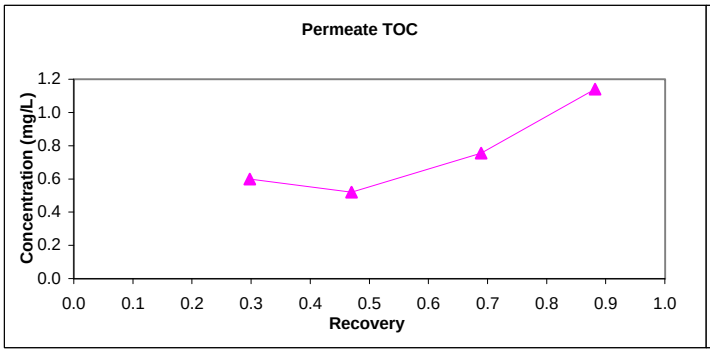
Design Parameters

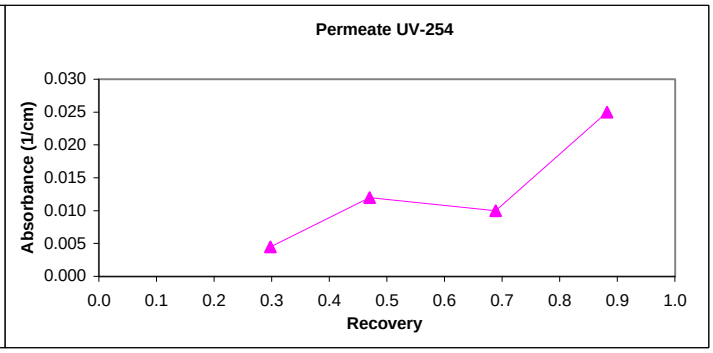
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.327 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	25.0
2	0.90	25.0
3	0.50	25.0
4	0.30	25.0

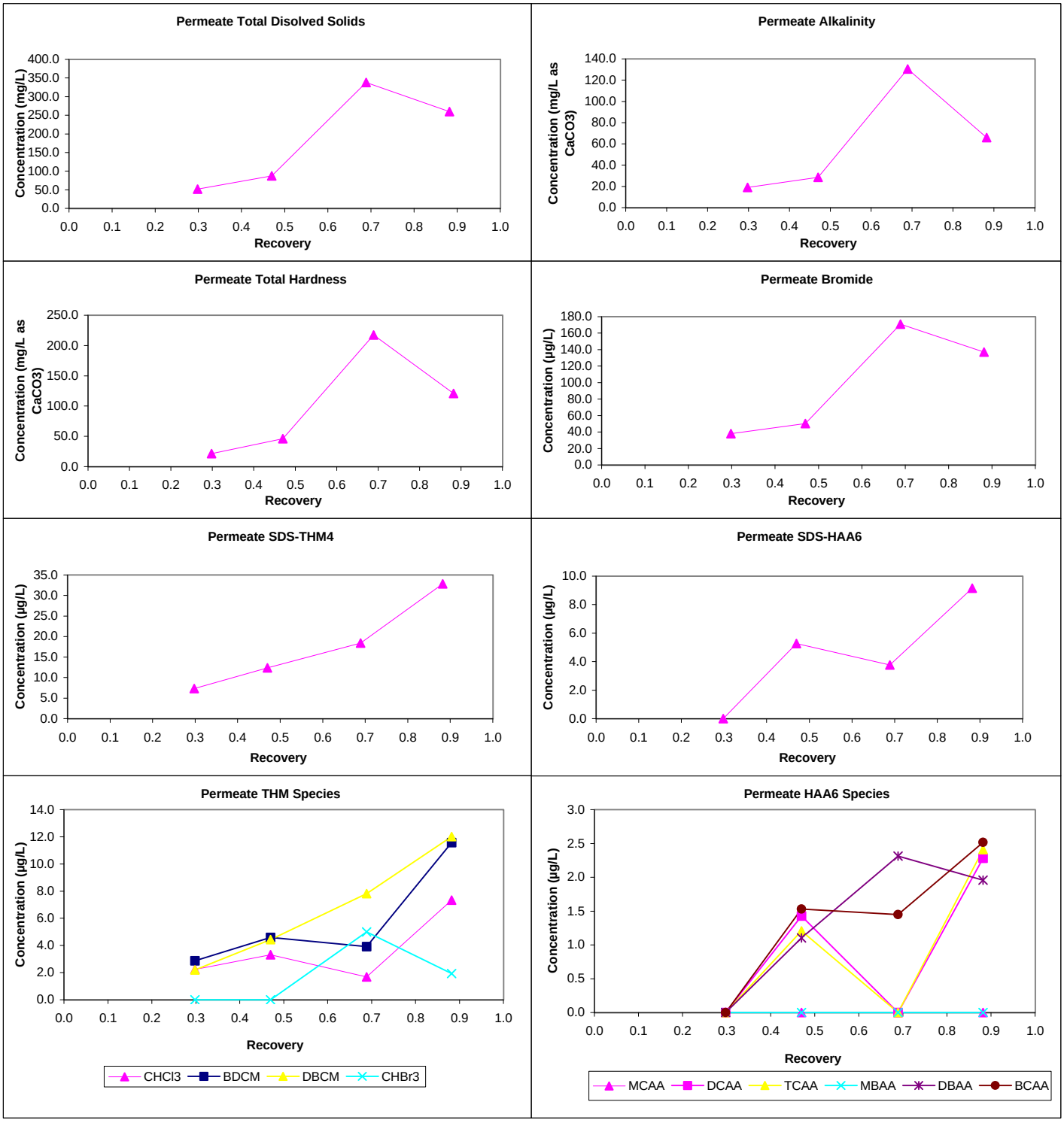
Comments:

Water Quality Parameter Graphs

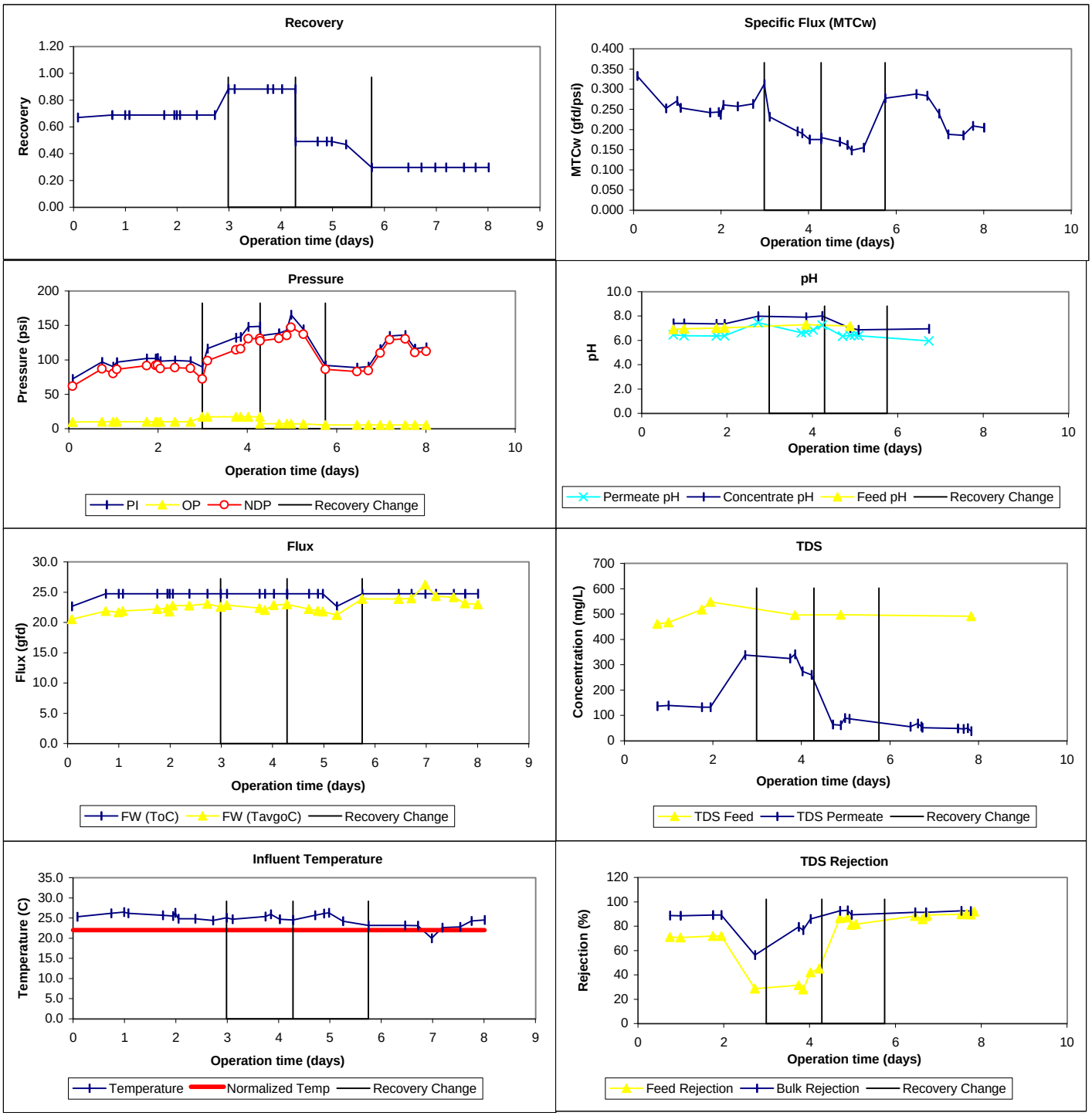




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (NF200B-400)** | **Quarter:** 2

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 11/23/98 - 12/16 (23 days)

Membrane Information

Manufacturer: Film Tec
Trade Name: NF200B-400
MWCO: 200-400 Daltons
Mfr. Flux: 21.1 gfd
Mfr. NDP: 71.0 psi
Mfr. MTCw: 0.284 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $800
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 58.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.30	0.48	0.71	0.87	0.30	0.48	0.71	0.87
pH	6.7	0.1	6.6	6.7	7.3	7.3	7.0	7.0	8.1	7.8
Temp	21.5	0.0	23.2	26.9	24.2	25.2	23.2	26.9	24.2	25.2
Alk	148	1	86	120	45	134	180	203	400	320
TDS	**474**	**5**	**200**	**414**	**122**	**374**	**235**	**NA**	**1236**	**NA**
TotHard	295	0	102	215	76	238	366	418	783	832
CaHard	279	0	99	206	72	227	344	392	716	751
Turb	0.38	0.02	0.00	0.04	0.03	0.14	0.33	0.36	0.44	0.59
Amm	0.64	0.00	0.44	0.51	0.45	0.54	NA	NA	0.75	NA
TOC	**9.7**	**0.0**	**0.9**	**1.2**	**0.8**	**1.9**	**12.4**	**23.5**	**61.0**	**108.0**
UV254	0.279	0.001	0.016	0.018	0.018	0.038	0.409	0.676	1.708	3.206
SUVA	2.88	0.00	1.88	1.55	2.12	2.02	3.30	2.88	2.80	2.97
Bromide	**185**	**1**	**174**	**175**	**78**	**181**				
TOX	**722**	**9**	**41**	**62**	**51**	**110**				
CHCl3	166.4	0.7	2.7	4.4	5.8	10.1				
BDCM	49.9	2.2	6.5	8.7	7.5	17.5				
DBCM	10.2	0.4	10.6	12.3	6.9	19.9				
CHBr3	0.0	0.0	3.7	4.0	0.0	5.2				
THM4	**226.5**	**3.2**	**23.5**	**29.3**	**20.2**	**52.7**				
MCAA	4.3	1.6	0.0	0.0	0.0	0.0				
DCAA	36.2	2.6	1.4	2.0	2.7	4.1				
TCAA	74.3	1.8	1.2	2.0	3.0	4.1				
MBAA	0.6	0.6	0.0	0.0	0.0	0.0				
DBAA	1.4	0.0	2.6	2.8	1.6	4.2				
BCAA	8.3	0.1	2.4	2.9	2.6	5.2				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**116.9**	**1.4**	**5.2**	**6.9**	**7.3**	**12.5**				
HAA6	**125.2**	**1.3**	**7.6**	**9.8**	**9.9**	**17.7**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	12	26	19
Alk	4	11	11
TDS	2	-79	72
TotHard	4	5	11
CaHard	4	4	12
Turb	3	-172	76
Amm	1	-44	n/a
TOC	4	27	25
UV254	4	28	19

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	1.38	0.17	6	1.11 - 1.56
Temp (°C)	23.0	0.0	6	23.0 - 23.0
pH (unit)	7.5	0.0	6	7.5 - 7.5
Time (hr)	23.6	0.0	6	23.6 - 23.7

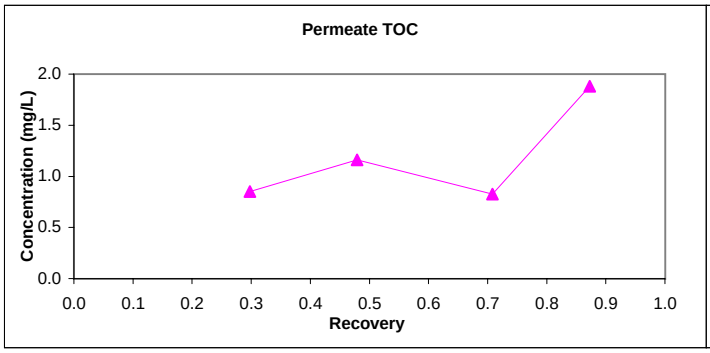
Design Parameters

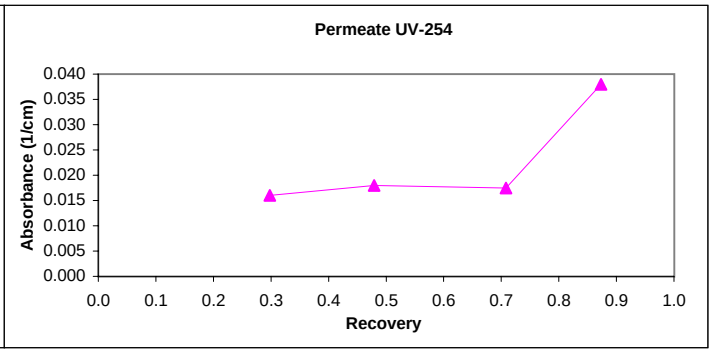
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.260 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	21.1
2	0.90	21.1
3	0.50	21.1
4	0.30	21.1

Comments:

Water Quality Parameter Graphs





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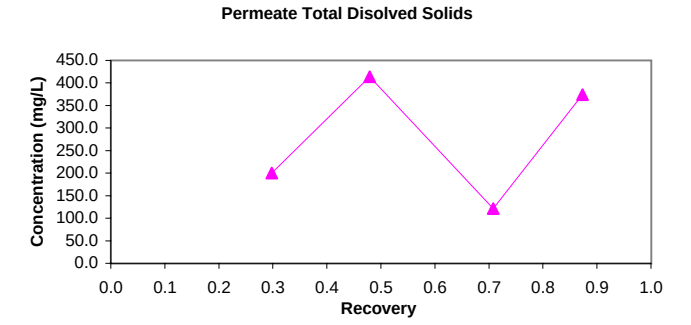
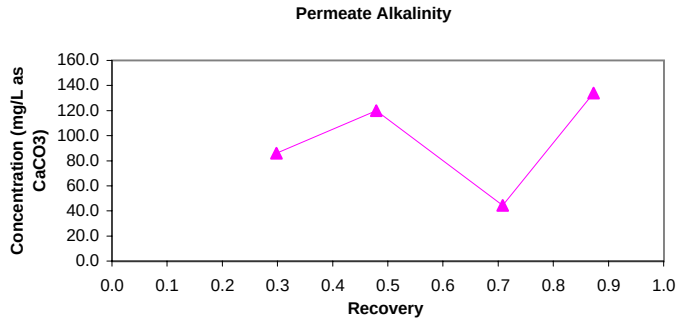
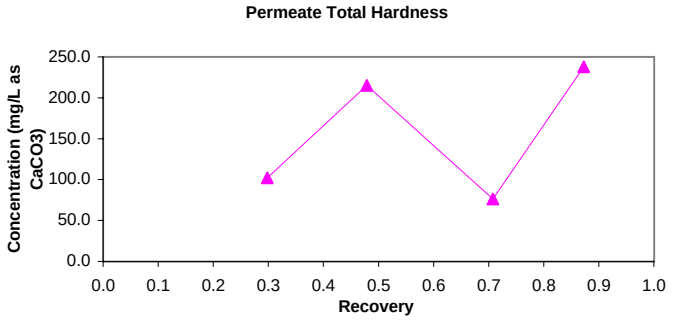
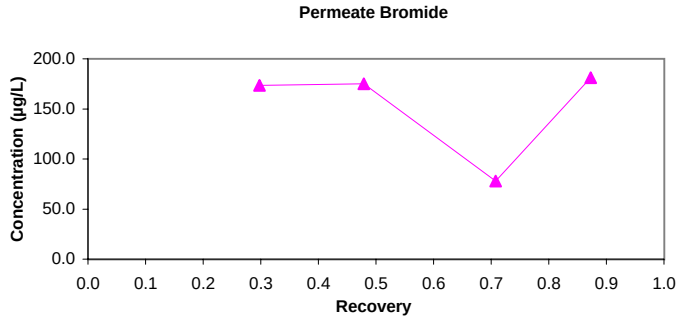
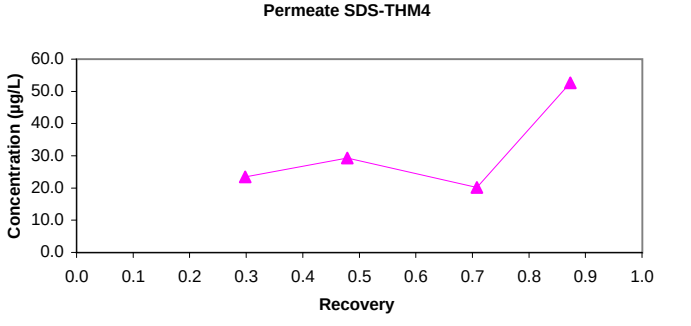
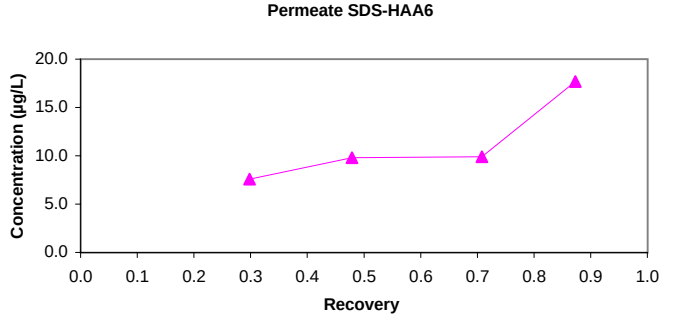


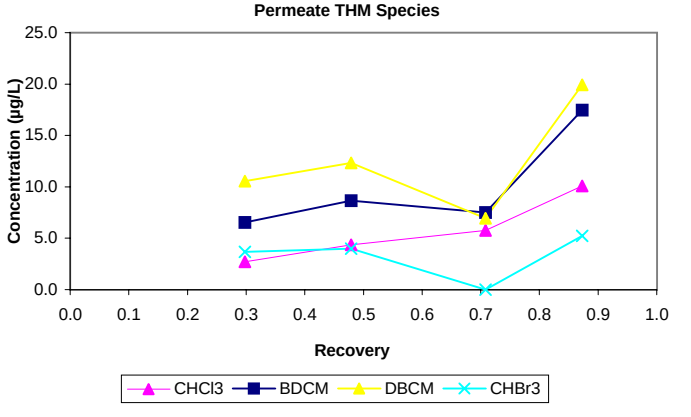


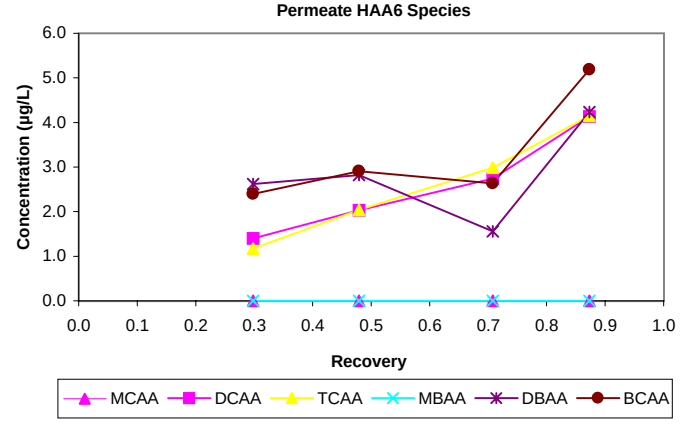




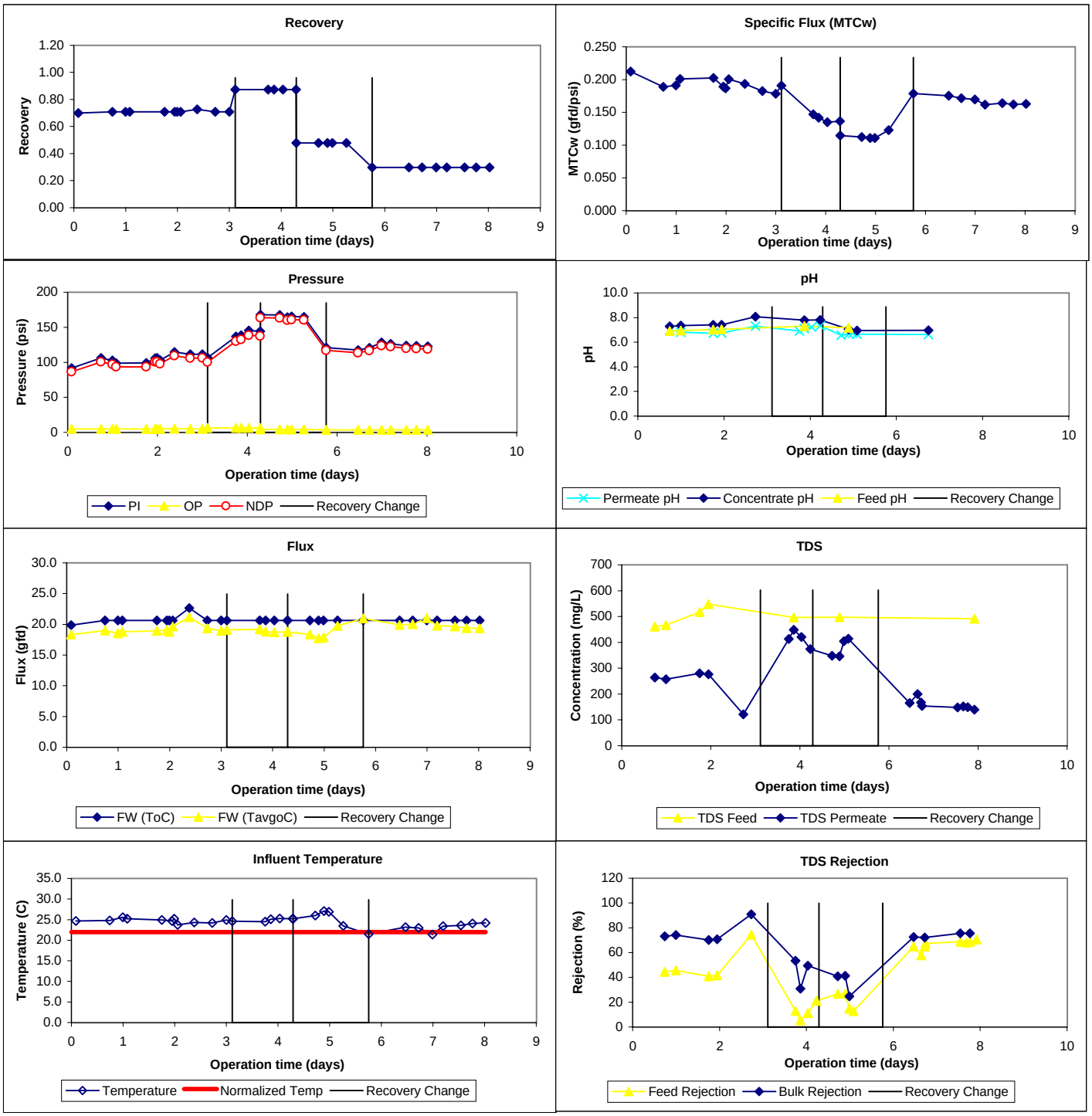








Productivity Graphs



City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (ESNA1)** | **Quarter:** 3

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 2/24/99 - 3/5/99 (9 days)

Membrane Information

Manufacturer: Hydranautics
Trade Name: ESNA1
MWCO: 180 Daltons
Mfr. Flux: 27.0 gfd
Mfr. NDP: 68.0 psi
Mfr. MTCw: 0.360 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $875
840 Maximum Flow: 75.0 gpm
840 Minimum Flow: 25.0 gpm
840 Total Width: 76.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.27	0.50	0.67	0.83	0.27	0.50	0.67	0.83
pH	6.4	0.0	5.8	5.8	6.1	6.0	6.7	6.7	6.8	7.9
Temp	21.5	0.0	24.6	24.5	24.1	24.9	24.6	24.5	24.1	24.9
Alk	70	3	10	10	12	17	100	138	196	425
TDS	**587**	**16**	**58**	**54**	**81**	**198**	**758**	**1120**	**1573**	**4010**
TotHard	285	1	18	23	33	68	385	511	808	1940
CaHard	268	1	18	23	33	64	362	479	756	1810
Turb	0.87	**0.38**	0.00	0.00	0.02	0.00	0.84	0.32	0.51	0.64
Amm	0.35	0.05	0.14	0.17	0.22	0.24	0.49	0.67	0.67	0.71
TOC	**11.0**	**0.4**	**0.3**	**0.3**	**0.3**	**0.5**	**15.0**	**21.0**	**34.9**	**93.3**
UV254	0.372	0.015	0.005	0.005	0.005	0.005	0.483	0.729	1.202	3.110
SUVA	3.39	0.26	1.80	1.80	1.80	0.85	3.22	3.47	3.44	3.33
Bromide	**177**	**2**	**24**	**32**	**52**	**77**				
TOX	**924**	**33**	**13**	**13**	**13**	**32**				
CHCl3	151.9	3.5	0.0	1.3	1.8	1.9				
BDCM	50.9	1.7	0.0	1.3	2.0	2.9				
DBCM	7.4	0.1	1.0	1.1	1.8	3.6				
CHBr3	0.0	0.0	0.0	0.0	0.0	1.1				
THM4	**210.2**	**5.1**	**1.0**	**3.6**	**5.7**	**9.5**				
MCAA	8.0	1.1	0.0	0.0	0.0	0.0				
DCAA	57.9	1.6	0.0	0.0	0.0	1.2				
TCAA	92.3	3.6	0.0	0.0	0.0	0.0				
MBAA	1.3	0.1	0.0	0.0	0.0	0.0				
DBAA	1.6	0.0	0.0	0.0	0.0	1.1				
BCAA	13.8	0.8	0.0	0.0	0.0	1.2				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**161.0**	**6.4**	**0.0**	**0.0**	**0.0**	**2.2**				
HAA6	**174.8**	**7.3**	**0.0**	**0.0**	**0.0**	**3.5**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.94	0.41	6	0.43 - 1.45
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.1	6	7.4 - 7.6
Time (hr)	23.4	0.3	6	23.0 - 23.9

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	6	4	18
Alk	4	11	8
TDS	4	8	20
TotHard	4	6	17
CaHard	4	6	16
Turb	1	**-406**	n/a
Amm	4	4	20
TOC	4	9	17
UV254	4	8	16

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

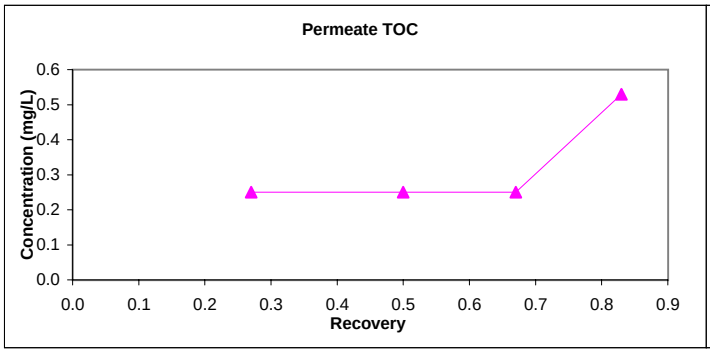
Design Parameters

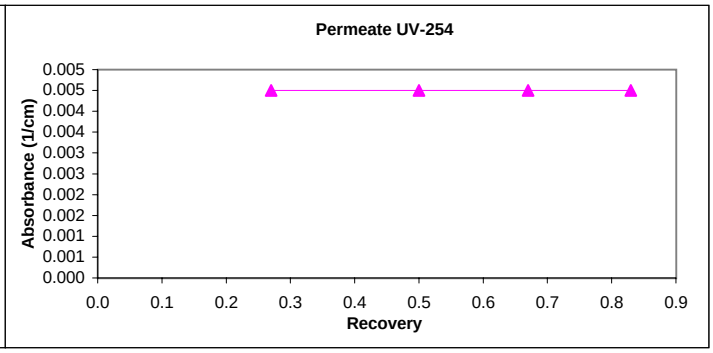
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.329 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	27.0
2	0.90	27.0
3	0.50	27.0
4	0.30	27.0

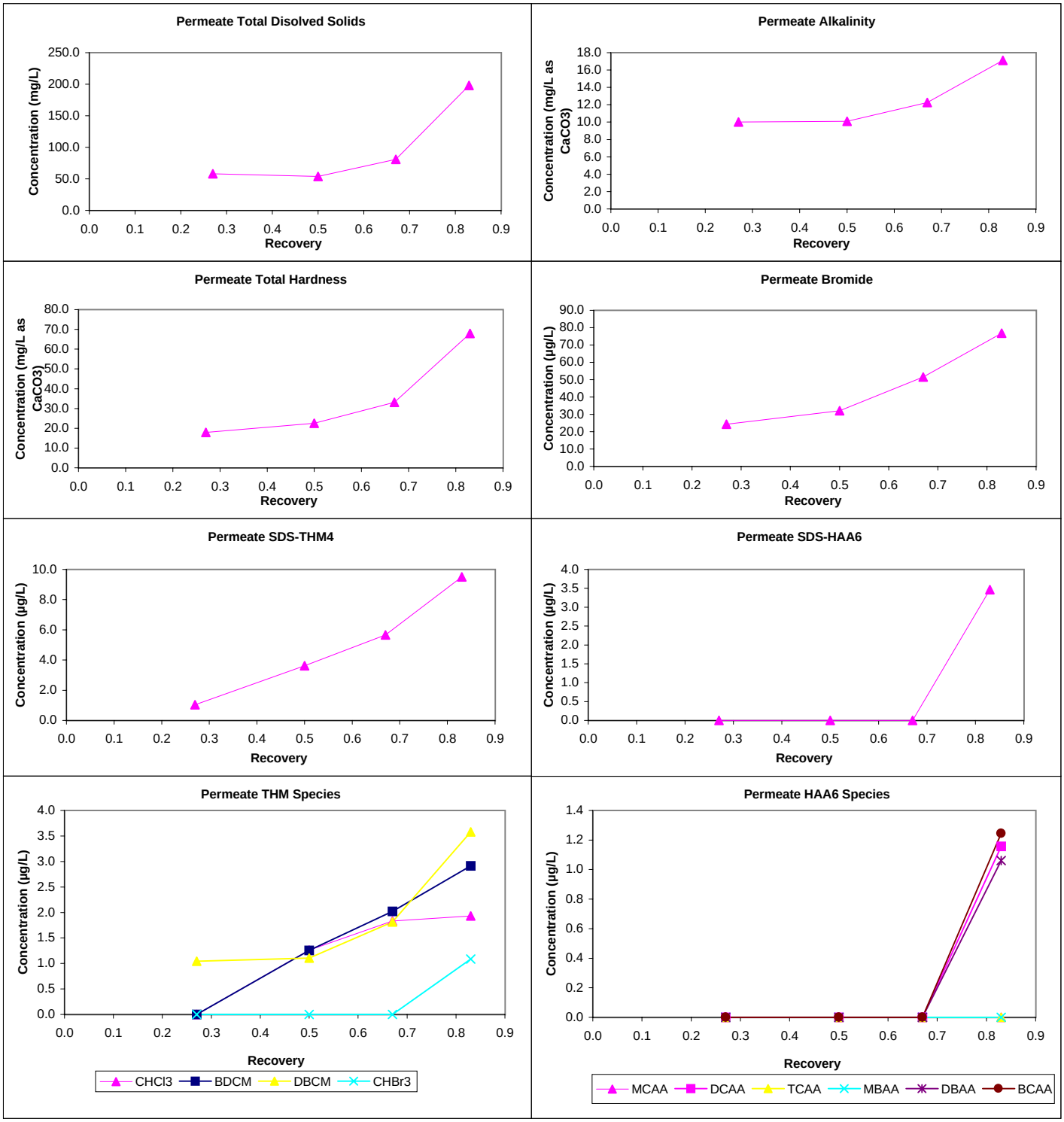
Comments:

Water Quality Parameter Graphs

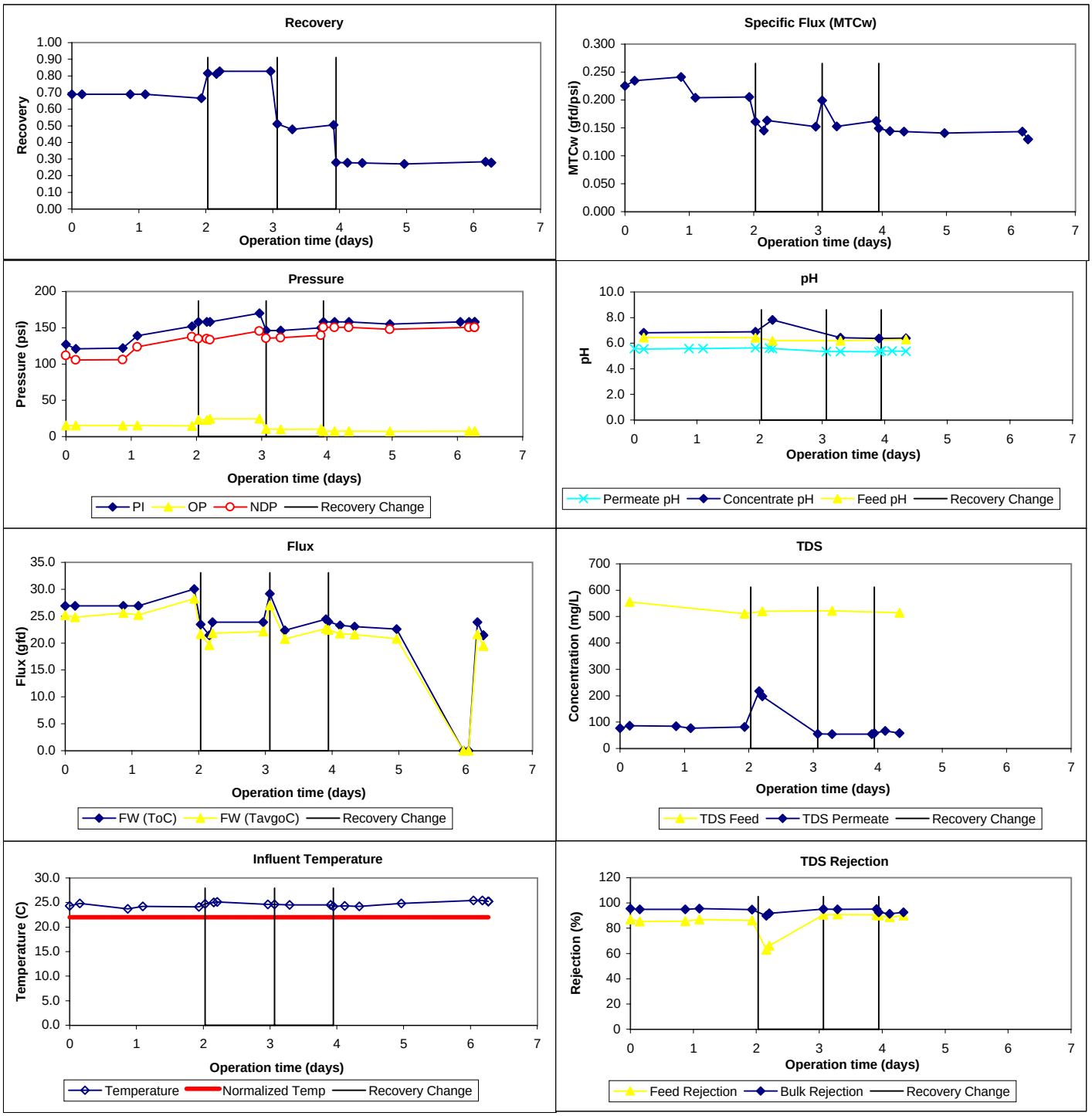




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (TFC 8921S-400)** | **Quarter:** 4

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 2/24/99 - 3/5/99 (9 days)

Membrane Information

Manufacturer: Fluid Systems
Trade Name: TFC 8921S-400
MWCO: 200 Daltons
Mfr. Flux: 15.0 gfd
Mfr. NDP: 56.5 psi
Mfr. MTCw: 0.265 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $846
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 15.0 gpm
840 Total Width: 63.2 ft
840 Feed Spacer Thickness: 0.0022 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.31	0.50	0.74	0.87	0.31	0.50	0.74	0.87
pH	6.4	0.0	6.1	5.9	6.3	6.5	6.8	7.0	7.2	8.2
Temp	21.5	0.0	24.0	24.4	23.9	24.3	24.0	24.4	23.9	24.3
Alk	70	3	12	16	28	39	85	144	247	399
TDS	**587**	**16**	**94**	**112**	**267**	**392**	**702**	**1020**	**1988**	**3380**
TotHard	285	1	37	51	111	180	395	522	956	1680
CaHard	268	1	35	48	104	171	372	489	893	1580
Turb	0.87	0.38	0.04	0.02	0.02	0.20	0.24	0.38	0.45	0.91
Amm	0.35	0.05	0.16	0.21	0.30	0.32	0.52	0.61	0.80	0.66
TOC	**11.0**	**0.4**	**0.3**	**0.5**	**1.1**	**2.0**	**15.2**	**22.6**	**51.1**	**101.8**
UV254	0.372	0.015	0.009	0.012	0.032	0.053	0.504	0.372	1.787	3.335
SUVA	3.39	0.26	3.60	2.26	2.94	2.60	3.32	1.65	3.50	3.28
Bromide	**177**	**2**	**42**	**53**	**132**	**134**				
TOX	**924**	**33**	**29**	**35**	**86**	**147**				
CHCl3	151.9	3.5	2.7	3.1	7.8	14.1				
BDCM	50.9	1.7	3.3	4.5	10.9	18.0				
DBCM	7.4	0.1	2.8	4.6	10.1	15.2				
CHBr3	0.0	0.0	0.0	1.0	1.6	2.2				
THM4	**210.2**	**5.1**	**8.9**	**13.3**	**30.5**	**49.6**				
MCAA	8.0	1.1	0.0	0.0	0.0	0.0				
DCAA	57.9	1.6	1.6	1.5	3.5	5.7				
TCAA	92.3	3.6	1.4	1.2	3.4	5.6				
MBAA	1.3	0.1	0.0	0.0	0.0	0.0				
DBAA	1.6	0.0	0.0	1.3	2.7	4.1				
BCAA	13.8	0.8	1.5	1.7	4.1	6.4				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**161.0**	**6.4**	**3.0**	**4.0**	**9.6**	**15.4**				
HAA6	**174.8**	**7.3**	**4.5**	**5.7**	**13.7**	**21.8**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.97	0.34	6	0.59 - 1.59
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.1	6	7.4 - 7.6
Time (hr)	23.3	0.3	6	23.0 - 23.8

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	6	0	41
Alk	4	14	19
TDS	4	12	27
TotHard	4	15	19
CaHard	4	15	20
Turb	4	-469	119
Amm	4	22	10
TOC	4	14	16
UV254	4	-13	57

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

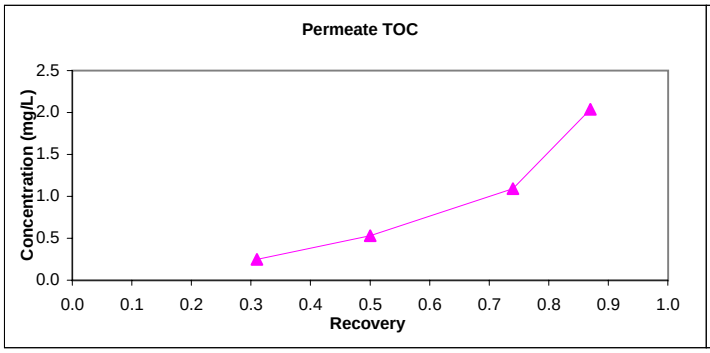
Design Parameters

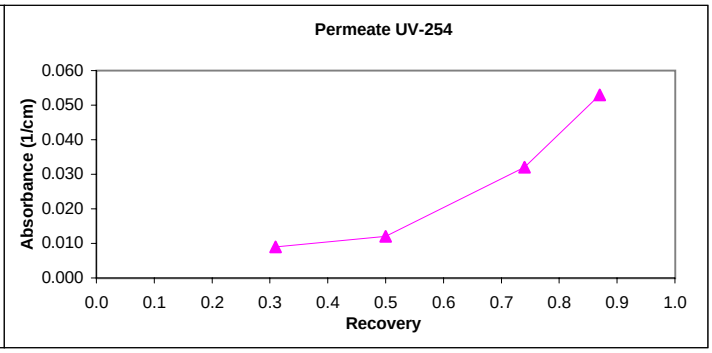
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.243 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	15.0
2	0.90	15.0
3	0.50	15.0
4	0.30	15.0

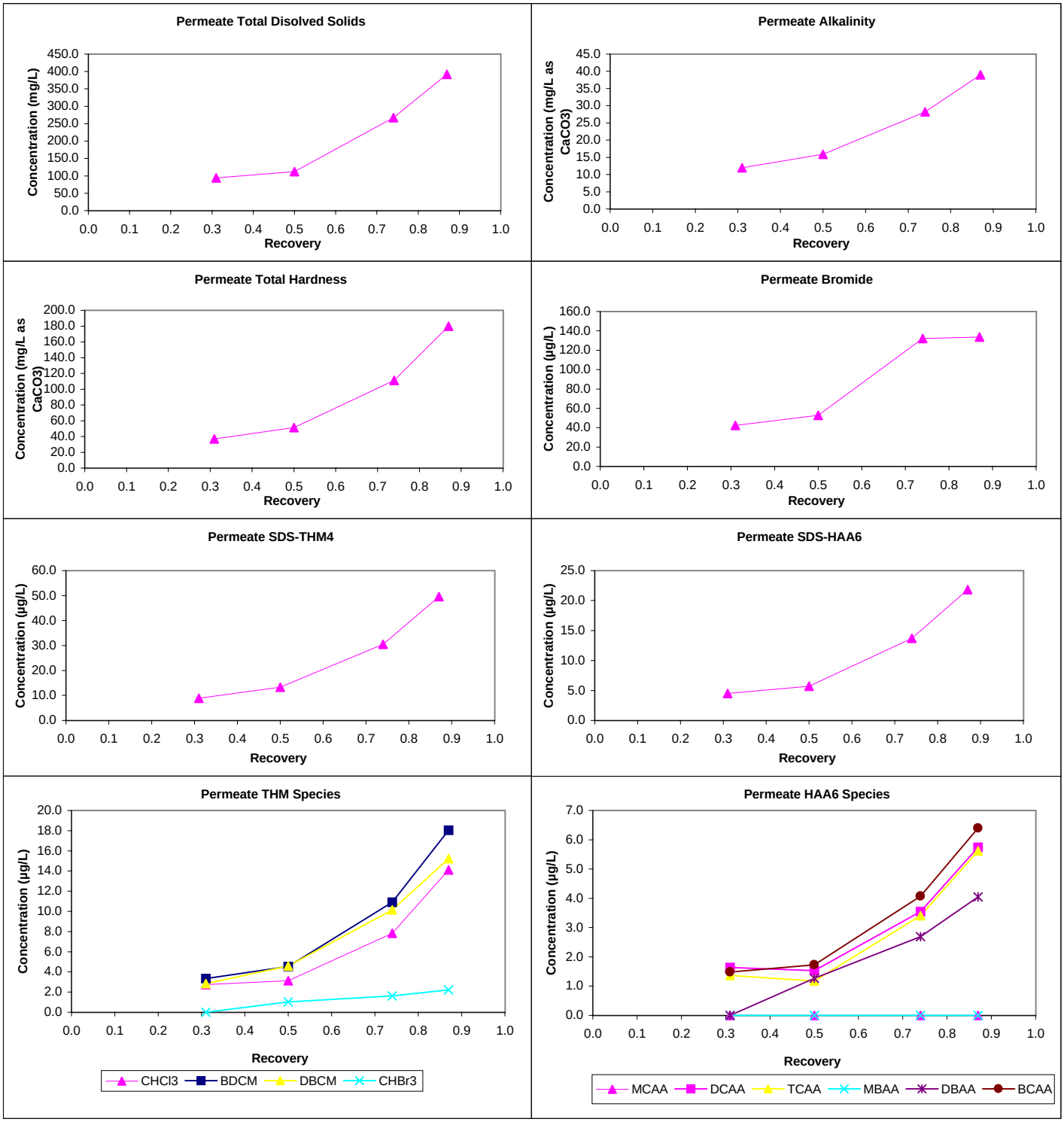
Comments:

Water Quality Parameter Graphs

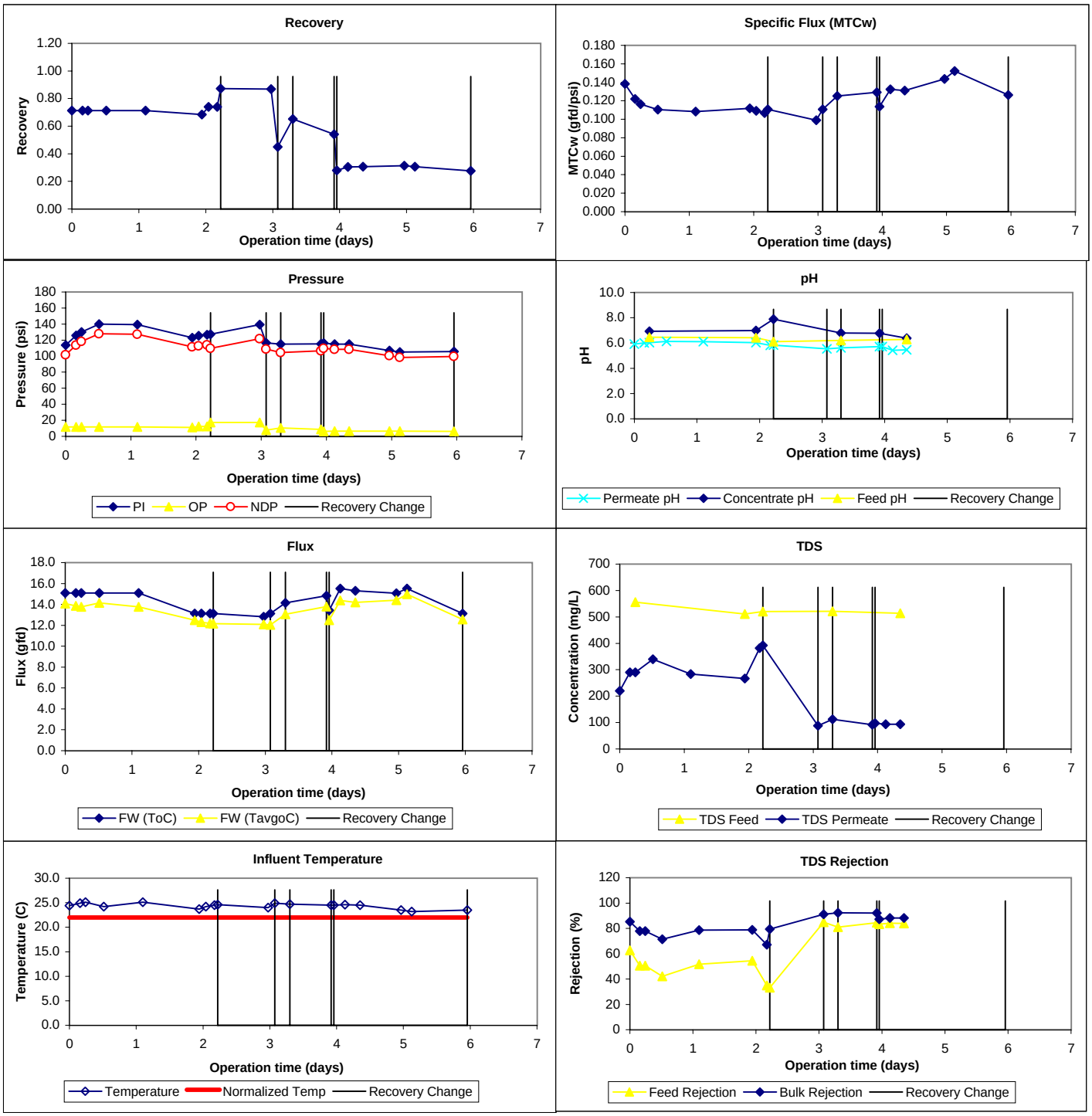




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Margate, DEES — **RBSMT Membrane Treatment Study Summary (NF70)** — **Quarter:** 1

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 5/3/99 - 5/8/99 (5 days)

Membrane Information

Manufacturer: Film Tec
Trade Name: NF70
MWCO: 200 Daltons
Mfr. Flux: 25.0 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.357 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $600
840 Maximum Flow: 75.0 gpm
840 Minimum Flow: 24.7 gpm
840 Total Width: 58.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90
pH	6.8	0.2	5.9	6.0	6.5	6.5	6.7	7.1	7.7	8.1
Temp	21.5	0.0	21.9	23.7	25.2	24.7	21.9	23.7	25.2	24.7
Alk	145	0	16	19	24	41	201	289	788	981
TDS	**511**	**24**	**63**	**63**	**115**	**158**	**692**	**1056**	**1346**	**2790**
TotHard	311	11	27	28	47	82	423	608	852	1790
CaHard	292	10	27	28	44	78	397	571	799	1680
Turb	0.28	**0.07**	0.00	0.00	0.00	0.09	0.23	0.31	0.28	1.42
Amm	0.61	0.01	0.24	0.33	0.34	0.53	0.72	0.99	1.08	1.33
TOC	**9.3**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**13.0**	**18.8**	**28.6**	**78.9**
UV254	0.230	**0.095**	0.005	0.005	0.005	0.014	0.409	0.631	0.831	2.535
SUVA	2.44	**0.92**	1.80	1.80	1.80	5.40	3.15	3.36	2.91	3.21
Bromide	**179**	**2**	**25**	**28**	**45**	**83**				
TOX	**791**	**12**	**13**	**13**	**13**	**37**				
CHCl3	127.0	2.0	1.5	0.0	2.1	2.1				
BDCM	46.7	0.1	2.1	1.2	3.1	3.7				
DBCM	9.1	0.0	2.4	1.8	3.3	6.6				
CHBr3	0.0	0.0	0.0	0.0	0.0	3.0				
THM4	**182.8**	**1.9**	**6.0**	**3.0**	**8.5**	**15.4**				
MCAA	6.5	0.1	0.0	0.0	0.0	0.0				
DCAA	42.6	2.4	0.0	0.0	0.0	0.0				
TCAA	70.5	7.2	0.0	0.0	0.0	0.0				
MBAA	1.1	0.0	0.0	0.0	0.0	0.0				
DBAA	1.6	0.0	0.0	0.0	0.0	1.8				
BCAA	11.4	0.0	0.0	0.0	0.0	1.3				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**122.2**	**9.4**	**0.0**	**0.0**	**0.0**	**1.8**				
HAA6	**133.5**	**9.5**	**0.0**	**0.0**	**0.0**	**3.1**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.63	0.27	6	0.23 - 0.87
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.0	6	7.5 - 7.6
Time (hr)	24.0	0.3	6	23.6 - 24.3

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	4	-6	15
Alk	4	10	24
TDS	4	-8	18
TotHard	4	-10	15
CaHard	4	-10	15
Turb	3	**-118**	102
Amm	4	-3	11
TOC	2	-10	3
UV254	1	14	n/a

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

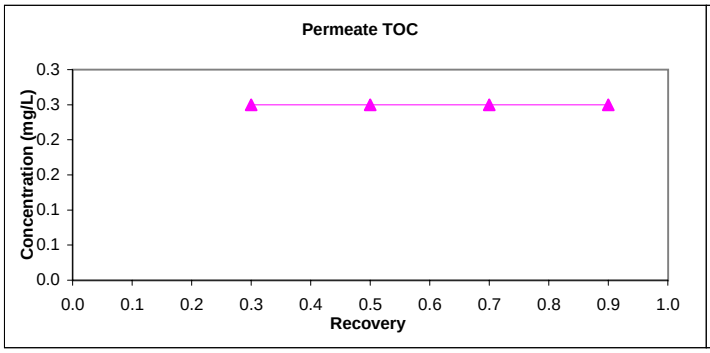
Design Parameters

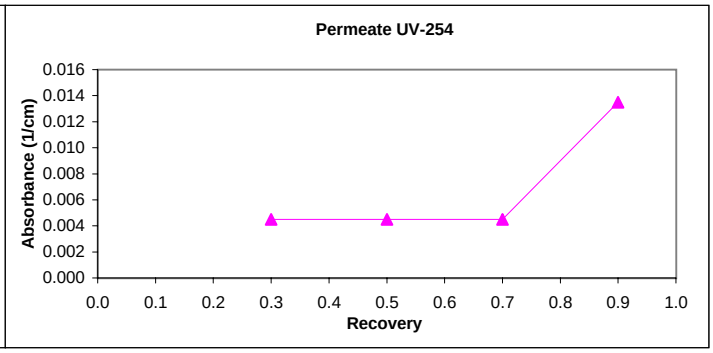
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.327 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	25.0
2	0.90	25.0
3	0.50	25.0
4	0.30	25.0

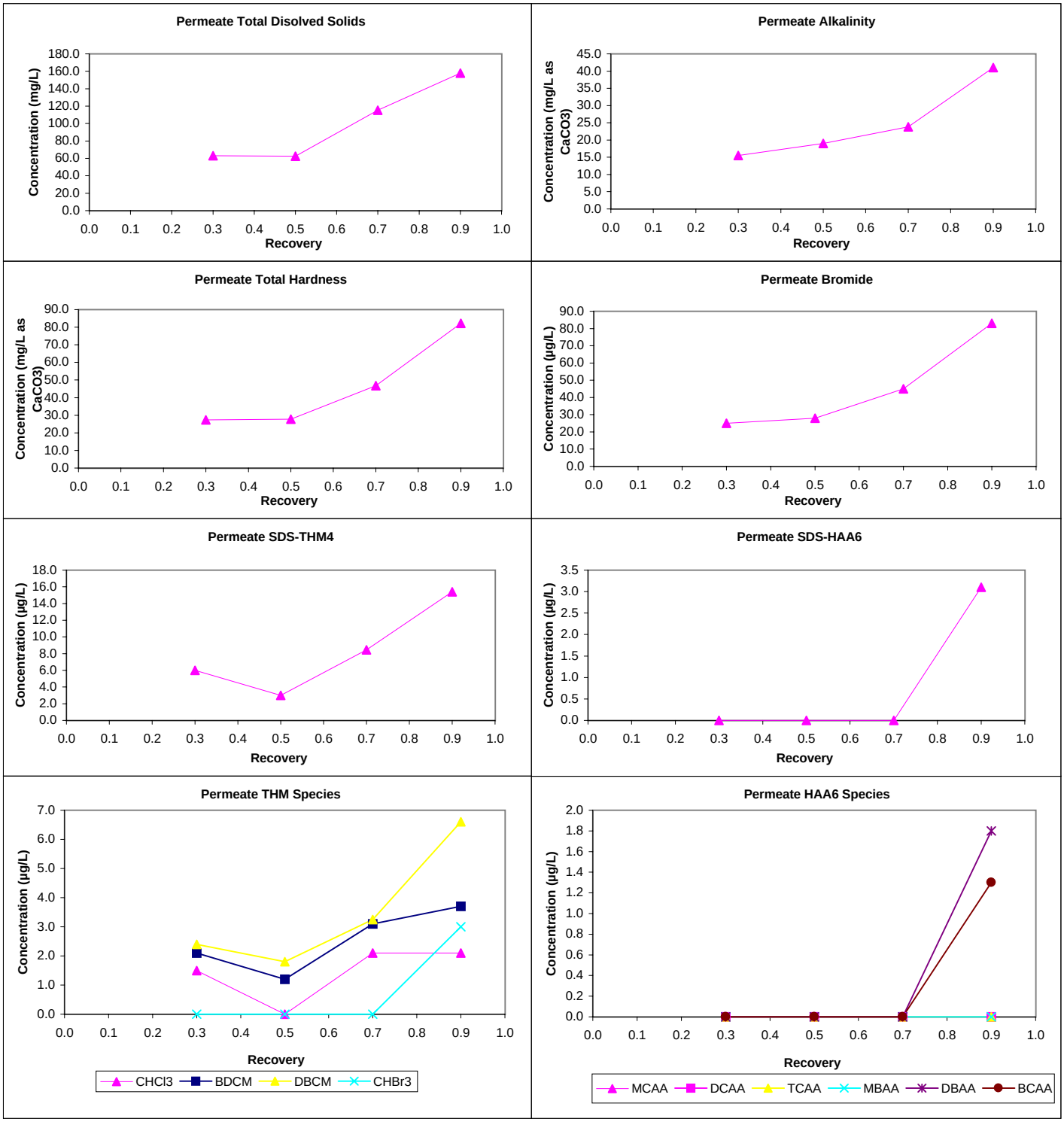
Comments:

Water Quality Parameter Graphs

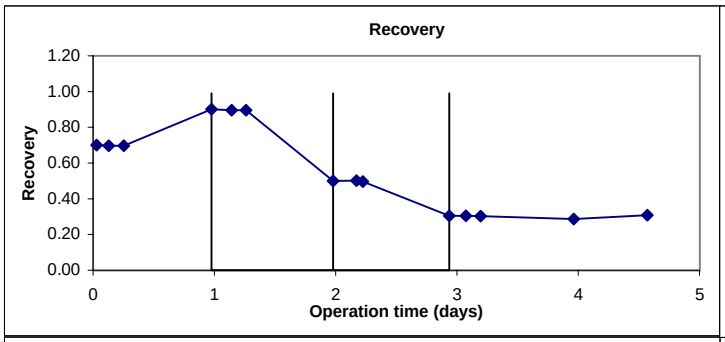


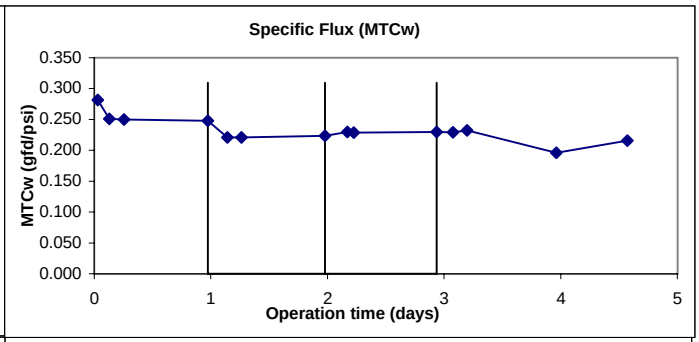


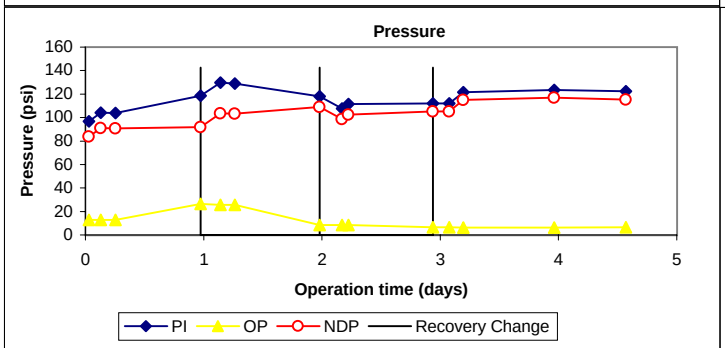
Water Quality Parameter Graphs (Continued)

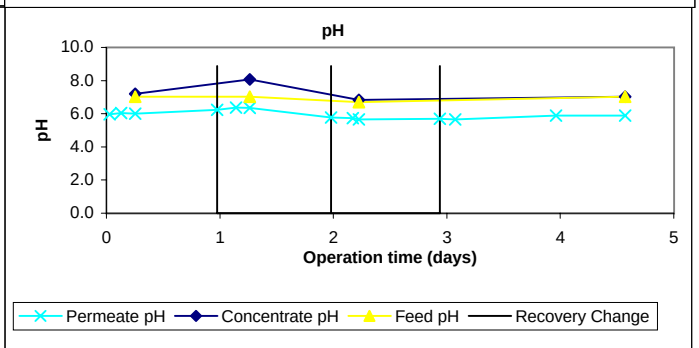


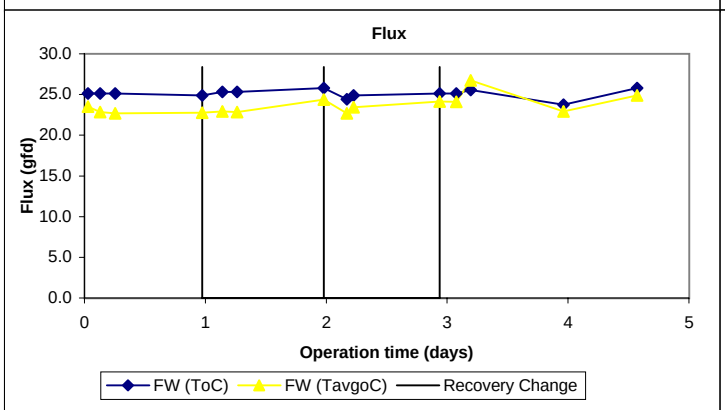
Productivity Graphs

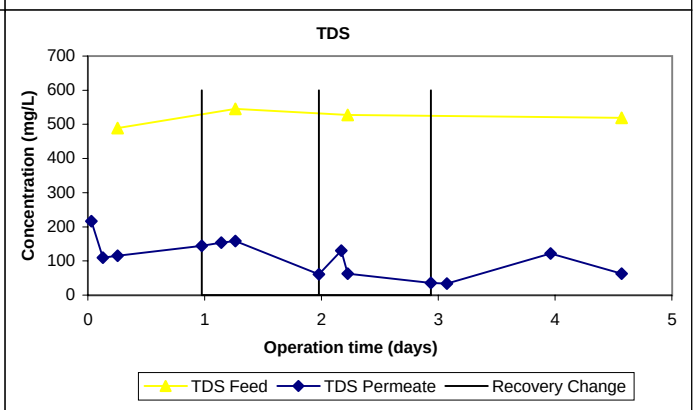


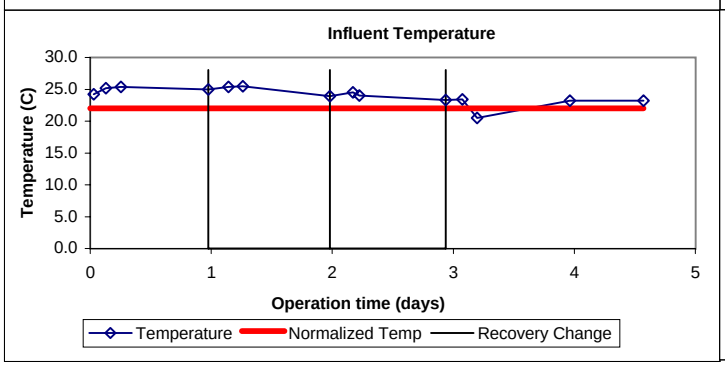


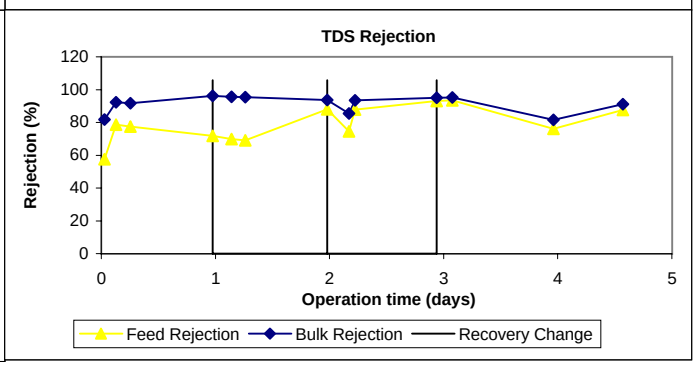












City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (NF200B-400)** | **Quarter:** 2

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 4/26/99 - 4/30/99 (4 days)

Membrane Information

Manufacturer: Film Tec
Trade Name: NF200B-400
MWCO: 200-400 Daltons
Mfr. Flux: 21.1 gfd
Mfr. NDP: 71.0 psi
Mfr. MTCw: 0.284 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $800
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 58.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90
pH	6.9	0.1	6.9	6.7	6.8	7.1	6.9	6.9	7.0	7.7
Temp	21.5	0.0	23.8	23.0	24.6	24.9	23.8	23.0	24.6	24.9
Alk	95	7	53	41	77	93	107	79	150	178
TDS	**514**	**126**	**374**	**469**	**350**	**432**	**583**	**700**	**568**	**1130**
TotHard	328	10	211	232	253	274	350	378	474	651
CaHard	308	9	201	220	239	259	327	352	439	599
Turb	0.86	**0.64**	0.00	0.00	0.00	0.00	0.20	0.29	0.42	0.61
Amm	0.72	0.09	0.50	0.58	0.61	0.70	0.65	0.74	0.93	0.90
TOC	**8.5**	**0.1**	**3.1**	**0.9**	**0.3**	**0.7**	**12.1**	**17.0**	**28.7**	**78.4**
UV254	0.207	**0.085**	0.018	0.026	0.010	0.020	0.427	0.562	0.952	2.583
SUVA	2.45	**1.03**	0.58	3.02	4.10	2.70	3.53	3.31	3.32	3.29
Bromide	**194**	**17**	**155**	**175**	**170**	**174**				
TOX	**618**	**50**	**45**	**60**	**33**	**89**				
CHCl3	146.5	0.5	2.6	3.8	1.7	4.1				
BDCM	50.8	0.3	6.4	9.3	4.0	9.2				
DBCM	9.6	0.0	12.2	16.8	8.7	14.6				
CHBr3	0.0	0.0	6.2	8.6	6.0	6.3				
THM4	**206.9**	**0.8**	**27.4**	**38.5**	**20.2**	**34.2**				
MCAA	7.3	1.3	0.0	0.0	0.0	0.0				
DCAA	43.8	0.8	1.3	2.0	0.0	2.2				
TCAA	72.5	0.7	0.0	1.5	0.0	1.7				
MBAA	1.2	0.0	0.0	0.0	0.0	0.0				
DBAA	1.6	0.2	2.9	4.4	2.4	3.5				
BCAA	11.6	1.0	2.3	3.4	1.5	3.1				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**126.3**	**2.9**	**4.2**	**7.9**	**2.4**	**7.4**				
HAA6	**137.9**	**3.9**	**6.5**	**11.3**	**3.9**	**10.5**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	5	-13	29
Alk	4	-12	54
TDS	4	-12	33
TotHard	4	-12	8
CaHard	4	-13	8
Turb	2	**-504**	11
Amm	4	-9	13
TOC	4	5	4
UV254	4	**30**	2

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	1.00	0.41	6	0.56 - 1.71
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.1	6	7.4 - 7.6
Time (hr)	23.9	0.4	6	23.0 - 24.2

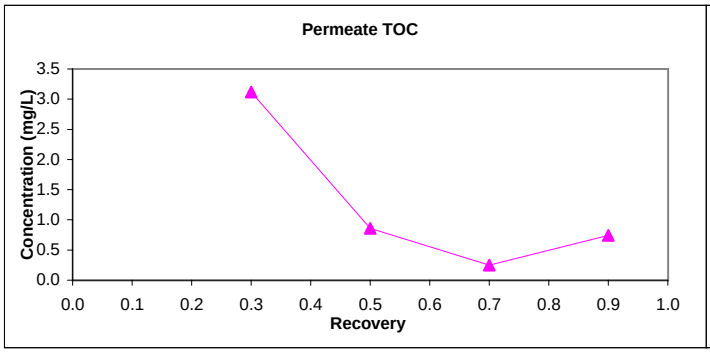
Design Parameters

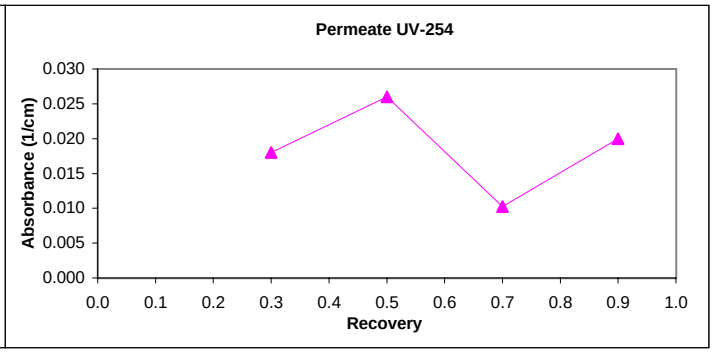
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.260 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	21.1
2	0.90	21.1
3	0.50	21.1
4	0.30	21.1

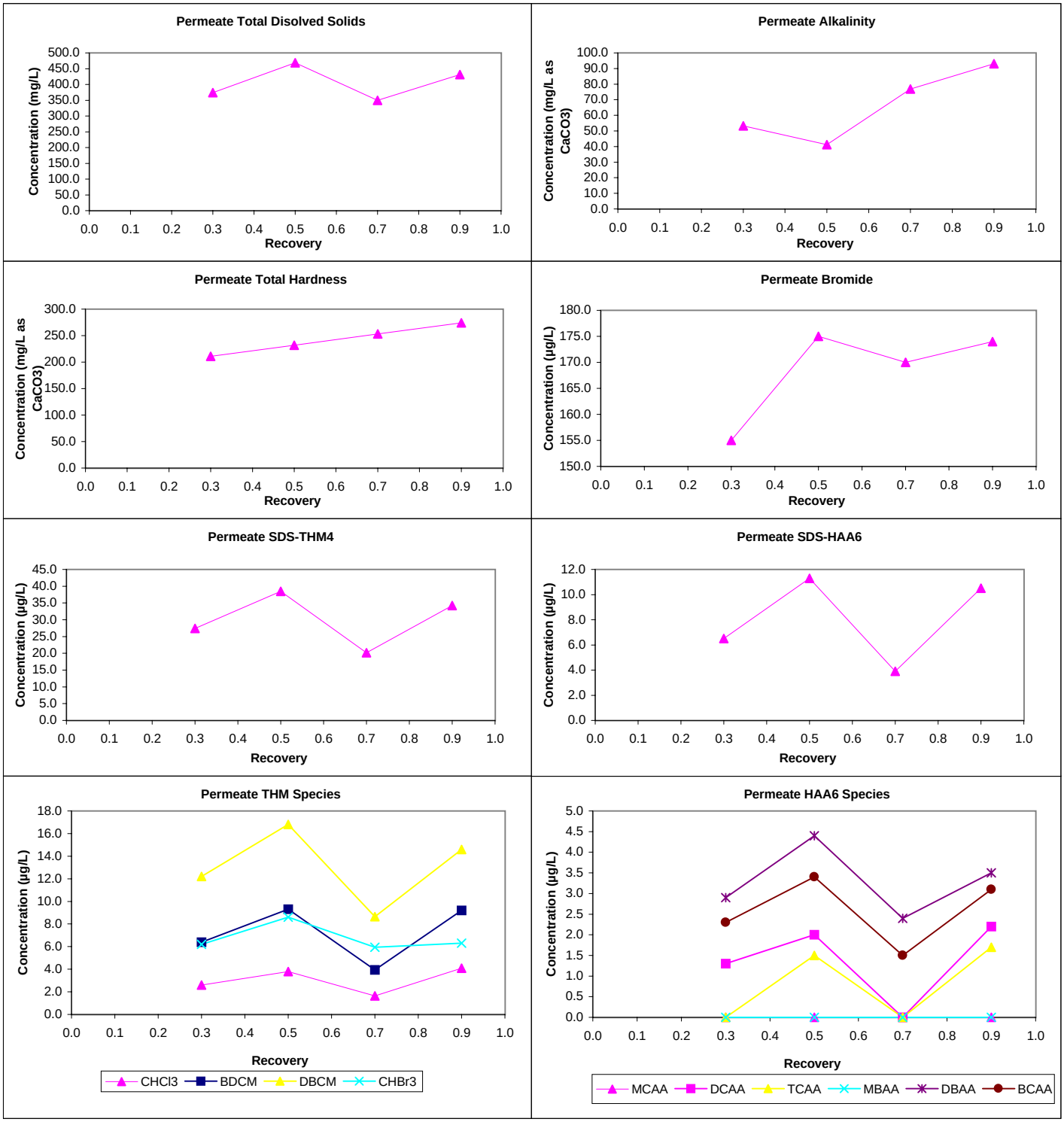
Comments:

Water Quality Parameter Graphs

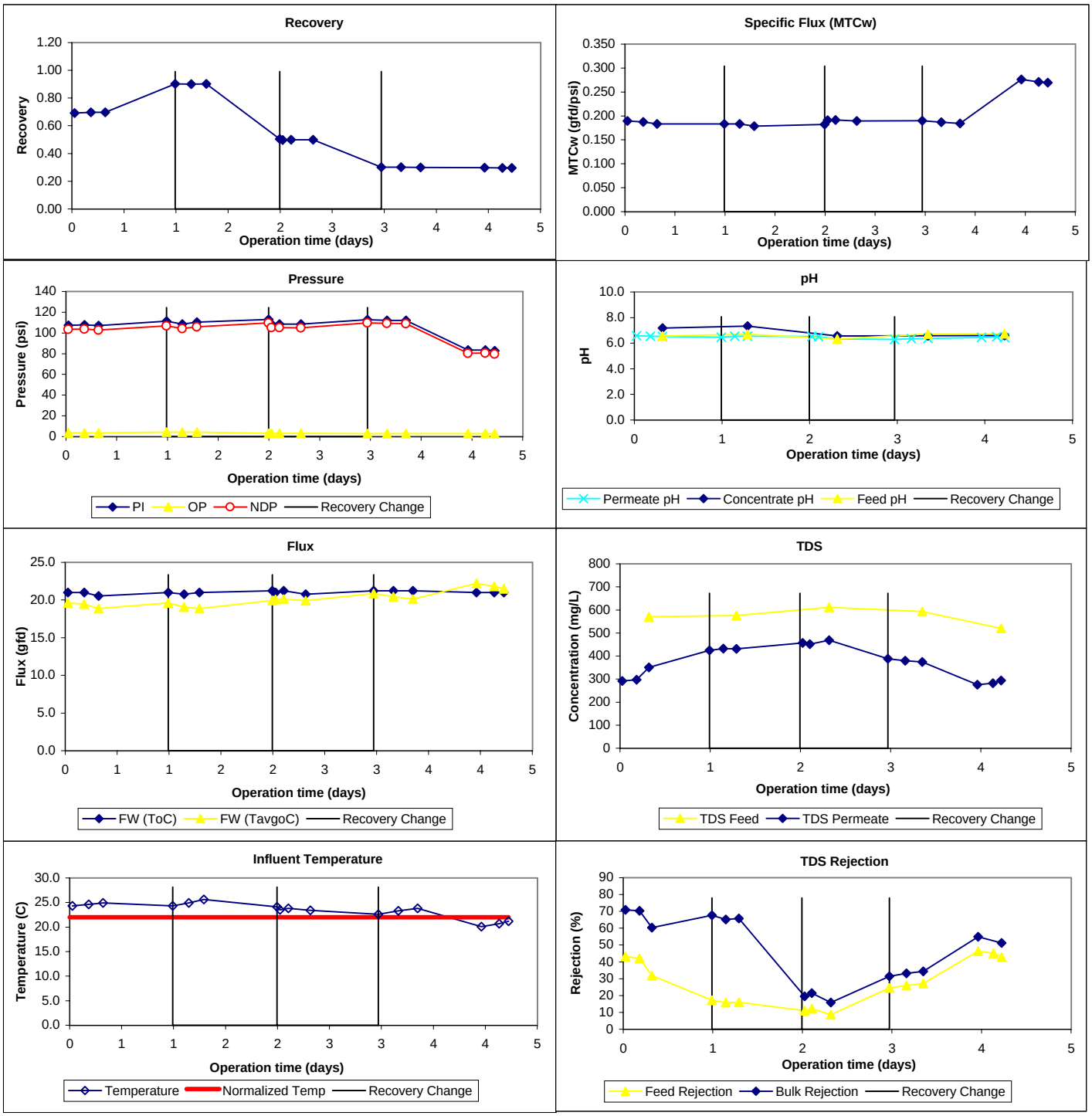




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (ESNA1)** | **Quarter:** 3

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 4/26/99 - 4/30/99 (4 days)

Membrane Information

Manufacturer: Hydranautics
Trade Name: ESNA1
MWCO: 180 Daltons
Mfr. Flux: 27.0 gfd
Mfr. NDP: 68.0 psi
Mfr. MTCw: 0.360 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $875
840 Maximum Flow: 75.0 gpm
840 Minimum Flow: 25.0 gpm
840 Total Width: 76.7 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.28	0.49	0.69	0.89	0.28	0.49	0.69	0.89
pH	6.9	0.1	6.8	6.7	6.8	7.1	7.0	7.1	7.3	8.0
Temp	21.5	0.0	24.3	25.3	26.1	27.3	24.3	25.3	26.1	27.3
Alk	95	7	36	25	59	77	112	90	197	288
TDS	**514**	**126**	**210**	**297**	**332**	**438**	**649**	**804**	**800**	**1546**
TotHard	328	10	115	143	209	254	377	445	611	858
CaHard	308	9	107	134	196	239	354	416	574	806
Turb	0.86	**0.64**	0.00	0.02	0.00	0.00	0.11	0.27	0.19	0.32
Amm	0.72	0.09	0.33	0.46	0.43	0.63	0.70	0.89	0.92	1.36
TOC	**8.5**	**0.1**	**0.6**	**1.0**	**1.7**	**2.2**	**11.8**	**16.3**	**18.8**	**59.0**
UV254	0.299	0.006	0.021	0.028	0.048	0.062	0.430	0.609	0.459	2.072
SUVA	3.51	0.04	3.28	2.95	2.78	2.82	3.64	3.74	2.44	3.51
Bromide	**194**	**17**	**82**	**91**	**127**	**146**				
TOX	**618**	**50**	**55**	**73**	**109**	**140**				
CHCl3	146.5	0.5	4.2	7.7	13.2	18.2				
BDCM	50.8	0.3	6.7	11.9	17.8	22.1				
DBCM	9.6	0.0	8.4	12.0	16.8	17.3				
CHBr3	0.0	0.0	1.6	2.4	3.7	1.9				
THM4	**206.9**	**0.8**	**20.9**	**34.0**	**51.5**	**59.5**				
MCAA	7.3	1.3	0.0	0.0	0.0	2.2				
DCAA	43.8	0.8	1.9	3.6	5.5	7.3				
TCAA	72.5	0.7	2.0	2.6	4.3	8.3				
MBAA	1.2	0.0	0.0	0.0	0.0	1.0				
DBAA	1.6	0.2	1.8	2.7	4.1	3.4				
BCAA	11.6	1.0	2.2	4.1	6.1	6.8				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**126.3**	**2.9**	**5.7**	**8.9**	**13.9**	**22.2**				
HAA6	**137.9**	**3.9**	**7.9**	**13.0**	**20.0**	**29.0**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	5	2	19
Alk	4	-14	45
TDS	4	6	17
TotHard	4	-7	7
CaHard	4	-7	7
Turb	2	**-752**	234
Amm	4	**-21**	20
TOC	4	-5	14
UV254	4	-20	45

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	1.09	0.42	6	0.52 - 1.59
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.1	6	7.4 - 7.6
Time (hr)	28.0	9.9	6	23.6 - 48.1

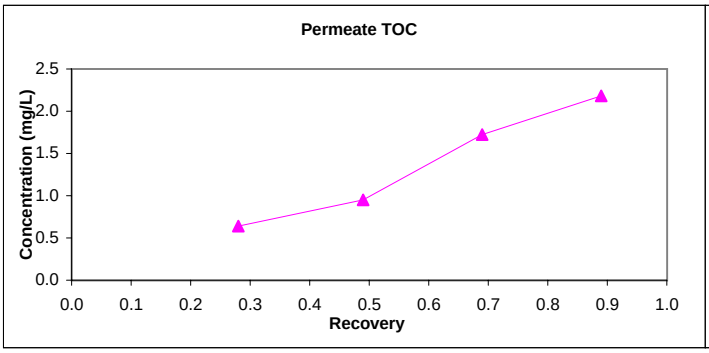
Design Parameters

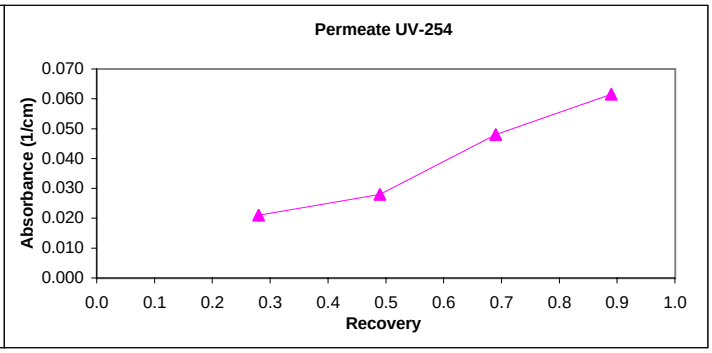
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.329 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	27.0
2	0.90	27.0
3	0.50	27.0
4	0.30	27.0

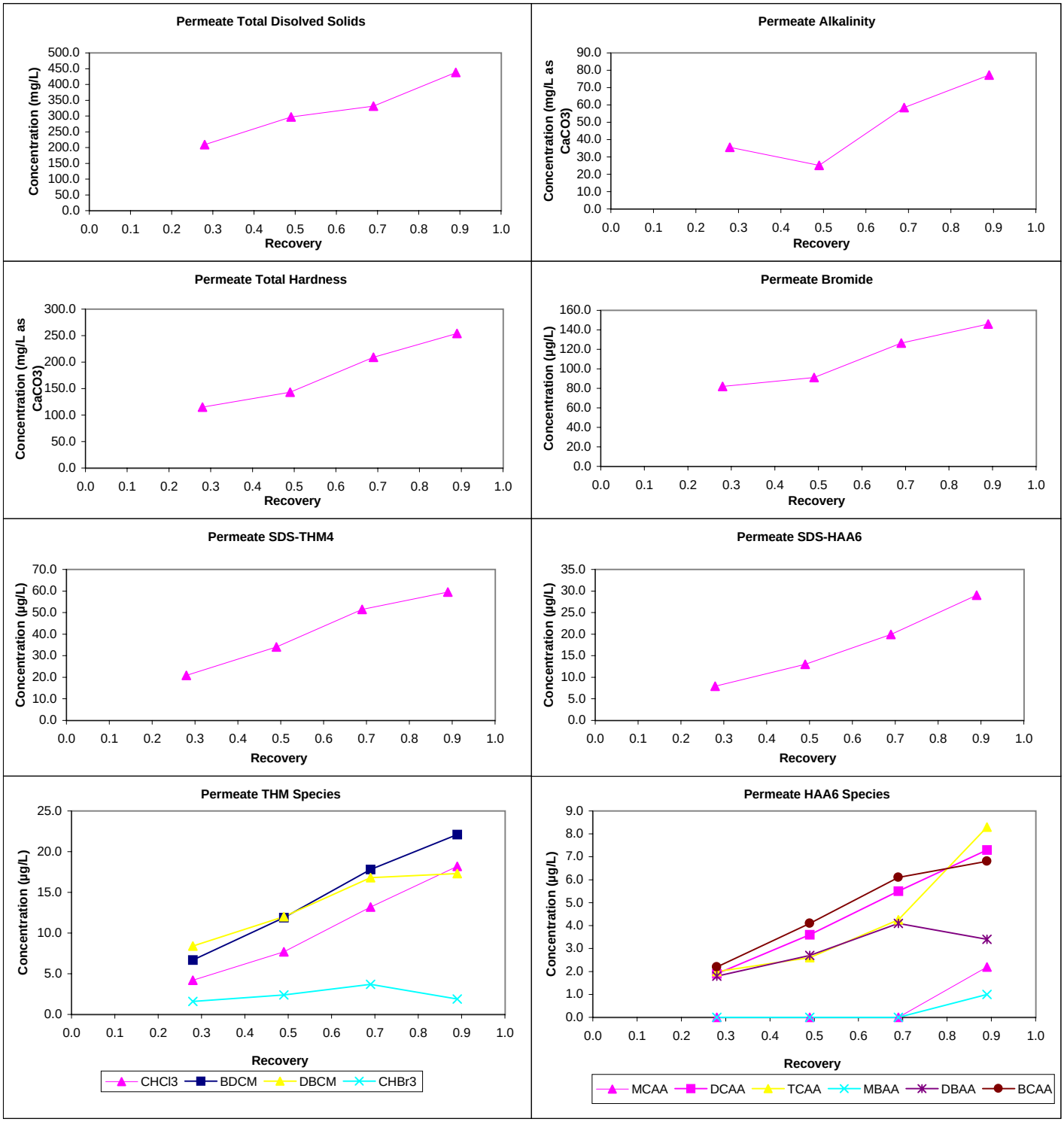
Comments:

Water Quality Parameter Graphs

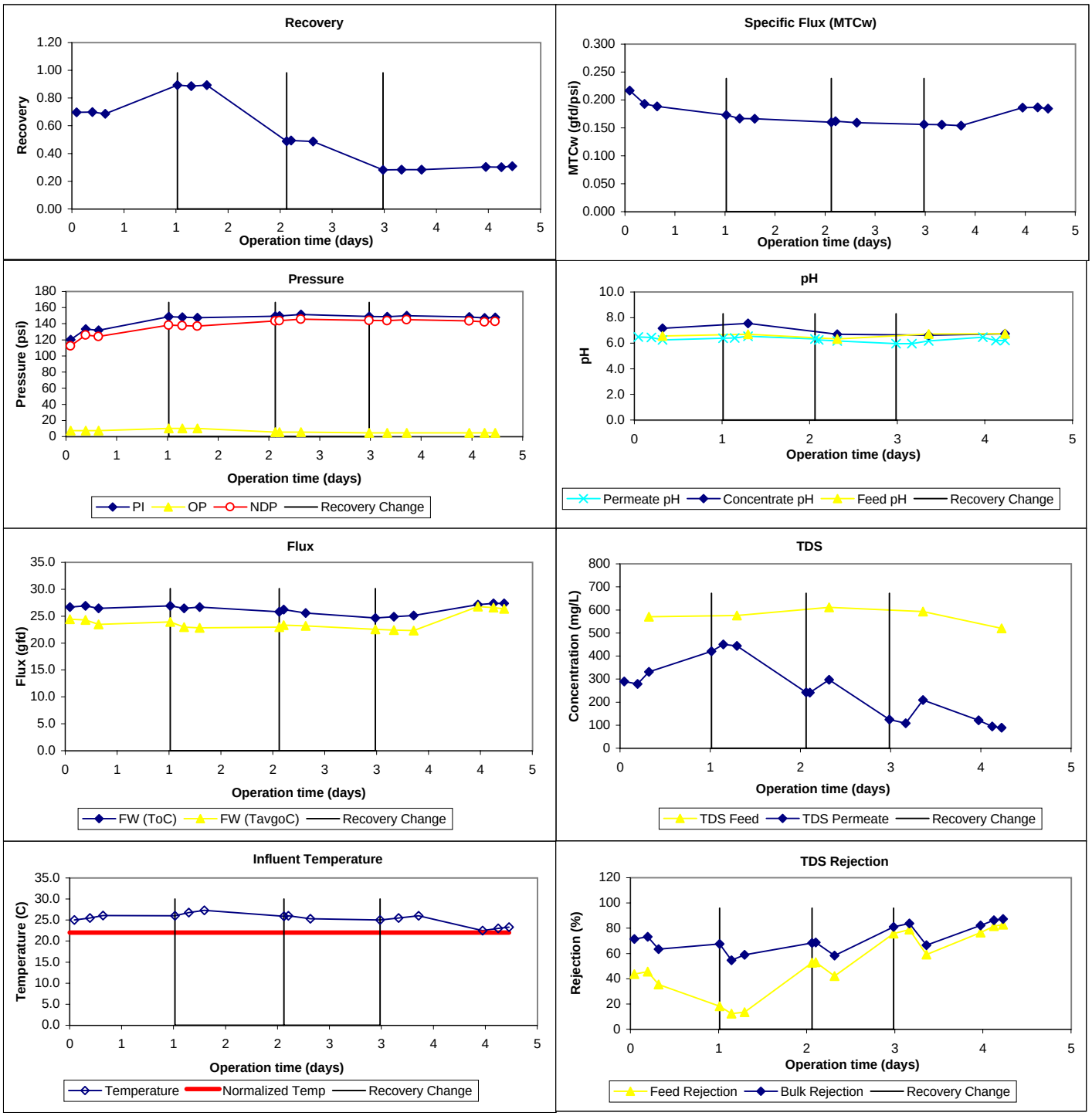




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Margate, DEES | **RBSMT Membrane Treatment Study Summary (TFC 8921S-400)** | **Quarter:** 4

ICR Information

ID / ICR#: 4060845 / 1077
ICR Contact: Ms. Laura Pastore
Phone No.: (954) 972-0828
Period: 5/3/99 - 5/8/99 (5 days)

Membrane Information

Manufacturer: Fluid Systems
Trade Name: TFC 8921S-400
MWCO: 200 Daltons
Mfr. Flux: 15.0 gfd
Mfr. NDP: 56.5 psi
Mfr. MTCw: 0.265 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: $846
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 15.0 gpm
840 Total Width: 63.2 ft
840 Feed Spacer Thickness: 0.0022 ft

Water Quality Summary

Source ->	Feed		Permeate				Concentrate			
Recovery ->	Avg	Diff	0.31	0.51	0.70	0.90	0.31	0.51	0.70	0.90
pH	6.8	0.2	6.1	6.6	6.9	7.0	6.8	7.5	7.6	8.2
Temp	21.5	0.0	22.6	24.0	24.9	24.5	22.6	24.0	24.9	24.5
Alk	145	0	18	45	35	60	208	458	740	890
TDS	**511**	**24**	**89**	**201**	**153**	**214**	**750**	**1632**	**1342**	**2630**
TotHard	311	11	23	84	69	123	437	974	797	1600
CaHard	292	10	23	79	64	116	409	913	746	1500
Turb	0.28	0.07	0.00	0.00	0.00	0.03	0.22	0.45	0.26	0.92
Amm	0.61	0.01	0.20	0.48	0.37	0.55	0.76	1.25	1.01	0.90
TOC	**9.3**	**0.4**	**0.3**	**0.7**	**0.8**	**1.1**	**13.6**	**34.5**	**27.2**	**76.4**
UV254	0.332	0.007	0.005	0.022	0.020	0.033	0.486	1.116	0.988	2.492
SUVA	3.58	0.22	1.80	3.14	2.65	3.08	3.57	3.23	3.63	3.26
Bromide	**179**	**2**	**24**	**78**	**64**	**120**				
TOX	**791**	**12**	**13**	**68**	**57**	**83**				
CHCl3	127.0	2.0	2.0	5.6	5.3	6.8				
BDCM	46.7	0.1	2.6	8.5	7.3	10.6				
DBCM	9.1	0.0	2.3	8.8	7.1	11.9				
CHBr3	0.0	0.0	0.0	1.4	1.1	2.1				
THM4	**182.8**	**1.9**	**6.9**	**24.3**	**20.7**	**31.4**				
MCAA	6.5	0.1	0.0	0.0	0.0	0.0				
DCAA	42.6	2.4	0.0	2.6	2.6	3.0				
TCAA	70.5	7.2	0.0	2.3	2.3	3.2				
MBAA	1.1	0.0	0.0	0.0	0.0	0.0				
DBAA	1.6	0.0	0.0	1.8	1.5	2.5				
BCAA	11.4	0.0	0.0	2.7	2.4	3.5				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**122.2**	**9.4**	**0.0**	**6.7**	**6.3**	**8.7**				
HAA6	**133.5**	**9.5**	**0.0**	**9.4**	**8.7**	**12.2**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.87	0.27	6	0.37 - 1.17
Temp (°C)	22.0	0.0	6	22.0 - 22.0
pH (unit)	7.5	0.0	6	7.5 - 7.6
Time (hr)	24.2	0.3	6	24.0 - 24.7

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	4	8	30
Alk	4	23	26
TDS	4	9	29
TotHard	4	2	30
CaHard	4	2	30
Turb	4	-136	102
Amm	4	-2	30
TOC	4	8	26
UV254	3	4	33

Pretreatment Information

Process	Description	Scale
Acidification	Hydrochloric acid to pH 6.5	Bench
Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench
Cartridge filtration	5 micron nominal	Bench

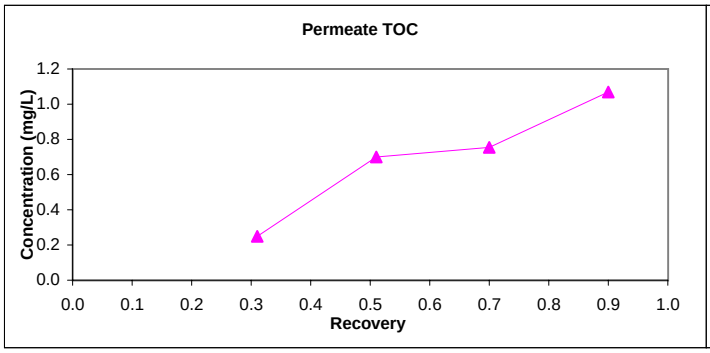
Design Parameters

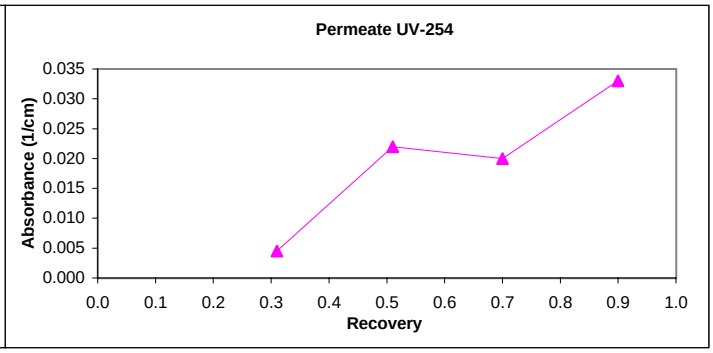
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 22.0 °C
Feed TDS: 545.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.243 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	15.0
2	0.90	15.0
3	0.50	15.0
4	0.30	15.0

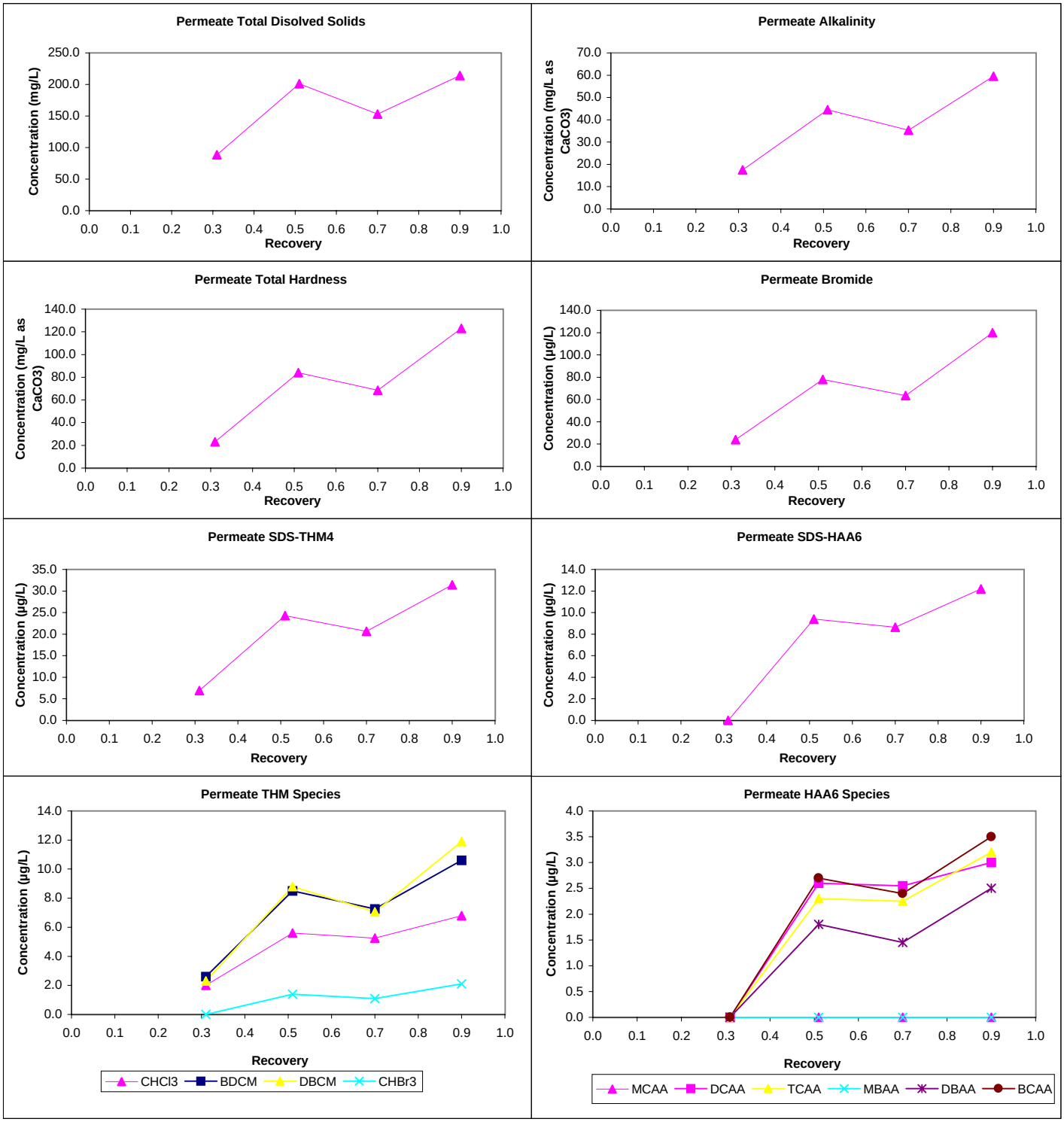
Comments:

Water Quality Parameter Graphs





Water Quality Parameter Graphs (Continued)



Productivity Graphs