ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 1069

Study Protocol RBSMT

Plant ICR Number 1076

PWS Name City of Lauderhill

City, State, Zip Lauderhill, FL 33313

General Comments:

1. During this bench-scale study, two membranes were evaluated: the FilmTec NF200 and the BW30-XLE. Each membrane was evaluated over four quarters (Winter, Spring, Summer and Autumn) as summarized in Table 3 of the Summary Report.

2. Influent to the treatment study was collected after full-scale lime softening and filtration (see Figure 1 in the Summary Report). Under normal plant operation, chlorine is added prior to lime softening and prior to filtration. However, these chlorine feeds were turned off prior to sample collection and the report states that "no chlorine residual was present at the time of collection".

3. During analysis, a water temperature of 25.6^{o}C was used for all four quarters. Since this is a groundwater source, the utility reported a constant temperature 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 in the Data Collection Spreadsheets are indicative of lab conditions.

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

Water Quality Comments:

1. 8 water quality outliers were removed from this study.

2. SDS conditions are summarized in Table 6 of the Summary Report. Constant target SDS conditions were used over the four quarters: temperature 25.3^{o}C, pH 8.0, incubation time 3.5 hours and free residual 0.5 to 1 mg/L.

3. High mass balance closure errors at 90% recovery indicate that the system may not have achieved psuedo steady-state performance at this recovery.

4. Some TOX results had high relative percent errors, and in general, the QC data indicate some problems with TOX analysis.

Productivity Comments:

1. 6 productivity outliers were removed from this study.

2. Note that antiscalant addition was used as pretreatment during the study; however, this is not show in the pretreatment schematic (Figure 2) in the Summary Report.

3. Algael growth was observed in the system tubing and could have contributed to membrane fouling.

4. The cleaning procedure utilized a phosphoric acid solution, followed by a sodium hydroxide solution. Additional information is provided in Section 3B of the Summary Report.

City of Lauderhill | **RBSMT Membrane Treatment Study Summary (NF200B-4040)** | **Quarter:** 1

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 6/3/98 - 6/10/98 (7 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	0.31	0.51	0.72	0.90	0.31	0.51	0.72	0.90	WQP	Count	Avg	SD
pH	8.7	0.0	7.5	8.5	8.4	8.2	8.1	8.6	8.6	8.2	TDSt	7	9	11
Temp	23.0	0.0	24.0	23.7	20.9	21.6	24.0	23.7	20.9	21.6				
Alk	43	1	21	27	30	38	55	68	84	105	Alk	4	10	5
TDS	**151**	**0**	**92**	**99**	**111**	**128**	**173**	**192**	**278**	**412**	TDS	4	3	9
TotHard	67	1	28	35	38	45	82	103	136	242	TotHard	4	-3	4
CaHard	56	1	25	30	32	39	69	87	115	203	CaHard	4	-2	4
Turb	0.59	0.04	0.10	0.00	0.00	0.00	0.60	0.81	0.58	0.68	Turb	1	-34	n/a
Amm	0.70	0.00	0.60	0.70	0.60	0.60	0.90	1.10	1.00	1.20	Amm	4	6	29
TOC	**8.2**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**12.0**	**18.0**	**30.0**	**79.0**	TOC	0	n/a	n/a
UV254	0.231	0.000	0.005	0.005	0.005	0.010	0.349	0.534	0.889	2.244	UV254	4	7	5
SUVA	2.83	0.02	1.80	1.80	1.80	4.00	2.91	2.97	2.96	2.84				
Bromide	**105**	**5**	**94**	**95**	**100**	**100**								
TOX	**468**	**23**	**13**	**13**	**13**	**40**								
CHCl3	81.5	1.6	0.0	0.0	0.0	1.2								
BDCM	21.4	0.4	0.0	0.0	0.0	1.9								
DBCM	4.1	0.1	0.0	0.0	1.2	2.9								
CHBr3	0.0	0.0	0.0	0.0	0.0	1.8								
THM4	**107.1**	**2.1**	**0.0**	**0.0**	**1.2**	**7.9**								
MCAA	3.5	0.0	0.0	0.0	0.0	0.0								
DCAA	40.6	0.9	0.0	0.0	0.0	1.2								
TCAA	45.9	2.3	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	1.2	0.0	0.0	0.0	0.0	1.4								
BCAA	8.0	0.1	0.0	0.0	0.0	1.0								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	**91.2**	**3.3**	**0.0**	**0.0**	**0.0**	**2.6**								
HAA6	**99.2**	**3.4**	**0.0**	**0.0**	**0.0**	**3.6**								
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**								

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	1.01	0.17	6	0.80 - 1.30
Temp (°C)	25.6	0.1	6	25.3 - 25.7
pH (unit)	8.0	0.0	6	8.0 - 8.0
Time (hr)	3.5	0.0	6	3.5 - 3.5

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

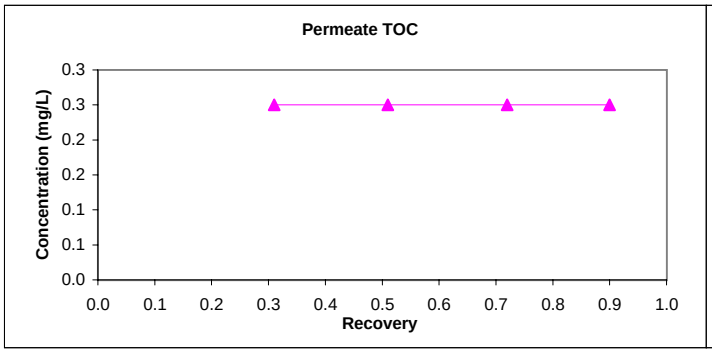
Design Parameters

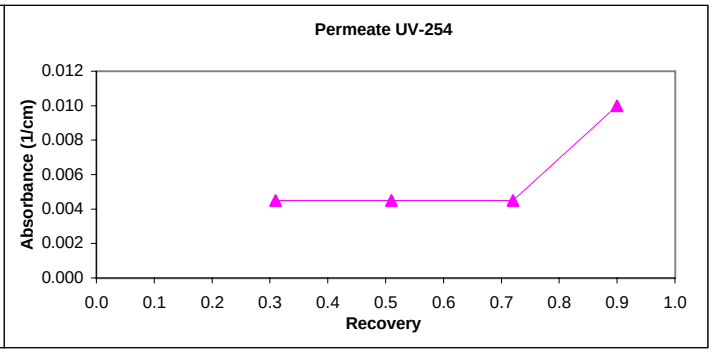
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 70%
Temp Norm MTC-w: 0.239 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	16.5
2	0.90	16.5
3	0.50	16.5
4	0.30	16.5

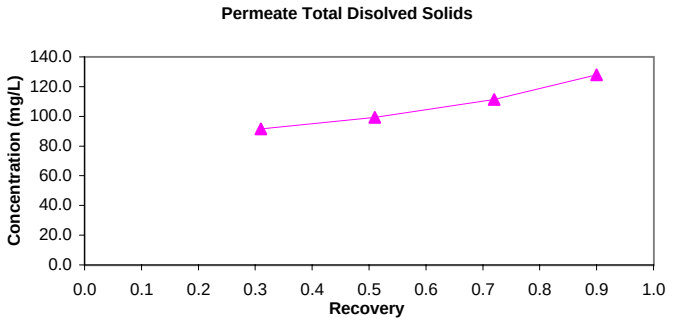
Comments:

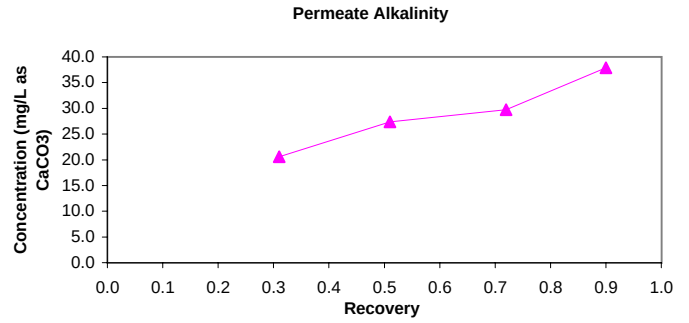
Water Quality Parameter Graphs

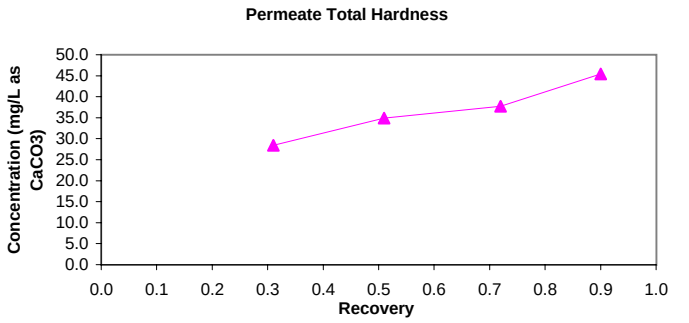


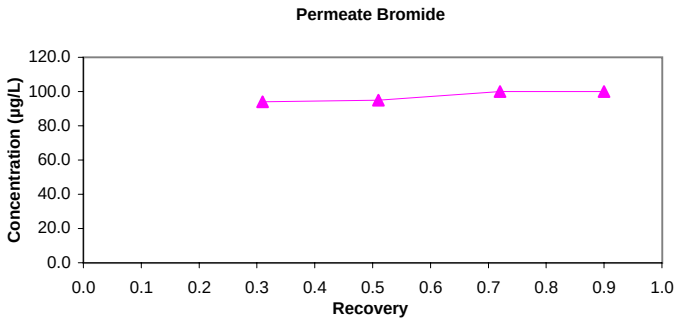


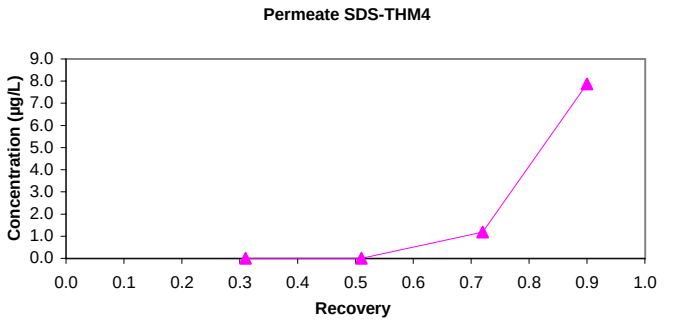
Water Quality Parameter Graphs (Continued)

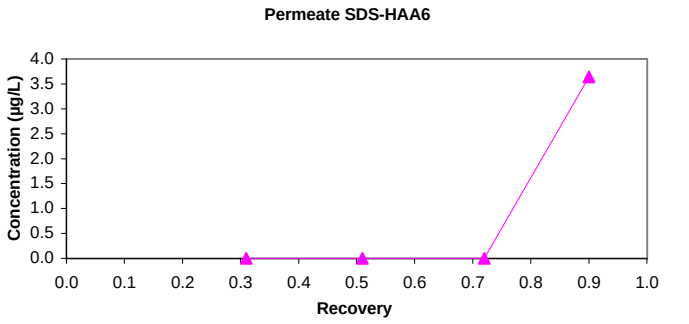


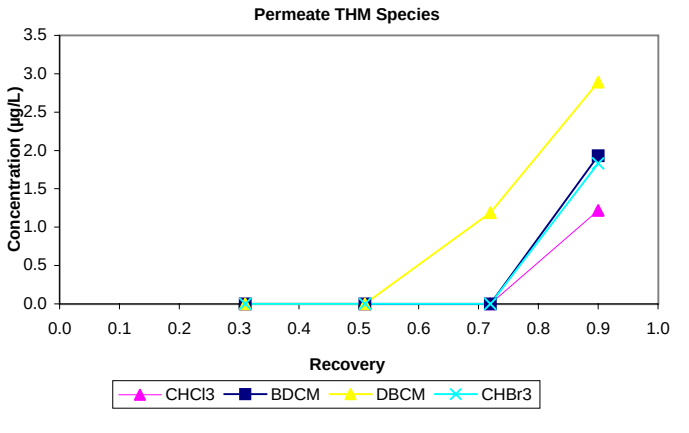


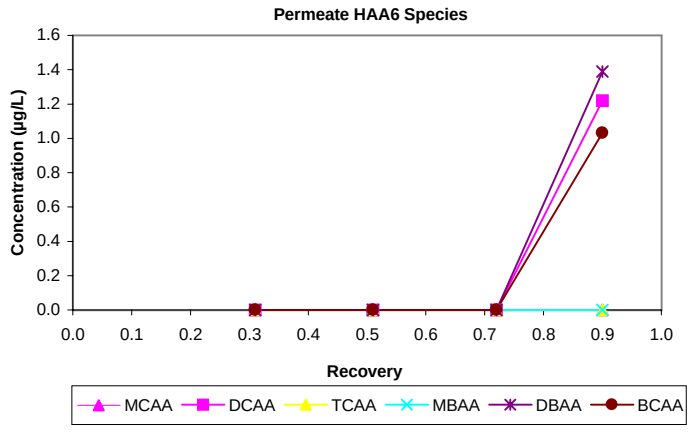




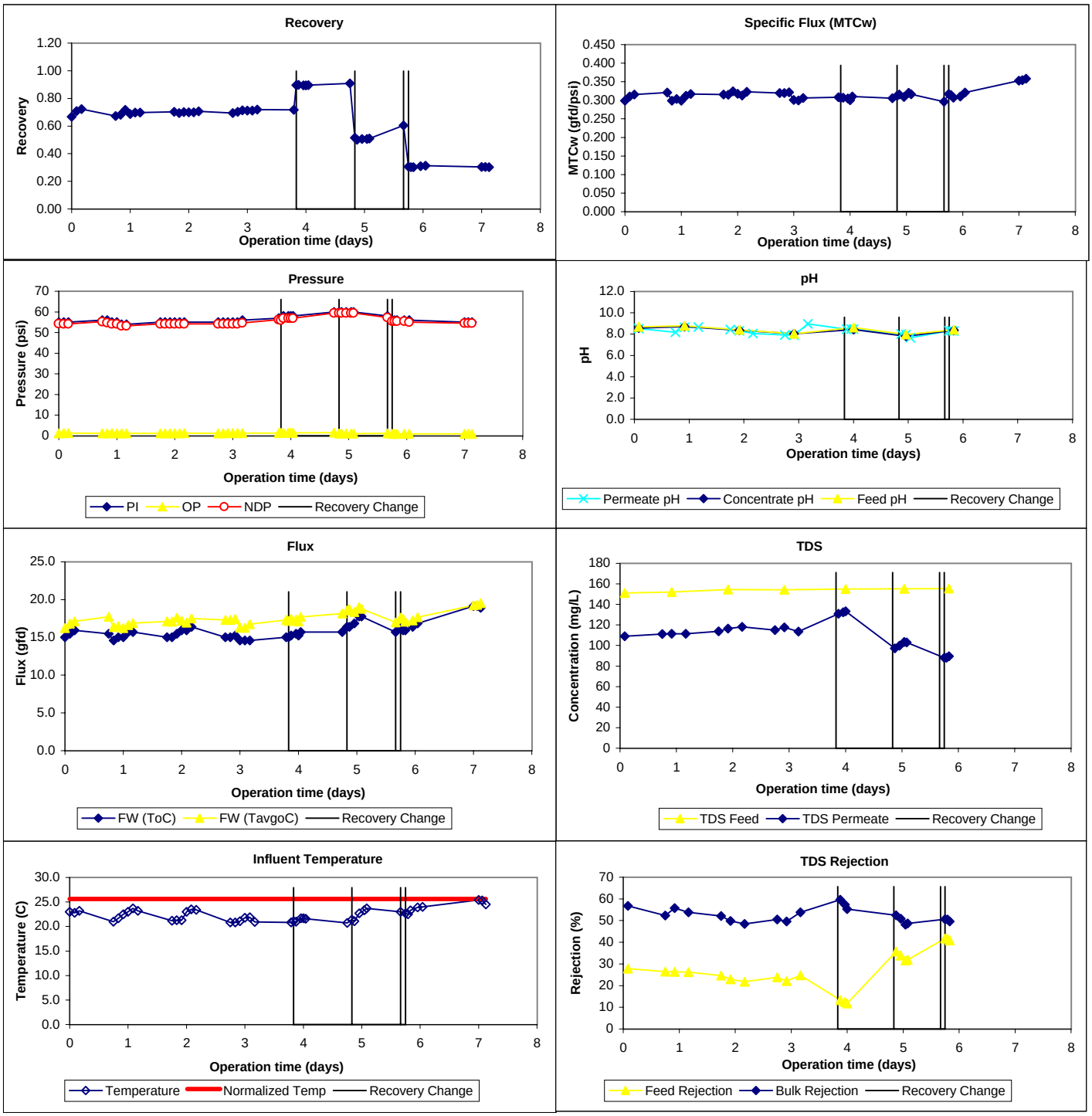








Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (NF200B-4040)** | **Quarter:** 2

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 8/26/98 - 9/4/98 (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			
Recovery ->	Avg	Diff	0.30	0.50	0.71	0.89	0.30	0.50	0.71	0.89
pH	8.7	0.1	8.5	7.5	7.7	8.3	8.4	7.8	8.1	8.3
Temp	23.9	0.5	23.6	22.9	23.0	23.7	23.6	22.9	23.0	23.7
Alk	54	9	43	27	32	39	55	65	77	97
TDS	**152**	**1**	**90**	**105**	**119**	**133**	**178**	**189**	**264**	**373**
TotHard	65	2	28	34	43	46	83	101	127	216
CaHard	55	1	23	29	37	40	71	87	108	185
Turb	0.26	0.01	0.16	0.10	0.10	0.12	0.32	0.32	0.40	0.55
Amm	0.75	0.05	0.50	0.60	0.65	0.60	0.80	0.90	1.10	1.20
TOC	**8.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**11.5**	**16.5**	**27.5**	**67.5**
UV254	0.220	0.003	0.005	0.005	0.005	0.009	0.320	0.445	0.717	1.770
SUVA	2.70	0.09	1.80	1.80	1.80	3.60	2.78	2.70	2.61	2.62
Bromide	**100**	**10**	**75**	**82**	**91**	**91**				
TOX	**345**	**70**	**13**	**13**	**13**	**13**				
CHCl3	73.2	0.3	1.5	0.0	0.0	2.4				
BDCM	20.9	0.2	0.0	0.0	1.1	2.3				
DBCM	3.8	0.0	0.0	0.0	1.6	2.9				
CHBr3	0.0	0.0	0.0	0.0	1.1	1.8				
THM4	**97.9**	**0.1**	**1.5**	**0.0**	**3.8**	**9.3**				
MCAA	0.0	0.0	0.0	0.0	0.0	0.0				
DCAA	35.1	6.6	0.0	0.0	0.0	2.2				
TCAA	38.7	7.5	0.0	0.0	0.0	0.0				
MBAA	0.0	0.0	0.0	0.0	0.0	0.0				
DBAA	1.2	0.2	0.0	0.0	0.0	1.3				
BCAA	7.0	1.2	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	**75.0**	**14.3**	**0.0**	**0.0**	**0.0**	**3.5**				
HAA6	**82.0**	**15.5**	**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)	0.67	0.11	6	0.57 - 0.84
Temp (°C)	25.4	0.1	6	25.3 - 25.7
pH (unit)	8.0	0.0	6	8.0 - 8.0
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	8	3	8
Alk	4	-41	35
TDS	4	6	10
TotHard	4	3	3
CaHard	4	5	2
Turb	4	-61	68
Amm	4	-15	33
TOC	0	n/a	n/a
UV254	4	-3	5

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

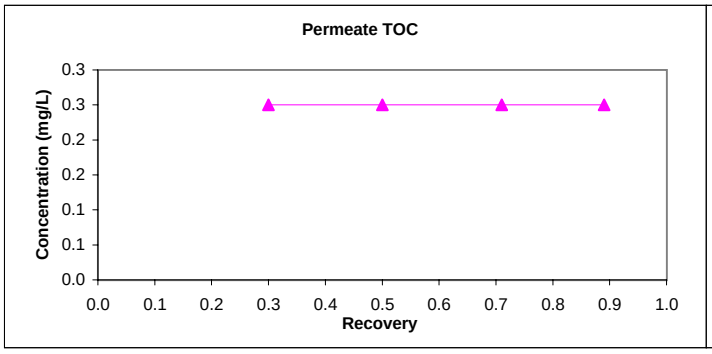
Design Parameters

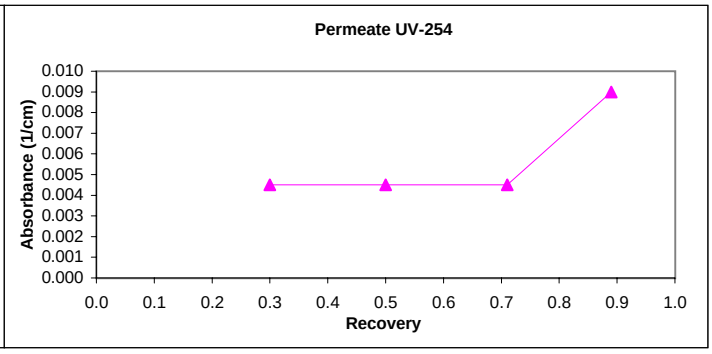
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 96%
Temp Norm MTC-w: 0.239 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	16.5
2	0.90	16.5
3	0.50	16.5
4	0.30	16.5

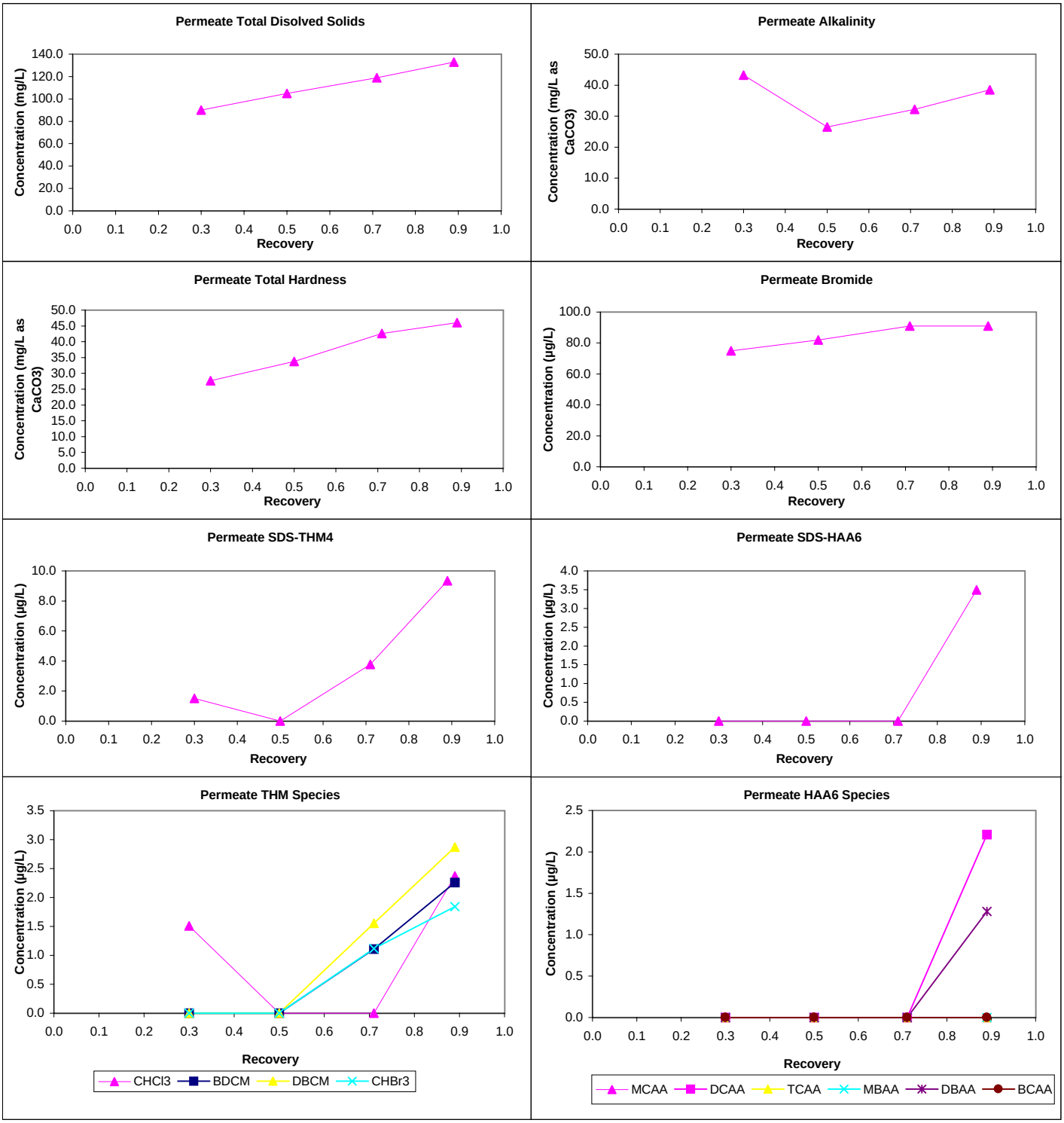
Comments:

Water Quality Parameter Graphs

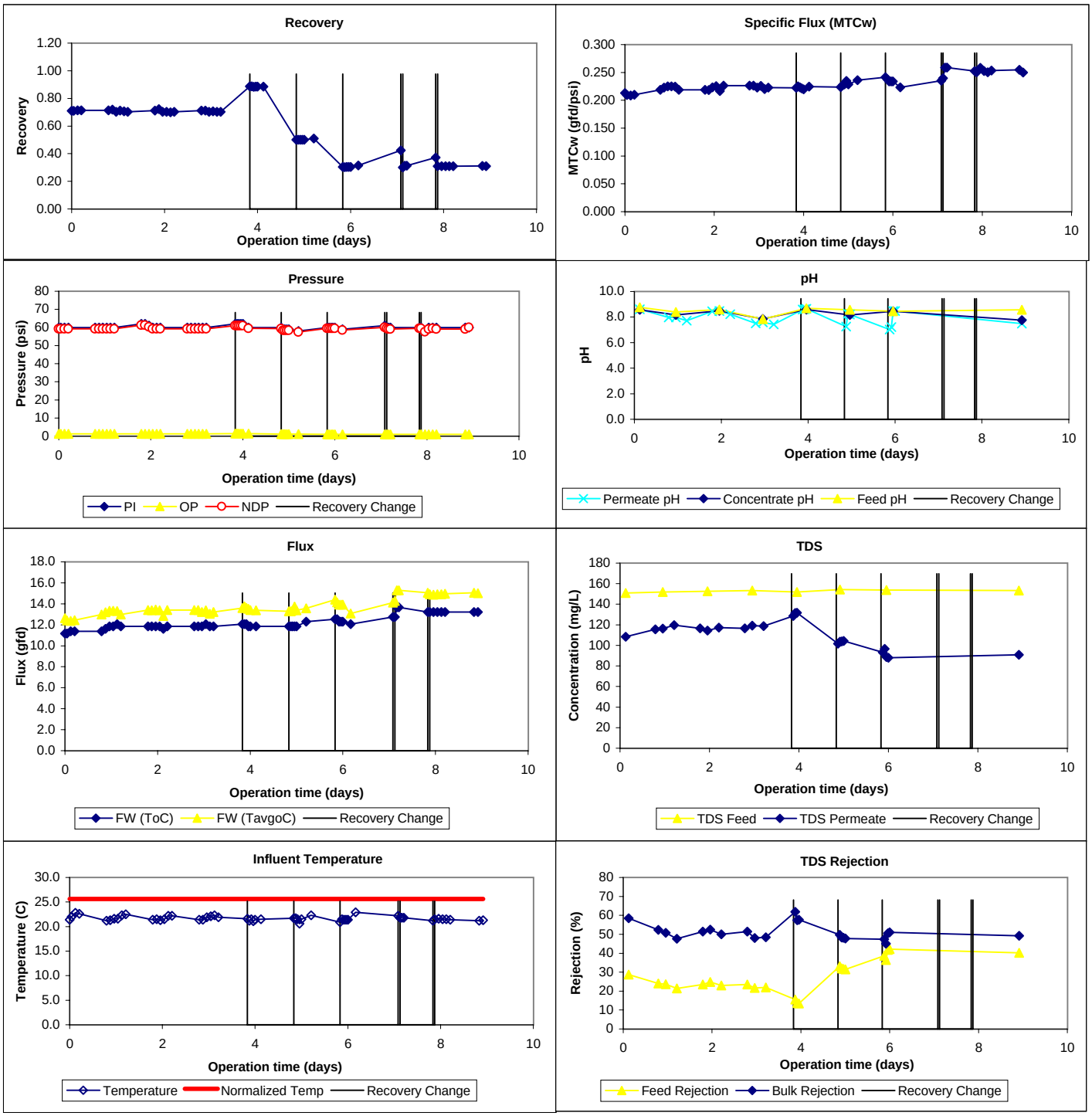




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (NF200B-4040)** | **Quarter:** 3

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 12/2/98 - 12/10/9 (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			
Recovery ->	Avg	Diff	0.31	0.50	0.69	0.90	0.31	0.50	0.69	0.90
pH	8.8	0.1	6.6	7.2	8.4	8.7	7.2	7.7	8.6	8.4
Temp	21.2	0.6	20.2	22.0	22.0	22.6	20.5	22.2	21.7	22.9
Alk	40	1	15	18	26	30	44	49	73	98
TDS	**146**	**1**	**91**	**105**	**111**	**128**	**160**	**201**	**196**	**342**
TotHard	57	4	24	35	33	38	70	81	106	178
CaHard	47	4	19	30	27	31	57	66	89	148
Turb	0.33	0.08	0.17	0.11	0.19	0.13	0.27	0.35	0.44	0.69
Amm	0.60	0.00	0.00	0.00	0.50	0.40	0.00	0.00	0.70	0.60
TOC	**7.6**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**11.0**	**16.0**	**24.5**	**67.5**
UV254	0.233	0.001	0.005	0.005	0.005	0.012	0.331	0.437	0.729	1.930
SUVA	3.06	0.03	1.80	1.80	1.80	4.80	3.01	2.73	2.98	2.86
Bromide	**110**	**0**	**95**	**100**	**100**	**110**				
TOX	**455**	**10**	**13**	**13**	**28**	**72**				
CHCl3	78.3	1.9	0.0	0.0	1.2	2.0				
BDCM	23.1	0.2	0.0	0.0	1.5	2.8				
DBCM	4.8	0.1	1.2	1.8	2.2	4.3				
CHBr3	0.0	0.0	1.5	1.2	1.5	2.9				
THM4	**106.3**	**2.0**	**2.7**	**3.0**	**6.4**	**11.9**				
MCAA	3.6	0.7	0.0	0.0	0.0	0.0				
DCAA	41.2	1.1	0.0	1.1	1.9	2.4				
TCAA	41.5	6.3	0.0	1.3	1.3	1.6				
MBAA	0.0	0.0	0.0	0.0	0.0	0.0				
DBAA	2.0	0.1	1.3	1.6	1.5	2.1				
BCAA	9.5	0.2	0.0	1.3	1.3	1.7				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**88.2**	**4.5**	**1.3**	**4.1**	**4.8**	**6.1**				
HAA6	**97.8**	**4.3**	**1.3**	**5.3**	**6.0**	**7.8**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.75	0.15	6	0.59 - 0.98
Temp (°C)	25.1	0.0	6	25.1 - 25.2
pH (unit)	8.0	0.0	6	8.0 - 8.0
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	8	2	6
Alk	4	-20	16
TDS	4	-1	11
TotHard	4	-7	13
CaHard	4	-7	13
Turb	4	-87	77
Amm	2	-159	141
TOC	0	n/a	n/a
UV254	4	-5	7

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

Design Parameters

Active memb area: 0.167 ft²
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ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
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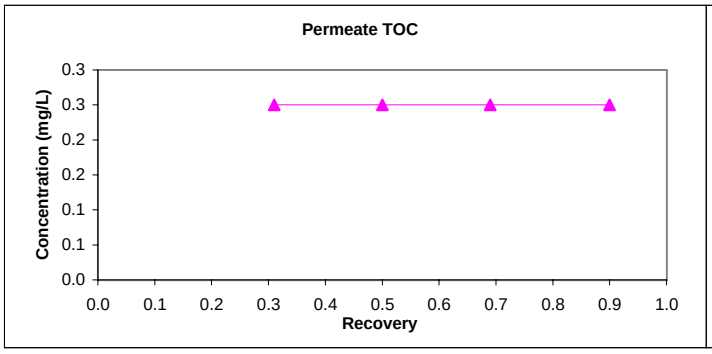
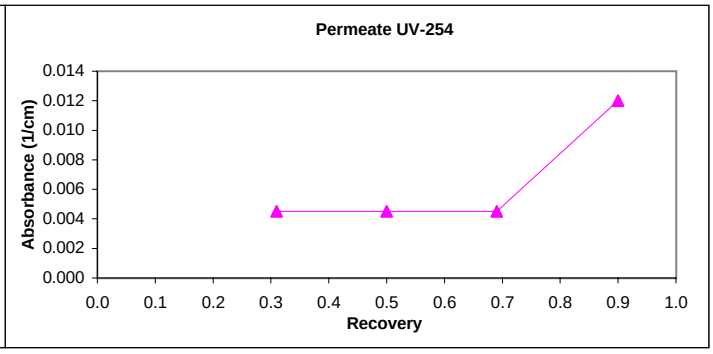
2	0.90	16.5
3	0.50	16.5
4	0.30	16.5

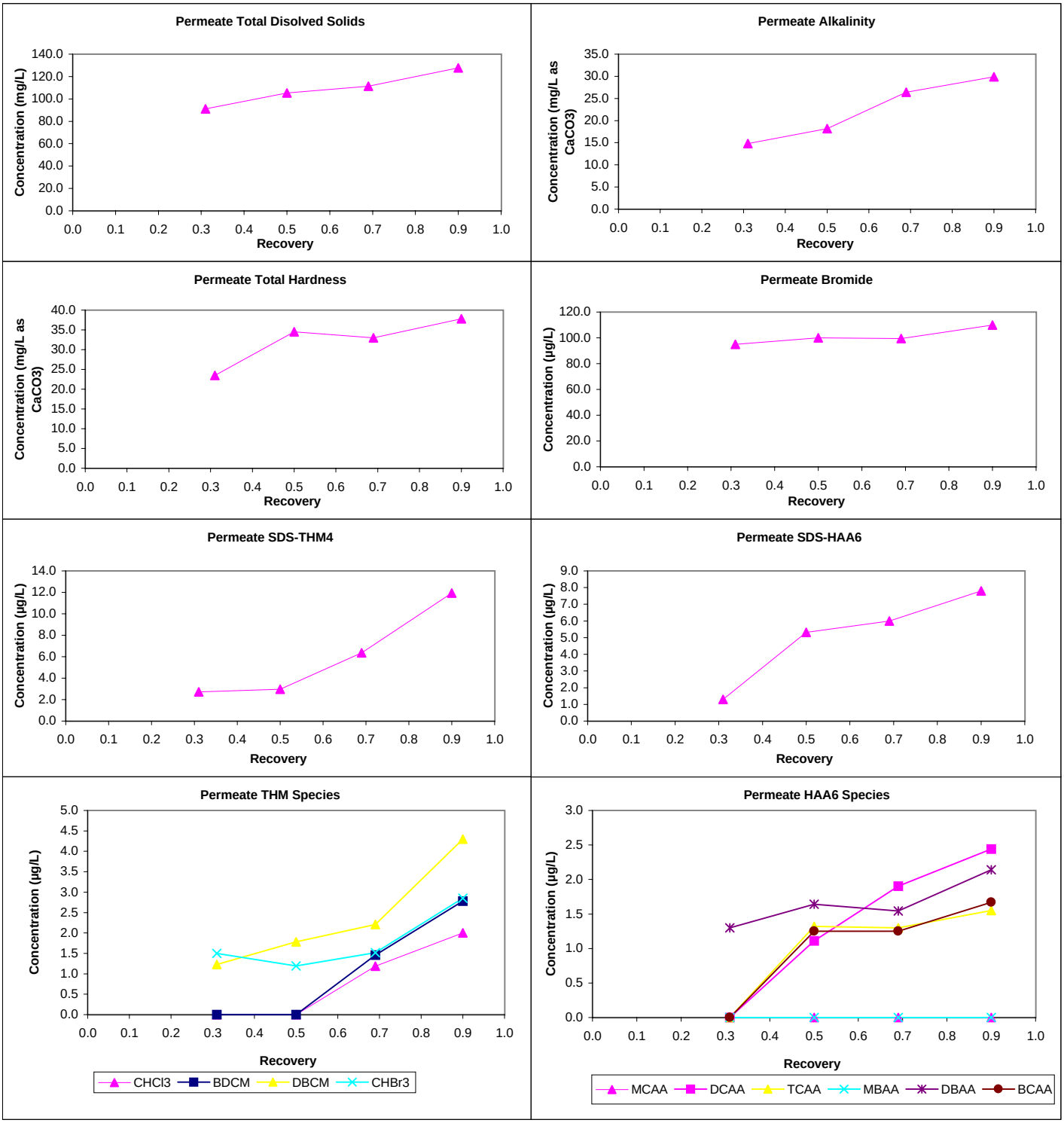
Comments:

Water Quality Parameter Graphs

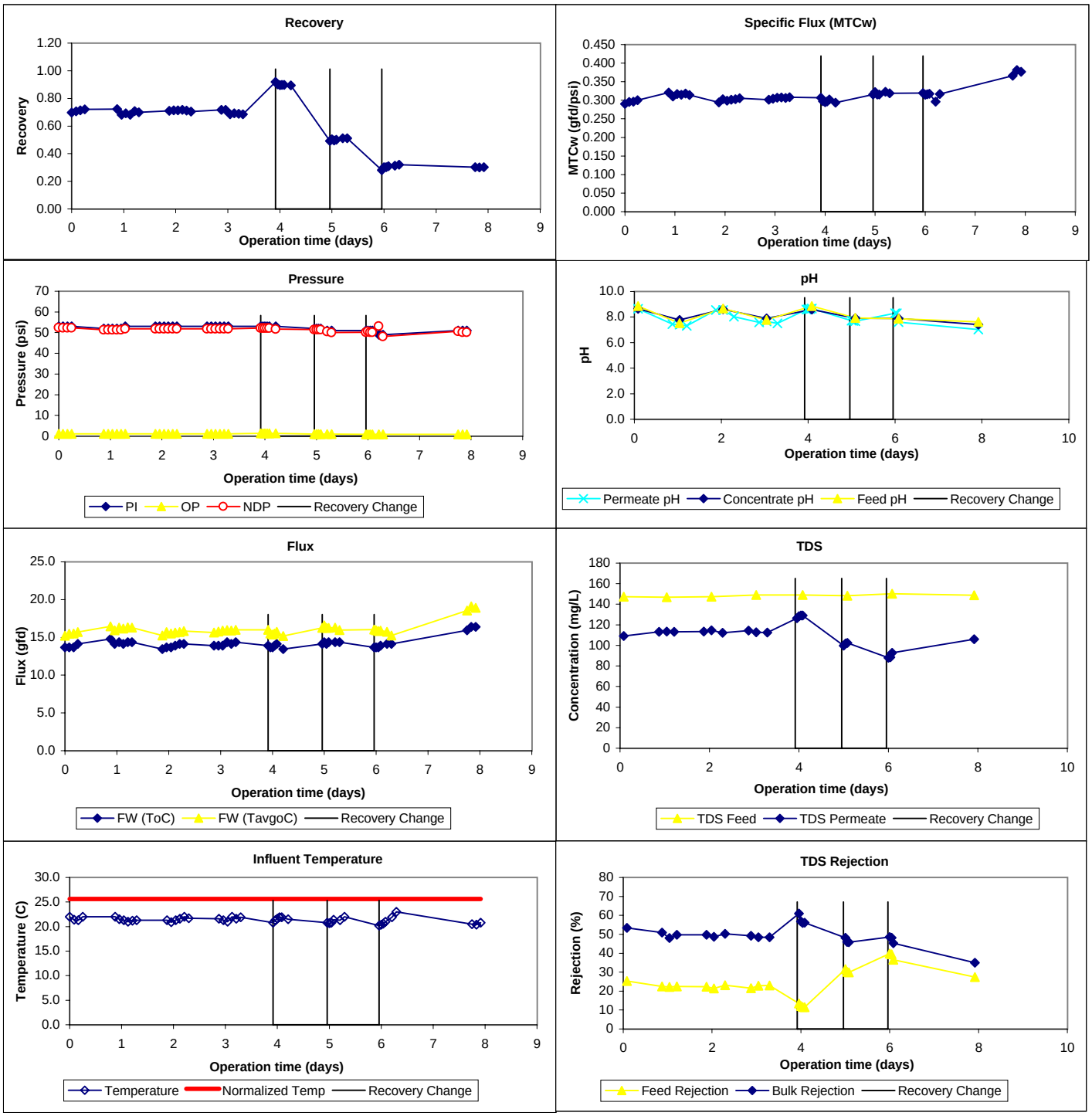




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (NF200B-4040)** | **Quarter:** 4

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 2/25/99 - 3/5/99 (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			
Recovery ->	Avg	Diff	0.31	0.50	0.71	0.91	0.31	0.50	0.71	0.91
pH	8.8	0.2	7.5	7.3	7.8	7.5	7.9	7.9	8.1	8.1
Temp	22.9	0.4	21.4	21.2	21.7	22.1	21.5	21.2	21.4	22.1
Alk	51	5	23	23	34	40	56	58	82	93
TDS	**151**	**0**	**82**	**96**	**114**	**131**	**162**	**198**	**250**	**327**
TotHard	64	3	30	31	36	43	75	88	114	196
CaHard	54	3	24	26	29	35	61	73	94	166
Turb	0.34	0.00	0.07	0.11	0.09	0.08	0.37	0.44	0.47	0.61
Amm	0.35	**0.35**	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
TOC	**7.4**	**0.1**	**0.3**	**0.3**	**0.3**	**0.7**	**10.0**	**18.0**	**19.0**	**73.0**
UV254	0.224	0.000	0.005	0.005	0.010	0.023	0.335	0.454	0.753	1.845
SUVA	3.05	0.04	1.80	1.80	4.00	3.29	3.35	2.52	3.96	2.53
Bromide	**87**	**3**	**78**	**83**	**88**	**93**				
TOX	**488**	**103**	**13**	**31**	**13**	**13**				
CHCl3	66.1	4.0	1.3	1.3	1.3	1.6				
BDCM	19.8	1.2	0.0	0.0	1.9	4.1				
DBCM	4.6	0.2	1.7	2.3	4.0	8.8				
CHBr3	0.0	0.0	1.2	1.8	2.1	3.3				
THM4	**90.5**	**5.0**	**4.3**	**5.4**	**9.3**	**17.9**				
MCAA	2.5	**2.5**	0.0	0.0	0.0	0.0				
DCAA	37.0	0.0	1.4	1.5	2.4	1.9				
TCAA	36.4	3.7	0.0	0.0	1.1	1.2				
MBAA	0.0	0.0	0.0	0.0	0.0	0.0				
DBAA	1.5	0.0	0.0	1.3	1.7	2.6				
BCAA	8.1	0.7	0.0	0.0	1.2	1.9				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**77.4**	**1.2**	**1.4**	**2.8**	**5.1**	**5.7**				
HAA6	**85.6**	**1.9**	**1.4**	**2.8**	**6.3**	**7.6**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.87	0.14	6	0.77 - 1.15
Temp (°C)	25.7	0.2	6	25.3 - 25.8
pH (unit)	8.1	0.0	6	8.1 - 8.1
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	7	2	9
Alk	4	**-36**	29
TDS	4	-6	7
TotHard	4	-18	16
CaHard	4	**-22**	17
Turb	4	**-132**	167
Amm	0	n/a	n/a
TOC	1	-2	n/a
UV254	4	-4	12

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

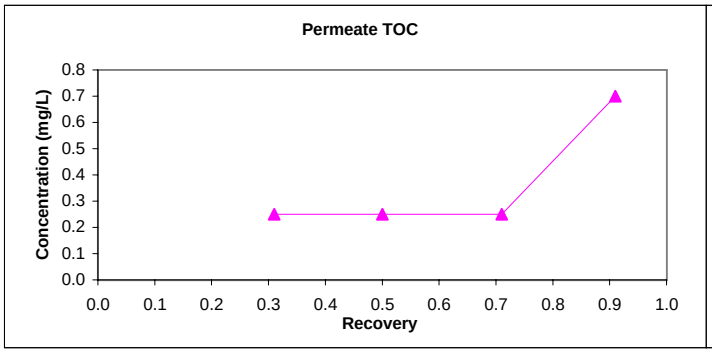
Design Parameters

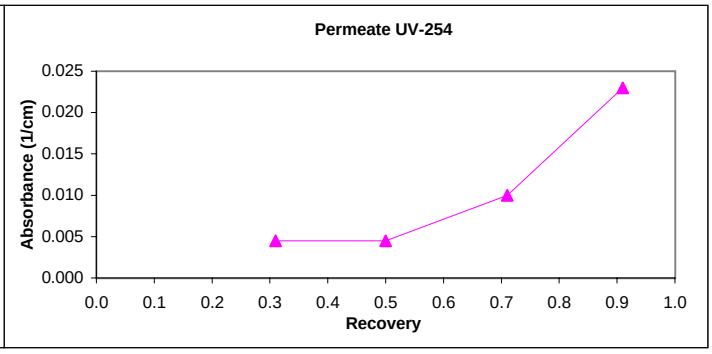
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 96%
Temp Norm MTC-w: 0.239 gfd/psi

ID#	Recov (dec.)	$F_{W\text{-des}}$ (gfd)
1	0.70	16.5
2	0.90	16.5
3	0.50	16.5
4	0.30	16.5

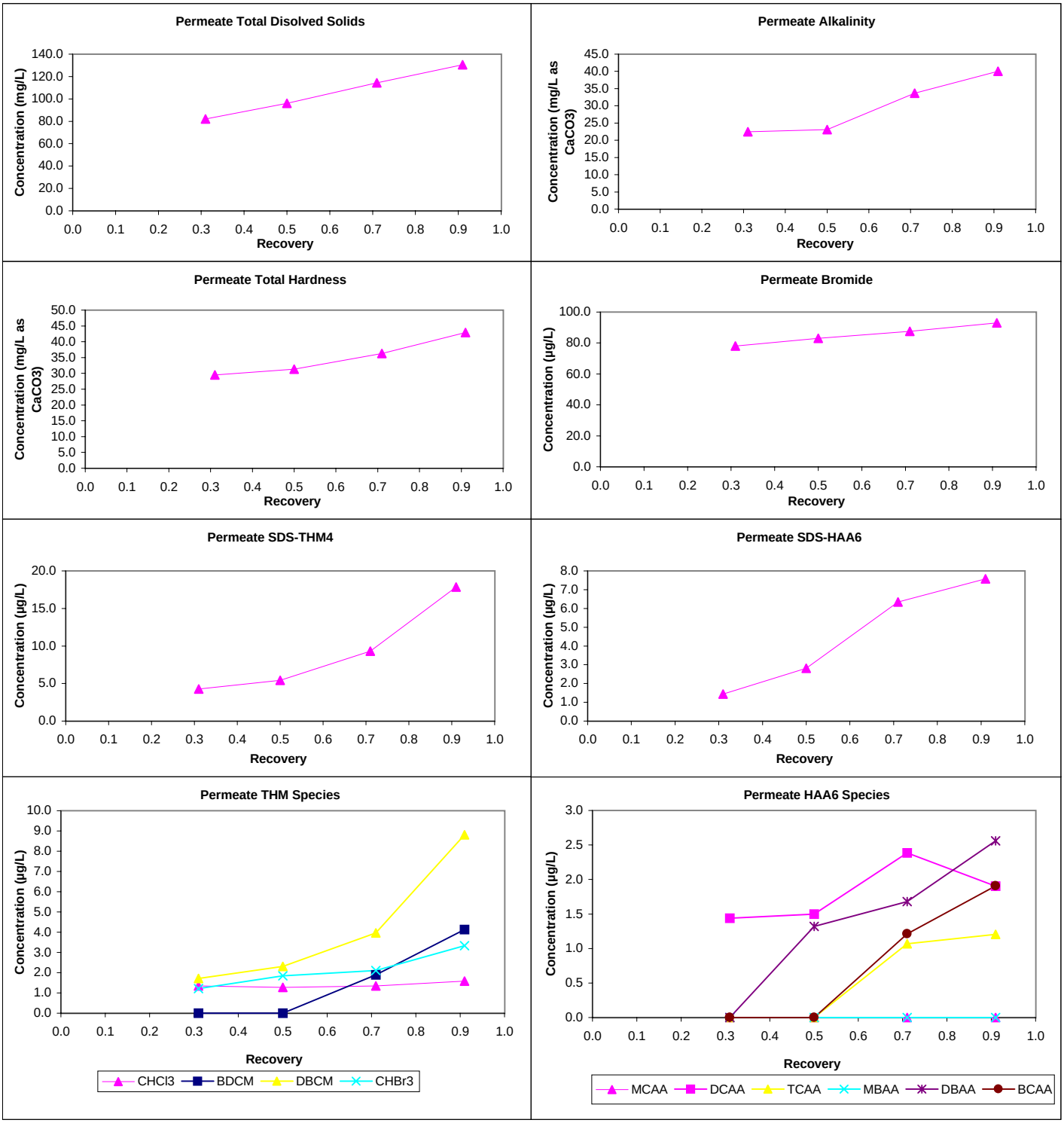
Comments:

Water Quality Parameter Graphs

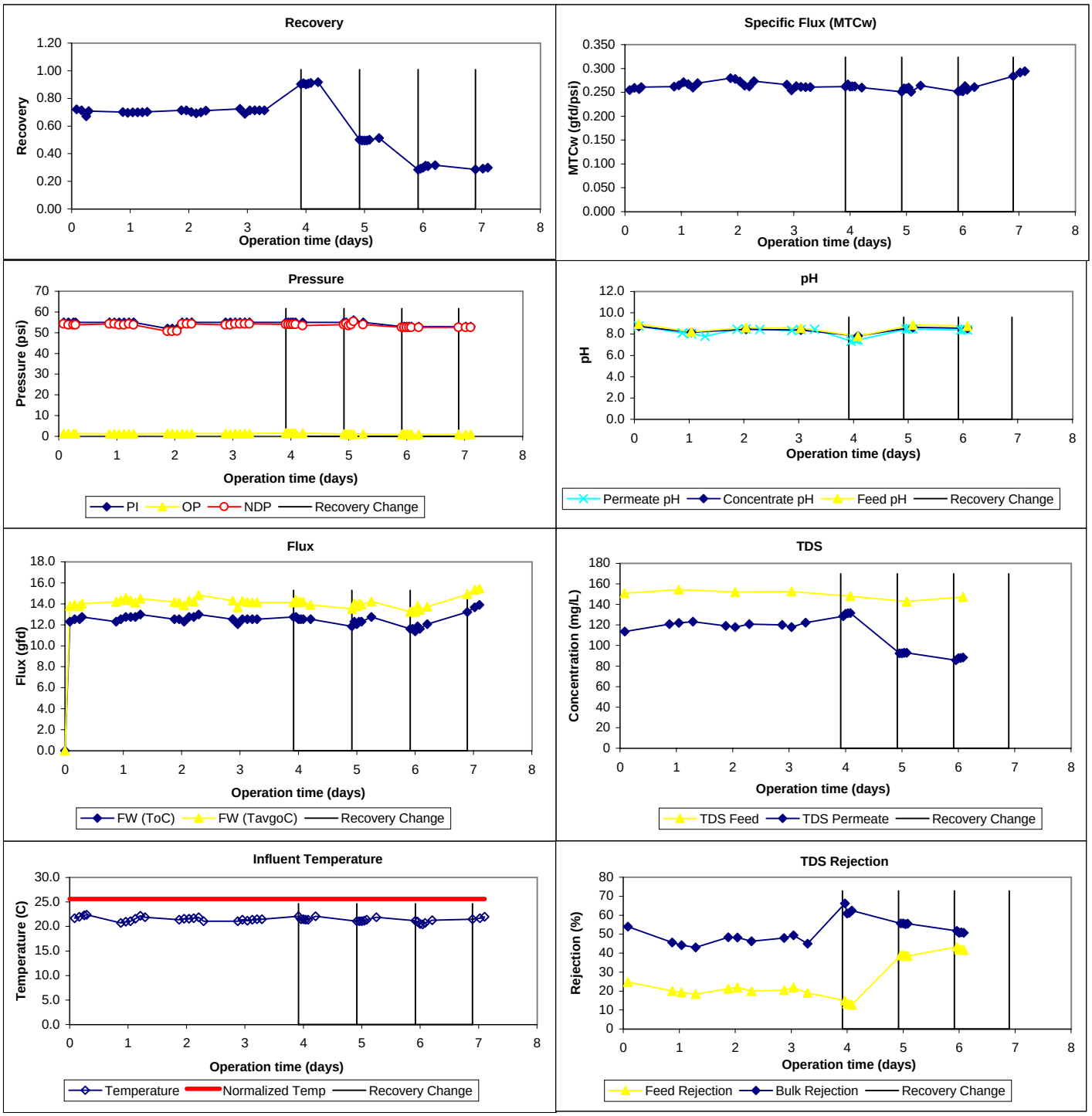




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (BW30-XLE)** | **Quarter:** 1

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 6/3/98 - 6/10/98 (7 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	0.31	0.50	0.69	0.89	0.31	0.50	0.69	0.89	WQP	Count	Avg	SD
pH	8.7	0.0	7.1	8.1	8.2	7.6	8.0	8.7	8.6	8.3	TDSt	7	0	8
Temp	23.0	0.0	25.7	24.9	21.5	22.4	25.7	24.9	21.5	22.4				
Alk	43	1	2	5	6	6	55	85	146	359	Alk	4	3	10
TDS	**151**	**0**	**9**	**14**	**18**	**35**	**192**	**304**	**483**	**1044**	TDS	4	-1	9
TotHard	67	1	0	5	0	1	95	127	220	549	TotHard	3	-2	6
CaHard	56	1	0	0	0	1	81	107	186	466	CaHard	3	-3	6
Turb	0.59	0.04	0.00	0.00	0.05	0.00	0.57	0.50	0.66	0.65	Turb	1	**-152**	n/a
Amm	0.70	0.00	0.00	0.60	0.50	0.60	1.10	1.20	1.50	2.50	Amm	3	**32**	8
TOC	**8.2**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**12.0**	**16.0**	**29.0**	**73.0**	TOC	0	n/a	n/a
UV254	0.231	0.000	0.005	0.005	0.005	0.005	0.349	0.478	0.826	2.297	UV254	4	7	4
SUVA	2.83	0.02	1.80	1.80	1.80	1.80	2.91	2.99	2.85	3.15				
Bromide	**105**	**5**	**10**	**10**	**10**	**41**								
TOX	**468**	**23**	**13**	**13**	**13**	**790**								
CHCl3	81.5	1.6	0.0	0.0	0.0	0.0								
BDCM	21.4	0.4	0.0	0.0	0.0	0.0								
DBCM	4.1	0.1	0.0	0.0	0.0	0.0								
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0								
THM4	**107.1**	**2.1**	**0.0**	**0.0**	**0.0**	**0.0**								
MCAA	3.5	0.0	0.0	0.0	0.0	0.0								
DCAA	40.6	0.9	0.0	0.0	0.0	0.0								
TCAA	45.9	2.3	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	1.2	0.0	0.0	0.0	0.0	0.0								
BCAA	8.0	0.1	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	**91.2**	**3.3**	**0.0**	**0.0**	**0.0**	**0.0**								
HAA6	**99.2**	**3.4**	**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)	0.98	0.26	6	0.60 - 1.35
Temp (°C)	25.5	0.1	6	25.3 - 25.7
pH (unit)	8.0	0.0	6	8.0 - 8.1
Time (hr)	3.5	0.0	6	3.5 - 3.5

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

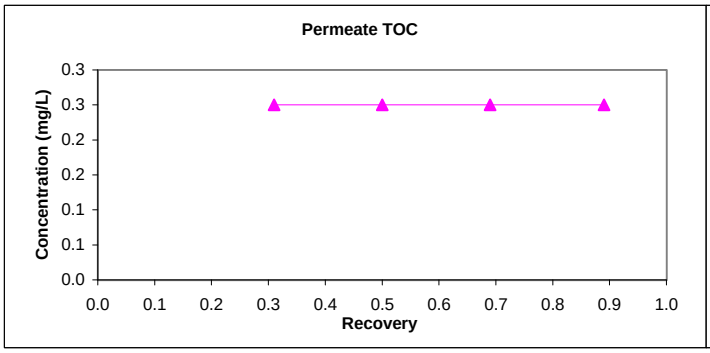
Design Parameters

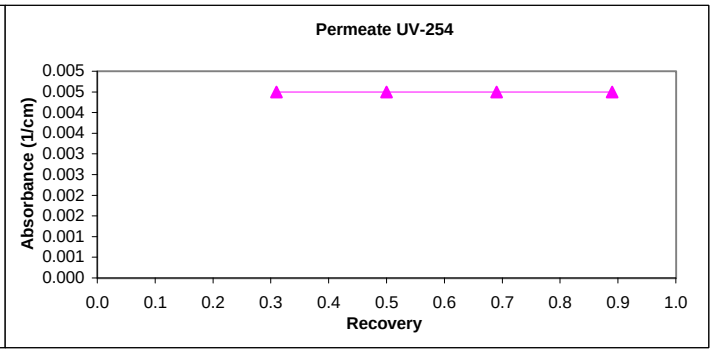
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 98%
Temp Norm MTC-w: 0.235 gfd/psi

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

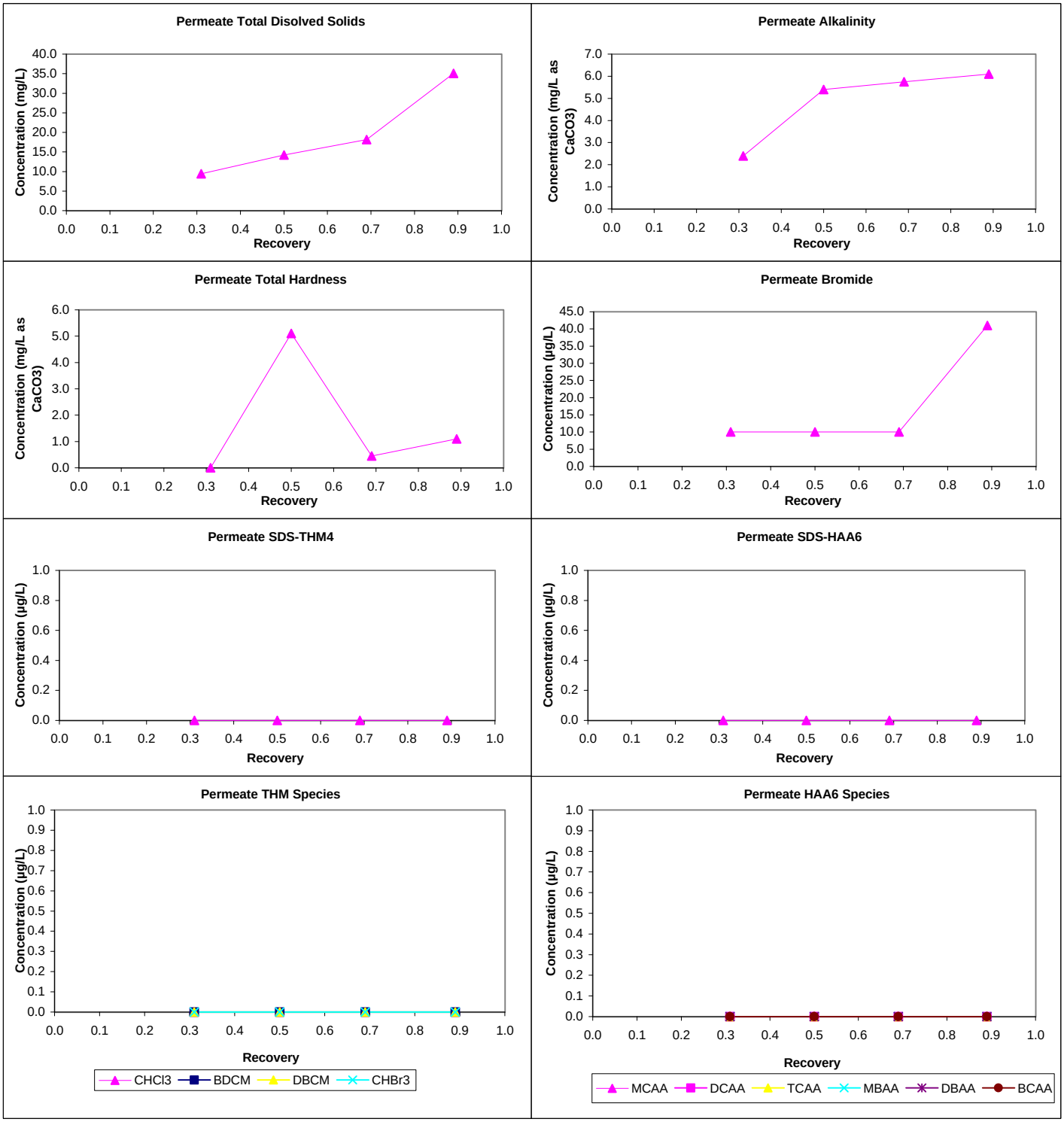
Comments:

Water Quality Parameter Graphs

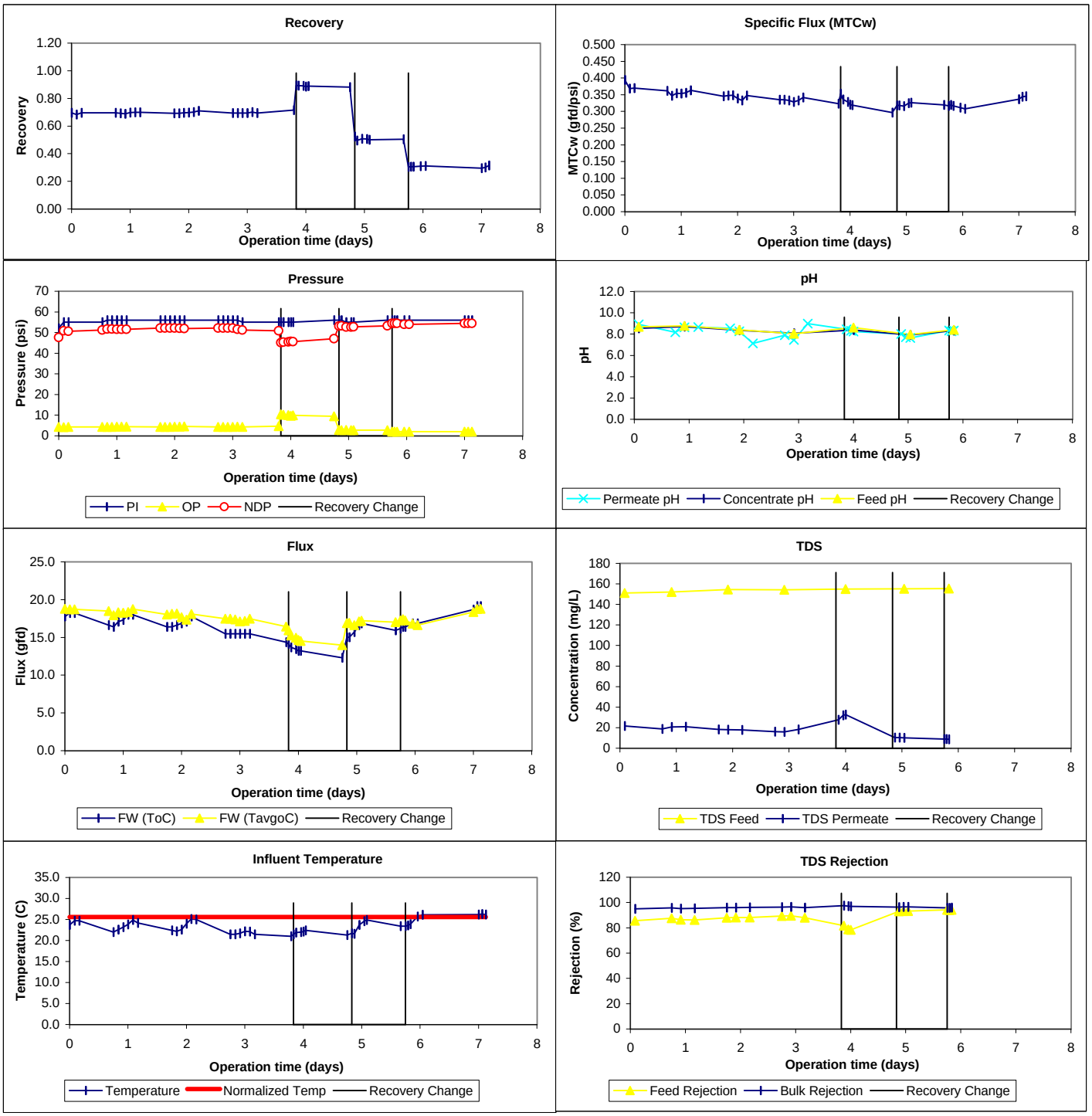




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (BW30-XLE)** | **Quarter:** 2

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 8/26/98 - 9/4/98 (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			
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90
pH	8.7	0.1	7.1	7.1	7.3	7.6	8.5	7.8	8.0	8.4
Temp	23.9	0.5	23.6	22.9	23.0	23.7	23.6	22.9	23.0	23.7
Alk	54	9	3	0	2	7	63	88	140	337
TDS	**152**	**1**	**13**	**13**	**18**	**37**	**304**	**310**	**458**	**981**
TotHard	65	2	0	0	1	1	90	131	211	573
CaHard	55	1	0	0	1	1	78	111	180	502
Turb	0.26	0.01	0.11	0.12	0.12	0.11	0.33	0.34	0.40	0.57
Amm	0.75	0.05	0.30	0.00	0.15	0.60	0.90	1.20	1.10	2.20
TOC	**8.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**11.0**	**16.5**	**25.0**	**66.5**
UV254	0.220	0.003	0.005	0.005	0.005	0.005	0.332	0.463	0.716	1.960
SUVA	2.70	0.09	1.80	1.80	1.80	1.80	3.02	2.81	2.86	2.95
Bromide	**100**	**10**	**10**	**10**	**10**	**35**				
TOX	**345**	**70**	**13**	**13**	**13**	**13**				
CHCl3	73.2	0.3	1.1	0.0	0.0	1.3				
BDCM	20.9	0.2	0.0	0.0	0.0	0.0				
DBCM	3.8	0.0	0.0	0.0	0.0	0.0				
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0				
THM4	**97.9**	**0.1**	**1.1**	**0.0**	**0.0**	**1.3**				
MCAA	0.0	0.0	0.0	0.0	0.0	0.0				
DCAA	35.1	6.6	0.0	0.0	0.0	0.0				
TCAA	38.7	7.5	0.0	0.0	0.0	0.0				
MBAA	0.0	0.0	0.0	0.0	0.0	0.0				
DBAA	1.2	0.2	0.0	0.0	0.0	0.0				
BCAA	7.0	1.2	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	**75.0**	**14.3**	**0.0**	**0.0**	**0.0**	**0.0**				
HAA6	**82.0**	**15.5**	**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)	0.87	0.35	6	0.57 - 1.50
Temp (°C)	25.3	0.3	6	25.0 - 25.7
pH (unit)	8.0	0.0	6	8.0 - 8.0
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	8	-2	16
Alk	4	-29	10
TDS	4	3	21
TotHard	2	-7	4
CaHard	2	-5	3
Turb	4	-62	83
Amm	3	-21	37
TOC	0	n/a	n/a
UV254	4	-1	8

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

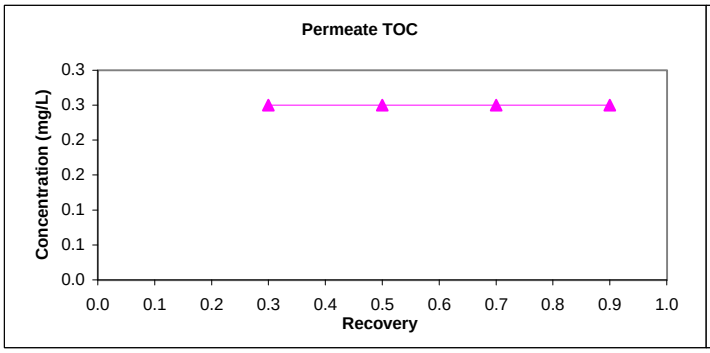
Design Parameters

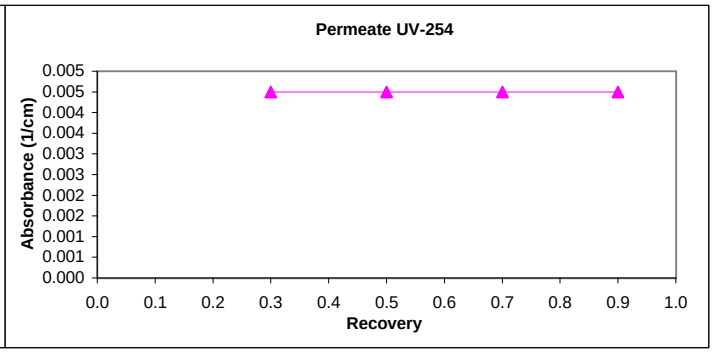
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 98%
Temp Norm MTC-w: 0.235 gfd/psi

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

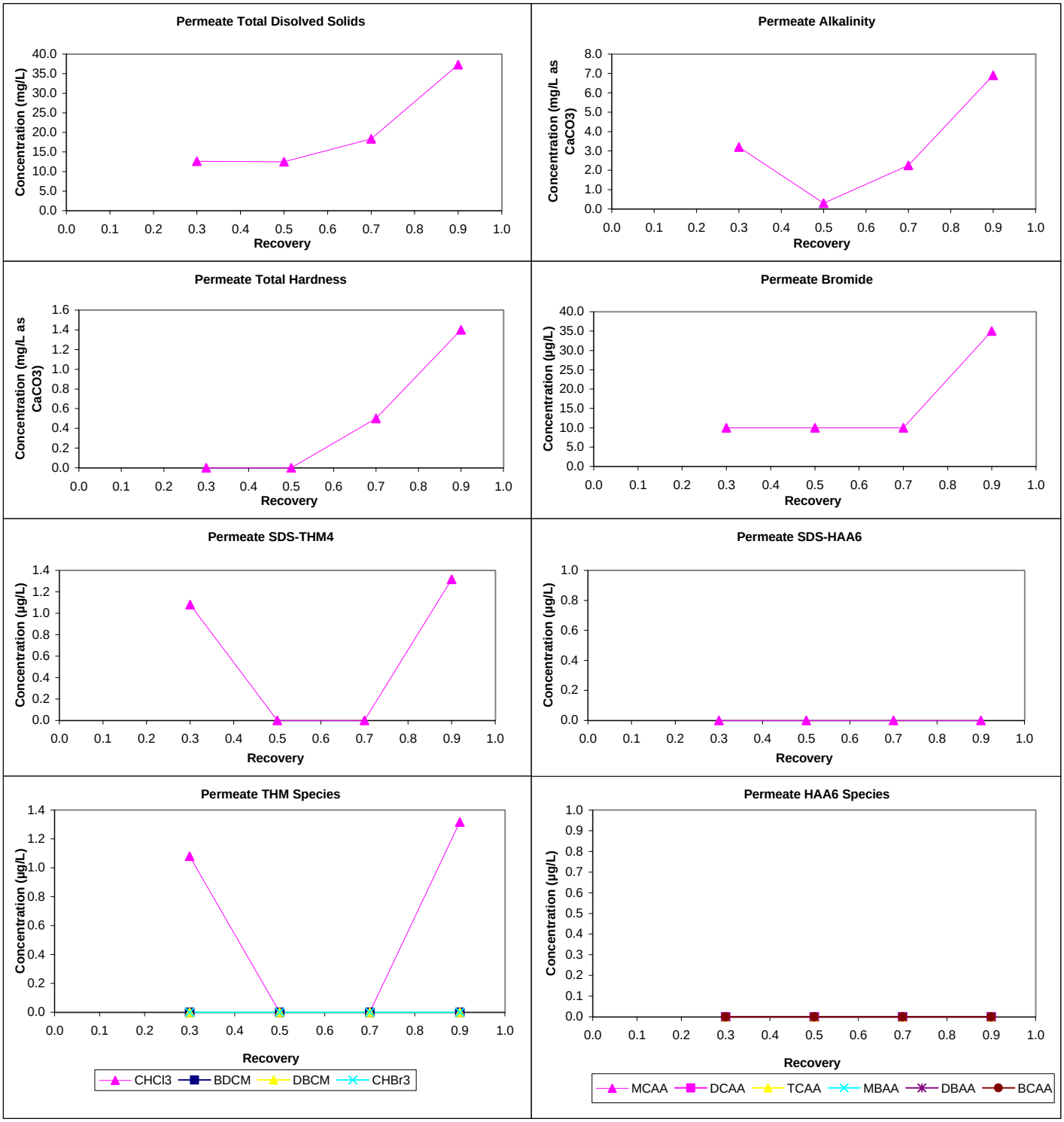
Comments:

Water Quality Parameter Graphs

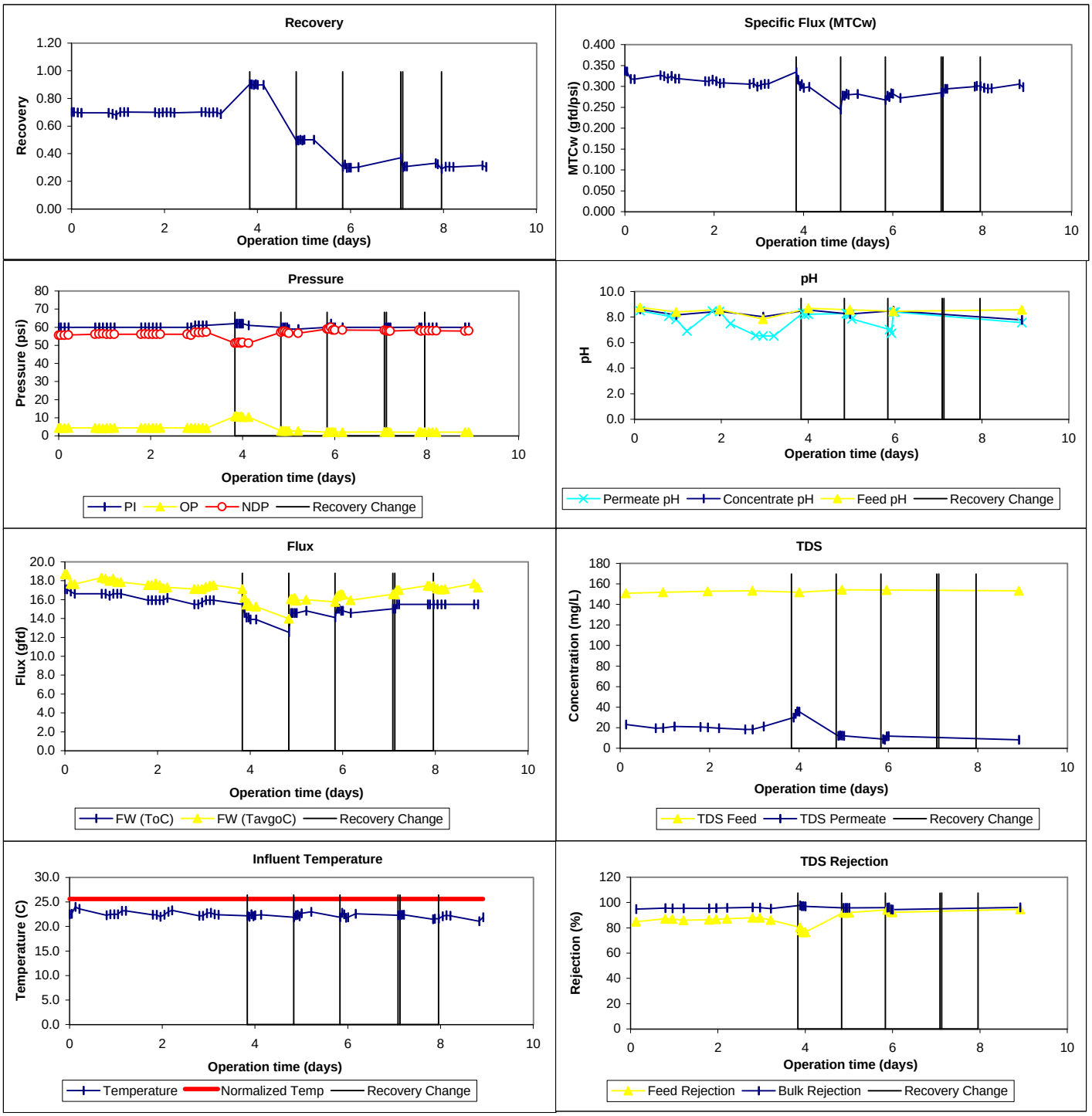




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (BW30-XLE)** | **Quarter:** 3

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 12/2/98 - 12/10/9 (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			
Recovery ->	Avg	Diff	0.31	0.50	0.70	0.90	0.31	0.50	0.70	0.90
pH	8.8	0.1	5.8	6.5	8.3	8.1	7.3	7.7	8.5	8.6
Temp	21.2	0.6	20.4	21.8	21.8	22.5	20.6	22.4	22.0	22.7
Alk	40	1	1	2	5	6	47	67	115	267
TDS	**146**	**1**	**9**	**13**	**21**	**41**	**179**	**299**	**440**	**903**
TotHard	57	4	0	1	1	2	74	114	169	447
CaHard	47	4	0	1	1	2	61	95	136	369
Turb	0.33	0.08	0.23	0.15	0.17	0.28	0.32	0.51	0.54	0.65
Amm	0.60	0.00	0.00	0.00	0.30	0.30	0.00	0.00	1.10	1.00
TOC	**7.6**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**10.0**	**15.5**	**25.5**	**65.0**
UV254	0.233	0.001	0.005	0.005	0.005	0.005	0.329	0.468	0.755	1.800
SUVA	3.06	0.03	1.80	1.80	1.80	1.80	3.29	3.02	2.96	2.77
Bromide	**110**	**0**	**10**	**10**	**21**	**46**				
TOX	**455**	**10**	**13**	**13**	**13**	**13**				
CHCl3	78.3	1.9	0.0	0.0	0.0	0.0				
BDCM	23.1	0.2	0.0	0.0	0.0	0.0				
DBCM	4.8	0.1	0.0	0.0	0.0	0.0				
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0				
THM4	**106.3**	**2.0**	**0.0**	**0.0**	**0.0**	**0.0**				
MCAA	3.6	0.7	0.0	0.0	0.0	0.0				
DCAA	41.2	1.1	0.0	0.0	0.0	0.0				
TCAA	41.5	6.3	0.0	0.0	0.0	1.1				
MBAA	0.0	0.0	0.0	0.0	0.0	0.0				
DBAA	2.0	0.1	0.0	0.0	0.0	1.0				
BCAA	9.5	0.2	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	**88.2**	**4.5**	**0.0**	**0.0**	**0.0**	**2.1**				
HAA6	**97.8**	**4.3**	**0.0**	**0.0**	**0.0**	**2.1**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.78	0.22	6	0.61 - 1.15
Temp (°C)	25.1	0.0	6	25.1 - 25.2
pH (unit)	8.0	0.0	6	8.0 - 8.0
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	8	-9	12
Alk	4	-20	10
TDS	4	-7	13
TotHard	4	-11	10
CaHard	3	-11	12
Turb	4	-14	13
Amm	2	-124	106
TOC	0	n/a	n/a
UV254	4	-8	14

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

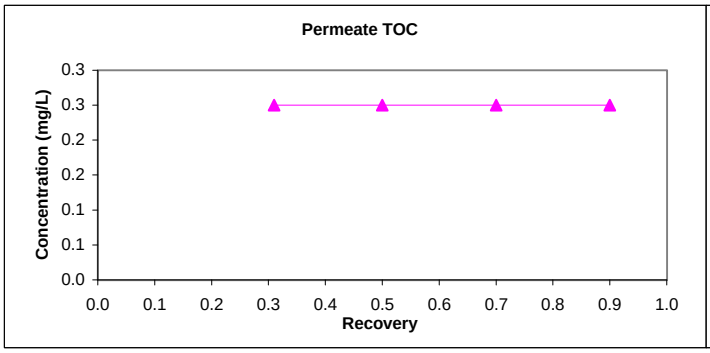
Design Parameters

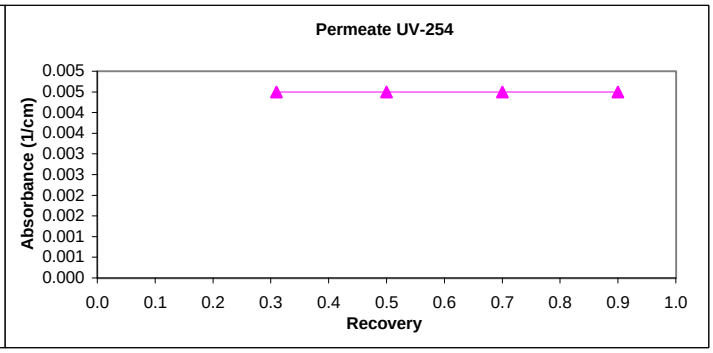
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 98%
Temp Norm MTC-w: 0.235 gfd/psi

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

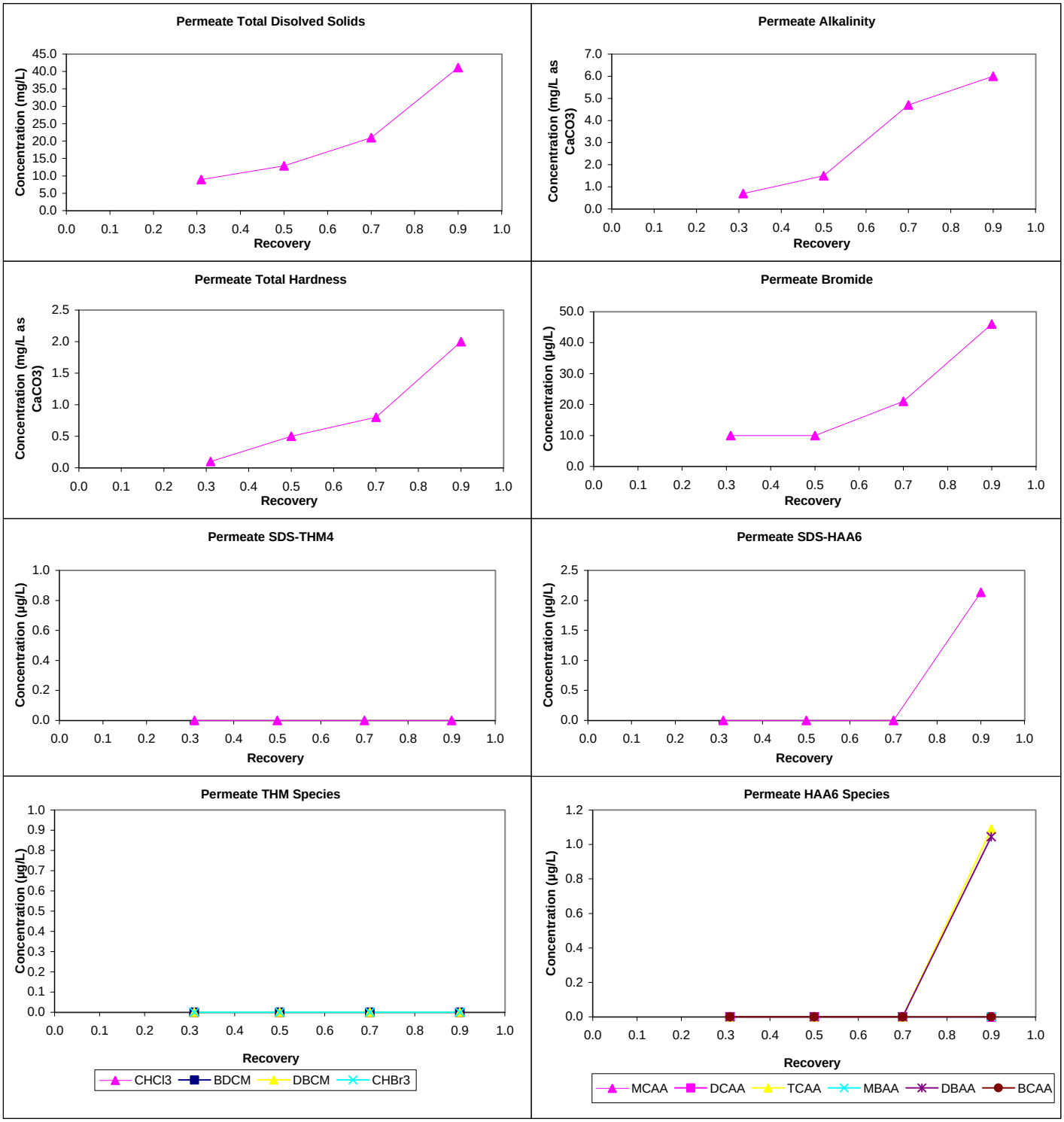
Comments:

Water Quality Parameter Graphs

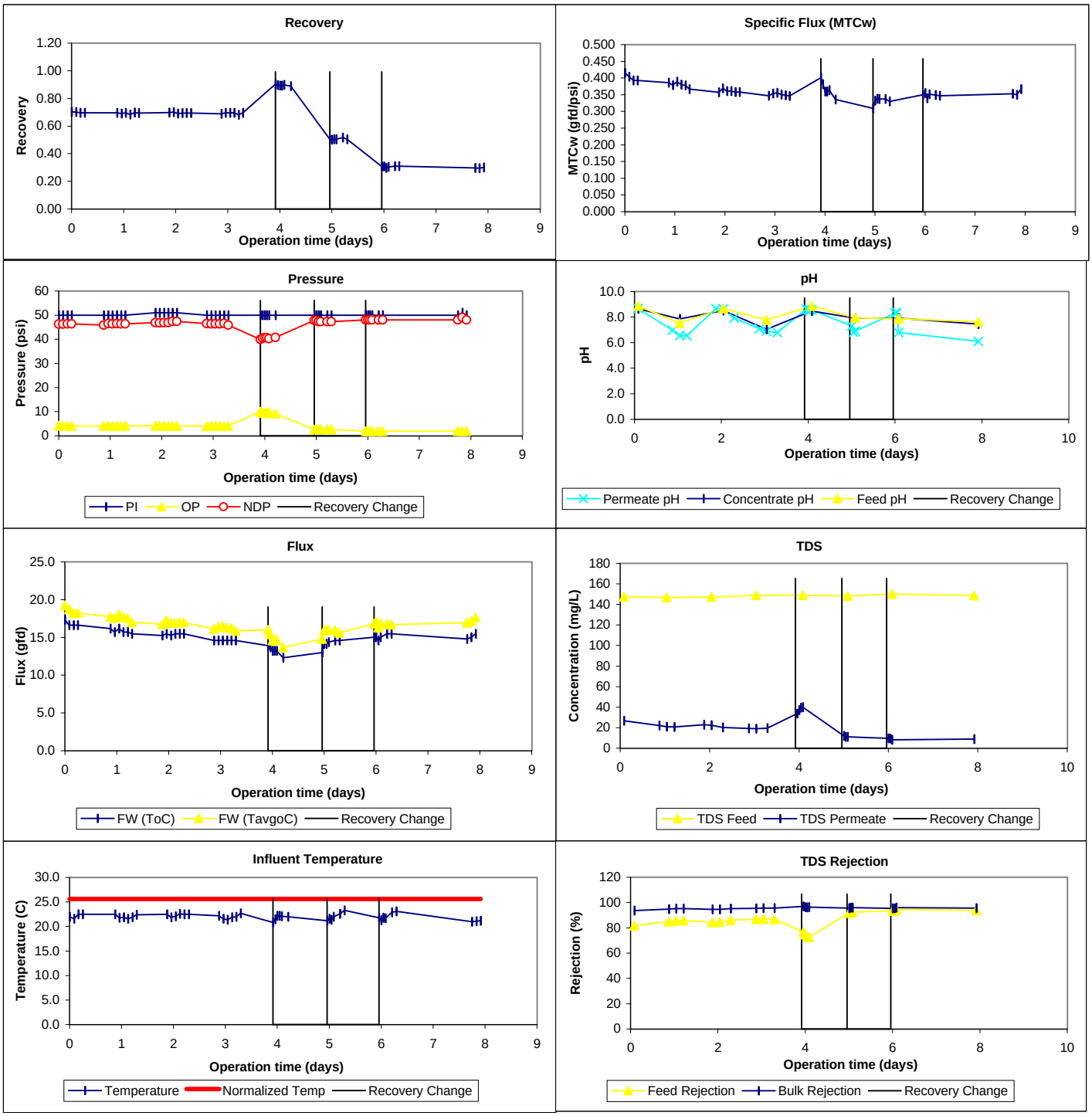




Water Quality Parameter Graphs (Continued)



Productivity Graphs



City of Lauderhill | **RBSMT Membrane Treatment Study Summary (BW30-XLE)** | **Quarter:** 4

ICR Information

ID / ICR#: FL 4060787 / 1076
ICR Contact: C. Randall Arline
Phone No.: 954-730-2972
Period: 2/25/99 - 3/5/99 (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			
Recovery ->	Avg	Diff	0.30	0.50	0.69	0.89	0.30	0.50	0.69	0.89
pH	8.8	0.2	6.6	6.2	6.6	6.8	8.3	8.0	8.2	8.3
Temp	22.9	0.4	21.5	21.4	22.0	22.4	21.3	21.4	21.0	22.3
Alk	51	5	2	2	4	7	65	81	135	336
TDS	**151**	**0**	**11**	**11**	**19**	**42**	**175**	**289**	**413**	**871**
TotHard	64	3	0	0	1	4	86	116	191	497
CaHard	54	3	0	0	1	4	70	95	159	413
Turb	0.34	0.00	0.07	0.08	0.07	0.07	0.40	0.42	0.39	0.55
Amm	0.35	**0.35**	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00
TOC	**7.4**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**10.0**	**15.0**	**17.0**	**8.0**
UV254	0.224	0.000	0.005	0.005	0.005	0.005	0.330	0.479	0.699	1.910
SUVA	3.05	0.04	1.80	1.80	1.80	1.80	3.30	3.19	4.11	23.88
Bromide	**91**	**7**	**10**	**10**	**22**	**43**				
TOX	**488**	**103**	**13**	**13**	**13**	**13**				
CHCl3	66.1	4.0	1.1	1.1	0.0	0.0				
BDCM	19.8	1.2	0.0	0.0	0.0	1.5				
DBCM	4.6	0.2	0.0	0.0	0.0	0.0				
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0				
THM4	**90.5**	**5.0**	**1.1**	**1.1**	**0.0**	**1.5**				
MCAA	2.5	**2.5**	0.0	0.0	0.0	NR				
DCAA	37.0	0.0	0.0	0.0	0.0	NR				
TCAA	36.4	3.7	0.0	0.0	0.0	NR				
MBAA	0.0	0.0	0.0	0.0	0.0	NR				
DBAA	1.5	0.0	0.0	0.0	0.0	NR				
BCAA	8.1	0.7	0.0	0.0	0.0	NR				
TBAA	NA	NA	NA	NA	NA	NA				
CDBAA	NA	NA	NA	NA	NA	NA				
DCBAA	NA	NA	NA	NA	NA	NA				
HAA5	**77.4**	**1.2**	**0.0**	**0.0**	**0.0**	**NR**				
HAA6	**85.6**	**1.9**	**0.0**	**0.0**	**0.0**	**NR**				
HAA9	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**				

SDS Conditions

WQP	Avg	SD	Count	Min - Max
Res (mg/L) (0)	0.96	0.20	6	0.81 - 1.36
Temp (°C)	25.7	0.2	6	25.3 - 25.8
pH (unit)	8.1	0.0	6	8.0 - 8.1
Time (hr)	3.5	0.0	6	3.5 - 3.5

Mass Balance Closure Err (%)

WQP	Count	Avg	SD
TDSt	7	-5	11
Alk	4	-19	6
TDS	4	-12	9
TotHard	2	-9	2
CaHard	2	-9	2
Turb	4	**-135**	153
Amm	0	n/a	n/a
TOC	0	n/a	n/a
UV254	4	1	5

Pretreatment Information

Process	Description	Scale
CONV	Conventional Filtration	Full-scale
SOFT	Softening	Full-scale
CS/SOFT	gulation/Sedimentation/Softeni	Full-scale
Cartridge Filtration	1 um pore	Bench-scale
Antiscalant	4 mg/L Hypersperse 400 UL	Bench-scale
Lime Softening	Ca(OH)2 - [CaO slaked to Ca(	Full-scale
Lime Softening	polymer(trade secret)Praestol 2	Full-scale

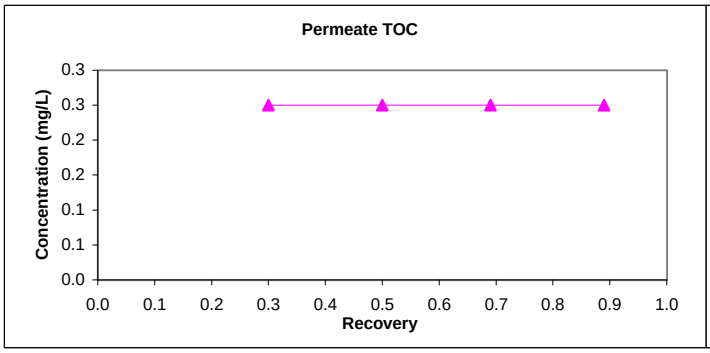
Design Parameters

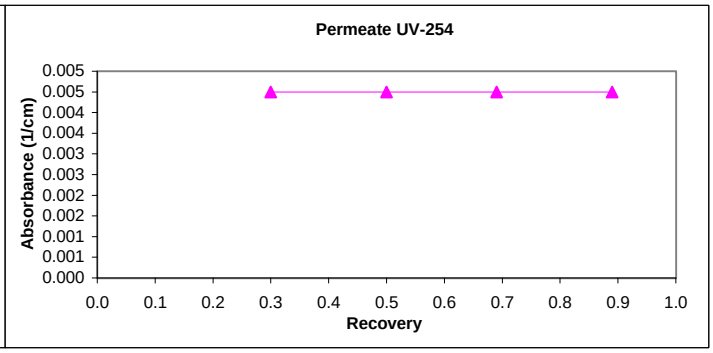
Active memb area: 0.167 ft²
Active width: 0.333 ft
Norm Temp: 25.6 °C
Feed TDS: 152.0 mg/L
Manuf rep TDS rej: 98%
Temp Norm MTC-w: 0.235 gfd/psi

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

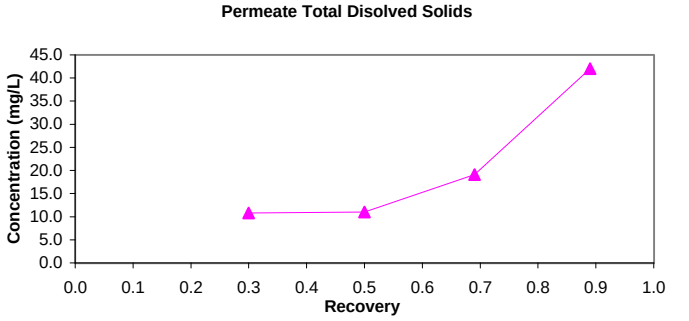
Comments:

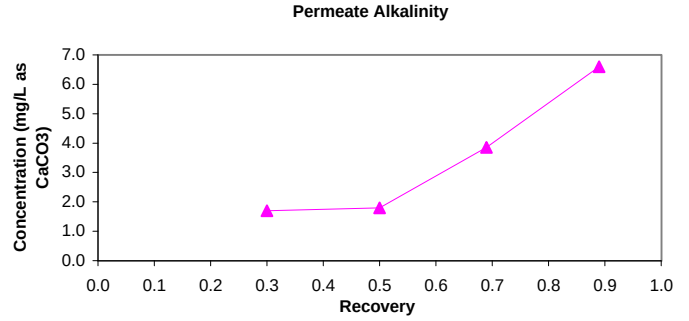
Water Quality Parameter Graphs

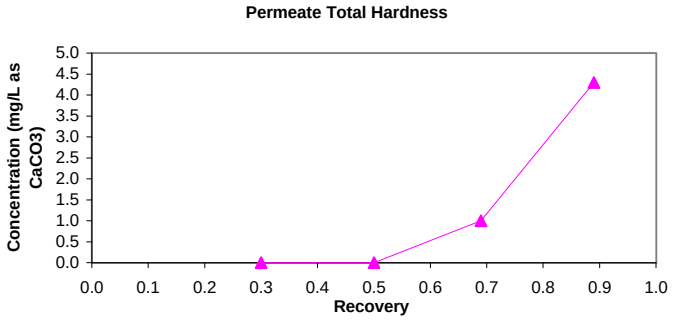


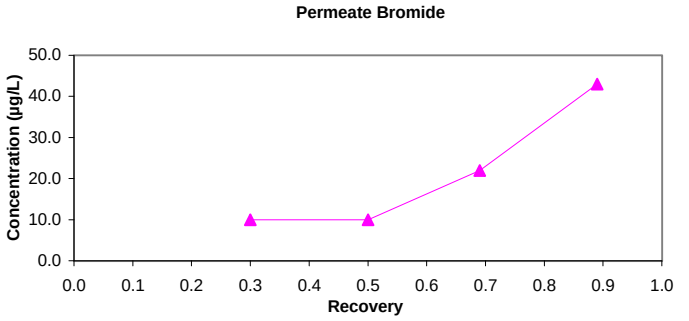


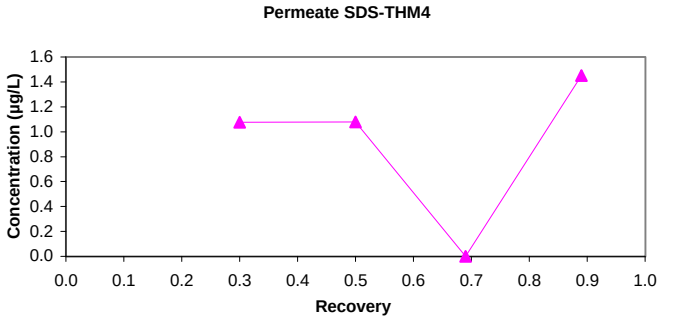
Water Quality Parameter Graphs (Continued)

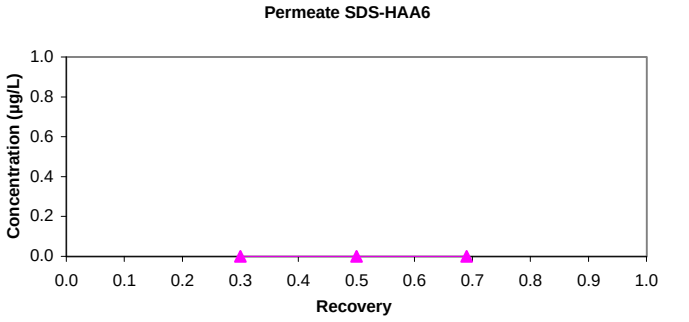


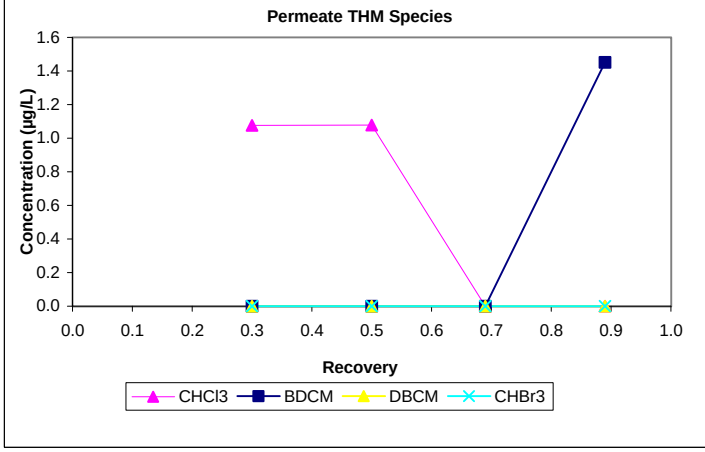


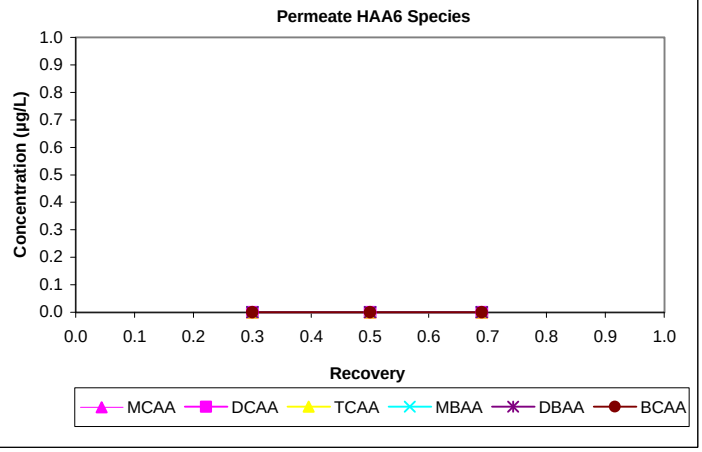












Productivity Graphs