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October 16, 2007

Kenneth Flatt Utilities Director Dare County Regional Water System 600 S. Mustian Street Kill Devil Hills, NC, 27948

Subject:

Final Report ~ RWS and Frisco Pilot Testing

Dear Ken:

We are pleased to provide you with the subject final report. The changes and corrections resulting from staff review of the draft have been addressed.

As you know, the final task in this contract is the preparation of preliminary design reports (PDR) for both locations. This work has been started, and the draft PDR for RWS should be ready for staff review early in November.

Yours truly,

Ian C. Watson, PE

RosTek Associates, Inc.

cc:

File:06-012.

DARE COUNTY, N. CAROLINA REGIONAL WATER SYSTEM

NANOFILTRATION PILOT PROGRAM

RODANTHE-WAVES-SALVO WTP SOUTH HATTERAS ISLAND WTP



FINAL REPORT

October 2007

Prepared by
ROSTEK ASSOCIATES, INC.
TAMPA, FLORIDA

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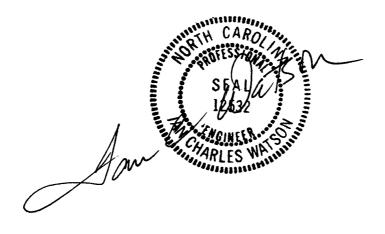
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October 2007

CERTIFICATION

The undersigned certifies that this report has been prepared by him, or under his direct supervision.



Ian C. Watson, PE

October 1, 2007 Date

12532_ NC Registration #

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PART 1

RODANTHE-WAVES-SALVO

SECTION 1-1. INTRODUCTION.

The Dare County Regional Water System operates a 1.0 MGD reverse osmosis (RO) water treatment plant to serve the villages of Rodanthe, Waves and Salvo. The plant, located in Rodanthe on Highway 12, takes its feed water from two brackish wells, one located on the plant property, and the other located at the elevated water storage tank in Rodanthe. The average water quality data for these two wells are shown in Table 1.1 below.

Table 1.1. Average Feed Water Quality

Cation	s, mg/l	Anio	Anions, mg/l				
Calcium	12.0	Bicarbonate	598.3				
Magnesium	18.3	Sulphate	12.9				
Sodium	510.0	Chloride	515.8				
Potassium	27.5	Fluoride	1.8				
Strontium	NR	Nitrate	0.01				
Barium	NR	Phosphate	0.25				
Iron	0.06						
Manganese	0.03						
UV-	-254	0	0.210				
TDS,	mg/l	13	1324.2				
Conductiv	vity, μSms	2	2890				
Color	, PCU		9.0				
TOC	mg/l		6.9				
p.	•		7.8				
Temper			18.8				
Silica			15.3				

The RO plant consists of two trains, with provision for bypassing part of the wellwater to blend with the RO permeate. Currently this blend is limited because of the presence of a significant concentration of total organic carbon (TOC) in the feedwater. Although the RO treatment process removes virtually all of the TOC, the blended water must comply with state drinking water primary standards for trihalomethanes (THM) and haloacetic acids (HAA), both of which are formed by the chlorination of organic matter in the water. By removing the organic material in the blend water, the blend ratio could be increased, thus increasing the plant's capacity, and reducing the finished water production cost.

In 2007, the Rodanthe-Waves-Salvo plant (RWS) experienced a peak day demand of 711,000 GPD for the first time since the plant was commissioned. This triggered the state requirement for planning for plant expansion, which in turn led to the pilot plant program. If the testing could demonstrate reliable and effective TOC reduction to a very low level, together with some TDS reduction, the blend ratio could be increased sufficiently to raise the finished water production capacity to 1.2 MGD.

To demonstrate the technical feasibility of using "loose" NF membranes to remove TOC from the wellwater, and to develop design input for scale-up to full size, a pilot test program was designed for the RWS location. The protocol can be reviewed in Appendix A. Partway through the test, it became clear that the membrane selected, the Koch SR-2, would not provide sufficient organics rejection to satisfy the primary goal of the test program, which was to reduce the disinfection byproduct formation potential of the blend water. Since the membranes that had been planned for the testing at the Frisco sight, Koch's TFCS membrane, was on hand, it was decided that these would be loaded at RWS and be operated for the final ~ 800 hours of the test program.

This report tabulates the results of the test program, discusses the results of both the SR-2 and TFCS tests, and provides some very preliminary ideas for integration of these membranes into the existing RO system.

SECTION 1-2. PILOT PLANT SETUP.

The pilot plant was leased from Koch Membrane Systems. As delivered to the site at RWS, it was equipped with six four-element pressure vessels arranged in a 2:2:1:1 array. In order to simulate full scale arrangement as accurately as possible, the first and third stage vessels were loaded with three elements and a spacer, while the second and fourth stage vessels were loaded with four elements. This arrangement simulates a 2:1 array using seven-element vessels. Such a full scale array was anticipated from implementation and would permit permeate recovery up to 90% of the feedwater.

The initial membrane loading was done with the Koch SR-2 membrane. This membrane is designed as a loose nanofiltration membrane with sodium chloride (NaCl) rejection of 10-30%, but good rejection of organics with a molecular weight of >300-400, and divalent ions such as calcium, magnesium and sulphate. The membrane has a very high specific flux or ~ 0.6 gfd/psi net. It was anticipated that if this membrane exhibited the level of organics and dissolved mineral rejection needed to significantly increase the blend ratio, the high specific flux would permit full scale system to be designed using only well pressure to drive the system.

Since the pilot plant was equipped with both acid and scale inhibitor feed systems, an existing tap on the raw water line for the RO plant, located after of the chemical injection point, was used to supply feedwater to the pilot plant. The concentrate and permeate were combined after all flow, pressure and conductivity measuring devices, and discharged to the existing RO concentrate disposal piping.

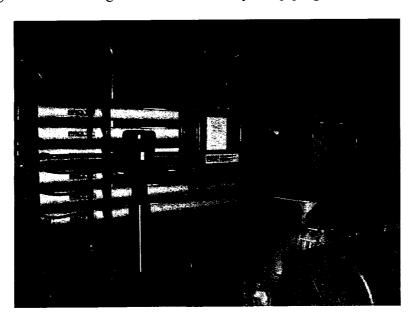


Figure 1-1. Pilot Plant Setup in the RWS Process Room.

SECTION 1-3. DISCUSSION OF RESULTS.

As stated previously, the primary goal of the RWS pilot test was to evaluate the potential for increasing the blend percentage by reducing the organics constituting trihalomethanes formation potential (THMFP) and haloacetic acid formation potential (HAAFP). The relatively high organic content of the RWS feedwater (9-10 mg/l typical) is the controlling factor which currently limits the blend ratio to less than 10%. Given the relatively low TDS of the raw water, absent the organics the blend ratio could be increased, thus increasing the plant capacity. If the TDS, particularly sodium chloride, is also reduced somewhat, increasing the blend ratio and plant capacity could be achieved without significantly changing the mineral quality of the water currently distributed to the three villages.

Tables 1-2 and 1-3 show the results of the pilot plant operation on permeate quality over a twelve week period. It is clear from the data covering the first nine weeks of operation of the pilot plant that the average organics removal by the SR-2 membrane was $\sim 56\%$. (Table 1-2) This is confirmed by inspection of the UV-254 results.

However, changing the membrane to a much tighter NF membrane, Koch's TFCS, showed organics rejection of almost 90%, again confirmed by UV-254 results. The TOC concentrations can also be viewed graphically in Figure 1-2

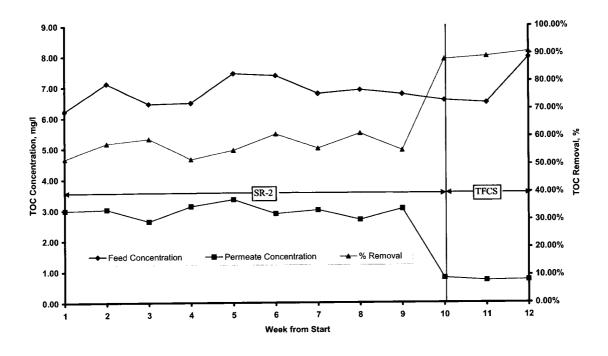


Figure 1-2. TOC Concentrations and Removal for SR-2 and TFCS

Table 1-2. Results of Analysis Performed by Outside Laboratory

Strontium (From Envirochem)	Feed		0.725mg/l																
Barium (From Envirochem) (From	Feed		0.097mg/l				nbrane					mbrane							
Silica, Reactive (From Envirochem)	Feed Permeate		11.4mg/l 10.6mg/l				SR-2 Membrane					IFCS Membrane							
Silica, Total (From Envirochem) (F	Permeate		11.				((C)				ı								
Silic (From E	Feed																		
HPC (CFU/mL) From NRO Lab	Feed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
TOC		51.93%	57.44%	59.13%	51.77%	55.03%	60.84%	25.67%	61.07%	54.95%	87.82%	88.98%	90.73%	56.52%	55.03%	27.56%	89.28%	%96.68	88.98%
Lab	Permeate	2.99	3.03	2.64	3.13	3.35	2.89	3.01	2.69	3.05	08.0	0.72	0.74	2.98	3.35	2.64	0.75	08.0	0.72
TOC (mg/L). From Frisco	1st Stage	3.79	3.67	3.61	3.85	4.00	3.67	3.88	3.78	3.72	0.92	0.81	1.01	3.77	4.00	3.61	0.91	1.01	0.81
TOC (m)	Feed	6.22	7.12	6.46	6.49	7.45	7.38	6.79	6.91	6.77	6.57	6.49	7.97	6.84	7.45	6.22	7.01	7.97	6.49
Week		1	2	က	4	5	9	7	8	6	10	11	12	Average	Мах.	Min.	Average	Мах.	Min.

Table 1-3. Results of Analysis Performed by County Laboratory

Potassium	Permeate	4.60											2.00	4.60	4.60	4.60	5.00	5.00	5.00
Pota	Feed	4.60											23.00	4.60	4.60	4.60	23.00	23.00	23.00
hate	Permeate	0.32					ane				rane	2	0.07	0.32	0.32	0.32	0.07	0.07	0.07
Phosphate	Feed	0.25					SR-2 Membrane				TECS Membrane		0.22	0.25	0.25	0.25	0.22	0.22	0.22
te .	Permeate	2.00					-2 M				0		0.00	2.00	2.00	2.00	0.00	0.00	0.00
Sulfate	Feed	9.00					SR				1		16.90	9.00	9.00	9.00	16.90	16.90	16.90
otal)	Permeate	0.029											0.017	0.029	0.029	0.029	0.017	0.017	0.017
Iron (Total)	Feed P	0.085											0.047	0.085	0.085	0.085	0.047	0.047	0.047
45	Permeate	0.104	0.099	0.097	960.0	0.093	960.0	0.095	0.091	0.094	0.010	0.021	0.016	960.0	0.104	160'0	0.016	0.021	0.010
UV - 254	Feed Per	0.214 0	0.210	0.217	0.212 (0.214 (0.208	0.206	0.210	0.202	0.199	0.214	0.217	0.21	0.22	0.20	0.21	0.22	0.20
ш	Permeate	528	537 (487 (909	504 (492 (449	491	460	137	123	155	495	537	449	138	155	123
Sodium	Feed Pe	989	520	528	522	521	522	449	518	502	454	494	497	519	989	449	482	497	454
ride	Permeate	540	550	520	540	540	540	420	530	530	180	200	200	523	920	420	193	200	180
Chloride	Feed P	540	250	520	540	540	540	420	530	530	440	520	520	523	920	420	493	520	440
ride	Permeate	1.51	1.51	1.33	1.59	1.50	1.82	1.70	1.64	1.50	0.59	0.50	0.59	1.57	1.82	1.33	0.56	0.59	0.50
Fluoride	Feed	1.80	1.77	1.56	1.78	1.75	2.00	1.91	1.87	1.69	1.94	1.95	1.89	1.79	2.00	1.56	1.93	1.95	1.89
Magnesium	Permeate	17.50	17.01	17.01	17.01	17.50	17.50	13.60	17.01	17.98	4.37	2.92	3.40	13.57	17.98	2.92	3.56	4.37	2.92
Magr	Feed	18.95	22.36	17.01	19.44	19.44	18.95	13.60	18.47	19.93	16.04	18.47	17.01	19	77	14	17	18	16
Calcium	Permeate	9.60	8.80	9.60	10.40	9.60	11.50	9.60	11.20	9.60	1.60	08.0	08.0	10	12	6	1	2	1
Cal	Feed	12.00	9.60	10.40	11.20	10.40	12.00	12.80	11.20	11.20	10.40	12.00	10.40	11	13	10	11	12	10
Alkalinity mg/l as CaCO3	Permeate	488	492	444	460	460	428	460	440	428	92	80	80	456	492	428	97	80	76
Alkalir as C	Feed	488	492	496	504	504	200	492	208	512	464	472	456	200	512	488	464	472	456
	Permeate	1290	1260	1330	1330	1320	1330	1100	1300	1310	380	425	448	1069	1330	380	418	448	380
TDS	Feed	1330	1290	1370	1340	1350	1410	1140	1330	1360	1190	1350	1430	1324	1430	1140	1323	1430	1190
T.H. mg/l as CaCO3	Permeate	96	92	26	96	96	100	80	86	86	22	14	16	94	100	80	17	22	14
T.H. r	Feed	108	116	96	108	106	108	88	104	110	85	106	96	105	116	88	86	106	92
Week		٢	2	е	4	2	9	7	80	6	10	11	12	Average	Max.	Min.	Average	Max.	Min.

Table 1-3 also compares feed and permeate concentrations for the common inorganic ions. It will be noted that there is virtually no reduction in total dissolved solids with the SR-2 membrane, but the TFCS membrane (weeks 10 through 12) gave about 68% overall salt rejection. As expected, the rejection of divalent ions was high, and sodium and chloride rejection was low. TDS rejection for both membranes is displayed graphically in Figure 1-3.

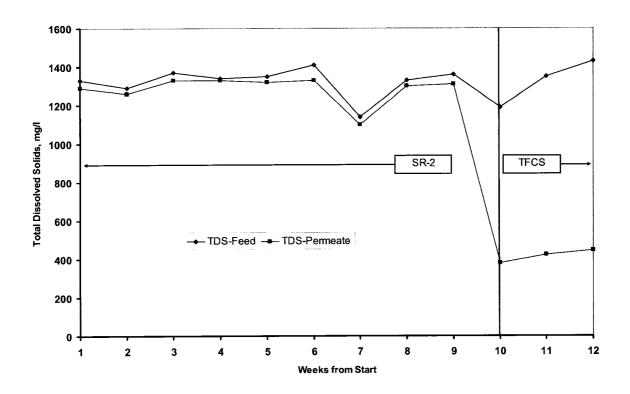


Figure 1-3. TDS rejection for SR-2 and TFCS Membranes

In terms of membrane process performance, both the SR-2 and TFCS membranes performed well. This was expected, since the RO plant operation at this site has historically been relatively trouble-free, particularly with respect to membrane fouling. Consequently fouling of the pilot test membranes was not expected, and did not occur.

Figure 1-4 shows the SR-2 flux during the test. At approximately 500 hours, the flux was increased, and remained stable for the remainder of the SR-2 test. The normalized flux shows some oscillation possibly due to normalization anomalies, connected with the apparent temperature variability, but the overall trend is flat.

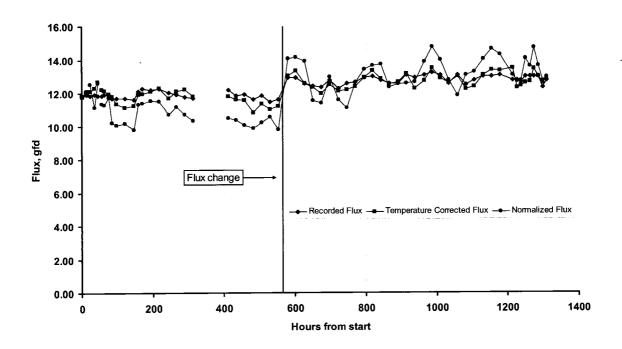


Figure 1-4. Fluxes. SR-2 Test

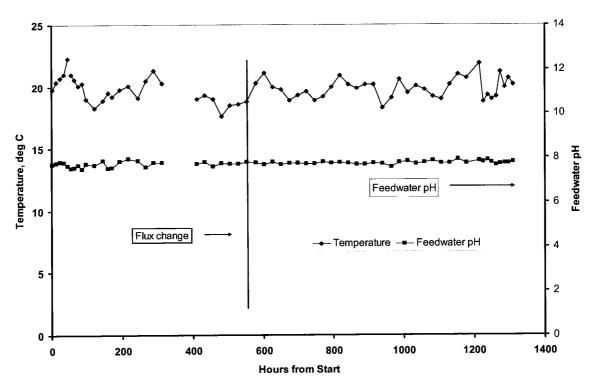


Figure 1-5. Temperature and pH. SR-2 Test

Figure 1-5 shows the temperature and pH during the test.

As mentioned earlier, the temperature showed some unexpected variability during the test. The pH remained stable at about 7.8, with only a small decrease from natural pH because of the small acid dose being applied to the feedwater. A decision not to increase the acid dose was made when it became apparent that the SR-2 membrane was exhibiting low TOC rejection, and additional sulphate ion was unlikely to improve the rejection of TOC. Therefore, the small acid dose and scale inhibitor was added during the SR-2 test, and also during the TFCS test, the latter because the good TOC rejection did not warrant the additional sulphate ion addition, and resultant TDS reduction.

Figure 1-6 shows the system pressure during the SR-2 test, together with the net pressure. The net pressure was calculated using the formula:

$$P_{NET} = P_{FEED} - (\pi_{AVE} + dP/2 + P_{PERM})$$

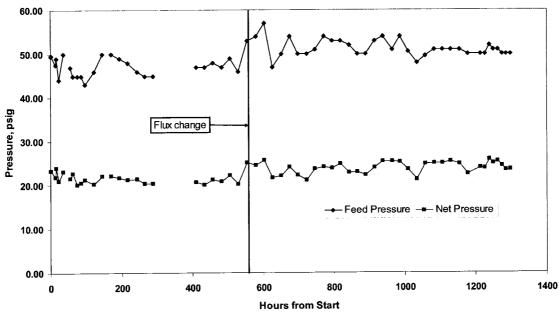


Figure 1-6. System and Net Driving Pressure, SR-2 Test

The assumptions made to calculate the osmotic pressure of the various flow streams are:

Feedwater	Conductivity to TDS	0.4620
	TDS to π	0.0105
Concentrate	Conductivity to TDS	0.4617
	TDS to π	0.011
Permeate	Conductivity to TDS	0.4621
	TDS to π	0.01

As with the flux data, it can be seen that both the feed pressure and the net pressure demonstrate a flat trend, indicating a stable membrane performance.

Figures 1-7 through 9- display graphically for the TFCS test the process data previously discussed for the SR-2 test. The raw data was normalized using the Koch software "NormPro", since the membrane type was listed in the data base of the software, whereas the SR-2 membrane was not listed.

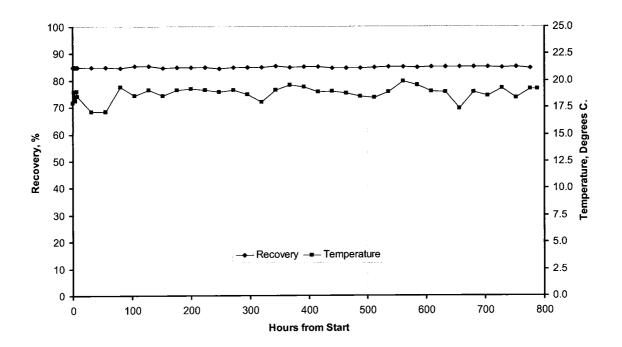


Figure 1-7. Temperature and Recovery, TFCS Test

As can be seen, the recovery during the test was held at 85%. This would be the minimum recovery to be incorporated into the design of a full scale RO plant addition, because of the need to conserve well water. As in the SR-2 test, the temperature still shows more variability than was expected from the operation of the RO plant. It is possible that this variability was connected somehow to the temperature change within the building, and its impact on the temperature of the water flowing in the PVC piping connecting the pilot to the raw water source. While this temperature variation may account for the oscillation in the normalized flux, it is expected that this will not impact the full scale design.

Figure 1-8 shows the system and normalized flux for the TFCS test. The system flux was held at a relatively high value for an NF membrane, but could be justified because of the very low fouling potential of the raw water. Once again as with the SR-2 test, the normalized flux demonstrates some oscillation.

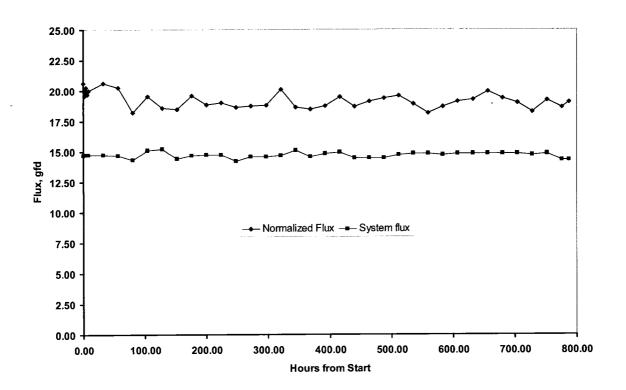


Figure 1-8. System and Normalized Flux, TFCS Test.

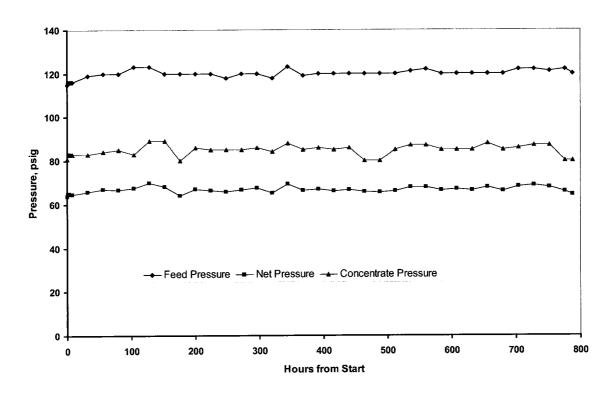


Figure 1-9. System and Net Pressures, TFCS Test.

Comparing Figure 1-6 with Figure 1-9, it can be seen that the feed pressure required to drive the TFCS membrane is more than twice that required for the SR-2 membrane, demonstrating both the lower specific flux, the impact of higher sodium chloride rejection, and the resultant higher average osmotic pressure in the system. From the net pressure plot, the same flat trend as the SR-2 can be seen, again reflecting the lack of fouling potential in this feedwater.

SECTION 1-4. CONCLUSIONS AND RECOMMENDATIONS.

From observation of the test results for the SR-2 membrane, it is clear that although there was some separation of the TOC, the average removal over the course of the test was only about fifty six percent, which is insufficient to significantly increase the potential blend ratio while maintaining the THMFP and HAAFP at or below the current primary standard. While there are other manufacturers who have similar products to the SR-2, it is believed that similar results would be obtained. In addition, there was virtually no TDS rejection with the SR-2 membrane, again impacting the potential for increasing the blend ratio. Therefore it must be concluded that installing a blend water membrane treatment system using the SR-2 or similar membrane is not a feasible option.

The TFCS membrane, however, provided very good TOC rejection, averaging almost 90%. In addition, this membrane, which is a fairly "tight" membrane compared to its competitors, exhibited reasonable overall TDS rejection compared to the SR-2, which would allow for a worthwhile increase in blend ratio without significantly changing the finished water quality which is currently produced at the RWS facility. The average feed TDS of 1323 mg/l was reduced to a permeate TDS of 418 mg/l, about a 70% reduction. Based on these results, it can be concluded that a blend water treatment system using the Koch TFCS, or similar membrane, is worthy of more detailed evaluation as a means of increasing the blend ratio, and the overall production capacity of the treatment plant.

Both membrane types performed well in terms of flux maintenance (Figures 1-4 and 1-8) with virtually no indication of fouling. Given the operating history of the main RO plant this was to be expected. Pressure requirements for the membranes were however quite different, the SR-2 requiring a considerably lower pressure than the TFCS, which is as expected given the higher rejecting capability of the TFCS membrane. The net driving pressure for the SR-2 was fairly constant at around 20 psi for the lower flux at the start of the test, and 25psi for the higher flux at the end. In comparison, the TFCS driving pressure was around 65-68 psi for the whole TFCS test, at an observed flux of 15 gfd.

The protocol that was used to establish the parameters of the membrane test program was modified to accommodate the actual conditions experienced during the test, including the on-site decision to test the TFCS membrane, originally planned for the South Hatteras test only. The TFCS test at Rodanthe was too short to make change of conditions worthwhile, but this test was run at a flux that is considered relatively high for nanofiltration membranes.

Based on these results, it is reasonable to assume that a full scale TFCS-type system to treat the blend water, given the constant temperature and stable raw water quality,

would operate without significant flux decline due to fouling. It should also be noted that the TFCS system, because of the higher rejection of the TDS, would be subject to carbonate scaling. However, this was not observed during what was a fairly short test, indicating that the scale inhibitor used throughout was adequately controlling the scaling potential.

Based on the test results, it is recommended that the feasibility of using a nanofiltration membrane system to pretreat the blend water for both organics reduction and TDS reduction be studied as the second part of the RWS study, and that the low pressure SR-2 membrane type no longer be considered for implementation.

PART 2 SOUTH HATTERAS

SECTION 2-1. INTRODUCTION.

The Dare County Regional Water System operates a 1.4 MGD reverse osmosis (RO) water treatment plant and a 0.6 MGD shallow groundwater ion exchange (IX) and iron removal system to serve the south end of Hatteras Island, and the village of Avon. The plant, located in Frisco on Water Plant Road, takes its RO feed water from four brackish wells, and the feedwater for the IX/filtration system from 19 shallow wells located in an area to the east of the plant known as Buxton Woods. The pilot test that was conducted at this site focused only on treatment of the shallow groundwater. The average water quality data for these shallow wells are shown in Table 1.1 below.

Table 2.1. Average Feed Water Quality

Cation	s, mg/l	Anior	Anions, mg/l				
Calcium	70.0	Bicarbonate	148.0				
Magnesium	26.8	Sulphate	<5.0_				
Sodium	93.0	Chloride	50.0				
Potassium	36.0	Fluoride	0.38				
Strontium	NR	Nitrate	0.01				
Barium	NR	Phosphate	0.38				
Iron	0.98						
Manganese	0.076						
TDS,	mg/l	429.8					
Conductiv	rity, μSms	6	684				
Color	, PCU						
TOC	mg/l	1	14.1				
p.	Н	7	7.25				
Temper		1	15.6				
Silica			1.9				
	, ,						

Current plant operation consists of two RO trains, the permeate from which is blended with the treated shallow groundwater. The original design was planned for adding a third RO train, and increasing the capacity of the shallow groundwater treatment system to bring the build out capacity of the plant to 3.0 MGD. However, the brackish ground has risen in TDS, and additional well sites have proven difficult to find at the required locations. Consequently, the decision was made to explore the possibility of using the third RO train space in the plant for an alternate shallow groundwater treatment system, since it would be almost impossible to increase the capacity of the existing IX/filtration system to the 1.6 MGD needed for the buildout capacity. Since the RO plant produces permeate which is almost completely lacking calcium hardness and bicarbonate alkalinity, an alternate treatment system needs to preserve some of these two components so that the resulting blended finished water has the stability needed to be in

compliance with the Lead and Copper Rule. The candidate process therefore is nanofiltration, which historically has been used, primarily in Florida but also in North Carolina, for the removal of TOC and for partial softening of reasonably hard waters. As can be seen from the table above the shallow groundwater is rich in TOC, and has a total hardness of about 285 mg/l, making it a good candidate water for treatment by nanofiltration.

Nanofiltration membranes are available in a fairly wide range of rejection capability for mono and divalent ions, and the true nanofilters all exhibit very good TOC rejection if the TOC consists of Natural Organic Material (NOM), basically humic and tannic acids typical of groundwater found in heavily vegetated areas, such as Buxton Woods. The objective of the South Hatteras pilot test was therefore to evaluate the rejection capability of a typical "tight" nanofiltration membrane, the Koch TFCS, and to determine the operating characteristics that are important for scale up to a full size train. Of particular interest in this test were flux maintenance and operating pressure.

SECTION 2-2. PILOT PLANT SETUP.

The pilot plant, leased from Koch Membrane Systems, was moved from the RWS site in March, 2007, and set up in the Frisco plant process room. Although the membranes had been changed to the TFCS type for the final few weeks at RWS, it was not necessary to clean the membranes prior to start up at Frisco. The membrane arrangement, simulating a 2:1 array using seven-element vessels, was not changed for the Frisco test, since it was anticipated that a recovery of 80-85%, typical for nanofiltration operations, would be feasible at this site. This array in full scale would permit permeate recovery up to 90% of the feedwater.



Figure 2-1. Frisco Pilot Setup, Showing Back of Unit

The test protocol developed for the Frisco pilot anticipated four segments, each scheduled for three weeks duration. Two tests were designed for natural pH, at flux rates of 13 and 14 gfd, and recoveries of 75% and 80% and two tests were to be conducted at lower pH, at flux rates of 14 and 15 gfd, and at 85% recovery.

The pilot plant was equipped with both acid and scale inhibitor feed systems. A tap on the existing shallow wellwater inlet piping supplied the raw water, and the tests were conducted using one well, so that feedwater variability was kept to a minimum. The

concentrate and permeate were combined after all flow, pressure and conductivity measuring devices, and discharged to the existing RO concentrate disposal piping.

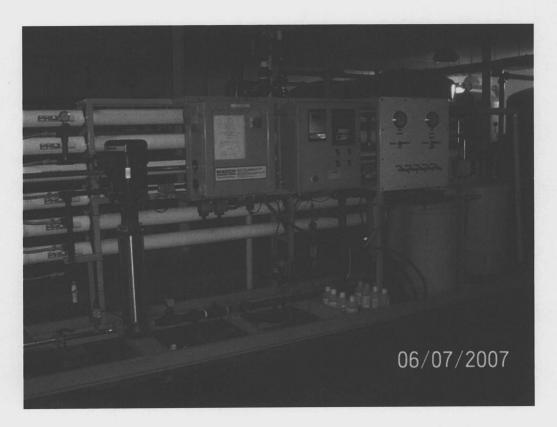


Figure 2-2. Frisco Pilot Setup, Showing Front of Unit

SECTION 2-3. DISCUSSION OF RESULTS.

As stated previously, the primary goals of the Frisco pilot test were to evaluate the feasibility of using nanofiltration (NF) membranes to treat the shallow groundwater for trihalomethanes formation potential (THMFP) and haloacetic acid formation potential (HAAFP), provide partial softening, and reduce iron and manganese. NF has been demonstrated to be a good process choice for this treatment scenario, but one aspect of its performance is that the rejection of iron is typically not as high as RO. This was to be evaluated during the test program. There was also some concern that the physical quality of the shallow wellwater, in terms of turbidity and Silt Density Index (measured as 2.1) may result in frequent cleanings. There was some discussion of the possible need to install a pre-filtration unit, but this was not done during the pilot test, and although as will be seen later there was some flux decline. A periodic flush with raw water at low flow and pressure seemed to be somewhat successful in controlling this flux decline.

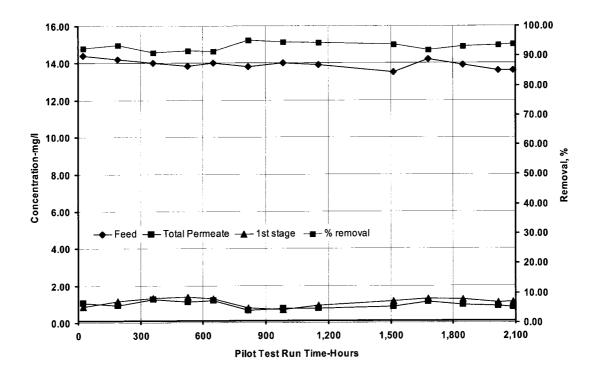


Figure 2-3. TOC Concentrations and Removal.

The TOC values can be seen graphically in Figure 2-3. It can be seen that there was very little difference in the TOC concentration of the permeate from the first stage, and the total permeate. This indicates that the average feed-brine concentration of the TOC may not be the mechanism that drives separation, but rather the sieving capability of the membrane. That is the membrane pore size will permit only a certain fraction of the

TOC to pass through, regardless of the average concentration on the "dirty" side of the membrane. This is different from the separation of ionized solutes, for which average feed-brine concentration determines the amount of passage through the membrane.

Table 2-2 shows the result of the pilot plant operation on permeate quality over the test period. Total run time was approximately 2,100 hours, almost thirteen weeks. It can be seen that the TOC rejection averaged better than 90%, and was reasonably consistent over the entire test period. The total hardness (TH) in the permeate was also very consistent, with an average rejection of approximately 80%. The TDS rejection was a little less, as would be expected, at about 73%.

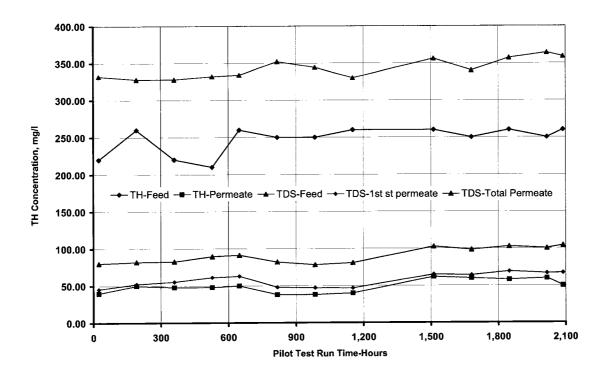


Figure 2-4. Total Hardness and TDS Reduction

It can be seen in Figure 2-4 that the TDS of the first stage permeate is about half the value of the total permeate TDS, confirming the earlier discussion about the different separation mechanisms for TOC and inorganic solutes.

Figure 2-5 shows the feed and permeate values for iron and manganese. These are significant results, since the concentration of these two metals varies considerably from well to well. It will be critical during preliminary design to pay particular attention to this variability, to make sure that the NF permeate has low enough concentrations of iron and manganese so that when blended with RO permeate and IX/filtered shallow groundwater, the secondary MCLs are not exceeded.

Results of Analysis Performed by Dare County Laboratory (condensed to one/week) **Fable 2-2.**

DARE COUNTY CAPE HATTERAS WATER TREATMENT FACILITY Report of Chemical Analysis for CHWP Pilot Project

% removal 91.80 91.00 91.50 94.50 92.00 93.20 93.90 94.70 93.70 93.50 93.60 95.20 Permeate 0.748 0.859 1.140 0.913 1.270 1.140 1.190 0.663 0.769 0.952 0.897 0.834 1.07 10C Feed 1s Stage 0.786 1.280 1.090 1.170 1.320 1.280 0.711 0.916 1.160 1.250 1.120 0.865 1.400 14.40 14.00 13.80 14.00 14.20 13.60 13.60 14.20 13.85 14.00 13.90 13.50 13.90 % Removed 91.53 64.86 88.41 63.83 67.21 69.62 80.00 77.11 73.61 92.65 65.38 86.67 85.92 Manganese %Removed Feed Permeate 0.020 0.012 0.019 0.019 0.005 0.008 0.010 0.008 0.017 0.024 0.005 0.026 0.027 0.083 0.059 0.072 0.068 0.074 0.078 0.060 0.071 0.069 0.047 0.061 0.079 0.060 87.88 76.47 82.08 83.78 83.33 90.11 89.74 82.83 82.18 79.44 84.16 90.32 87.07 <u>10</u> Permeate 0.08 0.19 0.16 0.15 0.18 0.24 0.09 0.18 0.22 0.12 0.03 0.08 0.17 Feed 1.06 1.01 0.99 0.31 1.02 0.48 0.78 1.16 1.1 0.99 1.07 0.9 1.01 Permeate 20.00 20.00 20.00 30.00 30.00 30.00 20.00 20.00 25.00 25.00 20.00 20.00 20.00 Chlorides Feed 1st stage 20.00 20.00 20.00 30.00 15.00 15.00 10.00 20.00 20.00 20.00 20.00 30.00 30.00 50.00 40.00 00.09 50.00 60.00 00.09 50.00 50.00 50.00 00.09 50.00 50.00 00.09 Permeate 102.70 100.50 104.20 80.90 102.80 98.40 80.10 82.00 91.40 82.10 82.90 89.60 78.20 1st Stage TDS 65.10 64.10 68.90 09.99 67.00 45.70 52.50 55.30 61.30 63.00 48.10 47.10 46.90 359.00 332.00 344.00 330.00 356.00 340.00 357.00 332.00 328.00 328.00 334.00 364.00 352.00 Feed Total Hardness (mg/l as CaCO3) 40.00 60.00 58.00 60.00 40.00 48.00 48.00 50.00 38.00 62.00 50.00 50.00 38.00 260.00 250.00 260.00 220.00 260.00 220.00 260.00 260.00 250.00 260.00 210.00 250.00 250.00 1,512 1,848 2,016 1,152 1,680 Hours 2,088 648 816 984 528 192 360 24 5/10/2007 5/31/2007 5/17/2007 4/25/2007 5/24/2007 3/29/2007 4/3/2007 4/18/2007 6/3/2007 3/15/2007 3/22/2007 4/11/200 3/8/2007

93.17 96.0 1.10 13.92 77.45 0.02 0.07 84.57 0.15 0.92 23.08 20.77 53.08 90.45 57.82 342.77 49.38 246.92 Average

Note: Data for 5-3-07 not included. TOC analyzer malfunctioned during this period

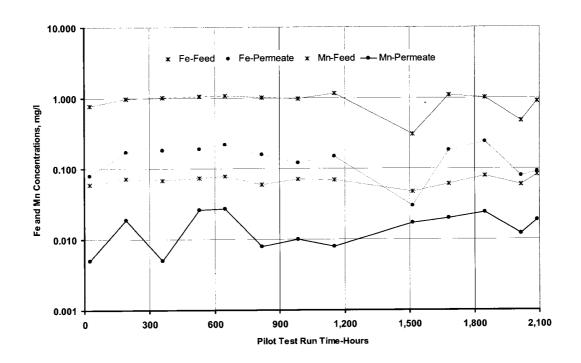


Figure 2-5. Iron and Manganese Feed and Permeate Concentrations

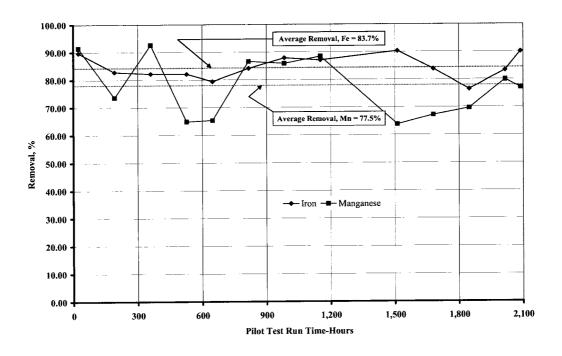


Figure 2-6. Iron and Manganese Removals

Figure 2-6 shows the removal percentages for iron and manganese. It can bee seen from this figure that there is some inconsistency, but generally the iron removal was slightly

higher than that for manganese. The arithmetic average removal for iron was 83.7% and 77.5% for manganese.

From Table 2-2, it can be seen that the average chloride rejection is about 57%, which is a little higher than the 50% expected from earlier projections.

The performance of the pilot in terms of flux maintenance and pressure was normalized using NORMPRO®, the Koch software. Figure 2-7 shows the pressure performance. During the pilot the recovery was changed twice, from 85% to 80% and back to 85%. The observed flux was also changed during the pilot test.

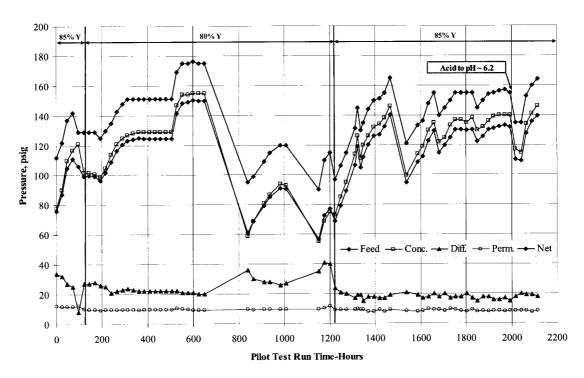


Figure 2-7. Pilot Plant Pressure Profiles

It can be seen in Figure 2-7 that the net driving pressure shows a considerable amount of change over the course of the test. Because the osmotic pressure of the shallow groundwater is very low, the net driving pressure consists primarily of the pressure required to compensate for friction losses in the membrane array, and the pressure required to operate at the selected flux. The fact that the net pressure shows a significant increase over the first six hundred or so hours of operation is a strong indication that some fouling and or scaling is taking place. However, when considering the differential pressure, there is little or no indication that a build-up of any kind of material is taking place within the membranes. At about six hundred hours, a flushing program was instituted, which showed an immediate reduction in net pressure. This flushing regime was continued for the rest of the test. In spite of the flush however, the net pressure again starts to increase when the recovery was increased back to 85% recovery at about

twelve hundred hours. It is interesting that when a short test with feed acidification took place, the net pressure went down significantly, only to increase again when acidification was terminated. Given the high recovery, relatively low exit concentrate velocity, and the predominance of calcium and bicarbonate in the water, it can be hypothesized that there was some carbonate scaling taking place, partially controlled at 80% recovery by the combination of scale inhibitor addition, flushing, and higher concentrate exit velocity, but becoming more pronounced as the recovery increased and the concentrate velocity declined.

Figure 2-8 shows an increase in recorded feedwater temperature at about 1150 hours into the test. The reason for this is not known, but the ambient temperature was increasing during this time, and the higher temperature may have caused an increase in the water temperature from the shallow wells.

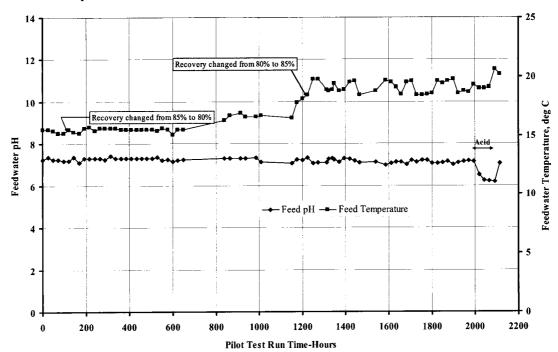


Figure 2-8. Temperature and pH.

As mentioned earlier, the temperature showed some unexpected variability during the test, averaging about 17 degrees C during the first part of the test, and about 19 degrees C during the second part of the test, with peaks of close to 20 degrees C. Why this change took place is unknown, but it is possible that with the increasing ambient temperature from the start to the conclusion of the test, sufficient heat gain took place within the building where the ductile iron piping is exposed to cause this increase. It is interesting to note that when looking at the temperature data and the pressure data (Figure 2-7) together, the feed pressure increased with increasing temperature, which is the opposite of what would be expected. This is further indication that some fouling or scaling was taking place in the membrane causing the pressure increase.

The pH remained stable for the bulk of the test run time, being adjusted with acid for a short run at the end. Again comparing the net pressure with the pH change, there is a distinct reduction in net pressure when the acidification started, and a return to a higher pressure when acidification was terminated. This is also an indication that possible carbonate scaling was occurring at the higher recovery.

Figure 2.9 shows the system flux profiles. The pilot was operated basically at two fluxes, 13gfd and 15gfd.

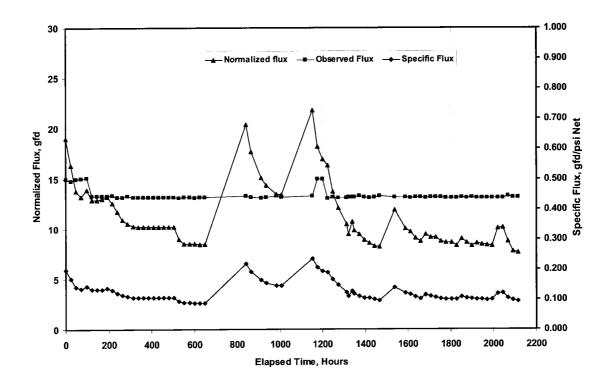


Figure 2-9. Flux Profiles

Comparison of the flux trends with the pressure trends shows definite correlation in the mid point of the test, where the pressure data show two distinct dips, and the flux data show two distinct peaks. This correlation cannot be explained by any normal operating event, although some of the pressure dip was undoubtedly caused by the flushing regime. If this data is ignored, however, both the specific flux, and the normalized flux demonstrate a slight decline in value over the course of the test period. If the pressure trend is compared to the flux profile, it would appear that the unit performed better at the lower flux, even though operation at 15 gfd was limited only to a few days.

SECTION 2-4. CONCLUSIONS AND RECOMMENDATIONS.

From observation of the test results for the TFCS membrane, membrane provided very good TOC rejection, averaging over 90%, slightly better than the results at RWS. In addition, this membrane, which is a fairly "tight" membrane compared to its competitors, exhibited reasonably high overall hardness and TDS rejection. The average feed TDS of 350 mg/l was reduced to a permeate TDS of 90-100 mg/l, about a 70% reduction. This is very comparable to the RWS result for TDS rejection, even though the water composition is quite different. Based on these results, it can be concluded that a shallow groundwater treatment system using the Koch TFCS or similar membrane, is capable of producing a permeate that can be easily blended with the RO permeate, and IX/filtered water to produce an acceptable finished water quality.

There was a significant flux decline during the course of the pilot test. Whether or not this was caused by fouling by the organics, partially oxidized iron and manganese, carbonate scaling, or a combination of circumstances could not be determined. What can be deduced from the test data is that acidification reversed the flux decline for the short period that it was in effect. It is also reasonable to assume that at least part of the fouling/scaling problems experienced in this test were due to the extremely low concentrate flows that were prevalent throughout the test.

The protocol that was used to establish the parameters of the membrane test program was modified to accommodate the actual conditions experienced during the test. Acid was used at this site for only a short period of time, so its influence on the performance of the membranes could not be fully evaluated. However, it appeared from the data recorded that the addition of acid had a fairly significant effect on the rate of flux decline, which is a fact that must be considered during full-scale design.

Based on these results, it is reasonable to assume that for a full scale nanofiltration system to treat the shallow groundwater water, a design based on lower flux, higher concentrate exit velocity, and acidification would operate satisfactorily at 85% recovery. Prefiltration may very well improve the cleaning frequency, but since testing was not possible during the nanofiltration pilot test, this cannot be stated with certainty.

Based on the test results, it is recommended that the feasibility of using a nanofiltration membrane system to treat the shallow groundwater from the Buxton Woods wellfield for both organics reduction and hardness reduction be studied as the second part of the South Hatteras study. The design will be based on 85% recovery and an average flux of 12 gfd.

It is also strongly recommended that the filtration system discussed earlier in this program, but not implemented during the pilot test, be acquired and tested, with particular emphasis on turbidity, iron, manganese and SDI reduction.

APPENDIX A PILOT PLANT PROTOCOL

DARE COUNTY REGIONAL WATER SYSTEM

COUNTY OF DARE, NORTH CAROLINA

RWS AND SOUTH HATTERAS WTPs

Nanofiltration (NF) Pilot Test Plan and Protocol



August 25, 2006

Prepared by

ROSTEK ASSOCIATES, INC.

TAMPA, FLORIDA.

DARE COUNTY REGIONAL WATER SYSTEM COUNTY OF DARE, NORTH CAROLINA

RWS AND SOUTH HATTERAS WTPs

Nanofiltration (NF) Pilot Test Plan and Protocol

CERTIFICATION

I hereby certify that this Document has been prepared by me, or under my direct supervision, for the County of Dare Water Department

Signed and Sealed this 19th day of September, 2006

by:			
•			

Ian C. Watson, PE

NC License #12532 Expires December 31st, 2006

RWS AND SOUTH HATTERAS WTPs

Nanofiltration (NF) Pilot Test Plan and Protocol

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1.0 Introduction

A Nanofiltration (NF) Pilot Study at the RWS and Frisco Water Treatment Plants (WTPs) will be conducted to evaluate the NF process for increasing the capacity of the two existing water treatment plants, while minimizing the cost of infrastructure improvements associated with expansion. The results of the pilot study, if applicable, will contribute to establishing the NF system operating parameters, configuration and criteria to be used for the design of plant modifications at both locations.

NF has traditionally been used to remove the dissolved salts that cause hardness in water, and for the reduction/removal of the organic precursors of trihalomethanes (THMs) and halo-acetic acids (HAAs) from groundwater. NF has been extensively applied to shallow ground waters in the state of Florida for this purpose, with good success. The largest membrane plant in Florida, located at Boca Raton, is of this type and has a capacity of 40.0 MGD.

The RWS pilot testing is being conducted primarily for organics removal from the blend water. The volume of raw water that can currently be blended with RO permeate is limited by the resultant THM and HAA formation potential in the blended finished water. By reducing the organics from the blend water prior to blending and chlorination, the blend volume can be increased significantly. Preliminary calculations indicate that the capacity of the existing plant can be increased from the current 1.0 MGD to about 1.2 MGD with this modification.

The Frisco pilot test will be conducted to demonstrate the feasibility of using NF with the shallow groundwater currently treated by ion exchange and filtration for softening and organics removal. If successful, it has been proposed that a 0.7 MGD train be installed adjacent to the two existing RO trains, in parallel with the existing shallow well treatment system. The finished water will then be a blend of RO and NF permeate, and the treated shallow groundwater.

Pilot testing will be conducted for approximately 90 days each at location. The RWS plant currently receives low TDS brackish water, rich in sodium bicarbonate, form two existing wells. The Frisco plant receives shallow groundwater from nineteen existing wells, is high in total hardness, and contains varying amounts of iron and TOC.

This Test Plan summarizes the pilot test program, including testing objectives, description of the test unit and the two different membrane types that will be tested, the Koch Membrane Systems SR-2 at RWS, and the Koch Membrane Systems TFCS at Frisco, an outline of the program sequence, and the sampling and monitoring plan.

2.0 Study Objectives

The objectives for the pilot study include the following:

- Achieve the treatment goals established for the RWS and Frisco sites.
- Combine blend water treatment and the alternatives for increasing the capacity of the existing RO trains at the RWS WTP,
- Accumulate data for use in developing design and operating parameters for full-scale expansion of the Frisco WTP.

2.1 Source Water Quality

The pilot systems will be supplied with well water from existing wells. The incoming feedwater piping will be tapped at a convenient location at both locations. The water quality from these wells based on a recent analysis is summarized in Table 1.

Table 1. Source Water Quality

Table 1. Source	/ Trutter Quarr	
Parameters	RWS	S. Hatteras
Alkalinity (mg/L as CaCO ₃)	350	320
Bicarbonate, mg/l	427	390
Barium (mg/L)		
Calcium (mg/L)	9.6	70
Chloride (mg/L)	460	70
Conductivity (mhos/cm)	4230	728
Copper (mg/L)	<0.07	<0.07
Fluoride (mg/L)	1.88	0.4
Iron (mg/L)	0.06	0.44
Manganese (mg/l)	0.3	0.08
Magnesium (mg/L)	21.4	26.8
Phosphate (mg/L)	0.5	0.4
Potassium (mg/L)	27.5	36
Silica (mg/L)	15.3	1.9
Sodium (mg/L)	269	186
Strontium (mg/L)		
Sulfate (mg/L)	5.7	1.0
Sulfide (mg/L as H₂S)	0	0
Color	9	42
TDS (mg/l)	2540	420
pH (s.u.)	7.3	7.2
Temperature (°F)	70	70
Hardness (mg/l, as CaCO3)	112	290
Turbidity, NTU	0.44	0.23

Water quality sampling performed during the pilot testing will be used to enhance this data and fill any data gaps required for establishing design criteria in the Preliminary Design Report (PDR).

2.2 Operational Parameters

The target operational parameters for this study are:

- 1. RWS. TOC removal, membrane flux rate and system recovery. The primary purpose of this pilot program is to reduce/remove the TOC in the blend water, so that the blend ratio can be increased without violating the Drinking Water Standard for THMs and HAAs. The tset will also examine flux rate and the potential impacts to treatment performance and potential limitations on other process components. In addition to flux, the test will examine recovery, so that the best solution is found for full scale design in terms of minimizing discharges without compromising permeate quality.
- 2. Hatteras. The main objective of the Hatteras pilot is to examine hardness, TOC, and iron rejection. In addition, the testing will examine flux rates for the purpose of minimizing membrane surface area while minimizing potential iron fouling. Since the feed water is coming from a limited resource, it is in the best interests of the test to establish the maximum safe recovery.

The goal of this pilot study is to produce a set of operating conditions that will economically and reliably produce a potable drinking water that meets all current and future drinking water regulations, and to establish the guidelines for full scale design of the two plant expansions.

3.0 Pilot Plant Treatment Process and Equipment Description

NF pilot test systems will be leased from Koch Membrane Systems (Wilmington, MA) and temporarily installed first at the RWS site, and then moved to the Frisco site. The NF pilots will be evaluated using unchlorinated well water, supplied as a composite of water from existing wells. Since the units will be drawing feed water from the two existing feed water systems, it is anticipated that the pilot operation will not be continuous, particularly at the RWS site. However, it would be advantageous for the pilot units to operate as consistently as possible. Therefore it is suggested that the pilot testing and the normal plant operation be integrated as much as possible to provide the maximum run time hours without causing undue inconvenience to the two plants' operating staff. It is suggested that prior to starting the test, a schedule of operation be worked out which will both meet the water production necessary to meet demand, and provide the best possible operating window for the pilots.

3.1 NF Membrane Treatment

The NF pilot system will be operated as a two-stage system. Concentrate recycle is not installed on the leased units. Recovery will therefore be limited to about 80% maximum. The County may wish to consider piping a recycle system, so that higher recovery can be examined. Initial operation at both test sites will be 75%. The pilot unit is equipped with interstage boost pumping capability, which can be bypassed if desired. A boost pressure protocol will be developed for each site when installation and startup occurs.

Each pilot system consists of a high pressure pump feeding an array of four-inch diameter pressure vessels. Each vessel is capable of holding three, four-inch diameter elements. Each pilot system will comprise of 18, 4-inch diameter, 40-inch long (4040) spiral-wound NF elements. The NF pilot systems are configured to a 2-2-1-1 tapered array system as shown in the attached P&ID. There will be 12 elements in Stage 1 and 6 elements in stage 2. The NF elements will be thin-film composite, polyamide membranes as described previously. The tapered, two-stage NF pilots systems will allow recoveries up to 80% without concentrate recycle.

Concentrate flow can be manually adjusted to maintain a flow set point (and recovery set point) using the concentrate control valve. Permeate flow is manually adjusted to a set point by adjusting the feedwater valve.

The NF feed water flow range for each pilot system will be in the range of 15 to 20 gpm. The NF permeate and NF brine will be combined and discharged. The actual disposition of the waste water is to be determined.

The NF pilot system will be equipped will sample taps to sample NF feed, interstage, permeate and concentrate streams. Field measurements will be recorded to asses the performance of the pilot system during operation (discussed in Section 5.0 below). For example, pressure gauges will be available to measure headloss across the NF membranes. When the headloss becomes excessive, the NF productivity would decline, necessitating cleaning of the membranes. The NF pilot system is supplied with a cleaning skid to clean the NF membranes if and when that becomes necessary.

The pilot unit P&ID is attached for reference.

3.2 NF Pretreatment

Pretreatment will consist of pH adjustment (optional), scale inhibitor addition and cartridge filtration.

The NF feed water will be filtered using 5 μ m cartridge filters. The cartridge filters will remove fine particles that may foul the NF membranes. The NF pilot systems will have the ability to add acid (sulfuric acid) and scale inhibitor. The addition of acid and antiscalant to the NF feed water assists in controlling membrane scaling from sparingly soluble salts (e.g. calcium carbonate, strontium sulfate)

Scale inhibitor and acid addition points are located upstream of the cartridge filter. Scale inhibitor addition equipment will include a day tank and chemical metering pump. Dose adjustment will be manual as the NF operation is continuous and will be maintained to flow set points. The initial dose is anticipated to be 3 mg/l.

4.0 Pilot Test Program

The pilot testing program is designed to facilitate the test objectives as specified in Section 2.0.

4.1 Operating Plan

Two types of NF membranes will be evaluated for permeate water quality and feed pressure at the two sites. At RWS, the membrane will be Koch Membrane Systems SR-2 membrane, designed for high organics rejection but fairly low inorganics rejection. At the Frisco site, the membrane will be Koch Membrane Systems TFCS membrane, which has good organics rejection, and somewhat higher inorganics rejection than the SR-2 membrane.

During the pilot test two flux rates and two recovery rates will be evaluated for each pilot system.

The baseline condition during the pilot testing will be established using a flux of 13 GFD, a permeate recovery of 75%, no pH adjustment of the NF feedwater, and an antiscalant dose of 3 mg/L. Other combinations of conditions will be tested during the program.

NF Operating Ranges

	perating range	
	RWS	Frisco
Membrane Element Model	SR-2	TFCS
Total quantity of elements	21	21
Array Staging (ratio of vessels in each stage)	2:2:1:1	2:2:1:1
Nominal Membrane Area (ft²)	80	80
Permeate Flow Range (gpm)	15-	17
Flux (GFD)	13-	16
NF Recovery	75-8	30
NF Feed Water pH	7.3 to 6.8	7.3-6.5
SI Dose (mg/l)	1-0	3

Once the system has shown a stable performance at the baseline condition, the flux and recovery rates will be modified to evaluate optimal system performance. Four combinations of flux and recovery rates will be evaluated over the duration of the pilot testing. The pilot system will be run in a constant flux and variable pressure mode for a minimum of two weeks before altering the flux and recovery combination. The two charts following identify the ranges of operating parameters that will be evaluated during the pilot testing and the preliminary schedule for modifying the operating parameters.

NF Operating Parameters

	III Opere	ttillig i alai	1101010	
	RWS	Frisco	Duration	pH Adj.
Membrane Element Model	SR-2	TFCS		
Initial: Flux (GFD) / NF Recovery (%)	13	3/75	3-weeks	No pH Adjustment
Step 1: Flux (GFD) / NF Recovery (%)	14	4/80	3 weeks	No pH Adjustment
Step 2: Flux (GFD) / NF Recovery (%)	14	4/85	3 weeks	pH 6.8
Step 3: Flux (GFD) / NF Recovery (%)	15	5/85	3 weeks	pH 6.5

Particularly at the Frisco site, iron fouling of the membranes is possible. At both sites, monitoring the headloss across the NF membranes will be a critical operator function to indicate if a membrane cleaning is necessary. The NF membranes will be cleaned when one of the following conditions occur:

- Differential pressure (feed pressure minus reject pressure) increases from start-up values by 15-20%, per stage.
- Normalized permeate flow decreases by 15-20%, or feed pressure increases by 15-20%.

The NF membrane cleaning could involve the following steps

- Recirculate 2% citric acid solution of pH 4 for 2 hours. This low pH cleaning will remove iron and some inorganic scale present on the NF membranes.
- Flush water through the NF system until the cleaning solution is completely flushed out.
- Re-circulate 0.1% caustic solution of pH 11.5 for 2 hours. This high pH cleaning solution will remove organic foulants, colloidal and biological materials.
- Flush water through the NF system until the cleaning solution is completely flushed out.

Also, when the headloss across the cartridge filters reaches 15 psi greater than the clean condition, the cartridge filters will be replaced with new filters

At the engineer's discretion the NF membrane may be replaced by an alternate NF membrane.

A daily operating log will be maintained for the duration of the pilot study. An operating log book will be kept on site at both locations to document any changes made to the pilot units and/or unexpected circumstances (pilot unit shut down/restart).

Start-up data has been derived for each site based upon projections made with Koch Membrane Systems software, "ROPRO". This is contained in the following table:

Predicted Start-up Conditions

	realc	tea St	art-up	COIL	iluons			
Parameter		RV	VS			Fri	sco	
Test No.	1	2	3	4	1	2	3	3
Flux, gfd	13	14	14	15	13	14	14	15
Recovery, %	75	80	85	85	75	80	85	85
Feed P, psig		40	-50		95	99	99	103
Permeate P, psig		1	2			1	0	
Concentrate P, psig		25	-30		54	62	68	70
Feed Q, gpm		2	0		23	23	22	23
Permeate Q, gpm	15	16	16	17	17.3	18.4	18.7	19.6
Concentrate Q, gpm	5	4	4	3	5.7	4.6	3.3	3.4
Feed pH	7.2	7.2	6.8	6.8	7.2	7.2	6.8	6.8
Permeate TDS ⁽¹⁾ , mg/l	1000	1100	1100	1200	164.8	170.5	200.7	193.3

⁽¹⁾ Permeate TDS for the SR-2 test at RWS is based on empiric data derived from experiments conducted with a low TDS feedwater. The ion passage will most likely be different when operating with the RWS feedwater.

4.2 Sampling and Monitoring

The sampling plan associated with the pilot test program is designed to facilitate the test objectives as specified in Section 2.0. The pilot study consists of field measurements and lab analyses. Field measurements will be conducted on site with hand-held analyzers. Lab samples will be collected and sent to the appropriate contract lab for analysis.

To ensure the accuracy of all collected data, consistent sampling methods with respect to location, timing, and technique must be maintained. Additionally, for samples analyzed at off-site laboratories, consistency in sample preservation, packaging and shipping is required. Membrane operational parameters such as

flow and pressure will be recorded at the time of sampling. All analyses will be performed according to <u>Standard Methods</u>.

The sampling locations (SL) for the pilot systems are identified on the P&ID.

4.2.1 Field Measurements

The field parameters and analyzers associated with each measurement are shown below.

Parameter	Raw	Pretreated
Temperature	$\sqrt{}$	
рН		$\sqrt{}$
TDS		√
Conductivity	$\sqrt{}$	V
Silt Density Index		√
Turbidity	√	V

Flow rate and pressure will also be recorded during the study. Flow rate measurements will be recorded for NF permeate, and NF concentrate from FE-1 and FE-2 (P&ID). Pressure will be recorded from the following locations:

- Cartridge filter inlet
- Cartridge filter outlet
- NF Feed
- Interstage (between stages 1 and 2)
- NF Permeate
- NF Concentrate

Chemical dosing tank levels and pump flow rates will be checked on a daily basis to ensure that the proper chemical dose is applied throughout the pilot study.

To ensure the accuracy of the field measurements any hand-held analyzers will be calibrated at the beginning of the study and as required per the manufacturer's recommendations throughout the study.

4.2.2 Lab Analyses

Table 2 shows the lab analysis parameters, frequency of sampling, and total number of samples for each pilot unit. The number of samples in Table 2 assumes a 12-week pilot study duration, at each site.

NF membrane integrity is monitored by on-line conductivity measurement of NF permeate. Additionally, conductivity profiles will be performed on the individual NF vessel permeate streams weekly.

Table 2. Lab analyses and frequency of sampling

Parameter	Sampling Frequency	No. o	of Sample Pilot Site		Test Location
		Feed	l'stage	Perm	
Total Hardness (mg/L as CaCO3)	1/week	12		12	RWS
TDS (mg/L)	1/week	12	12	12	NRO
TOC (mg/L)	1/week	12	12	12	Frisco
HPC (CFU/mL)	1/week	12			NRO
Alkalinity (mg/L as CaCO₃)	1/week	12		12	RWS
Calcium (Ca ²⁺)	1/week	12		12	RWS
Magnesium (Mg ²⁺)	1/week	12		12	RWS
Sodium (Na ⁺)	2/pilot	12		12	RWS
Potassium (K ⁺)	2/pilot	12		12	RWS
Barium (Ba ²⁺)	2/pilot	2			Outside lab
Strontium (Sr ²⁺)	2/pilot	2			Outside lab
Iron: total (Fe ²⁺) ⁽¹⁾	1/week	12		12	RWS
Iron: dissolved (Fe ²⁺) ⁽¹⁾	1/week	12			RWS
Manganese (Mn ²⁺) ⁽²⁾	1/week	12		12	RWS
Bicarbonate (HCO ₃)	1/week	Fr	om Alkali	nity	RWS
Sulfate (SO ₄ ²⁻)	2/pilot	2		2	RWS
Chloride (Cl ⁻)	1/week	12	12	12	RWS/Frisco
Fluoride (FI ⁻) ⁽³⁾	1/week	12		12	RWS
Phosphate (PO ₄ ³⁻)	2/pilot	2		2	RWS
Silica: total (SiO ₂) ⁽⁴⁾	2/pilot	2		2	Outside lab
Silica: reactive (SiO ₂) ⁽⁴⁾	2/pilot	2		2	Outside lab

⁽¹⁾ (2) Required for Frisco only. RWS should be done 2 times during pilot

4.3 **Data Handling Protocol**

Successful implementation of the performance testing will require coordination between all testing participants. All performance testing activities will be thoroughly documented. Documentation will include field logbooks, photographs, data sheets, electronic databases and chain-of-custody forms.

Required for Frisco only. RWS should be done 2 times during pilot

Required for Frisco only. RWS should be done 2 times during pilot (3)

Silica testing for Frisco should be done more frequently, unless the well combinations have (4) consistent silica

Original field sheets and chain-of-custody forms will accompany all samples shipped to the analytical laboratory. Copies of field sheets and chain-of-custody forms for all samples will be maintained in the project files. The data management system used in the pilot testing program will involve the use of computer spreadsheets and manual recording of operational parameters for the membrane equipment on a daily basis.

Daily measurements of all values will be recorded on specially-prepared data log sheets, which is attached for reference. An operating logbook maintained by the operator will include a record of events (equipment starts, stops, maintenance, and instrument calibrations) and description of any problems or issues. Photocopies will be made of each data-log and operating logbook page. The original sheets will be stored on-site; one photocopy will be forwarded to the engineer (RosTek Associates, Inc) at least once per week during each testing phase, to be placed in the project file. This protocol will not only facilitate referencing the original data, but offer protection of the original record of results.

4.4 Responsibilities

The management of the sampling and resulting data will involve a great deal of coordination. Some analyses will be conducted on-site at the pilot plants, and at the appropriate Dare County Water System labs, while some samples must be collected, preserved and shipped to an off-site laboratory.

This Pilot Testing Program is under the management of Dare County Water Department and RosTek Associates, Inc. Dare County has the overall responsibility of managing day-to-day coordination of the sample activities, establishing and communicating the sample schedule, and maintaining the operating data logs and logbooks. Maintenance of the project database and analysis of the operating data will be the responsibility of RosTek Associates, Inc.

5.0 Performance Evaluation

The following calculated parameters, together with the data collection described in Section 4.2, will be used for evaluation of performance of the membrane systems.

- Specific Flux (GFD/psi)
- Normalized Feed Pressure (psi)
- Normalized Differential Pressure (psi)
- Normalized Permeate Conductivity (µmhos/cm)

6.0 Reporting

At the conclusion of the testing, RosTek Associates, Inc will compile the entire data set and prepare a final report. The report will summarize the testing results, including an evaluation of each membrane's performance in terms of the test program goals. The data will be used to prepare a preliminary design report for each of the two WTPs.

7.0 Quality Assurance/Quality Control

Quality assurance and quality control of the operation of the membrane equipment and the measured water quality parameters will be maintained during the Pilot Testing Program.

When specific items of equipment or instruments are used, the objective is to maintain the operation of the equipment or instruments within the ranges specified by the manufacturer or by Standard Methods¹. Maintenance of strict QA/QC procedures is important, in that if a question arises when analyzing or interpreting data collected for a given experiment, it will be possible to verify exact conditions at the time of testing.

Equipment flow rates and associated signals will be documented and recorded on a routine basis. A routine daily walk through during testing should be conducted to verify that each piece of equipment or instrumentation is operating properly. Particular care will be taken to confirm that any chemicals are being fed at the defined flow rate into a flow stream that is operating at the expected flow rate, such that the chemical concentrations are correct. This will be accomplished through chemical drawdown measurements. In-line monitoring equipment such as flow meters, etc. will be checked to confirm that the readout matches with the

actual measurement (i.e. flow rate) and that the signal being recorded is correct. Flow measurement accuracy will be confirmed twice during each test program by stopwatch-and-bucket techniques. The accuracy of some on-line water quality instruments will be verified monthly by comparison to grab sample results.

<u>Reference:</u> American Public Health Association, American Water Works Association, Water Environment Federation. <u>Standard Methods for the Examination of Water and Waste water. Current Edition.</u>

APPENDIX B MEMBRANE DATA SHEETS



FLUID SYSTEMS® TFC® - SR®2 4" ELEMENTS

Low Pressure, Selective Rejection Elements

PRODUCT DESCRIPTION

Membrane Chemistry:

Proprietary TFC® membrane

Membrane Type:

TFC®-SR®2 membrane

Construction:

Spiral wound with fiberglass outerwrap

Applications:

Separation of higher molecular weight components (>300-400

dalton) and multivalent ions from solution

Feed spacer thickness:

31 mil (0.8 mm)

^{*} Consult KMS Process Technology for specific applications

SPECIFICATIONS	Part Number	Model	Perme	ate Flow	Rejec	ction %	Membra	ne Area
			gpd	(m³/d)	Chloride	Hardness	ft ²	(m²)
	8472000	4720 SR®2-N1	2,400	(9.1)	10-30*	97**	79	(7.3)

Test Conditions: 2,000 mg/l NaCl solution at 75 psi (518 kPa) applied pressure (50 psi (345 kPa) net pressure), 15% recovery (20% recovery for Magnum® elements), 77°F (25°C) and pH 7.5.

RECOMMENDED OPERATING LIMITS*

Typical operating pressure:

Maximum operating pressure:

Maximum operating temperature:

Maximum cleaning temperature: Maximum continuous free chlorine:

pH range – continuous operation:

pH range - short term cleaning:

Maximum differential pressure per element:

Maximum differential pressure per vessel:

Maximum feed turbidity:

Maximum feed SDI (15 minute):

50 - 100 psi (345 - 690 kPa)

350 psi (2,410 kPa)

113°F (45°C)

113°F (45°C)

<0.1 mg/l

4 – 9

2.5 - 9

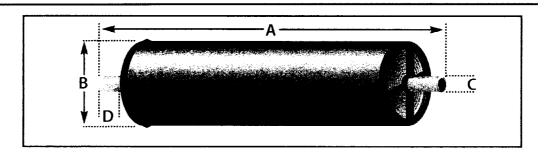
10 psi (69 kPa)

60 psi (414 kPa)

1 NTU

5

PRODUCT DIMENSIONS



Model

4720 SR®2-N1

inches (mm) 40 (1,016)

inches (mm) 4 (101.6)

inches (mm) 0.75 (19.0)

n inches (mm) 1.0 (25.4)

Weight 10 (4.5)

Part Numbers lbs (kg) Interconnector O-ring Brine Seal 0035458 0035702 0035267

Test Conditions: 2,000 mg/l MgSO₄ in deionized water at 55 psi (380 kPa) applied pressure (50 psi (345 kPa) net pressure), 15% recovery (20% recovery for Magnum® elements), 77°F (25°C) and pH 7.5.

Performance:

Performance specifications shown on the front side of this document are nominal values. Individual element permeate flows may vary +20/-15% from the values shown. Minimum hardness rejection is 92% at the conditions shown.

Selective Rejection (SR®2) nanofiltration membrane performance is highly dependent on water chemistry, temperature, pH and solution concentration. Performance can only be accurately known through pilot study. KMS strongly recommends that the appropriate pilot studies are conducted to determine suitability for a given application.

System operating data should be normalized and key performance parameters tracked using KMS' NORMPRO® software.

Operating Limits:

- Operating Pressure: Maximum operating pressure is 350 psi (2,410 kPa). Typical operating pressure for TFC®-SR2 systems is in the range of 50-100 psi (345-690 kPa). Actual operating pressure is dependent upon system flux rate (appropriate for feed source) as well as feed salinity, recovery and temperature conditions.
- Permeate Pressure: Permeate pressure should not exceed feed-concentrate pressure by more than 5 psi (34 kPa) at any time (on-line, off-line and during transition).
- Differential Pressure: Maximum differential pressure limits are 10 psi (69 kPa) for a 40" (1,016 mm) long element. Maximum differential pressure for any length pressure vessel is 60 psi (414 kPa).
- Temperature: Maximum operating temperature is 113°F (45°C). Maximum cleaning temperature is 113°F (45°C).
- pH: Recommended range for continuous operation is pH
 4-9. Allowable range for short term cleaning is pH 2.5-9.
- Turbidity and SDI: Maximum feed turbidity is 1 NTU.
 Maximum feed Silt Density Index (SDI) is 5.0 (15 minute test). Experience has shown that feedwater with turbidity greater than 0.2 NTU generally results in frequent cleanings.

Recovery: Maximum recovery is site and application specific. In general, single element recovery is approximately 15% for 40" (1,016 mm) long elements. Recovery limits should be determined using KMS' ROPRO program.

Chemical Tolerance:

- Chlorine: Intentional exposure of TFC-SR2 membrane to free chlorine or other oxidizing agents such as permanganate, ozone, bromine and iodine is not recommended. TFC-SR2 membrane has a free chlorine tolerance of approximately 1,000 ppm-hours based on testing at 77°F (25°C), pH 8. This tolerance may be significantly reduced if catalyzing metals such as iron are present or if the pH and/or temperature are different. Sodium metabisulfite (without catalysts such as cobalt) is the preferred reducing agent. TFC-SR2 membrane has a chloramine tolerance of approximately 60,000 ppm-hours in the absence of free chlorine based on testing at 77°F (25°C), pH 8.
- Cationic (Positively Charged) Polymers and Surfactants: TFC-SR2 membrane may be irreversibly fouled if exposed to cationic (positively charged) polymers or surfactants. Exposure to these chemicals during operation or cleaning is not recommended.

Lubricants:

For element loading, use only approved silicone lubricant, water, or glycerin to lubricate O-rings and brine seals. The use of petroleum based lubricants or vegetable based oils may damage the element and void the warranty.

Service and Ongoing Technical Support:

KMS has an experienced staff of professionals available to assist endusers, and OEM's for optimization of existing systems and support with the development of new applications. Along with the availability of supplemental technical bulletins, KMS also offers a complete line of KOCHTREAT® and KOCHKLEEN® RO pretreatment and maintenance chemicals.

The information contained in this publication is believed to be accurate and reliable, but is not to be construed as implying any warranty or guarantee of performance. We assume no responsibility, obligation or liability for results obtained or damages incurred through the application of the information contained herein. Refer to Standard Terms and Conditions of Sale and Performance Warranty documentation for additional information.

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FLUID SYSTEMS® TFC® - S 4" ELEMENT

Softening, Low Pressure RO Element

PRODUCT DESCRIPTION

Membrane Chemistry:

Proprietary TFC polyamide

Membrane Type:

TFC-S membrane

Construction:

Spiral wound with fiberglass outerwrap

Applications:

Municipal water treatment when softening and THMFP reduction

are the main objectives

SPECIFICATIONS

Part Numbers

8492000

Model

4920 S

Permeate Flow

Rejection %
Chloride Total Hardness MgSO₄

Membrane Area

gpd (m³/d) 2,180 (8.25)

90*

98.5*

ft² (m²) 85 (7.9)

 Test Conditions: mixed feed with 700 mg/l TDS of which at least 45% is monovalent, at 80 psi (552 kPa), applied pressure, 15% recovery, 77°F (25°C) and pH 7.5.

** Test Conditions: 1,000 mg/l MgSO₄ in deionized water, at 80 psi (550 kPa) applied pressure, 15% recovery, 77°F (25°C) and pH 7.5

OPERATING & DESIGN INFORMATION Typical operating pressure:

Maximum operating pressure:

Maximum operating temperature:

Maximum cleaning temperature:

Maximum continuous free chlorine:

Allowable pH – continuous operation:

Allowable pH – short term cleaning:

Maximum differential pressure per element:

Maximum differential pressure per vessel:

Maximum feed turbidity:

Maximum feed SDI (15 minute):

Feed spacer thickness:

80 psi (552 kPa)

350 psi (2,410 kPa)

113°F (45°C)

113°F (45°C)

<0.1 mg/l

4 – 11

2.5 – 11

40 -- -: /00 !-D

10 psi (69 kPa)

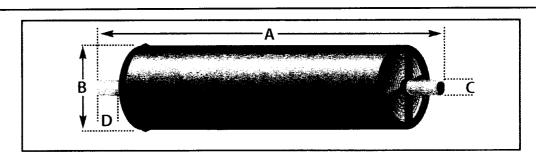
60 psi (414 kPa)

1 NTU

5

28 mil (0.71 mm)

PRODUCT DIMENSIONS AND WEIGHT



Model 4920 S

inches (mm) 40 (1,016) B inches (mm) 4 (101.6)

C inches (mm) 0.75 (19.0) D inches (mm) 1.0 (25.4) Weight lbs (kg) 10 (4.5)

Part Numbers
Interconnector O-ring Brine Seal
0035267 0035458 0035702

Performance:

Performance specifications shown on the front side of this document are nominal values. Individual element permeate flows may vary +20/-15% from the values shown. Minimum chloride ion rejection is 85%, and minimum total hardness rejection is 94% at the mixed feed conditions shown. Minimum MgSO₄ rejection is 95% at the MgSO₄ conditions shown.

System performance should be predicted using KMS' ROPRO® design software. Element performance is based on the nominal values shown.

System operating data should be normalized and key performance parameters tracked using KMS' NORMPRO® software.

Operating Limits:

- Operating Pressure: Maximum operating pressure is 350 psi (2,410 kPa). Typical operating pressure for TFC-S systems is in the range of 80 psi (552 kPa). Actual operating pressure is dependent upon system flux rate (appropriate for feed source) as well as feed salinity, recovery and temperature conditions.
- Permeate Pressure: Permeate pressure should not exceed feed-concentrate pressure by more than 5 psi (34 kPa) at any time (on-line, off-line and during transition).
- Differential Pressure: Maximum differential pressure is 10 psi (69 kPa) for a 40" (1,016 mm) long element. Maximum differential pressure for any length pressure vessel is 60 psi (414 kPa).
- **Temperature**: Maximum operating temperature is 113°F (45°C). Maximum cleaning temperature is 113°F (45°C).
- **pH**: Allowable range for continuous operation is pH 4-11. Allowable range for short term cleaning is pH 2.5-11.
- Turbidity and SDI: Maximum feed turbidity is 1 NTU.
 Maximum feed Silt Density Index (SDI) is 5.0 (15 minute test). Experience has shown that feedwater with turbidity greater than 0.2 NTU generally results in frequent cleanings.

Recovery: Maximum recovery is site and application specific. In general, single element recovery is approximately 15%. Recovery limits should be determined using KMS' ROPRO® program.

Chemical Tolerance:

- Chlorine: Intentional exposure of TFC-S membrane to free chlorine or other oxidizing agents such as permanganate, ozone, bromine and iodine is not recommended. TFC-S membrane has a free chlorine tolerance of approximately 1,000 ppm-hours based on testing at 77°F (25°C), pH 8. This tolerance may be significantly reduced if catalyzing metals such as iron are present or if the pH and/or temperature are different. Sodium metabisulfite (without catalysts such as cobalt) is the preferred reducing agent. TFC-S membrane has a chloramine tolerance of approximately 60,000 ppm-hours in the absence of free chlorine based on testing at 77°F (25°C), pH 8.
- Cationic (Positively Charged) Polymers and Surfactants: TFC-S membrane may be irreversibly fouled if exposed to cationic (positively charged) polymers or surfactants. Exposure to these chemicals during operation or cleaning is not recommended.

Lubricants:

For element loading, use only approved silicone lubricant (or approved equivalent), water, or glycerin to lubricate O-rings and brine seals. The use of petroleum based lubricants or vegetable based oils may damage the element and void the warranty.

Service and Ongoing Technical Support:

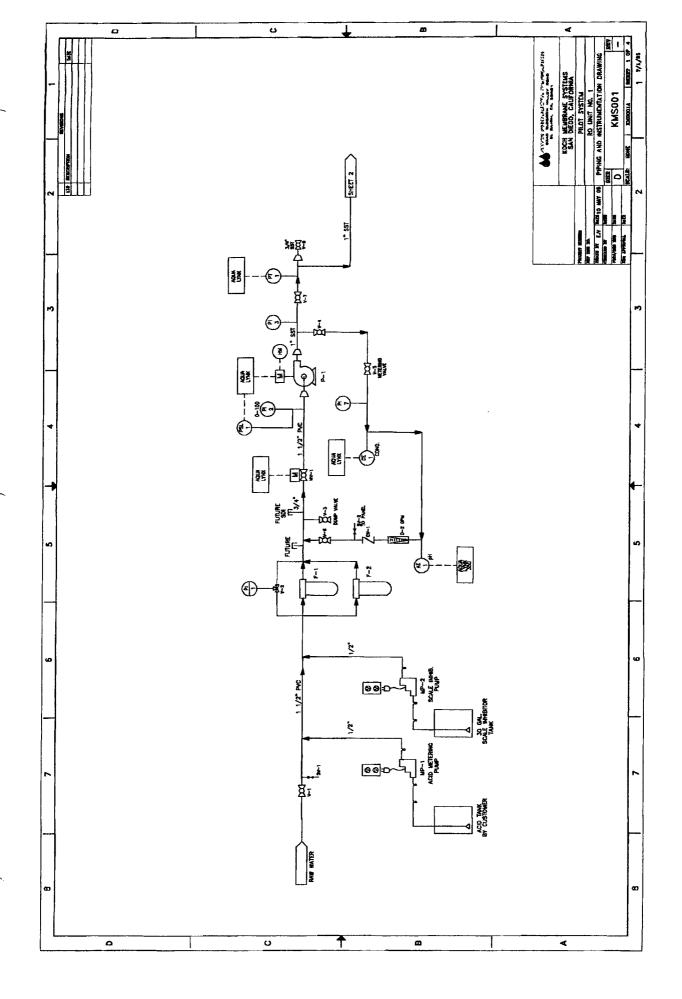
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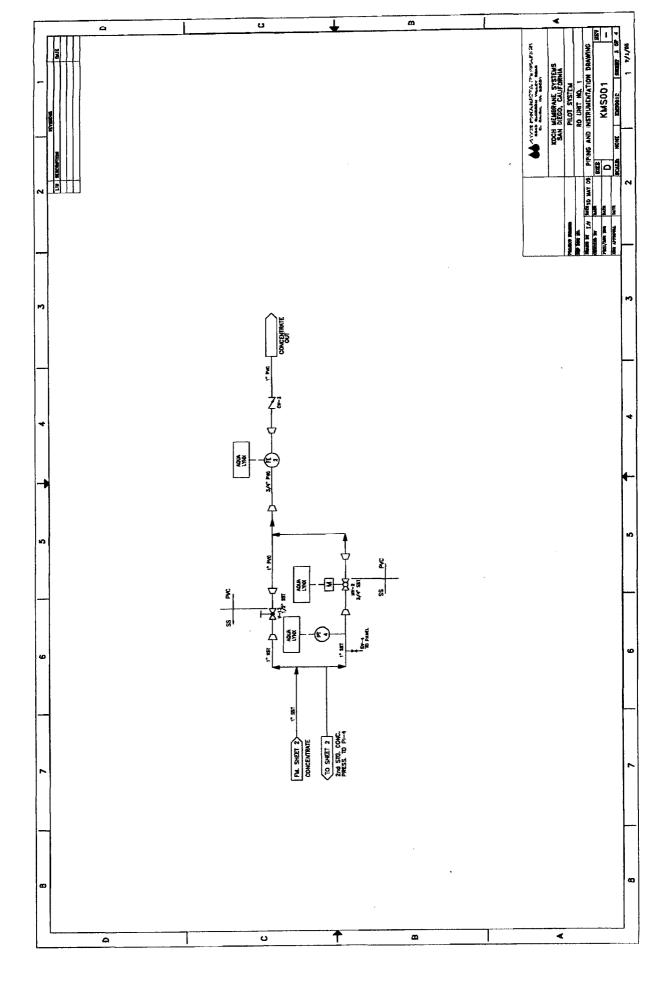
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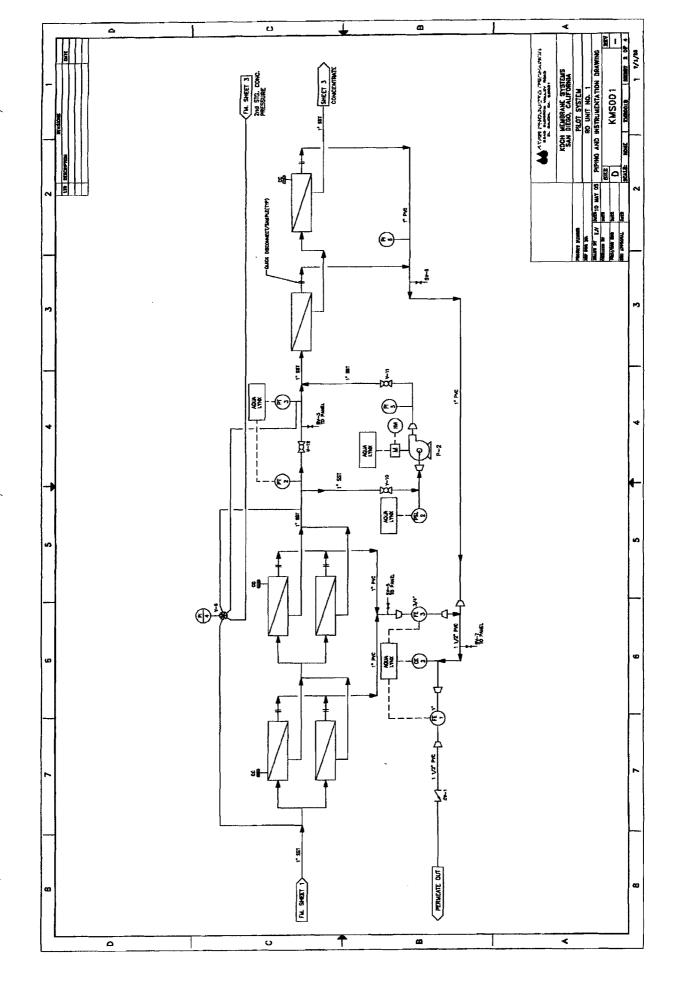
USA: 850 Main Street, Wilmington, MA 01887-3388, Telephone: 888-677-KOCH, Telephone: 978-694-7000, Fax: 978-657-5208
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AUSTRALIA: Ste. 6, Level 1/186-190 Church St., Parramatta, NSW 2150, Australia, Tel: +61-2-8833-4640, Fax: +61-2-9689-3615

APPENDIX C TEST UNIT P&IDS



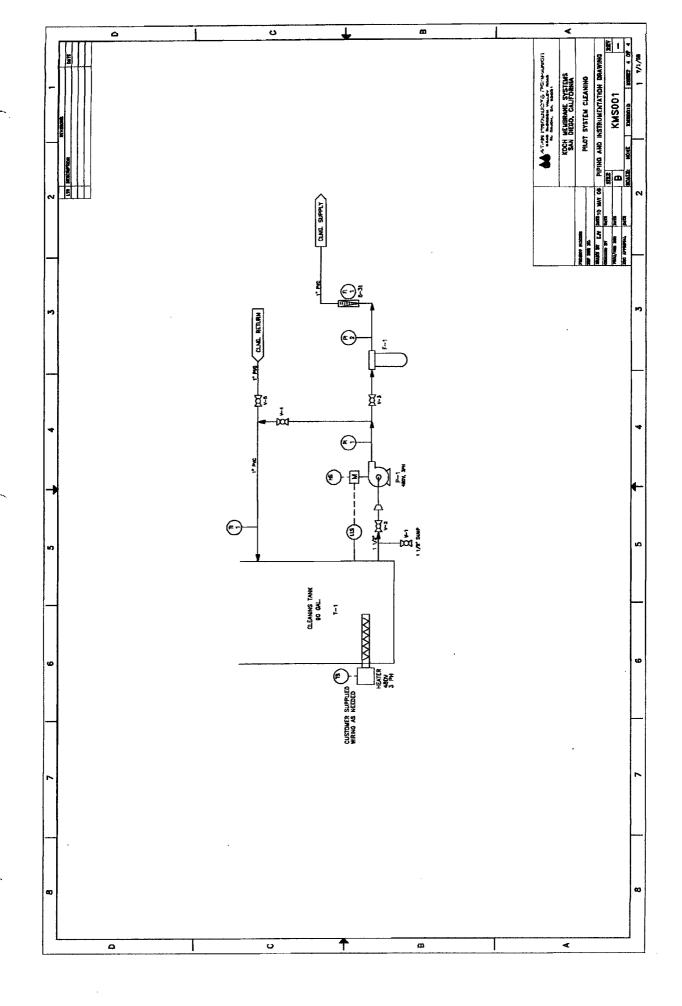
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APPENDIX D RODANTHE-WAVES-SALVO RAW DATA



				For For	******																
		- 1 62	TLO 1 1	Rodanthe-Waves-Salvo		Σ	Membrane	SR-2	Flux	Recovery	Hd	—									
		~	Month:				TEST CO	EST CONDITIONS													
PAR	PARAMETER				P	PRESSURE					FLC		! ⊦	Н	CONDUCTIVITY, AquaLynx	ITY, Aqual			Hd	ш	
TNE	LOCATION	Cart In C	Cart Out	Pump inlet	Pump Out	Feed	1st St out	2nd St feed	Conc	Permeate PI-6	1st St Perm FE-3	Total Perm FE-1	Conc.	CE-1	Interstage SV-5	Permeate CE-2	SV4	AE-1	Permeate SV-7	Feed SV-1	Operator
CMI	UNITS				pounds/sq.in. PSI	n. PSI] [gallo	gallons/minute, GPM	1 F	+	Microsi	Microsiemens, µS	1			Ш.	Initial
Day	Time												4				4	_			
14-Nov	1530	20	19.5	20		48	35	35	5 22	10	11.9		14.7	3.6 2870		15	1530 3320	20			IW
			20	20		49.5	35	35		10	11.9		14.7	3.6 2860		27	2760 32	3280 7.68	7.73	3 19.8	SS
15-Nov		_	19.5	20		49.5	35	35			0.11.9		14.8	3.5 2850		27	2760 3260	60 7.74	27.72	20.4	GW
			19.5	20		47.5	35	, m		10	6.11		14.8	3.5 2860	3050		2760 3260	09			IW
	1700		81			49	33							3.6 2870	3050		2760 32	3250 7.8	7.75	5 20.7	GW
16-Nov			17		,	44	32:											(5	7.75	5 21	GS
			23			50	35		35 20	9.5	5 11.9		14.7	3.6 2860	3050		2760 32	3230 7.63	7.7	7 22.3	GS
	SHUTDOWN FOR STORM	OR STORM 6	@ 1700 ON 16 NOV	- 1	RESTART @ 0900 ON 17 NOV	VON 11 NOV										_			_		
17-Nov	006	20	20			47	35		35 20	9.5	11	6	14.7	3.5 2870	3060		2760 32	3240 7.52	7.52	2 21	GS
	1700		21			47	35			5.6	5 11.9		14.8	3.6 2870	3050		2770 32	3250 7.54	7.72	2 20.6	KM
18-Nov			19		_	45	32			6.5	5 11.9		14.8	3.6 2860	3030		2770 32	3200 7.65	17.7	1 20.1	SS
			20			45	35				0 11.8		14.5	3.5 2880	3060		2770 32	3240 7.5	7.52	2 20.3	GS
19-Nov			22		2	45	35			01	0 11.8		14.5	3.5 2880	3040		2770 30	3040 7.72	7.78	8 19	GS
	1700	20	20		0	45	35		30 20	9.5	5. 11.7		14.4	3.4 2880	3040		2780 32	3220 7.52	7.54	4 19.4	GS
20-Nov	700	20	20	20	С	43	30		30 17	6.5	5 11.8		14.5	3.5 2870	3040	ļ	2780 32	3210 7.66	67.7	9 18.3	GW/SS
			23	23	3	48	35		35 21	10.5	5 12.3	6	15	3.6 2870	3040		2780 32	3230 7.94	16.7	19.6	GW/SS
21-Nov		2.	23		3	46	34		34 20	10.5	5 11.8		14.4	3.4 2880	3030		2780 32	3200 7.85	17.7	18.9	GW
			20		0	46	34		34 19	10	0 11.9		14.5	3.4 2880	3040		2780 32	3220 7.54	7.5	.5 20	GW/KW
_	SHUTDOWN FOR STORM	OR STORM (@ 1700 ON 16 NOV	- 1	RESTART @ 0900 ON 17 NO	DN 17 NG	25-Nov														
25-Nov	900	20	20		0	20	35		35 20	10.5	5 12.2	2	15	3.5 2730	2900		2590 30	3060 7.51	17.51	19.5	SS/SS
	1700		20	20	0	50	35		35 20	10.5	5 12.4		15.4	3.7 2730	2890		2590 30	3040 7.56	7.54	14 20.1	GS
	25 NOV RAN	RAN 2 WELLS A	ALL DAY	UNTIL 1700	- THEN BACK TO ONE WELI	TO ONE V	VELL						4				_				
26-Nov	730	0 23	23	23	3	50	35		35 20	10.5	5 12.	8	15.2	3.6 2900	3040		2780 32	3230 7.54	7.54	19.2	SS
	1700	0 21	21		21	49	35		35 20	10.5	5 12.2	.2	15	3.6 2880	3030		2800 32	3230 7.52			SS/GS
27-Nov	700	0 23.5	23.5		24	50	35		35 21		1 12.		15.1	3.6 2880	3030		2770 32	3220 7.83		19.8	8 GW
	1700	0 23.5	23.5		24	50	35		35 21	11	1 12.3		15.1	3.6 2840	3030		2770 32	3210 7.73	3, 7.67	57 20.3	GW/SS
28-Nov	700	0 23.5	23		24	49	35		35 21	-	1 12.2		15.2	3.6 2860	3020		2770 32	3210 7.94	4 7.75	75 20.1	GW/SS
													-				-	_			
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	NOTES																				
																	:				





PILOT TEST PROGRAM
Rodanthe-Waves-Salvo
Month: Nov 66/ Dec 06

Membrane SR-2
TEST CONDITIONS

)	·	Month:	Nov 06/ Dec 06		-	TEST	CONDITIONS		80		e:/									
PAR	PARAMETER		ĺ			PRESSURE						<u>`</u>	H		CONDUCTIVITY, Aqualynx	Y, Aqualyn		٦	+	EMP.	
FOC	ATION	Cart In	Cart Out	Pump inlet	Pump Out	Feed	1st St out	2nd St feed	Conc	Permeate PI-6	1st St Perm	Total Perm	Conc	Feed CF.1	Interstage SV-5	Permeate CE-2	SV4	Peed AE-1	SV-7	SV-1	Operator
LINSI	INSTRUMENT		-	7-1.2	PI3 pounds/sq.in.	in. PSI		1		11-0	gall	gallons/minute, GPM	- 1	1.77	Microsiemens, µS	ens, µS		₩		Deg C	Initial
Day	Time																				
29-Nov	1100	23	23	23		48	35	35	5 20	0 10.5	5 12.	1	14.9 3.7	7 2870	3020	2770	3190	7.86	7.80	19.1 G	GW
	1700			23		47	35	35	20	0.01	0 12.	1	14.8 3.6	2860	3020	2770	3190	7.81	7.72	21.5 G	GW
30-Nov	800	21.5	21	22	-	46	34	34	20	0 9.5	5 12.	2.0	1.8 3.6	5 2810	3020	2770	3170	7.57	7.50	20.5 G	GW
	1700		22.5	2		45	32	32	2 18	8.5	11.		14.5 3.6	5 2830	3010	2760	3180	7.76	17.7	21.6 G	GW
1-Dec	700			23		45	33.5	33	3 18	8 9.0		911.9	14.6 3.6	5 2850	3020	2770	3170	7.78	7.78	21.3 G	GS
	1700				_	45	34	33	3 18	8 9.0		12.0	14.6 3.6	5 2850	3000	2760	3180	7.69	77.7	22.1 GS	S
2-Dec	700			23		45	32	30	18	8 9.0		11.9	14.5 3.6	5 2840	3000	2770	3170	7.77	7.78	20.3 GS	S
	1700					45	32	30	0 20	9.6		11.7	14.3 3.6	5 2680	2870	2590	3040	7.63	7.47	20.8 GS	S
	Shut down. Broken port.		Restarted 12/5 KenM																		
6-Dec	930	20.5	20.5	20.5	2	47	35	3	35 20	0 11.0	0 12.	2	15.1	7 2870	3040	2780	3060	7.72	7.82	19.0 L	uş.
	1700					47	35	3	35 18	0.01		12.0	14.7 3.6		3030	2780	3190	7.75	7.71	20.0 G	GW
7-Dec	700) (47	35	3	35 19	10.0		12.0	14.7	5 2880	3030	2780	3200	7.80	7.74	19.3 G	GW
8-Dec	700	0 21	21	21		47	35	3	35 20	0 11.0		12.0	14.8 3.6	6 2870	3030	2770	3220	7.61	7.57	19.0 G	GS
	1700		20	20)	84	35	3	31 17	7 10.0	11.		14.4	2890	3030	2770	3210	7.53	7.52	19.4 G	GS
9=Dcc	700				2	48	35	. 3	30 20	10.	5	11.6	14.4 3.6	0682	3030	2770	3190	7.74	7.76	17.6 C	CS
	1700	2			0	46	34	3	32 17	7 10.0		11.8	14.2 3.5	2860	3060	2780	3180	7.73	77.7	18.9	CS
10-Dec	700				3,	47	35	9	34 20	20 10.5		11.9	14.7 3.6	6 2820	3030	2780	3200	7.71	7.79	18.5	CS
	1700				0	47	35	ξ0	34 2	20 10.4		11.9	14.6 3.6	6 2880	3040	2780	3200	7.72	7.76	19.8	GS
11-Dec	700				0	49	35	£	33 24	20 10.0		11.8	14.2 3.5	5 2880	3030	2790	3190	7.72	7.79	18.6.S	SS
	1700		20		0	49	35		33	18 10.0		11.8	14.3 3.5	5 2880	3040	2790	3200	7.69	7.68	19.8	SS
12-Dec	700	0 20			0	46	34	**1	33	19 10.0		11.7	14.4 3.6	6 2880	3040	2790	3200	7.81	7.76	18.8	GW
	1700	0 21.5	21	21		49	35		35 I	17 7.0		12.7	15.8 3.9	9 2880	3050	2780	3250	7.83	7.76	20.8 C	GW
13-Dec	815	5 21.5	21		2	53	39	121	39 2	24 11.0		12.7	16.0	4 2870	3040	2770	3250	77.7	7.78	20.3 C	GW
	1700	0 21	21		1	54	39	VIII	37 21	11.0		12.9	15.9 3.9	9 2870	3040	2770	3240	7.66	7.75	20.9	GW
14-Dec	700	0 21	21	21		54	38		38 2	22 11.0		12.9	16.0 3.9	9 2870	3040	2770	3240	7.70	7.74	21.1	GW
	1700		22.5		3	53	38		38 2	23 10.	8	12.8	15.9 3.9	9 2870	3040	2770	3230	7.75	7.75	21.7	GW
15-Dec	700		23		3	57	38		38	20 10.	5	12.6	15.6 3.8	8 2890	3060	2770	3210	7.80	7.78	20.0	SS
	1700	0 22	22	22	2	20	35		34 2	20 9.	9.0	12.5	15.8 3.8	8 2870	3040	2780	3230	7.75	7.75	20.3	SS
16-Dec	200	0 20	20		0	47	33		30	16 6.	7	12.5	15.4 3.8	8 2860	3030	2770	3530	7.68	7.76	19.80	GS
	1700	0 22	22	22	2	20	36		36 2	20 10.	16	12.4	15.3 3.8	8 2880	3050	2780	3220	7.72	7.78	20.1	SS
	NOTES																				





PILOT TEST PROGRAM Rodanthe-Waves-Salvo Month: 6-Dec

Membrane	SR-2	Flux	Recovery	hН
TEST CO	TEST CONDITIONS			

																TTV Acual			7	TEMP	
PAR	PARAMETER	n I tro	tu O tre	Pumn inlet	Pinn Out	Feed	1et Stout	2nd St feed	Supp	Permeate	1st St Perm	r LOW, Aquallynx	\vdash	┿	Interstage	Interstage Permeate		\vdash	Permeate	Feed	
INST	INSTRUMENT		PI-I	PI-2		٠.	;	PI4		₽	FE-3	FE-1	FE-2	CE-1	SV-5	CE-7	SV-4	AE-1	SV-7	SV-1	Operator
ſ	INITS				pounds/sq.in.	n. PSI					gallo	gallons/minute, GPM	_		Micros	Microsiemens, µS				Deg C	
Day	Time													4							
17-Dec	0000	22	21.5	22		20	36	36	20	0 10.5	12.3		15.3	3.8 2880	3040	0 2780	3220	7.75	7.74	18.9	GW
	1500	22	22			55	40	40	0 23	3 11.2	12.9		16.0	3.9 2860	3050	0 2770	3240	0 7.74	7.80	20.0	GS
18-Dec	0000		22	22		54	39	37	7 21	11.0	12.8		15.8	3.9 2870	3050	0 2770	3230	0 7.74	7.78	19.3	GS
	0021	Ĺ	22	22		54	40	38	8 22	2 10.5	5 12.8		16.0	4.0 2870	3040	.0 2780	3230	0 7.75	7.76	19.8	SS
19-Dec	0040		21			20	36				12.	3	15.2	3.8 2880	3050	0 2780	0 3210	0 7.73	7.74	19.60	GS
	1700		21			51	40	40	0 23	3 11.5	12.8		1.91	4.0 2880	3040	10 2780	0 3220	0 7.83	7.84	19.2	SS
20-Dec	0000		21			50	38	35		0 11.5	12.	7	15.6	3.8 2890	3040	07770	3220	0 7.72	7.83	18.9	SS
	1700		21			51	40		0 25	5 11.5	5 12.8		16.1	4.0 2890	3050	50 2780	3220	0 7.76	7.82	19.3	SS
21-Dec	0020	21	21	21		15	39	37	7 23	3 11.0	12.	8	15.7	3.9 2870	3050	50 2780	0 3230	0 7.80	7.85	19.2	SS
	Switch to well #2 at 0900	#2 at 0900																			
	1700	20	20	20		53	39	39	9 21	10.5	5 12.9		16.0	4.0 2480	0 2660	50 2380	0 2890	0 7.78	7.79	19.6	GW
22-Dec	0000					54	39	39	9	11.0	0 12.8		0.91	4.0 2500	0 2660	50 2380	0 2880	0 7.74	7.78	20.0	GW
	1700		20	20		54	39		9 24	11.0	0 12.9		16.2	4.0 2490	0 2660	50 2380	0 2880	0 7.78	7.79	20.5	GW
23-Dec	0000	2				53	38	8 36	6 20	10.5	12.	∞	16.1	3.9 2470	0 2660	50 2380	0 2850	0 7.78	7.83	20.9	gw
	1700		22			54	38	38	8 21	10.5	5 13	0	16.3	4.0 2440	0 2660	50 2380	0 2880	0 7.47	7.48	20.5	GW
24-Dec	0700	20.5	20			53	39	39	9 23	11.0	12	9	15.8	3.9 2440	0 2640	10 2380	0 2850	0 7.74	7.79	20.2	GW
	Switch to well #1 at 0800	#1 at 0800											_								
	1700	20	19.5	20	,	50.5	38	ì	36 2	20 11.0	0 12.7		5.7	3.9 2850	0 3050	50 2770	0 3220	17.7	77.7	20.2	GS
25-Dec	0200	20	21	20		52	38	35		20 10.8	8 12.7		15.6	3.8 2870	0 3050	50 2770	0 3220	0.77	7.79	19.9	cs
	1700	2	2	2		50.5	37		35 2	20 10.5	5 12.7		15.7	3.8 2880	3040	40 2760	0 3200	99''	7.68	20.5	GS
26-Dec	0100	22	22	22	3	50	35		32 1	15 7.2	12.8		15.6	3.8 2840	0 3030	30 2760	3210	07.70	77.7	20.2	SS
	1700	21.5	22	21		20	35		34	17 7.5	.5 12.8		15.8	3.9 2860		3040 2760	3220	7.74	7.76	20.1	GS
27-Dec	0200			2 21.5	2	50	35		35 2	20 8.0	.0 13.8		16.2	4.0 3860		3040 2760	3220	7.74	7.75	20.2	SS
	1700	20	21	20		50	35		36	17 10.5		13.0	16.4	4.0 2860		3050 2780	3240	7.62	7.63	19.7	SS
28-Dec	0200	22.5	22	22	2	53	39		38 2	22 11.3	.3 12.		16.0	3.9 2870		3050 2780	3240	7.73	7.79	18.3	GW
	Switch to well #2 at 0745	2 at 0745											+	_		_	_				
	1700	21	20.5	5 21		53	37		36 2	21 11.0	.0 12.	8	16.0	3.9 2470		2660 2390	2900	7.47	7.43	20.3	GW
	Did not run from 1700 12/28	1700 12/28	to 1000 12/29										\dashv	_							
29-Dec	1000	23	23	3 23		54	40		40	24 11.3		13.0	16.2	4.0 2510		2670 2390	2900	7.56	7.57	19.1	GW
	1700	22	21.5	5 22	2	\$	39		39 2	23 11.3	.3 13.	-	16.3	4.0 2470		2660 2390	2890	7.56	7.51	20.6	GW
													_				_		-		
													\dashv	\dashv							
	NOTES																				
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PILOT TEST PROGRAM
Rodanthe-Waves-Salvo
Month: Dec 06/Jan 07

Membrane SR-2
TEST CONDITIONS

No. 17. 17. 17. 17. 18. 17. 17. 17. 17. 17. 17. 17. 17. 17. 17		AME LEK				_	KESSUKE					2	AN AUGUSTAIN	•			2 - MILES		•	-	2	
This control This	LANG	VOIT	Cost In	100	Pumn inlat		Food	1et Stont	ö	2	Permeste	╀	Total Pern	H	┿	Interstage	Permeate		Ъ	Permeate	Feed	
This control This	INSTR	LIMENT		TILD III	Fump inier	PI-3	naau	1000	6		PI-6	FE-3	FE-1	+-	+-	SV-5	CE-2	\vdash	₩	SV-7	SV-1	Operator
Type 1919	Ü	NITS				i.ps/spunod	n. PSI					gallo	ns/minute, GP	!	H	Microsie	mens, µS	l l	\vdash		Deg C	Initial
Mathematical mat	ay	Time													_			_				
Maria Mari	1 #2																					
Column C	-Dec	0020	23.5	23.0	18.0		51.0	36.0	36.	0					1-1					7.76	20.6	GW
1 1 1 1 1 1 1 1 1 1	h wells #	જ																				
1		1700	21.0	21.0	22.0		54.0	39.0												7.51	20.4	GW
This color Thi	1#2													\downarrow								
The color The	-Dec	0020	22.	22.0			54.0	39.0												7.89	19.5	GW
The color The		1700		22.0			50.5	37.0					7							7.81	20.2	SS
1	ચ	12																				
This		0000	22.5	22.0			50.5	37.0			10.	5 12.	-							7.80		SS
400 22.0 22.0 22.0 30.0 10.3		1700	22.5	22.0			50.5	37.0							6					7.86		
1,100 1,20	311 #2																					
1.00 1.00	Jan	0020		22.0			48.0	35.0				12.	-							7.82		
4-1 CTO 220 220 220 150 <td></td> <td>1600</td> <td></td> <td>22.0</td> <td></td> <td></td> <td>48.0</td> <td>35.0</td> <td></td> <td></td> <td></td> <td>12.</td> <td>9</td> <td>_</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>7.85</td> <td>19.2</td> <td>Ken</td>		1600		22.0			48.0	35.0				12.	9	_						7.85	19.2	Ken
1700 210	Jan	0020		22.0			49.5	35.0		0	7.	2	3							7.86		
1700 210 210 210 490 350 300 120 120 120 310 310 310 310 310 310 310 310 310 310 310 310 320 320 110 112 218 27 380 300 310 310 390 360 110 112 280 300 300 330 776 110 110 110 112 280 300 330 370 310 370 310 <td>ch to W</td> <td></td> <td>\downarrow</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	ch to W														\downarrow							
This				21.0			49.0	35.0					4						_	7.51		SS
170 20 19 20 19 20 20 20 20 20 20 20 2	Jan	0020		20.0		_	51.0	39.0				12	.5		2					77.7		ВW
1, 10, 10, 10, 10, 10, 10, 10, 10, 10,		1700		19.5			51.0	39.0					9	_						7.65		GW
1700 215 210 220 220 220 230 230 250 102 126 126 126 280 280 290 2790 2390 2790 2390 2790 2390 2300 2790 2390 2300 2	Jan	0000		19.5			51.0	39.0					9:	_						7.67		G₩
0700 21.5 22.0 51.0 59.0 39.0 12.6 12.6 16.1 2.8 38.0 36.0 37.0 7.9 7.9 7.9 7.9 7.0		1700		21.0			51.0	39.0			10	2		_						7.70		GW
1770 23.0 22.5 23.0 31.0 39.0 39.0 26.0 10.5 11.2 16.2 28 28.0 30.0 27.8 7.6 7.7 7.6 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6 7.7 7.6	-Jan	0100		21.0			51.0	39.0				5								7.95		GW
0700 23.0 22.5 23.0 51.0 39.0 39.0 11.0 12.6 16.2 2.8 36.0 2780 2780 2770		1700		22.5			51.0	39.0												7.64	21	
no run 1700 21.0 20.0 38.0 31.0 21.0 10.5 11.5 12.6 15.8 2.7 2840 30.30 2770 33.00 7.87 7.84 21.9 0700 22.0 22.0 38.0 35.0 11.0 11.2 12.6 15.8 2.7 2880 30.0 27.9 33.0 7.84 18.8 1700 21.0 21.0 22.0 38.0 38.0 12.0 11.2 12.4 2.8 28.0 30.0 27.9 33.0 7.8 19.3 1700 21.0 21.0 36.0 38.0 36.0 12.0 12.4 15.7 27 29.0 37.0 7.8 19.3 1700 21.0 22.5 40.0 40.0 28.0 11.5 12.4 15.7 28.0 30.0 7.8 7.6 19.2 1700 22.5 22.5 40.0 40.0 28.0 11.5 12.4 15.5 <	Jan	0100		22.5			51.0	39.0												7.76	\perp	ΒW
1700 21.0 20.0 20.0 38.0 31.0 10.5 11.5 12.6 15.8 27.7 28.40 30.30 2770 33.00 7.84 21.9 0700 22.0 21.0 22.0 22.0 21.0 22.0 38.0 38.0 28.0 11.0 12.6 15.8 27.2 2880 30.00 27.90 38.0 7.84 18.8 0700 21.0 21.0 21.0 31.0 39.0 28.0 12.0 12.4 27.2 28.9 30.00 27.90 38.0 7.8 19.3 1700 21.0 21.0 31.0 38.0 26.0 11.0 12.4 15.7 27.9 30.0 7.79 7.82 19.3 1700 22.5 22.0 22.0 12.0 12.4 15.7 27.0 30.0 7.79 7.82 19.0 1700 23.0 22.5 23.0 23.0 12.4 15.5 27.7 2880 <td></td> <td>un ou</td> <td></td>		un ou																				
0700 22.0 21.0 22.0 50.0 38.0 33.0 25.0 11.0 12.6 15.8 27.8 36.0 27.80 27.9 77.9 77.9 77.9 77.9 78.4 18.8 1700 21.0 21.0 21.0 21.0 35.0 38.0 28.0 12.0 12.4 15.7 27.9 30.0 7.8 77.0 19.3 0700 21.0 21.0 21.0 21.0 21.0 30.0 28.0 27.0 12.0 17.0 27.0 27.0 77.0 77.0 19.3 1700 21.0 21.0 21.0 21.0 21.0 27.0 27.0 27.0 77.0 19.2 19.0 19.2 19.0 19.0 19.0 19.2 19.0 <td>-Jan</td> <td>1700</td> <td></td> <td>20.0</td> <td></td> <td></td> <td>50.0</td> <td>38.0</td> <td></td> <td>0</td> <td></td> <td>12.</td> <td>9</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>7.84</td> <td></td> <td>GS</td>	-Jan	1700		20.0			50.0	38.0		0		12.	9							7.84		GS
1700 210 210 210 210 210 380 380 380 280 120 120 124 157 27 2910 3960 2790 3340 7.80 7.82 19.7 19.3 1	-Jan	0200		21.0			50.0	38.0				12.		∞						7.84		SS
0700 21.0 21.0 21.0 21.0 21.0 21.0 21.0 38.0 38.0 27.0 12.0 12.4 15.7 2.7 29.10 3060 2790 33.0 7.782 19.3 1700 21.0 21.0 21.0 21.0 38.0 38.0 36.0 11.0 12.5 15.7 28.7 30.70 2790 33.0 7.6 19.3 NOTES 22.5 22.0 22.5 22.0 40.0 40.0 28.0 11.5 12.4 15.5 2.7 28.0 30.70 2790 33.0 7.76 19.2 NOTES 22.5 22.0 38.0 38.0 38.0 38.0 11.0 12.4 15.5 2.7 2880 30.0 2800 33.0 7.76 7.79 19.2		1700					51.0	39.0												7.85		Ken
1700 21.0 21.0 21.0 21.0 22.5 22.0 22.5)-Jan	0040					50.0	38.0				12.	4							7.82	19	
0700 22.5 22.0 22.5 22.0 40.0 40.0 40.0 11.5 11.5 12.4 15.5 2.7 28.80 3070 2790 3330 7.76 7.79 19.0 NOTES		1700					50.0	38.0					Si							7.60		SS
700 23.0 22.5 23.0 38.0 38.0 25.0 11.0 12.4 15.5 2.7 2880 3060 2800 3330 7.76 7.79 19.2	-Jan	0000	22.	22.0		16	52.0	40.0					9							7.83		GW
NOTES		1700					50.0	38.0	:										╝	7.75		SS
		NOTES																				



	SR-2	TEST CONDITIONS
	Membrane	TEST C
SRAM		
r PROGRAN	Rodanthe-Waves-Salvo	7-Jan

 Membrane
 SR-2
 Flux
 Recovery
 pH

 TEST CONDITIONS
 16.1
 85%

1	Mark Cont. Permante Mark Permante Mark Permante Pe	1	1		PRESSURE			FLOY	ı	4				ŀ			
1	1	1	1	峀	1st St	and St feed	\vdash	1st St Perm	\vdash	_		rstage Perme	ŀ	+	Permeate CV 7		Operator
39 27 115 12 2880 3800 2790 3549 766 773 192 39 27 11 12 161 28 2880 3000 2790 3590 772 774 203 39 27 11 126 161 28 2880 3000 2800 3590 772 774 203 39 27 11 126 161 28 2880 3000 2800 3590 772 774 203 38 26 11 126 184 2890 3000 2800 3300 778 779 279 204 200 2700 330 778 779 204 200 2700 330 765 779 204 200 2700 330 765 779 204 200 2700 310 765 779 204 200 2700 310 765 776 200	19 27 115 126 16.1 2.8 2880 3000 2790 3349 766 773 192 19 27 11 12 16.1 2.8 2880 3000 2390 3390 772 27.2 21.2 19 27 11 12.6 16.1 2.8 2880 3000 2390 3390 772 7.74 21.2 18 27 11 12.6 16.1 2.8 2880 3000 2390 3390 772 7.74 21.2 19 23 10.6 12.3 16.3 2.8 2880 3000 2390 3390 7.75 7.79 20.3 10 1.5 12.4 15.9 2.8 2870 2790 2390 7.6 7.76 7.79 20.3 10 1.5 1.2 1.5 2.8 2.8 3000 2.70 3310 7.8 7.76 2.7	39 27 11.5 12.6 16.1 2.8 3860 3700 3340 766 773 11.2 39 27 11.1 12.6 16.1 2.8 2870 3800 3350 777 7774 21.2 39 27 11 12.6 16.1 2.8 2880 3800 3350 777 7774 21.2 39 27 11 12.6 16.1 2.8 2880 3800 3350 772 777 17.7	39 77 115 161 2830 3800 770 756 7771 192 39 77 11 126 161 28 3870 3800 3850 777 774 212 39 77 11 126 161 28 2890 3970 2790 389 777 774 212 38 70 11 126 161 28 2890 3970 2790 339 777 774 212 39 70 11 126 161 28 2890 3970 2790 339 777 779 399 777 779 779 779 779 779 776 779 <	PI-3 nounds/so.in. PSI	IS	PI-4	PI-6	FE-3 gallons	-	-	-1	Microsiemens, μS	4	Н	/-46	1 1	Initial
39 27 11.5 12.6 16.1 2.880 3000 27.90 13.49 7.66 7.73 13.1 39 27 11 12.6 16.1 2.8 2870 3000 2300 35.9 77.7 7.77 20.3 39 27 11 12.6 16.1 2.8 2870 3000 2300 35.9 77.2 7.77 27.7 <t< th=""><th>39 27 11.5 12.6 16.1 2.8 3800 2700 31.49 7.6 7.2 11.7 12.0 39 27 11 12.6 16.1 2.8 3800 2700 31.90 7.7 7.7 20.3 39 27 11 12.6 16.1 2.8 280 3000 2300 31.90 7.72 7.7 27.0 12.0<</th><th>99 27 11.5 12.6 16.1 2.8 3800 2790 33-90 7.71 7.77 39.1 99 27 11 12.6 16.1 2.8 8500 2300 33-90 7.71 7.77 20.3 19 27 11 12.6 16.1 2.8 2870 3300 33-90 7.72 7.77 20.3 19 27 11 12.6 16.1 2.8 2870 3300 3390 7.72 7.77 7.79 19.1 20 28 11 12.6 15.8 2890 3000 2800 3300 7.72 7.79 19.2 30 20 10 12.3 15.8 2.8 3000 2790 330 7.6 7.70 20.2 30 10 10 12.4 15.8 2.8 300 2790 330 7.6 7.7 7.7 7.7 7.7 7.7 7.7 7.7<!--</th--><th> 10</th><th></th><th></th><th></th><th></th><th></th><th></th><th>\exists</th><th></th><th></th><th>\dashv</th><th></th><th></th><th></th><th></th></th></t<>	39 27 11.5 12.6 16.1 2.8 3800 2700 31.49 7.6 7.2 11.7 12.0 39 27 11 12.6 16.1 2.8 3800 2700 31.90 7.7 7.7 20.3 39 27 11 12.6 16.1 2.8 280 3000 2300 31.90 7.72 7.7 27.0 12.0<	99 27 11.5 12.6 16.1 2.8 3800 2790 33-90 7.71 7.77 39.1 99 27 11 12.6 16.1 2.8 8500 2300 33-90 7.71 7.77 20.3 19 27 11 12.6 16.1 2.8 2870 3300 33-90 7.72 7.77 20.3 19 27 11 12.6 16.1 2.8 2870 3300 3390 7.72 7.77 7.79 19.1 20 28 11 12.6 15.8 2890 3000 2800 3300 7.72 7.79 19.2 30 20 10 12.3 15.8 2.8 3000 2790 330 7.6 7.70 20.2 30 10 10 12.4 15.8 2.8 300 2790 330 7.6 7.7 7.7 7.7 7.7 7.7 7.7 7.7 </th <th> 10</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>\exists</th> <th></th> <th></th> <th>\dashv</th> <th></th> <th></th> <th></th> <th></th>	10							\exists			\dashv				
19 22 11 126 161 28 2870 3970 2890 3356 772 7.74 21.2	39 27 11 12.6 16.1 28 2870 300 2806 3559 77.1 77.7 20.3 39 27 11 12.6 16.1 28 2890 300 2790 3539 77.2 77.7 27.3 38 26 11 12.6 16.1 28 2890 300 2800 3590 77.2 77.9 20.4 34 21 10.4 12.3 16.1 2.8 300 2800 350 77.6 77.9 20.4 35 26 10.2 12.3 16.1 2.8 300 2790 3310 7.8 7.7 7.7 20.4 30 15 10.4 11.5 2.8 300 2790 3310 7.8 7.6 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 27.0 <th< td=""><td>39 27 11 126 164 28 2870 3900 2890 3550 771 777 303 39 27 11 126 161 28 2890 3500 772 773 774 773 773 774 773 774</td><td>39 27 11 12.6 16.1 28 2870 300 2800 3559 771 777 303 39 27 11 12.6 16.1 28 2890 3500 2500 3530 772 773 303 38 26 11 12.6 16.1 28 2890 3500 2790 3350 772 773 303 34 21 10.4 12.3 16.1 2.8 2890 3900 2790 3350 772 779 303 35 25 10.6 1.2 2880 300 2790 3310 776 779 204 30 12 10.4 11.5 2.2 2880 300 2790 3310 7.8 7.0 20.2 30 12 10.4 11.5 2.2 2880 300 2790 3310 7.8 7.0 7.0 2.0 2.0 2.0</td><td>22</td><td>51 3</td><td></td><td></td><td></td><td>16.1</td><td>2.8</td><td>2880</td><td></td><td></td><td>ļ</td><td></td><td></td><td>GW</td></th<>	39 27 11 126 164 28 2870 3900 2890 3550 771 777 303 39 27 11 126 161 28 2890 3500 772 773 774 773 773 774 773 774	39 27 11 12.6 16.1 28 2870 300 2800 3559 771 777 303 39 27 11 12.6 16.1 28 2890 3500 2500 3530 772 773 303 38 26 11 12.6 16.1 28 2890 3500 2790 3350 772 773 303 34 21 10.4 12.3 16.1 2.8 2890 3900 2790 3350 772 779 303 35 25 10.6 1.2 2880 300 2790 3310 776 779 204 30 12 10.4 11.5 2.2 2880 300 2790 3310 7.8 7.0 20.2 30 12 10.4 11.5 2.2 2880 300 2790 3310 7.8 7.0 7.0 2.0 2.0 2.0	22	51 3				16.1	2.8	2880			ļ			GW
19 19 10 10 10 10 10 10	1	10 12 12 13 13 14 15 15 15 15 15 15 15	10 12 12 13 13 14 15 15 15 15 15 15 15	23 51					16.1	2.8	2870						GW
1	19	19	19	22.5	í.	_			16.1	2.8	2880						
1	38 28	18 26 11 12 16 18 18 18 18 18 18 18	18 26	22 51	. 3				16.1	2.8	2870						GW
10	34 21 104 123 154 26 3860 2790 3790 772 779 32 23 105 112 153 26 2880 3070 2780 310 775 7780 30 15 10 12 15 28 3870 3700 2780 310 775 7780 30 15 10 12 15 2 28 3870 2790 330 765 776 30 15 10 12 15 2 28 2790 330 765 776 4 10 <td>34 21 104 123 154 26 380 3760 2775 775 779 36 23 105 123 153 26 2880 3000 2780 3310 775 778 30 15 10 12 15 2 2880 3070 2780 3310 778 776 30 15 10 12 15 2 2880 3070 2790 3310 778 776 4 10 12 12 15 2 2890 3070 2790 3310 778 776 4 10 12</td> <td>34 21 104 123 154 26 380 3700 2700 3700 2750 2700 36 25 105 124 153 26 2880 3070 2780 3310 775 778 30 15 105 124 158 27 3800 2700 3310 78 776 30 15 104 158 27 3800 2700 3310 78 776 4 105 124 158 27 3800 2700 3310 78 776 5 106 124 158 27 3800 2700 3310 78 776 6 107 124 158 27 3800 2700 3100 78 776 7 108 108 108 108 108 108 108 108 108 108 8 108</td> <td>22 50</td> <td></td> <td></td> <td></td> <td></td> <td>16.1</td> <td>2.8</td> <td>2890</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>ВW</td>	34 21 104 123 154 26 380 3760 2775 775 779 36 23 105 123 153 26 2880 3000 2780 3310 775 778 30 15 10 12 15 2 2880 3070 2780 3310 778 776 30 15 10 12 15 2 2880 3070 2790 3310 778 776 4 10 12 12 15 2 2890 3070 2790 3310 778 776 4 10 12	34 21 104 123 154 26 380 3700 2700 3700 2750 2700 36 25 105 124 153 26 2880 3070 2780 3310 775 778 30 15 105 124 158 27 3800 2700 3310 78 776 30 15 104 158 27 3800 2700 3310 78 776 4 105 124 158 27 3800 2700 3310 78 776 5 106 124 158 27 3800 2700 3310 78 776 6 107 124 158 27 3800 2700 3100 78 776 7 108 108 108 108 108 108 108 108 108 108 8 108	22 50					16.1	2.8	2890						ВW
10 10 11 11 11 11 11 11	36 23 10.5 12.3 15.3 2.6 2800 2700 2700 330 7.65 7.6 30 15 10.5 11.5 15.9 2.8 30.0 2700 330 7.65 7.6 30 15 10.5 11.5 10.5 11.5 10.5 11.5 17.6 4 10.5 10.5 11.5 10.5 11.5 10.5 11.5 17.6 5 10.5 10.5 10.5 10.5 10.5 10.5 11.5 17.6 6 10.5 10.5 10.5 10.5 10.5 10.5 10.5 10.5 7 10.5 10.5 10.5 10.5 10.5 10.5 10.5 10.5 8 10.5 10.5 10.5 10.5 10.5 10.5 10.5 10.5 10.5 10.5 8 10.5 1	36	153 164 153 154						15.4	2.6	2880						SS
30 26 105 1124 1158 27 2880 3900 2790 330 768 776 2012 201	30	36 15 10.5 11.4 15.8 27 286 310 2790 3130 7.8 7.76 20.2 30 11.4 11.5 12.7 2860 310.0 2790 310 7.8 7.76 20.2 31.0 12.1 12.1 12.8 12.7 2860 310.0 2790 310 7.8 7.76 20.2 32.0 12.1 12.1 12.1 12.1 12.1 12.1 12.1 1	36 15 10.5 12.4 15.8 2.8 2800 2790 3310 7.8 770 20.2 30 15 10.5 12.4 15.8 2.7 2880 30.0 2790 3310 7.8 7.7 20.2 10 10 10 10 10 10 10 10 10 10 10 10 10 1						15.3	2.6	2880						SS
30 15 10 10 10 10 10 10 10 10 10 10 10 10 10	30 15 10.5 10.5 10.5 10.5 10.5 10.5 10.5	15 10.5 10	310 15 10.5 11.5 12.5 12.5 12.5 12.5 12.5 12.5 12	20.5						2.8	2870						SS
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APPENDIX E RODANTHE-WAVES-SALVO ANALYTICAL DATA

DARE COUNTY RWS WATER TREATMENT FACILITY 04-28-035 Report of Chemical Analysis for RWS Organic Removal Pilot Project - November, 2006 - February, 2007 Analyses Results From Outside Labs

RWS Feed 7.12 ppm RWS RO 467 ppb Week #5 RWS Well#2

Jan18 2007 membrane change

DARE COUNTY RWS WATER TREATMENT FACILITY 04-28-035 Report of Chemical Analysis for RWS Organic Removal Pilot Project - November, 2006 - February, 2007

In-House Lab	ap																ļ				ŀ		ł					ľ				ſ
Week	Total Hardnes (mg/1 as CaCO3)	Total Hardness (mg/l as CaCO3)		SOT		Alkalinity (mg/l	7 (mg/l 3)	Bicarbonate (From Alkalinity)	ate nity)	Calcium		Magnesium		Fluoride		Chloride	6 5	Soc	Sodium	UV - 254	254	Iron (Total)		Iron (Ferrous)		Manganese	Sulfate	ate	Phosphate	ate	Potasslum	_
	Food	Permeste	Feed	1st Stage P	Permeato	Feed Pe	Permeate	Feed Per	Permosto Fe	Feed Perm	Permeate Feed	Perm	reate Feed	Permeate	Pood o	1s Stage	Permeate	Feed	Permeste	Food	Permeate	Feed Pe	Permeate Fe	Feed Permeate	eate feed		Permeste Fred Permeste		Feed Perm	Permeate	Feed Perr	Permeate
-	108	96	1330	1300	1290	488	488	595	595 12	12.00 9.0	9.60 18.95	11	.50 1.80	1.51	540	540	540	586	528	0.214	0.104	0.085 0	0.029 0.0	0.015 0.057	57 0.029	9 -0.005	9.00	2.00 0.250		0.320	4.60	4.60
2	116	92	1290	1300	1260	492	492 (009	600	9.60	8.80 22.36	17.	1.77	7 1.51	220	220	220	520	537	0.210	0.099											
8	96	94	1370	1330	1330	496	444	605	541 10	10.40 9.0	9.60 17.01	1	.01 1.56	3 1.33	520	520	520	528	487	0.217	0.097											
4	108	96	1340	1330	1330	504	460	614	560 11	11.20 10	10.40 19.44	=	1.78	3 1.59	540	540	240	522	909	0.212	960.0											
2	106	96	1350	1440	1320	504	460	614	560 10	10.40	9.60 19.	19.44 17.5	.50 1.75	5 1.50	540	540	540	521	504	0.214	0.093											
9	108	100	1410	1330	1330	200	428	610	522 12	12.00 11	11.50 18.	18.95 17.5	50 2.00	0 1.82	540	540	240	522	492	0.208	960.0											
7	88	80	1140	1100	1100	492	460	009	561 12	12.80 9.	9.60 13.	13.60 13.6	1.91	1.70	420	420	420	449	449	0.206	0.095											
8	104	86	1330	1300	1300	508	440	620	537 11	11.20 11	11.20 18.	18.47 17.0	.01 1.87	7 1.64	530	530	530	518	491	0.210	0.091											
6	110	86	1360	1310	1310	512	428 (624	522 11	11.20	9.60 19.	19.93 17.9	.98 1.69	1.50	230	230	530	502	460	0.202	0.094											
10	92	22	1190	248	380	464	76	999	90 10	10.40	1.60 16.	16.04 4.3	37 1.94	4 0.59	440	130	180	454	137	0.199	0.010											
11	106	14	1350	275	425	472	80	929	96 12	12.00 0.	0.80 18.	18.47 2.9	.92 1.95	5 0.50	520	130	200	494	23	0.214	0.021											
12	96	16	1430	276	448	456	80	556	96 10	10.40 0.	0.80 17.01	3	.40 1.89	9 0.59	520	130	200	497	155	0.217	0.016	0.05	0.02 0	0.02 0.01	0.00	0.01	16.90	0.00	0.22	0.07	23.00	5.00
																								-								
Average	103.167	75.167	1324.167	1324.167 1044.917 1068.583 490.667	1068.583		361.333 56	598.333 44	440.000 11.133		7.758 18.3	18.306 13.5	.568 1.826	1.315	515.833	33 425.000	0 440.833	509.375	397.417	0.210	0.076	0.066	0.023 0.	0.017 0.0	0.033 0.016	0.000	12.950	1.000	0.234	0.197	13.800 4.	4.800
Max.	116.000	116.000 100.000	1430.000	1430.000 1440.000 1330.000 512.000 492.000	1330.000	512.000 4		624.000 60	600.000 12.800		11.500 22.360	11	.980 2.000	1.820	550.000	00 220.000	000.055	586.000	537.000	0.217	0.104	0.085	0.029 0.	0.018 0.0	0.057 0.029	500.00	16.900	2.000	0.250	0.320 2	23.000 5.	5.000
Min.	88.000	14.000	1140.000	88.000 14.000 1140.000 248.000	380.000 456.000 76.000	156.000		556.000 9	90:000	9.600 0.8	0.800 13.600	600 2.920	1.560	0.500	420.000	130.000	180.000	448.500	23.000	0.199	0.010	0.047	0.017 0.	0.015 0.0	0.009 0.002	200.005	9.000	0.000	0.218	0.074	4.600 4.	4.600

APPENDIX F SOUTH HATTERAS RAW DATA

	1	

PILOT TEST PROGRAM FRISCO WATER PLANT Month:

lembrane		Flux	Recovery	μd
TEST CONDITIONS	SNOTE			

PARA	PARAMETER					PRESSURE				,	FLOY	FLOW, AquaLynx	,		CONDUCTIVITY, AquaLynx	Y, AquaLyn		H	рН В	TEMP.	
LOCATION	TION	Cart In	Cart Out	Pump inlet	Pump Out	Feed	1st St out	2nd St feed	Conc	Permeate PI-6	1st St Perm	Total Perm	Conc FE-2	CE-1	Interstage SV-5	Fermeate CE-2	SV4	Feed AE-1	SV-7	SV-1	Well #
NO UN	UNITS			741	pounds/sq.in. PSI	n. PSI					gallons/	i			Microsiemens, µS	Su ,sua				Deg C	
Date	Time																				
7-Mar	1500	33	32.5	32.5	300	112	92		78	12	12.2	17	2.9	189	1511	158.2	3730	7.24	7.08	13.5	15
8-Mar	730	35	30.5	30.5	300	118	66		82	11.5	13.2	17	3.0	683	1705	169.9	3060	7.29	7.18	15.6	15
8-Mar	1530	35	30	30	295	122	103		06	11.5	13.6	16.8	3	693	1819	174.4	3020	7.37	7.41	15.5	15
9-Mar	0730	35	32	32	290	133	115		105	11.5	14.6	17	2.9	089	2060	171.7	3010	7.21	7.29	15.2	15
9-Mar	1500	35	32	32	295	137	120		110	11.5	14.7	17		682	2012	172.1	3005	7.25	7.31	15.4	15
10-Mar	0730	35	32	32	300	140	125		115	11.5	15.1	17.1	8	683	5019	173.9	3003	7.22	7.13	15.5	15
10-Mar	1530	34	32	33	300	142	127		117	11.5	15.3	17.1	3.1	682	2015	172.8	3005	7.25	7.25	15.2	15
11-Mar	0730	35	34	34	300	144	128		119	11.5	15.3	17.1	3	682	2024	170.2	2095	7.22	7.16	15.2	15
11-Mar	1530	35	33	33	300	146	129		121	12	15.5	17.2	3	219	2027	172.3	2097	7.2	7.25	15.2	15
12-Mar	0730	35	34	34	300	149	130		125	12	15.5	17	3	829	2029	179.6	2091	7.22	7.2	15.3	15
12-Mar	1530	36	35	35	301	129	114	see note	102	10	13.8	15.1	3.7	089	1996	168.4	2470	7.2	7.17	15.5	15
13-Mar	0730	36	35	35	301	129	115		102	10.5	13.8	15.1	3.7	681	1976	170.5	2390	7.29	7.21	15.5	15
13-Mar	1530	36	35	35	301	129	115		102	9.5	13.7	15.1	3.7	673	1981	185.6	2390	7.36	7.25	15.3	15
14-Mar	0740	36	35	35	301	129	115		102	8.6	13.8	15.1	3.7	089	1661	173.4	2400	7.21	7.07	15.1	15
14-Mar	1515	36	35	35	301	129	114		101	9.5	13.8	15.1	3.7	089	1990	171.6	2401	7.09	7.1	15.2	15
15-Mar	0720	37	36	36	302	125	111		66	9.5	13.8	15.1	3.7	684	1975	191.5	2401	7.29	7.31	15.7	15
15-Mar	1530	36	35	35	301	125	110		66	9.2	13.7	15.1	3.7	189	1982	171.6	2380	7.32	7.19	15.6	15
16-Mar	0725	36	35	36	301	125	110		66	9.2	13.6	15	3.7	684	1969	176.8	2390	7.36	7.19	15.5	15
16-Mar	1530	36	35	35	301	130	115		105	9.5	13.7	15.2	3.7	629	1984	172.6	2330	7.31	7.35	15.7	15
17-Mar	0000	36	35	35	301	134	119		110	9.5	13.7	15	3.7	682	2000	175.2	2031	7.3	7.15	15.7	15
17-Mar	1530	37	36	36	301	135	120		114	9.5	13.8	15	3.7	684	1984	176.6	2360	7.32	7.19	15.4	15
18-Mar	0020	37	36	36	301	140	125		119	10	13.7	15	3.7	683	2011	175.3	2037	7.27	71.7	15.6	15
18-Mar	1530	37	36	36	301	143	130		121	9.5	13.7	15	3.7	682	2001	176.4	2360	7.3	7.12	15.6	15
19-Mar	0020	37	36	36	301	145	134		123	9.5	13.8	15	3.7	684	2012	174.1	2400	7.17	7.11	15.7	15
19-Mar	1530	37	36	36	304	148	137		125	9.5	13.7	15.1	3.7	683	2002	176.4	2400	7.25	7.15	15.6	15
20-Mar	0220	37	36	36	304	150	138		126	6.6	13.7	15	3.7	929	1997	191.1	2360	7.24	7.16	15.4	15
20-Mar	1530	37	36	37	304	151	139		127	9.5	13.7	15	3.7	089	1985	173.8	2340	7.41	7.12	15.6	15
21-Mar	0730	37	36	37	304	151	139		128	9.5	13.7	15	3.7	629	1984	175.9	2340	7.38	7.18	15.3	15
21-Mar	1530	37	36	37	304	151	139		128	9.5	13.7	15	3.7	682	1988	176.3	2340	7.31	7.16	15.6	15
22-Mar	0730	38	37	37	305	151	140		129	10	13.7	15	3.7	089	1973	188.5	2350	7.35	7.14	15.7	15
	NOTES	12 March 1	1500 reduced rec	12 March 1500 reduced recovery to 80% 15 gpm total permeate	5 gpm total pem	neate															ļ



PILOT TEST PROGRAM FRISCO WATER PLANT Month: March

Membrane Flux Recovery
TEST CONDITIONS

	I	•		i i		-															
PARA	PARAMETER					PRESSURE					FLOV	FLOW, Aqualynx		lt	II/	Y, AquaLynx		1	-	TEMP.	
TOC	LOCATION	Cartin	Cart Out	Pump inlet	곱	Feed	1st St out	2nd St feed	Conc	Permeate PL-6	1st St Perm FF-3	Total Perm FF.1	Conc FF-2	Feed CF-1	Interstage SV-5	Permeate CE-2	Conc.	Feed AE-1	Permeate SV-7	Feed SV-1	Well #
NS IR	ITS		-	11-2	PSI pounds/sq.in. PSI	n. PSI	4				gallons	gallons/minute, GPM		125	Microsiemens, µS	ens, µS			Ħ	Deg C	
Date	Time																		1	†	
23-Mar	0730	38	37	38	304	151	140		129	10	13.7	15	3.7	682	2001	185.5	2380	7.21	7.12	15.6	15
23-Mar	1515	37	36	37	304	150	140		128	6	13.8	15	3.7	682	2001	180.5	2380	7.14	7.24	15.8	15
24-Mar	0730	38	37	36	304	150	139		128	9.5	13.8	15	3.7	681	1995	180.4	2350	7.21	7.22	15.8	15
24-Mar	1530	37	36.5	37.5	304	151	140		129	6	13.8	15	3.7	629	1987	179.2	2340	7.28	7.24	15.9	15
25-Mar	0200	38	37	38	305	155	142		130	6	13.8	15	3.7	929	1986	183.1	2340	7.27	7.25	15.6	15
25-Mar	1545	37	36.5	38	304	160	149		135	10	13.8	15	3.8	829	1987	183.1	2340	7.31	7.25	15.5	15
26-Mar	0400	38	37.5	38	305	162	150		139	11.5	13.8	15	3.7	829	1988	182.1	2310	7.07	1.23	15.7	15
26-Mar	1530	37.5	37	38	304	162	150		140	6	13.8	15	3.7	681	1989	182.1	2330	7.11	7.12	15.9	15
27-Mar	0730	38	37.5	38	305	165	154		143	6	13.7	15	3.7	629	1991	184.3	2310	7.28	7.19	15.8	15
27-Mar	1530	38	37	38.5	305	166	155		145	6	13.7	14.9	3.7	681	1992	183.1	2320	7.21	7.12	15.6	15
28-Mar	0730	19.5	38.5	39	310	167	551		145	10.7	13.7	14.9	3.7	289	1992	203	2340	7.3	7.21	15.6	15
28-Mar	1520	39	38	39	305	166	551		145	6	13.7	14.9	3.7	889	1999	210	2340	7.22	7.19	15.6	15
29-Mar	0830	39.5	39	39.5	310	167	155		145	6	13.8	14.9	3.7	989	2661	207	2341	7.26	7.2	15.3	15
29-Mar	1600	39.5	39	39.5	307	169	158		147	10.5	13.7	14.9	3.7	269	1980	205	2350	7.36	7.17	15.4	15
30-Mar	0715	39.5	39	39.5	306	171	164		153	10.5	13.8	14.9	3.7	685	2010	187.4	2360	7.25	7.15	15.3	15
30-Mar	1530	39	38.5	39	304	175	164		154	10	13.9	15	3.7	089	2020	184.7	2370	7.21	7.06	15.6	15
31-Mar	0720	39	39	40	305	175	165		154	10.5	13.9	15	3.7	701	2040	184.3	2370	7.29	7.25	15.2	15
31-Mar	1530	39	38	40	305	175	165		154	9.5	13.9	15	3.7	682	1989	186.3	2360	7.25	7.22	15.5	15
1-Apr	0715	39.5	38.5	39	305	176	991		155	9.5	13.8	15	3.7	681	2010	185.4	2340	7.22	7.04	15.4	15
1-Apr	1535	39	38	39	305	176	166		155	6	13.8	14.9	3.7	089	2000	187.7	2340	7.15	7.01	15.1	15
2-Apr	0740	39	38	39	305	176	166		155	6	13.9	15	3.7	682	2010	186.6	2350	7.21	7.1	15.2	15
2-Apr	1530	39	38	39	305	175	166		155	6	13.8	15	3.7	089	2010	187	2360	7.21	7.05	15.5	15
3-Apr	0720	39	38	39	305	175	165		155	6	13.9	15	3.7	682	2010	186.6	2350	7.24	7.06	15.5	15
3-Apr	1530	41	40	40	305	175	165		155	6	13.8	15	3.7	675	1999	189.4	2330	7.26	7.11	15.5	15
11-Apr	1540	37	36	36.5	301	95	76		- 59	9.5	11.2	15.1	3.7	700	1447	160.7	2560	7.3	7.13	16.3	15
12-Apr	0715	37	36	37	302	96	08		99	6	11.7	15	3.7	682	1544	163.2	2390	7.09	66.9	16.9	15
12-Apr	1540	37	36	37	302	66	81		69	6	12	15	3.7	069	1607	163.7	2410	7.31	7.26	16.7	15
13-Apr	0745	38.5	37	37	301	100	85		73	6	12.5	15	3.7	683	1669	180.7	2400	7.19	7.21	16.3	15
14-Apr	0230	38.5	37	37.5	301	105	68		77	6	12.8	14.8	3.7	694	1671	171.1	2408	7.2	7.17	16.9	15
14-Apr	1530	37.5	36.5	37	303	109	93		81	9.5	13	14.9	3.7	687	1791	189.5	2400	7.32	7.2	16.9	15
15-Apr	0730	38	36.5	37	302	115	86		87	9.5	13.4	15	3.4	689	1889	182.4	2370	7.19	7.26	16.7	15





PILOT TEST PROGRAM FRISCO WATER PLANT Month: APRIL

| Membrane | Flux | Recovery pH | TEST CONDITIONS | |

)	•	Month:	AFRIL			IESI CO	CONDITIONS													
PARA	PARAMETER		•			PRESSURE					FLOW			Ιf	CONDUCTIVITY, AquaLynx	Y, AquaLyn		lŀ	_	TEMP.	
700T	LOCATION	Cartli	Cart Out	Pump inlet	Pump Out	Feed	1st St out	2nd St feed	Conc	Permeate	1st St Perm	Total Perm	Conc	Feed	Interstage GV/ 6	Permeate	Conc.	Feed	Permeate cv.7	Feed	**************************************
NO UN	UNITS			7-1-2	-	in. PSI		1		-11-	gallons	gallons/minute, GPM	7-34	1-3	Microsiemens, μS	ens, µS	†	T-GV	/-46	Deg C	±
Date	Time																				į
15-Apr	1500	38	36	37	302	115	66		87	9.5	13.5	15	3.4	989	1922	181.6	2382	7.3	7.19	16.6	15
16-Apr	0730	38.5	37	37	302	114	97		87	6	13.5	15.1	3.7	589	1919	167.9	2380	7.21	7.1	16.1	15
17-Apr	0715	38.5	36.5	36	303	126	112		100	9.5	13.5	15	3.7	069	1975	165.6	2400	7.03	7.14	16.5	15
17-Apr	1530	38	37	36.5	301	120	104		8	9.5	13.6	15.1	3.7	683	1968	163.2	2420	7.35	7.56	9:91	15
18-Apr	0735	38	36	36	302	120	105		94	9.5	13.7	15.1	3.7	189	1971	162.9	2410	7.33	7.32	16.2	15
18-Apr	1535	38	36	36	301	120	105		93	9.5	13.5	15	3.7	629	1975	163.9	2400	7.14	7.29	16.7	15
19-Apr	0725	39	36.5	36.5	303	120	105		94	9.5	13.6	15	3.7	683	1993	165.4	2420	7.17	7.21	16.2	15
24-Apr	1630	37	36	37	300	06	70		55	9.5	11.1	15.1	3.6	705	1526	193.6	2390	7.06	7.2	16.5	15
25-Apr	0730	38.5	37	37.5	302	16	73		99	9.5	11.3	15	3.7	589	1470	171.9	2410	7.11	7.3	16.7	15
25-Apr	1615	35.5	33.5	34	294	110	87		69	10.5	13	17	4.2	683	1515	158.3	2420	7.26	7.09	17.8	15
26-Apr	0710	36.5	34	35	295	110	90		75	10.5	13.5	17	4.2	682	1595	150.9	2390	7.42	7.16	18.1	15
26-Apr	1520	35.5	33	34	295	115	06		75	11.5	13.7	17	4.2	683	1590	159.2	2440	7.21	7.09	18.1	15
27-Apr	0730	36	33	34	290	113	91		75	11.5	13.6	17.1	4.2	689	1605	167.3	2480	7.28	7.11	18.5	15
27-Apr	1530	39.5	36.5	37.5	306	97	82		73	6	12.3	14.8	2.8	169	1590	162.4	2490	7.35	7.21	18.4	15
28-Apr	0230	40	36.5	37.5	305	104	90		81	6	13.2	15	2.6	691	1964	188.5	2770	7.21	7.32	20.3	15
28-Apr	1530	40	36.5	38	305	106	92		85	6	13.3	15	2.6	689	1924	176.2	2715	7.07	7.29	8.61	15
29-Apr	0730	40	37	37.5	306	110	97		06	6	13.5	15	2.7	692	2300	189.5	2850	7.02	7.12	6.61	15
29-Apr	1530	40	36.5	37.5	306	115	103		95	6	13.5	14.9	2.7	889	2350	198.2	2830	7.11	7.09	19.8	15
30-Apr	0745	38.5	35.5	36	305	126	116		109	6	14	15	2.6	621	2420	219	2760	7.01	7.07	19.9	15
1-May	0730	39.5	35	35.5	305	131	121		114	6	13.9	14.9	2.6	669	2490	198.7	2910	7.09	7.31	18.9	15
1-May	1520	39	34.5	35.5	304	145	134		126	9.5	14	15	2.6	989	2480	195.9	2900	7.27	7.21	18.8	15
2-May	0725	39	35	36	305	155	145		140	6	14.2	15.1	2.6	589	2460	201	2900	7.29	7.09	18.5	15
2-May	0830	39	35	36	304	130	120		Ξ	6	14	15	2.7	169	2360	213	2740	7.31	7.21	18.9	15
2-May	1530	39	34	36	305	135	125		120	6	14.3	15	2.5	829	2520	212	2930	7.25	7.23	19.4	15
3-Мау	0715	39.5	35.5	36	305	140	130		124	10	14.2	14.9	2.6	685	2520	212	2880	7.09	7.07	18.9	15
3-May	1515	39	35	36	305	144	133		126	∞	14.4	15.1	2.6	723	2510	248	2850	7.14	7.15	18.8	15
4-May	0720	39	35	36	305	148	138		130	8	14.4	15	2.6	723	2500	248	2820	7.21	7.09	18.8	15
4-May	1600	39	35	36	305	150	140		132	8	14.4	15	2.6	712	2509	240	2800	7.32	7.11	18.9	15
5-May	0730	39	36	36.5	305	150	140		133	6	14.2	14.9	2.6	720	2510	212	2840	7.28	7.1	18.7	15
5-May	1530	39.5	35.5	36.5	305	151	141		134	6	14.2	14.9	2.6	689	2480	218	2800	7.29	7.12	19.5	15
														\dashv							
																			1		





Fig. Recovery pilk	Fig. Recovery pH	Cont. Part. Recovery Part. P	PILOT TEST PROGRAM	PILOT TES	PILOT TES		T PROC	SRAM																
15 15 16 17 18 18 18 18 18 18 18	137 144 151 154	11 12 13 14 14 14 14 14 14 14	FRISCO WATER PLANT Month: MAY TEST C	WATER PLANT MA Y	WATER PLANT MA Y	Mem	Mem	Membrane TEST C	Membrane TEST C	⊢ ₹	orane TEST CONDITIONS	Flux	Recovery	Hd										
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	Cone Permene 1451 Perm Tokal Perm Cone Permene P	14.0 Conc. Permission 14.5 Permission Permiss	PRESSURE	PRESSURE	PRESSURE	PRESSURE	PRESSURE			1				FLO	W, AquaLynx			CONDUCTIVI	TY, AquaLy		1 }	Hq	TEMP.	
8 144 15 2.6 688 2490 244 200 100 70 70 100 100 8 144 15 2.6 681 2490 244 201 70 70 193 9 144 15 2.6 681 2390 246 70 70 196 193 8.5 144 15 2.6 681 2390 246 70 70 196 193 8.5 144 15 2.6 681 2390 246 70 70 188 190 689 190 190 188 190 190 188 190 190 188 190 190 188 190	8 144 15 2.6 688 2496 246 281 7.0 7.06 8 144 15 2.6 688 2496 246 281 7.0 7.0 7.0 8 144 15 2.6 681 2496 246 280 7.0 7.0 7.0 8.5 144 15 2.6 681 2496 246 280 7.0 7.0 7.0 8.5 144 15 2.6 681 2806 246 280 7.0 7.0 7.0 1.0 14.1 14.5 15.1 2.6 681 2540 20 20 7.0 7.0 7.0 8.5 14.4 15 2.6 671 2560 280 280 280 7.0 7.0 7.0 8.5 14.4 15 2.6 720 2560 280 20 7.0 7.0 7.0 9. </th <th>8 144 15 2.6 688 2490 244 281 7.0 7.06 19.3 8 144 15 2.6 688 2490 244 281 7.0 7.0 19.3 9 144 15 2.6 688 2490 236 286 7.0 7.0 19.3 8.5 144 15 2.6 684 2360 239 286 7.0 7.0 19.8 8.5 14.5 151 2.6 681 2360 236 286 7.0 7.0 19.8 1.0 14.1 14.5 2.6 741 2505 236 286 286 289 7.0 18.8 1.0 14.1 15 2.6 741 2505 289 286 289 7.0 18.8 8.5 14.2 15 2.6 741 250 280 296 280 7.0 18.8</th> <th>Cart In Cart Out Pump inlet Pump Out PI-1 PI-2 PI-3</th> <th> Cart Out Pump inlet Pump Out Feed 1st Pl-2 Pl-3 </th> <th> Cart Out Pump inlet Pump Out Feed 1st Pl-2 Pl-3 </th> <th>Pump Out Feed 1st PI-3</th> <th>Pump Out Feed 1st PI-3</th> <th>181</th> <th>티</th> <th><u>₹</u></th> <th>2nd St feed 4</th> <th>Cone</th> <th>Permeate PI-6</th> <th>1st St Perm FE-3</th> <th>Total Perm FE-1</th> <th>+</th> <th>Feed CE-1</th> <th>Interstage SV-5</th> <th>Permeate CE-2</th> <th></th> <th></th> <th>Permeate SV-7</th> <th>Feed SV-1</th> <th>Well#</th>	8 144 15 2.6 688 2490 244 281 7.0 7.06 19.3 8 144 15 2.6 688 2490 244 281 7.0 7.0 19.3 9 144 15 2.6 688 2490 236 286 7.0 7.0 19.3 8.5 144 15 2.6 684 2360 239 286 7.0 7.0 19.8 8.5 14.5 151 2.6 681 2360 236 286 7.0 7.0 19.8 1.0 14.1 14.5 2.6 741 2505 236 286 286 289 7.0 18.8 1.0 14.1 15 2.6 741 2505 289 286 289 7.0 18.8 8.5 14.2 15 2.6 741 250 280 296 280 7.0 18.8	Cart In Cart Out Pump inlet Pump Out PI-1 PI-2 PI-3	Cart Out Pump inlet Pump Out Feed 1st Pl-2 Pl-3	Cart Out Pump inlet Pump Out Feed 1st Pl-2 Pl-3	Pump Out Feed 1st PI-3	Pump Out Feed 1st PI-3	181	티	<u>₹</u>	2nd St feed 4	Cone	Permeate PI-6	1st St Perm FE-3	Total Perm FE-1	+	Feed CE-1	Interstage SV-5	Permeate CE-2			Permeate SV-7	Feed SV-1	Well#
8 144 15 26 689 2490 244 280 144 15 26 681 2490 246 2810 711 712 195 9 144 145 145 145 146 145 240 230 250 270 709 711 186 18 85 144 15 26 664 2500 286 700 700 188 18 10 14.1 15 26 741 2510 270 700 700 188 190 86 190 188 189 180 180 280 280 280 280 190 188 180 180 180 280 280 280 280 190 180	8 144 15 26 683 2860 244 210 710 706 8 144 15 26 681 2860 246 2810 713 713 714 9 141 143 26 684 2500 239 708 714 714 10 143 151 26 644 2500 279 700 714 10 141 15 26 741 2510 280 710 710 85 144 15 26 770 2860 280 710 710 85 143 145 27 700 2860 280 710 710 85 143 145 27 600 2860 280 710 710 85 144 15 26 674 2860 280 710 710 85 144 15 26 67	8 144 15 26 689 2490 244 2810 718 718 189	UNITS pounds/sq.in. PSI	pounds/sq.in. PSI	pounds/sq.in. PSI	pounds/sq.in. PSI	pounds/sq.in. PSI	in. PSI		\Box				gallo.	ns/minute, GPM			Microsic	mens, µS				o neg c	
8 144 15 26 681 2496 246 214 114 149 26 684 2500 236 286 718 714 18 9 141 142 26 684 2500 236 286 736 714 18 8.5 144 15 26 681 256 217 286 280 702 689 18 8.6 143 15 26 70 2560 208 70 70 18 9 144 15 26 70 2580 209 70 18 19 9 144 15 26 70 2580 209 70 70 19 9.5 144 15 26 693 2560 204 200 70 70 19 9.5 144 15 26 693 2560 201 70 70 19	8 144 15 26 681 2496 266 280 280 281 718 721 9 141 149 26 684 2800 299 2860 708 714 9 143 151 26 684 2800 239 2860 708 714 10 141 15 26 741 2540 210 280 712 712 8 143 15 26 70 280 280 712 689 71 701 8 143 15 26 70 280 280 280 71 701 9 144 15 26 70 280 290 71 701 9 144 15 26 695 2560 204 280 71 701 9 144 15 26 692 280 290 71 701 </td <td>8 144 15 26 684 2366 236 236 738 713 731 186 9 1431 143 26 644 2500 250 708 714 18 8.5 144 15 26 741 2500 709 709 709 719 18 10 143 15 26 741 2500 210 2000 702 709 18 10 141 15 26 740 2500 210 2000 702 709 188 8 143 15 26 70 2580 240 700 189 18 9 144 15 16 607 2580 269 712 700 18 8 9 144 15 26 607 2580 269 712 18 8 9 144 15 26 607</td> <td>0745 39.5 35.5 36 305 155 145</td> <td>35.5 36 305 155</td> <td>36 305 155</td> <td>305 155</td> <td>155</td> <td></td> <td>145</td> <td>Н</td> <td></td> <td>137</td> <td>*</td> <td>14.4</td> <td>15</td> <td>2.6</td> <td>889</td> <td>2490</td> <td>244</td> <td>2810</td> <td>7.01</td> <td>7.06</td> <td>19.3</td> <td>15</td>	8 144 15 26 684 2366 236 236 738 713 731 186 9 1431 143 26 644 2500 250 708 714 18 8.5 144 15 26 741 2500 709 709 709 719 18 10 143 15 26 741 2500 210 2000 702 709 18 10 141 15 26 740 2500 210 2000 702 709 188 8 143 15 26 70 2580 240 700 189 18 9 144 15 16 607 2580 269 712 700 18 8 9 144 15 26 607 2580 269 712 18 8 9 144 15 26 607	0745 39.5 35.5 36 305 155 145	35.5 36 305 155	36 305 155	305 155	155		145	Н		137	*	14.4	15	2.6	889	2490	244	2810	7.01	7.06	19.3	15
9 141 149 2.6 694 2350 236 286 718 719 184 184 9 145 151 2.6 681 2505 246 2870 709 711 184 8.5 144 15 2.6 741 2500 210 2890 717 701 188 9 144 15 2.6 730 2560 248 3010 688 689 197 8.5 144 15 2.6 730 2560 228 290 71 701 195 9.5 144 15 2.6 730 2560 228 290 71 701 195 9.5 144 15 2.6 693 2560 229 280 71 708 195 9.5 144 15 2.6 693 2560 220 280 71 71 196 9.2	9 141 149 26 684 2800 239 286 718 714 8 145 151 26 681 2565 246 2870 709 711 8 14 15 26 741 2510 270 709 711 10 141 15 26 70 2830 210 2980 712 8 144 15 26 70 2890 280 70 71 701 95 144 15 26 70 2580 20 280 70 71 701 95 144 15 26 694 2560 20 280 70 71 708 95 144 15 26 694 2560 20 280 70 71 70 85 144 15 26 694 2560 20 280 70 71 <	9 141 145 2.6 684 2.500 239 286 7.0 7.1 184 9 145 151 2.6 681 2.550 2.4 2.7 1.1 1.8 1.1 1.8 1.1 1.1 1.8 1.1 1.1 1.8 1.1 1.1 1.1 1.8 1.1 1.1 1.1 1.1 1.8 1.1 1.1 1.1 1.1 1.8 1.1 2.6 7.0 2.560 2.0 <td>1515 40 36 36 305 155 145</td> <td>36 36 305 155</td> <td>36 305 155</td> <td>305 155</td> <td>155</td> <td>_</td> <td>145</td> <td>\dashv</td> <td></td> <td>138</td> <td>*</td> <td>14.4</td> <td>15</td> <td>2.6</td> <td>189</td> <td>2496</td> <td>246</td> <td>2819</td> <td>7.18</td> <td>7.21</td> <td>19.6</td> <td>15</td>	1515 40 36 36 305 155 145	36 36 305 155	36 305 155	305 155	155	_	145	\dashv		138	*	14.4	15	2.6	189	2496	246	2819	7.18	7.21	19.6	15
8 145 151 26 681 2365 246 2870 709 711 184 8 14 15 26 741 2510 217 3040 712 700 188 10 141 15 26 74 2540 210 2980 702 699 189 8 144 15 26 790 2590 204 5910 699 189 9 144 15 26 70 2580 204 5910 70 195 95 144 15 26 697 2580 204 70 70 196 95 144 15 26 697 2580 20 70 70 196 9 144 15 26 699 2560 230 70 70 196 8 144 15 26 699 2560 20 70	9 145 151 26 681 2505 246 280 710 711 712 711 712 711 712 711 712 711 712 712 712 712 712 712 712 712 712 712 712 712 712 712 712 712 712	9 144 151 26 681 256 741 256 741 250 277 340 712 791 188 85 14 15 26 741 250 277 340 712 360 210 280 710 188 81 143 15 26 700 2890 280 280 189 189 189 85 144 15 26 700 2890 280 280 189 189 189 95 144 15 26 697 2580 280 280 771 701 180 95 144 15 26 697 2560 280 280 280 280 170 180 9 144 15 26 697 2560 280 280 170 180 8 144 15 26 694 2560 280	0730 40.5 36.5 36 305 157 148	36.5 36 305 157	36 305 157	305 157	157		148	+		140	6	14.1	14.9	2.6	469	2500	239	2860	7.08	7.14	18	15
8.5 14 15 2.6 741 2510 217 3040 712 701 188 10 141 15 2.6 708 2540 210 2980 702 6.99 189 8 145 15 2.6 700 2580 248 3010 6.98 6.89 19.7 9.5 144 15 2.6 700 2580 206 701 10.2 9.5 144. 15 2.6 697 2580 206 701 701 10.9 9.5 144. 15 2.6 697 2580 207 2870 70 11.4 11.6 11	8.5 14 15 2.6 741 2510 217 3040 712 701 10 14.1 15 2.6 708 2540 210 2980 702 6.99 8 14.5 15 2.6 700 2580 218 3010 6.98 6.89 9.5 14.4 15 2.6 700 2580 204 2010 7.1 7.01 9.5 14.4 15 2.6 700 2580 204 2010 7.1 7.01 9.5 14.4 15 2.6 694 2580 236 280 7.1 7.14 9 14.4 15 2.6 694 2560 207 280 7.1 7.14 9 14.4 15 2.6 694 2560 207 280 7.0 7.0 8.5 14.5 15 2.6 694 2560 207 280 7.0	8.5 14 15 2.6 741 2510 271 340 712 70 18.8 10 14.1 15 2.6 708 2540 210 286 70 6.99 18.9 8 14.5 15 2.6 700 2590 20 236 70 70 19.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 19.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 <	1540 40 36 37 305 165 155	36 37 305 165	37 305 165	305 165	165		155	\dashv		146	6	14.5	15.1	2.6	189	2505	246	2870	7.09	7.1	18.4	15
10 14.1 15 2.6 708 2340 210 2980 702 6.99 18.9 8 14.5 15 2.6 730 2580 234 3010 6.98 6.89 19.7 8 14.4 15 2.6 730 2580 234 3010 6.98 6.89 19.7 8.5 14.3 14.9 2.7 6.70 2580 204 7.0 7.1 19.5 9.5 14.4 15.1 2.6 695 2580 234 280 7.0 7.1 19.5 9 14.4 15 2.6 695 2560 200 280 7.1 7.0 18.6 9 14.4 15.1 2.6 695 2560 200 2310 7.0 7.1 18.6 9 14.4 15.1 2.6 696 2580 220 2810 7.0 7.1 18.7 8.5 <td< td=""><td>10 141 15 26 708 2540 210 2980 702 699 8 145 15 26 700 2680 248 3010 698 689 9 144 15 26 700 2590 201 701 701 85 143 143 26 700 2580 280 701 701 95 144 151 26 693 2580 240 702 701 95 144 15 26 694 2560 200 280 280 701 701 9 144 15 26 694 2560 201 280 701 701 9 144 15 26 694 2560 220 280 701 701 8 144 15 26 694 2560 201 280 701 8 144 15<!--</td--><td>10 141 15 26 708 2340 210 708 699 189 189 8 145 15 26 730 2860 248 3010 689 689 197 9 144 15 26 700 2590 204 2790 701 701 192 95 144 151 26 693 2560 204 2890 703 714 186 95 144 15 26 693 2560 204 2890 703 701 195 9 143 15 26 693 2560 204 280 703 703 196 9 144 15 26 693 2560 204 280 703 704 186 85 144 15 26 693 2560 204 200 703 703 186 85 144 <</td><td>1530 35 30 30.5 300 121 109</td><td>30 30.5 300 121</td><td>30.5 300 121</td><td>300 121</td><td>121</td><td></td><td>109</td><td></td><td></td><td>100</td><td>8.5</td><td>14</td><td>15</td><td>2.6</td><td>741</td><td>2510</td><td>217</td><td>3040</td><td>7.12</td><td>7.01</td><td>18.8</td><td>15</td></td></td<>	10 141 15 26 708 2540 210 2980 702 699 8 145 15 26 700 2680 248 3010 698 689 9 144 15 26 700 2590 201 701 701 85 143 143 26 700 2580 280 701 701 95 144 151 26 693 2580 240 702 701 95 144 15 26 694 2560 200 280 280 701 701 9 144 15 26 694 2560 201 280 701 701 9 144 15 26 694 2560 220 280 701 701 8 144 15 26 694 2560 201 280 701 8 144 15 </td <td>10 141 15 26 708 2340 210 708 699 189 189 8 145 15 26 730 2860 248 3010 689 689 197 9 144 15 26 700 2590 204 2790 701 701 192 95 144 151 26 693 2560 204 2890 703 714 186 95 144 15 26 693 2560 204 2890 703 701 195 9 143 15 26 693 2560 204 280 703 703 196 9 144 15 26 693 2560 204 280 703 704 186 85 144 15 26 693 2560 204 200 703 703 186 85 144 <</td> <td>1530 35 30 30.5 300 121 109</td> <td>30 30.5 300 121</td> <td>30.5 300 121</td> <td>300 121</td> <td>121</td> <td></td> <td>109</td> <td></td> <td></td> <td>100</td> <td>8.5</td> <td>14</td> <td>15</td> <td>2.6</td> <td>741</td> <td>2510</td> <td>217</td> <td>3040</td> <td>7.12</td> <td>7.01</td> <td>18.8</td> <td>15</td>	10 141 15 26 708 2340 210 708 699 189 189 8 145 15 26 730 2860 248 3010 689 689 197 9 144 15 26 700 2590 204 2790 701 701 192 95 144 151 26 693 2560 204 2890 703 714 186 95 144 15 26 693 2560 204 2890 703 701 195 9 143 15 26 693 2560 204 280 703 703 196 9 144 15 26 693 2560 204 280 703 704 186 85 144 15 26 693 2560 204 200 703 703 186 85 144 <	1530 35 30 30.5 300 121 109	30 30.5 300 121	30.5 300 121	300 121	121		109			100	8.5	14	15	2.6	741	2510	217	3040	7.12	7.01	18.8	15
8 14.5 15 2.6 730 2.680 2.94 310 6.98 6.89 19.7 9 14.4 15 2.6 700 2590 205 2070 7.1 7.01 19.2 8.5 14.4 15 2.6 697 2580 229 7.05 7.1 7.01 19.5 9.5 14.4 15.1 2.6 693 2580 229 7.03 7.12 7.08 19.1 9.5 14.4 15.1 2.6 693 2580 230 27.0 7.1 7.03 19.6 9 14.4 15.1 2.6 693 2580 230 230 7.1 7.04 18.6 9 14.4 15.1 2.6 693 2580 231 300 7.1 7.09 19.5 8.5 14.4 15 2.6 693 2580 231 300 7.1 7.0 11.8	8 145 15 26 730 2680 248 3010 6.98 689 9 144 15 26 700 2590 205 297 71 701 85 143 149 27 697 2560 204 291 71 95 144 151 26 693 2580 290 71 708 95 144 15 26 693 2580 280 711 708 9 143 15 26 694 2580 280 71 708 9 144 15 26 694 2580 281 71 708 9 144 15 26 694 2580 281 71 709 85 144 15 26 694 2580 27 70 70 85 144 15 26 673 250 70	8 145 15 26 730 2680 288 3010 6.88 6.89 197 9 144 115 2.6 700 2590 204 701 701 192 9.5 144. 11. 2.6 697 2560 204 700 71. 186 9.5 144. 15. 2.6 693 2560 239 703 703 19. 9.5 144. 15. 2.6 693 2560 239 700 70 19. 9. 143 15. 2.6 694 2560 230 280 70 19. 19. 9. 144 15. 2.6 694 2560 204 280 70 19. 19. 19. 9. 144 15. 2.6 694 2560 201 201 70 19. 19. 8.5 144 15 2.6 68	0800 32.5 26 27 295 133 120	26 27 295 133	27 295 133	295 133	133	_	120	+		114	10	14.1	15	2.6	708	2540	210	2980	7.02	66.9	18.9	15
85 144 15 26 700 2390 205 207 701 701 701 195 85 143 143 2.7 697 2560 204 201 7.0 7.0 191 195 95 146 151 2.6 695 2580 229 280 7.0 7.1 186 95 144 15 2.6 695 2280 229 7.2 679 186 9 143 15 2.6 694 2260 207 280 7.2 679 186 9 144 151 2.6 694 2260 227 280 7.1 7.0 186 9 144 151 2.6 694 2360 221 280 7.1 186 196 8.5 144 15 2.6 694 2360 221 280 7.1 186 8.5 144	9 144 15 26 700 2590 205 290 7.1 701 8.5 143 149 2.7 697 2560 204 2910 7.05 7.1 9.5 146 15.1 2.6 687 2580 236 239 7.03 7.14 9.5 14.3 15 2.6 685 2580 236 230 7.12 7.08 9 14.3 15 2.6 685 2580 230 280 7.14 9 14.4 15.1 2.6 680 2580 230 280 7.14 9 14.4 15.1 2.6 680 2580 230 280 7.10 8.5 14.4 15.1 2.6 670 2580 230 270 280 9.5 14.4 15 2.6 672 2590 231 200 7.11 9.5 14.4 15	85 1144 115 2.6 700 2590 205 2970 7.1 701 19.5 85 143 149 2.7 697 2560 204 290 7.06 7.1 10.5 95 1446 15.1 2.6 697 2560 204 290 7.06 7.1 10.5 95 144.6 15.1 2.6 695 2560 20.0 280 7.1 10.8 10.1 9 143 15 2.6 695 2560 230 2810 7.1 7.06 19.1 9 144 15.1 2.6 695 2560 230 280 7.1 7.06 19.5 8 144 15.1 2.6 688 2520 231 3040 7.1 7.05 19.6 8.5 144 15 2.6 727 250 221 300 7.1 7.05 118.4	1530 32 27 28 295 133 121	27 28 295 133	28 295 133	295 133	133		121	4		114	8	14.5	15	2.6	730	2680	248	3010	86.9	68.9	19.7	15
8.5 14.9 14.9 2.7 697 2560 204 201 7.06 7.1 195 9.5 14.6 15.1 2.6 695 2580 249 280 7.03 7.14 186 9.5 14.4 15 2.6 694 2560 220 280 7.12 7.03 19.1 9 14.3 15 2.6 694 2560 207 280 7.1 7.0 18.6 9 14.3 15 2.6 695 2565 220 280 7.1 7.0 679 18.6 9 14.4 15 2.6 695 2565 220 280 7.1 7.0 679 18.6 8.5 14.2 15 2.6 688 2550 231 20 7.1 18.6 19.6 8.5 14.4 15 2.6 7.2 250 221 230 7.1 7.1 18.6 </td <td>8.5 14.9 2.7 697 2560 204 2910 7.06 7.11 9.5 14.6 151 2.6 685 2580 239 2830 7.03 7.14 9.5 14.4 15 2.6 685 2580 236 7.03 7.12 7.08 9.5 14.3 15 2.6 684 2560 207 2870 7.12 7.08 9 14.3 15 2.6 689 2566 200 280 7.12 6.79 8.5 14.3 15 2.6 689 2560 280 7.12 7.09 8.5 14.4 15 2.6 689 2580 21 300 7.11 7.09 8.5 14.4 15 2.6 772 2570 225 3040 7.12 7.09 9.2 14.4 15 2.6 772 2580 257 3040 7.16 7.19</td> <td>8.5 14.3 14.9 2.7 69.7 256.0 20.4 29.0 7.06 7.11 19.5 9.5 14.6 15.1 2.6 69.7 258.0 249 2830 7.03 7.14 18.6 9.5 14.4 15 2.6 69.0 2580 236 7.01 7.02 19.1 9.5 14.3 15 2.6 69.0 2580 231 3040 7.12 7.08 19.1 9 14.4 15.1 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15.1 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15.2 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15 2.6 69.0 2580 231 301 7.12 707 11.8</td> <td>0730 30 25 26 295 133 123</td> <td>25 26 295 133</td> <td>26 295 133</td> <td>295 133</td> <td>133</td> <td></td> <td>123</td> <td></td> <td></td> <td>115</td> <td>6</td> <td>14.4</td> <td>15</td> <td>2.6</td> <td>700</td> <td>2590</td> <td>205</td> <td>2970</td> <td>7.1</td> <td>7.01</td> <td>19.2</td> <td>15</td>	8.5 14.9 2.7 697 2560 204 2910 7.06 7.11 9.5 14.6 151 2.6 685 2580 239 2830 7.03 7.14 9.5 14.4 15 2.6 685 2580 236 7.03 7.12 7.08 9.5 14.3 15 2.6 684 2560 207 2870 7.12 7.08 9 14.3 15 2.6 689 2566 200 280 7.12 6.79 8.5 14.3 15 2.6 689 2560 280 7.12 7.09 8.5 14.4 15 2.6 689 2580 21 300 7.11 7.09 8.5 14.4 15 2.6 772 2570 225 3040 7.12 7.09 9.2 14.4 15 2.6 772 2580 257 3040 7.16 7.19	8.5 14.3 14.9 2.7 69.7 256.0 20.4 29.0 7.06 7.11 19.5 9.5 14.6 15.1 2.6 69.7 258.0 249 2830 7.03 7.14 18.6 9.5 14.4 15 2.6 69.0 2580 236 7.01 7.02 19.1 9.5 14.3 15 2.6 69.0 2580 231 3040 7.12 7.08 19.1 9 14.4 15.1 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15.1 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15.2 2.6 69.0 2580 231 3040 7.11 706 19.5 8.5 14.4 15 2.6 69.0 2580 231 301 7.12 707 11.8	0730 30 25 26 295 133 123	25 26 295 133	26 295 133	295 133	133		123			115	6	14.4	15	2.6	700	2590	205	2970	7.1	7.01	19.2	15
95 1446 151 26 697 2380 249 2830 703 714 186 95 144 15 26 693 2590 236 2810 712 708 191 95 144 15 26 694 2560 236 2810 712 708 191 9 143 15 26 699 2580 212 3070 711 706 186 9 144 151 26 699 2580 231 3070 711 706 186 85 145 15 26 688 2550 231 3040 701 706 195 85 144 15 26 688 2550 221 3040 706 195 95 144 15 26 73 2730 222 3060 712 186 95 144 15 26	95 1446 151 26 694 2580 289 2890 703 714 95 144 15 26 695 2550 236 2810 712 708 95 143 15 26 694 2560 200 2810 712 708 9 143 15 26 699 2580 230 2810 711 708 9 144 151 26 699 2580 231 3070 711 706 8 145 15 26 689 2580 231 3070 711 706 8 144 15 26 688 2550 231 3040 71 695 95 144 15 26 771 2720 225 3020 707 71 95 144 15 26 772 2590 236 707 71 71 <td>95 146 151 26 697 2580 239 239 703 714 186 95 1444 15 26 6695 2590 236 2810 712 708 191 95 143 15 26 6694 2560 200 2810 712 704 186 9 1443 151 26 669 2580 201 2810 712 704 186 9 1444 151 26 688 2560 212 3070 711 704 186 85 1444 15 26 688 2550 216 290 712 707 709 195 85 1444 15 26 727 260 221 300 712 709 196 95 1444 15 26 734 2730 221 300 716 719 184 9</td> <td>1530 30 25.5 26 295 136 126</td> <td>25.5 26 295 136</td> <td>26 295 136</td> <td>295 136</td> <td>136</td> <td>4</td> <td>126</td> <td>- 1</td> <td></td> <td>119</td> <td>8.5</td> <td>14.3</td> <td>14.9</td> <td>2.7</td> <td>269</td> <td>2560</td> <td>204</td> <td>2910</td> <td>7.06</td> <td>7.1</td> <td>19.5</td> <td>15</td>	95 146 151 26 697 2580 239 239 703 714 186 95 1444 15 26 6695 2590 236 2810 712 708 191 95 143 15 26 6694 2560 200 2810 712 704 186 9 1443 151 26 669 2580 201 2810 712 704 186 9 1444 151 26 688 2560 212 3070 711 704 186 85 1444 15 26 688 2550 216 290 712 707 709 195 85 1444 15 26 727 260 221 300 712 709 196 95 1444 15 26 734 2730 221 300 716 719 184 9	1530 30 25.5 26 295 136 126	25.5 26 295 136	26 295 136	295 136	136	4	126	- 1		119	8.5	14.3	14.9	2.7	269	2560	204	2910	7.06	7.1	19.5	15
9.5 144 15 26 693 2390 236 2810 7.12 7.08 19.1 9.5 14.3 15 2.6 694 2360 207 2870 7.12 7.04 186 9 14.3 15 2.6 699 2360 230 2810 7.12 7.14 18.5 9 14.4 15.1 2.6 690 2380 21.2 3070 7.11 7.06 19.5 8.5 14.4 15.1 2.6 690 2380 21.2 3070 7.11 7.06 19.5 8.5 14.4 15. 2.6 734 2590 22.7 3040 7.12 0.09 19.5 8.5 14.4 15 2.6 734 2730 2250 227 3040 7.12 0.09 19.5 9.5 14.4 15 2.6 734 2730 225 300 7.12 0.09 19	9.5 144 15 2.6 695 2590 236 2810 7.12 7.08 9.5 14.3 15 2.6 694 2560 207 2870 7.12 7.08 9 14.3 15 2.6 699 2565 230 2810 7.12 7.14 9 14.4 15.1 2.6 690 2580 231 3070 7.11 7.06 8.5 14.2 14.9 2.6 7.34 2580 2.1 300 7.11 7.06 8.5 14.4 15 2.6 7.77 2670 2.23 3020 7.11 7.06 9.5 14.4 15 2.6 7.71 2670 2.25 300 7.12 6.95 9.5 14.4 15 2.6 7.71 2.60 2.25 300 7.12 7.02 9.5 14.4 15 2.6 7.72 2.70 2.25 3.00 </td <td>95 144 15 26 699 2560 236 236 271 772 708 191 95 143 15 26 699 2560 207 2810 712 714 185 9 143 15 26 699 2560 2280 271 711 706 195 9 1444 151 26 699 2580 221 3070 711 706 195 85 1445 15 26 699 2580 221 3070 711 706 195 85 144 15 26 688 2550 221 3070 721 695 195 85 144 15 26 688 2550 221 300 712 709 184 9 144 15 26 723 225 300 721 709 184 8 144</td> <td>0730 30 26 26 295 145 135</td> <td>26 26 295 145</td> <td>26 295 145</td> <td>295 145</td> <td>145</td> <td></td> <td>135</td> <td></td> <td></td> <td>129</td> <td>9.5</td> <td>14.6</td> <td>15.1</td> <td>2.6</td> <td>269</td> <td>2580</td> <td>249</td> <td>2830</td> <td>7.03</td> <td>7.14</td> <td>18.6</td> <td>15</td>	95 144 15 26 699 2560 236 236 271 772 708 191 95 143 15 26 699 2560 207 2810 712 714 185 9 143 15 26 699 2560 2280 271 711 706 195 9 1444 151 26 699 2580 221 3070 711 706 195 85 1445 15 26 699 2580 221 3070 711 706 195 85 144 15 26 688 2550 221 3070 721 695 195 85 144 15 26 688 2550 221 300 712 709 184 9 144 15 26 723 225 300 721 709 184 8 144	0730 30 26 26 295 145 135	26 26 295 145	26 295 145	295 145	145		135			129	9.5	14.6	15.1	2.6	269	2580	249	2830	7.03	7.14	18.6	15
9,5 14,3 15 2,6 694 2560 207 2870 7.2 6.79 18.6 9 14,3 15 2,6 695 2565 230 2810 7.12 7.14 18.5 9 14,4 15.1 2,6 696 2580 212 3070 7.11 7.06 19 8.5 14,2 14,9 2,6 734 2590 231 3040 701 6.96 19.5 8.5 14,4 15 2,6 688 2550 216 2930 7.07 7.07 19.6 8.5 14,4 15 2,6 737 2670 227 3040 7.07 7.07 19.6 9.5 14,4 15 2,6 734 2730 225 3020 7.07 7.07 18.4 9.5 14,4 15 2,6 732 2590 231 3040 7.07 7.07 18.4	9,5 14,3 15 2,6 694 2560 207 2870 712 6.79 9 14,3 15 2,6 695 2565 230 2810 7.12 7.14 9 14,4 15.1 2,6 690 2380 212 3070 7.11 7.06 9 14,4 15 2,6 734 2390 212 3070 7.11 7.06 8.5 14,4 15 2,6 688 2350 216 290 7.22 6.95 8.5 14,4 15 2,6 734 2730 225 300 7.12 7.07 9.5 14,4 15 2,6 731 2730 225 3040 7.12 7.07 9.5 14,4 15 2,6 731 2720 227 3040 7.16 7.19 8.5 14,4 15 2,6 731 2720 227 3040	95 143 15 26 694 2360 207 2870 7.2 679 186 9 143 15 26 695 2365 230 2810 7.12 7.14 185 9 144 151 26 699 2380 212 3070 7.11 706 195 85 145 145 26 724 2290 221 300 7.11 706 195 85 144 15 26 688 2250 221 300 7.12 700 195 85 144 15 26 727 2670 227 300 7.12 184 95 144 15 26 734 2730 227 3060 7.12 702 184 9 144 15 26 730 2720 227 3060 7.16 185 8 144 15 26	1600 30 26 26 295 148 137	26 26 295 148	26 295 148	295 148	148	_	137			130	9.5	14.4	15	2.6	695	2590	236	2810	7.12	7.08	19.1	15
9 143 15 26 695 2565 230 2810 712 714 18.5 9 144 15.1 26 690 2380 212 3070 711 706 19 9 144 15.1 26 696 2380 212 3070 711 706 19 8.5 145 15 26 734 2590 216 2930 722 695 196 195 8.5 144 15 26 737 2670 227 3010 723 709 195 9.5 144 15 26 734 2730 225 3060 712 709 195 9.5 144 15 26 731 2730 225 3040 716 719 184 9.2 144 15 26 732 2590 251 3040 716 719 184 8 <td>9 143 15 26 695 2565 230 2810 712 714 9 144 15.1 26 690 2380 212 3070 711 706 9 144 15.1 26 734 2390 231 3040 701 6.96 8.5 144 15 26 734 2590 216 230 722 6.95 8.5 144 15 26 727 2670 227 3010 722 6.95 9.5 144 15 26 734 2730 225 300 707 722 9.5 144 15 26 731 2730 225 300 707 707 8 144 15 26 705 2590 251 3040 716 719 8 144 15 26 705 2720 259 3010 719 716</td> <td>9 143 15 26 695 2565 230 2810 7.11 7.14 185 9 1444 151 26 690 2380 212 3070 7.11 706 19 9 142 143 26 634 2380 212 3070 7.11 706 195 85 145 15 26 688 2550 216 293 7.22 695 196 85 144 15 26 688 2550 216 230 7.22 695 196 95 144 15 26 734 2730 225 300 7.12 707 184 95 144 15 26 731 2730 225 300 7.12 707 184 95 144 15 26 721 270 227 300 7.16 719 185 8 144</td> <td>0720 30 26 27 295 150 140</td> <td>26 27 295 150</td> <td>27 295 150</td> <td>295 150</td> <td>150</td> <td></td> <td>140</td> <td>- 1</td> <td></td> <td>132</td> <td>9.5</td> <td>14.3</td> <td>15</td> <td>2.6</td> <td>694</td> <td>2560</td> <td>207</td> <td>2870</td> <td>7.2</td> <td>6.79</td> <td>18.6</td> <td>15</td>	9 143 15 26 695 2565 230 2810 712 714 9 144 15.1 26 690 2380 212 3070 711 706 9 144 15.1 26 734 2390 231 3040 701 6.96 8.5 144 15 26 734 2590 216 230 722 6.95 8.5 144 15 26 727 2670 227 3010 722 6.95 9.5 144 15 26 734 2730 225 300 707 722 9.5 144 15 26 731 2730 225 300 707 707 8 144 15 26 705 2590 251 3040 716 719 8 144 15 26 705 2720 259 3010 719 716	9 143 15 26 695 2565 230 2810 7.11 7.14 185 9 1444 151 26 690 2380 212 3070 7.11 706 19 9 142 143 26 634 2380 212 3070 7.11 706 195 85 145 15 26 688 2550 216 293 7.22 695 196 85 144 15 26 688 2550 216 230 7.22 695 196 95 144 15 26 734 2730 225 300 7.12 707 184 95 144 15 26 731 2730 225 300 7.12 707 184 95 144 15 26 721 270 227 300 7.16 719 185 8 144	0720 30 26 27 295 150 140	26 27 295 150	27 295 150	295 150	150		140	- 1		132	9.5	14.3	15	2.6	694	2560	207	2870	7.2	6.79	18.6	15
9 144 15.1 2.6 690 2580 212 3070 7.11 7.06 19 85 142 149 2.6 734 2590 231 3040 7.01 6.96 19.5 85 145 15 2.6 688 2550 216 2930 7.22 6.95 19.6 85 144 15 2.6 737 2670 227 3010 7.07 7.22 19.6 9.5 144 15 2.6 734 2730 225 3020 7.07 7.22 19.6 9.5 144 15 2.6 731 2730 225 3040 7.16 18.4 18.4 9 144.5 15 2.6 721 2590 221 3040 7.16 18.4 8 144.4 15 2.6 730 2720 227 3040 7.16 18.4 8 144.4 <	9 144 151 26 690 2880 212 3070 711 706 9 142 149 26 734 2590 231 3040 701 696 85 145 15 26 688 2550 216 290 722 695 85 144 15 26 737 2670 227 3010 722 695 95 144 15 26 731 2730 225 3020 712 707 95 144 15 26 731 2730 225 3060 712 707 9 144 15 26 731 2730 253 3040 716 716 8 144 15 26 731 2720 257 716 716 8 144 15 26 732 270 271 716 716 9 1	9 144 15,1 2.6 690 2580 212 3070 711 706 19 8.5 142 149 2.6 734 2590 231 3040 701 6.96 195 8.5 144 15 2.6 6.88 2550 216 290 722 6.95 196 8.5 144 15 2.6 6.88 2550 216 702 6.95 196 9.5 144 15 2.6 724 2730 225 300 707 722 185 9.5 144 15 2.6 731 2730 225 300 710 184 9.2 144 15 2.6 731 2730 251 3040 710 711 183 8.5 144 15 2.6 732 2590 251 3040 716 719 184 8.5 144 15	1520 41 37 38 315 155 145	37 38 315 155	38 315 155	315 155	155	-	145			135	6	14.3	15	2.6	969	2565	230	2810	7.12	7.14	18.5	15
9 142 149 26 734 2590 231 3040 701 6.96 19.5 85 145 15 2.6 688 2350 216 233 722 6.95 196 85 144 15 2.6 727 2670 227 3010 7.23 7.09 19.5 9.5 144 15 2.6 734 2730 225 3020 7.07 7.22 18.5 9.5 144 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.2 14.4 15 2.6 721 2730 225 3060 7.16 18.4 18.2 9 14.4 15 2.6 721 2510 227 3040 7.16 18.4 18.4 8 14.4 15 2.6 730 2720 227 3040 7.06 7.11 18.2 8 <t< td=""><td>9 142 149 26 734 2590 231 3040 701 6.96 85 145 15 26 688 2550 216 2930 722 6.95 85 144 15 26 727 2670 227 3010 7.23 7.09 95 1444 15 26 731 2730 225 3020 7.07 7.22 95 1444 15 26 705 2590 221 3040 7.12 7.07 9 1444 15 26 721 260 259 251 3040 7.16 7.19 9 1444 15 26 721 250 259 3010 7.11 7.16 8 1449 15 26 730 2720 250 7.00 7.11 7.16 9 1449 15 26 730 2650 234 3040 <</td><td>9 142 149 2.6 734 2590 231 3040 701 6.96 193 8.5 14.5 15 2.6 688 2550 216 2930 722 6.95 196 8.5 14.4 15 2.6 672 2670 227 3010 723 6.95 196 9.5 14.4 15 2.6 734 2730 227 3020 707 722 185 9.5 14.4 15 2.6 731 2730 225 3060 712 707 184 9.2 14.4 15 2.6 731 2730 225 300 716 719 183 9.2 14.4 15 2.6 731 2260 227 3060 716 719 184 9 14.4 15 2.6 633 2270 227 3060 716 716 184 8</td><td>0730 38.5 24 25 293 153 143</td><td>24 25 293 153</td><td>25 293 153</td><td>293 153</td><td>153</td><td></td><td>143</td><td></td><td></td><td>136</td><td>6</td><td>14.4</td><td>15.1</td><td>2.6</td><td>069</td><td>2580</td><td>212</td><td>3070</td><td>7.11</td><td>7.06</td><td>19</td><td>15</td></t<>	9 142 149 26 734 2590 231 3040 701 6.96 85 145 15 26 688 2550 216 2930 722 6.95 85 144 15 26 727 2670 227 3010 7.23 7.09 95 1444 15 26 731 2730 225 3020 7.07 7.22 95 1444 15 26 705 2590 221 3040 7.12 7.07 9 1444 15 26 721 260 259 251 3040 7.16 7.19 9 1444 15 26 721 250 259 3010 7.11 7.16 8 1449 15 26 730 2720 250 7.00 7.11 7.16 9 1449 15 26 730 2650 234 3040 <	9 142 149 2.6 734 2590 231 3040 701 6.96 193 8.5 14.5 15 2.6 688 2550 216 2930 722 6.95 196 8.5 14.4 15 2.6 672 2670 227 3010 723 6.95 196 9.5 14.4 15 2.6 734 2730 227 3020 707 722 185 9.5 14.4 15 2.6 731 2730 225 3060 712 707 184 9.2 14.4 15 2.6 731 2730 225 300 716 719 183 9.2 14.4 15 2.6 731 2260 227 3060 716 719 184 9 14.4 15 2.6 633 2270 227 3060 716 716 184 8	0730 38.5 24 25 293 153 143	24 25 293 153	25 293 153	293 153	153		143			136	6	14.4	15.1	2.6	069	2580	212	3070	7.11	7.06	19	15
8.5 14.5 15 2.6 6.88 2550 216 290 7.22 6.95 19.6 8.5 14.4 15 2.6 727 2670 227 3010 7.23 7.09 19.5 9.5 14.4 15 2.6 734 2730 225 3020 7.07 7.27 18.5 9.5 14.4 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.2 14.4 15 2.6 721 2610 225 3060 7.12 7.07 18.4 9 14.4 15 2.6 721 2610 227 3080 7.21 18.4 8 14.4 15 2.6 730 2720 227 3080 7.21 18.4 8 14.4 15 2.6 730 2720 224 3040 7.06 7.1 18.6 8 14.4	8.5 14.5 15 2.6 688 2550 216 290 722 695 8.5 144 15 2.6 772 2670 227 3010 7.23 7.09 8.5 144 15 2.6 774 2730 225 3020 707 7.22 9.5 144 15 2.6 771 2730 225 3060 7.12 7.07 9.2 144 15 2.6 721 2500 251 3040 7.16 7.19 9.2 144 15 2.6 730 2720 259 3010 7.11 7.02 8 144.0 15 2.6 693 2720 224 3040 7.16 7.11 8 144.0 15 2.6 730 2720 227 3080 7.12 7.16 9 144.3 14.9 2.6 727 2650 234 3040 <td< td=""><td>8.5 145 15 2.6 688 2550 216 2930 722 6.95 196 8.5 144 15 2.6 727 2670 227 3010 723 709 19.5 8.5 144 15 2.6 734 2730 225 3020 707 722 18.5 9.5 144 15 2.6 731 2730 225 3000 712 707 18.4 9.5 144 15 2.6 731 2730 225 300 712 707 18.4 9.2 144 15 2.6 705 2590 251 3040 716 719 18.2 9 144 15 2.6 730 2720 227 300 709 711 18.3 8 144 15 2.6 730 2720 234 3040 716 716 18.4 9</td><td>1530 40 36 37 305 140 130</td><td>36 37 305 140</td><td>37 305 140</td><td>305 140</td><td>140</td><td>4</td><td>130</td><td>- 1</td><td></td><td>122</td><td>6</td><td>14.2</td><td>14.9</td><td>2.6</td><td>734</td><td>2590</td><td>231</td><td>3040</td><td>7.01</td><td>96.9</td><td>19.5</td><td>15</td></td<>	8.5 145 15 2.6 688 2550 216 2930 722 6.95 196 8.5 144 15 2.6 727 2670 227 3010 723 709 19.5 8.5 144 15 2.6 734 2730 225 3020 707 722 18.5 9.5 144 15 2.6 731 2730 225 3000 712 707 18.4 9.5 144 15 2.6 731 2730 225 300 712 707 18.4 9.2 144 15 2.6 705 2590 251 3040 716 719 18.2 9 144 15 2.6 730 2720 227 300 709 711 18.3 8 144 15 2.6 730 2720 234 3040 716 716 18.4 9	1530 40 36 37 305 140 130	36 37 305 140	37 305 140	305 140	140	4	130	- 1		122	6	14.2	14.9	2.6	734	2590	231	3040	7.01	96.9	19.5	15
8.5 14.4 15 2.6 727 2670 227 3010 7.23 7.09 19.5 8.5 14.4 15 2.6 734 2730 225 3020 7.07 7.22 18.5 9.5 14.4 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.2 14.4 15 2.6 721 2610 229 3010 7.21 7.07 18.4 8 14.4 15 2.6 721 2610 229 3010 7.21 7.09 18.2 8 14.4 15 2.6 730 2570 224 2900 7.21 18.3 8 14.4 15 2.6 730 2720 224 3040 7.06 7.11 18.6 9 14.4 15 2.6 7.2 2720 224 3040 7.06 7.1 19.6 9	8.5 144 15 26 727 2670 227 3010 7.23 7.09 8.5 144 15 26 734 2730 225 3020 707 722 9.5 144 15 2.6 731 2730 225 3060 7.12 707 9.2 144 15 2.6 705 2590 251 3040 7.16 719 9 1444 15 2.6 693 2570 214 2900 709 711 8 1443 14.9 2.6 693 2770 227 3080 721 710 8 1444 15 2.6 730 2720 234 3040 716 8 1443 14.9 2.6 727 2650 234 3040 708 716 9 1443 14.9 2.6 727 2650 234 3040 708 716	8.5 144 15 2.6 727 2670 227 3010 7.23 7.09 19.5 8.5 144 15 2.6 734 2730 225 3020 707 707 18.5 9.5 144 15 2.6 731 2730 225 3060 712 707 18.4 9.2 144 15 2.6 705 2590 251 3040 716 719 18.4 9.2 144 15 2.6 705 2590 251 3040 716 719 18.2 8.5 144 15 2.6 721 250 3010 721 702 18.4 8 144.4 15 2.6 730 2720 227 3080 716 718 18.2 8 144.4 15 2.6 732 252 227 3040 708 716 18.2 8 144.5 <td>1725 28 24 25 295 145 135</td> <td>24 25 295 145</td> <td>25 295 145</td> <td>295 145</td> <td>145</td> <td></td> <td>135</td> <td>\dashv</td> <td></td> <td>125</td> <td>8.5</td> <td>14.5</td> <td>15</td> <td>2.6</td> <td>889</td> <td>2550</td> <td>216</td> <td>2930</td> <td>7.22</td> <td>6.95</td> <td>19.6</td> <td>15</td>	1725 28 24 25 295 145 135	24 25 295 145	25 295 145	295 145	145		135	\dashv		125	8.5	14.5	15	2.6	889	2550	216	2930	7.22	6.95	19.6	15
8.5 144 15 26 734 2730 225 3020 707 722 18.5 9.5 144 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.5 14.4 15 2.6 705 2590 251 3040 7.16 7.19 18.2 9. 14.4 15 2.6 721 2610 259 3010 7.21 7.02 18.4 8 14.3 14.9 2.6 693 2570 227 3080 7.21 7.02 18.4 8 14.4 15 2.6 693 2570 227 3080 7.22 7.16 18.3 8 14.4 15 2.6 73 2520 224 3040 7.03 18.4 9 14.3 14.9 2.6 7.2 2710 231 3040 7.06 7.1 19.6 9 <t< td=""><td>8.5 144 15 2.6 734 2730 225 3020 707 722 9.5 144 15 2.6 731 2730 225 3060 712 707 9.5 144 15 2.6 705 2580 251 3040 716 710 9 1444 15 2.6 693 2570 214 290 709 711 8 1443 1.6 2.6 730 2720 227 3080 722 716 9 14.3 1.4 1.5 2.6 737 2720 227 3080 7.1 7.1 9 14.3 1.6 2.6 727 2650 234 3040 7.1 7.1 9 14.2 1.5 2.6 727 2650 234 3040 7.06 7.1 8 14.4 1.5 2.6 727 2710 238 3040</td><td>8.5 144 15 26 734 2730 225 3020 707 722 18.5 9.5 144 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.5 144.5 15 2.6 721 2590 251 3040 7.16 7.19 18.2 9. 144.6 15 2.6 731 2590 227 3080 7.21 7.02 18.4 8 14.4 15 2.6 693 2570 227 3080 7.21 7.02 18.4 8 14.4 15 2.6 693 2520 227 3080 7.22 7.16 18.3 8 14.4 15 2.6 73 2520 224 3040 7.22 7.16 18.6 9 14.3 14.9 2.6 73 225 234 3040 7.06 7.1 19.6 <</td><td>1515 28 23.5, 25 300 150 135</td><td>23.5 25 300 150</td><td>25 300 150</td><td>300 150</td><td>150</td><td></td><td>135</td><td>_</td><td></td><td>130</td><td>8.5</td><td>14.4</td><td>15</td><td>2.6</td><td>727</td><td>2670</td><td>227</td><td>3010</td><td>7.23</td><td>7.09</td><td>19.5</td><td>15</td></t<>	8.5 144 15 2.6 734 2730 225 3020 707 722 9.5 144 15 2.6 731 2730 225 3060 712 707 9.5 144 15 2.6 705 2580 251 3040 716 710 9 1444 15 2.6 693 2570 214 290 709 711 8 1443 1.6 2.6 730 2720 227 3080 722 716 9 14.3 1.4 1.5 2.6 737 2720 227 3080 7.1 7.1 9 14.3 1.6 2.6 727 2650 234 3040 7.1 7.1 9 14.2 1.5 2.6 727 2650 234 3040 7.06 7.1 8 14.4 1.5 2.6 727 2710 238 3040	8.5 144 15 26 734 2730 225 3020 707 722 18.5 9.5 144 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.5 144.5 15 2.6 721 2590 251 3040 7.16 7.19 18.2 9. 144.6 15 2.6 731 2590 227 3080 7.21 7.02 18.4 8 14.4 15 2.6 693 2570 227 3080 7.21 7.02 18.4 8 14.4 15 2.6 693 2520 227 3080 7.22 7.16 18.3 8 14.4 15 2.6 73 2520 224 3040 7.22 7.16 18.6 9 14.3 14.9 2.6 73 225 234 3040 7.06 7.1 19.6 <	1515 28 23.5, 25 300 150 135	23.5 25 300 150	25 300 150	300 150	150		135	_		130	8.5	14.4	15	2.6	727	2670	227	3010	7.23	7.09	19.5	15
9.5 14.4 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 18.2 9.2 14.4 15 2.6 721 2610 259 3010 7.11 7.02 18.4 8.5 14.4 15 2.6 693 2570 227 3080 7.21 7.10 18.3 8 14.4 15 2.6 693 2570 227 3080 7.22 7.16 18.5 8 14.4 15 2.6 730 2720 227 3080 7.22 7.16 18.5 8 14.4 15 2.6 727 2720 234 3040 7.08 7.16 18.6 9 14.3 14.9 2.6 727 2710 231 3040 7.08 7.16 19.1	9.5 14.4 15 2.6 731 2730 225 3060 7.12 7.07 9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 9.2 14.4 15 2.6 731 2610 259 3010 7.21 7.02 8 14.4 15 2.6 693 2770 214 2900 7.09 7.11 8 14.4 15 2.6 730 2720 227 3080 7.22 7.16 9 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 9 14.3 1.5 2.6 727 2650 234 3040 7.08 7.16 9 14.4 1.5 2.6 727 2710 238 3030 7.08 7.16 8 14.4 1.5 2.6 736 2653 234 3040	9.5 14.4 15 2.6 731 2730 225 3060 7.12 7.07 18.4 9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 18.2 9.2 14.4 15 2.6 721 2610 259 3010 7.11 7.02 18.4 8.5 14.4 15 2.6 693 2570 224 2900 7.09 7.11 18.3 8 14.4 15 2.6 693 2570 227 3080 7.22 7.16 18.5 8 14.4 15 2.6 777 2650 234 3040 7.16 18.5 9 14.3 14.9 2.6 727 2650 234 3040 7.06 7.11 19.6 9 14.4 15 2.6 730 2650 234 3040 7.06 7.11 19.4 8	0742 28.5 24 25 29.4 149 139	24 25 29,4 149	25 29.4 149	29.4 149	149		139			131	8.5	14.4	15	2.6	734	2730	225	3020	7.07	7.22	18.5	15
9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 18.2 9.2 14.4 15 2.6 731 2610 259 3010 7.21 7.02 18.4 8.5 14.4 15 2.6 693 2570 214 2900 7.09 7.11 18.3 8 14.4 15 2.6 730 2720 280 3050 7.12 7.16 18.5 9 14.3 14.9 2.6 727 2650 234 3040 7.01 18.8 18.6 9 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.4 15 2.6 727 2710 231 3050 7.09 7.11 19.6 9 14.4 15 2.6 730 2655 234 3040 7.08 7.16 19.1	9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 9.2 14.4 15 2.6 721 2610 259 3010 7.21 7.02 8 14.4 15 2.6 693 2570 214 2900 7.09 7.11 8 14.4 15 2.6 730 2720 227 3080 7.22 7.16 9 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 9 14.2 1.5 2.6 727 2710 231 3050 7.0 7.18 9 14.4 15 2.6 736 2670 238 3000 7.06 7.1 8 14.4 15 2.6 730 2650 234 3040 7.08 7.16 9 14.4 15 2.6 730 2655 234 3020 7.	9.5 14.5 15 2.6 705 2590 251 3040 7.16 7.19 18.2 9.2 14.4 15 2.6 693 2570 214 2900 7.09 7.11 18.4 8 14.4 15 2.6 693 2570 214 2900 7.09 7.11 18.3 8 14.4 15 2.6 730 2720 227 380 7.22 7.16 18.5 9 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.5 9 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.2 14.9 2.6 727 2710 231 3050 7.09 7.11 19.6 8 14.4 15 2.6 730 2653 234 3030 7.08 7.14 19.6	1535 40 36 37 305 150 140	36 37 305 150	37 305 150	305 150	150		140	\rightarrow		133	9.5	14.4	15	2.6	731	2730	225	3060	7.12	7.07	18.4	15
92 144 15 26 721 2610 259 3010 7.21 7.02 184 9 144 15 26 693 2570 214 2900 7.09 7.11 18.3 8 144.3 14.9 2.6 730 2720 227 380 7.12 7.16 18.5 8 144.4 15 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.3 14.9 2.6 727 2710 231 3050 7.21 18.6 19.4 9 14.2 14.9 2.6 727 2710 231 3050 7.06 7.1 19.6 9 14.4 15 2.6 730 2655 234 3030 7.06 7.11 19.4 8 14.6 15 2.6 730 2625 234 3030 7.09 7.18 19.4 <	92 14.4 15 2.6 721 2610 259 3010 721 702 9 14.4 15 2.6 693 2570 214 2900 7.09 7.11 8 14.3 14.9 2.6 730 2770 227 3080 7.22 7.16 9 14.4 15 2.6 727 2650 234 3040 7.08 7.16 9 14.2 1.5 2.6 727 2710 231 3050 7.06 7.1 9 14.4 15 2.6 736 2670 238 3000 7.06 7.1 9 14.4 15 2.6 736 2655 234 3030 7.06 7.16 8 14.4 15 2.6 736 2655 234 3030 7.08 7.16 9 14.3 14.9 2.6 732 2655 234 3030 7.09<	92 144 15 26 721 2610 259 3010 7.21 7.02 184 9 144 15 26 693 2570 214 2900 7.09 7.11 18.3 8 143 149 26 730 2770 227 3080 7.22 7.16 18.5 8 144 15 26 713 2850 280 3050 7.19 7.21 18.8 9 143 15 26 727 2710 231 3050 7.21 18.6 9 144.9 15 26 727 2710 231 3050 7.08 7.11 19.6 9 144.0 15 26 736 2670 238 3000 7.08 7.11 19.6 8 144.6 15 26 732 2655 234 3030 7.08 7.14 19.6 8 144.6	0730 30.5 26 26 295 154 144	26 26 295 154	26 295 154	295 154	154	-	144	\dashv		134	9.5	14.5	15	2.6	705	2590	251	3040	7.16	7.19	18.2	15
9 144 15 26 693 2570 214 2900 7.09 7.11 18.3 8 143 149 2.6 730 2720 227 3080 7.22 7.16 18.5 8 144 15 2.6 713 2850 280 3050 7.19 7.21 18.8 9 14.3 14.9 2.6 727 2710 231 3050 7.21 7.18 19 9 14.2 14.9 2.6 727 2710 231 3050 7.21 18.6 9 14.4 15 2.6 727 2710 238 3000 7.06 7.1 19.6 8 14.4 15 2.6 730 2655 234 3030 7.08 7.18 19.4 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3	9 14.4 15 2.6 693 2570 214 2900 7.09 7.11 8 14.3 14.9 2.6 730 2720 227 3080 7.22 7.16 8 14.4 15 2.6 773 2580 280 3050 7.19 7.21 9 14.3 14.9 2.6 727 2710 231 3050 7.21 7.18 9 14.4 15 2.6 736 2670 238 3000 7.06 7.1 8 14.6 15 2.6 736 2655 238 3000 7.06 7.1 9 14.4 15 2.6 736 2655 238 3030 7.06 7.16 9 14.4 15 2.6 732 2655 234 3030 7.09 7.18 9 14.3 14.9 2.7 7.04 2690 213 3010 7.	9 144 15 26 693 2570 214 2900 709 711 18.3 8 143 149 26 730 2720 227 3080 722 716 18.5 8 144 15 26 713 2880 280 3050 719 721 18.8 9 143 149 2.6 727 2710 231 3050 7.0 716 18.6 9 144.2 15 2.6 737 2710 238 3000 7.06 7.1 19.6 9 144.2 15 2.6 730 2655 235 3030 7.08 7.16 19.6 8 146 15 2.6 732 2655 234 3030 7.08 7.18 19.4 9 144.5 15 7.04 2690 213 3030 7.09 7.14 19.6 8.5 14.3	1525 30 26 26 295 155 145	26 26 295 155	26 295 155	295 155	155	_	145	+		137	9.2	14.4	15	2.6	721	2610	259	3010	7.21	7.02	18.4	15
8.5 14.3 14.9 2.6 730 2720 227 3080 7.22 7.16 18.5 8 14.4 15 2.6 713 2880 280 3050 7.19 7.21 18.8 9 14.3 14.9 2.6 727 2710 231 3050 7.21 7.18 19 9 14.2 14.9 2.6 727 2710 238 3000 7.06 7.1 19.6 9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 19.6 8 14.6 15 2.6 730 2655 235 3030 7.08 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8 14.4 15 2.7 704 2690 213 3010 7.19 7.11 19.6	8.5 14.3 14.9 2.6 730 2720 227 3080 722 7.16 8 14.4 15 2.6 713 2580 280 3050 7.19 7.21 8 14.3 14.9 2.6 727 2630 234 3040 7.08 7.16 9 14.3 15 2.6 727 2710 231 3050 7.21 7.18 9 14.4 15 2.6 736 2655 238 3000 7.06 7.1 8 14.6 15 2.6 732 2655 234 3030 7.08 7.16 9 14.3 14.9 2.6 732 2655 235 3030 7.09 7.18 9 14.4 15 2.6 774 2690 213 3010 7.19 7.11 8 14.6 14.9 2.7 774 2690 213 3010 <td< td=""><td>8.5 14.3 14.9 2.6 730 2720 227 3080 722 7.16 18.5 8 14.4 15 2.6 773 2580 280 3050 7.19 7.21 18.8 9 14.3 14.9 2.6 727 2710 231 3050 7.08 7.16 18.6 9 14.4 15 2.6 736 2650 238 3000 7.06 7.11 196 8 14.4 15 2.6 730 2655 235 3030 7.08 7.16 19.1 8 14.6 15 2.6 732 2655 234 3030 7.08 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3030 7.09 7.18 19.4 8.5 14.3 14.9 2.7 7.11 2700 220 3010 7.16 7.14 19.6</td><td>0730 32.5 28 29 298 154 144</td><td>28 29 298 154</td><td>29 298 154</td><td>298 154</td><td>154</td><td>_</td><td>144</td><td>+</td><td></td><td>136</td><td>6</td><td>14.4</td><td>15</td><td>2.6</td><td>693</td><td>2570</td><td>214</td><td>2900</td><td>7.09</td><td>7.11</td><td>18.3</td><td>15</td></td<>	8.5 14.3 14.9 2.6 730 2720 227 3080 722 7.16 18.5 8 14.4 15 2.6 773 2580 280 3050 7.19 7.21 18.8 9 14.3 14.9 2.6 727 2710 231 3050 7.08 7.16 18.6 9 14.4 15 2.6 736 2650 238 3000 7.06 7.11 196 8 14.4 15 2.6 730 2655 235 3030 7.08 7.16 19.1 8 14.6 15 2.6 732 2655 234 3030 7.08 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3030 7.09 7.18 19.4 8.5 14.3 14.9 2.7 7.11 2700 220 3010 7.16 7.14 19.6	0730 32.5 28 29 298 154 144	28 29 298 154	29 298 154	298 154	154	_	144	+		136	6	14.4	15	2.6	693	2570	214	2900	7.09	7.11	18.3	15
8 14.4 15 2.6 713 2.80 280 30.50 7.19 7.21 18.8 8 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.3 15 2.6 727 2710 231 3050 7.21 7.18 19 9 14.4 15 2.6 736 2670 238 3000 7.06 7.1 19.6 8 14.6 15 2.6 732 2635 235 3030 7.08 7.16 19.1 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8 14.5 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	8 14.4 15 2.6 713 2.80 280 3050 7.19 7.21 8 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 9 14.4 15 2.6 736 2655 235 3030 7.08 7.16 9 14.4 15 2.6 732 2655 235 3030 7.08 7.16 9 14.4 15 2.6 732 2655 234 3030 7.09 7.18 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 7.11 2700 220 3010 7.16 7.14	8 144 15 2.6 713 2.880 280 3050 7.19 7.21 18.8 8 14.3 14.9 2.6 727 2650 224 3040 7.08 7.16 18.6 9 14.3 15 2.6 727 2710 231 3050 7.0 7.18 19 9 14.4 15 2.6 736 2655 238 3000 7.06 7.1 19.6 8 14.6 15 2.6 732 2655 234 3030 7.08 7.16 19.1 8 14.5 15 2.6 732 2655 234 3030 7.09 7.18 19.4 8.5 14.3 14.9 2.7 7.1 2890 2.13 3010 7.14 19.6	1530 32 28 28.5 297 155 145	28 28.5 297 155	28.5 297 155	297 155	155	4	145	+		137	8.5	14.3	14.9	2.6	730	2720	227	3080	7.22	7.16	18.5	15
8 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.3 1.5 2.6 727 2710 231 3050 7.21 7.18 19 9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 19.6 8 14.4 1.5 2.6 732 2655 234 3030 7.08 7.16 19.1 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 71 2700 220 3010 7.16 7.14 19.6	8 14.3 14.9 2.6 727 2650 234 3040 708 716 9 14.3 15 2.6 727 2710 231 3050 721 718 9 14.4 15 2.6 736 2655 238 3000 706 7.1 8 14.6 15 2.6 732 2655 234 3030 7.08 7.16 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8 14.3 14.9 2.7 711 2700 220 3010 7.19 7.14 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	8 14.3 14.9 2.6 727 2650 234 3040 7.08 7.16 18.6 9 14.3 15 2.6 727 2710 231 3050 7.21 7.18 19 9 14.4 15 2.6 736 2655 238 3000 7.06 7.1 19.6 8 14.6 15 2.6 732 2655 234 3030 7.08 7.16 19.1 9 14.3 14.9 2.7 704 2690 213 3030 7.09 7.18 19.4 8.5 14.3 14.9 2.7 7.11 2700 220 3010 7.16 7.14 19.6	0730 31.5 27 28 298 154 145	27 28 298 154	28 298 154	298 154	154	_	145		i	137	8	14.4	15	2.6	713	2580	280	3050	7.19	7.21	18.8	15
9 14.3 15 26 727 2710 231 3050 721 718 19 9 14.2 14.9 2.6 736 2670 238 3000 706 7.1 19.6 8 14.4 15 2.6 730 2655 235 333 7.08 7.16 19.1 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	9 14.3 15 2.6 727 2710 231 3050 721 718 9 14.2 14.9 2.6 736 2670 238 3000 706 7.1 8 14.4 15 2.6 732 2655 235 3030 708 7.16 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	9 14.3 15 2.6 727 2710 231 3050 721 7.18 19 9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 19.6 8 14.4 15 2.6 732 2655 234 3030 7.08 7.16 19.1 9 14.3 14.9 2.7 704 2695 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 7.11 2700 220 3010 7.16 7.14 19.6	1545 31 27 28 300 155 145	27 28 300 155	28 300 155	300 155	155		145	\dashv		135	8	14.3	14.9	2.6	727	2650	234	3040	7.08	7.16	18.6	15
9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 19.6 9 14.4 15 2.6 730 2655 235 333 7.08 7.16 19.1 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.16 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	9 14.2 14.9 2.6 736 2670 238 3000 706 7.1 9 14.4 15 2.6 730 2655 235 333 7.08 7.16 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	9 14.2 14.9 2.6 736 2670 238 3000 7.06 7.1 19.6 9 14.4 15 2.6 730 2655 235 3030 7.08 7.16 19.1 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	0730 32 27.5 28.5 299.5 155 145	27.5 28.5 299.5 155	28.5 299.5 155	299.5 155	155		145	\dashv		138	6	14.3	15	2.6	727	2710	231	3050	7.21	7.18	19	15
9 14.4 15 26 730 2655 235 3030 7.08 7.16 19.1 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	9 144 15 2.6 730 2655 235 335 7.08 7.16 8 146 15 2.6 732 2625 234 3030 7.09 7.18 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	9 14.4 15 2.6 730 2655 235 3030 7.08 7.16 19.1 8 14.6 15 2.6 732 2625 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	1530 31.5 27.5 28.5 299.5 155 145	27.5 28.5 299.5 155	28.5 299.5 155	299.5 155	155		145	\dashv		138	6	14.2	14.9	2.6	736	2670	238	3000	7.06	7.1	9.61	15
8 14.6 15 2.6 732 26.55 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	8 14.6 15 2.6 732 26.55 234 3030 7.09 7.18 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	8 14.6 15 2.6 732 26.55 234 3030 7.09 7.18 19.4 9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	0720 32 28 30 300 155 145	28 30 300 155	30 300 155	300 155	155	_	145	-+		135	6	14.4	15	2.6	730	2655	235	3030	7.08	7.16	19.1	15
9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14	9 14.3 14.9 2.7 704 2690 213 3010 7.19 7.11 19.7 8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	1600 33 28.5 30 300 145 135	28.5 30 300 145	30 300 145	300 145	145		135			130	∞	14.6	15	2.6	732	2625	234	3030	7.09	7.18	19.4	15
8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	8.5 14.9 2.7 711 2700 220 3010 7.16 7.14	8.5 14.3 14.9 2.7 711 2700 220 3010 7.16 7.14 19.6	0800 33 28 29 297 150 139	28 29 297 150	29 297 150	297 150	150		139	-		131	6	14.3	14.9	2.7	704	2690	213	3010	7.19	7.11	19.7	15
			1530 33 28 29.5 299.5 150 140	28 29.5 299.5 150	29.5 299.5 150	299.5	150		140	-1		132	8.5	14.3	14.9	2.7	711	2700	220	3010	7.16	7.14	19.6	15

Parameter Para	ĺ	(PILOT TE	PILOT TEST PROGRAM	GRAM																
Control Cont			1	FRISCO W	ATER PLAN	F			SNOILIONS	Flux	Recovery	Hd										
Control Cont	13	TETER					PRESSUR					FLOV	W, AquaLynx		11 6	ONDUCTIVI	Y, AquaLyn.	×	1 1	Н	TEMP.	
1	∖ા≱	TION	Cart In PI	Cart Out	Pump inlet PI-2	Pump Out PI-3	Feed	1st St out	2nd St feed	Conc	Permeate PI-6	1st St Perm FE-3	Total Perm FE-1	Conc FE-2	Feed CE-1	Interstage SV-5	Permeate CE-2	Conc. SV4	-	Permeate SV-7	Feed SV-1	Well#
No. Z	TTS				bs/spunod	in. PSI					gallon	s/minute, GPM			Microsien	nens, µS				Deg C		
11 11 12 13 13 13 13 13	1	0740	32	27	28	297	151	140		134		14.4	15	2.6	713	2630	242	3000	7.17	7.21	19.2	15
1.1 1.1	ıl	1525	31	27	36	297	154	145		136	*	14.4	15	2.6	721	2616	256	3100	7.02	7.14	19.8	15
1	Ш	0725	32.5	28	29	298	154	143		135	6	14.4	15	2.6	701	2620	209	3000	7.05	7.24	18.9	15
13 13 13 13 13 13 14 14		1525	32	28	29	298	155	146		139	8.5	14.3	14.9	2.6	732	2750	219	3050	7.11	7	18.6	15
10 11 12 13 14 14 15 15		0715	32	28	29	298	156	146		139.5	8.5	14.3	14.9	2.6	731	2740	220	3070	7.2	7.11	18.6	15
		1530	32	28	29	298	156	147		140	8.5	14.3	14.9	2.6	730	2730	220	3030	7.17	7.22	18.8	15
	Ц	0730	32	28	59	298	156	147		140	7.9	14.2	15	2.6	727	2750	219	3050	7.04	7.19	18.9	15
	_	1525	32	28	29	298	157	149		140	∞	14.3	15	2.6	732	2740	221	3040	7.2	7.21	18.7	15
	_	0720	32	28	30	300	155	149		140	7.5	14.3	15	2.6	729	2730	225	3050	7.35	7.27	18.9	15
23 24 25 344 143 144 143 144 143 144 143 144 144 143 144 143 144 144 144 144 144 145 144	4	1540	32	28	30	300	155	148		140	8.5	14.3	14.9	2.6	722	2740	220	3040	7.17	7.24	19.3	15
23 23 38 13 13 85 143 149 26 72 2740 270	_	1530	28	24	25	294	135	124		117	8.5	14.3	14.9	2.6	747	2690	219	3080	6.51	6.05	61	15
13 15 15 15 15 15 15 15	_	0725	28	23	24	295	135	125		115	8.5	14.3	14.9	2.6	742	2740	212	3110	6.34	6.3	19	15
315 256 256 142 131 124 15 15 15 15 15 15 15 1	_	1550	28	23	24	295	135	125		115	8.5	14.3	14.9	2.6	740	2730	220	3100	6.25	6.3	61	15
31 24 255 254 155 145 145 154 85 145 145 151 145 1	_	0740	31.5	25	56	294	142	131		124	6	14.4	15	2.6	701	2650	195.5	2950	6.79	95.9	19.4	15
305 24 25 25 145 145 145 15 145 15 145 15 145 15 145 15 145 15 145 15 145 15 145 145 15 260 273 2500 627 201 201 30 23 24 23 140 15 143 15 260 273 2900 627 200 201 200 201 200 201 200 201 200 201 200 201 200 201 200 201 201 200 201<		1540	31	24	25.5	294	153	142		134	8.5	14.5	15.1	2.6	735	2710	218	2990	6.24	6.31	19.1	15
30 23 24 293 160 150 151 145 151 15 15 150 254 200 224 3000 224 3000 225 200 225 2	_	0745	30.5	24	25	295	154	143		135	20	14.5	15	2.6	714	2590	227	3090	6.27	6.32	20.1	15
30 23 24 253 162 151 145 145 143 151 156 241 2560 221 2560 706 701 198 150 251 251 251	_	1530	30	23	24	293	160	150		141	7.7	14.5	15	2.6	739	2610	224	3080	6.21	6.3	20.6	15
30 23 24 283 164 154 154 154 154 154 155 143 15 15 15 15 15 15 15 1	\dashv	0745	30	23	24	293	162	151		145	7.5	14.3	15	2.6	741	2640	221	3090	7.06	7.01	8.61	15
	_	1520	30	23	24	293	164	154		146	8.2	14.3	15	2.6	736	2660	223	3070	7.22	7.07	20.2	15
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APPENDIX G SOUTH HATTERAS ANALYTICAL DATA

DARE COUNTY CAPE HATTERAS WATER TREATMENT FACILITY
Report of Chemical Analysis for CHWP Pilot Project
In-House Lab

Total Hardness		1	TDS			Chlorides		 	Iron	Mang	Manganese		100	-	% removal
// as CaCO3)									9				0.000	Doming	
Peed Permeate Feed 1st Stage Permeate F	1st Stage Fermeate	e Permeate	meate	_ (Feed 50 00	1st stage	20.00	Feed 0.78	Permeate 0.08	0.059	Permeate	14.40	18 Stage	Permeate	92.60
42.00 335.00 46.20 82.10	46.20 82.10	82.10		2	50.00	15.00	20.00	0.91	0.15	0.086	0.011	14.20	0.962	1.23	91.34
44.00 332.00 46.30 81.60	46.30 81.60	81.60		50	50.00	15.00	20.00	1.06	0.15	0.099	0.016	13.90	1.30	1.14	91.80
180.00 44.00 332.00 46.20 82.10 50	46.20 82.10	82.10	_	20	50.00	15.00	20.00	06.0	0.15	0.091	0.012	13.90	0.974	0.948	93.20
180.00 42.00 331.00 50.80 84.40 50	50.80 84.40	84.40		20	50.00	15.00	20.00	1.07	0.15	0.075	0.016	14.00	1.060	0.982	93.00
180.00 48.00 327.00 51.50 79.80 50	51.50 79.80	79.80	9.80	δ	50.00	15.00	20.00	1.03	0.20	0.069	0.018	14.00	1.030	0.863	93.90
170.00 50.00 327.00 50.60 80.60	50.60 80.60	80.60		"	50.00	15.00	20.00	0.97	0.22	0.072	0.017	14.10	1.320	0.915	93.60
160.00 50.00 328.00 52.50 82.00 5	52.50 82.00	82.00	_	5	50.00	15.00	20.00	0.99	0.17	0.072	0.019	14.20	1.170	0.913	93.60
180.00 48.00 334.00 53.30 84.10 50	53.30 84.10	84.10	\dashv	Š	50.00	15.00	20.00	1.01	0.16	0.075	0.018	14.00	0.918	0.854	93.90
180.00 52.00 333.00 54.70 83.60 50	54.70 83.60	83.60	-	2	50.00	15.00	20.00	0.78	0.14	0.091	0.011	13.90	1.210	1.010	92.80
180.00 50.00 329.00 54.80 83.50 50	54.80 83.50	83.50		20	50.00	15.00	20.00	1.13	0.18	0.076	0.015	14.10	1.190	1.030	92.70
180.00 64.00 333.00 54.80 82.70 50.	54.80 82.70	82.70	-	20	50.00	15.00	20.00	1.09	0.180	0.080	0.015	14.00	1.180	1.110	92.10
200.00 60.00 327.00 54.30 82.00 50	54.30 82.00	82.00		20	50.00	15.00	20.00	1.02	0.17	0.081	0.023	14.10	1.100	1.170	91.80
220.00 54.00 326.00 55.50 83.40 50.00	55.50 83.40	83.40		20.	8	10.00	20.00	1.06	0.20	0.062	0.013	14.10	1.120	1.150	91.90
220.00 48.00 328.00 55.30 82.90 40.	55.30 82.90	82.90		40	40.00	10.00	20.00	1.01	0.18	0.068	0.005	14.00	1.320	1.270	91.00
200.00 40.00 332.00 57.40 85.60 50	57.40 85.60	85.60		20	50.00	15.00	20.00	1.15	0.19	0.062	0.004	13.90	1.350	1.330	90.50
240.00 46.00 331.00 57.50 85.90 50.00	57.50 85.90	85.90		50.	8	20.00	25.00	1.16	0.21	0.078	0.017	14.10	1.180	1.270	91.00
240.00 46.00 326.00 59.40 87.50 50.00	59.40 87.50	87.50		50.	8	15.00	25.00	1.22	0.21	0.079	0.017	13.90	1.410	1.130	91.90
240.00 48.00 329.00 59.20 87.20 50	59.20 87.20	87.20		22	50.00	20.00	25.00	1.09	0.19	0.075	0.017	14.10	1.330	1.290	90.90
230.00 42.00 330.00 58.10 87.40 40	58.10 87.40	87.40		4	40.00	20.00	20.00	1.06	0.20	0.075	0.016	14.00	1.320	1.180	91.60
240.00 44.00 332.00 61.20 89.70	61.20 89.70	89.70	-	"	50.00	20.00	20.00	1.01	0.17	0.079	0.028	13.90	1.300	1.210	91.30
210.00 48.00 332.00 61.30 89.60 5	61.30 89.60	89.60		2	50.00	20.00	20.00	1.06	0.19	0.074	0.026	13.85	1.400	1.140	91.80
280.00 50.00 334.00 61.30 89.30	61.30 89.30	89.30		~	50.00	20.00	25.00	1.08	0.22	0.075	0.015	14.00	1.220	1.160	91.80
250.00 50.00 334.00 61.20 88.00 5	61.20 88.00	88.00		2	50.00	20.00	20.00	1.08	0.19	0.076	0.016	13.90	1.280	1.170	91.60
260.00 48.00 332.00 61.10 88.20 5	61.10 88.20	88.20	+	3	50.00	20.00	25.00	1.11	0.20	0.077	0.014	14.10	1.320	1.230	91.30
280.00 48.00 331.00 61.30 89.70	61.30 89.70	89.70		"	50.00	20.00	25.00	1.16	0.17	0.077	0.011	14.00	1.320	1.190	91.50
260.00 50.00 334.00 63.00 91.40 5	63.00 91.40	91.40		(C)	50.00	20.00	25.00	1.07	0.22	0.078	0.027	14.00	1.280	1.190	91.50
250.00 38.00 352.00 48.10 82.10 E	48.10 82.10	82.10		<u> </u>	90.09	20.00	25.00	1.01	0.16	090.0	0.008	13.80	0.786	0.663	95.20
250.00 36.00 332.00 45.20 77.80 (45.20 77.80	77.80			60.00	20.00	25.00	0.99	0.14	0.078	0.014	14.00	0.882	0.786	94.40
210.00 46.00 334.00 47.20 80.20 6	47.20 80.20	80.20	-	"	50.00	20.00	20.00	0.82	0.14	0.076	0.013	13.50	0.972	0.707	94.80
47.200 331.633 54.500 84.483	54.500 84.483	84.483		(c)	50.000	16.833	21.500	1.029	0.176	9/0.0	0.015	13.998	1.169	1.077	92.345
64.000 352.000 63.000 91.400	63.000 91.400	91.400		<u>ن</u> و	60.000	20.000	25.000	1.220	0.220	0.099	0.028	14.400	1.410	1.330	95.200
326.000 45.200 / 7.800	45.200 77.800	77.800	+	9	300	10.000	20.000	0.780	0.080	ecu.u	0.004	13.500	0.780	0.663	90.500

DARE COUNTY CAPE HATTERAS WATER TREATMENT FACILITY
Report of Chemical Analysis for CHWP Pilot Project
In-House Lab
Tabel Hardness

	% removal		95.20	95.10	95.30	95.10	94.70	94.50			90.00	87.20	88.60	88.60	81.00	82.20	82.30	82.50	82.20	82.80	93.70	93.80	93.50	93.50	93.40	93.70	92.00	91.20	91.70	91.80	91.80	91.80	000 330	90.329
		Permeate	0.679	0.677	0.658	0.684	0.748	0.769	0.582	0.545	0.665	0.854	0.785	0.774	1.270	1.190	1.220	1.210	1.230	1.190	0.859	0.848	0.905	0.923	0.947	0.920	1.140	1.190	1.190	1.160	1.170	1.120	2000	0.937
Ş	2	1s Stage	0.751	0.731	0.724	0.726	0.711	0.916	0.788	0.673	0.960	0.924	0.811	0.762	1.330	1.290	1.480	1.320	1.540	1.340	1.160	1.100	1.140	1.280	1.010	1.310	1.280	1.260	1.450	1.220	1.510	1.510	1 100	9 .
		Feed	14.00	13.80	13.90	13.80	14.00	13.90			6:59	6.63	6.83	6.75	6.67	6.67	6.86	6.88	6.88	6.90	13.50	13.60	14.00	14.20	14.40	14.50	14.20	13.50	14.30	14.00	14.20	13.60	11 305	000.1
000000	manganese	Permeate	0.009	0.015	0.011	0.009	0.010	0.008	0.011	900.0	0.005	0.009	0.007	0.013	0.016	0.015	0.027	0.012	0.014	0.018	0.017	0.019	0.020	0.017	0.010	0.021	0.020	0.017	0.022	0.021	0.023	0.023	0.045	0.010
N N		Feed	0.068	0.085	0.072	0.077	0.071	0.069	0.070	0.076	0.081	0.079	0.082	0.080	0.075	0.083	0.073	0.081	0.079	0.079	0.047	0.062	0.049	0.061	0.062	0.071	0.061	0.070	0.081	0.065	0.081	0.071	6200	210.0
100		Permeate	0.12	0.14	0.18	0.13	0.12	0.15	0.16	0.13	0.12	0.17	0.17	0.180	0.28	0.22	0.13	0.16	0.19	0.21	0.03	0.04	90.0	0.05	0.02	0.20	0.18	0.10	0.15	0.19	0.21	0.18	0.146	0. 140
-		Feed	0.94	1.00	0.98	1.03	0.99	1.16	0.99	1.05	0.98	96.0	1.01	1.01	1.01	1.04	0.83	1.03	0.98	1.02	0.31	0.49	0.33	0.39	1.13	1.08	1.11	0.49	1.09	0.89	0.86	0.81	0000	0000
		Permeate	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	30.00	20 333	20.000
Chlorides	CINOLINES	1st stage	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	30.00	20 333	20000
		Feed	20.00	50.00	90.09	55.00	00.09	50.00	50.00	50.00	50.00	50.00	20.00	50.00	50.00	50.00	50.00	90.09	50.00	50.00	50.00	00.09	50.00	50.00	50.00	50.00	50.00	70.00	50.00	70.00	00.09	60.00	53 500	0000
		Permeate	81.20	78.90	84.10	78.40	78.20	80.90	72.80	74.40	88.60	89.60	93.50	95.00	101.80	102.10	102.30	102.40	104.00	101.80	102.80	100.90	101.80	97.10	101.10	98.60	98.40	108.50	99.90	103.40	103.00	102.60	07.0	108 500
SUL	3	1st Stage	46.30	46.70	49.10	46.40	47.10	46.90	42.20	41.80	50.20	51.70	54.80	56.80	09:99	69.20	68.40	69.10	70.90	68.30	65.10	64.60	66.40	63.40	63.90	63.00	64.10	73.30	67.40	00.69	69.40	69.10	202 65	79.300
		Feed	335.00	336.00	341.00	334.00	344.00	330.00	334.00	337.00	335.00	337.00	334.00	334.00	334.00	335.00	331.00	336.00	338.00	336.00	356.00	356.00	355.00	340.00	333.00	338.00	340.00	356.00	334.00	345.00	336.00	340.00	339 000	356,000
Total Hardness	s CaCO3)	Permeate	40.00	44.00	38.00	40.00	38.00	40.00	42.00	40.00	42.00	38.00	52.00	50.00	44.00	52.00	62.00	56.00	90.09	52.00	62.00	54.00	58.00	52.00	58.00	90.09	90.09	90.09	62.00	62.00	62.00	00.09	51 333	00000
	(mg/l a	Feed	230.00	220.00	240.00	250.00	250.00	260.00	234.00	250.00	220.00	260.00	280.00	250.00	250.00	270.00	240.00	260.00	240.00	250.00	260.00	240.00	250.00	240.00	250.00	250.00	250.00	300.00	280.00	270.00	280.00	270.00	253 133	200.00
Tana area	Date		4/14/2007	4/15/2007	4/16/2007	4/17/2007	4/18/2007	4/25/2007	4/26/2007	4/27/2007	4/28/2007	4/29/2007	4/30/2007	5/1/2007	5/2/2007	5/3/2007	5/4/2007	5/5/2007	5/6/2007	5/7/2007	5/10/2007	5/12/2007	5/13/2007	5/14/2007	5/15/2007	5/16/2007	5/17/2007	5/18/2007	5/19/2007	5/20/2007	5/21/2007	5/22/2007	AVG	NAN Y

DARE COUNTY CAPE HATTERAS WATER TREATMENT FACILITY
Report of Chemical Analysis for CHWP Pilot Project
In-House Lab

% removal		91.60	93.20	93.30	93.10	93.20	0000	93.20	93.20	92.70 93.50	92.70 93.70 93.70	93.20 92.70 93.50 93.70	93.20 93.50 93.50 93.90 93.90	93.70 93.50 93.90 93.90	93.70 93.50 93.90 93.90	93.70 93.70 93.70 93.90	92.70 93.50 93.90 93.90	93.70	93.70 93.50 93.90 93.90	93.70 93.50 93.90 93.90	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.70	93.209
	Permeate	1.200	0.952	0.914	0.987	0.924	0.930	>>>>	0.981	0.981	0.981	0.987 0.926 0.926 0.838	0.981 0.897 0.926 0.838 0.834	0.926 0.926 0.838 0.834	0.926 0.926 0.838 0.838	0.838	0.987	0.987	0.897	0.981 0.926 0.838 0.834	0.834	0.981	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987
T0C	1s Stage	1.270	1.250	1.180	1.060	0.993	1.210		0.985	0.985	0.985 1.090 0.912	0.985 1.090 0.912 1.090	0.985 1.090 0.912 1.090 1.120	0.985 1.090 0.912 1.090	0.985 1.090 0.912 1.090 1.120	0.985 1.090 0.912 1.090 1.120	0.965 1.090 0.912 1.090 1.120	0.985 1.090 0.912 1.090 1.120	1.096 0.912 1.090 1.120	1.096 0.912 1.090 1.120	1.105													
	Feed	14.20	13.90	13.50	14.30	13.50	13.60	13.40	13.40	13.60	13.60	13.60	13.60 13.60 13.70	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.60	13.800
ese	Permeate	0.049	0.024	0.029	0.018	0.015	0.016	0.018		0.012	0.012	0.012 0.018 0.016	0.012 0.018 0.016	0.012 0.018 0.016 0.019	0.012 0.018 0.016	0.012 0.018 0.016 0.019	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Manganese	Feed	0.168	0.079	0.087	980.0	0.065	690.0	0.071		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.000	0.060	0.060
	Permeate	0.22	0.24	0.21	0.18	0.07	0.12	0.06		0.08	90.0	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Iron	Feed	1.10	1.02	1.06	0.92	0.50	0.87	0.44		0.48	0.98	0.98	0.98 0.82 0.91	0.98	0.98	0.98	0.98	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.98
_	Permeate	30.00	30.00	30.00	25.00	30.00	30.00	30.00		30.00	30.00	30.00	30.00 30.00 30.00 30.00	00.00	0.00	00.00	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	30.00
des			+	-		-	_																											
Chlorides	1st stage	30.00	30.00	30.00	25.00	30.00	30.00	30.00	30.00	000	30.00	30.00	30.0	30.00	30.00	30.00	30.0	30.0	30.00	000000000000000000000000000000000000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.00	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
	Feed	90.09	60.00	90.09	90.09	60.00	90.00	60.00	60.00		60.00	00.09	60.00	00.09	60.00	60.00	60.00	60.00	00.09	60.00	00.00	00.00	00.00	00.00	00.00	00.09	00.09	00.09	00.09	00.00	00'09	00'09	00'00	00009
	Permeate	103.90	102.70	104.40	99.50	105.70	102.90	105.90	100.50		93.30	93.30	93.30	93.30	93.30	101.60	93.30	101.60	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30	93.30
TDS	1st Stage	70.10	06.89	00.89	64.30	68.70	67.80	68.60	09.99	:: ;;	60.40	65.60	65.60 67.00	65.60 67.00	65.60	65.60	65.60	67.00	67.00	65.60	65.60	67.00	65.60	65.60	65.60	65.60	65.60	65.60	65.60	65.60	65.60	65.60	65.60	66.909
	Feed	273.00	357.00	356.00	338.00	356.00	359.00	358.00	364.00	65.60	00:00	359.00	359.00	359.00	359.00	359.00	359.00	369.00	359.00	359.00	359.00	359.00	359.00	359.00	359.00	359.00	359.00	359.00	359.00	359:00	359:00	359:00	359.00	359.00
dness aCO3)	Permeate	00.09	58.00	00.09	54.00	56.00	54.00	26.00	00.09	50.00		50.00	50.00	50.00	50.00	50.00	00009	50.00	50.00	20.00	50.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	50.00
Total Hardness (mg/l as CaCO3)	Feed	270.00	260.00	270.00	250.00	260.00	240.00	260.00	250.00	260.00		240.00	240.00	240.00	240.00	260.00	240.00	260.00	260.00	240.00	240.00	240.00	240.00	240.00	240.00	260.00	260.00	260.00	260.00	240.00	260.00	260.00	260.00	260.00
Date		5/23/2007	5/24/2007	5/25/2007	5/26/2007	5/27/2007	5/28/2007	5/29/2007	5/31/2007	6/1/2007		6/2/2007	6/2/2007	6/2/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007	6/3/2007 6/3/2007 AVG