WATER TREATMENT FOR SMALL PUBLIC SUPPLIES

OPERATION DATA - 1979

SAN JON AND ALAMOGORDO

by

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ABSTRACT

This project, demonstrating the application of reverse osmosis and electrodialysis to drinking water supplies, continued during 1979 with the mobile unit located first at San Jon from January through April, and the remainder of the year in Alamogordo. It was the second visit to San Jon, principally to give an extended operation on a high fluoride supply. Operation at Alamogordo was directed to assist the proposed large-scale desalination project in the Tularosa Basin.

The units operated satisfactorily in both locations, i.e., product water was certified by the EID as meeting state drinking water standards. Product water was delivered to the San Jon community system. In Alamogordo, product water was recombined with reject brine to provide sufficient feed for a small evaporation pond. Data were taken on pond evaporation to substantiate available values.

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INTRODUCTION

The continuation of third year funding for this project called for the water treatment system (mobile van unit) to be demonstrated at three New Mexico communities:

1. San Jon - water supply has high fluoride and TDS;
2. Alamogordo - wells within current system have high TDS, and major future water resource has high TDS; and
3. Gallup/Grants Area - readily available industrial waste waters have radioactive solutes.

In addition, work was to continue on laboratory development of alternative technology for removing single solutes, i.e., chemical precipitation.

The operation of the demonstration systems continued under the supervision of Mr. Steve Hanson. Mr. C. C. Wu, a graduate student at New Mexico State University in Chemical Engineering, was trained and operated the systems for a period during the summer. Mr. Wu is performing his thesis research on precipitation kinetics for fluorides. Dr. H. G. Folster officially terminated from the project in August.

The operation of the system at Alamogordo is supporting that city's application for the design and construction of a large brackish water desalination project in the Tularosa Basin. Operation data have been supplied to Kaiser Engineering, Inc. and to Gordon Herkenhoff & Associates, Inc. The reverse osmosis system is being redesigned to support the Alamogordo project.

A. Operation at San Jon, New Mexico

Start Up: The van arrived in San Jon on January 6, 1979. The operation was similar to last time[1]. A two week delay in obtaining electrical power, in conjunction with extremely cold weather, resulted in freeze-up of some piping within the van. Temperatures within the van reached -5°F. The reverse osmosis system was repaired first. After certification by the Water Quality Office of the Envrionmental Improvement Division (New Mexico), the product water was introduced into the San Jon community supply beginning 20 February. Repairs on the electrodialysis system were completed and after certification by the EID its product water was also fed to the San Jon community.

Operation: There were no recurring problems once the equipment was in operation. The high pH of the San Jon water supply required adjustment for the reverse osmosis system. The supply to the demonstration van was already chlorinated so the feed to the reverse osmosis system did not have bleach added and the feed to the electrodialysis unit had to be passed through carbon filters to remove the chlorine. Table 1 gives the summary of operating conditions for both the reverse osmosis and the electrodialysis systems at San Jon. Table 2 summarizes water quality throughout the demonstration system and Table 3 gives the overall operating summary. Detail water analysis is in Appendix A. Complete operating data for San Jon are collected in Appendix B.

[1] Folster, H. G., et. al., "Water Treatment for Small Public Supplies". Report of Operation," WRRI Report #107, Las Cruces, NM July 1979

METER READING AT

SAN JON

ELECTRODIALYSIS

DATE	21 February - 25 April
TIME	
POLARITY	+/-
FEED SALINITY (ppm)	1000
PRODUCT SALINITY (ppm)	87
PRODUCT CONDUCTIVITY	110
DILUTE FLOW (gpm)	3.7
BRINE FLOW (gpm)*	.5
FEED TEMPERATURE (°F)	60
STACK INLET	41
STACK OUTLET	1.5
DIFFERENTIAL IN	VAR
DIFFERENTIAL OUT	VAR
BEFORE FILTER	62
AFTER FILTER	60
AFTER PRV	53
ELECTRODE INLET	43
STAGE ONE VOLTS	57
AMPS	2.6
STAGE TWO VOLTS	55
AMPS	1.1

REVERSE OSMOSIS

DATE	31 January - 25 April
TIME	
FEED CONDUCTIVITY	1300
PRODUCT CONDUCTIVITY	220 / 30
PRODUCT FLOW (gpm)	3.7 / 3.9
CONCENTRATE FLOW (gpm)	1.0 / 1.1
RECYCLE FLOW (gpm)	-
FEED TEMPERATURE (°F)	60
ΔP ACROSS HFF	15
MEMBRANES SW	25
ΔP ACROSS C. FILTERS	3
FEED PRESSURE	31
INLET pH	7.3
PRODUCT pH	6.2
ΔP ACROSS $KMnO_4$ FILTERS	2
ΔP ACROSS SAND TRAP	6
PUMP PRESSURE HFF	515
SW	430

COMMENTS:

* Does not include .5gpm electrode discharge

Table 1. Summary of Operating Conditions - San Jon

Table 2. Water Quality - San Jon
(Average Data for Operation)

	Raw	RO Feed	Product HFF	Product SW	Waste	ED Feed	ED Prod	Ed Waste
Chloride	93	86	8	45	331	85	9	195
Fluoride	5.73	4.7	.3	.73	6.75	2.	.1	4.0
Hardness	15.6	13.75	0	0	61	25	0	29
Alkalinity	575	405	21	110	1168	575	60	841
Sulfate	178	306	4	15	1448	183	11	273
pH	8.2	7.31	6.02	6.8	7.9	8.2	7.24	8.35
TDS	890	898	28	214	4167	890	73	1850
EC	1612	1600	53	396	5712	1535	136	3166

Table 3. Operation Summary - San Jon

Gallons	Total	Product	Waste	Recovery (%)
Ro	862,200			
HFF		342,990	96,700	78
SW		333,700	88,810	79
ED	200,00	170,000	30,000	85

Electrical Energy (KW Hrs.)

Total	20,644
ED	2,585
RO HFF	3,695
RO WS	3,705

The material balance for the reverse osmosis system operation closes within an average 5% for the solute species shown in Table 2. The electrodialysis system material balance does not close, since the electrode discharge stream was not sample and the analysis of Table 2 is only on the brine discharge.

B. Operation at Alamogordo, New Mexico

The mobile van, containing the desalting equipment, was demonstrated in Las Cruces, in conjunction with the Annual Water Conference at New Mexico State University. The Conference was May 3 and 4, 1979. After the Conference, the van was relocated to Alamogordo. The van was located next to Well No. 6, southwest from Green Reservoir. The van supply (raw water) came directly from the well discharge line via a two-inch bleed valve. Water analysis is shown in Appendix C.

Van operation at Alamogordo was principally directed toward demonstration of technology appropriate to demineralizing Tularosa Basin brackish water resources. While the basin has ground water ranging in quality from potable to saturated brine, the raw water source available for the van operation was 1300 ppm total dissolved residue. This is lower than desired; however, satisfactory for the demonstration.

In conjunction with the van operation, brine evaporation rates were measured to verify available data. These measurements gave an annual rate of 60 to 70 inches (net).

During the course of operation, both the reverse osmosis system and the electrodialysis system were modified. The operating summaries will be given on a monthly basis to reflect these changes. Tables 4 through 9 are summaries of the monthly operating conditions. Table 10 gives water quality for May, June, and August.

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE		MAY 1979	DATE		MAY 1979
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		1285	FEED CONDUCTIVITY		1900
PRODUCT SALINITY (ppm)		81	PRODUCT CONDUCTIVITY	SW*	150
				HFF	150
PRODUCT CONDUCTIVITY		127	PRODUCT FLOW (gpm)		2.2 / 5.3
DILUTE FLOW (gpm)		3.6	CONCENTRATE FLOW (gpm)		1.9 / 3.0
BRINE FLOW (gpm)*		1.0	RECYCLE FLOW (gpm)		–
FEED TEMPERATURE (°F)		70	FEED TEMPERATURE (°F)		72
STACK INLET		44	ΔP ACROSS	HFF	10
STACK OUTLET		1.5	MEMBRANES	SW	27
DIFFERENTIAL IN		40	ΔP ACROSS C. FILTERS		3
DIFFERENTIAL OUT		5	FEED PRESSURE		30
BEFORE FILTER		48	INLET pH		7.0
AFTER FILTER		47	PRODUCT pH		6.0 / 6.1
AFTER PRV		46	ΔP ACROSS $KMnO_4$ FILTERS		9
ELECTRODE INLET		46	ΔP ACROSS SAND TRAP		12
STAGE ONE	VOLTS	62	PUMP PRESSURE	HFF	475
	AMPS	4.0		SW	430
STAGE TWO	VOLTS	62			
	AMPS	1.5			

COMMENTS:

* Does not include .5gpm electrode discharge

* SW - spiral wound module; HFF - Hollow-fine fiber

Table 4. Operating Conditions - May, Alamogordo

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS

DATE JUNE 1979

TIME	
POLARITY	
FEED SALINITY (ppm)	1300
PRODUCT SALINITY (ppm)	78
PRODUCT CONDUCTIVITY	120
DILUTE FLOW (gpm)	3.6
BRINE FLOW (gpm)*	.75
FEED TEMPERATURE (°F)	70
STACK INLET	44
STACK OUTLET	1.5
DIFFERENTIAL IN	40
DIFFERENTIAL OUT	10
BEFORE FILTER	49
AFTER FILTER	48
AFTER PRV	47
ELECTRODE INLET	46
STAGE ONE VOLTS	61
AMPS	3.9
STAGE TWO VOLTS	61
AMPS	1.5

REVERSE OSMOSIS

DATE JUNE 1979

TIME	
FEED CONDUCTIVITY	1880
PRODUCT CONDUCTIVITY SW# / HFF	180 / 120
PRODUCT FLOW (gpm)	2.1 / 5.3
CONCENTRATE FLOW (gpm)	1.9 / 2.3
RECYCLE FLOW (gpm)	—
FEED TEMPERATURE (°F)	74
ΔP ACROSS HFF	10
MEMBRANES SW	30
ΔP ACROSS C. FILTERS	3
FEED PRESSURE	30
INLET pH	7.2
PRODUCT pH	6.1 / 6.15
ΔP ACROSS $KMnO_4$ FILTERS	9
ΔP ACROSS SAND TRAP	13
PUMP PRESSURE HFF	450
SW	450

COMMENTS:

* Does not include .5gpm electrode discharge
# SW - spiral wound module; HFF - Hollow fine fiber

Table 5. Operating Conditions - June, Alamogordo

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS

DATE July 1979

TIME		
POLARITY		
FEED SALINITY (ppm)		1280
PRODUCT SALINITY (ppm)		90
PRODUCT CONDUCTIVITY		150
DILUTE FLOW (gpm)		3.6
BRINE FLOW (gpm)*		.6
FEED TEMPERATURE (°F)		70
STACK INLET		50
STACK OUTLET		1.5
DIFFERENTIAL IN		20
DIFFERENTIAL OUT		25
BEFORE FILTER		65
AFTER FILTER		64
AFTER PRV		53
ELECTRODE INLET		52
STAGE ONE	VOLTS	61
	AMPS	4.3
STAGE TWO	VOLTS	61
	AMPS	1.7

REVERSE OSMOSIS

DATE July 1979

TIME		
FEED CONDUCTIVITY		2000
PRODUCT CONDUCTIVITY	SW* / HFF	280 / 400
PRODUCT FLOW (gpm)		2.1 / 4.6
CONCENTRATE FLOW (gpm)		2.0 / 3.1
RECYCLE FLOW (gpm)		—
FEED TEMPERATURE (°F)		74
ΔP ACROSS	HFF	15
MEMBRANES	SW	30
ΔP ACROSS C. FILTERS		3
FEED PRESSURE		30
INLET pH		5.7
PRODUCT pH		4.8 / 4.7
ΔP ACROSS $KMnO_4$ FILTERS		5
ΔP ACROSS SAND TRAP		9
PUMP PRESSURE	HFF	470
	SW	435

COMMENTS:

*Does not include .5 gpm electrode discharge

‡ Spiral wound module; HFF - Hollow fine fiber (ran only 4 days)

Table 6. Operating Conditions - July, Alamogordo

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE		August 1979	DATE		August 1979
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		1280	FEED CONDUCTIVITY		2000
PRODUCT SALINITY (ppm)		90	PRODUCT CONDUCTIVITY	SW / HFF	300 / 135
PRODUCT CONDUCTIVITY		160	PRODUCT FLOW (gpm)		2.1 / 4.1
DILUTE FLOW (gpm)		3.6	CONCENTRATE FLOW (gpm)		2.0 / 2.8
BRINE FLOW (gpm) * (a)		.4	RECYCLE FLOW (gpm)		—
FEED TEMPERATURE (°F)		70	FEED TEMPERATURE (°F)		73
STACK INLET		50	ΔP ACROSS	HFF	20
STACK OUTLET		1.5	MEMBRANES	SW	30
DIFFERENTIAL IN		18	ΔP ACROSS C. FILTERS		2
DIFFERENTIAL OUT		20	FEED PRESSURE		30
BEFORE FILTER		72	INLET pH		6.2
AFTER FILTER		66	PRODUCT pH		5.5 / 5.4
AFTER PRV		53	ΔP ACROSS $KMnO_4$ FILTERS		9
ELECTRODE INLET		52	ΔP ACROSS SAND TRAP		12
STAGE ONE	VOLTS	62	PUMP PRESSURE	HFF	485
	AMPS	4.3		SW	445
STAGE TWO	VOLTS	61			
	AMPS	1.5			

COMMENTS:

* Does not include .5 gpm electrode discharge

‡ SW - Spiral wound module; HFF - Hollow fine fiber

(a) Changed to 0.0 8-17-79

Table 7. Operating Conditions - August, Alamogordo

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS

DATE	SEPT. 1979
TIME	
POLARITY	
FEED SALINITY (ppm)	1220
PRODUCT SALINITY (ppm)	90
PRODUCT CONDUCTIVITY	190
DILUTE FLOW (gpm)	3.6
BRINE FLOW (gpm)*	.0
FEED TEMPERATURE (°F)	70
STACK INLET	28
STACK OUTLET	1.5
DIFFERENTIAL IN	18
DIFFERENTIAL OUT	30
BEFORE FILTER	64
AFTER FILTER	63
AFTER PRV	53
ELECTRODE INLET	29
STAGE ONE VOLTS	55
AMPS	5.8
STAGE TWO VOLTS	55
AMPS	2.2

REVERSE OSMOSIS

DATE	SEPT. 1979
TIME	
FEED CONDUCTIVITY	2000
PRODUCT CONDUCTIVITY SW / HFF	290 / 135
PRODUCT FLOW (gpm)	2.0 / 4.0
CONCENTRATE FLOW (gpm)	1.9 / 2.7
RECYCLE FLOW (gpm)	—
FEED TEMPERATURE (°F)	73
ΔP ACROSS HFF	20
MEMBRANES SW	30
ΔP ACROSS C. FILTERS	2
FEED PRESSURE	30
INLET pH	6.3
PRODUCT pH	5.6 / 5.4
ΔP ACROSS $KMnO_4$ FILTERS	9
ΔP ACROSS SAND TRAP	11
PUMP PRESSURE HFF	485
SW	435

COMMENTS:

* Does not include .5 gpm electrode discharge

Table 8. Operating Conditions - September, Alamogordo

METER READING AT

ALAMOGORDO

ELECTRODIALYSIS

DATE OCTOBER 1979

TIME	
POLARITY	
FEED SALINITY (ppm)	1330
PRODUCT SALINITY (ppm)	130
PRODUCT CONDUCTIVITY	190
DILUTE FLOW (gpm)	3.7
BRINE FLOW (gpm)	0.0
FEED TEMPERATURE (°F)	70
STACK INLET	30
STACK OUTLET	1.5
DIFFERENTIAL IN	21
DIFFERENTIAL OUT	25
BEFORE FILTER	60
AFTER FILTER	60
AFTER PRV	53
ELECTRODE INLET	33
STAGE ONE VOLTS	55
AMPS	4.9
STAGE TWO VOLTS	55
AMPS	2.0

REVERSE OSMOSIS

DATE OCTOBER 1979

TIME	
FEED CONDUCTIVITY	2000
PRODUCT CONDUCTIVITY SW* / HFF	130 / 400
PRODUCT FLOW (gpm)	2.0 / 4.1
CONCENTRATE FLOW (gpm)	1.9 / 2.0
RECYCLE FLOW (gpm)	—
FEED TEMPERATURE (°F)	73
ΔP ACROSS HFF	18
MEMBRANES SW	30
ΔP ACROSS C. FILTERS	2
FEED PRESSURE	30
INLET pH	6.4
PRODUCT pH	5.5 / 5.4
ΔP ACROSS $KMnO_4$ FILTERS	9
ΔP ACROSS SAND TRAP	11
PUMP PRESSURE HFF	485
SW	435

COMMENTS:

Approximately .5 gpm electrode discharge

* SW Spiral wound Module; HFF Hollow fine fiber

Table 9. Operating Conditions - October, Alamogordo

Table 10. Water Quality - May

	Raw	RO Feed	HF Product	SW Product	ED Waste	ED Feed	Ed Product	ED Brine
Calcuim	440	480	5	10	1300	450	35	1100
Sulfate	570	520	13	10	1400	550	40	1100
pH	7.6	7.3	6.02	6.02	7.2	7.35	6.75	7.6
TDS	1290	1290	62	90	3080	1290	78	2730
			Water Quality - June					
Calcium	450	450	5	5	1100	450	20	1450
Sulfate	570	580	13	6	1300	540	28	1400
pH	7.6	7.3	6.1	6.05	7.15	7.4	7.0	7.6
TDS	1260	1210	58	72	2950	1280	88	3450
			Water Quality - August					
Calcium	400	500	40	30	900	500	15	1500
Sulfate	580	620	57	36	1300	580	24	1875
pH	7.42	6.46	5.8	5.7	6.7	7.3	6.72	7.35
TDS	1280	1300	175	162	2350	1280	80	4300

The material balances are consistent within the experimental error.

SELECTIVE CATION REMOVAL BY PRECIPITATION

Although trace heavy metal occurrences in drinking water have concerned public health officials and water treatment engineers for many years, there have been surprisingly few studies of their distribution in water supplies and of the effects of water treatment processes on trace heavy metals. The existing data on heavy metal distribution in public water supplies has come largely from grab sample techniques rather than indepth studies. The existing data on trace heavy metals in U.S. water supplies were obtained by techniques useful for screening purposes but not of great accuracy. Numerous advances have occurred in the field of trace metal analysis within the past decade, and with the recently reported statistical relationships between trace heavy metal levels in water and food and the geography of human health problems, a renewed and closer study of biologically significant trace heavy metals in drinking water and of their removal by conventional treatment process is necessary. Concern over heavy metals in drinking water stems largely from human health considerations, i.e., the effects of chronic low levels of exposure to such elements as cadmium, lead, and mercury.

The greatest impetus for studies of trace heavy metals in water supplies has come from recent mercury and cadmium episodes where poisoning occurred. For example, the best known case occurred over a period of years at Minamata Bay in Japan. Death and cases of mental and physical retardation resulted among persons eating fish contaminated with mercury. The most serious cases of environmental pollution

by cadmium also occurred in Japan after World War II. The illness, called "itai-itai kyo" or ouch-ouch disease" caused painful bone changes and resulted from cadmium wastes from mines and smelters producing zinc and lead. A mercury pollution scare occurred in North America in 1970 with many reports of elevated mercury levels in waters, rediments and fish of the lower Great Lakes.

While no serious episodes have been related to the occurrence of these elements in drinking water, the incidents cited previously have raised the general level of public and scientific concern about toxic metals in the environment and man's exposure to them. A few toxic metals do occur relatively often in drinking water supplies at levels approaching the 1974 U.S. drinking water standards (within an order of magnitude of the standards), and several recent reports, indicate that standards are exceeded in a percentage of supplies that are sufficient in number to warrant concern.

There are eight elements of principal concern in terms of toxicity that are found in drinking water supplies. These are arsenic, barium, cadmium, chromium, mercury, lead, selenium and zinc. The physiological effects of these metals are quite varied; for example, low level cadmium exposure has been implicated in cardiovascular problems, whereas, at higher levels it causes kidney and liver damage as well as the skeletal disorder osteomalacia, e.g., a severe brittling of the bones. The toxicological effects of mercury are neurological damage and birth defects, predominately resulting from the organic compounds of mercury, mono- and dimethyl-mercury.

The ignorance of the effects of heavy metals on human health probably exceeds the knowledge in the field. This is especially true

for subtle subacute effects, which by their nature, are difficult to detect, let alone relate to specific causes. If ignorance of health implications precludes definitive conclusions regarding the "safe" levels of various trace metals in water supplies, the scattered available evidence provides plausible cause for concern. Thus, which the increased direct and indirect use of waste water for drinking purposes, further information on the levels of various trace heavy metals in water supplies and the extent to which they are removed by conventional treatment processes such as lime soda softening coagulation-filtration, sand filters and alum coagulation, is highly desirable and necessary.

This study concerns group II-B elements; the metals cadmium, mercury and zinc. The chemistries of zinc and cadmium are very similar, but that of mercury differs considerably and cannot be regarded as homologous. This group is of a particular interest of study for three reasons: cadmium and mercury are highly toxic metals which are found at levels in most water supplies such as to warrant studies of the best means of their removal; zinc, while toxic only at high levels (actually an essentially element in human metabolism) in a source of cadmium. Zinc is used as a coating of galvanized iron pipes used in water distribution. Dissolution or corrosion of the coating, thus provides the cadmium. Additionally, zinc has an esthetic significance in that it may lead to taste and discoloration in water.

The methodology proposed for the removal of these heavy metals from drinking water is sulfide precipitation. The combination of the metal cations which the sulfide anions is called coordination or complex formation. The metal cations (central atom) cadmium,

mercury and zinc react with the ligands S^{2-}, HS^{-}, or S_x^{2-} in aqueous solutions to form very insoluable precipitates. The kinetics of the precipitation of cadmium, mercury and zinc with sulfide as polysulfides (S_x^{2-}) (converted by addition of hydrogen peroxide) will be studied as a function of pH, temperature, and metal concentration.

The rates of precipitation were measured using a rapid-mixing instrument, called a multi-mixing spectrophotometer (Durrum). Products from the reaction are subsequently analyzed to determine the percentage of metal removal via the sulfide. Once these variables have been studied and the results analyzed, the process using sodium sulfide ($Na_2S \cdot 9H_2O$) as the sulfide source can be evaluated for possible use in drinking water systems.

Precipitation reactions were accomplished by initially oxidizing a sulfide solution with excess hydrogen peroxide to obtain the polysulfide in the form of S_x^{2-} which was then rapidly mixed with a solution containing the metal cation. The initial rates of absorbance versus reaction time were calculated and converted to precipitation rates by using the molecular absorptivities of the polysulfides at the specific solution pH levels.

Analysis of variance or F-tests were performed for each set of rate data. From these tests and other investigation the following conclusions can be made:

1. The most significant effects on the precipitation rate for all three metals occurred when the pH level of sulfide solution was 9.0.

   A) At this pH the predominant polysulfide species present (90%) are S_4^{2-} and S_5^{2-} which appear to selectively remove

the metals in the form of the highly insoluble metal sulfide.

B. At the lower pH level (7.0) these polysulfide species are less predominant due to the pressence of S° and H_2S which also act to remove the metals. At the high pH (11.0) the precipitation rate may be somewhat effected by precipitation of the metals as their hydroxide salts, but this effect is probably very small compared to the sulfide precipitation due to the greater affinity of the metals for the S_x^{2-} ligand over the OH^- ligand.

2. An increase in temperature of the reaction system results in lower precipitation rates of the metals.

   A) Highest precipitation rates and also percentage removal rates tend to occur at the lowest temperature 10°C.

   B) Values fall significantly when the reaction system is at 21.1°C due to increased solubility of the cations caused by the increased temperature.

APPENDIX A

CHEMICAL ANALYSIS - SAN JON

Location: SAN JON

Component	Sample Information: RAW FEED	ED FEED	ED PRODUCT	ED WASTE
Sodium	315	314	28.	1006
Potassium	1.	1.	0.	2.7
Calcium	2.	2.6	.2	8.6
Magnesium	2.3	2.2	1.2	8.4
Iron-Total	<.10	<.10	<.10	<.10
Manganese	<.05	<.05	<.05	<.05
Chloride	59.6	58.8	5.3	181.9
Fluoride	2.95	2.8	.25	8.5
Nitrate	11.3	10.9	.5	39.4
Bicarbonate	286.8	447.9	59.8	1315.5
Carbonate	–	46.8	–	127.2
Sulfate	338.1	151.3	16.3	504.8
Phosphate	.08	.06	–	.28
Total Hardness				
Alkalinity				
Total Dissolved Residue	882	812	76	2452
Surfactants				
pH	7.6	8.51	7.34	8.83
Odor	–	–	–	–
Color	1	1	1	1
Turbidity	.45	.50	.47	.51
Conductance Micromhos/cm 25 C	1360	1300	130	3550
Arsenic	.022	.024	.027	.042
Barium	<.4	<.4	<.4	<.4
Boron	.75	.80	.64	.84
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.10	<.10	<.10	<.10
Cyanide	–	–	–	–
Lead	<.001	<.001	<.001	.004
Mercury	.0005	.0010	.0006	.0009
Molybdenum	.015	.015	<.010	.054
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	.02	.0075	<.001	.0399
Zinc	<.02	<.02	<.02	<.02
Radium 226	–	–	–	–
Strontium	<.02	<.02	<.02	.21
~~Cross Beta~~ SiO_2	11.8	13.0	11.2	12.5

Location: SAN JON

Component	Sample Information: RO[1] FEED	HF[2] PRODUCT	SW[3] PRODUCT	COMBINED WASTE
Sodium	318	14.9	80.5	1312.
Potassium	.8	0.	0.	3.5
Calcium	1.8	.2	.2	13.4
Magnesium	2.2	.1	.1	10.9
Iron-Total	<.10	<.10	<.10	<.10
Manganese	<.05	<.05	<.05	<.05
Chloride	61.7	5.7	36.4	191.4
Fluoride	3.25	.17	1.08	9.0
Nitrate	11.1	4.2	10.2	26.5
Bicarbonate	513.8	18.3	107.4	1130.
Carbonate	0.	0.	0.	0.
Sulfate	147.9	13.9	27.9	1570.1
Phosphate	.05	0.	0.	.32
Total Hardness				
Alkalinity				
Total Dissolved Residue	812.	32	184	3726
Surfactants				
pH	7.3	5.54	6.38	7.83
Odor	–	–	–	–
Color	1	1	1	1
Turbidity	.57	.40	.42	.62
Conductance Micromhos/cm 25 C	1280	70	340	5020
Arsenic	.020	.013	.011	.040
Barium	<.4	<.4	<.4	<.4
Boron	.75	.64	.73	1.08
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.10	<.10	<.10	<.10
Cyanide				
Lead	.002	<.001	.001	.002
Mercury	.0005	.0008	.0006	.0011
Molybdenum	.015	<.01	<.01	.066
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	.0072	<.001	<.001	.0643
Zinc	<.02	<.02	<.02	.07
Radium 226	–	–	–	–
Strontium	<.02	<.02	<.02	.19
~~Gross Beta~~ SiO_2	11.5	1.25	6.25	37.0

(1) After pH adjustment and hypochlorite if required
(2) Hollow-fiber module
(3) Spiral-wound module

APPENDIX B

OPERATION LOGS - SAN JON

LOCATION: SAN JON

METER READING AT: SAN JON

REVERSE OSMOSIS

DATE	1-31	2-1	2-5	2-6	2-7	2-8	2-10	2-21	2-22	2-23
TIME	1:00	1:30		1:30	8:30	8:30	3:30	9:pm	12:00 noon	1:30
FEED SALINITY	1100	1100	1100	1100	1200	1050	1100	1080	1080	950
FEED CONDUCTIVITY	1500	1500	1500	1460	1540	1375	1410	1340	1340	1240
PRODUCT CONDUCTIVITY	205	200	210	200	-	-	-	-	-	-
PRODUCT FLOW (gpm) SW/HFF	3.0	3.1	3.4	3.1/2.9	3.7	3.4	3.5/3.2	3.8	3.8	3.6/3.8
CONCENTRATE FLOW (gpm)	1.8	1.9	1.8	1.8/1.5	2.0	1.9	1.2/1.4	1.4	1.4	1.1/1.4
RECYCLE FLOW (gpm)	-	-	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)	53	50	55	53	53	47	58	58	58	57
ΔP ACROSS HFF	-	-	-	15	15	15	15	15	15	10
MEMBRANES SW	30	25	30	30	-	-	30	-	-	30
ΔP ACROSS C. FILTERS	2	3	4	8	6	6	10	9	9	4
FEED PRESSURE	32	32	32	32	32	32	32	32	32	32
INLET pH	7.4	6.95		6.55	6.32	7.17		7.1		6.97
PRODUCT pH	6.4	6.0		5.58	4.7	6.0		5.4		5.8/5.6
ΔP ACROSS $KMnO_4$ FILTERS	1	1	1	5	2	3	5	2	3	6
ΔP ACROSS SAND TRAP	7	6	8	12	8	7	8	4	5	7
PUMP PRESSURE HFF	-	-	-	515	515	510	510	510	510	510
SW	425	430	440	440	-	-	430	-	-	430
TURBIDITY	.7			.4	.6				-	
PRODUCT SALINITY	145	132	140	/143	21	14	220/20	16	16	200/14.5

COMMENTS:

Raw water temp. 41°F

All water prechlorinated

LOCATION: SAN JON

METER READING AT:

REVERSE OSMOSIS

DATE		2-26	2-27	2-28	3-1	3-5	3-6	3-7	3-8	3-9	3-11
TIME		11:00	4:00	9:00	9:15	7:00	10:55	2:45	2:30	5:45	5:15
FEED SALINITY		1100	930	800	750	1000	920	1000	1000	920	910
FEED CONDUCTIVITY		1400	1220	1080	1100	1300	1240	1340	1330	1250	1230
PRODUCT CONDUCTIVITY		350/31	330/24	300/18	330/17	350/26	340/37	340/46	310/40	340/32	320/26
PRODUCT FLOW (gpm)		3.5/3.8	3.5/3.8	3.5/3.8	3.5/3.8	3.6/3.8	3.5/3.7	3.5/3.8	3.6/3.9	3.5/3.8	3.5/3.9
CONCENTRATE FLOW (gpm)		.9/1.4	.9/1.4	.9/1.4	.9/1.4	.9/1.4	1.0/1.4	.9/1.4	1.0/1.4	1.0/1.4	1.0/1.4
RECYCLE FLOW (gpm)		-	-	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)		58	58	58	58	59	59	61	62	59	61
ΔP ACROSS	HFF	15	15	15	15	15	25	13	15	15	15
MEMBRANES	SW	25	27	27	25	30	30	35	25	25	30
ΔP ACROSS C. FILTERS		3	3	4	4	3	3	4	4	4	4
FEED PRESSURE		31	31	31	31	31	31	31	31	31	31
INLET pH		7.05	7.15	8.05	8.1			6.9	6.52		7.9
PRODUCT pH		6.3/5.4	6.75/5.8	7.5/6.6	7.8/6.9			6.0/5.5	5.72/4.9		7.7/6.96
ΔP ACROSS $KMnO_4$ FILTERS		5	5	5	4	4	25	5	5	5	5
ΔP ACROSS SAND TRAP		7	7	7	7	4	7	7	8	7	7
PUMP PRESSURE	HFF	515	515	515	515	515	515	515	515	515	515
	SW	435	435	435	435	440	440	440	435	435	435
TURBIDITY		.32						.73	.45	.30	.45
PRODUCT SALINITY		250/19	215/14.5	195/20	175/10	250/16	225/23	230/33	195/23	205/17	215/18

COMMENTS:

LOCATION: SAN JON METER READING AT:

REVERSE OSMOSIS

DATE		3-12	3-13	3-14	3-15	3-16	3-19	3-21	3-22	3-23	3-27
TIME		6:15		6:20	5:30	8:15	4:30	2:30	1:30	8:30	8:15
FEED SALINITY		1000	1000	910	900	900	890	900	910	1000	1140
FEED CONDUCTIVITY		1310	1320	1240	1230	1240	1200	1220	1260	1350	1460
PRODUCT CONDUCTIVITY		300/35	280/35	320/30	290/26	280/25	290/24	400/33	309/40	330/57	520/58
PRODUCT FLOW (gpm)		3.6/3.9	3.6/4.0	3.6/4.0	3.6/4.0	3.4/3.8	3.5/3.9	3.5/3.9	3.5/3.9	3.4/3.7	3.5/3.8
CONCENTRATE FLOW (gpm)		1.0/1.4	1.0/1.3	1.0/1.3	1.0/1.3	1.0/1.3	.9/1.3	0.9/1.3	.9/1.3	0.8/1.3	1.0/1.3
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		63	63	62	62	59	61	62	60	60	60
ΔP ACROSS	HFF	15	15	14	14	15	15	15	15	15	15
MEMBRANES	SW	25	25	25	30	25	27	27	25	25	25
ΔP ACROSS C. FILTERS		4	4	4	4	3	4	4	4	3	4
FEED PRESSURE		31	31	31	31	31	31	31	31	31	31
INLET pH		6.4	6.35	7.8	8.2	8.05	8.10	8.2		6.60	8.5
PRODUCT pH		6.0/5.3	6.0/5.2	7.4/6.4	7.4/6.8	7.8/7.0	8.05/7.15	8.05/7.2		5.85/5.2	8.30/7.61
ΔP ACROSS $KMnO_4$ FILTERS		6	6	6	6	5	6	6	6	6	4
ΔP ACROSS SAND TRAP		7	7	7	7	7	7	6	6	6	7
PUMP PRESSURE	HFF	515	515	515	515	515	515	515	515	515	520
	SW	435	435	435	435	435	435	440	435	440	435
TURBIDITY			.58	.67	.36	.75	.73	.77		.74	.63
PRODUCT SALINITY		198/23.	212/17	180/19	195/15	172/14.	285/13	215/19	205/23	220/60	340/35.5

COMMENTS:

PRODUCT TANK DEVELOPED LEAK - ALL EQUIPMENT OFF 3-23

LOCATION: SAN JON

METER READING AT:

REVERSE OSMOSIS

DATE		3-28	3-29	3-30	4-1	4-2	4-3	4-4	4-5	4-6	4-8
TIME		6:55	4:40	6:45	8:55	5:30	2:10	2:10	11:15	11:20	2:30
FEED SALINITY		1250	1050	1000	890	975	950	950	830	910	890
FEED CONDUCTIVITY		1560	1560	1310	1190	1260	1250	1270	1130	1225	1190
PRODUCT CONDUCTIVITY		490/77	398/65	350/57	360/36	330/38	330/48	340/47	360/34	320/48	400/35
PRODUCT FLOW (gpm)		3.7/4.0	3.8/4.0	5.6/3.9	3.7/4.0	3.7/4.0	3.6/3.9	3.6/3.9	3.6/3.9	3.7/4.0	3.8/4.1
CONCENTRATE FLOW (gpm)		1.0/1.4	1.0/1.3	1.0/1.2	1.0/1.2	1.0/1.2	1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.1
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		64	64	60	62	61	60	60	61	62	65
ΔP ACROSS	HFF	15	15	15	10	16	12	14	14	16	15
MEMBRANES	SW	30	30	25	30	30	25	25	25	30	30
ΔP ACROSS C. FILTERS		4	4	4	4	4	4	5	5	5	5
FEED PRESSURE		31	31	31	31	31	31	31	31	31	31
INLET pH		7.0	6.64		8:40	6.7	6.43	6.5	8.05	6.4	8.4
PRODUCT pH		6.5/5.4	6.05/5.6		825/7.10	6.00/5.25	6.0/5.3	5.9/4.9	7.5/6.7	6.0/5.1	7.6/6.6
ΔP ACROSS $KMnO_4$ FILTERS		6	6	6	7	4	6	6	6	6	6
ΔP ACROSS SAND TRAP		7	7	7	7	7	7	7	7	7	7
PUMP PRESSURE	HFF	515	515	515	515	515	515	515	515	515	515
	SW	430	430	435	435	435	435	435	435	435	430
TURBIDITY		.47	.82	.79	.45	.57	.46	.68	.40	.61	.60
PRODUCT SALINITY		330/44	260/37.5	240/35	255/22	230/27	210/28	215/28	230/21	210/28	260/22

COMMENTS:

LOCATION: SAN JON

METER READING AT:

- REVERSE OSMOSIS

DATE		4-9	4-10	4-11	4-12	4-13	4-14	4-15	4-16	4-17	4-18
TIME		9:10	5:00	4:10	4:15	6:15	11:15	5:35	8:10	4:10	1:50
FEED SALINITY		930	930	920	820	920	900	880	930	750	950
FEED CONDUCTIVITY		1240	1250	1200	1120	1240	1250	1160	1240	1040	1270
PRODUCT CONDUCTIVITY		340/45	320/50	360/38	280/43	320/40	330/40	360/30	330/45	250/45	330/48
PRODUCT FLOW (gpm)		3.7/4.0	3.7/4.0	3.6/3.9	3.7/4.0		3.8/4.0	3.9/4.1	3.8/4.1	4.0/4.2	3.9/4.1
CONCENTRATE FLOW (gpm)		1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.1		1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.1
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		64	63	61	61	63	64	67	65	69	68
ΔP ACROSS	HFF	16	15	14	15	12	16	14	17	13	14
MEMBRANES	SW	30	30	30	30	30	25	30	30	30	30
ΔP ACROSS C. FILTERS		5	5	5	5	6	5	5	6	7	7
FEED PRESSURE		31	31	31	31	31	31	31	31	31	31
INLET pH		7.2	6.47	7.15	6.31	6.0	7.0	8.1	6.7	6.3	6.7
PRODUCT pH			5.8/5.1	7.0/6.0	5.7/5.3	5.4/5.0	6.0/5.22	7.7/6.7	6.0/5.3	6.0/4.98	6.0/4.0
ΔP ACROSS $KMnO_4$ FILTERS		6	6	6	6	6	6	5	6	6	6
ΔP ACROSS SAND TRAP		8	7	7	7	7	7	8	7	8	7
PUMP PRESSURE	HFF	515	515	515	515	515	515	515	515	515	515
	SW	435	435	435	435	435	435	430	432	430	430
TURBIDITY		.55	.55	.66	.90	.85	.59	.65	.65	.74	.95
PRODUCT SALINITY		215/28	205/29	255/23	175/25	205/27	215/39	250/10	210/28	165/27	220/31

COMMENTS:

LOCATION: SAN JON

METER READING AT:

REVERSE OSMOSIS

DATE		4-19	4-20	4-23	4-24	4-25					
TIME		11:20	12:50	10:50	5:20	2:00					
FEED SALINITY		920	890	850	920	930					
FEED CONDUCTIVITY		1230	1200	1125	1250	1260					
PRODUCT CONDUCTIVITY		390/39	320/45	360/90	340/73	330/77					
PRODUCT FLOW (gpm)		3.9/4.0	3.8/4.0	3.9/3.9	4.0/4.0	3.9/3.9					
CONCENTRATE FLOW (gpm)		1.0/1.1	1.0/1.1	1.0/1.1	1.0/1.0	1.0/1.0					
RECYCLE FLOW (gpm)		–	–	–	–	–					
FEED TEMPERATURE (°F)		67	66	69	71	69					
ΔP ACROSS	HFF	13	16	17	15	17					
MEMBRANES	SW	30	30	30	30	30					
ΔP ACROSS C. FILTERS		6	6	6	6	6					
FEED PRESSURE		31	31	31	31	31					
INLET pH		8.2	6.4		6.4	6.5					
PRODUCT pH		7.5/6.5	6.0/5.3		6.0/5.9	6.0/5.15					
ΔP ACROSS $KMnO_4$ FILTERS		6	6	6	6	6					
ΔP ACROSS SAND TRAP		7	7	7	7	7					
PUMP PRESSURE	HFF	515	515	515	515	515					
	SW	430	432	432	430	430					
TURBIDITY		.8	.95		1.0	.79					
PRODUCT SALINITY		260/24	210/27	260/33	225/44	220/46					

COMMENTS:

System flushed with formaldehyde & Citric acid solutions prior to relocating van.

LOCATION: SAN JON

METER READING AT:

ELECTRODIALYSIS

		2-21	2-22	3-6	3-7	3-19	3-21	3-22	3-23	3-28	3-29
DATE		2-21	2-22	3-6	3-7	3-19	3-21	3-22	3-23	3-28	3-29
TIME		9:00 pm	12:00	10:55	3:45	4:30	2:30	1:30	8:30	6:55	4:50
POLARITY		+	−	+	−	+	+	−	−	−	+
FEED SALINITY (ppm)		1100	1100	900	980	880	910	840		1200	960
PRODUCT SALINITY (ppm)		90	90	80	75	70	72	62		130	92
PRODUCT CONDUCTIVITY		55	−		118	115	85	90	95	170	140
DILUTE FLOW (gpm)		3.6	3.6	3.7	3.7	3.6	3.7	3.7	3.7	3.8	3.7
BRINE FLOW (gpm)*		.6	.6	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		55	55	58	50	60	61	58	57	60	60
PRESSURES	STACK INLET	41	41	42	38	40	42	40	42	39	41
	STACK OUTLET	1.5	1.5	1.5	1.5	2.0	1.5	1.5	1.5	1.5	2.0
	DIFFERENTIAL IN	30	35	52	39	51	52	49	49	50	57
	DIFFERENTIAL OUT	-9	-100	2	2	34	2	27	2	1	28
	BEFORE FILTER	67	67	65	65	59	59	59	59	58	57
	AFTER FILTER	65	65	63	63	59	58	58	58	58	57
	AFTER PRV	53	53	53	53	51	51	52	51	53	53
	ELECTRODE INLET	43	43	43	43	43	43	43	43	42	42
STAGE ONE	VOLTS	56	55	58	56	58	58	57	56	56	58
	AMPS	2.9	2.9	2.9	2.9	2.8	2.8	2.5	2.7	3.3	3.0
STAGE TWO	VOLTS	55	55	58	56	58	58	57	56	56	58
	AMPS	1.4	1.4	1.1	1.0	1.0	1.2	.9	1.2	1.4	1.2

COMMENTS:

* Does not include approximately .5gpm electrode discharge

LOCATION: SAN JON

METER READING AT:

ELECTRODIALYSIS

DATE		3-30	4-1	4-2	4-3	4-4	4-5	4-6	4-8	4-9	4-10
TIME		6:50	8:55	8:10	2:10	2:10	11:25	11:40	2:40	9:15	5:00
POLARITY		+	+	-	+	+	-	+	-	+	-
FEED SALINITY (ppm)		910	890	900	900	880	830	850	890	880	850
PRODUCT SALINITY (ppm)		83	70	80	80	70	68	68	65	67	70
PRODUCT CONDUCTIVITY		150	45	-	130	135	130	130	-	-	-
DILUTE FLOW (gpm)		3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.9	3.8	3.7
BRINE FLOW (gpm) *		.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		59	60	60	58	58	59	60	62	61	60
PRESSURES	STACK INLET	41	40	39	42	43	41	43	41	42	40
	STACK OUTLET	1.5	1.5	2	2	2	2	2	1.5	1.5	1.5
	DIFFERENTIAL IN	52	52	50	60	61	53	65	60	59	53
	DIFFERENTIAL OUT	28	29	28	6	31	24	27	30	25	27
	BEFORE FILTER	57	57	57	58	57	57	57	57	57	56
	AFTER FILTER	57	56	57	58	57	56	53	57	57	56
	AFTER PRV	52	52	52	53	52	52	53	51	51	51
	ELECTRODE INLET	42	41	41	43	44	44	44	44	43	43
STAGE ONE	VOLTS	57	59	56	58	60	57	59	57	58	57
	AMPS	2.8	2.8	2.5	2.7	2.8	2.5	2.8	2.8	2.9	2.6
STAGE TWO	VOLTS	57	59	56	58	60	57	59	57	58	57
	AMPS	1.1	1.1	.9	1.1	1.1	.9	1.1	1.0	1.1	1.0

COMMENTS:

* Does not include .5gpm electrode discharge

LOCATION: SAN JON

METER READING AT:

ELECTRODIALYSIS

DATE		4-11	4-12	4-13	4-14	4-15	4-16	4-17	4-18	4-19	4-20
TIME		4:10	4:20	6:15	11:30	5:40	8:25	4:10	2:00	11:15	12:55
POLARITY		+	-	+	-	+	-	+	-	+	-
FEED SALINITY (ppm)		890	800	820	850	890	890	720	900	900	820
PRODUCT SALINITY (ppm)		78	70	78	78	70	80	58	65	70	75
PRODUCT CONDUCTIVITY		-	-	-	-	-	-	-	-	-	-
DILUTE FLOW (gpm)		3.8	3.8	3.8	3.8	3.7	3.7	3.7	3.7	3.5	3.5
BRINE FLOW (gpm)*		.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		59	58	59	61	64	62	65	65	64	64
PRESSURES	STACK INLET	43	41	41	38	42	39	41	39	40	38
	STACK OUTLET	1.5	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	63	58	57	50	63	59	61	57	57	49
	DIFFERENTIAL OUT	33	25	32	28	32	27	28	25	29	29
	BEFORE FILTER	57	57	57	57	57	57	57	57	57	57
	AFTER FILTER	57	57	57	57	57	57	57	57	57	57
	AFTER PRV	52	52	51	52	52	52	52	52	52	52
	ELECTRODE INLET	44	44	42	42	43	43	42	42	42	41
STAGE ONE	VOLTS	59	57	59	57	59	57	58	57	58	57
	AMPS	2.8	2.3	2.8	2.6	2.8	2.6	2.4	2.7	2.9	2.5
STAGE TWO	VOLTS	59	57	59	57	59	57	58	57	58	57
	AMPS	1.2	1.0	1.1	.9	1.1	1.0	.9	1.0	1.1	.9

COMMENTS:

* Does not include .5gpm electrode discharge

LOCATION: SAN JON

METER READING AT:

ELECTRODIALYSIS

DATE		4-23	4-24	4-25								
TIME		2:00	5:17	2:00								
POLARITY		-	+	-								
FEED SALINITY (ppm)		900	840	860								
PRODUCT SALINITY (ppm)		65	58	65								
PRODUCT CONDUCTIVITY		-	105	110								
DILUTE FLOW (gpm)		3.7	3.7	3.7								
BRINE FLOW (gpm)*		.5	.5	.5								
FEED TEMPERATURE (°F)		65	67	66								
PRESSURES	STACK INLET	39	40	38								
	STACK OUTLET	1.5	2	15								
	DIFFERENTIAL IN	57	60	53								
	DIFFERENTIAL OUT	25	31	23								
	BEFORE FILTER	57	56	57								
	AFTER FILTER	57	56	57								
	AFTER PRV	52	52	52								
	ELECTRODE INLET	42	41	41								
STAGE ONE	VOLTS	57	59	57								
	AMPS	2.7	2.8	2.6								
STAGE TWO	VOLTS	57	59	57								
	AMPS	1.0	1.0	.9								

COMMENTS:

* Does not include .5gpm electrode discharge

APPENDIX C

CHEMICAL ANALYSIS - ALAMOGORDO

Location: ALAMOGORDO

Component	Sample Information: RAW	ED FEED	RO FEED	HFFP
Sodium	173.1	179.7	169.9	15.2
Potassium	1.9	1.9	1.9	0.
Calcium	166.9	166.9	165.7	15.8
Magnesium	66.4	66.1	65.8	1.2
Iron-Total	<.10	<.10	<.10	<.10
Manganese	<.05	<.05	<.05	<.05
Chloride	208.5	209.5	209.2	17.4
Fluoride	.29	.29	.28	<.2
Nitrate	.59	.61	.59	.11
Bicarbonate	247.7	245.3	253.2	37.8
Carbonate	0.	0.	0.	0.
Sulfate	520.2	505.8	544.2	15.8
Phosphate	.01	.01	.01	.08
Total Hardness				
Alkalinity				
Total Dissolved Residue	1300	1320	1352	98
Surfactants				
pH	7.71	7.83	7.90	7.59
Odor				
Color	1.	1.	1.	1.
Turbidity	.39	.40	.39	.43
Conductance Micromhos/cm 25 C	1990	1960	1970	130.
Arsenic	.024	.017	.017	.001
Barium	<.4	<.4	<.4	<.4
Boron	.09	.01	.09	.14
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.10	<.10	<.10	<.10
Cyanide	—	—	—	—
Lead	.005	<.005	<.005	<.005
Mercury	<.0002	<.0002	.0003	<.0002
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	.011	.005	.013	<.002
Zinc	<.02	<.02	.26	.07
Radium 226	—	—	—	—
Strontium	2.58	2.58	2.16	.1
~~Strontium~~ SiO_2	17.7	17.2	17.2	1.90

Location: ALAMOGORDO

Component	Sample Information			
	EDP	SWP	ROW	EDW
Sodium	20.0	20.2	415.9	422.5
Potassium	1.6	0.	44.6	50.0
Calcium	5.4	2.2	264.3	426.4
Magnesium	2.7	1.2	159.6	194.7
Iron-Total	<.10	<.10	<.10	<.10
Manganese	<.05	<.05	<.05	<.05
Chloride	12.0	28.0	488.5	600.
Fluoride	<.20	<.20	.68	.76
Nitrate	.02	.28	1.19	1.75
Bicarbonate	37.2	16.5	238.	607.7
Carbonate	0.	0.	0.	0.
Sulfate	32.2	11.0	1320.9	1550.
Phosphate	.38	.02	.01	.01
Total Hardness				
Alkalinity				
Total Dissolved Residue	74.	64.	3094.	3668.
Surfactants				
pH	7.05	6.92	8.01	7.96
Odor	–	–	–	–
Color	1	1	1	1
Turbidity	.39	.43	.41	.43
Conductance Micromhos/cm 25 C	160.	140.	4240	4970
Arsenic	.003	.012	.029	.051
Barium	<.4	<.4	<.4	<.4
Boron	.16	.13	.17	.09
Cadmium	<.005	<.005	.006	.009
Chromium	<.05	<.05	<.05	<.05
Copper	<.10	<.10	<.10	.08
Cyanide	–	–	–	–
Lead	<.005	<.005	<.005	<.005
Mercury	<.0002	.0004	.0082	.0005
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	<.002	.005	.020	.021
Zinc	<.02	<.02	.69	.04
Radium 226	–	–	–	–
Strontium	<.02	<.02	6.40	8.70
~~Unidentified~~ SiO_2	16.20	3.65	39.40	16.90

APPENDIX D

OPERATION LOGS - ALAMOGORDO

LOCATION: Alamogordo

METER READING AT:

REVERSE OSMOSIS

DATE		5-21	5-22	5-23	5-24	5-25	5-26	5-27	5-28	5-29	5-30
TIME		3:50	8:45	9:30	8:40	8:45	7:30	5:40	2:30	4:58	1:30
FEED SALINITY		1300	1300	1310	1310	1310	1300	1310	1300	1290	1290
FEED CONDUCTIVITY		2300	2000	2000	2000	2000	1990	1990	1980	1830	1825
* PRODUCT CONDUCTIVITY		105 150 162	186 138 140	172 195 135	146 192 138	160 180 130	164 170 136	160 180 128	146 - -	146 166 126	143 160 128
* PRODUCT FLOW (gpm)		2.5 3.7	2.6 4.8	2.5 4.8	2.3 5.8	2.3 5.3	2.2 5.3	2.2 5.3	2.2 —	2.2 5.3	2.2 5.3
* CONCENTRATE FLOW (gpm)		3.0 4.9	1.7 3.5	2.0 2.3	2.0 3.4	1.9 3.1	1.9 3.0	1.9 3.0	1.9 —	1.9 3.0	1.9 3.0
RECYCLE FLOW (gpm)		—	—	—	—	—	—	—	—	—	—
FEED TEMPERATURE (°F)		71	70	71	72	72	71	75	74	72	75
ΔP ACROSS	DuP	0	10	8	10	15	10	10	—	5	5
	HFF Dow	10	12	15	15	8	12	15	—	15	15
MEMBRANES	SW	35	30	30	30	30	25	25	25	30	25
ΔP ACROSS C. FILTERS		3	3	3	3	3	3	3	2	4	3
FEED PRESSURE		29	30	30	30	30	30	30	32	30	30
INLET pH		6.6	7.4	6.4	6.4	6.45	6.85	6.46	6.97	7.3	7.3
* PRODUCT pH		5.0 5.9	6.0 6.1	5.8 5.8	5.8 5.8	5.8 5.8	5.9 6.0	5.6 5.8	6.0 —	6.02 6.02	6.05 6.15
ΔP ACROSS $KMnO_4$ FILTERS		11	9	8	8	9	9	9	2	9	9
ΔP ACROSS SAND TRAP		16	12	11	12	13	12	12	6	13	12
PUMP PRESSURE	HFF	460	475	485	470	475	475	475	—	475	470
	SW	415	425	430	425	430	430	430	430	430	435
TURBIDITY		—	—	—	—	0.59	0.72	0.66	0.48	0.43	0.44
PRODUCT SALINITY		— —	125 105	115 80	95 70	98 62	100 58	95 60	88 —	90 62	87 58

COMMENTS:

Hollow Fine Fiber modules down to replace feed line fittings 5-28

Total Kwhrs used HF - 494 SW - 571 5-21 — 5-30

Total gallons processed 141,965

* RO SW given first RO HF second ; in those cases where 3 appear ① SW ② Dow HF ③ Du Pont HF

LOCATION: Alamogordo

METER READING AT:

REVERSE OSMOSIS

		5-31	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11
DATE											
TIME		8:35	7:20	12:40	6:20	3:00	9:15	8:00	4:30	3:00	10:20
FEED SALINITY		1290	1300	1290	1290	1290	1250	1300	1300	1300	1300
FEED CONDUCTIVITY		1800	1800	1780	1780	1780	1820	1900	1900	1900	1925
PRODUCT CONDUCTIVITY		196 160 130	120 160 130	120 115 100	120 120 100	120 105	120 105	133 99	133 95	125 98	123 82
PRODUCT FLOW (gpm)		2.2 5.3	2.2 5.3	2.1 5.3	2.1 5.3	2.1 5.6	2.1 5.6	2.1 5.1	2.1 5.5	2.1 5.6	2.1 5.7
CONCENTRATE FLOW (gpm)		1.9 3.0	1.9 3.0	1.8 3.0	1.8 3.0	1.8 3.2	1.8 3.2	1.8 2.9	1.8 3.1	1.9 3.1	1.9 3.2
RECYCLE FLOW (gpm)		—	—	—	—	—	—	—	—	—	—
FEED TEMPERATURE (°F)		75	75	74	73	74	73	74	74	74	74
ΔP ACROSS	DuP	5	10	8	8	10	10	8	10	10	10
	HFF Dow	15	15	13	18	15	20	15	18	20	15
MEMBRANES	SW	25	25	30	25	30	27	27	30	25	30
ΔP ACROSS C. FILTERS		3	3	3	3	3	3	3	3	4	3
FEED PRESSURE		30	30	30	30	30	30	30	30	30	30
INLET pH		7.3	7.3	7.2	7.3	7.4	7.4	7.4	7.2	7.2	7.2
PRODUCT pH		6.02 6.02	6.05 6.15	6.08 6.13	6.05 6.13	6.08 6.13	6.1 6.15	5.9 6.0	6.08 6.10	6.16 6.20	6.0 6.15
ΔP ACROSS $KMnO_4$ FILTERS		9	8	9	9	8	10	8	11	9	11
ΔP ACROSS SAND TRAP		12	12	11	11	12	12	11	13	13	12
PUMP PRESSURE	HFF	470	470	475	475	468	468	400	470	470	465
	SW	435	435	435	435	435	435	435	435	435	435
TURBIDITY		0.55	0.50	0.49	0.46	0.27	0.37	0.41	0.46	0.38	0.51
PRODUCT SALINITY		80 62	87 58	80 52	72 55	68 52	80 58	75 58	72 58	72 58	75 50

COMMENTS:

Starting 6-6-79 Dow and DuPont conductivity values given together (measured as HFRO product)

Total Kwhrs used HF – 811 SW – 811

Total gallons used 218,320

LOCATION: Alamogordo

METER READING AT:

REVERSE OSMOSIS

DATE		6-12	6-13	6-14	6-15	6-18	6-19	6-20	6-21	6-22	6-25
TIME		10:00	5:00	8:45	9:20	1:10	10:00	9:30	10:00	9:00	11:20
FEED SALINITY		1290	1290	1290	1290	1250	1250	1300	1300	1300	1250
FEED CONDUCTIVITY		2200	2200	2100	2200	2000	2200	2100	2100	2100	2000
PRODUCT CONDUCTIVITY		123 77	163 108	134 100	124 98	180 170	140 100	145 130	145 120	140 110	160 145
PRODUCT FLOW (gpm)		2.2 6.1	2.2 5.5	2.1 5.4	2.1 5.6	2.4 5.0	2.0 4.8	2.0 5.2	2.0 4.8	2.0 4.7	1.9 4.4
CONCENTRATE FLOW (gpm)		1.9 3.7	1.9 3.3	1.9 3.4	1.9 3.1	1.9 3.1	1.9 3.1	1.9 3.2	1.9 3.1	1.9 3.1	1.8 3.0
RECYCLE FLOW (gpm)		—	—	—	—	—	—	—	—	—	—
FEED TEMPERATURE (°F)		72	73	72	72	77	74	74	74	74	74
ΔP ACROSS	DuP HFF Dow	14 17	14 17	15 18	15 20	13 18	15 15	17 20	30 25	20 25	30 15
MEMBRANES	SW	30	27	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		4	4	4	4	4	3	4	3	3	3
FEED PRESSURE		30	30	30	30	30	30	28	29	29	29
INLET pH		7.3	7.4	7.2	7.3	7.4	7.2	6.8	7.0	7.2	6.91
PRODUCT pH		6.0 6.0	6.15 6.19	6.38 6.30	6.0 6.21	6.4 6.31	6.1 6.0	6.3 6.28	6.3 6.3	6.3 6.2	6.36 6.37
ΔP ACROSS $KMnO_4$ FILTERS		11	11	11	4	5	12	17	19	8	10
ΔP ACROSS SAND TRAP		13	14	14	10	5	12	9	7	18	15
PUMP PRESSURE	HFF	460	465	465	465	425	420	390	385	390	390
	SW	435	435	435	435	475	450	440	435	450	450
TURBIDITY		0.54	0.46	0.48	0.50	0.54	0.51	0.49	0.49	0.50	0.46
PRODUCT SALINITY		70 45	95 65	72 58	75 70	150 85	140 90	90 85	120 100	120 100	140 110

COMMENTS:

Signs of $CaSO_4$ scaling observed 6-13-79

Total Kwhrs used: HF — 621 SW —

Total gallons processed — 153,690

LOCATION: Alamogordo

METER READING AT:

REVERSE OSMOSIS

DATE		6-26	6-27	6-28	6-29	7-3	7-4	7-11	7-12	7-13	7-16
TIME		1:30	10:30	2:40	9:20	6:30	9:40	6:45	9:50	7:35	6:45
FEED SALINITY		1250	1250	1250	1250	1300	1300	2320	2150	1300	1300
FEED CONDUCTIVITY		2000	1900	2000	2000	1820	1900	3000	2800	2000	2000
PRODUCT CONDUCTIVITY		180 150	220 210	240 240	260 260	400	280	940 500	760 400	340 144	280
PRODUCT FLOW (gpm)		2.0 4.3	1.8 4.3	1.8 4.3	1.8 4.3	2.4	2.1	2.0 4.4	2.0 4.4	4.6	2.1
CONCENTRATE FLOW (gpm)		1.9 3.0	1.8 3.1	1.8 3.1	1.8 3.1	2.0	2.0	1.5 3.0	1.5 3.2	3.2	2.5
RECYCLE FLOW (gpm)		—	—	—	—	-	-	-	-	-	-
FEED TEMPERATURE (°F)		74	74	74	74	72	74	76	74	74	75
ΔP ACROSS	DuP	30	25	25	30	-	-	13	15	16	-
	HFF Dow	15	15	13	10			26	28	30	
MEMBRANES	SW	30	30	30	30	30	30	30	30	-	30
ΔP ACROSS C. FILTERS		3	3	3	3	2	2	4	3	2	2
FEED PRESSURE		30	30	30	30	30	30	30	29	31	32
INLET pH		6.8	6.9	7.6	7.5		5.2	3.5	3.5	7.	6.9
PRODUCT pH		6.38 6.34	6.4 6.38	6.4 6.35	6.4 6.34		5.1	<4. <4.	<4. <4.		6.05
ΔP ACROSS $KMnO_4$ FILTERS		9	8	8	8		3	8	7	5	0
ΔP ACROSS SAND TRAP		16	16	16	16		7	14	14	10	2
PUMP PRESSURE	HFF	350	345	345	345	-		470	470	470	-
	SW	450	450	445	450	435	440	440	440	-	435
TURBIDITY		0.42	0.41	0.42	0.44			.37	.27		.6
PRODUCT SALINITY		150 140	150 150	140 140	150 140	220	175	580 290	470 240	120	170

COMMENTS:

7-2 System flushed with cleaning solution

7-4 HFF pump down for repairs

7-10 Flushed RO system with cleaning solution

7-11 Flushed RO system with cleaning solution

LOCATION: ALAMOGORDO

METER READING AT:

REVERSE OSMOSIS

DATE		7-18	7-19	7-20	7-21	7-22	7-23	7-24	7-25	7-26	7-27
TIME		10:10	8:30	11:15	10:36	8:40	9:30	9:00	9:20	6:00	9:30
FEED SALINITY		1300	2200	1300	1850	1350	1350	1350	1350	1350	1320
FEED CONDUCTIVITY		2000	3000	2000	2800	2000	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		250	520	240	250	250	240	240	440* 300 180	280 360 140	290 360 120
PRODUCT FLOW (gpm)	SW HF	2.2	2.0	2.2	2.1	2.1	2.1	2.1	2.2 4.4	2.1 4.4	2.1 4.4
CONCENTRATE FLOW (gpm)		2.2	2.2	2.2	2.1	2.1	2.1	2.1	2.1 3.4	2.1 3.4	3.1 3.4
RECYCLE FLOW (gpm)		-	-	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)		75	74	74	75	75	76	74	73	75	75
ΔP ACROSS	HFF DOW DUPONT	-	-	-	-	-	-	-	15 25	10 30	10 30
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	3	3	3
FEED PRESSURE		32	32	32	32	32	32	32	30	29	30
INLET pH		7.05	3.6	7.0	6.05	6.05	6.05	6.30	7.	6.6	6.5
PRODUCT pH		6.3	<4.	6.05	5.50	5.50	5.58	5.50		5.98 6.00	5.90 5.90
ΔP ACROSS $KMnO_4$ FILTERS		2	2	3	3	3	2	3	1	9	10
ΔP ACROSS SAND TRAP		6	4	4	5	5	4	5	0	16	15
PUMP PRESSURE	HFF	-	-	-	-	-	-	-	475	475	485
	SW	435	440	440	440	440	440	440	445	435	435
TURBIDITY		.72	.68	.98	.80	.62	.75	.83	.76	.98	.28
PRODUCT SALINITY		170	320	160	270	155	150	145	250 125	170 130	165 130

COMMENTS:

RO pumps have a shaft pin (key) which has corroded. Both replaced

* Refers to type of membrane Spiral wound DOW HF DuPont HF

LOCATION: ALAMOGORDO

METER READING AT:

REVERSE OSMOSIS

		7-28	7-29	7-30	7-31	8-1	8-8	8-9	8-10	8-11	8-12
DATE											
TIME		11:20	8:00pm	8:30	10:15	1:45	3:50	10:30	11:20	11:15	10:40
FEED SALINITY		1300	1300	1320	1320	1000	1250	1300	1300	1320	1300
FEED CONDUCTIVITY		2000	2000	2000	2000	1800	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		275 360 125	260 360 130	260 360 130	150	360 127	300 475 132	280 440 140	280 450 134	275 500 130	270 500 132
PRODUCT FLOW (gpm)		2.1 4.5	2.1 4.4	2.1 4.4	2.2	2.1 4.4	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1
CONCENTRATE FLOW (gpm)		2.1 3.5	2.1 3.5	2.1 3.5	2.1	2.1 3.5	1.8 2.8	2.0 2.7	2.0 2.8	2.0 2.9	2.0 2.8
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		74	74	74	74	75	75	74	75	73	73
ΔP ACROSS	HFF	14 30	10 30	10 30	–	10 30	10 20	15 25	15 25	10 20	10 25
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		3	3	3	2	3	3	2	2	2	2
FEED PRESSURE		30	30	30	32	30	30	30	30	30	30
INLET pH		6.5	6.6	6.6	6.2	6.4	6.4	6.0	7.0	6.2	6.2
PRODUCT pH		6.0 5.8	6.05 5.8	6.05 5.8	5.55	5.8 5.8	6.0 6.0	5.6 5.8	6.2 6.3	5.4 5.3	5.6 5.55
ΔP ACROSS $KMnO_4$ FILTERS		10	10	10	3	7	10	1	8	8	8
ΔP ACROSS SAND TRAP		15	15	15	6	9	16	2	13	12	13
PUMP PRESSURE	HFF	485	485	485	–	480	485	485	485	485	485
	SW	435	435	435	440	440	445	445	445	445	445
TURBIDITY		.21	.23	.23	.22	.18	.17	.15	.17	.17	.16
PRODUCT SALINITY		165 130	160 140	160 130	150	190 160	190 162	170 165	175 162	172 175	172 175

COMMENTS:

7-30 HFF Modules Flushed

7-31 All RO Modules Flushed

LOCATION: ALAMOGORDO

METER READING AT:

- REVERSE OSMOSIS

DATE		8-13	8-14	8-15	8-16	8-17	8-21	8-22	8-23	8-24	8-25
TIME		8:55	1:00	11:15	10:45	9:25	10:00	9:55	8:55	11:30	1:00
FEED SALINITY		1320	1300	1300	1310	1300	1280	1280	1250	1250	1250
FEED CONDUCTIVITY		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		260 550 134	270 600 134	260 590 133	270 550 135	275 500 132	260 560 136	260 580 134	260 560 138	270 560 132	270 600 132
PRODUCT FLOW (gpm)		2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1
CONCENTRATE FLOW (gpm)		2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8
RECYCLE FLOW (gpm)		-	-	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)		73	73	73	73	73	73	73	73	73	73
ΔP ACROSS	HFF	10 25	12 30	10 20	10 30	10 30	15 30	15 30	15 30	15 30	15 30
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		30	30	30	30	30	30	30	30	30	30
INLET pH		6.2	6.2	7.05	6.2	6.2	7.05	6.2	6.3	6.3	6.8
PRODUCT pH		5.70 5.50	5.6 5.7	6.35 6.35	4.0 4.1	5.5 5.7	64 64	5.55 5.50	5.6 5.6	5.5 5.6	5.85 6.00
ΔP ACROSS $KMnO_4$ FILTERS		9	8	9	8	9	9	9	9	8	8
ΔP ACROSS SAND TRAP		12	12	11	12	12	12	12	11	12	12
PUMP PRESSURE	HFF	485	485	485	485	485	485	485	485	485	485
	SW	445	445	445	445	445	445	445	445	445	445
TURBIDITY		.18	.19	.2	.19	.18	.20	.21	.44	.24	.20
PRODUCT SALINITY		165 182	160 190	160 185	160 175	162 160	155 175	160 180	155 170	160 172	162 182

COMMENTS:

LOCATION: ALAMOGORDO

METER READING AT:

REVERSE OSMOSIS

DATE		8-26	8-27	8-28	8-29	8-30	8-31	9-4	9-5	9-6	9-7
TIME		6:35a	4:30	8:55	10:05	4:00	8:15	4:30	10:30	10:30	11:40
FEED SALINITY		1250	1250	1250	1280	1220	1250	1220	1220	1220	1220
FEED CONDUCTIVITY		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		270 660 134	270 520 130	270 490 136	280 600 136	280 640 127	280 610 138	320 570 126	300 540 133	300 600 139	300 640 132
PRODUCT FLOW (gpm)		2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.1 4.1	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0
CONCENTRATE FLOW (gpm)		2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	2.0 2.8	1.9 2.8	1.9 2.8	1.9 2.8	1.9 2.8	1.9 2.8
RECYCLE FLOW (gpm)		-	-	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)		73	73	73	73	73	75	75	73	73	74
ΔP ACROSS	HFF	15 30	15 30	15 30	15 30	15 30	13 25	13 25	13 27	12 25	12 28
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		30	30	30	30	30	30	30	30	30	30
INLET pH		6.2	6.1	7.1	6.2	6.1	6.2	6.2	6.2	6.9	6.3
PRODUCT pH		5.4 5.55	5.50 5.62	6.46 6.52	5.55 5.62		5.6 5.2	5.6 5.2	5.6 5.5	6.0 6.12	5.6 5.75
ΔP ACROSS $KMnO_4$ FILTERS		8	10	9	9	9	8	8	8	8	8
ΔP ACROSS SAND TRAP		12	12	12	12	11	11	11	11	11	11
PUMP PRESSURE	HFF	485	485	485	485	485	485	485	485	485	485
	SW	445	445	445	445	445	435	435	435	435	435
TURBIDITY		.28	.28	.28	.23	.24	.26	.26	.27	.26	.24
PRODUCT SALINITY		160 195	162 158	162 152	162 190	162 188	195 185	195 185	178 185	180 190	178 192

COMMENTS:

9-1 System Flushed

9-2 System down to repair storage brine pond liner

LOCATION: ALAMOGORDO

METER READING AT:

REVERSE OSMOSIS

DATE		9-8	9-11	9-12	9-13	9-17	9-18	9-20	9-21	9-22	9-24
TIME		9:30	3:30	9:45	4:00	3:00	9:15	10:20	10:35	10:50	10:20
FEED SALINITY		1220	1220	1210	1220	1220	1220		1210	1220	1200
FEED CONDUCTIVITY		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		290 580 135	290 540 133	290 540 142	280 540 125	320 660 138	300 540 138	290 560 133	290 640 135	290 520 138	290 570 135
PRODUCT FLOW (gpm)		2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.0	2.0 4.1	2.0 4.1	2.0 4.1
CONCENTRATE FLOW (gpm)		1.9 2.8	1.9 2.8	1.9 2.8	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		73	73	73	74	73	73	73	73	73	73
ΔP ACROSS	HFF	15 30	20 30	12 30	12 30	12 25	12 25	13 28	13 30	13 30	12 28
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		30	30	30	30	30	30	30	30	30	30
INLET pH		6.3	6.3	7.1	6.2	6.0	6.2	6.2	6.9	6.2	6.3
PRODUCT pH		5.6 5.5	5.6 5.8	6.25 6.04	5.6 5.5	5.32 5.4	5.55 5.65		5.8 6.0		5.6 5.7
ΔP ACROSS $KMnO_4$ FILTERS		9	8	9	9	1	8	8	8	8	9
ΔP ACROSS SAND TRAP		11	10	11	11	1	10	11	11	10	11
PUMP PRESSURE	HFF	485	495	495	498	485	485	485	485	485	495
	SW	435	435	435	435	435	435	435	435	435	435
TURBIDITY		.29	.27	.38	.28	.25	.33		.29	.64	.52
PRODUCT SALINITY		165 175	165 172	160 162	162 192	185 200	182 160		168 182	170 150	168 168

COMMENTS:

LOCATION: ALAMOGORDO

METER READING AT:

REVERSE OSMOSIS

DATE		9-25	9-26	9-27	9-28	9-29	10-1	10-2	10-3	10-4	10-5
TIME		4:10	2:10	11:10	9:00	5:00	12:30	11:00	7:45	4:00	9:30
FEED SALINITY		1200	1200	1210	1200	1200	1200	1200	1200	1200	1200
FEED CONDUCTIVITY		2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
PRODUCT CONDUCTIVITY		290 550 126	290 640 127	290 620 133	290 590 135	290 590 126	290 520 128	290 600 133	290 620 134	290 580 128	280 540
PRODUCT FLOW (gpm)		2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.1	2.0 4.0
CONCENTRATE FLOW (gpm)		1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.7	1.9 2.0	1.9 2.0	1.9 2.0	1.9 2.0	1.9 2.7
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		73	73	73	73	73	78	73	73	73	
ΔP ACROSS	HFF	12 25	10 25	12 30	12 30	12 30	13 30	13 30	13 30	13 30	12 - 30
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		30	30	30	30	30	30	30	30	30	30
INLET pH		6.3	6.4	6.2	6.2	6.2	7.2	6.2	6.2	6.3	6.3
PRODUCT pH		5.5 5.8	5.8 6.0	5.55 5.45		5.5 5.6	6.35 6.30	5.5 5.45	5.6 5.5	5.35 5.6	5.5 5.5
ΔP ACROSS $KMnO_4$ FILTERS		10	10	10	10	10	9	9	9	10	10
ΔP ACROSS SAND TRAP		10	10	10	10	10	11	11	11	11	11
PUMP PRESSURE	HFF	485	485	485	485	485	485	485	485	485	485
	SW	435	435	435	435	435	435	435	435	435	435
TURBIDITY		.7	.42	.47		.46	.25	.40	.38	.39	.38
PRODUCT SALINITY		170 170	160 175	162 182	162 160	162 168	168 152	155 175	155 170	155 190	162 152

COMMENTS:

10-5 DOWN FOR LACK OF RAW WATER - WELL SHUT DOWN.

LOCATION: Alamogordo

METER READING AT:

ELECTRODIALYSIS

		5-21	5-22	5-23	5-24	5-25	5-26	5-27	5-28	5-29	5-30
DATE											
TIME		3:30	8:40	9:30	8:40	9:00	7:30	5:45	2:40	4:58	1:30
POLARITY		+	—	+	—	+	—	+	—	+	—
FEED SALINITY (ppm)		1300	1250	1290	1300	1280	1250	1300	1300	1290	1290
PRODUCT SALINITY (ppm)		80	70	75	85	80	82	90	82	78	80
PRODUCT CONDUCTIVITY		140	120	120	130	100	150	100	115	140	140
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7	3.6	3.6
BRINE FLOW (gpm)*		1.2	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FEED TEMPERATURE (°F)		70	69	69	69	69	68	70	70	70	70
PRESSURES	STACK INLET	43	42	44	43	44	42	44	44	44	44
	STACK OUTLET	2	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	46	30	38	36	42	30	46	38	43	32
	DIFFERENTIAL OUT	2	1	4	0	2	7	32	1	5	4
	BEFORE FILTER	48	48	48	48	48	48	48	49	49	49
	AFTER FILTER	40	48	47	47	47	47	47	49	48	48
	AFTER PRV	45.5	45.5	46	46	46	45	46	47	46	46
	ELECTRODE INLET	45.5	44	45	45	45	45	46	47	46	46
STAGE ONE	VOLTS	63	61	61	60	63	61	62	61	63	61
	AMPS	4.0	3.8	4.0	3.9	4.1	4.0	4.0	4.0	4.0	3.9
STAGE TWO	VOLTS	63	61	61	60	63	61	62	61	63	61
	AMPS	1.6	1.3	1.5	1.5	1.6	1.5	1.3	1.6	1.5	1.5

COMMENTS:

Brine pump average 5-21 - 5-30 58

Total Kwhrs used - 5-30 428.8

* Does not include .5 gpm electrode discharge

LOCATION: Alamogordo

METER READING AT:

ELECTRODIALYSIS

DATE		5-31	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11
TIME		8:35	7:20	1:05	6:45	3:30	9:20	8:10	4:50	3:07	10:45
POLARITY		+	−	+	−	+	−	+	−	+	−
FEED SALINITY (ppm)		1290	1300	1290	1300	1290	1300	1300	1300	1300	1300
PRODUCT SALINITY (ppm)		78	70	70	72	80	80	80	80	75	90
PRODUCT CONDUCTIVITY		140	105	120	120	138	160	105	105	130	162
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
BRINE FLOW (gpm)*		1.0	1.0	1.0	1.0	1.0	1.0	0.75	0.75	0.75	0.75
FEED TEMPERATURE (°F)		70	70	70	70	70	70	70	70	70	69
PRESSURES	STACK INLET	44	43	44	42	44	43	45	44	45	44
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	2	1.5	1.5	1.5
	DIFFERENTIAL IN	42	30	42	33	44	38	34	28	35	22
	DIFFERENTIAL OUT	2	0	3	3	5	5	21	8	6	4
	BEFORE FILTER	49	51	51	49	49	49	50	49	49	49
	AFTER FILTER	48	49	50	48	48	48	49	49	49	49
	AFTER PRV	46	49	48	46	46	46	46	47	47	46
	ELECTRODE INLET	46	46	43	45	45	46	46	47	47	46
STAGE ONE	VOLTS	62	62	63	62	61	60	61	61	62	60
	AMPS	4.0	4.2	4.0	3.8	4.0	3.8	3.9	3.9	4.0	3.9
STAGE TWO	VOLTS	62	62	63	62	61	60	61	61	62	60
	AMPS	1.6	1.5	1.5	1.4	1.6	1.6	1.6	1.5	1.6	1.6

COMMENTS:

Brine pump average 5-31 — 6-11 60

Total Kwhrs used 5-31 — 6-11 494

Changed Brine flow rate from 1.0 gpm to 0.75 gpm to increase SO_4 level in waste stream 6-8-79

* Does not include .5 gpm electrode discharge

LOCATION: Alamogordo

METER READING AT:

ELECTRODIALYSIS

DATE		6-12	6-13	6-14	6-15	6-18	6-19	6-20	6-21	6-22	6-25
TIME		10:10	5:00	9:10	9:20	1:10	10:15	10:10	10:30	9:20	11:50
POLARITY		+	—	+	—	+	—	+	—	+	—
FEED SALINITY (ppm)		1300	1300	1300	1300	1250	1250	1250	1250	1250	1300
PRODUCT SALINITY (ppm)		80	82	70	70	85	90	80	90	95	* 110
PRODUCT CONDUCTIVITY		120	150	120	130	150	140	140	150	145	160
DILUTE FLOW (gpm)		3.5	3.5	3.5	3.5	3.5	3.4	3.6	3.5	3.5	3.5
BRINE FLOW (gpm) *		0.75	0.75	0.75	0.75	0.6	0.5	0.5	0.5	0.5	0.5
FEED TEMPERATURE (°F)		69	70	69	69	70	70	70	70	70	70
PRESSURES	STACK INLET	45	44	45	45	46	44	44	44	44	43
	STACK OUTLET	1.5	1.5	1.5	1.5	2.0	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	31	22	32	33	40	30	38	42	33	36
	DIFFERENTIAL OUT	17	22	24	20	27	20	28	30	4	2
	BEFORE FILTER	49	49	49	49	50	49	48	48	48	48
	AFTER FILTER	49	49	49	49	50	49	48	48	48	48
	AFTER PRV	46	47	46	47	47.5	48	46	46	46	46
	ELECTRODE INLET	46	47	46	47	47	47	46	46	46	46
STAGE ONE	VOLTS	61	61	63	61	61	61	61	62	61	61
	AMPS	3.9	3.8	4.0	3.8	3.8	3.8	3.9	3.8	3.5	3.1
STAGE TWO	VOLTS	61	61	63	61	61	61	61	62	61	61
	AMPS	1.5	1.3	1.6	1.5	1.6	1.4	1.6	1.6	1.6	1.8

COMMENTS:

Brine Pump average 6-12 — 6-25 60
Total Kwhrs used 491.4 6-12 — 6-25
Changed Brine flow from 0.75 to 0.50 6-18-79
6-25-79 marked increase in product quality (electrodes to be replaced.)

* Does not include .5gpm electrode discharge

LOCATION: Alamogordo

METER READING AT:

ELECTRODIALYSIS

DATE		6-26	6-27	7-2	7-3	7-4	7-5	7-6	7-9	7-11	7-12
TIME		2:00	11:00	7:15	6:35	9:50	5:05	6:10	1:30	6:45	10:00
POLARITY		+	−	−	+	−	+	−	−	+	−
FEED SALINITY (ppm)		1300	1300	1250	1250	1220	1220	1220	1220	1220	1280
PRODUCT SALINITY (ppm)		120	150	95	92	140	110	130	70	72	75
PRODUCT CONDUCTIVITY		160	180	180	175	300	190	230	130	130	130
DILUTE FLOW (gpm)		3.5	3.5	3.75	3.6	3.6	3.6	3.6	3.6	3.6	3.6
BRINE FLOW (gpm) *		0.5	0.5	.5	.6	.6	.6	.6	.6	.6	.6
FEED TEMPERATURE (°F)		70	70	70	70	70	70	71	72	70	70
PRESSURES	STACK INLET	44	42	52	52	52	52	52	50	50	49
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	2	1.5	2	2	1.5
	DIFFERENTIAL IN	40	47	18	18	18	21	20	7	12	10
	DIFFERENTIAL OUT	3	2	26	30	0	31	2	24	25	37
	BEFORE FILTER	48	48	72	70	72	71	68	62	64	64
	AFTER FILTER	48	48	71	70	71	69	67	61	62	62
	AFTER PRV	46	46	54	54	54	54	54	53	53	53
	ELECTRODE INLET	46	46	52	54	54	54	54	52	51	51
STAGE ONE	VOLTS	61	60	61	62	60	62	61	60	62	61
	AMPS	3.5	2.9	4.0	4.2	3.4	3.8	3.9	4.4	4.4	4.3
STAGE TWO	VOLTS	61	60	61	62	60	62	61	60	62	61
	AMPS	1.6	1.9	1.7	1.8	2.0	2.1	1.8	1.5	1.5	1.5

COMMENTS:

* Does not include .5 gpm electrode discharge

7-9 Electrodes changed

LOCATION: ALAMOGORDO

METER READING AT:

ELECTRODIALYSIS

DATE		7-13	7-16	7-18	7-19	7-20	7-21	7-22	7-23	7-24	7-25
TIME		7:40	6:45	9:55	8:40	11:25	10:40	9:00p	9:40p	9:20	9:40
POLARITY		+	-	+	-	+	-	+	-	+	-
FEED SALINITY (ppm)		1280	1250	1280	1300	1300	1250	1300	1300	1300	1300
PRODUCT SALINITY (ppm)		75	80	70	78	70	75	72	75	70	80
PRODUCT CONDUCTIVITY		130	130	130	135	130	135	125	130	130	140
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
BRINE FLOW (gpm)*		.6	.6	.6	.6	.6	.6	.6	.6	.6	.6
FEED TEMPERATURE (°F)		69	70	70	70	70	70	70	70	70	70
PRESSURES	STACK INLET	50	46	45	49	50	50	50	49	49	50
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	13	10	12	10	14	14	16	8	10	15
	DIFFERENTIAL OUT	25	27	24	28	22	28	24	39	26	32
	BEFORE FILTER	64	50	48	58	58	56	56	58	58	65
	AFTER FILTER	63	50	48	56	56	54	53	56	56	63
	AFTER PRV	53	48	43	52	52	52	52	51	51	53
	ELECTRODE INLET	51	46	43	52	52	52	52	51	51	53
STAGE ONE	VOLTS	62	61	62	61	63	61	63	61	62	60
	AMPS	4.5	4.3	4.3	4.3	4.4	4.3	4.3	4.1	4.4	4.4
STAGE TWO	VOLTS	62	61	62	61	63	61	63	61	61	60
	AMPS	1.5	1.4	1.4	1.4	1.6	1.4	1.5	1.4	1.5	1.5

COMMENTS:

*Does not include .5 gpm electrode discharge

LOCATION: ALAMOGORDO

METER READING AT:

ELECTRODIALYSIS

DATE		7-26	7-27	7-28	7-29	7-30	7-31	8-8	8-9	8-10	8-11
TIME		6:10	9:30	11:35	8:00p	8:50a	10:20	3:10	10:50	11:35	11:15
POLARITY		+	−	+	−	+	−	+	−	+	−
FEED SALINITY (ppm)		1300	1300	1300	1300	1300	1300	1250	1250	1300	1300
PRODUCT SALINITY (ppm)		72	75	70	75	75	80	85	85	85	85
PRODUCT CONDUCTIVITY		130	140	140	140	140	150	125	130	150	150
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
BRINE FLOW (gpm)*		.6	.6	.6	.6	.6	.6	.4	.4	.4	.4
FEED TEMPERATURE (°F)		70	70	70	70	70	70	70	70	70	70
PRESSURES	STACK INLET	48	50	50	50	50	50	50	50	50	50
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	1.5
	DIFFERENTIAL IN	8	9	10	8	13	11	15	13	18	15
	DIFFERENTIAL OUT	25	30	25	25	25	29	27	45	25	34
	BEFORE FILTER	64	66	65	66	67	67	70	72	71	72
	AFTER FILTER	63	64	63	63	64	64	66	67	66	66
	AFTER PRV	53	53	53	53	53	53	53	53	53	53
	ELECTRODE INLET	49	51	51	51	51	51	52	52	52	52
STAGE ONE	VOLTS	63	61	63	62	63	61	62	61	62	62
	AMPS	4.4	4.3	4.3	4.2	4.4	4.2	4.4	4.2	4.2	4.4
STAGE TWO	VOLTS	63	61	63	62	63	61	62	61	62	62
	AMPS	1.4	1.4	1.5	1.4	1.5	1.4	1.5	1.6	1.6	1.6

COMMENTS:

*Does not include .5 gpm electrode discharge

8-8 Brine discharge reduced to .4 gpm

8-10 4500 ml/min total discharge from ED to pond

Brine Pond - Depth 16" TDS ~1500 ppm

LOCATION: ALAMOGORDO

METER READING AT:

ELECTRODIALYSIS

DATE		8-12	8-13	8-14	8-15	8-16	8-17	8-21	8-22	8-23	8-24
TIME		10:40	9:20	11:10	11:40	11:10	9:50	10:10	10100	9:15	11:30
POLARITY		+	-	+	-	+	-	+	-	+	-
FEED SALINITY (ppm)		1250	1300	1250	1290	1280	1250	1250	1220	1210	1220
PRODUCT SALINITY (ppm)		85	90	85	90	78	102	95	95	95	95
PRODUCT CONDUCTIVITY		150	160	150	150	160	180	130	160	160	160
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
BRINE FLOW (gpm)*		.4	.4	.4	.4	.4	0.	0.	0.	0.	0.
FEED TEMPERATURE (°F)		70	70	70	70	70	70	70	70	70	70
PRESSURES	STACK INLET	50	50	50	50	50	50	50	50	50	50
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	18	15	15	18	18	18	22	20	20	19
	DIFFERENTIAL OUT	30	36	26	30	8	18	9	20	8	19
	BEFORE FILTER	72	72	71	70	72	72	74	74	74	74
	AFTER FILTER	66	66	66	66	66	67	66	66	66	66
	AFTER PRV	53	53	53	53	53	53	53	53	53	53
	ELECTRODE INLET	52	52	52	52	52	52	52	52	52	52
STAGE ONE	VOLTS	62	61	62	63	63	63	62	61	62	62
	AMPS	4.4	4.2	4.3	4.4	4.2	4.2	4.3	4.2	4.3	4.2
STAGE TWO	VOLTS	62	61	62	63	63	63	62	61	62	62
	AMPS	1.6	1.5	1.5	1.6	1.6	1.4	1.7	1.5	1.7	1.5

COMMENTS:

*Does not include electrode discharge

8-12 4300 ml/min total discharge (Brine Flow + Electrode discharge)
Pond Depth 16" (1450 TDS)

8-~~13~~ 4000 ml/min total discharge Pond depth 12" (1750 TDS)

8-15 Pond Depth 10" (2100 TDS)

8-17 Stopped Brine flow, only discharge electrode waste 2200 ml/min

LOCATION: ALAMOGORDO

METER READING AT:

ELECTRODIALYSIS

DATE		8-25	8-26	8-27	8-28	8-29	8-31	9-4	9-5	9-6	9-7
TIME		12:40	6:35a	4:30	9:25	10:10	8:40	4:30	10:40	10:30	11:40
POLARITY		+	-	+	-	+	-	+	-	+	-
FEED SALINITY (ppm)		1220	1220	1220	1250	1220	1700	1220	1220	1220	1220
PRODUCT SALINITY (ppm)		92	92	95	105	92	220	175	110	115	98
PRODUCT CONDUCTIVITY		160	160	190	185	170	400	250	190	210	180
DILUTE FLOW (gpm)		3.6	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7
BRINE FLOW (gpm)		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FEED TEMPERATURE (°F)		70	70	70	70	70	70	70	70	70	70
PRESSURES	STACK INLET	50	50	50	51	51	26	29	27	28	28
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	18	18	10	17	15	18	16	16	23	16
	DIFFERENTIAL OUT	11	20	10	20	9	28	10	10	30	40
	BEFORE FILTER	74	74	74	75	74	70	56	63	65	64
	AFTER FILTER	66	66	66	67	66	66	56	63	65	63
	AFTER PRV	53	53	53	53	54	53	52	53	53	53
	ELECTRODE INLET	52	52	52	52	53	27	30	29	29	30
STAGE ONE	VOLTS	62	62	63	61	62	55	57	54	56	55
	AMPS	4.3	4.2	4.4	4.2	4.3	8.5	6.1	5.6	5.6	5.6
STAGE TWO	VOLTS	62	62	63	61	62	55	57	54	56	55
	AMPS	1.6	1.5	1.6	1.5	1.7	4.0	2.8	2.3	2.3	2.1

COMMENTS:

ED system change: (1) Stack to 4 stages (2) Electrode line to feed tank (3) Feed tank installed (4) Brine blowdown off

9-1 System flushed with raw water

Note: Electrode discharge to pond ~.5gpm

LOCATION: ALAMOGORDO

METER READING AT:

ELECTRODIALYSIS

DATE		9-8	9-26	9-27	10-1	10-2	10-3	10-4			
TIME		11:40	2:15	11:15	1:15	11:10	7:45	4:00			
POLARITY		+	−	+	+	−	+	−			
FEED SALINITY (ppm)		1210	1200	1250	1200	1350	1350	1350			
PRODUCT SALINITY (ppm)		138	85	112	105	110	140	145			
PRODUCT CONDUCTIVITY		210	200	180	185	180	210	220			
DILUTE FLOW (gpm)		3.7	3.5	3.6	3.7	3.7	3.7	3.7			
BRINE FLOW (gpm)		0.	0.	0.	0.	0.	0.	0.			
FEED TEMPERATURE (°F)		70	72	73	70	70	70	82			
PRESSURES	STACK INLET	33	25	25	27	29	30	35			
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5			
	DIFFERENTIAL IN	23	11	22	16	20	23	20			
	DIFFERENTIAL OUT	32	39	18	28	30	21	54			
	BEFORE FILTER	64	60	66	56	62	64	62			
	AFTER FILTER	64	60	66	56	62	64	62			
	AFTER PRV	53	52	52	53	53	53	53			
	ELECTRODE INLET	33	28	24	30	32	33	38			
STAGE ONE	VOLTS	56	55	56	56	55	56	55			
	AMPS	5.9	5.6	6.3	5.6	4.8	4.9	3.5			
STAGE TWO	VOLTS	56	55	56	56	55	56	55			
	AMPS	2.4	2.1	2.5	2.1	1.9	2.1	2.5			

COMMENTS:

Note: Electrode discharge to pond ~.5gpm

9-8 ED down-brine pump out