WATER TREATMENT FOR SMALL PUBLIC SUPPLIES

REPORT OF OPERATION:

CUBA

CARRIZOZO

LA LUZ

SAN YSIDRO

BLUEWATER

MORIARTY

HAGERMAN

DEPARTMENT OF CHEMICAL ENGINEERING

NEW MEXICO STATE UNIVERSITY

LAS CRUCES, NEW MEXICO

JUNE 1979

PROJECT STAFF:

Dr. H. G. Folster
Dr. D. B. Wilson
Dr. G. Kramer
Mr. S. Hanson
Mr. R. Duran
Mr. W. Boyle
Mr. C. Bennett

This project is being supported by funds provided by the Office of Water Research and Technology, United States Department of the Interior as authorized by the Water Research and Development Act of 1978 under Project No. T-0009-NMEX; by The Interstate Stream Commission, State of New Mexico; The New Mexico Water Resources Research Institute; and New Mexico State University. Industry has supplied equipment and technical assistance.

The purpose of WRRI technical reports is to provide a timely outlet for research results obtained on projects supported in whole or in part by the Institute. Through these reports we are promoting the free exchange of information and ideas and hope to stimulate thoughtful discussion and action which may lead to resolution of water problems. The WRRI, through peer review of draft reports, attempts to substantiate the accuracy of information contained in its reports but the views expressed are those of the author(s) and do not necessarily reflect those of the WRRI or its reviewers.

ABSTRACT

The major objective of the project "Water Treatment for Small Public Supplies" was the demonstration of technology development for desalination being successfully applied to bring domestic water supplies into compliance with the National Drinking Water standards. To that end, a mobile unit containing the necessary pretreatment and post-treatment equipment to support reverse osmosis and electrodialysis as primary units was assembled. This equipment is described in WRRI Report #095, June, 1978, "Water Tretment for Small Public Supplies - Project Description Report."

During the late fall of 1977 and all of 1978 the mobile demonstration unit was operating in eight New Mexico communities: Cuba, (pop. 1200), Carrizozo (pop. 1250), La Luz (pop. 750), San Jon (pop. 300), San Ysidro (pop. 250), Bluewater (pop. 2500), Moriarty (pop. 1750), and Hagerman (pop. 750). This report details the operating experience and the performance data on the two systems - reverse osmosis and electrodialysis. The appropriate standards of the National Drinking Water Act were met in all communities.

Summary data for operation in the eight communities was as follows:

	COMMUNITY	WATER PROBLEM*	PERIOD OF VAN OPERATION	UNITS OPERATING	PRODUCT WATER QUALITY
1.	Cuba	High Fe, Mn* Turbidity	Nov. 21 - Dec. 18, 1977	RO-Spiral Wound ED Green sand Filters	Certified-EID Certified-EID
2.	Carrizozo	TDR (900 mg/1)	Jan. 10 - Feb. 22, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID Certified-EID Certified-EID
3.	La Luz	TDR (2000 mg/1) Sulfate	March 9 - Apr. 24, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID Certified-EID Certified-EID
4.	San Jon	TDR (1100 mg/1) Fluoride, (Sodium)	June 1 - July 8, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID** Certified-EID** Certified-EID**
5.	San Ysidro	TDR (1200 mg/1) As (periodically)	Aug. 1 - Aug. 24, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID Certified-EID Certified-EID
6.	Bluewater	TDR (1000 mg/1)	Sept. 14 - Oct. 21, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID** Certified-EID** Certified-EID**
7.	Moriarity	TDR (1000 mg/1)	Oct. 30 - Nov. 16, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID Certified-EID Certified-EID
8.	Hagerman	TDR (1500 mg/1) H_2S, $SO_4^=$	Nov. 21 - Dec. 21, 1978	RO-Spiral Wound RO-Hollow Fiber ED	Certified-EID Certified-EID Certified-EID

*As defined by the Water Quality Group of the New Mexico Environmental Improvement Division

**Product Water, returned to community water supply

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Page

WATER TREATMENT FOR SMALL PUBLIC SUPPLIES

Dr. H. G. Folster - Principal Investigator
Dr. D. B. Wilson - Co-Principal Investigator

I. INTRODUCTION

The Chemical Engineering Department at New Mexico State University has constructed and placed into operation a demonstration van.[1] Figure 1 is a schematic of the systems contained within the van. The units have the necessary control instrumentation that the systems operate with nominal, dedicated man-power. The purpose of operation is to demonstrate that technology developed for the federal saline water programs is appropriate technology for use in small communities to bring their domestic water supplies into compliance with the National Drinking Water Act standards, e.g., Table 1 [2]

This report describes the eight New Mexico communities that were visited by the demonstration van. Given for each community are general location and water supply system currently in use, the daily usage (annual average), current water supply analysis, and a description of the van performance in the community, including operating problems within the van. In addition typical daily operating log-sheets for each community are supplied in the Appendices. Conclusions as to the operating experience, e.g., cost, etc. will be covered in a separate report.

A. Community Water Supplies and Treatment System

1. Cuba, New Mexico: A small mountain community located in the Jemez Mountains in the northwest quadrant of the state. The community is an incorporated town of approximately 1200 people. It serves as a shopping community for ranches in the area, has some tourism (hunting) and is

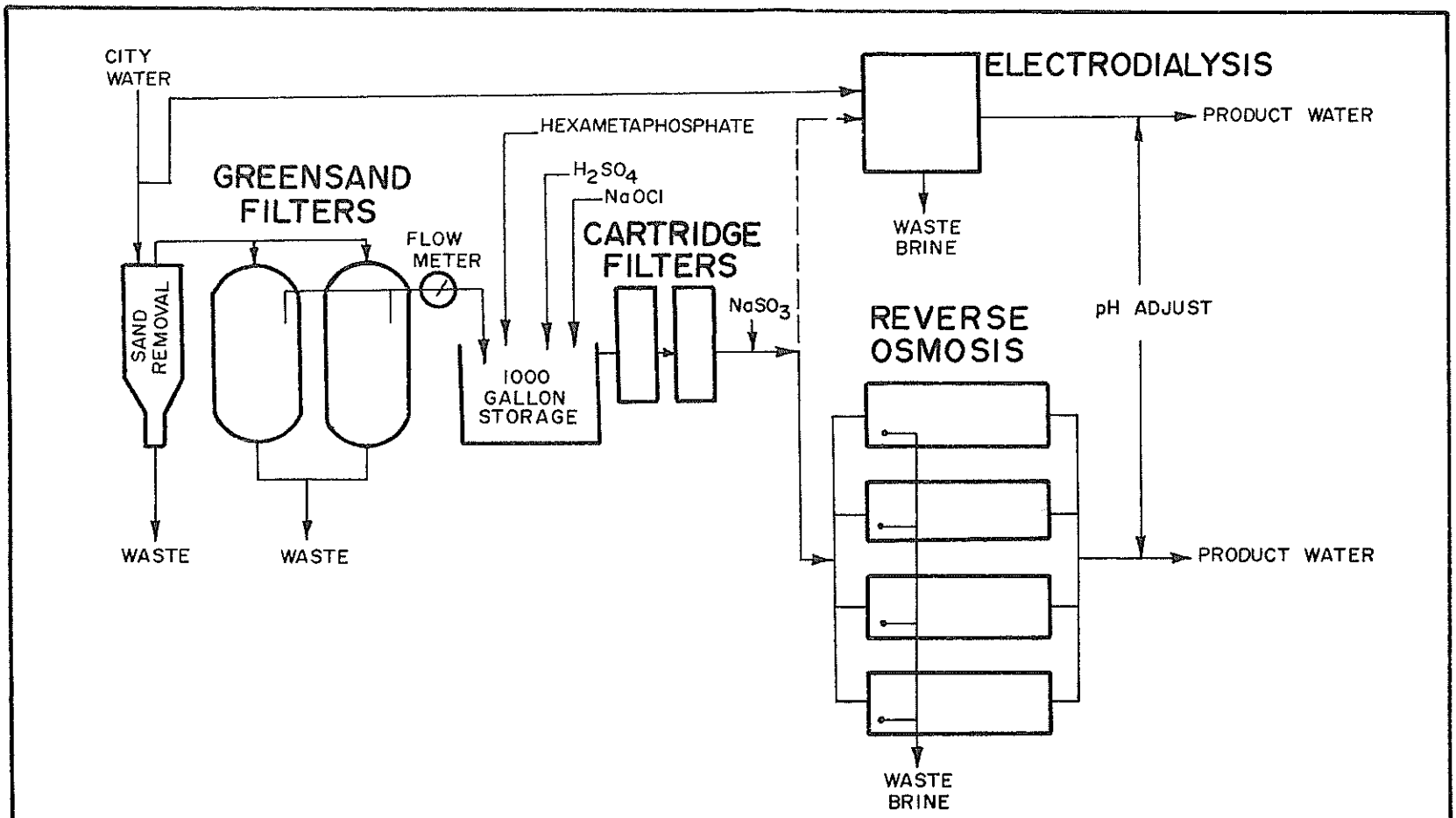


FIGURE 1.
PROCESS FLOW SCHEMATIC
SMALL COMMUNITY WATER TREATMENT VAN

Table 1

PRIMARY DRINKING WATER QUALITY STANDARDS

Parameters	Annual Average Maximum Daily Air Temperature °F	°C	Maximum Level+
Inorganic Chemicals			
Arsenic			0.05
Barium			1.
Cadmium			0.010
Chromium			0.05
Lead			0.05
Mercury			0.002
Nitrate (as N)			10.
Selenium			0.01
Silver			0.05
Fluoride			
	53.7 and below	12.0 and below	2.4
	53.8 to 58.3	12.1 to 14.6	2.2
	58.4 to 63.8	14.7 to 17.6	2.0
	63.9 to 70.6	17.7 to 21.4	1.8
	70.7 to 79.2	21.5 to 26.2	1.6
	79.3 to 90.5	26.3 to 32.5	1.4
Chlorinated Hydrocarbons			
Endrin (1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-endo-5, 8-dimethano naphthalene)			0.0002
Lindane (1, 2, 3, 4, 5, 6-hexachlorocyclohexane, gamma isomer)			0.004
Methoxychlor (1, 1, 1-Trichloroethane) 2, 2-bis (p-methoxyphenyl)			0.1
Toxaphene ($C_{10}H_{10}Cl_8$-Technical chlorinated camphene, 67-69 percent chlorine)			0.005
Chlorophenoxys: 2,4-D, (2, 4-Dichlorophenoxyacetic acid)			0.1
2, 4, 5-TP Silvex (2, 4, 5-Trichlorophenoxy-propionic acid)			0.01
Turbidity (for surface water sources)	1 TU up to 5 TU*		
Coliform Bacteria			
Membrane filter technique:	1/ml mean/month 4/ml in one sample if <20 samples/month 4/ml in more than 5% if >20 samples/month		
Fermentation tube with 10 ml portions:	no coliforms in >10% of portions/month no coliforms in >3 portions/sample if <20 samples/month no coliforms in >3 portions of 5% of samples if >20 samples/month		
Fermentation tube with 100 ml portions:	no coliform bacteria in >60% of portions/month no coliform in 5 portions in one sample if <5 samples/month no coliform in 5 portions in 20% of samples if >5 samples/month		

Radioactive Material	Level
Combined radium 226 and radium 228	5 pCi/l
Gross alpha particle activity**	15 pCi/l
Beta particle and photon radioactivity from man-made radionuclides	4 millirem/year
Tritium for total body	20,000 pCi/l
Strontium-90 in bone marrow	8 pCi/l

+mg/l unless otherwise stated.

*Includes Ra^{226} excludes Radon, Uranium.

**If meet special requirements.

Source: Reference 2

on the major road linking Albuquerque and northwestern New Mexico. There is logging of timber in the Jemez region although there are no major sawmills in the Cuba region. The extensive mineral resources of northwestern New Mexico have not yet made a major impact on Cuba.

The current water supply is well-water obtained from wells 3-5 miles from the town. Table 2 gives the summary analysis of the Cuba water (that which was used in the demonstration van). Complete analysis is given in Appendix A. Figure 2 shows the flow schematic of the current treatment system.

TABLE 2. CUBA WATER SUPPLY DATA

Contaminant	Concentration, mg/l
TDR	780.0
Iron	1.6
Manganese	1.4
Sodium	69.7
Chloride	1.0
pH	6.5
Conductivity mhos at 25°C	947.0
USAGE:	180,000 ± 20% gallons per day

2. Carrizozo, New Mexico: Located on the northeastern edge of the Tularosa basin, Carrizozo serves the ranching region on the northern end of the Sacramento Mountains north to Vaughn. The terrain is semi-arid plateau in the Tularosa Basin and changes to pine mountains. The Tularosa Basin has enormous resources of saline (brackish to saturated) water. While the Sacramento Mountains provide a limited quality of good surface water to some of the basin communities, Carrizozo is using well-water having high total dissolved solids except in summer when some water comes from Bonita Lake. Table 3 gives the current water supply data (Complete analysis is in the Appendix A) and Figure 3 shows the current treatment system.

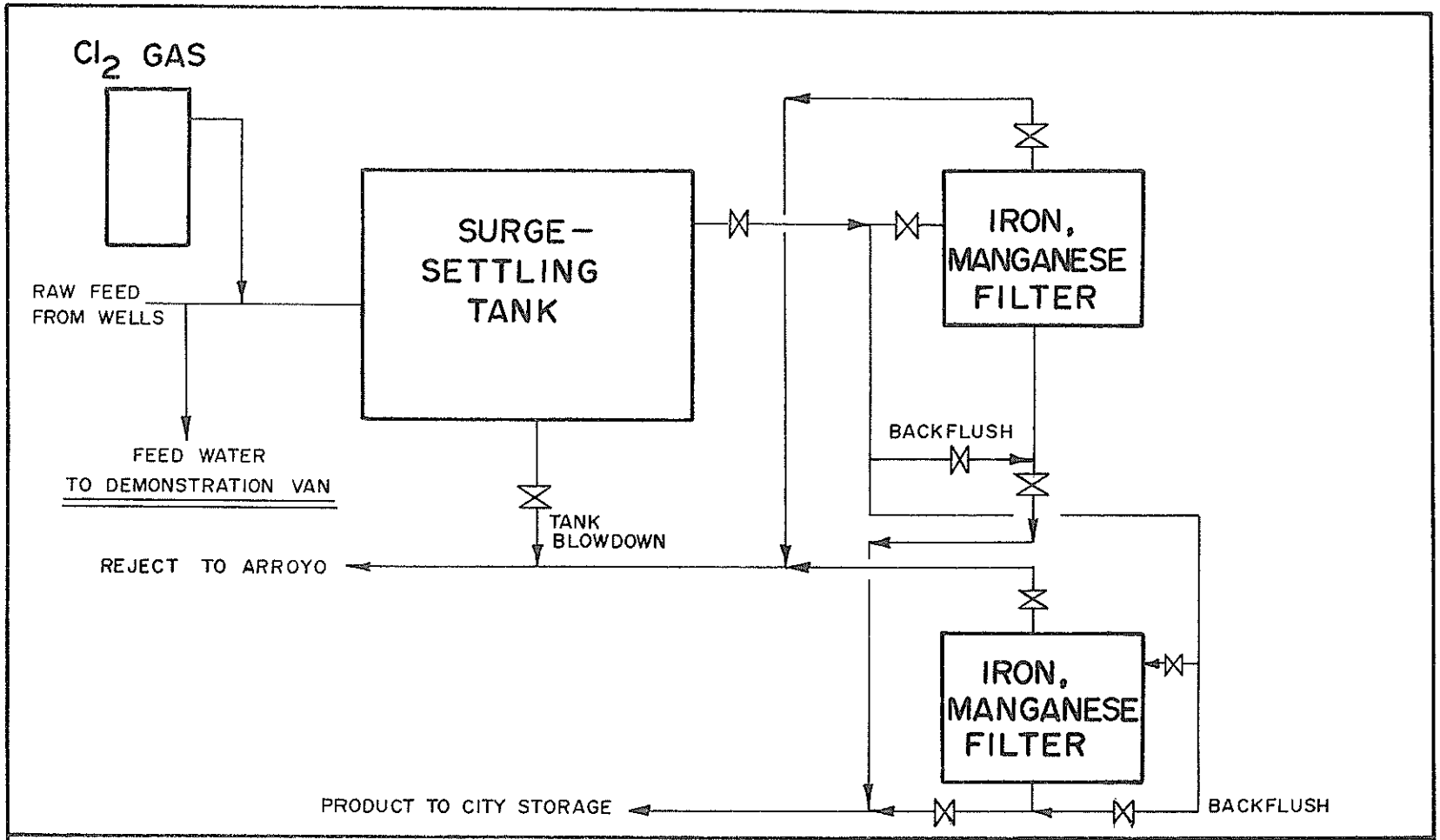


FIGURE 2

CITY OF CUBA EXISTING WATER TREATMENT SYSTEM SCHEMATIC

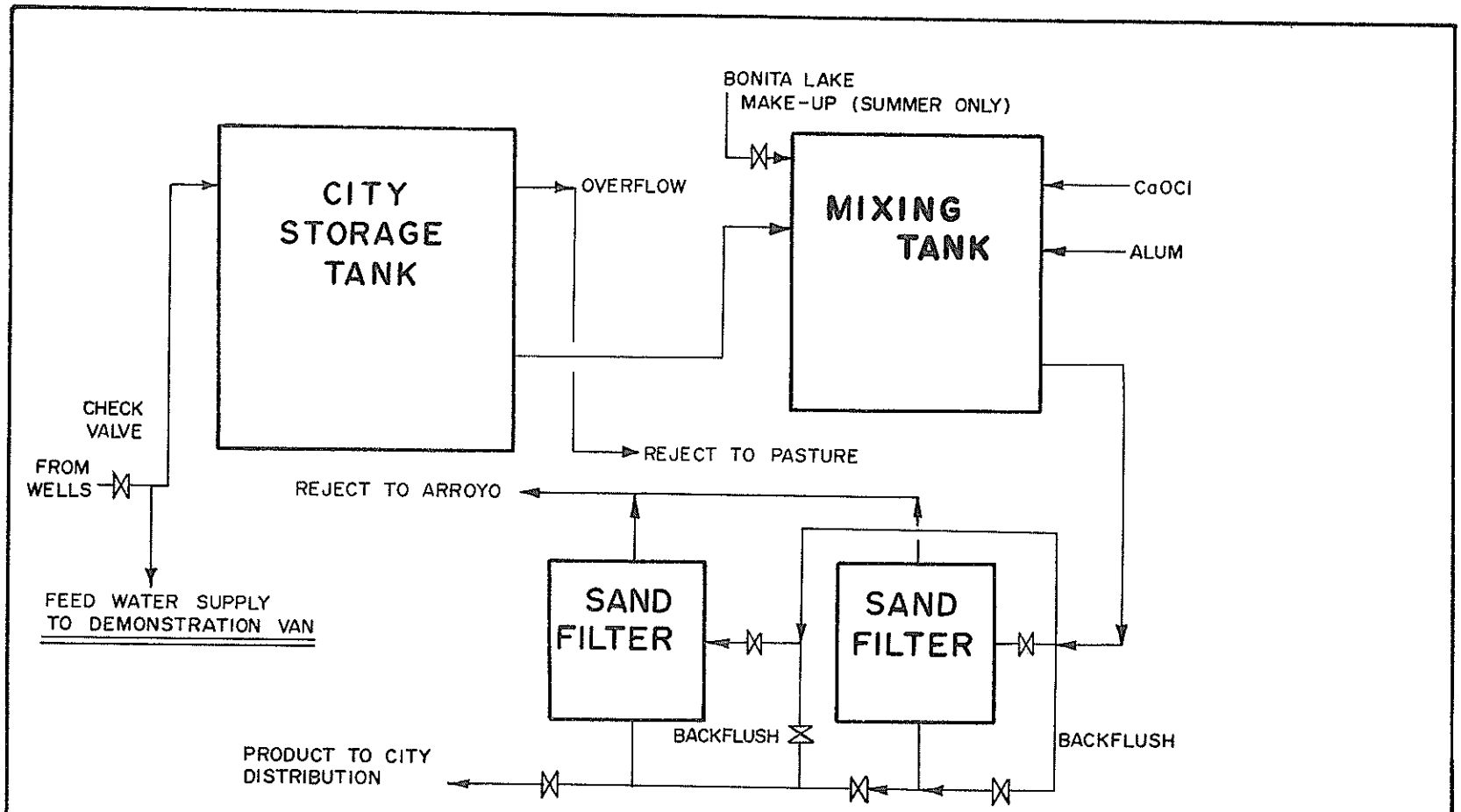


FIGURE 3

EXISTING CARRIZOZO WATER TREATMENT SYSTEM SCHEMATIC

TABLE 3. CARRIZOZO WATER QUALITY DATA

Contaminant	Concentration, mg/l
TDR	950
Iron	.02
Manganese	.03
Sodium	88.
Sulfate	374.
pH	6.6
Conductivity, mhos	1490.
Strontium	2.8
USAGE:	200,000 ± 25% gallons per day

The treatment system was installed to primarily remove suspended solids brought into the system from the Bonita Lake supply. There is a current project to upgrade the Carrizozo system through desalination. [3]

3. La Luz, New Mexico: A second Tularosa Basin community, La Luz, is described as a semi-retirement/artists community. The community water system services some 750-800 people. Daytime supply of water is taken from wells, while in the night-time the well-water is shut-off and Bonita Lake water supplies the system. Table 4 gives information on the average water quality (complete analysis is given in Appendix A). Figure 4 shows the current La Luz water treatment system.

TABLE 4. LA LUZ WATER QUALITY DATA

USAGE: 100,000± 20% gallons per day
100% filtered

Contaminant	Concentration, mg/l
TDR	1994.
Sodium	309.
Sulfates	1004.
Chloride	370.
Arsenic	.03
Hardness	1155.
Conductivity micro mhos	3260
Strontium	2.5

4. San Jon, New Mexico: San Jon is a farming community on the eastern plains of the state. The population numbers 300 residents. The water supply is well-water. Its quality is shown in Table 5. The complete

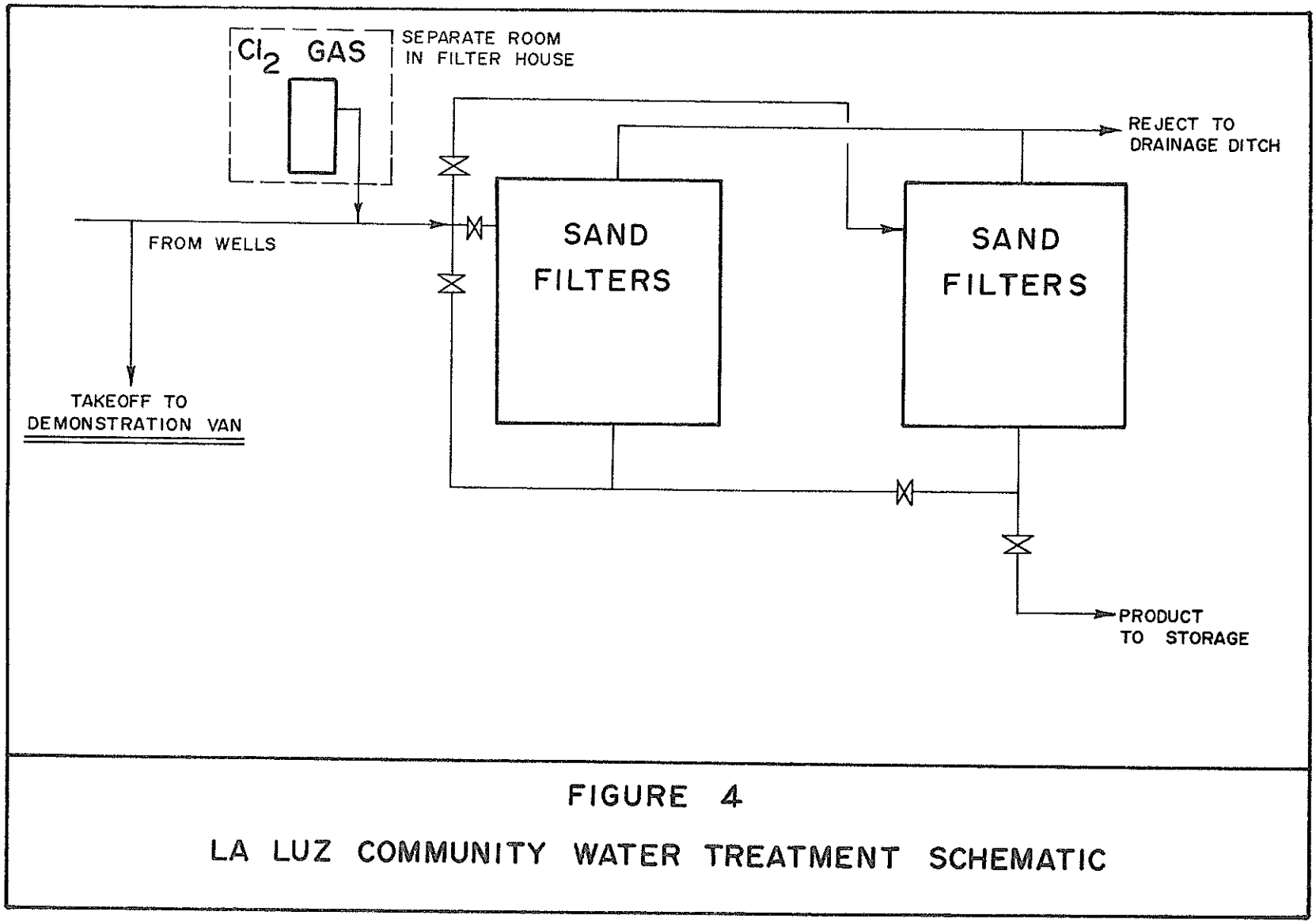
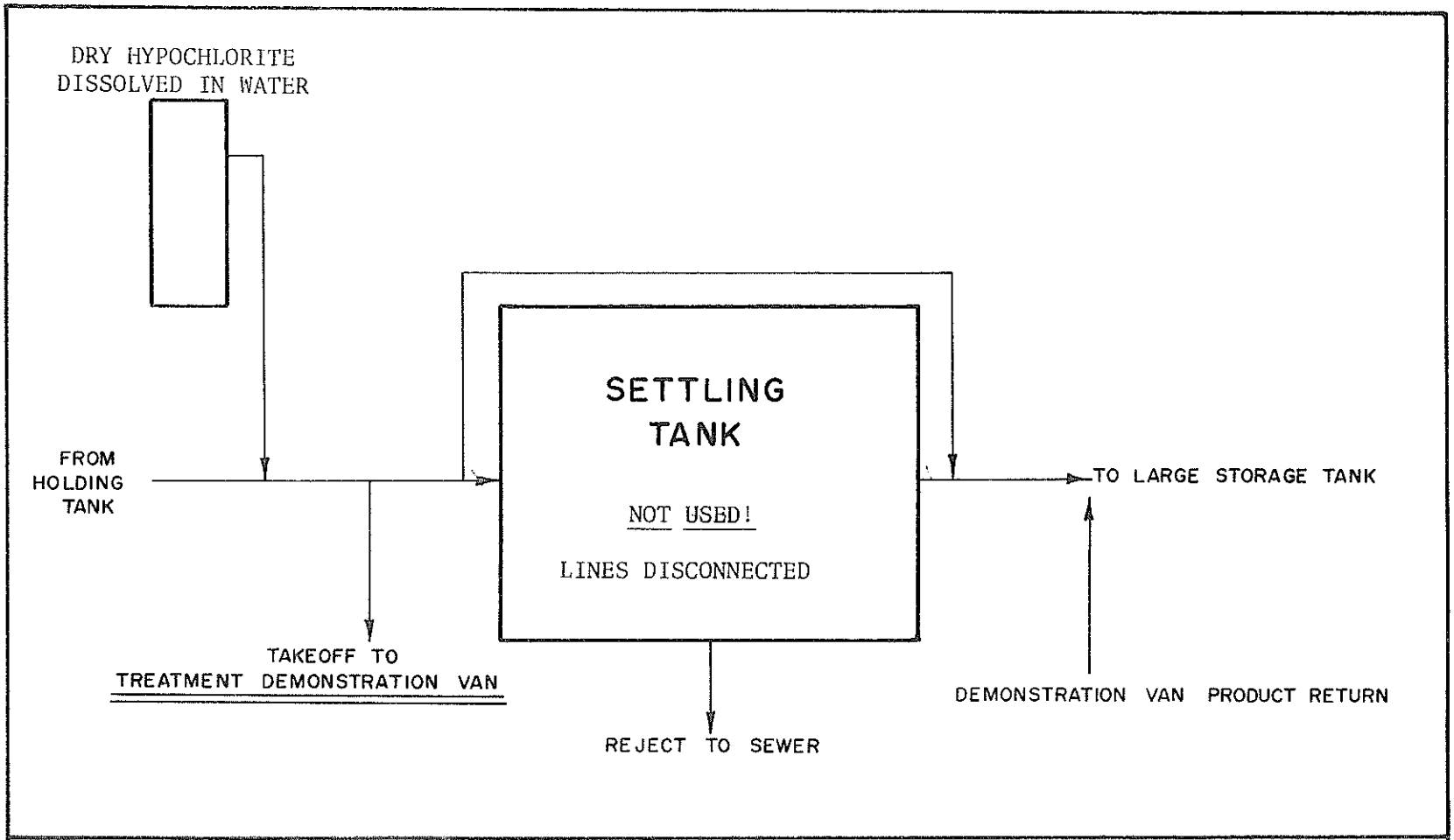


FIGURE 4

LA LUZ COMMUNITY WATER TREATMENT SCHEMATIC



FIGURE

SAN JON COMMUNITY WATER TREATMENT SCHEMATIC

analysis is given in Appendix A.

TABLE 5. SAN JON COMMUNITY WATER SUPPLY

USAGE: 50,000± 40% gallons per day
No filtration Cl_2 addition only

Contaminant	Concentration mg/l
TDR	1180.
Sodium	420.
Sulfates	197.
Fluoride	3.8
Conductivity, mhos	1690

The current treatment system consists of a settling tanks and chlorine addition as shown in Figure 5. The San Jon community has had fluoride levels approximately twice the concentration shown in Table 5. This community was the first small town to request the demonstration van operation for their water supply. The throughput for the demonstration van will approach 40% of the average daily usage when all systems are operating Reinjection of the van product water will have an appreciable effect on the community drinking water.

5. San Ysidro, New Mexico: The community of San Ysidro is a small (permanent population 100) town in the Jemez River Valley at the south entrance to the Jemez National Forest. There has been recent summer cabin development in the valley. During the summer the water system has a difficult time supplying the community needs. Table 6 gives the current water quality. Complete analysis is in Appendix A.

TABLE 6. SAN YSIDRO WATER QUALITY SUMMARY

USAGE: 13,220± 50% gallons per day
No filtration, Cl_2 addition only

Contaminant	Concentration, mg/l
TDR	1100.
Sodium	192.

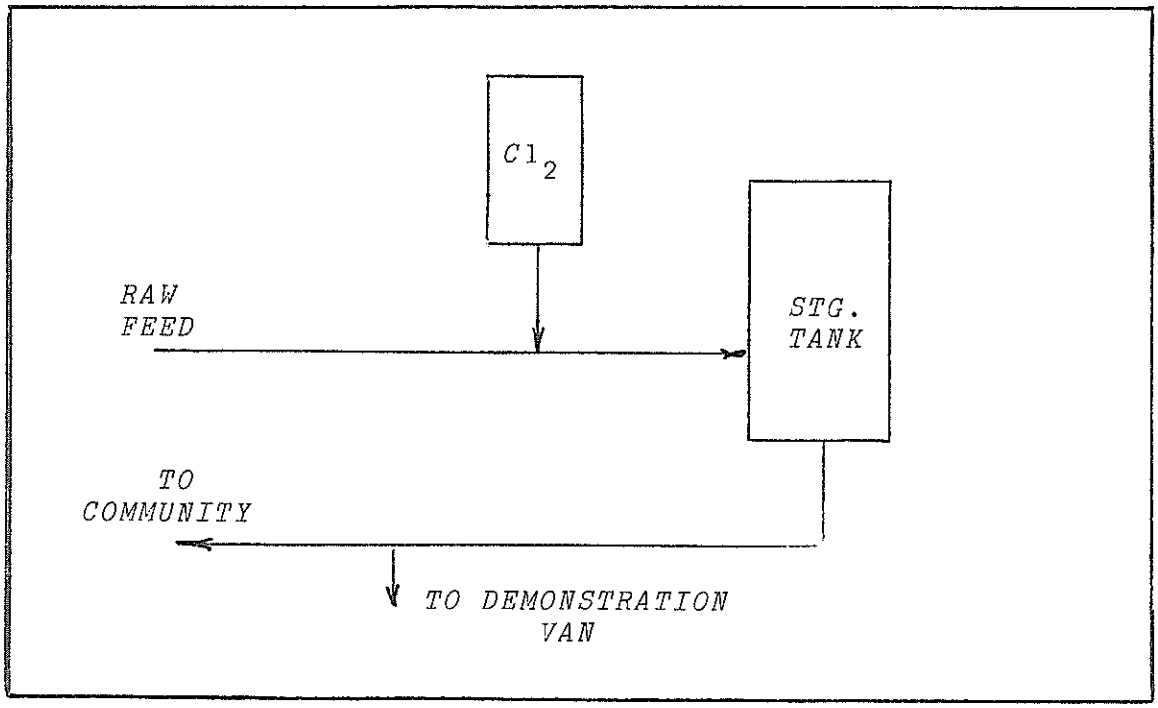


FIG. 6. SAN YSIDRO COMMUNITY TREATMENT SYSTEM

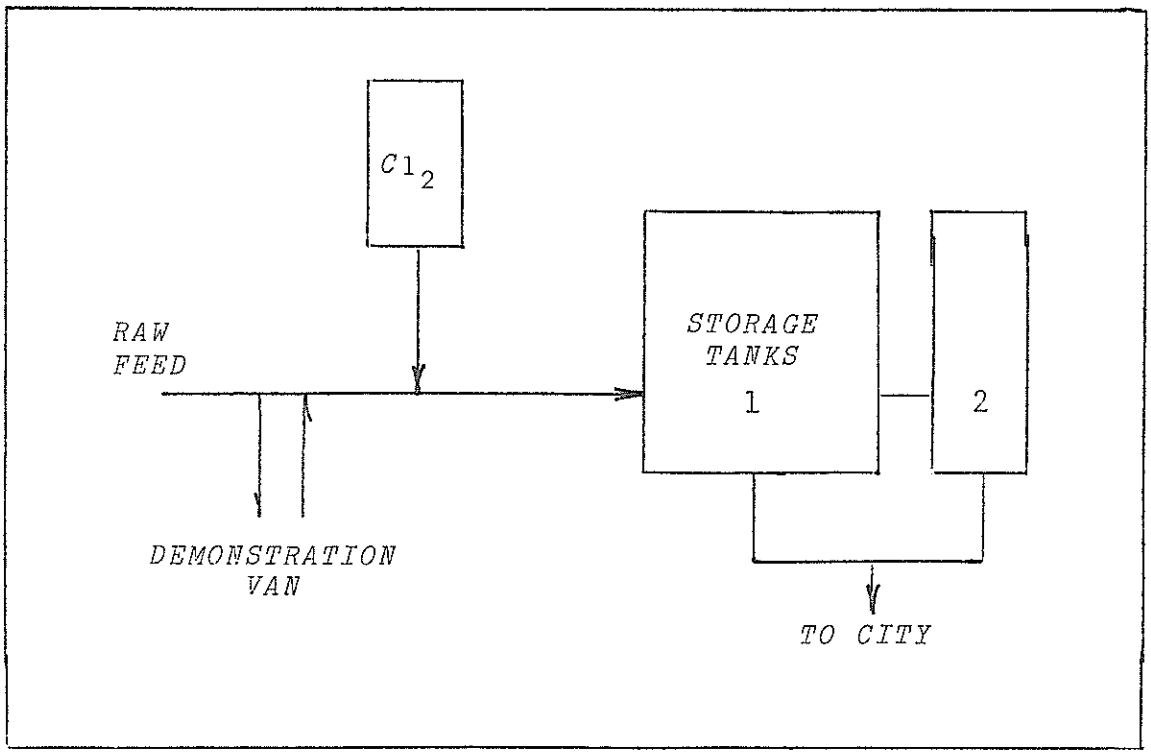


FIG. 7. BLUEWATER SYSTEM

Sulfates	83.5
Fluoride	1.4
Aresenic	.05
Conductivity, micro mhos	1410.

The current water treatment system is shown in Figure 6. Without reinjection of product water into the community supply, the demonstration van will consume the available water. The community is currently evaluating its water supply and treatment operations to handle the increased recreational development of the area.

6. Bluewater, New Mexico: Originally a small farming community south of 'Route 66' and best known for carrots, Bluewater has developed as a result of the uranium boom in northwestern New Mexico. Bluewater has experienced the usual problems of a rapid expansion in population, although much of the influx of people into the area have settled in Grants, some 10 miles north. The population ranges around 2000 people depending on construction and mining development currently active.

The water quality in the Bluewater region has high selenium as the primary contaminant although like most of New Mexico small communities total dissolved solids exceed the National Drinking Water Standards. Table 7 gives the water analysis summary and Figure 7 shows the current treatment system. Complete analysis of the Bluewater supply is given in Appendix A.

TABLE 7. Bluewater Water Quality

USAGE: 400,000 ± 30% gallons per day

Contaminant	Concentration mg/l
TDR	908
Sulfate	402
Conductivity, micro mhos	1360
Radioactivity	1. pc/l
Strontium	1.3

The current supplies are well-water and there have been no plans announced to change the current system.

7. Moriarty, New Mexico: Moriarty had originally been scheduled for the demonstration van during the summer; however, the eastward growth of Albuquerque has brought new development to the area and the current water supply does not meet the demand during the summer months. Tourism (Interstate 40) and farming are the principal econcomic industries in the area. Although not a major farm center (Albuquerque is 40 miles west) Moriarity is an old New Mexico community. The population has reached 1500 people servd by the water system. Table 8 summarizes the water quality.

TABLE 8. MORIARTY WATER QUALITY

USAGE: 135,000± 15% gallons per day
No filtration, Cl_2 addition only

Contaminant	Concentration, mg/l
TDR	1000
Sulfate	383
Hardness	637
Conductivity, micro mhos	1330

The current treatment system simply allows for Cl_2 (gas) addition. The system is shown in Figure 8. The community is investigating possible sources of additional water; however, the present water supply is part of a "closed-basin", i.e., wells can only be drilled after permits have been received from the Office of the State Engineer.

8. Hagerman, New Mexico:

The community of Hagerman was a replacement for Puerto de Luna as a stop for the demonstration van. Puerto de Luna is serviced by a 110 volt electrical line only, and arrangements for the van operation using that system were not warranted. A farm community of the Pecos River

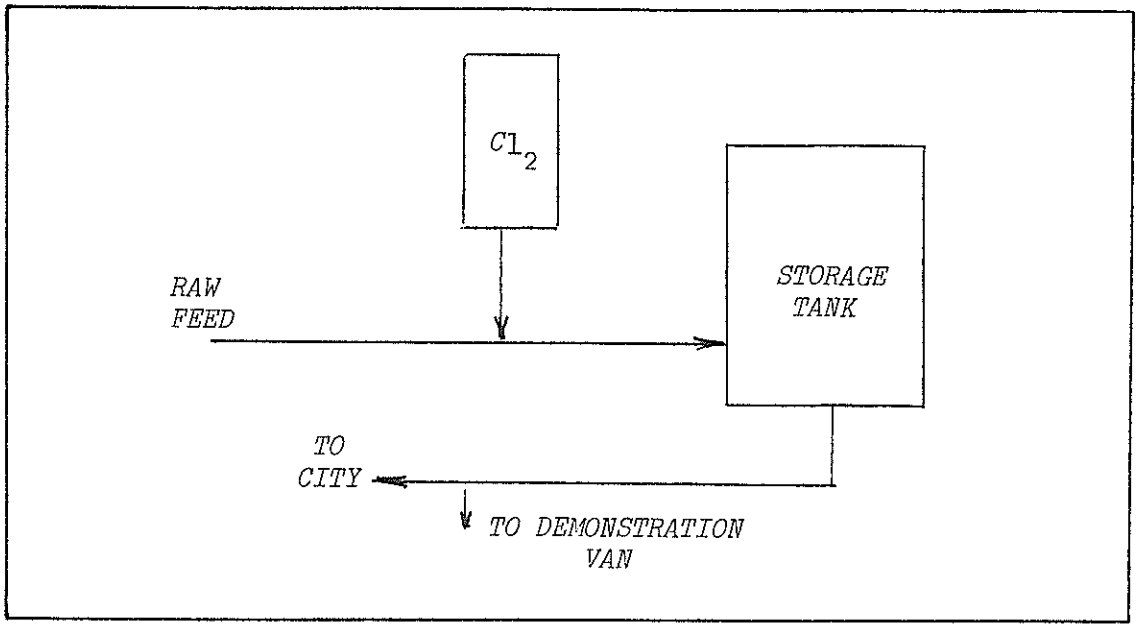


FIG. 8. MORIARTY WATER SYSTEM

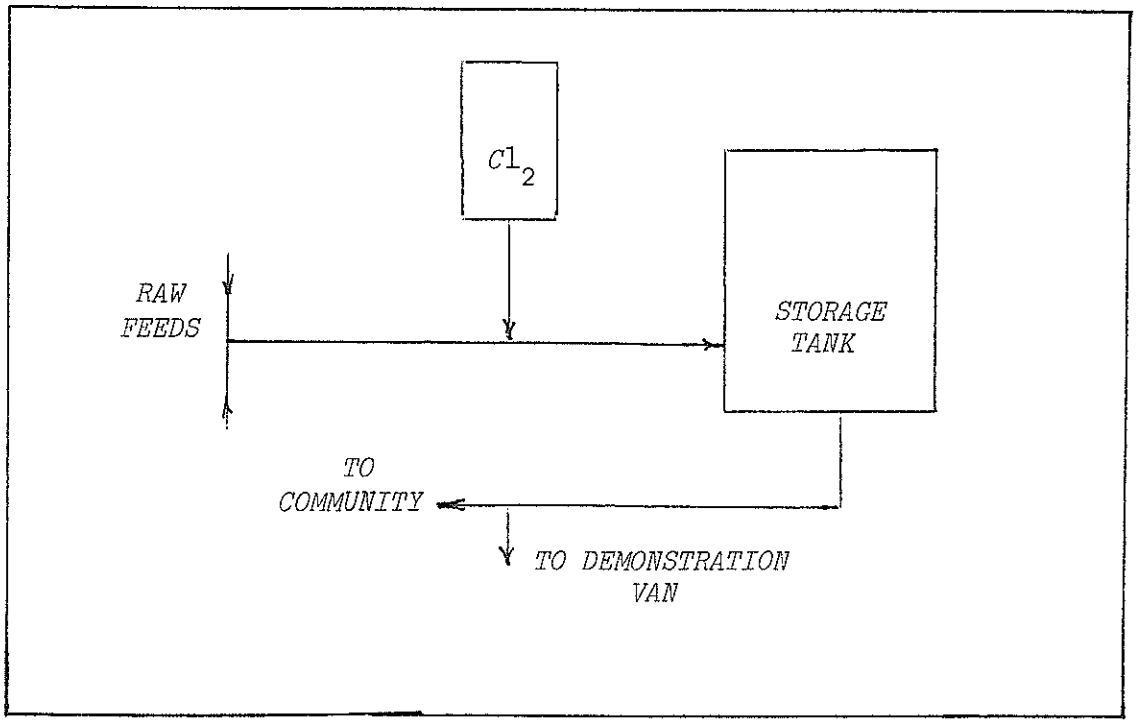


FIG. 9. HAGERMAN WATER SYSTEM

valley, Hagerman's water supply has high total dissolved solids and iron. In addition, the well that was used to supply the van had high turbidity. Figure 9 gives the flow schematic for the current treatment system. Complete analysis of the Hagerman well water is given in Appendix A.

TABLE 9. HAGERMAN WATER QUALITY DATA

USAGE: 175,000± 25% gallons per day
No filtration, Cl_2 addition only

Contaminant	Concentration, mg/l
TDR	1280.
Sulfate	492.
Hydrogen Sulfide	0.15
Conductivity, mcro mhos	1670
Strontium	2.1

The community population of Hagerman is static, decreasing if anything. The Pecos River water is deteriorating in quality, although there will be farming operations for many years. No plans have been announced for changing the current system.

B. Van Operating Philosophy

The mobile desalting (demonstration) unit was designed to treat no specific water supply but rather a composite of supplies found throughout New Mexico. Consequently, for a given supply the design and subsequent operation of the system would not necessarily be optimal. The objective of the operation was to achieve a product water of sufficient quality to meet the National Drinking Water Standards.

The operation of the van units was the responsibility of Mr. Steve Hanson, Project Engineer. Where appropriate Mr. Hansen consulted with the equipment suppliers or manufacturers on the 'best' operating conditions for a given community's water. The actual operation within a community also entailed coordination with the current operation and requirements of the water supply and treatment system. In some communities visited this later restriction

significantly affected the demonstration unit's operation.

As mentioned above, 'optimization' in some communities simply meant all systems operating, although it was generally desired that the units would give maximum product with maximum solute rejection. While the operator (Mr. Hanson) would adjust flows and chemical addition rates, the emphasis was as stated; i.e., to show the community that the water treatment systems would provide the necessary quality water as the product.

Each community was orginally scheduled for a 1000 hour operating period. Transportation delays, hook-up problems, and the previously-mentioned water supply problems did not permit this time-period for many of the communities. (The 1000 hours had been selected as the minimum time required for system malfunctioning.) In addition, the units within the van were being modified and additional components were being added so not all the components were tested in all communities. However, it was decided that rather than operating strict comparison tests between units (and/or types of RO modules) the overall demonstration of satisfactory water treating was more important.

The final two considerations in operation of the demonstration van are: (1) disposal of brine reject and (2) certification of quality of product water and reinjection to the community supply. In all communities the location of the water system (and van) permitted the disposal of reject brine directly to the natural surface drainage in the area. In those communities where the product water was not returned to the supply, brine and product were discharged to the same drainage.

In all communities the product water was certified to be of suitable quality to comply with the National Drinking Water Standards. However, only two communities received the product water back into their system. This was due to the location of the van and/or the unavailability of a means of reintroducing the water into the system.

II. OPERATING PERFORMANCE

A. Cuba, New Mexico

The assembled reverse osmosis system, installed in the trailer, was received from SALTECH, Inc. by the Chemical Engineering Department on November 7, 1977. At this time only one spiral wound reverse osmosis unit, plus all pre- and post-treatment components (see Figure 1, pg) had been installed. This system was operated at NMSU for several days as a check-out period. The trailer was returned to El Paso where the IONICS, Inc. Aquamate V electrodialysis system was installed. The trailer was moved directly to Cuba, New Mexico where it began operation on November 21, 1977. The total available system was operated.

The Cuba community water supply is high in iron, manganese, turbidity and total dissolved residue. After suspended solids were reduced by filtration, the iron and manganese levels were to be controlled by removal in the "green-sand" filters. Additional suspended solids removal occurred in the "green-sand" filters. The filtered product was held in a retention tank for a maximum of 30 minutes. Previous experience with reverse osmosis systems at the Roswell Test Facility of OWRT has shown that there is a strain of bacteria in New Mexico brackish waters which require a longer chlorination period, i.e. compared to the conventional 10 minute for usual water treating chlorination. [4] Sodium sulfite, sulfuric acid and hypochlorite are metered into the reverse osmosis feed water to adjust the pH to the 4.5 - 5.5 range, having reduced the residual chlorine. The reduction of the chlorine was required since the RO module material was cellulose acetate. The feed to the electrodialysis unit received the same pretreatment.

While the operation at Cuba was still a 'shake-down' period the systems worked well - approximately 170,000 gallons were processed - and the product water met the required standards. Table 10 summarizes the operating

METER READING AT

CUBA, N.M.

ELECTRODIALYSIS		
DATE : 29 NOV - 14 DEC (1977)		
TIME		
POLARITY		
FEED SALINITY (ppm)		603.
PRODUCT SALINITY (ppm)		418.
PRODUCT CONDUCTIVITY		
DILUTE FLOW (gpm)		5.1
BRINE FLOW (gpm)		1.04[a]
FEED TEMPERATURE (°F)		59.
STACK INLET		44psig
STACK OUTLET		1.5psig
DIFFERENTIAL IN		-
DIFFERENTIAL OUT		-
BEFORE FILTER		-
AFTER FILTER		-
AFTER PRV		-
ELECTRODE INLET		40.5
STAGE ONE	VOLTS	27.
	AMPS	1.7
STAGE TWO	VOLTS	27.
	AMPS	1.7

REVERSE OSMOSIS		
DATE : 21 NOV - 14 DEC (1977)		
TIME		
FEED CONDUCTIVITY		1116.
PRODUCT CONDUCTIVITY		97.
PRODUCT FLOW (gpm)		3.14
CONCENTRATE FLOW (gpm)		4.2
RECYCLE FLOW (gpm)		3.0
FEED TEMPERATURE (°F)		56.
ΔP ACROSS	HFF	-
MEMBRANES	SW	40psi
ΔP ACROSS C. FILTERS		3psi
FEED PRESSURE		30psig
INLET pH		5.7
PRODUCT pH		6.6
ΔP ACROSS $KMnO_4$ FILTERS		4psi
ΔP ACROSS SAND TRAP		15psi
PUMP PRESSURE	HFF	-
	SW	417psig

COMMENTS:

a Does not include .5gpm electrode waste.

TABLE 10. CUBA OPERATING CONDITIONS

conditions and Table 11 gives a comparison of the water quality. As it proceeds through the treatment chain, more detailed product water analysis is provided in Appendix B along with additional operating data in the form of log sheets. Table 12 summarizes the operation of Cuba.

TABLE 11. SUMMARY OF DATA AVERAGES - CUBA, NEW MEXICO

PARAMETER	WELL WATER	GREENSAND FILTER EFFLUENT	ED & RO FEED WATER	PRODUCT WATER	PRODUCT WATER	WASTE BRINE	WASTE BRINE
Flow, gpm	14.0	13.98	13.98	3.14	5.10	4.2	1.54
pH	6.7	6.40	5.66	6.60	5.80	5.5	5.50
E. C. mhos	950.0	970.00	1030.00	86.00	740.00	1655.0	2300.00
TDR, mg/l	780.0	603.00	640.00	48.00	418.00	915.0	1390.00
Na, mg/l	70.0	70.00	70.00	13.00	73.00	122.0	110.00
Fe, mg/l	1.6	0.43	0.43	0.02	0.02	0.4	0.22
Mn, mg/l	1.4	1.30	1.30	0.13	0.80	2.2	3.00
Cl^-, mg/l	1/0	1.00	1.00	0.40	0.98	0.9	1.20

TABLE 12. OPERATION SUMMARY

PRODUCTION	GALLONS	TDR mg/l
RO	33,000	72
ED	50,000	418

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal food}} \times 100$

RO	43%
ED	77%

TDR REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

Greensand Filter	22%
RO	88%
ED	31%

B. Carrizozo, New Mexico

The demonstration unit operations at Carrizozo began on January 10 and continued through February 22. The water supply to the van was as shown in Figure 3 (pg). System operation consisted of raw water flow through the sand filters and then, for the reverse osmosis system, through the

METER READING AT

CARRIZOZO, N.M.

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE:		10 JAN. 1978 to	DATE:		22 FEB 1978
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		981.	FEED CONDUCTIVITY		2330.
PRODUCT SALINITY (ppm)		226.	PRODUCT CONDUCTIVITY		290.
PRODUCT CONDUCTIVITY		376.	PRODUCT FLOW (gpm)		3.1
DILUTE FLOW (gpm)		4.6	CONCENTRATE FLOW (gpm)		2.5
BRINE FLOW (gpm)		1.4[a]	RECYCLE FLOW (gpm)		—
FEED TEMPERATURE (°F)		61.	FEED TEMPERATURE (°F)		63.
STACK INLET		46. psig	ΔP ACROSS	HFF	
STACK OUTLET		1.5 psig	MEMBRANES	SW	
DIFFERENTIAL IN		—	ΔP ACROSS C. FILTERS		
DIFFERENTIAL OUT		—	FEED PRESSURE		30 psig
BEFORE FILTER		—	INLET pH		2.9
AFTER FILTER		—	PRODUCT pH		5.2
AFTER PRV		—	ΔP ACROSS $KMnO_4$ FILTERS		4 psi
ELECTRODE INLET		49.	ΔP ACROSS SAND TRAP		~1 psi
STAGE ONE	VOLTS	71	PUMP PRESSURE	HFF	455.
	AMPS	5.6		SW	455.
STAGE TWO	VOLTS	71			
	AMPS	5.6			

COMMENTS:

a Does not include .5 gpm electrode waste

TABLE 13. OPERATING CONDITIONS - CARRIZOZO

'greensand' filters. These filters were simply used for filtration and were not recharged with permanganate since iron and manganese were not a problem in the Carrizozo raw water. The feed to the electrodialysis unit was taken directly from the effluent of the sand filter. About 1000 hours of operation was performed and approximately 274,000 gallons of product water was produced. Average operating conditions are shown in Table 13. (more complete operating information is in Appendix B.)

Table 14 gives the summary of the data averages control points throughour the units. Table 15 summarizes the operation at Carrizozo.

TABLE 14. SUMMARY OF DATA AVERAGES - CARRIZOZ, N. MEX.

PARAMETERS	WELL WATER	GREENSAND FILTER EFFLUENT	RO FEED WATER	RO PRODUCT WATER	ED PRODUCT WATER	RO WASTE	ED WASTE
Flow, gpm	12.10	5.60	5.6	3.10	4.60	2.50	1.90
pH	6.47	6.37	2.9	5.18	6.36	4.03	6.37
E. C., mmhos	1506.00	1510.00	2330.0	290.00	360.00	4656.00	3761.00
TDR, mg/l	981.00	950.00	1447.0	130.00	220.00	3276.00	2920.00
Na, mg/l	85.00	88.00	95.0	12.00	31.00	164.00	161.00
SO_4, mg/l	425.00	438.00	689.0	47.00	72.00	2107.00	1298.00
HCO_3, mg/l	185.00	185.00	0.0	8.00	78.00	*	343.00

* only one sample read-out given - not representative

TABLE 15. OPERATION SUMMARY - CARRIZOZO

PRODUCTION	GALLONS	TDR mg/l
RO	108,000	130
ED	166,400	226

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO	55%
ED	71%

TDR REJECTION RATION $\frac{\text{in-out}}{\text{in}} \times 100$

RO	91%
ED	77%

METER READING AT

LA LUZ

ELECTRODIALYSIS		
DATE:		
TIME		
POLARITY		
FEED SALINITY (ppm)		1994.
PRODUCT SALINITY (ppm)		520.
PRODUCT CONDUCTIVITY		730.
DILUTE FLOW (gpm)		5.1
BRINE FLOW (gpm)		1.5[a]
FEED TEMPERATURE (°F)		63.5
STACK INLET		50. psig
STACK OUTLET		1.5 psig
DIFFERENTIAL IN		–
DIFFERENTIAL OUT		–
BEFORE FILTER		–
AFTER FILTER		–
AFTER PRV		–
ELECTRODE INLET		52. psig
STAGE ONE	VOLTS	80.
	AMPS	10.4
STAGE TWO	VOLTS	51.
	AMPS	4.8

REVERSE OSMOSIS		
DATE:		
TIME		
FEED CONDUCTIVITY		3260
PRODUCT CONDUCTIVITY	SW/HFF	859 / 176
PRODUCT FLOW (gpm)		5.3
CONCENTRATE FLOW (gpm)		1.8
RECYCLE FLOW (gpm)		–
FEED TEMPERATURE (°F)		63.4
ΔP ACROSS	HFF	8.4 psi
MEMBRANES	SW	41. psi
ΔP ACROSS C. FILTERS		2. psi
FEED PRESSURE		30. psig
INLET pH		4.5
PRODUCT pH		5.
ΔP ACROSS $KMnO_4$ FILTERS		2. psi
ΔP ACROSS SAND TRAP		4. psi
PUMP PRESSURE	HFF	502.
	SW	455.

COMMENTS:

a Does not include .5 gpm electrode waste.

TABLE 16. OPERATING CONDITIONS - LA LUZ

C. La Luz, New Mexico

The demonstration van began operation in La Luz on March 9 and moved to San Jon on April 24. Units operated at La Luz were the electrodialysis, directly on system-water (after sand filter) and RO, both spiral-wound and hollow, fine fibers with required pre-treatment. Table 16 gives the average operating conditions for these units. Table 17 gives data summaries (averages) on the operation through the Unit. Table 18 gives the operating summary for La Luz. Appendix B gives detailed chemical analysis and operating logs for La Luz.

TABLE 17. SUMMARY OF DATA AVERAGES - LA LUZ, NEW MEXICO

PARAMETERS	E. D. FEED RAW WELL WATER	RO FEED	RO PRODUCT (sw,hff)	ED PRODUCT	RO WASTE (sw,hff)	ED WASTE
Flow, gpm	6.6	7.1	5.3	5.10	1.8	2.0
pH	6.9	4.3	4.1,5.2	6.32	5,3.4	6.8
E.C., mhos	3160.0	3627.0	930,180	790	6210,8073	4870.0
TDR, mg/l	1994.0	2177.0	130	520	4700	4690.0
Na, mg/l	309.0	309.0	57	130	519	590.0
$SO_4^=$, mg/l	1036.0	1415.0		276	1952	2571.0
CL^-, mg/l	370.0	370.0	19.4	76.5	882	1133.0

TABLE 18. OPERATION SUMMARY - LA LUZ, NEW MEXICO

PRODUCTION	GALLONS	TDR mg/l
RO	102,240	130
ED	102,000	520

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO	75%
ED	73%

TDR REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

RO	94%
ED	74%

METER READING AT

SAN JON

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE:			DATE:		
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		1312	FEED CONDUCTIVITY		1821
PRODUCT SALINITY (ppm)		206	PRODUCT CONDUCTIVITY	SW/HFF	61/136
PRODUCT CONDUCTIVITY		248	PRODUCT FLOW (gpm)		4.5
DILUTE FLOW (gpm)		4.5	CONCENTRATE FLOW (gpm)		2.7
BRINE FLOW (gpm)		1.25[a]	RECYCLE FLOW (gpm)		–
FEED TEMPERATURE (°F)		83.	FEED TEMPERATURE (°F)		71.
STACK INLET		45psig	ΔP ACROSS	HFF	10psi
STACK OUTLET		–	MEMBRANES	SW	30psi
DIFFERENTIAL IN		–	ΔP ACROSS C. FILTERS		6psi
DIFFERENTIAL OUT		–	FEED PRESSURE		30psig
BEFORE FILTER		–	INLET pH		7.2
AFTER FILTER		–	PRODUCT pH		–
AFTER PRV		–	ΔP ACROSS $KMnO_4$ FILTERS		6psi
ELECTRODE INLET		45psig	ΔP ACROSS SAND TRAP		18 psi
STAGE ONE	VOLTS	57	PUMP PRESSURE	HFF	505psig
	AMPS	5.3		SW	460psig
STAGE TWO	VOLTS	57			
	AMPS	2.8			

COMMENTS:

a Does not include .5gpm electrode waste.

TABLE 19. SUMMARY OF OPERATING CONDITIONS - SAN JON

D. San Jon, New Mexico

The demonstration van started operation in San Jon on June 1 and stopped on July 8. During that period 300,000 gallons of product water were produced and, after certification as to quality by the EID, the product water was introduced into the community supply. Table 19 gives the summary of operating conditions. Table 20 gives the average analysis data for the operation and Table 21 gives the summary of the San Jon operation.

TABLE 20. SUMMARY OF DATA AVERAGES - SAN JON, NEW MEXICO

PARAMETER	ED FEED	RO FEED	RO PRODUCT (sw,hff)	ED PRODUCT	RO WASTE (sw,hff)	ED WASTE
Flow	6.35	7.2	2.4,2.1	4.5	1.3,1.4	1.75
pH	8.00	8.2	6.9,7.5	7.6	7.1	7.30
E.C. mhos	1818.00	1721.0	83,165	263.0	3253	3258.00
TDR, mg/l	1312.00	1260.0	91, 50	206.0	2000	2344.00
Na, mg/l	420.00	420.0	67, 47	108.0	592	
SO_4, mg/l	197.00	196.0	106,142		274	286.00
Cl, mg/l	61.00	64.0	0.7,1.2	5.3	102	129.00

TABLE 21. OPERATION SUMMARY - SAN JON

PRODUCTION	GALLONS		TDR mg/l
RO	259,209	(sw)	91.
		(hff)	50.
ED	222,000		206.

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO (Total)	63%
ED	72%

TDR REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

RO	(sw)	93%
	(hff)	96%
ED		84%

E. San Ysidro, New Mexico

Operations at San Ysidro were started on August 1 and stopped (due to lack of water) on August 24. Table 22 shows the summary of operating

METER READING AT

SAN YSIDRO

ELECTRODIALYSIS		REVERSE OSMOSIS	
DATE: 1 August 1978 to		DATE 24 August 1978	
TIME		TIME	
POLARITY			
FEED SALINITY (ppm)	806	FEED CONDUCTIVITY	1380
PRODUCT SALINITY (ppm)	161	PRODUCT CONDUCTIVITY SW/HFF	194/106
PRODUCT CONDUCTIVITY	162.	PRODUCT FLOW (gpm)	7.3
DILUTE FLOW (gpm)	4.9	CONCENTRATE FLOW (gpm)	3
BRINE FLOW (gpm)	.9 [a]	RECYCLE FLOW (gpm)	—
FEED TEMPERATURE (°F)	75.	FEED TEMPERATURE (°F)	79.
STACK INLET	43psig	ΔP ACROSS HFF	9psi
STACK OUTLET	—	MEMBRANES SW	24psi
DIFFERENTIAL IN	—	ΔP ACROSS C. FILTERS	4psi
DIFFERENTIAL OUT	—	FEED PRESSURE	30psig
BEFORE FILTER	—	INLET pH	6.2
AFTER FILTER	—	PRODUCT pH	—
AFTER PRV	—	ΔP ACROSS $KMnO_4$ FILTERS	5psi
ELECTRODE INLET	45psig	ΔP ACROSS SAND TRAP	10psi
STAGE ONE VOLTS	55.	PUMP PRESSURE HFF	505psig
AMPS	4.2	SW	401psig
STAGE TWO VOLTS	55.		
AMPS	2.2		

COMMENTS:

a Does not include .5 gpm electrode waste.

TABLE 22. SUMMARY OF OPERATING CONDITIONS AT SAN YSIDRO

conditions for the short period of operation. Table 23 gives the average analysis for the unit operations and Table 24 gives the summary of the operations at San Ysidro.

TABLE 23. SUMMARY OF DATA AVERAGES - SAN YSIDRO, NEW MEXICO

PARAMETER	RAW	RO FEED	RO PRODUCT	ED PRODUCT	RO WASTE	ED WASTE
Flow, mg/l	16.60	7.3	7.3	4.9	-	1.40
pH	-	-	-	-	-	-
E.C., mhos	1300.00	1230.0	297.0	260.0	3900.0	2200.00
TDR, mg/l	912.00	763.0	184.0	161.0	2418.0	1364.00
SO_4, mg/l	84.00	220.0	16.0	32.0	630.0	500.00
SiO_2, mg/l	40.00	40.0	16.0	40.0		
Cl^-, mg/l	150.00	150.0	48.0	23.0	472.0	290.00

TABLE 24. SUMMARY OF OPERATION

PRODUCTION	GALLONS	TDR, mg/l
RO	15,000	184
ED	9,100	161

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO	71%
ED	78%

TDR, REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

RO	80%
ED	82%

F. Bluewater, New Mexico

Operation started at Bluewater on September 14, 1978 and continued through October 19. Table 25 gives the summary of average operating conditions; Table 26 gives the average data analysis; and Table 27 summarizes the operation at Bluewater.

METER READING AT

BLUEWATER

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE :	14 September 1978 to		DATE :	19 October 1978.	
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		908	FEED CONDUCTIVITY		
PRODUCT SALINITY (ppm)		224	PRODUCT CONDUCTIVITY		606
PRODUCT CONDUCTIVITY		216	PRODUCT FLOW (gpm)		1.6
DILUTE FLOW (gpm)		3.8	CONCENTRATE FLOW (gpm)		1.4
BRINE FLOW (gpm)		.5[a]	RECYCLE FLOW (gpm)		–
FEED TEMPERATURE (°F)		58.	FEED TEMPERATURE (°F)		63.
STACK INLET		47 psig	ΔP ACROSS	HFF	10 psi
STACK OUTLET		–	MEMBRANES	SW	
DIFFERENTIAL IN		–	ΔP ACROSS C. FILTERS		2 psi
DIFFERENTIAL OUT		–	FEED PRESSURE		32 psig
BEFORE FILTER		–	INLET pH		6.2
AFTER FILTER		–	PRODUCT pH		–
AFTER PRV		–	ΔP ACROSS $KMnO_4$ FILTERS		–
ELECTRODE INLET		48 psig	ΔP ACROSS SAND TRAP		2 psi
STAGE ONE	VOLTS	56	PUMP PRESSURE	HFF	510 psig
	AMPS	2.3		SW	–
STAGE TWO	VOLTS	56			
	AMPS	1.4			

COMMENTS:

a Does not include .5 gpm electrode waste.

TABLE 25. SUMMARY OF OPERATING CONDITIONS AT BLUEWATER

TABLE 26. SUMMARY OF DATA ANALYSIS

PARAMETER	ED FEED	RO FEED	RO PRODUCT	ED PRODUCT	RO WASTE	ED BRINE
Flow, gpm	4.80	3.0	1.6	3.8	1.4	1.0
pH	7.10	6.2	5.1	6.5	3.5	7.8
E.C., mhos	1300.00	1300.0	606.0	216.0	-	2210.0
TDR, mg/l	908.00	3000.0	36.0	224.0	-	1732.0
Na, mg/l	78.00	80.0	6.6	21.0	-	111.0
$SO_4^=$, mg/l	398.00	402.0	79.0	31.0	-	770.0
SiO_2, mg/l	16.20	16.2	1.6	16.2	-	16.2
Cl^-, mg/l	52.00	52.0	6.7	6.7	-	92.5

TABLE 27. SUMMARY OF OPERATIONS AT BLUEWATER

PRODUCTION	GALLONS	TDR, mg/l
RO	25,300	36
ED	123,120	224

RECOVERY RATE $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO	53%
ED	79%

TDR REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

RO	96%
ED	75%

G. Moriarty, New Mexico

Operations started at Moriarty on October 30, 1978 and were terminated on November 16. The unit processed 121,000 gallons of feed water, producing a total of 84,000 gallons of product. Table 28 gives a summary of the operating conditions for Moriarty. Table 29 gives the average chemical analysis for this period of operation and Table 30 summarizes the operations at Moriarty.

METER READING AT

MORIARTY

ELECTRODIALYSIS			REVERSE OSMOSIS		
DATE : 30 OCTOBER 1978		to	DATE : 16 NOVEMBER 1978		
TIME			TIME		
POLARITY					
FEED SALINITY (ppm)		900.	FEED CONDUCTIVITY		1330
PRODUCT SALINITY (ppm)		228	PRODUCT CONDUCTIVITY		291
PRODUCT CONDUCTIVITY		291	PRODUCT FLOW (gpm)		1.5
DILUTE FLOW (gpm)		4.3	CONCENTRATE FLOW (gpm)		1.1
BRINE FLOW (gpm)		1.0 [a]	RECYCLE FLOW (gpm)		—
FEED TEMPERATURE (°F)		58.	FEED TEMPERATURE (°F)		64.
STACK INLET		44psig	ΔP ACROSS	HFF	16psi
STACK OUTLET		—	MEMBRANES	SW	—
DIFFERENTIAL IN		—	ΔP ACROSS C. FILTERS		2psi
DIFFERENTIAL OUT		—	FEED PRESSURE		32psig
BEFORE FILTER		—	INLET pH		6.1
AFTER FILTER		—	PRODUCT pH		4.1
AFTER PRV		—	ΔP ACROSS $KMnO_4$ FILTERS		1psi
ELECTRODE INLET		45psig	ΔP ACROSS SAND TRAP		3psi
STAGE ONE	VOLTS	57.	PUMP PRESSURE	HFF	515psig
	AMPS	2.4		SW	—
STAGE TWO	VOLTS	57.			
	AMPS	1.2			

COMMENTS:

a Does not include .5gpm electrode waste.

TABLE 28. SUMMARY OF OPERATING CONDITIONS AT MORIARTY

TABLE 29. SUMMARY OF DATA ANALYSIS

PARAMETER	RAW WELL WATER	ED FEED	RO FEED	RO PRODUCT	RO BRINE	ED PRODUCT	ED BRINE
Flow, gpm	8.4	5.8	2.6	1.5	1.1	4.3	1.5
pH	7.6	7.6	6.1	4.1	6.2	7.4	7.7
E.C., mmhos	1330.0	1330.0	1430.0	68.0	1650.0	291.0	2210.0
TDR, mg/l	1004.0	1004.0	890.0	24.0	1340.0	228.0	1796.0
Na^+, mg/l	49.4	49.4	-	2.8	60.5	17.0	100.0
Ca^{++}. MG?L	170.1	170.0	-	1.0	224.0	35.0	328.0
SO_4^-, mg/l	383.0	383.0	510.0	15.0	480.0	31.0	750.0
Cl, mg/l	88.0	88.0	100.0	1.0	108.0	12.0	157.0

TABLE 30. SUMMARY OF OPERATIONS AT MORIARTY

PRODUCTION	GALLONS	TDR, mg/l
RO	37,000	24.
ED	83,000	228.

RECOVERY RATIO $\frac{\text{gal prod.}}{\text{gal feed}} \times 100$

RO	58%
ED	74%

TDR REJECTION RATIO $\frac{\text{in-out}}{\text{in}} \times 100$

RO	97%
ED	77%

H. Hagerman, New Mexico

The demonstration van arrived in Hagerman on November 18 and the power was connected and production started on November 21. This phase of the project was ended in Hagerman on December 21. Operating conditions at Hagerman are summarized in Table 31. Average chemical analysis are given in Table 32; Table 33 summarizes the Hagerman operation.

METER READING AT

HAGERMAN

ELECTRODIALYSIS			REVERSE OSMOSIS	
DATE: 21 November 1978		to	DATE: 21 December 1978	
TIME			TIME	
POLARITY				
FEED SALINITY (ppm)	1248.		FEED CONDUCTIVITY	1650.
PRODUCT SALINITY (ppm)	98.		PRODUCT CONDUCTIVITY	82.
PRODUCT CONDUCTIVITY	144.		PRODUCT FLOW (gpm)	1.7
DILUTE FLOW (gpm)	3.5		CONCENTRATE FLOW (gpm)	1.0
BRINE FLOW (gpm)	.5 [a]		RECYCLE FLOW (gpm)	—
FEED TEMPERATURE (°F)	68.		FEED TEMPERATURE (°F)	72.
STACK INLET	40psig		ΔP ACROSS HFF	20psi
STACK OUTLET	1.5psig		MEMBRANES SW	—
DIFFERENTIAL IN	—		ΔP ACROSS C. FILTERS	2psi
DIFFERENTIAL OUT	—		FEED PRESSURE	32psig
BEFORE FILTER	—		INLET pH	6.3
AFTER FILTER	—		PRODUCT pH	5.9
AFTER PRV	—		ΔP ACROSS $KMnO_4$ FILTERS	5psi
ELECTRODE INLET	—		ΔP ACROSS SAND TRAP	8psi
STAGE ONE VOLTS	64.		PUMP PRESSURE HFF	515psig
AMPS	3.6		SW	—
STAGE TWO VOLTS	64.			
AMPS	1.4			

COMMENTS:

a Does not include .5gpm electrode waste

TABLE 31. SUMMARY OF OPERATING CONDITIONS - HAGERMAN, NEW MEXICO

TABLE 32. SUMMARY OF CHEMICAL ANALYSIS - HAGERMAN

PARAMETER	WELL WATER	ED FEED	RO FEED	RO PRODUCT	RO BRINE	ED PRODUCT	ED BRINE
Flow, gpm	7.3	4.5	2.7	1.7	1.0	3.5	1.0
pH	7.8	7.4	7.6	6.5	7.5	6.3	7.3
E.C., mmhos	1670.0	1660.0	1650.0	82.0	3770.0	144.0	2770.0
TDR, mg/l	1280.0	1248.0	1220.0	48.00	3312.0	98.0	2320.0
Na^{+}, mg/l	85.2	87.0	86.1	10.7	206.0	12.1	152.0
Ca^{++}, mg/l	197.0	197.0	198.0	4.1	523.0	8.7	365.0
$SO_4^{=}$, mg/l	492.0	512.0	525.0	19.7	1425.0	36.0	950.0
Cl^{-}, mg/l	178.3	184.0	178.0	3.9	472.0	8.1	330.0

TABLE 33. SUMMARY OF OPERATION IN HAGERMAN

PRODUCTION	GALLONS	TDR, mg/l
RO	91,000	48
ED	152,000	98

RECOVERY RATIO $\left(\frac{\text{gal prod.}}{\text{gal feed}}\right) \times 100$

RO	63%
ED	78%

TDR REJECTION RATIO $\left(\frac{\text{in-out}}{\text{in}}\right) \times 100$

RO	96%
ED	90%

III. DISCUSSION OF RESULTS

A. Material Balances

Confirmation of the operation of a chemical process is obtained by making a "material" (mass) balance around the process, i.e. at steady state operation, in the absence of chemical reactions,

$$\text{Mass of species i which enters the system} = \text{Mass of species i which leaves the system}$$

For the demonstration van units this is the equivalent of a schematic as shown in Figure 10.

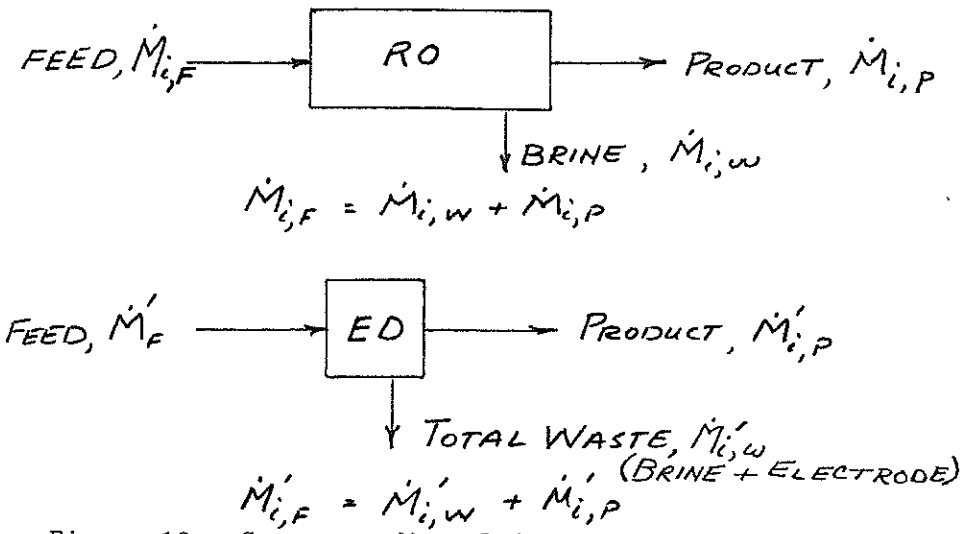


Figure 10. Component Mass Balance

Material balances do not necessarily describe the efficiency of an operation; however, they do confirm analytical and operating data. In those cases where the "efficiency" of operation is defined on a mass ratio, as in desalination, the mass balance must be 'closed' before an operator can evaluate system performance.

In the case of the demonstration unit, there is reasonable (written experimental errors) mass balance closure for the data from the reverse osmosis operation, as shown in Table 34. (references Table 32)

TABLE 34. MASS BALANCE RO - HAGERMAN

FLOW IN	2.7 gpm	PRODUCT OUT	1.7 gpm
Conc TDR	1220.0	Conc TDR	48.0
Conc Na	86.1	Conc Na	10.7
Conc SO_4	525.0	Conc SO_4	19.7

WASTE OUT	1.0 gpm
Conc TDR	3312.0
Conc Na	206.0
Conc SO_4	1425.0

TOTAL IN	mg/min	TOTAL OUT	mg/min
TDR	12.46		12.84
Na	0.88		0.85
SO_4	5.36		5.52

The concentrations used as input values are measured after the cartridge filters since pretreatment adds chemicals to the RO feed.

The material (mass) balances across the electrodialysis unit do not close. The operating flow variables for the unit are the dilute (product) flow and brine flow. As shown in Figure 11 there is an additional waste stream, e.g. electrode waste. This electrode waste stream is not measured and was not sampled. A further complication in establishing a closed material balance for the ED unit is that the model of operation is not "steady-state". Upon a reversal of the electrode polarity there is a finite period before the ion flux becomes constant. Unless samples were taken at the same time in the cycle each time sampling occurred, there should be a difference in the concentrations measured. The data support this.

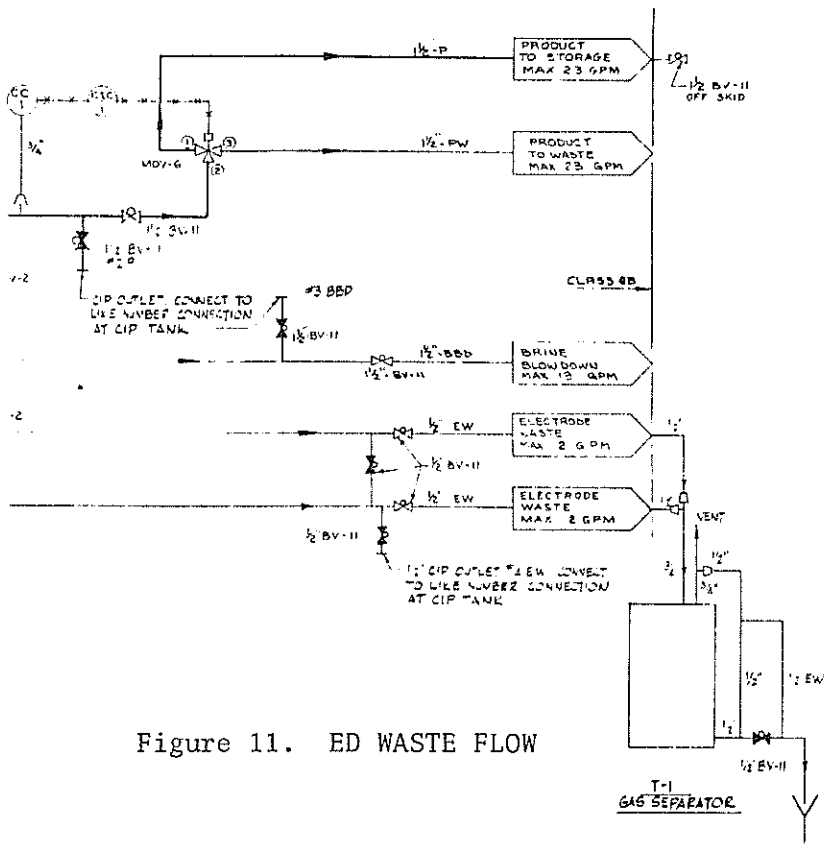


Figure 11. ED WASTE FLOW

Ref: Ionics, Inc. Aquamite V - MKII Flow Diagram (7-12-74 FM-1)

B. Operating Experience

1. Cuba, New Mexico: The problem at Cuba was control of iron and manganese. When the water-treating van was designed, Cuba had already been chosen as a location to demonstrate the selected desalination technology, with green-sand filters to control the iron-manganese. The results of the operation of these filters (which were regenerated using permanganate) was to effectively control iron; however, during the latter period (December) of operation the level of manganese in the product increased.

Spot samples showed that the level of manganese was increasing at the effluent of the green-sand filters. A more detailed analysis showed that the raw water pH had decreased (between November's samples and December's samples). This reduction in pH from 7 to 6 was stripping manganese from the filters. Stumm [5] has reported that manganese sorption is very sensitive to pH and that decreases in pH will result in losses of "bound" manganese into solution.

2. La Luz, New Mexico: The feed water at La Luz is characterized by a high level of sulfate (1004 mg/l). This, plus the problems of availability of feed water, e.g. the community supply was switched from well-water to lake water sometime between 6 and 10 p.m., required close control of the operation of the reverse osmosis system. As shown by the operating logs (Appendix B), pressure drop across the spiral-wound membranes reached 120 psi and subsequent removal and physical examination showed calcium sulfate scaling. The membranes were replaced.

3. Hagerman, New Mexico: One of the major frustrations encountered in moving from community to community was the connection of electrical power to the van terminal box. On many occasions extended delays resulted

between local idiosyncrasies (permits) and availability of required electricians. This problem would not exist in permanent installations and other than loss of operating time, only one serious equipment problem resulted.

A delay in available power and an extended cold period (4 days at -10^{o} F) resulted in freezing of the ED stack membranes and the lower RO modules. In addition, minor plastic piping (tubing) and fittings shattering occurred. With electric power connected the tubing was replaced and operation of the units was started. The RO membranes which had been frozen were replaced; however, the ED membranes recovered and have operated at a high performance (rejection ratio).

IV. REFERENCES

1. Folster, H. G., et. al, "Water Treatment for Small Public Supplies: Project Description Report", WRRI #095, Las Cruces, New Mexico, July 1978.

2. Barkley, W. A. and J. W. Hernandez, "Training Seminar on The National Safe Drinking Water Act,", College of Engineering, New Mexico State University, Las Cruces, New Mexico, July 1976.

3. Pierce, J., New Mexico Environmental Improvement Division, Water Quality Group, Santa Fe, New Mexico, private communication, April, 1979.

4. Newton, J. R., Roswell Test Facility OWRT, Dept. of Interior, private communication, July, 1977.

5. Stumm, W. and J. J. Morgan, Aquatic Chemistry, John Wiley & Sons, New York 1970.

APPENDIX A

Complete Water Analysis

Appendix A.

Location: CUBA, N.M.

Component	Sample Information: EID [a] Well #2	EID [b] Well #4	City [c] Oct. '77	Project [d] (3 samples)
Sodium	47.2		58.5	69.7
Potassium	2.9		3.5	3.4
Calcium	132.		115.	118.
Magnesium	27.1		30.2	44.6
Iron-Total	2.5	1.7	1.6	.43
Manganese	1.4	.1	1.5	1.3
Chloride	6.0		.24	.84
Fluoride	.2			-
Nitrate	7.0		<.05	.2
Bicarbonate	434.	277.	434.	477.
Carbonate	-		-	.0
Sulfate	184.	218.	151.	294.
Phosphate	-		<.01	<.05
Total Hardness	440.	355.	285.	470.
Alkalinity	356.	227.	356.	391.
Total Dissolved Residue	690.	580.	1290.	603.
Surfactants	. .02			
pH	7.7		7.2	6.5
Odor	Normal			
Color	Light yellow			
Turbidity	20.0			
Conductance Micromhos/cm 25 C	920.0	767.	723.	947.
Arsenic	<.05		.005	.004
Barium			.22	.24
Boron				.09
Cadmium	.005		<.004	.004
Chromium	<.002		<.06	<.02
Copper			<.02	<.01
Cyanide			-	-
Lead	<.050		.004	<.002
Mercury			<.0002	<.0002
Molybdenum				<.1
Nickel			<.03	<.03
Silver			<.01	<.01
Selenium	NONE		<.006	<.006
Zinc	<.03		.03	.03
Radium 226				
Strontium			.3	.35
~~Iron-Iron~~ SiO_2			28.2	26.7

Appendix A.

Location: CARR1ZOZO, N.M.

Component	Sample Information: EID[e] Well #1	EID[e] Well #2	PROJECT[f] (2 SAMPLES)	PROJECT[g] (1 SAMPLE)
Sodium	69.	66.7	104.	88.4
Potassium	2.3	1.9	2.4	2.7
Calcium	174.	157.	162.	164.
Magnesium	40.9	36.6	60.	35.2
Iron-Total	<.25	<.25	.09	<.02
Manganese		<.05	.03	<.01
Chloride	99.	88.6	105.	96.5
Fluoride	.16	.19	-	
Nitrate	4.5	4.4	8.8	10.5
Bicarbonate	153.	169.5	183.	187.
Carbonate	-	-	0.0	0.0
Sulfate	446.	409	492.	374.
Phosphate	-	-	<.05	<.05
Total Hardness	602.	542.	678.	690.
Alkalinity	125.	139.	150.	153.
Total Dissolved Residue	1040.	915.	835.	950.
Surfactants	<.05	<.05		
pH	7.8	7.8	6.6	6.5
Odor	NONE	NONE		
Color	NONE	NONE		
Turbidity	.3	.7		
Conductance Micromhos/cm 25 C	1322.	1232.	1320.	1490.
Arsenic	<.01	<.01	.012	.009
Barium			.35	.3
Boron			.17	0.0
Cadmium			.005	<.001
Chromium	.25		<.02	<.02
Copper			<.01	.04
Cyanide	.016	.01	-	-
Lead	.002	.0027	.004	<.0006
Mercury			<.0002	<.0002
Molybdenum			<.01	.07
Nickel			<.03	<.03
Silver	<.01	<.01	<.01	<.01
Selenium	.85	—	<.006	.006
Zinc			.2	.02
Radium 226				
Strontium			1.5	2.8
~~Gross Beta~~ SiO_2			18.4	21.5

Appendix A.

Location: LA Luz, N.M.

Component	Sample Information: EID e Well #1	Project b Well	Project c Surface	Project d (3 Samples)
Sodium	242.	275	160	309.
Potassium	1.9	2.9	1.2	2.2
Calcium	385.	259.	164	270.
Magnesium	82.4	111.	60.3	76.1
Iron-Total	1.2	<.02	<.02	<.02
Manganese	<.05	.02	.03	<.01
Chloride	347.	369.	173.	370.
Fluoride	.34			
Nitrate	2.5	4.8	2.7	4.4
Bicarbonate	243.	247.	387	240.
Carbonate	-	0.0	0.0	0.0
Sulfate	872.	941.	350.	1004
Phosphate	-	<.05	<.05	<.05
Total Hardness	1125.	1162.	695.	1147.
Alkalinity	200	202	318.	199.
Total Dissolved Residue	2235.	1730	990.	1994.
Surfactants	<.05			
pH	7.7	6.4	6.7	7.0
Odor	NONE			
Color	NONE			
Turbidity	4.3			
Conductance Micromhos/cm 25 C	2782.	2677	1540.	3260
Arsenic	<.01	.04	.01	.03
Barium		.6	.34	.7
Boron	<.25	.18	.16	<.05
Cadmium		.007	.01	<.001
Chromium		2.0	1.1	<.02
Copper		<.01	<.01	.05
Cyanide		-	-	-
Lead	<.01	<.002	<.002	<.001
Mercury	<.0005	<.0002	<.0002	<.0002
Molybdenum		<.01	<.01	<.01
Nickel		<.03	<.03	<.03
Silver		<.02	<.02	<.01
Selenium		<.006	<.006	.01
Zinc		<.003	.35	.009
Radium 226				
Strontium		2.0	<.01	2.5
~~Gross Beta~~ SiO_2				14.8

Appendix A.

Location: SAN JON, N.M.

Component	Sample Information k			
	EID Well #1	Project Well #1	EID Well #2	Project Well #2
Sodium	350.	412.	345.	414.
Potassium	.8	.8	.8	1.1
Calcium		14.	2.	11.
Magnesium	5.4	7.8	5.7	3.6
Iron-Total	<.25	<.02	<.25	<.02
Manganese	<.05	<.01	<.05	<.01
Chloride	40.9	41.	39.	34.
Fluoride	5.4	3.3	5.8	3.6
Nitrate	4.3	4.4		5.2
Bicarbonate	698.	651.	668.	610.
Carbonate	0.0	35.	22.	55.
Sulfate	162.	178.	114.	160.
Phosphate		<.05		.09
Total Hardness		60.	24.	20.
Alkalinity	571.	533.	584.	500.
Total Dissolved Residue	1335.	1170.	1210.	1130.
Surfactants	<.05		<.05	
pH	8.2	8.4	8.6	8.6
Odor				
Color				
Turbidity	.3		1.3	
Conductance Micromhos/cm 25 C	1505	1820	1466	1730
Arsenic		.03		.03
Barium		.05		.05
Boron		.44		.65
Cadmium		<.001		<.001
Chromium		<.02		<.02
Copper		<.02		<.02
Cyanide		—		—
Lead		.002		<.001
Mercury		<.0002		<.0002
Molybdenum		<.01		<.01
Nickel		<.02		<.02
Silver		<.01		<.01
Selenium		.011		.009
Zinc		<.004		.08
Radium 226				
Strontium		.06		.09
~~Gross Beta~~ SiO_2		17.0		10.5

Appendix A.

Location: SAN JON, N. M.

Component	Sample Information k			
	EID Well #4	Project Well #4	EID Well #6	Project Well #6
Sodium	442.	472.	437.	419.
Potassium	1.2	1.5	1.2	.9
Calcium	.8	8.	2.	17.
Magnesium	.7	1.2	1.5	10.2
Iron-Total	<.25	.5	<.25	<.02
Manganese	<.05	<.01	<.05	<.01
Chloride	95.	100.	100.	49.2
Fluoride	1.73	2.1	2.1	3.6
Nitrate	.2	4.5	.18	5.9
Bicarbonate	594.	509.	594.	607
Carbonate	64.3	123.	32.	39.
Sulfate	273.5	285.	263.5	204.
Phosphate		.2		<.05
Total Hardness	5.	0.0	11.	105.
Alkalinity	594.	418.	540.	498
Total Dissolved Residue	1562	1250	1515	1080.
Surfactants	<.05		<.05	
pH	9.1	9.5	8.8	8.8
Odor				
Color				
Turbidity	.4			
Conductance Micromhos/cm 25 C	2070	1960	1903	1690
Arsenic		.02		.02
Barium		.05		.05
Boron		.98		.64
Cadmium		<.001		<.001
Chromium		<.02		<.02
Copper		<.02		<.02
Cyanide		—		—
Lead		<.001		<.001
Mercury		<.0002		<.0002
Molybdenum		<.01		<.01
Nickel		<.02		<.02
Silver		<.01		<.01
Selenium		.011		.01
Zinc		.10		<.004
Radium 226				
Strontium		.11		.07
~~Gross Beta~~ SiO_2		16.5		17.5

Appendix A.

Location: SAN JON, N.M.

Component	Sample Information: EID Well #7	Project Well #7		Project AT VAN
Sodium	382.	448.5		420.
Potassium	.8	1.1		1.9
Calcium	9.6	17.		15.
Magnesium	7.8	10.8		7.6
Iron-Total	1.3	<.02		<.02
Manganese	<.05	<.01		<.01
Chloride	52.	34.4		61.
Fluoride	5.5	3.6		3.8
Nitrate	2.9	5.		11.
Bicarbonate	691.	672.		640.
Carbonate	27.8	49.2		46.
Sulfate	182.7	287.		197.
Phosphate		.09		<.05
Total Hardness	56	105		77.5
Alkalinity	613.	551.		524.
Total Dissolved Residue	1600.	1390.		1180.
Surfactants	<.05			
pH	8.7	8.4		8.6
Odor				
Color	5.			
Turbidity	2.2			
Conductance Micromhos/cm 25 C	1706	2180		1690.
Arsenic		.03		.02
Barium		.07		<.02
Boron		.76		<.05
Cadmium		<.001		<.001
Chromium		<.02		<.02
Copper		<.02		<.02
Cyanide		–		–
Lead		<.001		<.001
Mercury		<.0002		<.0002
Molybdenum		<.01		<.01
Nickel		<.02		<.02
Silver		<.01		<.01
Selenium		.02		<.01
Zinc		<.004		<.003
Radium 226				
Strontium		.08		<.01
~~Gross Beta~~ SiO_2		15.8		15.0

Appendix A.

Location: SAN YSIDRO, N.M.

Component	Sample Information: EID Well #1	Project	Project (Spot Check)
Sodium	177.	192.	
Potassium	20.3	22.	
Calcium	69.8	83.2	
Magnesium	20.3	15.8	
Iron-Total	<.25	<.02	
Manganese	<.05	<.01	
Chloride	117.	155.	140.
Fluoride	1.2	1.4	
Nitrate	<.1	.5	
Bicarbonate	515.6	525.	
Carbonate	NONE	0.0	
Sulfate	38.	84.	42.
Phosphate	-	<.05	.5
Total Hardness	257.5	315.	290.
Alkalinity	422.6	430.2	415.
Total Dissolved Residue	725.	1100.	
Surfactants	<.05		
pH	7.8	7.6	
Odor	NONE		
Color	NONE		
Turbidity	.03		
Conductance Micromhos/cm 25 C	1192.	1410.	1250.
Arsenic	.08	.05	
Barium	<.5	.32	
Boron	1.6	1.8	
Cadmium	<.01	<.001	
Chromium	<.01	<.02	
Copper	.15	.13	
Cyanide	-	-	
Lead	<.01	<.001	
Mercury	<.0005	<.0002	
Molybdenum	-	<.01	
Nickel	<.1	<.03	
Silver	<.05	<.01	
Selenium	<.01	.014	
Zinc	<.025	.4	
Radium 226			
Strontium		.4	
~~Gross Beta~~ SiO_2		18.8	

Appendix A.

Location: BLUEWATER, N.M.

Component	Sample Information PROJECT 2-28-78	EID 9-26-78	PROJECT 10-19-78	
Sodium	85.1		80.5	
Potassium	4.9		6.	
Calcium	174.		165.5	
Magnesium	43.8		44.8	
Iron-Total	<.02		<.1	
Manganese	<.01		<.05	
Chloride	48.3		52.5	
Fluoride	.43		.5	
Nitrate			7.04	
Bicarbonate	363		336.	
Carbonate	6.		0.	
Sulfate	346.		402.	
Phosphate	<.05		<.02	
Total Hardness	667.			
Alkalinity	298.			
Total Dissolved Residue	1070.		908	
Surfactants				
pH	8.5		7.5	
Odor			1.	
Color			<1	
Turbidity			.45	
Conductance Micromhos/cm 25 C	1360		1300	
Arsenic	.012		.02	
Barium	.24		<.4	
Boron	.004		.41	
Cadmium	<.001		<.005	
Chromium	<.02		<.05	
Copper	<.02		<.10	
Cyanide	—			
Lead	<.001		.008	
Mercury	<.0002		.0003	
Molybdenum	<.01		<.01	
Nickel	<.02		<.05	
Silver	<.01		<.05	
Selenium	.006		.009	
Zinc	<.004		.07	
~~Radium 226~~ Gross Alpha		<.5 pc/l		
Strontium	.93		1.3	
Gross Beta		<.5 pc/l		
SiO_2	18.		16.2	

Appendix A.

Location: MORIARTY, N. M.

Component	Sample Information PROJECT 3-13-78	PROJECT 11-1-78
Sodium	67.8	49.4
Potassium	2.8	2.9
Calcium	159.	170.1
Magnesium	36.3	41.8
Iron-Total	<.02	<.10
Manganese	<.01	<.05
Chloride	82.6	87.9
Fluoride	0.4	.4
Nitrate	5.	1.08
Bicarbonate	301.	257.
Carbonate	0.0	0.0
Sulfate	328.	383.
Phosphate	<.05	.01
Total Hardness	638.	
Alkalinity	247.	
Total Dissolved Residue	1000.	1004.
Surfactants		
pH	7.7	7.6
Odor		1
Color		1
Turbidity		.6
Conductance Micromhos/cm 25 C	1370.	1330.
Arsenic	.02	.002
Barium	.3	<.4
Boron	<.05	.01
Cadmium	<.001	<.005
Chromium	<.02	<.05
Copper	<.02	<.1
Cyanide	-	-
Lead	<.001	<.005
Mercury	<.0002	.0003
Molybdenum	<.1	<.01
Nickel	<.03	<.05
Silver	<.01	<.05
Selenium	<.005	.007
Zinc	.09	.08
Radium 226		
Strontium	.91	1.1
~~Gross Beta~~ SiO_2	26.0	26.5

Appendix A.

Location: HAGERMAN, N.M.

Component	Sample Information PROJECT 6-29-78		PROJECT 11-29-78	
Sodium	255.		85.2	
Potassium	4.5		2.1	
Calcium	167.		197.	
Magnesium	72.		65.	
Iron-Total	<.02		<.1	
Manganese	<.01		<.05	
Chloride	383.		178.3	
Fluoride	1.		1.3	
Nitrate	3.3		<.01	
Bicarbonate	299.		233.	
Carbonate	0.		0.	
Sulfate	509.		492.	
Phosphate	<.05		.02	
Total Hardness	1125.			
Alkalinity	245.			
Total Dissolved Residue	1950.		1280.	
Surfactants				
pH	7.		7.8	
Odor			1	
Color			<1	
Turbidity			.53	
Conductance Micromhos/cm 25 C	2630		1670	
Arsenic	.005		.002	
Barium	<.02		<.4	
Boron	<.05		.09	
Cadmium	<.001		<.005	
Chromium	<.03		<.05	
Copper	<.01		<.1	
Cyanide	–		–	
Lead	<.001		.005	
Mercury	<.0002		.0003	
Molybdenum	<.1		<.01	
Nickel	<.03		<.05	
Silver	<.01		<.05	
Selenium	<.006		.003	
Zinc	<.003		.05	
Radium 226				
Strontium	2.3		2.1	
~~Gross Beta~~ SiO_2	31.		18.	

Appendix A

a. Cuba — East Well (Well #2)
Ref. — State of New Mexico, Water Quality Survey, 1972

b. Cuba — Well #4
Ref. — EIA Laboratory Code #67201 July 11 '75
Collected 6/11/75

c. Cuba — City Water Oct. 25, 1977
Ref. — Analyzed by Project Technician

d. Cuba — Raw Well Water at inlet to van
Sampled 11/22/77
11/28/77
12/05/77
Ref. — Analyzed by Project Technician

e. Carrizozo
Ref. — State of New Mexico

f. Carrizozo — Raw water at inlet to van
Sampled 11/29/77
Ref. — Project Technician

g. Carrizozo — Raw water at inlet to van
Sampled 2/03/78
Ref. — Project Technician

h. La Luz — Sample at Well 11/29/77
Ref. — Project Technician

i. La Luz — Sampled from Lake 11/29/77
Ref. — Project Technician

j. La Luz — Sampled at inlet to Van
3/13/78
4/12/78
4/17/78
Ref. — Project Technician

k. San Jon
1. Well #1 EID; Sampled 3/8/77
Sample Analysis 3/09/77 2038-64201
2. Well #1 Project; Sampled 2/28/78
Project Technician
3. Well #2 EID; Sampled 4/19/77
Sample Analysis 4/20/77 2570-64201
4. Well #2 Project; Sampled 2/28/78
Project Technician
5. Well #4 EID; Sampled 3/8/77
Sample Anaylsis 3/9/77 2032-64201
6. Well #4 Project; Sampled 2/28/78
Project Technician
7. Well #6 EID; Sampled 3/08/77
Sample Analysis 3/09/77 2034-64201
8. Well #6 Project; Sampled 3/8/77
Project Technician

9. Well #7 EID; ampled 3/08/77
   Sample Analysis 3/9/77 2036-64201
10. Well #7 Project; Sampled 2/28/78
    Project Technician
11. Project Feed (at Van) 6/02/78
    Project Technician

l. San Ysidro

1. Project Sampled 3/13/78
   Project Technician
2. Project Spot Check 8/24/78
   Project Technician

m. Bluewater

1. Project 2/28/78
   Analyzed by Project Technician
2. EID 9/26/78
   Analyzed by EID 9/29/78 RC-437 53-310
3. Project 10/19/78
   Analyzed by Dept. of Agronomy Water Lab 11/29/78

n. Moriarty

1. Project 3/13/78
   Analyzed by Project technician
2. Project 11/01/78
   Analyzed by Dept. of Agromony Water Lab 11/30/78

o. Hagerman

1. Project 6/29/78
   Analyzed by Project Technician
2. Project 11/29.78
   Analyzed by Dept. of Agronomy Water Lab 12/13/78

APPENDIX B

Operating Log Sheets and Product Quality Analysis

Appendix B.

Location: CUBA, N.M.

Component	Sample Information: RO PRODUCT (NOV)	RO CONC (NOV)	ED PRODUCT (NOV)	ED CONC (NOV)
Sodium	9.9	112.	77.	104.
Potassium	.35	6.2	2.2	4.
Calcium	3.8	163.	47.1	330.
Magnesium	1.9	74.5	24.5	135.
Iron-Total	<.02	.7	<.02	<.15
Manganese	.04	.9	.5	1.8
Chloride	.8	.8	1.9	2.7
Fluoride	.1	<.2	.2	.3
Nitrate	<.05	<.05	<.05	<.05
Bicarbonate	18.3	189.1	50.2	125.
Carbonate	0.0	0.0	0.0	0.0
Sulfate				
Phosphate	<.05	<.05	<.05	<.05
Total Hardness	12.	685.	256.	511.
Alkalinity				
Total Dissolved Residue	25.	820.	380.	1300.
Surfactants				
pH	7.8	6.6	6.7	6.4
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C	62.	1267	560.	2225.
Arsenic	.006	.01	.008	.03
Barium	<.02	.03	.09	.78
Boron	.16	.12	.15	.16
Cadmium	.005	.005	.089	.06
Chromium	<.02	<.02	<.02	<.02
Copper	<.01	<.01	<.01	<.01
Cyanide	–	–	–	–
Lead	<.002	.004	.004	.04
Mercury	.0003	.0014	.0005	.001
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.03	<.03	<.03	<.03
Silver	<.01	<.01	<.01	<.01
Selenium	<.006	<.006	<.006	<.006
Zinc	<.003	<.003	<.003	<.003
Radium 226				
Strontium	<.005	.09	.1	1.25
~~Cross Beta~~ SiO_2	3.1	35.7	18.2	37.3

Appendix B.

Location: CUBA, N.M.

Component	Sample Information: RO Product (Dec)	RO Conc. (Dec)	ED Product (Dec)	ED Conc. (Dec)
Sodium	15.8	131.	70.	115.
Potassium	.8	7.6	2.5	7.
Calcium	4.9	265.	65.5	307.
Magnesium	2.6	68.	28.4	100.
Iron-Total	<.02	.17	.02	.3
Manganese	.22	3.7	1.22	4.1
Chloride	.01	.09	.06	.06
Fluoride	<.2	<.2	<.2	<.2
Nitrate	<.05	<.05	<.05	<.05
Bicarbonate	16.5		40.	85.4
Carbonate	0.0	0.0	0.0	0.0
Sulfate				
Phosphate	<.05	<.05	<.05	<.05
Total Hardness	24.	960.	270.	1300.
Alkalinity				
Total Dissolved Residue	72.	1010.	456.	1480.
Surfactants				
pH	6.	4.2	6.1	6.
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C	110.	2050.	916.	2330.
Arsenic	.008	.035	.005	.03
Barium	<.03	1.	.1	1.1
Boron	.04	.08	.08	.1
Cadmium	<.001	<.001	<.001	<.001
Chromium	<.02	<.02	<.02	<.02
Copper	<.01	<.01	<.01	<.01
Cyanide	–	–	–	–
Lead	<.002	<.002	<.002	.04
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.10	<.10	<.10	<.1
Nickel	<.03	<.03	<.03	<.03
Silver	<.01	<.01	<.01	<.01
Selenium	<.006	.008	<.006	.006
Zinc	.01	.3	.08	.35
Radium 226				
Strontium	.012	.86	.19	1.
~~Gross Beta~~ SiO_2	5.8	53.	27.	34.

APPENDIX B

LOCATION: CUBA, N.M.

METER READING AT:

REVERSE OSMOSIS

DATE		11-21	11-28	11-28	11-28	11-28	11-29	11-29	11-30	12-2	12-2
TIME		9pm	9:30	11:00	1:45	4:00	10:30	5:00	10:30	2:00	3:15
FEED SALINITY											
FEED CONDUCTIVITY		1100	1040	1070	1100	1150	1100	1070	1070	1060	1070
PRODUCT CONDUCTIVITY		45	53	66	57	55	52	63	152	120	210
PRODUCT FLOW (gpm)		2.7	2.0	2.7	3.1	3.15	3.15	3.	2.8	2.35	2.3
CONCENTRATE FLOW (gpm)		4.5	5.5	4.6	4.9	4.9	4.95	4.9	4.6	4.6	4.6
RECYCLE FLOW (gpm)		3.0	–	–	2.4	2.45	2.45	2.5	3.0	3.0	3.1
FEED TEMPERATURE (°F)		56	56	56	56	56	56	56	56	56	56
ΔP ACROSS	HFF	–									
MEMBRANES	SW	330-280 50	20	40	30	30	32	30	65	58	55
ΔP ACROSS C. FILTERS		33-31 2	2	2	2	2	2	2	3	2	2
FEED PRESSURE		33	27		35	35	30	32	30	30	30
INLET pH		5.6	-	-	-						
PRODUCT pH		5.9	-	-	-						
ΔP ACROSS $KMnO_4$ FILTERS		0	4		2	3	7	7	4	6	6
ΔP ACROSS SAND TRAP		7	16		11	11	16	21	15	16	16
PUMP PRESSURE	HFF										
	SW	410	452	412	410	410	420	415	410	420	420
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

11-21 3 BANKS ON LINE - 14 HRS ; FEED pH probe measuring cell broken

11-28 3 BANKS ON LINE, ROGA 1&2 ; ENRO 1

11-29 Flushed Media Filters ; ROGA #1

11-30 Flushed Media Filters

12-2 Electrical problems at well ; Flushed media filters

APPENDIX B

LOCATION: CUBA, N. M. METER READING AT:

REVERSE OSMOSIS

DATE	12-5	12-5	12-6	12-7	12-7	12-8	12-8	12-12	12-14	
TIME	10:15	4:15	2:00	10:00	4:00				10:15	
FEED SALINITY										
FEED CONDUCTIVITY	1020	1080	1090	1070	1040	1100	1350	1575		
PRODUCT CONDUCTIVITY	290	120	72	107	67	65	66	125		
PRODUCT FLOW (gpm)	2.6	2.6	2.75	3.05	3.0	3.0	3.0	4.6	3.75	
CONCENTRATE FLOW (gpm)	4.1	3.75	3.75	3.6	3.6	3.6	3.55	4.15	1.45	
RECYCLE FLOW (gpm)	2.9	3.0	2.95	2.95	2.95	2.95	2.9	2.85	1.90	
FEED TEMPERATURE (°F)	57	56	56	56	56	56	56	56	56	
ΔP ACROSS HFF										
MEMBRANES SW	50	43	40	40	43	40	40	20	45	
ΔP ACROSS C. FILTERS	2	2	5	2	3	3	4	2	2	
FEED PRESSURE	32	32	31	30	30	30	30	32	30	
INLET pH										
PRODUCT pH										
ΔP ACROSS $KMnO_4$ FILTERS	2	1	5	7	5	6	FLUSH	2	2	
ΔP ACROSS SAND TRAP	6	6	16	18	18	19	28	9	17	
PUMP PRESSURE HFF										
SW	420	422	415	420	415	415	420	415	410	
TURBIDITY										
PRODUCT SALINITY										

COMMENTS:

12-5 Backwashed Media Filters

12-7 Washed & rinsed Media Filters

12-8 $KMnO_4$ recharge to Media Filters

12-14 Flushed membranes at 100 psi with Citric acid and Formaldehyde System closed in.

APPENDIX B

LOCATION: CUBA, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		11-29	11-29	11-30	12-2	12-2	12-6	12-6	12-7	12-7	12-7
TIME		3:00	5:00	10:30	2:00	3:15	10:45	2:00	10:00	2:30	4:00
POLARITY		−	+	+	−	+	+	−	+	−	+
FEED SALINITY (ppm)		750									
PRODUCT SALINITY (ppm)		430									
PRODUCT CONDUCTIVITY		510	500	510	550	460	625	575	390	370	500
DILUTE FLOW (gpm)		5.0	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.1	5.1
BRINE FLOW (gpm)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FEED TEMPERATURE (°F)		60	60	58	54	58	58	60	58	61	61
PRESSURES	STACK INLET	44	46.5	44	44.5	46	46	44	45.5	44	45
	STACK OUTLET	2	4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	38	40	32	38	38	40	35	52	42	50
	DIFFERENTIAL OUT	0	1.5	6	2	6	3	2	9	5	6
	BEFORE FILTER	68	68	69	74	72	75	73	75	74	74
	AFTER FILTER	67	67	69	74	71	74	72	74	73	73
	AFTER PRV	53	53	53.5	54	54	54	54	54	54	54
	ELECTRODE INLET	36	41	42	36	42	41	42	42	43	42
STAGE ONE	VOLTS	28	26	29	27	28	26	26	26	26	26
	AMPS	1.9	1.7	1.9	1.6	1.8	1.7	1.8	1.7	1.7	1.7
STAGE TWO	VOLTS	28	26	29	27	28	26	26	26	26	26
	AMPS	1.6	1.5	1.6	1.4	1.6	1.5	1.6	1.5	1.5	1.5

COMMENTS:

12-2 E.D. left on over weekend with no chemical addition to feed tank

12-6 E.D. feed pump off over weekend - Motor starter tripped (gray box)

12-7 Changed out cartridge filter at ΔP = 8psi

APPENDIX B
LOCATION: CUBA, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		12-8	12-13	12-14	12-14						
TIME		10:00	2:30	10:15	5:00						
POLARITY		-	+	-	+						
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		600	700	600	700						
DILUTE FLOW (gpm)		5.1	5.0	5.0	5.0						
BRINE FLOW (gpm)		1.0	1.0	1.0	1.0						
FEED TEMPERATURE (°F)		58	60	58	60						
PRESSURES	STACK INLET	43	45	43	45						
	STACK OUTLET	1.5	1.5	1.5	1.5						
	DIFFERENTIAL IN	46	52	56	60						
	DIFFERENTIAL OUT	5	6	5	6						
	BEFORE FILTER	72	69	70	70						
	AFTER FILTER	71	68	69	69						
	AFTER PRV	53.5	53	53.5	53.5						
	ELECTRODE INLET	35	41	41.5	41.5						
STAGE ONE	VOLTS	26	26	26	26						
	AMPS	1.5	2.1	1.5	2.2						
STAGE TWO	VOLTS	26	26	26	26						
	AMPS	1.5	1.8	1.4	2.0						

COMMENTS:

12-9 E.D. flushed with filtered water (1hr.)
12-15 CIP at 33psi from 8:55 to 9:10
CIP at 45psi from 9:10 to 9:25

Appendix B

Location: CARRIZOZO, N.M.

Component	Sample Information: RO Product	RO Conc.	ED Product	ED Conc.
Sodium	11.3	177.	36.4	160.
Potassium	.3	6.3	.7	5.6
Calcium	7.4	608.	32.6	534.
Magnesium	1.6	114.	7.7	104.
Iron-Total	<.02	.3	<.02	<.02
Manganese	<.01	<.01	<.01	<.01
Chloride	29.3	92.	26.4	290.
Fluoride	<.2	.4	<.2	<.2
Nitrate	9.4	20.8	4.8	40.3
Bicarbonate			78.7	368.
Carbonate	0.0	0.0	0.0	0.0
Sulfate	49.	3740	91.2	1588.
Phosphate	<.05	<.05	<.05	<.05
Total Hardness	37.5	2207.	137.5	1942.
Alkalinity				
Total Dissolved Residue	120.	3276.	230.	2930.
Surfactants				
pH	3.6	2.1	5.9	6.2
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C			380.	3680.
Arsenic	.004	.08	.005	.03
Barium	.03	.9	.07	.85
Boron	.03	.02	.02	.02
Cadmium	.002	.006	.001	.002
Chromium	<.02	<.02	<.02	<.02
Copper	.08	1.8	<.02	.06
Cyanide	—	—	—	—
Lead	<.001	.006	<.001	<.002
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.02	<.02	<.02	<.02
Silver	<.01	<.01	<.01	<.01
Selenium	.006	.012	<.006	.009
Zinc	.004	.05	<.004	.03
Radium 226				
Strontium	.04	.4	.16	.37
~~Gross Beta~~ SiO_2	5.2	75.6	24.5	43.2

Appendix B

Location: CARRIZOZO, N.M.

Component	Sample Information			
	RO PRODUCT	RO CONC.	ED PRODUCT	ED CONC.
Sodium	13.4	151.	34.4	164.
Potassium	.4	5.3	.6	5.9
Calcium	8.9	406.	24.7	505.
Magnesium	1.4	86.1	5.1	100.
Iron-Total	<.02	.01	<.02	.05
Manganese	<.01	<.01	<.01	.02
Chloride	17.5	213.	20.2	270.
Fluoride	<.2	<.2	<.2	.3
Nitrate	5.1	93.	2.1	86.
Bicarbonate			73.2	345.
Carbonate	0.0	0.0	0.0	0.0
Sulfate	41.3	1540.	53.8	1219.
Phosphate	<.05	<.05	<.05	<.05
Total Hardness	25.	1515.	95.	1740.
Alkalinity				
Total Dissolved Residue	140.	2590.	190.	2415.
Surfactants				
pH	5.8	4.5	6.5	6.5
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C	220.	4040.	304	3770
Arsenic	.001	.02	.003	.2
Barium	<.02		.03	1.
Boron	.0	.0	.0	.0
Cadmium	.007	.006	.001	.004
Chromium	<.02	<.02	<.02	<.02
Copper	.06	.2	<.02	<.02
Cyanide	—	—	—	—
Lead	<.006	<.006	<.006	<.006
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.01	.01	<.01	<.01
Nickel	<.03	<.03	<.03	<.03
Silver	<.01	<.01	<.01	<.01
Selenium	<.006	.009	<.006	.2
Zinc	.06	.3	.02	.02
Radium 226				
Strontium	.15	5.7	.21	6.8
~~Grace Beta~~ SiO_2	4.8	53.8	21.5	30.3

APPENDIX B

LOCATION: CARRIZOZO, N.M. METER READING AT:

REVERSE OSMOSIS

DATE	1-18	1-23	1-24	1-24	1-25	1-29	1-31	2-3	2-6	2-7
TIME	6:00	11:15	11:15	4:25	8:10	4:00	8:30		9:35	9:05
FEED SALINITY										
FEED CONDUCTIVITY	4000	3800	3600	3800	3500	1550	3200	1390	3300	3300
PRODUCT CONDUCTIVITY	900	850	630	640	500	270	650	107	380	380
PRODUCT FLOW (gpm)	3.6	2.5	3.5	2.75	2.8	3.05	2.95	2.95	2.95	2.95
CONCENTRATE FLOW (gpm)	3.9	4.2	4.3	2.9	2.85	2.7	2.75	2.45	2.25	2.25
RECYCLE FLOW (gpm)		4.1	-	-	-	-	-	-	-	-
FEED TEMPERATURE (°F)	61	58	58	58	63	67	62		65	65
ΔP ACROSS HFF										
MEMBRANES SW	70	40	40	160	160	158	178	165	150	153
ΔP ACROSS C. FILTERS	2	2	1	2	2	2	2	2	2	2
FEED PRESSURE	30	32	31	32	33	33	34	31	32	32
INLET pH					-				3	3
PRODUCT pH		5.5			-				5	5
ΔP ACROSS $KMnO_4$ FILTERS	4	-	1	1	1	0	0	1	2	1
ΔP ACROSS SAND TRAP	0	6	3	4	4	4	1	4	2	4
PUMP PRESSURE HFF										
SW	440	440	440	468	468	460	470	452	460	458
TURBIDITY										
PRODUCT SALINITY										

COMMENTS:

1-17 Flushpump line broke at start-up; RO recycle line leaks

1-23 ROSA 142 online only; HFF (DuPont) started - system leaks

Pump runs backward; reverse motor leads

APPENDIX B

LOCATION: CARRIZOZO, N.M. METER READING AT:

REVERSE OSMOSIS

DATE		2-9	2-10	2-16	2-17	2-18	2-21	2-23			
TIME		1:25		11:48	10:25	1:15	10:44				
FEED SALINITY											
FEED CONDUCTIVITY		3300	1510	1500	3200	3000	1500	3400			
PRODUCT CONDUCTIVITY		380	280	104	350	590	137	440			
PRODUCT FLOW (gpm)		2.75	3.0	3.45	3.45	3.45	3.35	3.3			
CONCENTRATE FLOW (gpm)		2.25	1.95	1.8	1.8	1.5	1.45	1.4			
RECYCLE FLOW (gpm)		-	-	-		-	-	-			
FEED TEMPERATURE (°F)		65	65	63	63	58	65	65			
ΔP ACROSS	HFF										
MEMBRANES	SW	150	48	47	47	42	45	45			
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2			
FEED PRESSURE		32	32	33	33	30	30	30			
INLET pH		3	6	6	5.	6.	6.4	4.5			
PRODUCT pH		5	6	6			6.8	5.0			
ΔP ACROSS $KMnO_4$ FILTERS		2	1	1	1	0	1	1			
ΔP ACROSS SAND TRAP		2	4	4	4	2	3	3			
PUMP PRESSURE	HFF										
	SW	460	450	450	450	460	460	460			
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

2-16 R.O. Feed pump replaced gasket

2-23 System flush per shutdown procedure

APPENDIX B

LOCATION: CARRIZOZO, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		1-17	1-18	1-20	1-23	1-23	1-24	1-24	1-25	1-29	1-31
TIME		7:25	5:00	12:00	9:15	4:00	8:50	4:45	8:15	4:00	8:30
POLARITY		−	−	−	+	−	−	+	+	−	+
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		390	340	360	350	350	380	390	380	375	260
DILUTE FLOW (gpm)		5.0	5.0	5.1	5.1	5.3	5.3	5.3	5.3	5.2	5.3
BRINE FLOW (gpm)		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.25
FEED TEMPERATURE (°F)		61	61	59	62	62	62	60	62	64	62
PRESSURES	STACK INLET	46	45.5	47	48	47	48	48	50	48	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	36	33	40	46	43	50	45	52	40	52
	DIFFERENTIAL OUT	4	3	2	2.	2	3	1	1.0	1	2
	BEFORE FILTER	79	79	82	68	68	71	70	72	69	73
	AFTER FILTER	78	78	81	67	67	70	69	71	68	72
	AFTER PRV	54.5	54.5	55	53	53	54	53.5	54	53.5	54
	ELECTRODE INLET	47	41	47.5	47.5	48.5	48.5	48.	48	48.5	48
STAGE ONE	VOLTS	70	70	70	72	71	70	71	71	70	71
	AMPS	5.5	5.8	5.4	6.0	5.8	5.7	5.6	5.9	5.7	4.8
STAGE TWO	VOLTS	41	41	41	42	41	41	42	42	41	42
	AMPS	2.1	2.1	2.0	2.1	2.1	2.2	2.2	2.2	2.1	1.6

COMMENTS:

APPENDIX B

LOCATION: CARRIZOZO, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		2-3	2-6	2-7	2-9	2-10	2-16	2-17	2-18	2-21	2-23
TIME		2:15	9:35	9:05	1:30	8:45	11:45	10:25	1:15	10:42	2:55
POLARITY		-	+	-	+	-	-	+	-	-	-
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		330	340	330	320	350	380		350	390	360
DILUTE FLOW (gpm)		5.5	5.4	5.3	5.0	5.1	5.2	5.2	5.1	5.2	5.3
BRINE FLOW (gpm)		1.5	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4
FEED TEMPERATURE (°F)		64	63	60	60		59	58	62	60	63
PRESSURES	STACK INLET	50	48	49.5	49.5	48.5	49.5	51	50	50	49
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	49	56	40	40	38	38	48	40	40	44
	DIFFERENTIAL OUT	1	2	2	4	1	3	1	2	2	2
	BEFORE FILTER	69	64	78	67	67	77	78	78	77	75
	AFTER FILTER	68	63	77	66	66	76	77	77	76	74
	AFTER PRV	54	53	54.5	53.5	53	54.5	54.5	54.5	54.5	54
	ELECTRODE INLET	49	48.5	50	48	49	50	49.5	50	50	50
STAGE ONE	VOLTS	71	71	71	71	70	71	71	71	71	71
	AMPS	5.4	5.9	5.5	5.5	5.5	5.4	5.3	5.8	5.5	5.7
STAGE TWO	VOLTS	42	42	42	42	42	42	42	42	42	42
	AMPS	1.8	2.2	2.1	2.0	2.0	2.1	2.1	2.1	2.2	2.1

COMMENTS:

2-25 C.I.P @ 6pm

Appendix B.

Location: LA Luz, N.M.

Component	Sample Information: RO Product	RO Conc.	ED Product	ED Conc
Sodium	57.	519	130.	590.
Potassium	.3	5.5	.5	6.1
Calcium	4.	604	42.	745.
Magnesium	1.1	133.	13.6	149.
Iron-Total	<.02	.7	<.02	<.02
Manganese	<.01	<.01	<.01	<.01
Chloride	19.4	882.	76.5	1133.
Fluoride	.3	.5	.2	.5
Nitrate	.3	7.2	.8	12.6
Bicarbonate	33.	62.	140.	500.
Carbonate	0.	0.	0.	0.
Sulfate	23.	2496.	280.	2600.
Phosphate	<.05	<.05	<.05	<.05
Total Hardness	140.	3187.	360.	3350.
Alkalinity	27.			
Total Dissolved Residue	130.	4700.	520.	4690.
Surfactants				
pH	5.9	5.4	6.8	7.1
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C	185.	6850.	830.	8500.
Arsenic	.001	.07	.005	.1
Barium	.0		.04	2.
Boron	<.05	<.05	<.05	<.05
Cadmium	<.001	<.001	<.001	<.001
Chromium	<.02	<.02	<.02	<.02
Copper	.06	.5	.04	.08
Cyanide	—	—	—	—
Lead	<.002	<.002	<.002	<.002
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.1	<.1	<.1	<.1
Nickel	<.02	<.02	<.02	<.02
Silver	<.01	<.01	<.01	<.01
Selenium	.001	.03	.002	.01
Zinc	.0		.008	.06
Radium 226				
Strontium	.02	1.6	.41	1.9
~~Gross Beta~~ SiO_2	2.6	41.4	15.2	18.

APPENDIX B

LOCATION: LA Luz, N.M.

METER READING AT:

REVERSE OSMOSIS

DATE		3-13	3-13	3-14	3-15	3-17	3-17	3-18	3-19	3-20	3-21
TIME		2:30	4:07	2:55	9:00	3:25	4:15	2:00	8:10	8:30	8:50
FEED SALINITY											
FEED CONDUCTIVITY		1600	4000	3200	2200	4000	4000	4000	2300	3900	2600
PRODUCT CONDUCTIVITY		510	240	165/800	147/550	1560	300	220/800	140/490	146	73/90
PRODUCT FLOW (gpm)		3.9	2.7	2.7/3.6	2.5/8.75	3.65	2.8	2.35/3.95	2.3/3.45	2.0	1.7/3.0
CONCENTRATE FLOW (gpm)		3.9	2.6	2.65/2.15	1.4/1.5	1.0	1.0	1.0/.85	1.0/0.95	1.0	.95/.8
RECYCLE FLOW (gpm)		-	-	-			-				
FEED TEMPERATURE (°F)		60	60	60	58	66	66	66	70	68	61
ΔP ACROSS	HFF		22	12	5		10	5	5	5	10
MEMBRANES	SW	50		30	30	30		30	30		30
ΔP ACROSS C. FILTERS		2	2	2	2	1	2	2	2	1	2
FEED PRESSURE		28	27	27	28	28	30	30	30	28	29
INLET pH		5.5	4.5	4.8	6.0	4.0	4.0	4.0	5.0	4.5	4.8
PRODUCT pH											
ΔP ACROSS $KMnO_4$ FILTERS		2	2	2		0	0	0	1	1	1
ΔP ACROSS SAND TRAP		4	4	4		4	4	3	4	4	4
PUMP PRESSURE	HFF		480	495	500		510	500	505	500	500
	SW	402		430	440	450		450	450		450
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

3-17 Raw water feed limited, only running one RO system at a time

APPENDIX B

LOCATION: LA LUZ, N.M.

METER READING AT:

REVERSE OSMOSIS

DATE		3-22	3-23	3-27	3-28	3-29	3-30	3-31	4-10	4-11	4-12
TIME		12:30	9:00	1:15	3:20	9:50	3:15	9:00	4:55	2:10	
FEED SALINITY											
FEED CONDUCTIVITY		2600	4000	3800	3900	2400	3900	3900	2000	3000	3000
PRODUCT CONDUCTIVITY		600	156	185/280	142	64/130	1050	132		320	250/1200
PRODUCT FLOW (gpm)		2.7	2.0	1.6/2.1	2.0	1.75/2.4	2.25	1.9	2.2/1.75	2.1	2.0/2.45
CONCENTRATE FLOW (gpm)		.95	.95	1.0/.8	.8	.8/.85	.9	.75	.9/.8	.8	.8/.8
RECYCLE FLOW (gpm)						-					
FEED TEMPERATURE (°F)		65	61	63	62	63	69	62	60	60	
ΔP ACROSS	HFF		10	10	10	10		7	10	5	5
MEMBRANES	SW	120		70		105	20		25		30
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		30	29	30	30	30	30	28	35	35	35
INLET pH		6.4	4.3	4.5	4.2	5.0	3.8	4.2	5.5	5.5	6.5
PRODUCT pH		-		4.2	-				5.0		
ΔP ACROSS $KMnO_4$ FILTERS		0	1	0	0	0	0	0	0	0	0
ΔP ACROSS SAND TRAP		3	5	3	4	4	4	5	2	2	1
PUMP PRESSURE	HFF		500	500	500	500		500	510	505	510
	SW	460		480		480	470		450		470
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

4-3 RO Feed pump gasket replaced

4-10 Continuing difficulty with RO system

APPENDIX B

LOCATION: LA LUZ, N.M.

METER READING AT:

. REVERSE OSMOSIS

DATE		4-14	4-14	4-20	4-21						
TIME		8:45	10:00		10:30						
FEED SALINITY											
FEED CONDUCTIVITY		2500	2800	3600	3000						
PRODUCT CONDUCTIVITY		73	940	1110	150/700						
PRODUCT FLOW (gpm)		1.8	2.3	1.7	1.8/1.2						
CONCENTRATE FLOW (gpm)		.8	.75	.7	.8/.6						
RECYCLE FLOW (gpm)											
FEED TEMPERATURE (°F)		60	60	71	71						
ΔP ACROSS	HFF	5			5						
MEMBRANES	SW		20	20	15						
ΔP ACROSS C. FILTERS		2	2	2	2						
FEED PRESSURE		36	36	36	35						
INLET pH		4.8	4.8	3.8	3.8						
PRODUCT pH											
ΔP ACROSS $KMnO_4$ FILTERS		0	0	0	1						
ΔP ACROSS SAND TRAP		3	4	3	4						
PUMP PRESSURE	HFF	505			505						
	SW		460	480	500						
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

4-14 R.O. flushed

4-21 Spiral wound RO Modules disassembled; completely scaled over ($CuSO_4$)

APPENDIX B

LOCATION: LA Luz, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		3-14	3-15	3-17	3-18	3-19	3-20	3-21	3-22	3-23	3-27
TIME		3:00		3:30	2:00	8:15	8:30	9:50	12:30	10:45	1:55
POLARITY		−	+	−	−	+	−	+	+	+	−
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		800	750	900	850	700	850	840	825	790	700
DILUTE FLOW (gpm)		5.0	4.75	5.0	5.3	5.1	5.3	5.2	5.1	5.0	5.0
BRINE FLOW (gpm)		1.5	1.3	1.5	1.5	1.4	1.3	1.3	1.4	1.3	1.5
FEED TEMPERATURE (°F)		60	70	66	67	60	61	62	65	62	62
PRESSURES	STACK INLET	47	49	50	49.5	51	50	51	50	50	50
	STACK OUTLET	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	24	33	38	37	34	32	42	42	38	26
	DIFFERENTIAL OUT	16	-10	16	16		16	-8	-8	-7	6
	BEFORE FILTER	58	60	82	79	64	82	80	79	74	79
	AFTER FILTER	57	59	81	78	63	81	79	78	73	78
	AFTER PRV	52	52.5	55	55	52	55	54.5	54	54	54
	ELECTRODE INLET	49	50	52	52	50	52	52	52	52	52
STAGE ONE	VOLTS	87	88	87	87	88	86	88	87	88	75
	AMPS	11.9	12.	12.2	12.3	11.9	12.0	11.1	12.2	12.2	10.8
STAGE TWO	VOLTS	40	42	41	40	42	40	41	42	42	58
	AMPS	3.6	3.7	3.8	3.9	3.7	3.7	4.0	3.9	3.8	5.5

COMMENTS:

3-23 E.D. Switched rectifier to med. from low to raise Volts & Amps to 2nd Stage

APPENDIX B

LOCATION: LA LUZ, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		3-28	3-29	3-30	3-31	4-3	4-4	4-7	4-10	4-11	4-12
TIME		3:15	10:05	3:30	9:10	4:00	4:50	4:40	4:50	2:10	11:35
POLARITY		—	—	+	—	+	+	+	—	—	—
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		700	285	650	700	650	720	780	710	700	720
DILUTE FLOW (gpm)		5.2	5.1	5.0	5.0	5.1	5.1	5.3	5.1	5.1	5.0
BRINE FLOW (gpm)		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5	1.5
FEED TEMPERATURE (°F)		62	58	64	62	63	62	62	62	62	79
PRESSURES	STACK INLET	51	50	50	49	49	50	51	49	49	48
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	34	42	38	32	34	42	48	34	38	34
	DIFFERENTIAL OUT	7	8	0	8	-8	-4	-2	2	3	1
	BEFORE FILTER	80	86	64	67	71	67	84	67	70	62
	AFTER FILTER	79	85	63	66	70	66	82	66	69	61
	AFTER PRV	54.5	55	53	53	53	53	55	53	53	52.5
	ELECTRODE INLET	52	53	50	51	50	51	53	51	51	51
STAGE ONE	VOLTS	76	75	76	75	77	76	76	75	75	76
	AMPS	10.9	6.3	10.7	9.7	10.3	10.7	10.6	10.6	9.8	10.7
STAGE TWO	VOLTS	59	58	59	58	60	59	59	58	57	58
	AMPS	5.7	2.8	5.4	5.6	5.7	5.6	5.8	5.5	5.8	5.3

COMMENTS:

3-29 Feed surface water (Fresnel Pioeing)

APPENDIX B

LOCATION: LA LUZ, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		4-14	4-21								
TIME		9:00	10:30								
POLARITY		+	+								
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		700	750								
DILUTE FLOW (gpm)		5.0	5.2								
BRINE FLOW (gpm)		1.5	1.5								
FEED TEMPERATURE (°F)		64	62								
PRESSURES	STACK INLET	50	51								
	STACK OUTLET	1.5	1.5								
	DIFFERENTIAL IN	34	46								
	DIFFERENTIAL OUT	3	4								
	BEFORE FILTER	69	81								
	AFTER FILTER	68	80								
	AFTER PRV	53	54								
	ELECTRODE INLET	52	52								
STAGE ONE	VOLTS	76	76								
	AMPS	9.7	10.2								
STAGE TWO	VOLTS	59	59								
	AMPS	6.1	6.0								

COMMENTS:

Appendix B.

Location: SAN JON, N.M.

Component	Sample Information: RO PRODUCT HFF	RO PRODUCT SW	RO CONC (COMBINED)	ED PRODUCT
Sodium	46.3	66.6	592.	108.
Potassium	.3	.4	3.3	.6
Calcium	2.3	2.2	51.5	2.1
Magnesium	.5	.7	8.1	.6
Iron-Total	<.02	<.02	<.02	<.02
Manganese	<.01	<.01	<.01	<.01
Chloride	1.2	.7	102.	5.3
Fluoride	<.2	<.2	4.8	1.
Nitrate	2.4	<.5	16.2	1.1
Bicarbonate	12.2	96.	851.	128.
Carbonate	0,	0.	0,	0.
Sulfate	142.	106.	.	125
Phosphate	<.05	<.05	<.05	<.05
Total Hardness				
Alkalinity				
Total Dissolved Residue	50.	91.	2000,	220.
Surfactants				
pH	8,	8,	7.5	7.9
Odor				
Color				
Turbidity				
Conductance Micromhos/cm 25 C	75.	130.	2850.	300.
Arsenic	.02	.02	.04	.005
Barium	<.02	<.02	<.02	<.02
Boron	<.05	<.05	<.05	<.05
Cadmium	<.001	<.001	<.001	<.001
Chromium	<.02	<.02	<.02	<.02
Copper	<.01	<.01	<.01	<.01
Cyanide	—	—	—	—
Lead	<.001	<.001	<.001	<.001
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.1	<.1	<.1	<.1
Nickel	<.03	<.03	<.03	<.03
Silver	<.01	<.01	<.01	<.01
Selenium	<.006	<.006	<.006	<.006
Zinc	<.003	<.003	<.003	<.003
Radium 226				
Strontium	<.01	<.01	.1	<.01
~~Gross Beta~~ SiO_2	1.5	1.5	25.	15.

APPENDIX B

LOCATION: SAN JON, N.M. METER READING AT:

REVERSE OSMOSIS

DATE		6-5	6-6	6-7	6-8	6-9	6-12	6-13	6-14	6-15	6-16
TIME		3:15	9:50	11:15	9:33	8:00		5:45	5:40	9:50	7:00
FEED SALINITY											
FEED CONDUCTIVITY		1650	1800	1860	1870	1875	2005	1790	1840	1800	2000
PRODUCT CONDUCTIVITY SW/HFF		57/280	57/210	70/157	71/142	60/156	56/94	55/70	70/163	69/160	90/200
PRODUCT FLOW (gpm)		2.3/2.1	2.2/2.0	2.2/2.0	2.2/2.0	2.2/2.0	2.3/2.0	2.6/2.1	2.5/2.2	2.4/2.1	2.6/2.1
CONCENTRATE FLOW (gpm)		1.9/1.6	1.6/1.5	1.6/1.5	1.6/1.5	1.6/1.5	1.5/1.5	1.5/1.5	1.0/1.0	1.0/1.0	.9/.9
RECYCLE FLOW (gpm)		–	–	–	–	–	–	–	–	–	–
FEED TEMPERATURE (°F)		69	68	69	70	70	75	78	78	76	92
ΔP ACROSS	HFF	10	10	10	5	10	10	10	10	10	10
MEMBRANES	SW	30	30	30	30	30	30	30	30	30	30
ΔP ACROSS C. FILTERS		5	7	8	7	9	4	2	2	2	2
FEED PRESSURE		30	30	30	29	29	28	32	32	32	30
INLET pH		6.4	6.0	7.1	6.5	6.9	7.1	10	7.1	7.1	5.5
PRODUCT pH		–	–	–		–	–				–
ΔP ACROSS $KMnO_4$ FILTERS		6	10	10	9	10	9	4	2	0	11
ΔP ACROSS SAND TRAP		18	22	22	21	20	23	12	8	2	21
PUMP PRESSURE	HFF	505	500	500	500	500	500	510	510	510	510
	SW	450	450	450	450	450	465	460	460	465	475
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

6-6 Took EID samples

6-12 Product to City system

APPENDIX B

LOCATION: SAN JON, N.M. METER READING AT:

REVERSE OSMOSIS

DATE		6-20	6-21	6-22	6-23	6-27	6-28	6-29			
TIME		4:20	11:50	5:25	12:20	9:50	9:30	8:30			
FEED SALINITY											
FEED CONDUCTIVITY		1930	1880	1660	1810	1810	1810	1575			
PRODUCT CONDUCTIVITY		67/148	38/65	56/84	64/130	65/100	62/140	38/24			
PRODUCT FLOW (gpm)		2.4/1.9	2.4/2.0	2.8/2.2	2.5/2.0	2.7/2.2	2.4/1.9	2.4/2.0			
CONCENTRATE FLOW (gpm)		1.0/1.5	1.0/1.4	1.0/1.4	1.0/1.5	1.0/1.4	1.0/1.4	1.0/1.5			
RECYCLE FLOW (gpm)		-	-	-			-	-			
FEED TEMPERATURE (°F)		76	76	84	78	86	76	78			
ΔP ACROSS	HFF	20	10	15	10	10	10	10			
MEMBRANES	SW	30	25	30	30	30	30	30			
ΔP ACROSS C. FILTERS		4	4	5	4	4	4	4			
FEED PRESSURE		30	30	30	30	30	30	30			
INLET pH		7.3	7.2	9.2	7.0	7.4	7.0	9.5			
PRODUCT pH		-	-	-	-	-					
ΔP ACROSS $KMnO_4$ FILTERS		11	6	7	10	M		11			
ΔP ACROSS SAND TRAP		21	16	18	22	21		21			
PUMP PRESSURE	HFF	505	510	510	505	440	505	505			
	SW	465	465	475	480	455	460	450			
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

APPENDIX B

LOCATION: SAN JON, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		6-1	6-2	6-5	6-6	6-7	6-8	6-9	6-12	6-13	6-20
TIME		7:20p	7:20a	3:15	10:10	11:15	9:30	8:00		5:40	4:15
POLARITY		+	+	-	-	+	-	+	-	-	-
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		240	320	280	280	260	200	190	218	220	200
DILUTE FLOW (gpm)		4.9	4.75	4.9	4.75	4.4	4.6	4.3	4.3	3.6	4.5
BRINE FLOW (gpm)		1.3	1.2	1.3	1.3	1.3	1.25	1.25	1.25	1.1	1.3
FEED TEMPERATURE (°F)		70	66	66	64	66	64	67	81	74	72
PRESSURES	STACK INLET	47	47	45	43	42	40	38	49	45	45
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	41	40	29	26	34	29	32	29	39	36
	DIFFERENTIAL OUT	20	22	12	10	21	9	24	14	>100	100
	BEFORE FILTER	61	62	59	51	48	47	47	51	58	56
	AFTER FILTER	61	62	59	50	48		46	49	57	55
	AFTER PRV	51	52	51	48.5	47	46	44	49	51	50
	ELECTRODE INLET	47	47	46	44	42	42	40	44	46	46
STAGE ONE	VOLTS	58	58	56	56	58	57	57	56	57	56
	AMPS	4.9	4.8	5.	5.1	5.1	5.1	5.2	6.1	5.5	5.6
STAGE TWO	VOLTS	58	58	56	56	58	57	57	56	57	56
	AMPS	3.1	3.2	3.1	2.9	2.9	2.8	2.8	3.2	2.8	2.6

COMMENTS:

6-1 Brine pump fixed

6-7 Changed carbon filters high ΔP

APPENDIX B

LOCATION: SAN JON, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		6-21	6-22	6-23	6-27	6-28	6-29				
TIME		11:50	5:20	12:30	9:45	9:30	8:30				
POLARITY		+	−	+	+	−	+				
FEED SALINITY (ppm)											
PRODUCT SALINITY (ppm)											
PRODUCT CONDUCTIVITY		195	175	175	135	190	190				
DILUTE FLOW (gpm)		4.7	4.6	4.5	4.5	4.6	4.5				
BRINE FLOW (gpm)		1.3	1.3	1.25	1.25	1.25	1.25				
FEED TEMPERATURE (°F)		81	80	83	81	78	74				
PRESSURES	STACK INLET	45	45	46	46	46	46				
	STACK OUTLET	9	1.5	9	9	1.5	9				
	DIFFERENTIAL IN	46	25	42	42	30	40				
	DIFFERENTIAL OUT	100	100	100	100	100	100				
	BEFORE FILTER	58	58	55	56	56	56				
	AFTER FILTER	58	48	55	56	56	56				
	AFTER PRV	50	50	51	50	50	51				
	ELECTRODE INLET	46	46	46	45	45	46				
STAGE ONE	VOLTS	58	57	58	58	57	58				
	AMPS	5.4	5.4	5.5	5.6	5.3	4.6				
STAGE TWO	VOLTS	58	57	58	58	57	58				
	AMPS	2.6	2.5	2.7	2.5	2.4	2.6				

COMMENTS:

APPENDIX B

LOCATION: SAN YSIDRO, N.M. METER READING AT:

REVERSE OSMOSIS

DATE		8-7	8-8	8-9	8-11	8-16	8-18	8-24			
TIME		1:30	10:00	1:40	1:30	1:15	11:15	2:00			
FEED SALINITY											
FEED CONDUCTIVITY		1280	1300	1300	1750	1350	1360	1320			
PRODUCT CONDUCTIVITY		70	60	96	85	122	178	150			
PRODUCT FLOW (gpm)		2.1 / 4.6	2.2	2.1	2.0	2.0 / 5.1	2.1 / 5.0	2.1 / 5.6			
CONCENTRATE FLOW (gpm)		1.4 / 3.4	1.3	1.3	1.3	1.0 / 1.8	1.0 / 1.1	1.0 / .9			
RECYCLE FLOW (gpm)						–					
FEED TEMPERATURE (°F)		80	80	79	78	78	78	78			
ΔP ACROSS	HFF	10	10	10	10	5	5	10			
MEMBRANES	SW	20				25	25	25			
ΔP ACROSS C. FILTERS		3	3	4	4	2	3	2			
FEED PRESSURE		33	30	28	27	32	30	31			
INLET pH		7.5	7.4	7.5	5.2	6.9	6.6	7.0			
PRODUCT pH											
ΔP ACROSS $KMnO_4$ FILTERS		2	2	7	6	0		0			
ΔP ACROSS SAND TRAP		6	8	14	13	4		3			
PUMP PRESSURE	HFF	510	505	500	500	505	505	510			
	SW	370				410	415	410			
TURBIDITY (of feed)		.56				.42	.56				
PRODUCT SALINITY											

COMMENTS:

8-8 Low water supply ; only run one RO system

8-14 Low water supply

8-24 Community requested we discontinue demonstration - Low water supply

APPENDIX B

LOCATION: SAN YSIDRO, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		8-8	8-9	8-11	8-14	8-16	8-18				
TIME		3:00	2:40	2:40	2:30	1:15	11:07				
POLARITY		−	+	−	+	−	−				
FEED SALINITY (ppm)		800	800	820	800	800	820				
PRODUCT SALINITY (ppm)				120	105	110	140				
PRODUCT CONDUCTIVITY		160	200	200	160	160	170				
DILUTE FLOW (gpm)		5.0	4.75	4.8	4.9	4.8	5.1				
BRINE FLOW (gpm)		1.0	1.0	1.0	0.8	0.8	.8				
FEED TEMPERATURE (°F)		73	74	76	74	74	76				
PRESSURES	STACK INLET	43	46	42	45	45	43				
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5				
	DIFFERENTIAL IN	42	34	27	48	22	58				
	DIFFERENTIAL OUT	0	4	4	-2	12	16				
	BEFORE FILTER	60	68	71	55	56	66				
	AFTER FILTER		68	69	54	52	62				
	AFTER PRV	51	50	52	50	51	51				
	ELECTRODE INLET	44	46	47	44	46	44				
STAGE ONE	VOLTS	55	56	55	56	55	55				
	AMPS	3.7	4.9	5.1	3.9	3.8	4.0				
STAGE TWO	VOLTS	55	56	55	56	55	55				
	AMPS	2.2	2.5	2.7	2.2	2.1	2.4				

COMMENTS:

8-4 Feed pipe in stack replaced.

Appendix B.

Location: BLUEWATER, N.M.

Component	Sample Information: ED FEED	ED PRODUCT	ED WASTE	HFFP (PRODUCT)
Sodium	77.9	21.4	111.	6.6
Potassium	6.	.9	9.9	.3
Calcium	163.	14.	325.	1.7
Magnesium	44.	4.6	85.	.5
Iron-Total	<.1	<.1	<.1	<.1
Manganese	<.05	<.05	<.05	<.05
Chloride	52.	6.7	92.5	6.7
Fluoride	.5	.2	.75	.7
Nitrate	7.3	.6	13.4	1.5
Bicarbonate	332.	79.	506.	0.
Carbonate	0.	0.	0.	0.
Sulfate	398.	31.	770.	79.2
Phosphate	.05	.04	.01	.04
Total Hardness				
Alkalinity				
Total Dissolved Residue	908.	224.	1732.	36.
Surfactants				
pH	7.1	6.5	7.8	3.5
Odor	5	2	1	1
Color				
Turbidity	.47	.39	.4	.41
Conductance Micromhos/cm 25 C	1300	216	2210	606
Arsenic	.021	.003	.042	.001
Barium	<.4	<.4	<.4	<.4
Boron	.5	.5	.45	.22
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.1	<.1	<.1	<.1
Cyanide	-	-	-	-
Lead	.005	.005	.005	.021
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	.007	<.002	.015	<.002
Zinc	.03	<.02	.05	.26
Radium 226				
Strontium	1.3	.05	2.7	.02
~~Gross Beta~~ SiO_2	16.25	16.25	16.25	1.65

APPENDIX B

LOCATION: BLUEWATER, N.M. METER READING AT:

REVERSE OSMOSIS

DATE		9-26	9-26	9-27	9-28	10-9	10-10	10-11	10-12	10-16	10-17
TIME		11:37	2:50	1:30		2:45	2:40	10:20	8:45	2:00	6:50
FEED SALINITY (ppm)		PRODUCT 350	FEED 190	FEED 160		2700	-	2600	>5000	>5000	>5000
FEED CONDUCTIVITY		3000	5100	5500	6000	2500	6500	3500	9200	9200	10,200
PRODUCT CONDUCTIVITY		1-500 2-290	240	280	360	300	147	59	180	220	
PRODUCT FLOW (gpm)		3.9	1.7	1.8	1.7	1.8	1.7	1.6	1.5	1.6	1.6
CONCENTRATE FLOW (gpm)		.9	.8	1.8	1.0	1.5	1.3	1.3	1.4	1.3	1.4
RECYCLE FLOW (gpm)											
FEED TEMPERATURE (°F)		65	66	66		68	64	63	63	63	65
ΔP ACROSS	HFF		5	10		8	10	10	10	10	12
MEMBRANES	SW	30									
ΔP ACROSS C. FILTERS		2	2	2	2	2	2	2	2	2	2
FEED PRESSURE		32	32	32	32	32	32	32	32	32	32
INLET pH		6.1	6.1	6.2	6.6	5.3	6.4	7.0	6.4	6.4	6.2
PRODUCT pH					6.2						
ΔP ACROSS $KMnO_4$ FILTERS		1	1	0	0	0	0	0	0	0	0
ΔP ACROSS SAND TRAP		4	1	2	2	2	3	0	3	3	3
PUMP PRESSURE	HFF		510	510	510	510	510	510	510	512	512
	SW	450									
TURBIDITY							.22				
PRODUCT SALINITY						130	130	78	115	170	172

COMMENTS:

9-26 EID SAMPLES

10-16 Leak in feed pump

10-17 Fixed

APPENDIX B

LOCATION: BLUEWATER, N.M.

METER READING AT:

REVERSE OSMOSIS

DATE		10-18									
TIME		3:20									
FEED SALINITY											
FEED CONDUCTIVITY		11,400									
PRODUCT CONDUCTIVITY		240									
PRODUCT FLOW (gpm)		1.5									
CONCENTRATE FLOW (gpm)		1.5									
RECYCLE FLOW (gpm)											
FEED TEMPERATURE (°F)		65									
ΔP ACROSS	HFF	12									
MEMBRANES	SW										
ΔP ACROSS C. FILTERS		2									
FEED PRESSURE		32									
INLET pH		6.6									
PRODUCT pH											
ΔP ACROSS $KMnO_4$ FILTERS		0									
ΔP ACROSS SAND TRAP		2									
PUMP PRESSURE	HFF	572									
	SW										
TURBIDITY											
PRODUCT SALINITY											

COMMENTS:

10-19 High pressure pump down - sheared pin on shaft

APPENDIX B

LOCATION: BLUEWATER, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		9-20	9-20	9-21	9-22	9-26	9-27	9-28	9-29	9-30	10-5
TIME		9:50	9:55	8:35	10:30	11:40	3:50	4:10	3:30	3:10	4:25
POLARITY		−	+	−	+	+	−	−	+	−	+
FEED SALINITY (ppm)		800	800	820	820	900	900	820	820	820	850
PRODUCT SALINITY (ppm)		-	220	250	260	135	155	130	138	145	140
PRODUCT CONDUCTIVITY		380	310	425	400	210	240	200	215	230	220
DILUTE FLOW (gpm)		4.8	4.8	4.8	4.8	3.8	4.0	3.8	3.8	4.0	3.8
BRINE FLOW (gpm)		.9	.9	.9	.8	.6	.6	.5	.5	.5	.5
FEED TEMPERATURE (°F)		55	55	55	56	58	58	60	58	58	58
PRESSURES	STACK INLET	44	46	46	47	49	48	46	48	47	49
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3.0	1.5	1.5
	DIFFERENTIAL IN	47	47	49	58	39	35	32	40	34	40
	DIFFERENTIAL OUT	13	2	100+	100+	61	50	78	48	42	50
	BEFORE FILTER	60	62	78	78	78	80	61	72	74	75
	AFTER FILTER			72	66	75	80	60	71	73	74
	AFTER PRV	50	51	53	52	53	53	51	52	52	53
	ELECTRODE INLET	44	45	47	46	49	50	48	48	49	48
STAGE ONE	VOLTS	55	56	55	56	56	55	55	57	55	57
	AMPS	3.2	3.3	3.1	3.3	2.4	2.3	2.4	2.4	2.4	2.4
STAGE TWO	VOLTS	55	56	55	56	56	55	55	57	55	57
	AMPS	2.6	2.5	2.4	2.5	1.4	1.4	1.3	1.4	1.4	1.4

COMMENTS:

APPENDIX B

LOCATION: BLUEWATER, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		10-6	10-7	10-9	10-10	10-11	10-12	10-16	10-17	10-18	10-19
TIME		4:00	9:30	7:10	2:40	10:24	8:40	1:30	6:50	3:25	9:00
POLARITY		−	−	+	+	+	−	−	+	+	−
FEED SALINITY (ppm)		900	820	810	880	850	820	820	820		810
PRODUCT SALINITY (ppm)		140	138	125	135	138	125	130	130		150
PRODUCT CONDUCTIVITY		260	235	230	215	210	220	218	210	210	220
DILUTE FLOW (gpm)		3.8	3.8	3.8	3.8	3.7	3.8	3.8	3.8	3.8	3.8
BRINE FLOW (gpm)		.6	.5	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		58	56	58	58	58	58	58		58	57
PRESSURES	STACK INLET	48	47	47	48	48	47	47	48	48	48
	STACK OUTLET	1.5	1.5	3.0	4.0	4.0	1.5	1.5	3.0	1.5	1.5
	DIFFERENTIAL IN	32	34	38	38	38	36	32	38	38	32
	DIFFERENTIAL OUT	90	56	86	88	88	100	84	86	86	96
	BEFORE FILTER	79	70	63	67	65	65	70	64	68	72
	AFTER FILTER	78	69	63	66	64	64	70	64	65	70
	AFTER PRV	53	52	52	52	52	52	52	52	52	52
	ELECTRODE INLET	50	48	48	48	48	48	48	48	48	48
STAGE ONE	VOLTS	56	55	57	56	57	55	55	57	57	55
	AMPS	2.3	2.2	2.4	2.4	2.4	2.2	2.2	2.4	2.4	2.2
STAGE TWO	VOLTS	56	55	57	56	57	55	55	57	57	55
	AMPS	1.3	1.3	1.4	1.5	1.4	1.3	1.3	1.4	1.4	1.2

COMMENTS:

Appendix B

Location: MORIARTY, N.M.

Component	Sample Information: ED PRODUCT	ED CONC.	RO PRODUCT (AFF)	RO CONC.
Sodium	17.	100.	2.8	60.5
Potassium	.5	4.5	.2	4.9
Calcium	35.	328.5	1.	224.
Magnesium	4.9	78.3	.3	54.
Iron-Total	<.1	<.1	<.1	.12
Manganese	<.05	<.05	<.05	<.05
Chloride	11.7	157.	.1	108.
Fluoride	.2	.51	.54	.33
Nitrate	.11	2.2	.05	1.31
Bicarbonate	128.	445.	0.	0.
Carbonate	0.	0.	0.	0.
Sulfate	30.7	749.8	14.9	480.3
Phosphate	.01	.02	.01	.01
Total Hardness				
Alkalinity				
Total Dissolved Residue	228.	1796.	24.	1340.
Surfactants				
pH	7.4	7.7	4.1	6.2
Odor	1	1	1	1
Color	1	1	1	1
Turbidity	.4	.5	.4	.5
Conductance Micromhos/cm 25 C	291	2210	68	1650
Arsenic	.002	.002	<.001	.002
Barium	<.4	<.4	<.4	<.4
Boron	<.01	<.01	<.01	.03
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.1	<.1	<.1	<.1
Cyanide	-	-	-	-
Lead	<.005	<.005	<.005	<.005
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	<.002	.011	<.002	.007
Zinc	<.02	.04	.02	.13
Radium 226				
Strontium	<.02	2.3	<.02	1.8
~~Gross Beta~~ SiO_2	26.5	26.5	.9	33.2

APPENDIX B

LOCATION: MORIARTY, N.M. METER READING AT:

REVERSE OSMOSIS

DATE	10-31	11-1	11-6	11-7	11-8	11-9	11-13	11-14	11-15	11-16
TIME	2:10	4:30	11:00	2:55	7:50	10:45	5:00	2:20	3:35	7:30
FEED SALINITY	890		890	880	880		820	850	850	880
FEED CONDUCTIVITY	1870	2100		1360	1360	1380	1360	1370	1360	1380
PRODUCT CONDUCTIVITY	121	82		260	102	80		86	66	68
PRODUCT FLOW (gpm)	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4
CONCENTRATE FLOW (gpm)	1.2	1.2	1.15	1.2	1.1	1.1	1.1	1.1	1.1	1.1
RECYCLE FLOW (gpm)	-	-		-						
FEED TEMPERATURE (°F)	66	66	66	65	65	65	63	63	63	62
ΔP ACROSS HFF	6	12	12	15	18	18		16	16	16
MEMBRANES SW										
ΔP ACROSS C. FILTERS	2	1	1	2	2		2	2	2	2
FEED PRESSURE	32	32	32	32	32	32	32	32	32	32
INLET pH	6.3	5.2		6.25	6.0	6.0	6.1	6.0		
PRODUCT pH	5.8	4.9		6.0			5.6	5.64		
ΔP ACROSS $KMnO_4$ FILTERS	0	1	1	1	0	0	1	1	0	1
ΔP ACROSS SAND TRAP	7	7	4.5	4	4	4	3	3	2	3
PUMP PRESSURE HFF	515	515	515	515	520	520	515	515	515	515
SW										
TURBIDITY	.38	.28		.48					.24	
PRODUCT SALINITY	50		48	48	42	44	47	44	39.5	42

COMMENTS:

11-13 Repaired RO flush pump; could not complete job (fittings) will flush system of Hagerman

APPENDIX B

LOCATION: MORIARTY, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		10-31	11-1	11-6	11-7	11-8	11-9	11-13	11-14	11-15	11-16
TIME		3:30	4:30	10:00	2:50	7:50	10:45	5:00p	2:20	2:20	7:30
POLARITY		+	−		+	−	−	−	+	−	−
FEED SALINITY (ppm)		820		890	850	860	880	820	810	810	850
PRODUCT SALINITY (ppm)		120		130	105	115	120	105	115	115	118
PRODUCT CONDUCTIVITY		180	210	200	170	185	190	180	175	175	190
DILUTE FLOW (gpm)		3.9	3.9	3.9	3.7	3.7	3.7	3.7	3.7	3.7	3.7
BRINE FLOW (gpm)		.6	.6	.5	.6	.6	.6	.6	.6	.6	.6
FEED TEMPERATURE (°F)		60		58	60	58	58	57	56	56	56
PRESSURES	STACK INLET	48	47		45	43	44	43	45	44	44
	STACK OUTLET	1.5	1.5		1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	39	35		36	37	32	38	36	32	32
	DIFFERENTIAL OUT	2	8		-7	-9	9	10	-6	10	10
	BEFORE FILTER	74	74		73	74	74	74	72	74	74
	AFTER FILTER	71	70		72	73	73	73	71	71	72
	AFTER PRV	52	52		52	52	52	52	52	52	53
	ELECTRODE INLET	48	49		45	44	46	44	46	46	46
STAGE ONE	VOLTS	58	57		58	56	56	56	58	56	56
	AMPS	2.5	2.4		2.5	2.3	2.4	2.3	2.4	2.2	2.3
STAGE TWO	VOLTS	58	57		58	56	56	56	58	56	56
	AMPS	1.4	1.3		1.3	1.2	1.2	1.1	1.3	1.1	1.2

COMMENTS:

11-6 Power pole breaker tripped - ED would not restart properly

11-7 ED back on (?)

Appendix B.

Location: HAGERMAN, N. M.

Component	Sample Information: RO Product	RO Conc.	ED Product	ED Conc.
Sodium	10.7	206.	12.1	152.
Potassium	.2	5.	.1	3.9
Calcium	4.1	523.	8.7	365.
Magnesium	1.4	173.	3.4	123.
Iron-Total	<.1	<.1	<.1	<.1
Manganese	<.05	.09	<.05	.08
Chloride	3.9	472.	8.1	330.
Fluoride	<.2	1.4	<.2	1.8
Nitrate	<.01	<.01	<.01	<.01
Bicarbonate	18.3	356.3	22.	256
Carbonate	0.	0.	0.	0.
Sulfate	19.7	1425.	36.	950.
Phosphate	.02	.09	.04	.08
Total Hardness				
Alkalinity				
Total Dissolved Residue	48	3312	98	2320
Surfactants				
pH	6.5	7.5	6.3	7.3
Odor	1	1	1	1
Color	<1	<1	<1	<1
Turbidity				
Conductance Micromhos/cm 25 C	82.	3770	144	2770
Arsenic	.003	.013	.002	.005
Barium	<.4	<.4	<.4	<.4
Boron	.1	.19	.15	.1
Cadmium	<.005	<.005	<.005	<.005
Chromium	<.05	<.05	<.05	<.05
Copper	<.1	<.1	<.1	<.1
Cyanide	-	-	-	-
Lead	<.005	<.005	<.005	<.005
Mercury	<.0002	<.0002	<.0002	<.0002
Molybdenum	<.01	<.01	<.01	<.01
Nickel	<.05	<.05	<.05	<.05
Silver	<.05	<.05	<.05	<.05
Selenium	<.002	.008	<.002	.006
Zinc	.14	.87	<.02	.68
Radium 226				
Strontium	<.02	6.3	.03	3.8
~~Gross Beta~~ SiO_2	.7	46.2	18.5	18.5

APPENDIX B

LOCATION: HAGERMAN, N.M.

METER READING AT:

REVERSE OSMOSIS

DATE	11-21	11-22	11-27	11-28	11-29	11-30	12-1	12-2	12-3	12-4
TIME	4:30	7:45	5:00	11:15	2:15	1:10	8:20p	8:20a	1:05	10:25a
FEED SALINITY	1110		1100	1110	1100	1100	1100	1100	1100	1110
FEED CONDUCTIVITY	1740	1880	1800	1760	1760	1750	1750	1750	1760	1760
PRODUCT CONDUCTIVITY	94	60								
PRODUCT FLOW (gpm)	1.7	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
CONCENTRATE FLOW (gpm)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
RECYCLE FLOW (gpm)		-								
FEED TEMPERATURE (°F)	73	73	72	73	74	74	74	73	73	72
ΔP ACROSS HFF	15	15	20	20	20	20	20	20	20	20
MEMBRANES SW										
ΔP ACROSS C. FILTERS	1	1	2	3	3	3	3	3	3	2
FEED PRESSURE	32	32	32	32	32	32	32	32	32	32
INLET pH	7.0		6.3	6.5	6.5	7.0	7.2	7.3	7.2	7.3
PRODUCT pH	6.0		5.95	5.9	5.8	6.0	6.0	6.0	6.0	6.0
ΔP ACROSS $KMnO_4$ FILTERS	0	1	5	5	5	5	7	7	6	7
ΔP ACROSS SAND TRAP	1	1	8	8	9	8	7	7	7	7
PUMP PRESSURE HFF	515	520	515	515	515	515	515	515	515	515
SW										
TURBIDITY	.5		.22	.16						.2
PRODUCT SALINITY	43		55	46	45	37	34	32.5	31.5	33

COMMENTS:

11-21 Flushpump fixed; system cleaned out; Media filters recharged with $KMnO_4$

12-4 Recharged Media Filters ½# $KMnO_4$ to each

APPENDIX B

LOCATION: HAGERMAN, N.M. METER READING AT:

REVERSE OSMOSIS

DATE	12-5			12-8	12-15	12-16	12-17	12-18	12-19	12-20
TIME	4:25			8:00	3:15	10:68	12:	11:00	2:10	10:05
FEED SALINITY	1110	1110	1120	1100	1700	1690	1680	1700	1710	1700
FEED CONDUCTIVITY	2110	2100	2000	1530	2250	2250	2250	2100	2200	2200
PRODUCT CONDUCTIVITY					300	200	192	200	200	200
PRODUCT FLOW (gpm)	1.7	1.7	1.7	1.7	4.4	2.5	2.6	2.6	2.6	2.5
CONCENTRATE FLOW (gpm)	1.0	1.0	1.0	1.0	2.0	1.5	1.5	1.5	1.5	1.5
RECYCLE FLOW (gpm)										
FEED TEMPERATURE (°F)	74	72	72	70	74	74	72	73	74	72
ΔP ACROSS HFF	25	25	22	25						
MEMBRANES SW					30	30	32	30	30	30
ΔP ACROSS C. FILTERS	3	2	2	2	4	2	2	2	2	2
FEED PRESSURE	32	32	32	32	30	30	31	31	31	31
INLET pH	6.7	6.4	6.7	6.6	6.6	6.1	6.5	6.9	6.5	6.5
PRODUCT pH	6.0	5.8	6.0	6.0	6.	5.5	5.5	6.0	5.7	5.6
ΔP ACROSS $KMnO_4$ FILTERS	6	6	8	8	7	0	7	9	10	9
ΔP ACROSS SAND TRAP	8	8	8	8	10	0	11	11	10	11
PUMP PRESSURE HFF	515	515	515	515						
SW					425	455	475	460	460	460
TURBIDITY	.22	.29	.28			.38	.35	.30	.28	.31
PRODUCT SALINITY	33.5	41	45	43	205	135	128	135	180	122

COMMENTS:

12-5 Flushed RO; high ΔP

12-6 Flushed RO; all night with feed water

12-8 All equipment off; Filters plugged

12-15 low feed

12-15 Mechanical seals replaced

APPENDIX B

LOCATION: HAGERMAN, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		11-27	11-28	11-29	11-30	12-1	12-2	12-3	12-4	12-5	12-6
TIME		5:00	11:45	2:00	1:00	8:15	8:30	1:05	10:22	4:25	2:30
POLARITY		−	+	+	−	−	+	+	−	+	−
FEED SALINITY (ppm)		1100	1110	1100	1100	1100	1100	1100	1110	1110	1110
PRODUCT SALINITY (ppm)		75	82	100	95	93	88	95	90	80	98
PRODUCT CONDUCTIVITY		130	130	145	150	145	150	150	160	138	170
DILUTE FLOW (gpm)		3.6	3.6	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
BRINE FLOW (gpm)		.6	.6	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		66	68	68	68	68	68	68	68	68	66
PRESSURES	STACK INLET	39	40	40	40	39	40	40	39	40	39
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	32	33	33	34	31	33	33	32	34	36
	DIFFERENTIAL OUT	4	-2	-1	1	-2	0	1	2	1	3
	BEFORE FILTER	48	47	48	47	47	45	47	48	47	48
	AFTER FILTER	46	46	46	46	46	44	46	46	46	46
	AFTER PRV	44	44	43	44	43	44	44	44	44	44
	ELECTRODE INLET	41	40	39	39	39	40	40	41	40	40
STAGE ONE	VOLTS	63	65	64	64	64	64	65	64	64	63
	AMPS	3.5	3.6	3.7	3.6	3.5	3.6	3.6	3.4	3.6	3.4
STAGE TWO	VOLTS	63	65	64	64	64	64	65	64	64	63
	AMPS	1.3	1.4	1.2	1.4	1.3	1.4	1.4	1.3	1.4	1.3

COMMENTS:

APPENDIX B

LOCATION: HAGERMAN, N.M.

METER READING AT:

ELECTRODIALYSIS

DATE		12-7	12-8	12-13	12-14	12-15	12-16	12-17	12-18	12-19	12-20
TIME		4:00	8:00	2:30	3:45	3:15	11:10	11:50	10:55	2:05	10:25
POLARITY		+	-	+	-	-	+	-	+	-	+
FEED SALINITY (ppm)		1120	1100	1120	1710	1700	1690	1700	1700	1710	1700
PRODUCT SALINITY (ppm)		130	140	158	135	140	132	140	123	140	142
PRODUCT CONDUCTIVITY		215	220	255	230	230	230	250	215	240	240
DILUTE FLOW (gpm)		3.5	3.5	3.6	3.7	3.5	3.5	3.5	3.5	3.5	3.5
BRINE FLOW (gpm)		.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
FEED TEMPERATURE (°F)		66	64	66	67	71	70	67	68	70	68
PRESSURES	STACK INLET	40	38	43	41	39	41	41	41	40	41
	STACK OUTLET	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	DIFFERENTIAL IN	38	38	35	33	30	33	33	34	32	33
	DIFFERENTIAL OUT	1	9	8	-4	0	0	1	1	0	1
	BEFORE FILTER	48	48	49	49	46	47	48	47	47	48
	AFTER FILTER	46	46	49	48	46	46	47	47	47	47
	AFTER PRV	44	44	46	46	44	44	46	45	45	45
	ELECTRODE INLET	40	40	43	43	40	41	42	41	41	41
STAGE ONE	VOLTS	65	63	65	63	63	65	63	65	63	65
	AMPS	3.6	3.1	4.9	4.8	4.9	5.0	4.7	5.0	4.9	4.9
STAGE TWO	VOLTS	65	63	65	63	63	65	63	65	63	65
	AMPS	1.4	1.3	2.3	2.2	1.9	2.1	2.1	2.2	2.1	2.2

COMMENTS: