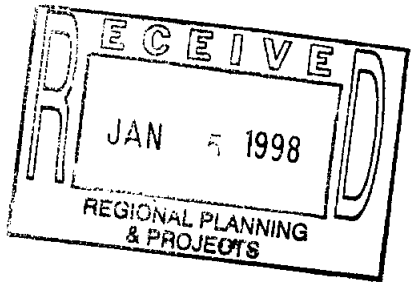
SEAWATER DESALINATION FEASIBILITY STUDY IN THE LAGUNA MADRE AREA

TWDB Contract No. 97-483-202

FINAL REPORT

December 1997



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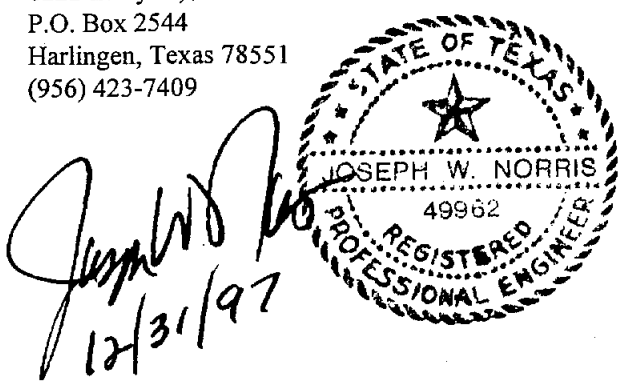

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CHAPTER 1 - EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to evaluate the feasibility of developing and treating sea water resources available in the Laguna Madre Area which includes South Padre Island, Port Isabel and Laguna Vista. The main objective of this project is to present recommendations regarding the treatment of seawater to produce a product water that would meet regulatory guidelines and requirements of the Safe Drinking Water Act (SDWA).

1.2 Background

The Laguna Madre Water District (District) obtains raw water for treatment from the Rio Grande. Over the past three years, the reservoirs supplying the Rio Grande have continued to deplete due to the drought conditions in the South Texas Region. The District has serious concerns that a continuation of this drought, coupled with increased demands from other users and the potential for water theft will severely limit the District's ability to meet its customers demands. The record low flows in the Rio Grande, which represents the only source of water to the District, have dramatically increased the potential for water quality problems to occur, especially given the chronically poor water quality within the river caused by wastewater discharges, brackish seepage from irrigation leach drains, and irrigation return flows. Without a means to utilize alternative sources during times of unacceptable water quality or quantity, the District and its customers are likely to be faced with a very critical situation.

Desalination of sea water has the potential to partially solve the District's long-term drought water storage problems. Currently, the only water available to the District is the storage in Amistad and Falcon Reservoirs associated with raw water rights. If the District was able to desalinize sea water to supplement their daily requirements for South Padre Island, then reliance on this reservoir-based storage system would be diminished, and both the quantity and quality of their supplies would potentially be assured.

As part of the District's effort to decrease their dependancy on the Rio Grande, this study was authorized by the District and the Texas Water Development Board (TWDB). Common resources were used to reduce the overall cost to the District and the TWDB. This project, which includes the desalination of sea water, would allow sea water to be treated and distributed to supplement surface water supply and treatment and improve overall water quality.

1.3 Scope

The principal elements of the study include:

1.3.1 Phase I - Preliminary evaluation

- Data Collection and Evaluation
- Establish Optimum Water Quality for Treatment
- Permitting
- Concentrate disposal alternatives

- Prepare Preliminary Letter Report

1.3.2 Phase II - Reverse Osmosis (RO) Implementation Program

- Conduct pilot plant study to include:
  - Development of design criteria
  - Evaluate membrane fouling characteristics
  - Service life of membranes
  - Concentrate characteristics
  - Pretreatment requirements
- Monitoring of Pilot Plant
- Evaluate test results
- Provide Final Report of Findings

1.4 Treatment Requirements

Sea water contains excess salts and minerals or total dissolved solids consisting mainly of sodium, calcium, magnesium, sulfate, chlorides, and bicarbonates. Nitrates, fluorides, and potassium are found in smaller amounts. The EPA has recommended a maximum total dissolved solids (TDS) content of domestic water supplies of 500 parts per million (ppm). Texas standards currently require a TDS not to exceed 1,000 ppm. At times, the Rio Grande supply exceeds the 1,000 ppm and conventional treatment methods do not remove the TDS in the water. Exceeding this amount is acceptable if no better supplies are available.

Safe Drinking Water Act (SDWA) Standards can only be met through the use of special processes, to remove excess mineral content from sea water. The most recognized process for treating sea water and generating a product which would meet SDWA standards is Reverse Osmosis (RO). With the feedwater quality information available, this process was evaluated and determined that it could easily reduce TDS levels within the recommended concentration value.

1.5 Pilot Plant Operations

A reverse osmosis pilot plant was installed on South Padre Island and started on May 6, 1997 and operated for three months. The purpose of the pilot testing was to determine if there are potential fouling agents found in the sea water that would prematurely cause the plant membranes to foul. The plant testing helped to further refine the costs associated with operation and maintenance of this type of facility.

The pilot plant operated at a recovery rate of 30 percent. This recovery was based on the flux of the available membrane area. Higher recovery is expected at 50% with additional membrane area.

The pre-treatment program included a filtration system, chemical feed system, and a cartridge filter. The filtration system is a proprietary system called " JelCleer$_{®}$" filter developed by Argo Scientific. This filtration system provides the benefits of polymer-enhanced coagulation. The chemical feed system allowed for both scale inhibitor and acid to be introduced into the flow stream upstream of the membranes. The cartridge filter was used to minimize the particulate loading such as sand and other debris suspended in the feedwater to the membrane process over 5 microns in size.

Over the 200 hours that the pilot plant operated, the normalized flux decreased by 7%. It is common practice to clean an RO system when the normalized flux has dropped about 15 percent. Assuming that flux continues to drop in a linear fashion, then cleaning would be required after about 400 hours of operation, or every 17 days. This cleaning frequency is much higher than would normally be experienced with an RO plant, and it is a strong indication that the JelCleer filtration unit used or other type of filtration unit would not be adequate as a stand alone system for the pretreatment of sea water at this location due to high amount of solids in the influent.

Preliminary indication is that the use of shallow beach wells could be used to collect and provide the source water for a sea water RO facility. Utilizing beach wells would provide a natural sand "filter" to the RO plant with consistent water qualities. It is therefore determined that the best feasible way to provide a sea water source to an RO plant is through the use of shallow beach wells for purposes of projecting costs.

1.6 Summary of Cost Projections

Based on available information and work performed in this study, a reverse osmosis facility utilizing sea water could be a viable alternative, in the future, to supplement the Laguna Madre Water District's current surface water supply from the Rio Grande. While costs are projected to be three to four times the cost of conventional treatment, this alternative would give the District an alternate source of water with unlimited supply. It is not expected that sea water RO (SWRO) would replace the less expensive source of surface water, however, a partial use of SWRO on South Padre Island would add reliability to the system and provide additional pressure in the area that would minimize the size of transmission lines as future development occurs. The development of a reverse osmosis membrane treatment system, a sea water collector well, a 1.0 mgd product water treatment plant can be developed at a cost for $2.06 per 1000 gallons capital cost and $1.99 per 1,000 gallons operational cost. These figures include the cost savings of the value of the 1,120 acre-feet of surface water rights valued at $900,000 that would be purchased to provide this amount of water. A summary of costs can be found in Table 1.1.

Another alternative source of water that the District could compare to is the use of brackish groundwater. The source of brackish water, however is located approximately 15 miles away. Projected cost of treatment of brackish water RO (BWRO) in the Brownsville area is $0.93 to $1.20 per 1,000 gallons, including transmission costs[1]. The District's system could possibly utilize existing surface raw water transmission lines in the same area as the brackish water field area to deliver brackish water to the Laguna Madre area.

1.7 Recommendations

In order for the District to reduce its overall dependancy on the Rio Grande, an alternative source of water should be established if economically feasible. The use of seawater can be an alternate water supply that can partially supply current demands on the system that is independent of the Rio Grande supplies. This should be compared to the cost and availability of other sources, these would include wastewater reuse, brackish groundwater treatment and water conservation.

[1] Development of Brackish Ground Water Resources in the Brownsville Area, NRS Consulting Engineers, November 1996. TWDB Contract No. 95-483-1411.

1.7.1 Implementation Plan

The District can implement this project by accomplishing the following items in the order shown.

- Initiate the permitting process to discharge RO concentrate into the Laguna Madre and approval to construct in wetland and dune areas.
- Compile and review available geologic data, water quality information, and hydraulic characteristics of the South Padre Island area to identify prospective sites for determination of the general extent and depth of permeable materials.
- Conduct additional test drilling to verify the character of the subsurface material. This information will be useful for selection of one or more sites for more detailed testing.
- At the selected site (s), construct a temporary test pumping well and at least three (3) observation wells to conduct a pumping test for determination of site specific hydraulic characteristics of the formation necessary for well system design and estimation of a yield.
- With the use of a computer model, evaluate the performance of the formation in response to pumping.
- Develop water quality testing parameters to develop treatment needs.

It is recommended that land purchase options be obtained for test drilling sites. Sites should not be bought until test drilling at each site have indicated favorable subsurface conditions.

Table 1.1 - Summary of Costs

CAPITAL COST PROJECTIONS	PHASE I
SEAWATER COLLECTOR WELL	$1,605,000
REVERSE OSMOSIS	$1,905,000
SUPPORT SYSTEMS	$2,270,000
TOTAL CONSTRUCTION COSTS	$5,780,000
OVERHEAD AND PROFIT @ 25%	$1,445,000
ENG., FISCAL, LEGAL & ADMIN @ 20%	$1,156,000
CONTINGENCIES @ 20%	$1,156,000
TOTAL CONSTRUCTION	$9,537,000
LESS WATER RIGHTS VALUE	($900,000.00)
TOTAL CAPITAL COST	8,637,000.0
PRODUCT WATER, MGD	1.0
ANNUAL DEBT SERVICE @ 6%, 20 YRS.	$753,013
DEBT SERVICE PER 1000 GALLONS	**$2.06**
OPERATION AND MAINTENANCE PROJECTIONS	
POWER @ $0.07/KWH	$467,000
MEMBRANE REPLACEMENT	$50,000
CHEMICAL	$61,000
LABOR	$85,000
MAINTENANCE	$50,000
CARTRIDGE FILTER REPLACEMENT	$15,000
TOTAL TREATMENT O&M PER YEAR	$728,000
OPERATIONAL COST/1000 GALLONS	**$1.99**
TOTAL ANNUAL COST	
TOTAL $$ PER YEAR	$1,481,013
TOTAL $$/1,000 GALLONS	**$4.06**
TOTAL $$/ACRE FOOT OF WATER PRODUCED	$1,322.07

CHAPTER 2 - REVERSE OSMOSIS PILOT STUDY

2.1 Work Program

The work program during this pilot study included:

- Site Selection and Data Collection
- Seawater Quality
- Pre-treatment requirements
- Reverse Osmosis Pilot Unit
- Pilot Unit Operation
- Operating data evaluation
- Conclusions

2.2 Site Selection and Data Collection

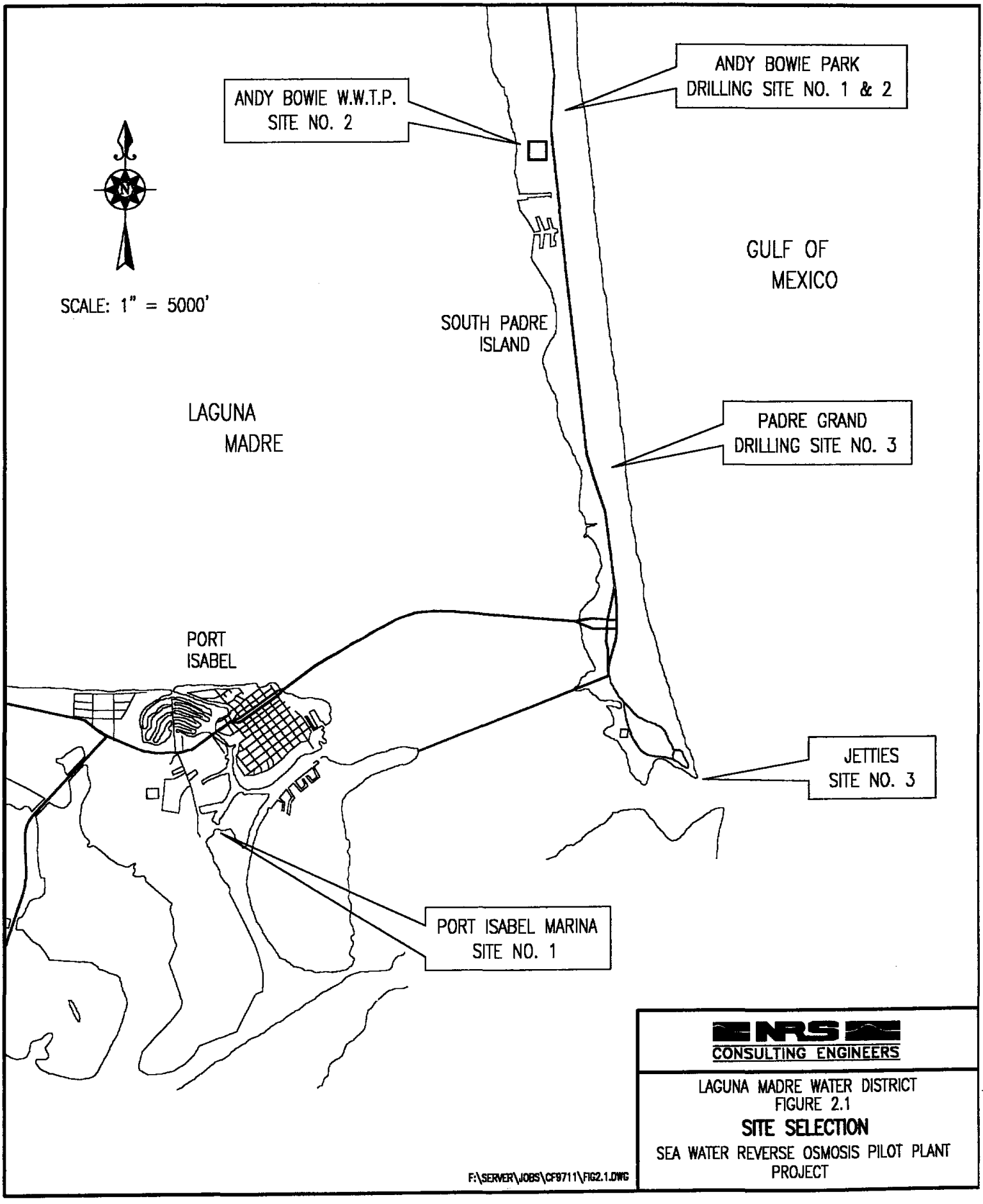
A suitable location was necessary to implement the Reverse Osmosis Pilot Unit. The identification and selection of this site were based on the following guidelines:

- Consistent Seawater Quality
- Seawater intake accessability without bottom sediment uptake.
- Concentrate/Product blend disposal without interference with a sea water intake.
- Minimum Pre-treatment requirements.
- Minimum Permit Requirement.

NRS Engineers identified three sites as possible locations for implementation of this study. Figure 2.1 illustrates the location of these sites. The site locations identified were:

- The Marina at Port Isabel
- The Andy Bowie Wastewater Treatment Plant
- The Jetties at the south end of South Padre Island

The Marina at Port Isabel was initially identified as a possible location because of its accessability and space availability for installation of the RO Pilot Unit. The site had easy access to the Laguna Madre for seawater intake and concentrate discharge. The site was discarded in regards to water quality. Oil and gasoline in the water were visually identified coming from the boats docked in the Marina. The pre-treatment requirement would have been extensive and costly precluding the use of this site.


ANDY BOWIE W.W.T.P.
SITE NO. 2
ANDY BOWIE PARK
DRILLING SITE NO. 1 & 2
N
SCALE: 1" = 5000'
GULF OF
MEXICO
SOUTH PADRE
ISLAND
LAGUNA
MADRE
PADRE GRAND
DRILLING SITE NO. 3
PORT
ISABEL
JETTIES
SITE NO. 3
PORT ISABEL MARINA
SITE NO. 1
NRS
CONSULTING ENGINEERS
LAGUNA MADRE WATER DISTRICT
FIGURE 2.1
SITE SELECTION
SEA WATER REVERSE OSMOSIS PILOT PLANT
PROJECT
F:\SERVER\JOBS\CF9711\FIG2.1.DWG

The second site identified was the Andy Bowie Wastewater Treatment Plant on the north end of South Padre Island. As the first site, this site was initially identified as a possible location because of its accessability and space availability for installation of the RO Pilot Unit. The site, however, did not have easy access to the Laguna Madre for seawater intake.

A pipe approximately 500 ft long away from the Andy Bowie Wastewater Plant effluent discharge was necessary for a sea water intake. Discharge of the concentrate stream was not a problem. This site was discarded in regards to seawater quality and intake accessability. The Laguna Madre average depth near the intake point is of approximately 3 ft. This depth would not allow the intake of seawater without sediment intake from the bottom of the lagoon. The seawater quality within the Laguna Madre was determined to be significantly variable in chemical composition. The Laguna Madre is considered a hypersaline lagoon.

The third site identified was the area of the Jetties located on the south end of South Padre Island. The Jetties site was determined to be a feasible location. The site has space availability for installation of the RO Pilot Unit and easy traffic access. A sea water intake of 50 gpm is also viable with minimal bottom sediment intake. The water depth at the proposed intake point varies from 6-9 feet. In addition, there is a stand pipe at approximately 30 ft from shore, near the location of the site, which was used to provide bracing support while extending the intake pipe along the sea bottom. The proximity of the Jetties site to the Brazos Pass entrance from the Gulf of Mexico provides for more consistent seawater quality. The sea water feed to the RO pilot unit would still, however, require pre-treatment. This pre-treatment requirement would be less costly than the one required at the other evaluated sites.

The pre-treatment requirements for the mentioned sites prompted the decision to evaluate the feasibility of obtaining the feed source to the RO pilot unit from a shallow beach well. Well drilling was not part of the scope of this report, however, the District took the initiative to explore this alternative and cover the expenses associated with this drilling. The objective was to obtain a well able to produce at least 50 gpm with a consistent water quality similar to that of sea water requiring minimum pre-treatment. The Texas Water Development Board provided assistance in drilling three shallow 10-20 feet deep wells at South Padre Island. Figure 2.1 illustrates the location of these drilling sites. Appendix A compiles the information provided by the Texas Water Development Board on these wells. None of the wells drilled provided sufficient quantity of water to feed 50 gpm to the RO pilot unit. These wells proved to be a non-viable alternative at this time for this project. In addition, the discharge of concentrate from the pilot unit was also becoming an issue for this alternative mainly because of the complications associated with the disposal of the sea water from any of the drilled well sites. Therefore, a sea water intake from the Jetties was further evaluated as a possible site for implementation of the RO pilot unit.

While the attempt to cost effectively construct temporary beach wells was not successful, beach wells appear to be a viable alternative to supply sea water to an RO facility. The location of wells close enough to the beach was not possible due to time, cost and environmental approvals required for drilling at South Padre Island. Locations of test wells drilled were too far inland with inadequate permeability.

To better define the feasibility and cost effectiveness of a sea water supply from wells at South Padre Island a more extensive test drilling would be necessary. This test drilling would better define location, feasibility and likelihood of finding favorable sites with the desired quantity and quality of sea water. This is beyond the scope of this study.

2.3 Sea Water Quality

The next step in the evaluation of the selected Jetties site was to determine the quality of the seawater at the proposed intake point. The District began a testing program to determine water consistency with regards to total suspended solids, pH, temperature, and oil and grease. In addition a single grab analysis was performed by a private laboratory on other additional chemical analysis. Appendix B compiles the results of this testing. Table 2.1 summarizes these results.

Table 2.1 - Seawater Chemical Analysis

PARAMETER	VALUE
Calcium	389 milligrams/liter (mg/L)
Magnesium	1,270 mg/L
Sodium	10,400 mg/L
Potassium	379 mg/L
Bicarbonate	151 mg/L
Sulfate	2,250 mg/L
Chlorides	19,300 mg/L
Nitrates	ND
pH	8.19
Electrical Conductivity	62,500 umhos/cm
Total Dissolved Solids	35,074 mg/L
Total Suspended Solids	9-100 mg/L
Non-Volatile Organic Compounds	2 mg/L
Barium	ND
Silicon Dioxide	4.0 mg/L
Strontium	7.12 mg/L
Oil and Grease	1.4 mg/L

2.4 Pre-treatment

To control the rate and type of possible fouling that can occur within the membrane element a pretreatment scheme requiring a filtration system, acid and scale inhibitor was identified upstream of the RO system for implementation of the pilot unit. The filter system was used to minimize the total suspended solids loading of the feed water to the membrane process. Acid and scale inhibitor were utilized to prevent scale formation and precipitation of calcium carbonate on the membrane surface.

The JelCleer filter functioned as pretreatment filtration for the reverse osmosis system. The JelCleer filter is a proprietary filtration system developed by Argo Scientific. The system consists of a medium composed of small alumina beads, which are coated with a polymeric substance. The beads themselves are not capable of fine filtration, but when coated

should provide the benefits of polymer-enhanced coagulation. The filter operates at about 2.5 to 5 gpm per square foot loading rates. The filter is backwashed when pressure drop exceeds about 15 psi. The polymer coating was replaced once during pilot testing.

The filter supplied was a 4.5-foot diameter by 6 foot sideshell pressure vessel equipped with piping and valves sufficient to allow operation and manual backwashing. Design capacity of the filter was 80 gallons per minute (gpm) at 5 gpm per square foot. The intent of the JelCleer system is to provide the simplicity of a direct filtration system with the solids-removal efficiency of a coagulation/sedimentation/filtration system.

Filter performance data (feed and discharge pressure, flow, and inlet and outlet turbidity) were recorded two to three times a day. In addition, the silt density index (SDI) of the filtered water was measured when filter data was recorded. SDI is a measure of the number of particles contained in the water and their potential to foul the membranes. The data recorded by the District during the pilot test is included in Appendix C. In addition to the operating data, the raw and filtered water were sampled on July 23 and subjected to particle size and total organic carbon (TOC) analyses. The results of the laboratory analyses are compiled in Appendix B.

Raw water quality, as measured by turbidity, during the test varied widely from a minimum of 0.8 nephelometric turbidity units (NTU) to a maximum of 27 NTU. These variations had a substantial impact upon the filter. When the water quality was poor, filter runs (between backwashes) were as short as four hours. It was soon observed that these short filter runs generally coincided with the passage of a large ship through the adjacent ship channel. As a result, during the later portions of the test the plant was not operated for about a day after the passage of a large ship.

The JelCleer filter provided an average of 94.2 percent removal of turbidity, which is about the same as the measured particle removal efficiency of 94.6 percent for 20 micron and larger particles. Removal of 5 micron particles was about 83 percent.

Silt density Index (SDI) is often described as the best measure of the fouling tendency of a particular RO feed water. Membrane warrantees often require that feedwater SDI be below a particular level, either 4 or 5 depending upon the manufacturer. The best SDI produced by the JelCleer filter was 4.4, on July 23. This happened to be the same time that samples were taken for particle size analysis. Thus, it is likely that the particle removal efficiency noted above represents the best filter operation, and may not be representative of normal day-to-day operation.

Based upon the results noted, it does not appear that the JelCleer filter alone provides adequate pre-treatment for the RO system with this difficult and highly variable surface seawater. If the JelCleer filter is used in a full scale plant treating surface seawater, additional pre-treatment should be considered.

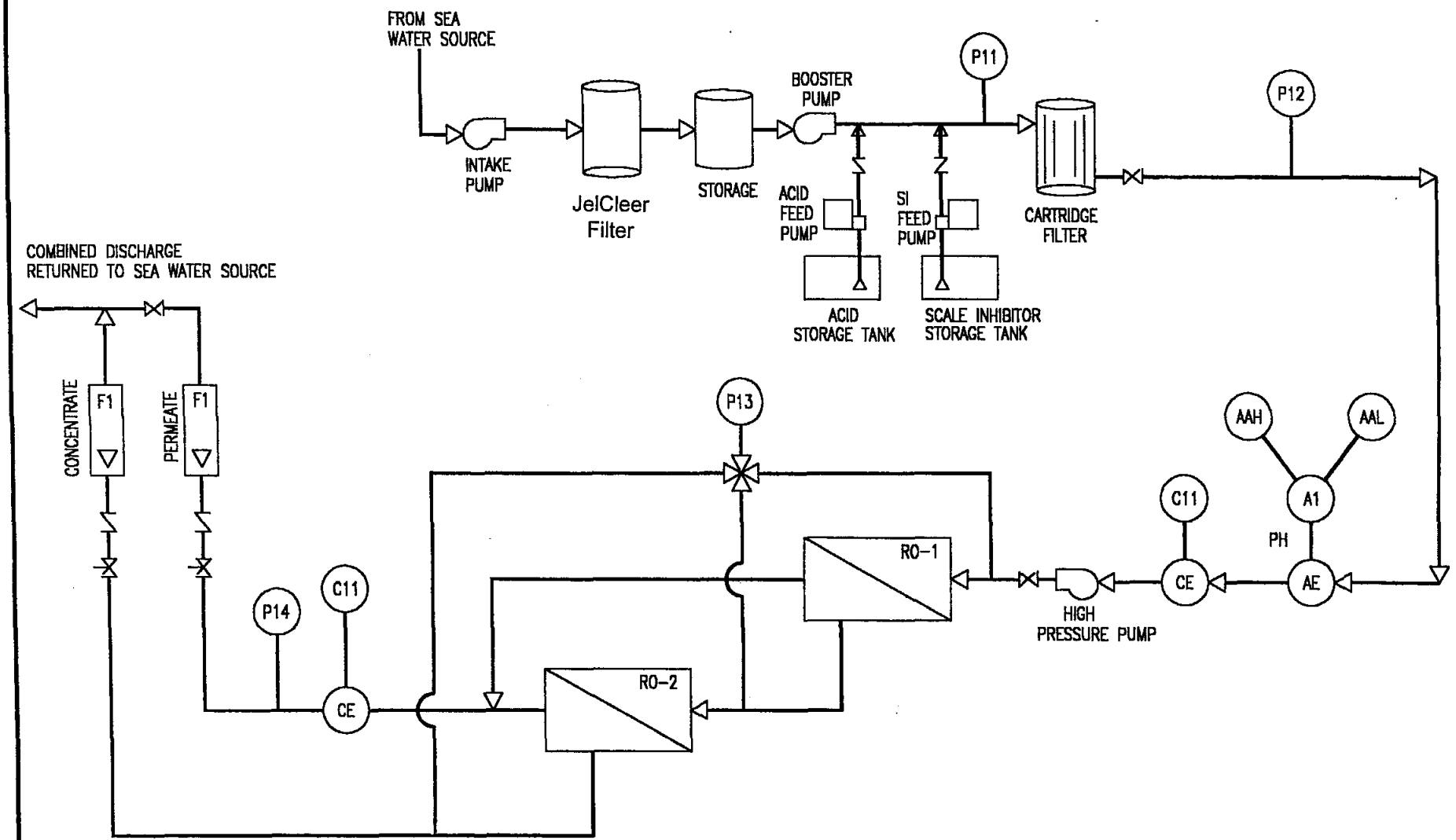
2.5 Reverse Osmosis Pilot Plant Description

This self-contained trailer mounted system, provided by Boyle Engineering Corporation, included the RO membranes housed in fiberglass pressure vessels, a chemical feed system, a Wheatley-Gasso quintuplex plunger pump capable of providing up to 1000 psig discharge pressure at 37 gpm delivered flow, a semiautomatic control system, and analytical instrumentation. The process and instrumentation diagram on Figure 2.2 illustrates the system.

The RO system comes standard with two fiberglass pressure vessels arranged into two stages in series. The two stages are interconnected such that the concentrate stream from stage one makes up the feed water for stage two. Each vessel houses three membrane elements for a total of six membranes. The Hydranautics Model 8040-HSY-SWC1spiral wound membrane elements were selected for this study. These are a new generation of high specific flux/high surface area thin film composite sea water membranes.

The chemical feed system allows for both scale inhibitor and acid to be introduced into the flow stream upstream of the membranes. The system includes two 25 gallon chemical storage tanks and chemical metering pumps. The pilot plant's control system monitors the chemical levels in each of the storage tanks and shuts the pilot plant down if the levels drops below a preset depth.

Analytical instrumentation installed on the RO system monitors water temperature, electrical conductivity of the feed and permeate flow streams, pH of the feed water, and pressures throughout the system. The RO control system monitors each of these parameters. Rotameters measure the concentrate, and permeate flow streams.



PROCESS AND INSTRUMENTATION DIAGRAM

Legend

F	Flowmeter	RO	Reverse Osmosis Unit
P	Pressure Gage	AE	Analyzer Element
C	Conductivity	A	Analyzer
CE	Conductivity Element	AAH	Analyzer Alarm High
		AAL	Analyzer Alarm Low

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NRS CONSULTING ENGINEERS

LAGUNA MADRE WATER DISTRICT
FIGURE 2.2
PROCESS & INSTRUMENTATION DIAGRAM
SEA WATER REVERSE OSMOSIS PILOT PLANT PROJECT

2.6 Pilot Plant Operation

The RO pilot unit was delivered to the Laguna Madre Water District on April 1, 1997. After set up and operator training to the District's staff, the pilot plant began operating on May 6, 1997 and ran during working hours (8:00 A.M. to 4:30 P.M.) for the three-month duration of the pilot study. Unmanned continuous operation was not possible because of the relatively short backwash intervals required by the JelCleer filter.

The operator would first turn on the intake pump and establish filtration through the JelCleer filter. If pressure drop through the filter indicated that backwashing would be required soon, he would perform the backwash prior to starting the RO. Otherwise, when the RO supply tank was full, he would start the RO.

When operation of the pilot was established, the operator would record operating data on the log sheet and take samples for analysis. Analyses performed by the District included inlet and filtered water turbidity of the JelCleer filter and permeate water turbidity and bacteriological analysis.

The primary means of measuring filter performance was the silt density index (SDI) test. This test measures the tendency of small particles contained by water to plug a 0.45 micron filter pad. The SDI test of the filtered water was generally measured twice a day.

The plant would be allowed to run through the day with operator supervision. Log sheet data was taken at approximately noon and again just before shutting the system down for the day. If filter pressure drop reached 15 psi, the RO system would be shut down and the filter backwashed. After backwash the RO system would be restarted when sufficient filtered water became available.

At the end of the day, the operator would shut down the RO system, and finally the intake pump. If necessary, the filter would be backwashed. The plant would then be shutdown for the night.

The District's operators recorded operating data twice a day. These readings consisted of feed water temperature, permeate and concentrate flow rates, pressures throughout the system including feed, concentrate, permeate, interstage, the pressure drop across the cartridge filter, and the electric conductivity of the feed and permeate flow streams. Samples of the feed and permeate were also taken and sent to a private laboratory for analysis of anions and cations.

The pilot plant began operation at a recovery of 30 percent. Recovery is defined as the percentage of feed water that is converted to "treated water" or permeate. This recovery was established from preliminary water quality analyses of the expected feed water. Table 2.2 summarizes the operating conditions of the pilot plant.

Table 2.2 - Pilot Plant Operating Conditions

Raw/Feed Water Flow Stream (gpm)	Permeate Flow Stream(gpm)	Concentrate Flow Stream (gpm)	Recovery
37.0	11.0	26.0	30%

2.7 Operating Data

The data collected at the pilot plant was tabulated and analyzed. The following discussion is a summary of the findings and conclusions of the analysis.

2.7.1 Pilot Plant

The reverse osmosis system was operated for a total of 225 hours during the pilot test. Essentially all of this time was during the daytime, as it was necessary to continuously monitor the operation of the pretreatment filter.

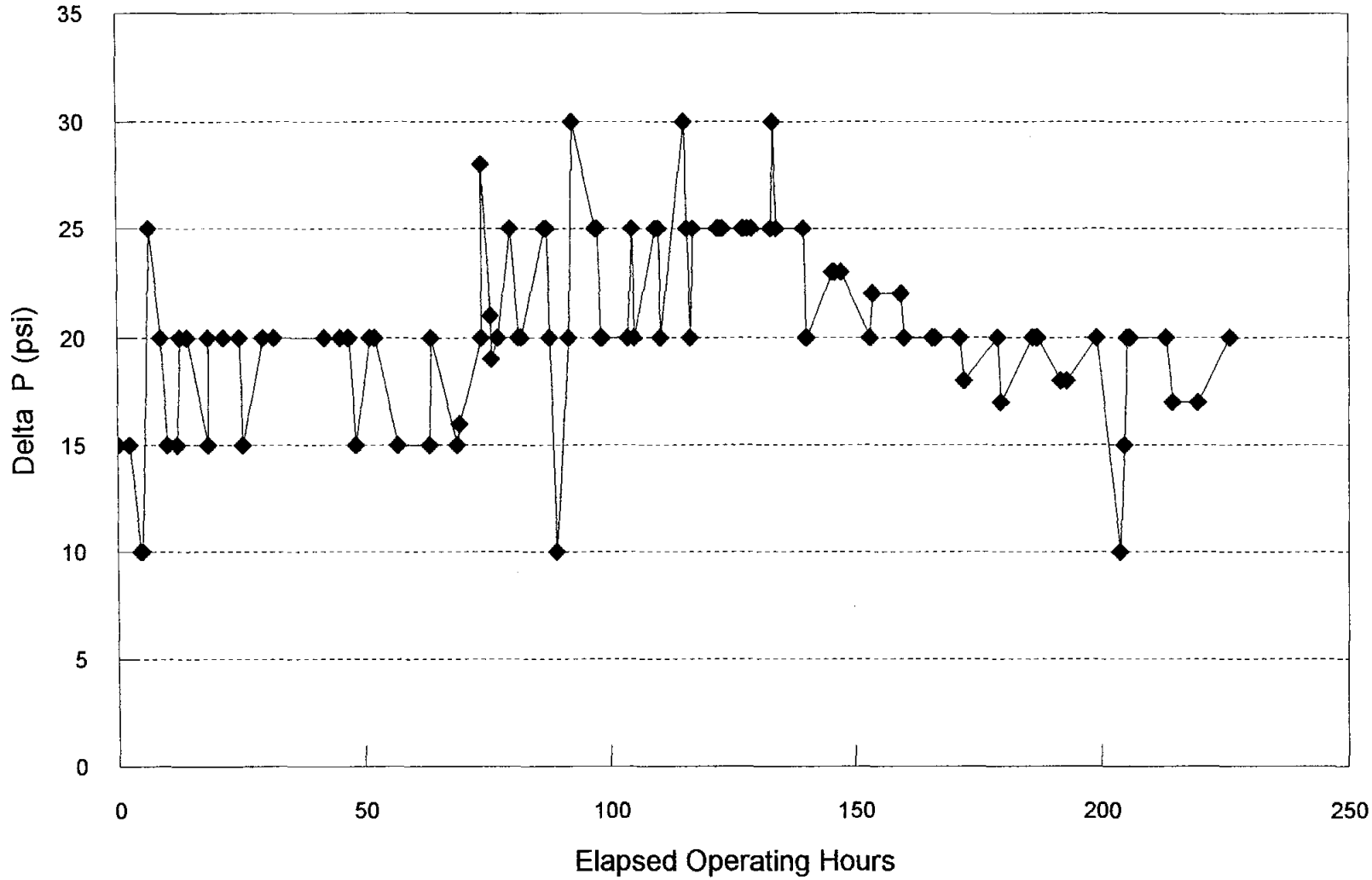
Because of the relatively small amount of time the RO plant was operated, it is difficult to make long-term projections of membrane performance. However, the relatively high solids content of the RO feedwater provided some data as to the performance of the membranes with a fouling feedwater.

The pilot RO unit operated at a relatively low average feed pressure of 735 pounds per square inch gage (psig). This low feed pressure resulted from several factors:

- The pilot operated at a relatively low recovery of 30 percent.
- The membrane flux was kept to 7 gallons per square foot per day (gfd).
- The membrane modules provided by Hydranautics are a new generation of high-specific flux, high surface area membrane.

The average net driving pressure required to produce the 7 gfd flux was 266 pounds per square inch (psi). The high solids content of the feedwater led to a relatively rapid buildup of pressure drop through the feed side of the membranes. Initial pressure drop (as can be seen in Figure 2.3, Delta Pressure) was around 15 psig. After about 100 hours of operation, the pressure drop had increased to about 25 psig. It should be noted that the pressure drop was calculated by subtracting the concentrate pressure from the feed pressure. These pressures were in the range of 700 psig, and were read from a pressure gauge with a full scale range of 1000 psig. It was impossible to read this gauge closer than 5 psi.

FIGURE 2.3
DELTA P (Feed - Concentrate)



The increased pressure drop indicates that material accumulated in the feed channel of the membranes. This material restricted the flow of water in the feed channel, increasing the pressure drop. The RO membranes were cleaned after about 200 hours of operation. It can be seen from Figure 2.3 that initial pressure drop for one reading only was restored by the cleaning, indicating that the cleaning was successful in removing the particulate material.

2.7.2 Membrane Performance

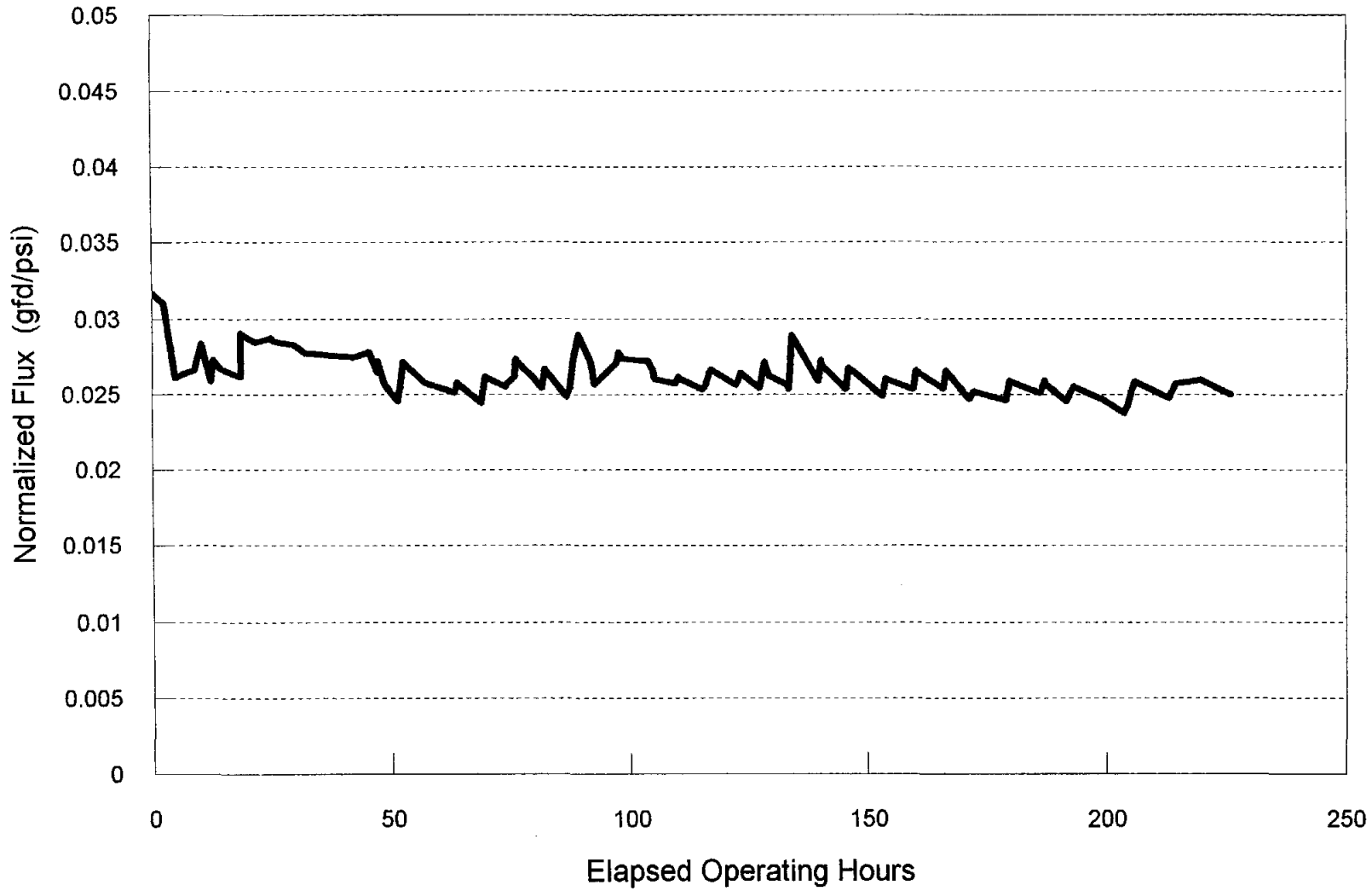
The performance of the membrane elements is generally monitored by observing the relationship between flux and pressure. Flux is expressed as permeate flow through a unit of membrane area measured in volume per square unit of membrane surface area per day. In the United States flux has the units of gallons per square foot per day or gfd . Normalizing the flux consists of compensating for feed water temperature fluctuations and for osmotic pressure, delta pressure, and permeate back pressure variations (a function of the feed, concentrate, and permeate TDS).

Ideally the normalized flux would be constant throughout the pilot study. A decrease in normalized flux indicates that the membranes are scaling or fouling and that additional pressure is required to produce the same permeate flow.

An increase in normalized flux indicates that less pressure is required to produce the same permeate flow. Increases in normalized flux generally indicates a shifting or tearing of the membranes which allows feed water to bypass the membranes. The normalized flux for the pilot plant is plotted against hours of operation in Figure 2.4.

Figure 2.4 shows that after an initial drop (common to placing new membranes in service) the normalized flux remained fairly constant, but with a very slight downward slope. Over the period of operation from about 4 hours to 200 hours, the normalized flux decreased from about 0.027 gallons per day per square foot per psi (gfd/psi) to about 0.025 gfd/psi, or about 7 percent. It is common practice to clean an RO system when the normalized flux has dropped about 15 percent. Assuming that flux continues to drop in a linear fashion, it could be expected that cleaning would be required after about 400 hours of continuous operation, or every 17 days. If operated at 8 hours per day, cleaning would take place every 50 days. This cleaning frequency is much higher than would normally be experienced with an RO plant and is a strong indication that the pre-treatment system was not performing adequately. As previously mentioned, the RO membranes were subjected to a chemical cleaning on July 25 after about 200 hours of operation in order to determine whether the normalized flux could be restored to its initial value. The cleaning consisted of a low-pH cleaning, a high pH and detergent cleaning, and a final flush. The cleaning was successful in reducing pressure drop through the membrane system approximately to its startup value. However, while normalized flux improved slightly, it was not returned to its startup level.

FIGURE 2.4
NORMALIZED FLUX



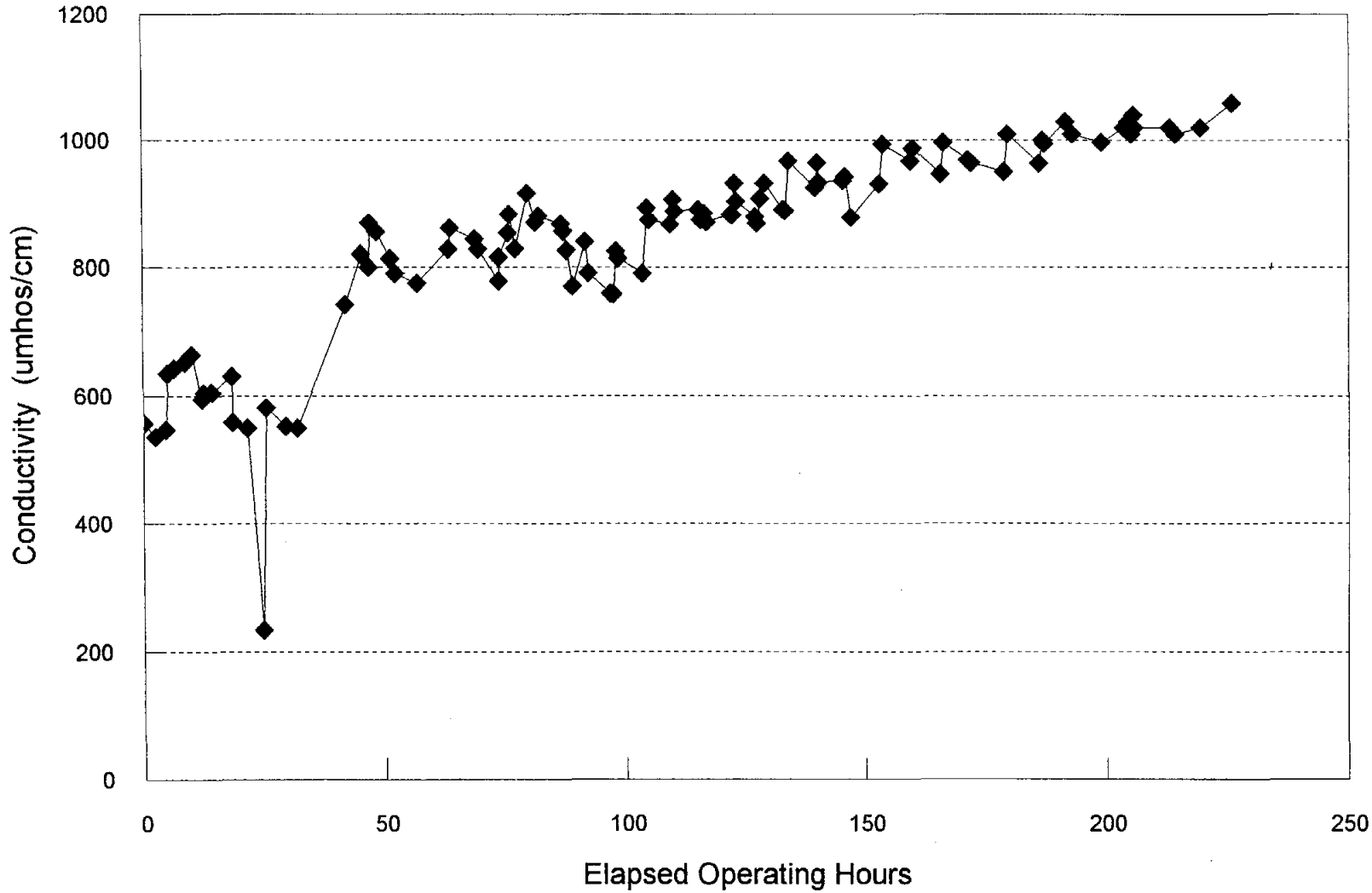
The average electrical conductivity of the feed water was 53,300 micromos per centimeter (umhos/cm), while the average conductivity of the permeate was 833 umhos/cm. This indicates an overall conductivity rejection of 98.4 percent. Initial permeate conductivity was about 580 umhos/cm (salt rejection of 98.9 percent). Figure 2.5 displays permeate conductivity over the course of the test. The figure shows a consistent increase in conductivity passage over the period of the test. The cause of this increase is undetermined, but it is hoped that analysis of the membranes after they are returned to the manufacturer will help determine the cause.

Samples of the RO permeate stream were taken on July 23 and delivered to a private laboratory for analysis. The analysis results are included in Appendix B, and summarized in Table 2.3 below. The TDS shown in the table represents approximately 1.3 percent of the TDS of seawater, indicating that actual salt rejection of the membranes was about 98.7 percent.

Table 2.3 - Permeate Analysis Results

Constituent	Value (mg/L)
Calcium	2.6
Magnesium	4.0
Sodium	162
Potassium	8
Bicarbonate	4
Chloride	249
Sulfate	35
Total Dissolved Solids	450

FIGURE 2.5
PERMEATE CONDUCTIVITY



2.8 Pilot Plant Conclusions

Based upon the information gathered in the pilot test, the following conclusions can be drawn:

- Reverse osmosis can successfully be practiced on the Laguna Madre sea water.
- Using the latest, high-specific flux, high surface area membranes allows for a lower net driving pressure operation, and hence a lower feed pressure to the membrane system than previous generation of membranes.
- Using the latest generation membranes, the energy requirement for producing a million gallons of potable water from sea water is about 22,000 kilowatt-hour (KWHr) at 30 percent recovery, dropping to about 14,650 KWHr at 50 percent recovery (assuming high pressure pump efficiency of 80 percent). This includes the energy necessary for filtering the incoming seawater.
- While chloride concentration of the permeate approaches the Secondary Standard of 250 mg/L, the water quality produced by the reverse osmosis process is generally very good compared to other South Texas locations. At higher recovery, feed pressure and flux will be higher and salt passage will be lower.
- The JelCleer filter is not by itself a sufficient pretreatment for surface sea water at this location.

CHAPTER 3 - FULL SCALE OPERATIONAL PARAMETERS

3.1 Full Scale Plant

For purposes of this analysis, it is considered an RO treatment facility capable of producing 1.0 mgd of product water at a 50% recovery. The pilot plant operated at a 30% recovery with an average feed pressure of 735 psig. Increasing the recovery to 50% will require a higher feed pressure (about 920 psig), but at a substantially reduced feed flow of 2.0 mgd versus 3.33 mgd at 30% recovery.

3.2 Source Water Quality

The quality of water is the most critical parameter with regard to membrane treatment processes. The options for source of water at South Padre Island include: open sea intake and shallow beach wells.

The use of an open sea intake could prove to be an expensive option. The major cost factors associated with an open sea intake include pipe layout, intake installation and permitting requirements. As with any surface water source the cost and feasibility of treatment begins with primary filtration systems designed to remove suspended or floating particles in the water source. The water quality from a sea intake would tend to be very inconsistent requiring the implementation of a pre-treatment filtration system.

The use of sea wells is the preferred option and will be the one utilized for cost purposes. The use of shallow beach wells allows the sea water source to be filtered by the sand rather than a pre-treatment system, so that it is generally not necessary to install pre-treatment filtration. In some cases, supplemental filtration may be required, but it is generally possible to use a less expensive filtration system than is required for an open sea intake. In an oceanfront setting, it is possible to pre-filter sea water using an infiltration system called "Ranney Collector" well that creates drawdown in the coastal setting, inducing the sea water to infiltrate into the beach sands and flow through the sands into the well screens placed horizontally beneath the beach. In this manner, suspended particles in the sea water are filtered out before reaching the membrane process, simplifying the treatment process and reducing treatment costs. A Ranney collector well essentially consists of a reinforced concrete caisson that extends below the ground surface with water well screens projected out horizontally from inside the caisson into the surrounding aquifer deposits. Since the well screen in a collector well is placed horizontally at depth, more drawdown is available, so that higher yields, per well site, are possible. This results in fewer wells being required to meet demand yields. For purposes of cost estimation only one well collector with two laterals at a depth of approximately 50 ft is considered to obtain a 2.0 mgd feedwater flow to the RO treatment plant.

3.3 Pre-treatment

The results of the pilot test indicate that the JelCleer filter by itself does not provide adequate pre-treatment for the RO system utilizing a surface sea water at this location. If the treatment system is provided with an open sea intake, it will be necessary to provide pre-treatment filtration for the reverse osmosis system. Based upon the high solids loading experienced during the operation of the pilot unit and the fact that a good percentage of the suspended solids appear to be very fine, there are two primary choices for pre-treatment: (1) conventional treatment with flocculation/sedimentation/filtration; and (2) membrane filtration.

Sludge disposal would be difficult on South Padre Island because of the lack of suitable disposal sites. Therefore, membrane filtration would be selected as the most appropriate method of pre-treatment for an open sea intake. Most membrane filtration systems presently in the United States are the "Memtech" microfilters provided by Memcor. The microfilters are provided as modular units, nominally rated at 1 million gallons per day (mgd). However, for waters containing significant suspended solids loadings, the filters should be operated at lower capacities.

As previously mentioned, however, the preferred option will be the use of shallow beach wells for which it is assumed no pre-treatment filtration will be required. The pilot study required both acid and scale inhibitor injection to prevent scale formation. Both of these pre-treatment processes will be required in the full scale plant.

3.4 Water Quality

The design feed water analysis along with the Fluid Systems ROPRO6 computer program was used to determine the expected full scale water quality. This projection includes the feed, concentrate, permeate and final product flow streams. Table 3.1 summarizes the expected water quality for each of the flow streams.

Table 3.1 - Water Quality Summary

Constituent	Process Streams			
	Feed (mg/L)	Concentrate (mg/L)	Permeate (Before Post-treatment) (mg/L)	Product (After Post-treatment) (mg/L)
Calcium	389	777.1	0.9	20
Magnesium	1,270	2,537.0	3.0	3.0
Sodium	10,400	20,681.5	118.5	118.5
Potassium	379	752.6	5.4	5.4
Strontium	7.12	14.2	0.0	0.0
Barium	nd	0.0	0.0	0.0
Bicarbonate	151	235.9	2.1	100
Sulfate	2,250	4,545.1	5.7	5.7
Chloride	19,300	38,407.4	192.6	192.6
Nitrate	0.0	0.0	0.0	0.0
Fluoride	1.3	2.6	0.0	0.0
Silicon Dioxide	4.0	8.0	0.0	0.0
TDS	35,074	67,954	328	450

The product water goal for this plant is to have a TDS of less than 500 mg/l as the most cost effective means of producing a better quality water than is currently.

3.5 Post-treatment

Post-treatment requirements include lime beds for pH adjustment and corrosion control and chlorine for disinfection.

3.6 Permitting

Permitting was an issue during implementation of this pilot project. Several governmental agencies were involved in this project. The U.S. Corps of Engineers had jurisdiction over the selected Jetties site. To conduct the study on government property and especially near the jetties a U.S. Corps of Engineers permit was required before implementation of this study. It took approximately two months to obtain this permit. In addition, the Environmental Protection Agency (EPA) required a permit for the temporary sea water intake and discharge. The Texas Natural Resource Conservation Commission (TNRCC) was advised and approved the pilot study. Appendix D compiles all permit correspondence. Thus, permitting the implementation of a full scale RO plant using an open sea intake could not only take quite sometime to obtain but could also become a major expense. Concentrate disposal will require a discharge permit regardless of the feed source (surface or beach wells) from the TNRCC and the EPA.

3.7 Concentrate Disposal

For the purposes of this analysis, it is expected that the concentrate discharge can be permitted to discharge into the Laguna Madre, a hyper saline water body.

3.8 Geological and Hydrogeological Investigation

To better define the feasibility and cost effectiveness of Ranney collectors, the geology and hydrogeologic conditions of prospective sites at South Padre Island must be evaluated to determine first if the site conditions appear favorable for developing a sea water supply. Then site-specific detailed testing must be conducted to calculate the necessary values for the hydraulic characteristics of the formation to enable well design and determination of well yields. The cost estimates prepared include the investigation of these geologic and hydrogeologic conditions at South Padre Island.

CHAPTER 4- PROJECTED COSTS

4.1 Treatment Facility

For the purpose of this cost projection, basic assumptions were made and the best available information, including surface sea water data, and actual pilot reverse osmosis operations, was used to determine the feasibility of treating sea water in the South Padre Island area. The projected capital cost for the treatment system is shown in Table 4.1.

4.1.1 Capital Cost Factors

- LOCATION - The initial planned location of the plant would be next to the existing Andy Bowie Wastewater Facility. This offers the advantage of utilizing existing offices and other site facilities already in existence at this site. In addition the concentrate could be blended with the effluent discharged from the wastewater facility to prevent fresh water inflows into the Laguna Madre. Other advantages would include improved pressure distribution resulting in a reduction of future water transmission capital expenditures. Figure 4.1 illustrates the proposed layout.

- SOURCE WATER QUALITY - The quality of water is the most critical parameter with regard to membrane treatment processes. A shallow beach water collector well is the selected most economical option for source of sea water supply at South Padre Island.

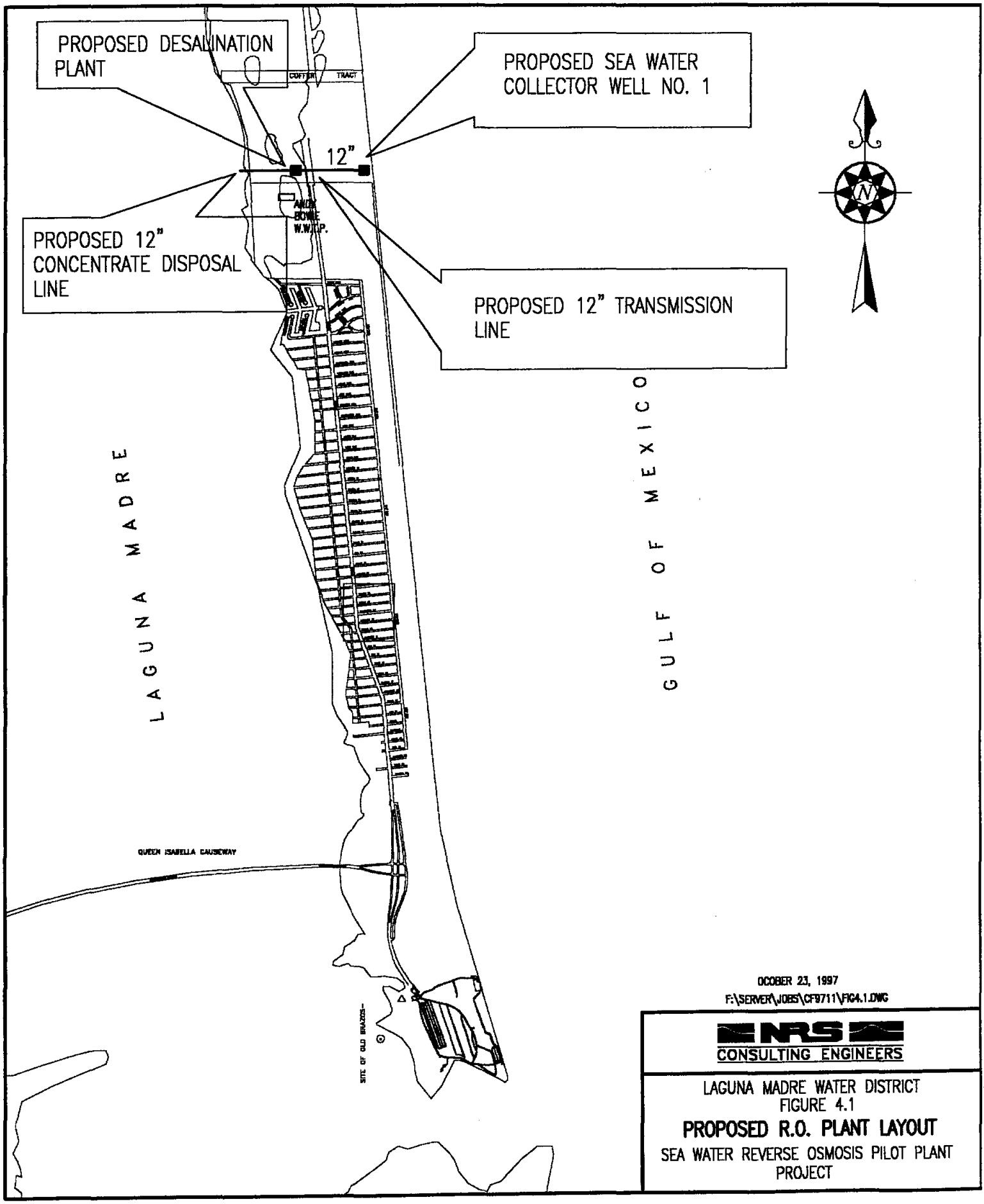
- CONCENTRATE DISPOSAL -. For the purposes of this analysis, it is expected that the concentrate from the membrane process can be permitted to discharge into the Laguna Madre, a hyper saline water body. This is shown in Figure 4.1.

- SIZE OF FACILITY - For purposes of this analysis, it is considered a treatment facility with a capacity of 1.0 mgd product water.

- WATER RIGHTS - The Laguna Madre Water District as an ongoing process, purchases rights to obtain surface water from the Rio Grande. These rights, if available, are purchased at an approximate rate of $800 per acre-foot. This one time capital charge was deducted from the capital cost of the project since there are no water rights required for the use of sea water.

Table 4.1 - Projected Capital Cost for Reverse Osmosis System

CAPITAL COSTS	COST
SEA WATER COLLECTOR WELL	
COLLECTOR WELL	$1,100,000
PUMPS AND CONTROLS	$200,000
PUMP HOUSE	$75,000
TEST DRILLING	$150,000
PROPERTY	$30,000
TRANSMISSION PIPING	$50,000
REVERSE OSMOSIS SYSTEM	
MEMBRANE SYSTEM	$1,000,000
FEED PUMPS	$200,000
ENERGY RECOVERY TURBINE	$100,000
CLEANING SYSTEM	$75,000
INSTRUMENTATION AND CONTROLS	$300,000
CONCENTRATE DISPOSAL PIPING	$50,000
CONCENTRATE DISPOSAL PERMITTING	$100,000
START UP AND TRAINING	$80,000
SUPPORT SYSTEMS	
BUILDING	$600,000
CHEMICAL FEED SYSTEMS (Pretreatment & Post-treatment)	$300,000
TREATMENT BUILDING PIPING	$170,000
ELECTRICAL	$350,000
STORAGE	$500,000
HIGH SERVICE PUMP STATION	$200,000
SITE CIVIL	$150,000
TOTAL CONSTRUCTION COSTS	**$5,780,000**
CONTR OH &V PROFIT @ 25%	$1,445,000
Engr. Fiscal, Legal Admin @ 20%	$1,156,000
Continency @ 20%	$1,156,000
TOTAL RO SYSTEM COSTS	**$9,537,000**



OCOBER 23, 1997
F:\SERVER\JOBS\CF9711\FIG4.1.DWG

NRS CONSULTING ENGINEERS

LAGUNA MADRE WATER DISTRICT
FIGURE 4.1
PROPOSED R.O. PLANT LAYOUT
SEA WATER REVERSE OSMOSIS PILOT PLANT PROJECT

4.1.2 Operational Cost Factors

- PRE-TREATMENT - A major factor in the operational cost of membrane treatment is attributed with the quality of water. It is projected that sulfuric acid will need to be added for pH adjusted prior to the membrane process and an antiscalant will be utilized to prevent premature fouling of the membranes.

- POST-TREATMENT - It is projected that caustic soda will need to be added for pH adjusted after the membrane treatment process. Additional post-treatment such as lime beds would be required for corrosion control and chlorine for disinfection.

- MEMBRANE REPLACEMENT - In a properly operated plant, membranes can be expected to last 4 to 10 years, depending upon pret-treatment and the frequency of cleaning. With properly designed sea water collector wells, it should be possible to obtain at least a five-year membrane life.

- LABOR - Labor can be expected to require at least one operator working eight (8) hours per day, seven (7) days a week, and one (1) maintenance technician working half-time at the treatment plant, for a total of 80 hours per week

- ENERGY COSTS -Power cost have a significant impact on the overall O&M cost. power costs. It is considered a cost of $0.07 per KW.

4.2 Cost Analysis

A summary of costs which includes total capital costs and an operation and maintenance cost analysis can be found in Table 4.2. An interest rate of 6% was used to arrive at an annual payment for capital costs for 20 years.

Table 4.2 - Summary of Costs for RO System

CAPITAL COST PROJECTIONS	PHASE I
SEAWATER COLLECTOR WELL	$1,605,000
REVERSE OSMOSIS	$1,905,000
SUPPORT SYSTEMS	$2,270,000
TOTAL CONSTRUCTION COSTS	$5,780,000
OVERHEAD AND PROFIT @ 25%	$1,445,000
ENG., FISCAL, LEGAL & ADMIN @ 20%	$1,156,000
CONTINGENCIES @ 20%	$1,156,000
TOTAL CONSTRUCTION	$9,537,000
LESS WATER RIGHTS VALUE	($900,000)
TOTAL CAPITAL COSTS	$8,637,000
PRODUCT WATER, MGD	1.0
ANNUAL DEBT SERVICE @ 6%, 20 YRS.	$753,013
DEBT SERVICE PER 1000 GALLONS	**$2.06**
OPERATION AND MAINTENANCE PROJECTIONS	
POWER @ $0.07/KWH	$467,000
MEMBRANE REPLACEMENT	$50,000
CHEMICAL	$61,000
LABOR	$85,000
MAINTENANCE	$50,000
CARTRIDGE FILTER REPLACEMENT	$15,000
TOTAL TREATMENT O&M PER YEAR	$728,000
OPERATIONAL COST/1000 GALLONS	**$1.99**
TOTAL ANNUAL COST	
TOTAL $$ PER YEAR	$1,481,013
TOTAL $$/1,000 GALLONS	**$4.06**
TOTAL $$/ACRE FOOT OF WATER PRODUCED	$1,322.07

APPENDIX A
WELL DRILLING INFORMATION

FROM: 5124451488 1997-03-14(FRI) 11:11 PAGE:02

State of Texas
WELL REPORT

ATTENTION OWNER: Confidentiality Privilege Notice on reverse side of Well Owner's copy (pink)

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087
512-239-0880

1) OWNER Laguna Madre Water District (Name) ADDRESS 105 Port Rd (Street or RFD) Port Isabel (City) TX (State) 78578 (Zip)

2) ADDRESS OF WELL: County Cameron Padre Blvd (Street, RFD or other) South Padre Island, Texas 78578 (City) (State) (Zip) GRID # 88-55-8

3) TYPE OF WORK (Check): [x] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [ ] Public Supply [ ] De-watering [x] Test well
If Public Supply well, were plans submitted to the TNRCC? [ ] Yes [ ] No

5)

6) WELL LOG:
Date Drilling: Started 11-20-96 Completed ____ 19__

DIAMETER OF HOLE	Dia. (in.)	From (ft.)	To (ft.)
	9-7/8	Surface	25

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [x] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other ____

N

From (ft.)	To (ft.)	Description and color of formation material
0	18	Light brown sand & shale
18	25	Blue clay

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): [ ] Open Hole [ ] Straight Wall [ ] Underreamed [x] Gravel Packed [ ] Other ____
If Gravel Packed give interval ... from 0 ft. to 25 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	new	Plastic	0	5	
4	new	Slotted	5	25	.010

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 25 ft. No. of sacks used 3
____ ft. to ____ ft. No. of sacks used ____
Method used Tremi pipe
Cemented by Texas Water Development Board
Distance to septic system field lines or other concentrated contamination ____ ft.
Method of verification of above distance ____

10) SURFACE COMPLETION
[ ] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[x] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 10 ft. below land surface Date 11-20-96
Artesian flow ____ gpm. Date ____

12) PACKERS:

Type	Depth
None	

13) TYPE PUMP:
[ ] Turbine [ ] Jet [x] Submersible [ ] Cylinder
[ ] Other ____
Depth to pump bowls, cylinder, jet, etc. 21 ft.

14) WELL TESTS:
Type test: [x] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: 60 gpm with 21 ft. drawdown after 3 minutes

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [x] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ____ Depth of strata ____
Was a chemical analysis made? [ ] Yes [ ] No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2327 WT

ADDRESS 1700 Hydro Dr. (Street or RFD) Austin (City) Texas (State) 78728-7225 (Zip)

(Signed) ____ (Licensed Well Driller) (Signed) ____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

[redacted] mail to: TNRCC, MC 177, P.O. Box 13087, Austin, TX 78711-3087

State of Texas WELL REPORT

Texas Water Well Drillers Advisory Council
MC 177
P.O. Box 13087
Austin, TX 78711-3087

1) OWNER Laguna Madre Water District (Name) ADDRESS 105 Port Rd. (Street or RFD) Port Isabel (City), TX (State) 78578 (Zip)

2) ADDRESS OF WELL: County Cameron Padre Blvd., South Padre Island, Texas 78578 (Street, RFD or other) (City) (State) (Zip) GRID # 88-65-9

3) TYPE OF WORK (Check): [X] New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering [X] Testwell
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

6) WELL LOG:
Date Drilling:
Started 11-19-96 19
Completed 11-19-96 19

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
12-3/4	Surface	10
9-7/8	10	50

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary [X] Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other ______

From (ft.)	To (ft.)	Description and color of formation material
0	18	Light brown sand, shale
18	50	Brown & blue clay

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed [X] Gravel Packed ☐ Other
If Gravel Packed give interval ... from 0 ft. to 50 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casting Screen
4	New	Plastic	0	20	
4	New	Slotted	20	50	.010

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 50 ft. No. of sacks used 4
______ ft. to ______ ft. No. of sacks used ______
Method used Trem pipe
Cemented by Texas Water Development Board
Distance to septic system field lines or other concentrated contamination ______ ft.
Method of verification of above distance ______

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
[X] Approved Alternative Procedure Used [Rule 338.71]

11) WATER LEVEL:
Static level 10 ft. below land surface Date 11-19-96
Artesian flow ______ gpm. Date ______

12) PACKERS: Type Depth
None

13) TYPE PUMP:
☐ Turbine ☐ Jet [X] Submersible ☐ Cylinder
☐ Other ______
Depth to pump bowls, cylinder, jet, etc., ______ ft.

14) WELL TESTS:
Type test: [X] Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 60 gpm with 42 ft. drawdown after 3 minutes

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? ______ Depth of strata ______
Was a chemical analysis made? ☐ Yes ☐ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2327 WI

ADDRESS 1700 Hydro Drive (Street or RFD) Austin (City) Texas (State) 78728-7725 (Zip)

(Signed) [signature] (Licensed Well Driller) (Signed) [signature] (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) *White - TNRCC* *Yellow - DRILLER* *Pink - WELL OWNER*

ATTENTION Owner: Complete and Privilege Notice on reverse side of Well Owner's copy (pink)

State of Texas
WELL REPORT

Texas Water Development Board
P.O. Box
Austin, TX 78711-3087

1) OWNER Laguna Madre Water District (Name) ADDRESS 105 Port Rd. (Street or RFD) Port Isabel (City) TX (State) 78578 (Zip)

2) ADDRESS OF WELL: County Cameron Gulf Blvd., South Padre Island, Texas 78578 (Street, RFD or other) (City) (State) (Zip) GRID # 68-62-3

3) TYPE OF WORK (Check): [X] New Well ☐ Deepening ☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check): ☐ Monitor ☐ Environmental Soil Boring ☐ Domestic ☐ Industrial ☐ Irrigation ☐ Injection ☐ Public Supply ☐ De-watering [X] Test well
If Public Supply well, were plans submitted to the TNRCC? ☐ Yes ☐ No

5)

6) WELL LOG:
Date Drilling: Started 12-03 19 96 Completed 12-03 19 96

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
9-7/8	Surface	45

7) DRILLING METHOD (Check): ☐ Driven ☐ Air Rotary [X] Mud Rotary ☐ Bored ☐ Air Hammer ☐ Cable Tool ☐ Jetted ☐ Other

From (ft.)	To (ft.)	Description and color of formation material
0	18	Light brown sand, shale
18	45	Blue & brown clay

(Use reverse side of Well Owner's copy, if necessary)

8) Borehole Completion (Check): ☐ Open Hole ☐ Straight Wall ☐ Underreamed [X] Gravel Packed ☐ Other
If Gravel Packed give interval... from 0 ft. to 45 ft.

CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	New	Plastic	0	5	
4	New	Slotted	5	45	.020

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 45 ft. No. of sacks used 4
ft. to ft. No. of sacks used
Method used Trem pipe
Cemented by Texas Water Development Board
Distance to septic system field lines or other concentrated contamination ft.
Method of verification of above distance

10) TYPE PUMP:
☐ Turbine ☐ Jet [X] Submersible ☐ Cylinder ☐ Other
Depth to pump bowls, cylinder, jet, etc. 42 ft.

10) SURFACE COMPLETION
☐ Specified Surface Slab Installed [Rule 338.44(2)(A)]
☐ Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
☐ Pitless Adapter Used [Rule 338.44(3)(b)]
[X] Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: [X] Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: 60 gpm with 42 ft. drawdown after 3 minutes

11) WATER LEVEL:
Static level 10 ft. below land surface Date 12-03-96
Artesian flow gpm. Date

16) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
☐ Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Depth of strata
Was a chemical analysis made? ☐ Yes ☐ No

12) PACKERS: Type Depth
None

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Texas Water Development Board (Type or print) WELL DRILLER'S LICENSE NO. 2387 WT

ADDRESS 1700 Hydro Dr. (Street or RFD) Austin (City) Texas (State) 78728-7725 (Zip)

(Signed) (Licensed Well Driller) (Signed) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

TNRCC-0199 (Rev. 05-21-96) White - TNRCC Yellow - DRILLER Pink - WELL OWNER

APPENDIX B
SEAWATER QUALITY

CHEMICAL ANALYSIS

(1) Location:

Jetties Site Location

(2) Sampling Point:

Sea Water Source

(3) Date:

Various (See Enclosed Table)

(4) Analysis:

Total Suspended Solids
pH
Temperature
Oil and Grease
Anions and Cations

NRS CONSULTING ENGINEERS

1222 E. Tyler Suite C
P.O. Box 2544
Harlingen, Texas 78551
Phone (210) 423-7409
Fax (210) 423-7482

MEMORANDUM

Date: January 13, 1997 LA9501

From: Jesus Leal, NRS Engineers

To: Mark Hurley, Boyle Engineering
Chris Martin, Boyle Engineering

Subject: South Padre Island R.O. Pilot Unit

The Laguna Madre Water District has been collecting samples twice a day at the proposed site location of the R.O. pilot unit. These are the results for TSS, pH, and Temperature.

DATE	TSS (mg/L)		pH		TEMPERATURE(°C)	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
1/7/97	64.8	79.2	8.1	-------	11.3	-------
1/8/97	92.1	96.1	8.2	-------	8.9	-------
1/9/97	38.4	54.8	8.2	-------	9.7	-------
1/10/97	42.8	43.2	8.2	-------	14.2	-------

The results on the TSS have been performed by allowing any collected sand in the sample to settle before performing the TSS analysis. I have asked the laboratory to perform pH and Temperature in the afternoons also. The District will continue sampling and conducting these analyses all week.

Jesus

cc: Bill

NRS CONSULTING ENGINEERS

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Harlingen, Texas 78551
Phone (210) 423-7409
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CF9611

MEMORANDUM

Date: January 22, 1997

From: Jesus Leal, NRS Engineers

To: Ian Watson, Boyle Engineering
Mark Hurley, Boyle Engineering
Chris Martin, Boyle Engineering

Subject: South Padre Island R.O. Pilot Unit
Testing Update

The Laguna Madre Water District has continued collecting samples twice a day at the proposed site location of the R.O. pilot unit. These are all the analyses results for TSS, pH, and Temperature..

DATE	TSS (mg/L)		pH		TEMPERATURE(°C)	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
1/7/97	64.8	79.2	8.1	-------	11.3	-------
1/8/97	92.1	96.1	8.2	-------	8.9	-------
1/9/97	38.4	54.8	8.2	-------	9.7	-------
1/10/97	42.8	43.2	8.2	-------	14.2	-------
1/13/97	168.1 (*)	303.2 (*)	8.3	8.2	9.0	7.0
1/14/97	187.2 (*)	174.4 (*)	8.2	8.2	9.0	6.0
1/15/97	85.6	100.0	8.2	8.1	9.0	11.0
1/16/97	44.8	48.4	8.2	8.1	8.0	10.0
1/17/97	28.8	46.0	8.2	8.2	8.5	12.0

(*) TSS Results on these two days include the collected sand in the sample

The results on the TSS have been performed by allowing any collected sand in the sample to settle before performing the TSS analysis (except on 1/13/97 and 1/14/97). I have asked the District to send samples to a private laboratory to perform Oil and Grease analysis.

I have asked the District to stop sampling for TSS, pH, and Temperature. . Please let me know if additional testing is necessary to determine pre-treatment requirements. Give us a call when ready to discuss pre-treatment requirements

Saludos,

Jesus

cc: Bill Norris

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THE COMPLETE SERVICE LAB

P. O. BOX 9000 – KILGORE, TEXAS 75663-9000 – 903/984-0551 – FAX 903/984-5914

Analytical Chemistry • Utility Operations

TEST REPORT: R16209

Laguna Madre Water District
105 Port Rd.
Port Isabel, TX 78578-
Attention: Memo Perez

Sample Identification: Jetties Project
Collected By: Jarrod Martinez
Date & Time Taken: 01/24/97 1345

Bottle Data:

#01 - O&G (Hexane Rinsed w/H2SO4-Teflon Lid)
#02 - O&G (Hexane Rinsed w/H2SO4-Teflon Lid)

Sample Matrix: Aqueous Liquid
Report Date: 02/03/97 **Received:** 01/24/97 **Client:** CAM5

PARAMETER	RESULTS	UNITS	ANALYZED	MAL	METHOD	BY
Oil & Grease	ND	mg/l	1345 01/31/97	6	EPA Method 413.1	EAH

Quality Assurance for the SET with Sample R16209

Sample #	Description	Result	Units	Dup/Std Value	Spk Conc.	Percent	Time	Date	By
				Oil & Grease					
	Blank	-0.0002	grams				1345	01/31/97	EAH
	Standard	21	mg/l	20		105	1345	01/31/97	EAH
R16208	Duplicate	ND	mg/l	ND		0	1345	01/31/97	EAH
R16209	Spike		grams		.1032	92	1345	01/31/97	EAH

MAL is our Minimum Analytical Level/Minimum Quantitation Level. The MAL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL), and any dilutions and/or concentrations performed during sample preparation (EQL).

Our analytical result must be above this MAL before we report a value in the "Results" column of our report. Otherwise, we report ND (Not Detected above MAL), because the result is "<" (less than) the number in the MAL column.

I certify that the results were generated using the above specified methods.

C. H. Whiteside, Ph.D., President

Laguna Madre Sampling Results, BC Labs, January 2, 1997

Ca	389
Mg	1270
Na	10,400
K	379
HCO3	151
SO4	2250
Cl	19,300
NO3	nd
pH	8.19
EC	62,500
TDS	21,100
TSS	9
NVOC	2
Ba	nd
Silica	0.42
Sr	7.12
Oil & Grease	1.4

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) Sampling Point:

JelCleer Filter Influent

(3) Date:

7/23/97

(4) Analysis:

Total Organic Carbon

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Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 350223

Sample Identification: ***Gel-Filter Influent***
Date & Time Taken: ***07/23/97*** ***1245***
Collected By: ***JAJ***
Sample Matrix: ***Liquid Aqueous***
Received: ***07/23/97*** *Client:* ***NRS*** *Report Date:* ***08/11/97***

Results for Sample 350223

	Parameter	Results	Units	EQL
001	Total Organic Carbon	12.6	mg/l	.4

Analytical Details for Sample 350223

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	Total Organic Carbon		EPA 415.2	02	08/07/97 1300	WOB

Sample Preparation Steps for 350223

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/11/97	10:54	KEK

Bottle Data for Sample 350223

Bottle	Derived in Lab From
#01 - Sm Plastic w/1+1 H2SO4	
#02 - Sm Plastic w/1+1 H2SO4	

Quality Assurance for the SET with Sample 350223

Sample	Description	Result	Value	Units	%
Total Organic Carbon (Analyzed: 08/07/97 1300 WOB		**Verified: 08/11/97 1006 WJP)**			
	Standard	10.0	10.0	mg/l	100
	Standard	10.1	10.0	mg/l	101
350595	Duplicate	0.6	0.6	mg/l	0
350595	Spike		10.0	mg/l	97

ACCREDITED

Continued

MEMBER ACIL

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Analytical Chemistry • Utility Operations

TEST REPORT: 350223

Quality Assurance for the SET with Sample 350223

Sample	Description	Result	Value	Units	%
Total Organic Carbon (Analyzed: 08/07/97 1300 WOB Verified: 08/11/97 1006 WJP)					
	LCS	5.14	4.90	mg/l	105

Bottle Tracking for Sample 350223

Bottle #: 01 Sm Plastic w/1+1 H2SO4			
07/24/97	20:36	AAJ	Login
07/24/97	20:36	AAJ	Main Walk In Cooler in Main
Bottle #: 02 Sm Plastic w/1+1 H2SO4			
07/24/97	20:36	AAJ	Login
07/24/97	20:36	AAJ	Main Walk In Cooler in Main

EQL is Estimated Quantitation Limit. The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

I certify that the results were generated using the above specified methods.

C. H. Whiteside, Ph.D., President

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) Sampling Point:

JelCleer Filter Effluent

(3) Date:

7/23/97

(4) Analysis:

Total Organic Carbon

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Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 350222

Sample Identification: ***Gel-Filter Effluent***
Date & Time Taken: ***07/23/97*** ***1250***
Collected By: ***JAJ***
Sample Matrix: ***Liquid Aqueous***
Received: ***07/23/97*** *Client:* ***NRS*** *Report Date:* ***08/11/97***

Results for Sample 350222

	Parameter	Results	Units	EQL
001	Total Organic Carbon	1.1	mg/l	.4

Analytical Details for Sample 350222

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	Total Organic Carbon		EPA 415.2	01	08/07/97 1300	WOB

Sample Preparation Steps for 350222

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/11/97	10:54	KEK

Bottle Data for Sample 350222

Bottle	Derived in Lab From
#01 - Sm Plastic w/1+1 H2SO4	
#02 - Sm Plastic w/1+1 H2SO4	

Quality Assurance for the SET with Sample 350222

Sample	Description	Result	Value	Units	%
Total Organic Carbon (Analyzed: 08/07/97 1300 WOB Verified: 08/11/97 1005 WJP)					
	Standard	10.0	10.0	mg/l	100
	Standard	10.1	10.0	mg/l	101
350595	Duplicate	0.6	0.6	mg/l	0
350595	Spike		10.0	mg/l	97

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Analytical Chemistry • Utility Operations

TEST REPORT: 350222

Quality Assurance for the SET with Sample 350222

Sample	Description	Result	Value	Units	%
Total Organic Carbon (Analyzed: 08/07/97 1300 WOB Verified: 08/11/97 1005 WJP)					
	LCS	5.14	4.90	mg/l	105

Bottle Tracking for Sample 350222

Bottle #: 01 Sm Plastic w/1+1 H2SO4			
07/24/97	20:33	AAJ	Login
07/24/97	20:33	AAJ	Main Walk In Cooler in Main
Bottle #: 02 Sm Plastic w/1+1 H2SO4			
07/24/97	20:33	AAJ	Login
07/24/97	20:33	AAJ	Main Walk In Cooler in Main

EQL is Estimated Quantitation Limit. The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

I certify that the results were generated using the above specified methods.

C. H. Whiteside, Ph.D., President

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) JelCleer Filter Influent

(3) Date:

8/14/97

(4) Analysis:

Particle Count

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Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 351952

Sample Identification: ***Gel-Filter Influent***
Date & Time Taken: ***08/14/97*** ***1605***
Collected By: ***Client***
Sample Matrix: ***Liquid Aqueous***
Received: ***08/15/97*** *Client:* ***NRS*** *Report Date:* ***08/23/97***

Results for Sample 351952

	Parameter	Results	Units	EQL
001	Particle Count	See Attached		

Analytical Details for Sample 351952

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	Particle Count				08/22/97	COU

Sample Preparation Steps for 351952

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/22/97	16:27	KEK

Bottle Data for Sample 351952

Bottle	Derived in Lab From
#01 - Unpreserved	

Bottle Tracking for Sample 351952

Bottle #: 01 Unpreserved

08/15/97	14:28	SKL	Login
08/15/97	14:28	SKL	Main Walk In Cooler in Main

EQL is Estimated Quantitation Limit. The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

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TEST REPORT: 351952

These analytical results relate to the sample tested. This report may not be reproduced except in full without written approval of Ana-Lab Corp.

I certify that the results were generated using the above specified methods.

Bill Peery, Jr., M.S., Lab Manager

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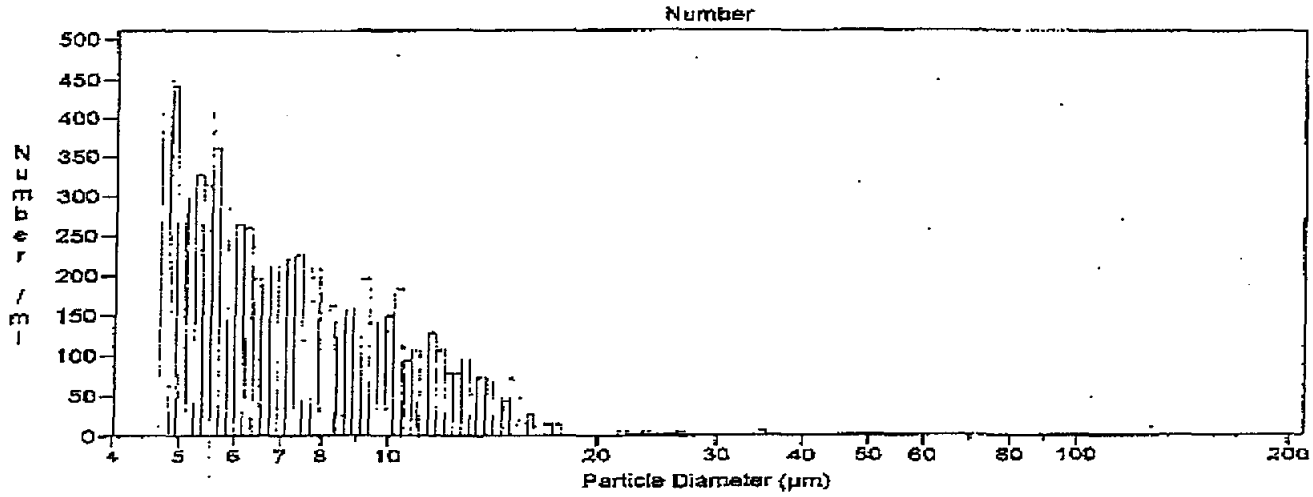
COULTER

MULTISIZER AccuComp® 1.19

Filename:	13045.#01	Sample Number:	0
Group ID:	13045		
Sample ID:	ANA LAB		
Comment:	WATER, LOT= 351952-01		
Operator:	JC		
Electrolyte:	ISOTON		
Dispersant:	NO		
Aperture Size:	200 µm	Aperture Current:	3200 uA
Channels:	128	Kd:	2151
Full Data, Log Diameter		Gain:	1
Control Method:	Siphon 2000 ul		
Elapsed Time:	11.8 Seconds		
Raw Count:	1955		
Coinc. Corr. Count:	1983		
Acquired:	14:55 22 Aug 1997		
Serial Number:	21403444		
Electrolyte Vol:	150 ml		
Analytic Volume:	2000 ul		
Sample:	20 ml		



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COULTER

MULTISIZER AccuComp® 1.19

Number Statistics (Arithmetic) 13045.#01

Calculations from 4.197 µm to 146.0 µm

Number	1928			
Mean:	7.623 µm	95% Conf. Limits:	7.496-7.750 µm	
Median:	6.763 µm	S.D.:	2.84 µm	
Mean/Median Ratio:	1.127	Variance:	8.07 μm^2	
Mode:	4.755 µm	C.V.:	37.3%	
Spec. surf. area:	0.595 m^2/ml	Skewness:	1.73	Right skewed
		Kurtosis:	6.32	Leptokurtic

% >	10	25	50	75	90
Size µm	11.59	9.134	6.763	5.436	4.935

13045.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
1	4.197	0	100.00	0	8,194
2	4.315	0	100.00	0	8,194
3	4.437	0	100.00	0	8,194
4	4.561	0	100.00	0	8,194
5	4.690	0.888	100.00	450.5	8,194
6	4.822	0.945	99.11	442	7,743.5
7	4.957	0.987	98.17	425	7,301.5
8	5.096	0.751	97.18	297.5	6,876.5
9	5.240	0.898	96.43	327.25	6,579
10	5.387	0.937	95.53	314.5	6,251.75
11	5.538	1.17	94.60	361.25	5,937.25
12	5.694	1.00	93.43	284.75	5,576
13	5.854	0.943	92.42	246.5	5,291.25
14	6.019	1.10	91.48	283.5	5,044.75
15	6.188	1.17	90.39	259.25	4,761.25
16	6.362	0.960	89.21	195.5	4,522
17	6.541	0.998	88.25	167	4,326.5
18	6.725	1.23	87.26	212.5	4,139.5
19	6.914	1.29	86.03	204	3,927
20	7.108	1.51	84.74	221	3,723
21	7.308	1.68	83.23	225.25	3,502
22	7.514	1.99	81.55	246.5	3,276.75
23	7.725	1.83	79.56	208.25	3,030.25
24	7.942	1.62	77.73	170	2,822
25	8.165	1.68	76.10	161.5	2,652
26	8.395	1.73	74.43	153	2,490.5
27	8.631	1.93	72.70	157.25	2,337.5
28	8.873	1.84	70.77	123.25	2,180.25
29	9.123	2.83	69.13	195.5	2,057
30	9.379	2.21	66.30	140.25	1,861.5
31	9.643	2.33	64.10	136	1,721.25

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13045.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
32	9.914	2.76	61.77	148.75	1,585.25
33	10.19	3.69	59.01	182.75	1,436.5
34	10.48	2.05	55.32	93.5	1,253.75
35	10.77	2.53	53.26	106.25	1,160.25
36	11.08	2.97	50.73	114.75	1,054
37	11.39	3.59	47.76	127.5	939.25
38	11.71	3.25	44.17	106.25	811.75
39	12.04	2.54	40.92	76.5	705.5
40	12.38	2.76	38.37	76.5	629
41	12.72	3.67	35.61	93.5	552.5
42	13.08	3.45	31.93	80.75	459
43	13.45	3.35	28.49	72.25	378.25
44	13.83	3.43	25.14	68	306
45	14.22	2.56	21.71	46.75	238
46	14.62	2.53	19.15	42.5	191.25
47	16.03	3.02	16.62	46.75	148.75
48	15.45	1.20	13.59	17	102
49	15.88	1.95	12.40	25.5	85
50	16.33	1.41	10.45	17	59.5
51	16.79	1.15	9.04	12.75	42.5
52	17.26	1.25	7.89	12.75	29.75
53	17.75	0	6.64	0	17
54	18.25	0	6.64	0	17
55	18.76	0	6.64	0	17
56	19.29	0	6.64	0	17
57	19.83	0	6.64	0	17
58	20.39	0	6.64	0	17
59	20.96	0	6.64	0	17
60	21.55	0.811	6.64	4.25	17
61	22.15	0	5.83	0	12.75
62	22.78	0	5.83	0	12.75
63	23.42	1.04	5.83	4.25	12.75
64	24.08	0	4.79	0	8.5
65	24.75	0	4.79	0	8.5
66	25.45	0	4.79	0	8.5
67	26.16	1.45	4.79	4.25	8.5
68	26.90	0	3.33	0	4.25
69	27.66	0	3.33	0	4.25
70	28.43	0	3.33	0	4.25
71	29.23	0	3.33	0	4.25
72	30.05	0	3.33	0	4.25
73	30.90	0	3.33	0	4.25
74	31.77	0	3.33	0	4.25
75	32.66	0	3.33	0	4.25
76	33.58	0	3.33	0	4.25
77	34.52	3.33	3.33	4.25	4.25
78	35.49	0	0	0	0

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Analytical Chemistry • Utility Operations

13045.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
79	36.49	0	0	0	0
80	37.62	0	0	0	0
81	38.57	0	0	0	0
82	39.66	0	0	0	0
83	40.77	0	0	0	0
84	41.92	0	0	0	0
85	43.10	0	0	0	0
86	44.31	0	0	0	0
87	45.55	0	0	0	0
88	46.83	0	0	0	0
89	48.15	0	0	0	0
90	49.50	0	0	0	0
91	50.90	0	0	0	0
92	52.33	0	0	0	0
93	53.80	0	0	0	0
94	55.31	0	0	0	0
95	56.87	0	0	0	0
96	58.47	0	0	0	0
97	60.11	0	0	0	0
98	61.80	0	0	0	0
99	63.54	0	0	0	0
100	65.32	0	0	0	0
101	67.16	0	0	0	0
102	69.05	0	0	0	0
103	70.99	0	0	0	0
104	72.98	0	0	0	0
105	75.04	0	0	0	0
106	77.15	0	0	0	0
107	78.31	0	0	0	0
108	81.54	0	0	0	0
109	83.84	0	0	0	0
110	86.19	0	0	0	0
111	88.62	0	0	0	0
112	91.11	0	0	0	0
113	93.67	0	0	0	0
114	96.30	0	0	0	0
115	99.01	0	0	0	0
116	101.8	0	0	0	0
117	104.7	0	0	0	0
118	107.6	0	0	0	0
119	110.6	0	0	0	0
120	113.7	0	0	0	0
121	116.9	0	0	0	0
122	120.2	0	0	0	0
123	123.6	0	0	0	0
124	127.1	0	0	0	0
125	130.6	0	0	0	0

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Analytical Chemistry • Utility Operations

COULTER MULTISIZER AccuComp® 1.19

13045.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
128	134.3	0	0	0	0
127	138.1	0	0	0	0
126	142.0	0	0	0	0
	146.0		0		0

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) JelCleer Filter Effluent

(3) Date:

8/14/97

(4) Analysis:

Particle Count

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P. O. BOX 9000 – KILGORE, TEXAS 75663-9000 – 903/984-0551 – FAX 903/984-5914

Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 351953

Sample Identification: ***Gel-Filter Effluent***
Date & Time Taken: ***08/14/97*** ***1605***
Collected By: ***Client***
Sample Matrix: ***Liquid Aqueous***
Received: ***08/15/97*** *Client:* ***NRS*** *Report Date:* ***08/23/97***

Results for Sample 351953

	Parameter	Results	Units	EQL
001	Particle Count	See Attached		

Analytical Details for Sample 351953

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	Particle Count				08/22/97	COU

Sample Preparation Steps for 351953

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/22/97	16:27	KEK

Bottle Data for Sample 351953

Bottle	Derived in Lab From
#01 - Unpreserved	

Bottle Tracking for Sample 351953

Bottle #: 01 Unpreserved

08/15/97	14:30	SKL	Login
08/15/97	14:30	SKL	Main Walk In Cooler in Main

EQL is Estimated Quantitation Limit. The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit
(PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

ACCREDITED

Continued

MEMBER ACIL

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P. O. BOX 9000 – KILGORE, TEXAS 75663-9000 – 903/984-0551 – FAX 903/984-5914

Analytical Chemistry • Utility Operations

TEST REPORT: 351953

I certify that the results were generated using the above specified methods.

Bill Peery, Jr., M.S., Lab Manager

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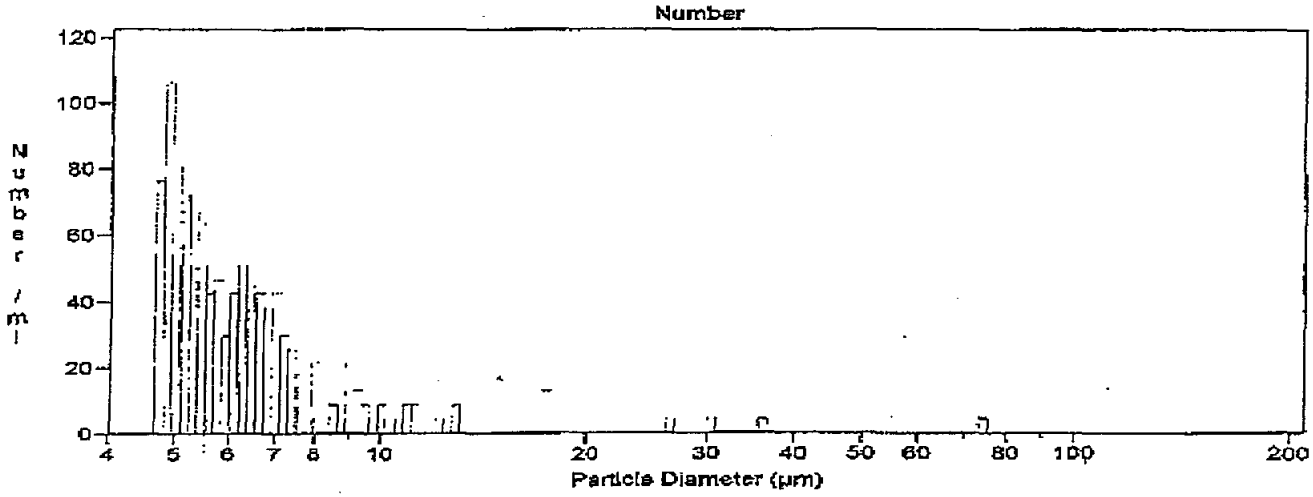
Analytical Chemistry • Utility Operations

COULTER

MULTISIZER AccuComp® 1.19

Filename:	13045b.#01	Sample Number:	0
Group ID:	13045b		
Sample ID:	ANA LAB		
Comment:	WATER, LOT= 351953-01		
Operator:	JC		
Electrolyte:	ISOTON		
Dispersant:	NO		
Aperture Size:	200 µm	Aperture Current:	3200 uA
Channels:	128	Kd:	2151
Full Data, Log Diameter		Gain:	1
Control Method:	Siphon 2000 ul		
Elapsed Time:	11.9 Seconds		
Raw Count:	203		
Coinc. Corr. Count:	204		
Acquired:	15:03 22 Aug 1997		
Serial Number:	21403444		
Electrolyte Vol:	150 ml		
Analytic Volume:	2000 ul		
Sample:	20 ml		



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Number Statistics (Arithmetic) 13045b.#01

Calculations from 4.197 µm to 146.0 µm

Number	252.0			
Mean:	6.989 µm	95% Conf. Limits:	6.323-7.655 µm	
Median:	5.901 µm	S.D.:	5.39 µm	
Mean/Median Ratio:	1.184	Variance:	29.1 μm^2	
Mode:	4.889 µm	C.V.:	77.2%	
Spec. surf. area:	0.200 m^2/ml	Skewness:	8.84	Right skewed
		Kurtosis:	97.2	Leptokurtic

% >	10	25	50	75	90
Size µm	9.063	7.011	5.901	5.108	4.661

13045b.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
1	4.197	0	100.00	0	1,071
2	4.315	0	100.00	0	1,071
3	4.437	0	100.00	0	1,071
4	4.561	0	100.00	0	1,071
5	4.690	0.328	100.00	76.5	1,071
6	4.822	0.496	99.67	106.25	994.5
7	4.957	0.409	99.18	80.75	888.25
8	5.096	0.281	98.77	51	807.5
9	5.240	0.433	98.49	72.25	756.5
10	5.387	0.332	98.05	51	684.25
11	5.538	0.301	97.72	42.5	633.25
12	5.694	0.359	97.42	46.75	590.75
13	5.854	0.246	97.06	29.75	544
14	6.019	0.386	96.81	42.5	514.25
15	6.188	0.503	96.43	51	471.75
16	6.362	0.547	95.92	51	420.75
17	6.541	0.495	95.38	42.5	369.75
18	6.725	0.464	94.88	38.25	327.25
19	6.914	0.585	94.40	42.5	289
20	7.108	0.445	93.81	29.75	246.5
21	7.308	0.414	93.37	25.5	216.75
22	7.514	0.450	92.95	25.5	191.25
23	7.725	0.082	92.50	4.25	165.75
24	7.942	0.443	92.42	21.25	161.5
25	8.165	0.096	91.98	4.25	140.25
26	8.395	0.209	91.88	8.5	136
27	8.631	0.114	91.67	4.25	127.5
28	8.873	0.618	91.56	21.25	123.25
29	9.123	0.403	90.94	12.75	102
30	9.379	0.292	90.54	8.5	89.25
31	9.643	0.159	90.25	4.25	80.75

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13045b.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
32	9.914	0.345	90.09	8.5	76.5
33	10.19	0.187	89.74	4.25	68
34	10.48	0.204	89.56	4.25	63.75
35	10.77	0.443	89.35	8.5	59.5
36	11.08	0.481	88.91	8.5	51
37	11.39	0	88.43	0	42.5
38	11.71	0	88.43	0	42.5
39	12.04	0.309	88.43	4.25	42.5
40	12.38	0	88.12	0	38.25
41	12.72	0.729	88.12	8.5	38.25
42	13.08	0	87.39	0	29.75
43	13.45	0	87.39	0	29.75
44	13.83	0	87.39	0	29.75
45	14.22	0	87.39	0	29.75
46	14.62	0	87.39	0	29.75
47	15.03	0	87.39	0	29.75
48	15.45	0	87.39	0	29.75
49	15.88	0	87.39	0	29.75
50	16.33	0	87.39	0	29.75
51	16.79	0	87.39	0	29.75
52	17.26	2.73	87.39	12.75	29.75
53	17.75	0	84.66	0	17
54	18.25	0	84.66	0	17
55	18.76	0	84.66	0	17
56	19.29	0	84.66	0	17
57	19.83	0	84.66	0	17
58	20.39	0	84.66	0	17
59	20.96	0	84.66	0	17
60	21.55	0	84.66	0	17
61	22.15	0	84.66	0	17
62	22.78	0	84.66	0	17
63	23.42	0	84.66	0	17
64	24.08	0	84.66	0	17
65	24.75	0	84.66	0	17
66	25.45	0	84.66	0	17
67	26.16	3.17	84.66	4.25	17
68	26.90	0	81.49	0	12.75
69	27.66	0	81.49	0	12.75
70	28.43	0	81.49	0	12.75
71	29.23	0	81.49	0	12.75
72	30.05	4.80	81.49	4.25	12.75
73	30.90	0	76.69	0	8.5
74	31.77	0	76.69	0	8.5
75	32.66	0	76.69	0	8.5
76	33.58	0	76.69	0	8.5
77	34.52	0	76.69	0	8.5
78	35.49	7.91	76.69	4.25	8.5

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13045b.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
79	36.48	0	68.78	0	4.25
80	37.52	0	68.78	0	4.25
81	38.57	0	68.78	0	4.25
82	39.66	0	68.78	0	4.25
83	40.77	0	68.78	0	4.25
84	41.92	0	68.78	0	4.25
85	43.10	0	68.78	0	4.25
86	44.31	0	68.78	0	4.25
87	45.55	0	68.78	0	4.25
88	46.83	0	68.78	0	4.25
89	48.15	0	68.78	0	4.25
90	49.50	0	68.78	0	4.25
91	50.90	0	68.78	0	4.25
92	52.33	0	68.78	0	4.25
93	53.80	0	68.78	0	4.25
94	55.31	0	68.78	0	4.25
95	56.87	0	68.78	0	4.25
96	58.47	0	68.78	0	4.25
97	60.11	0	68.78	0	4.25
98	61.80	0	68.78	0	4.25
99	63.54	0	68.78	0	4.25
100	65.32	0	68.78	0	4.25
101	67.16	0	68.78	0	4.25
102	69.05	0	68.78	0	4.25
103	70.99	0	68.78	0	4.25
104	72.98	68.78	68.78	4.25	4.25
105	75.04	0	0	0	0
106	77.15	0	0	0	0
107	79.31	0	0	0	0
108	81.54	0	0	0	0
109	83.84	0	0	0	0
110	86.19	0	0	0	0
111	88.62	0	0	0	0
112	91.11	0	0	0	0
113	93.67	0	0	0	0
114	96.30	0	0	0	0
115	99.01	0	0	0	0
116	101.8	0	0	0	0
117	104.7	0	0	0	0
118	107.6	0	0	0	0
119	110.6	0	0	0	0
120	113.7	0	0	0	0
121	116.9	0	0	0	0
122	120.2	0	0	0	0
123	123.6	0	0	0	0
124	127.1	0	0	0	0
125	130.6	0	0	0	0

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Analytical Chemistry • Utility Operations

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MULTISIZER AccuComp® 1.19

13045b.#01

Channel Number	Particle Diameter µm	Diff Volume %	Cum > Volume %	Diff Number /ml	Cum > Number /ml
126	134.3	0	0	0	0
127	138.1	0	0	0	0
128	142.0	0	0	0	0
	146.0		0		0

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) Sampling Point:

Permeate (Product Water) from RO Pilot Plant

(3) Date:

7/23/97

(4) Analysis:

Anions and Cations

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Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 350221

Sample Identification: ***RO Permeate***
Date & Time Taken: ***07/23/97*** ***1255***
Collected By: ***JAJ***
Sample Matrix: ***Liquid Aqueous***
Received: ***07/23/97*** *Client:* ***NRS*** *Report Date:* ***08/11/97***

Results for Sample 350221

	Parameter	Results	Units	EQL
001	pH (On Site)	6.22	SU	
002	Cation-Anion Balance	7.72 / 7.97	meq/meq	
003	Bicarbonate	4.00	mg/l	0.5
004	Carbon Dioxide	8.34	mg/l	0.5
005	Carbonate	ND	mg/l	0.5
006	Free Carbon Dioxide	4.82	mg/l	0.5
007	Hydroxide	ND	mg/l	0.5
008	Ammonia Nitrogen	.03	mg/l	.02
009	Specific Conductance at 25 C	9.75	umho/cm	
010	Total Dissolved Solids	450	mg/l	5
011	Temperature	21.2	degrees C	.1
012	Total Barium	ND	ug/l	10.0
013	Total Calcium	2.64	mg/l	0.0500
014	Total Iron	0.0930	mg/l	0.0500
015	Total Magnesium	4.04	mg/l	0.100
016	Total Manganese	ND	mg/l	0.0300
017	Total Potassium	7.92	mg/l	2.00
018	Total Sodium	162	mg/l	5.00
019	Total Strontium	27.0	ug/l	10.0
020	Silicon (as Silica, SiO2)	2.07	mg/l	0.107
021	Chloride	249	mg/l	20.0
022	Fluoride	ND	mg/l	0.10
023	Nitrate	ND	mg/l	0.09
024	Sulfate	35.2	mg/l	20.0
025	Alkalinity (as CaCO3)	4	mg/l	1
026	Hydrogen Sulfide	ND	mg/l	0.050

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Analytical Chemistry • Utility Operations

TEST REPORT: 350221

Analytical Details for Sample 350221

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	pH (On Site)		EPA Method 150.1		07/23/97 1255	JAJ
002	Cation-Anion Balance		APHA 18th 1030F		08/08/97	NGT
003	Bicarbonate		APHA 18th 4500-CO2 D		07/31/97 1725	NGT
004	Carbon Dioxide		APHA 18th 4500-CO2 D		07/31/97 1725	NGT
005	Carbonate		APHA 18th 4500-CO2 D		07/31/97 1725	NGT
006	Free Carbon Dioxide		APHA 18th 4500-CO2 D		07/31/97 1725	NGT
007	Hydroxide		APHA 18th 4500-CO2 D		07/31/97 1725	NGT
008	Ammonia Nitrogen		EPA 350.1	12	07/29/97 1000	RSV
009	Specific Conductance at 25 C		EPA Method 120.1		07/23/97 1255	JAJ
010	Total Dissolved Solids		EPA Method 160.1	01	07/25/97 0920	SKL
011	Temperature		EPA Method 170.1		07/23/97 1255	JAJ
012	Total Barium	7440-39-3	EPA Method 200.7	13	08/01/97 1604	WOB
013	Total Calcium	7440-70-2	EPA Method 200.7	13	08/01/97 1646	WOB
014	Total Iron	7439-89-6	EPA Method 200.7	13	08/01/97 1601	WOB
015	Total Magnesium	7439-95-4	EPA Method 200.7	13	08/01/97 1646	WOB
016	Total Manganese	7439-96-5	EPA Method 200.7	13	08/01/97 1646	WOB
017	Total Potassium	7440-09-7	EPA Method 200.7	13	08/01/97 1646	WOB
018	Total Sodium	7440-23-5	EPA Method 200.7	13	08/01/97 1646	WOB
019	Total Strontium	7440-24-6	EPA Method 200.7	13	08/07/97 1503	WOB
020	Silicon (as Silica, SiO2)		EPA Method 200.7 MOD	13	08/08/97 1027	WOB
021	Chloride		EPA Method 300.0	01	07/28/97 1037	KLB
022	Fluoride		EPA Method 300.0	01	07/28/97 1037	KLB
023	Nitrate		EPA Method 300.0	01	07/28/97 1037	KLB
024	Sulfate		EPA Method 300.0	01	07/28/97 1037	KLB
025	Alkalinity (as CaCO3)		EPA Method 310.1	04	07/30/97 1100	BAP
026	Hydrogen Sulfide		EPA Method 376.2	09	07/25/97 1500	RSV

Sample Preparation Steps for 350221

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/11/97	10:54	KEK
pH of Metals Bottle upon Receipt	<2	07/24/97	1932	AAJ
pH of Metals Bottle upon Receipt	<2	07/24/97	1932	AAJ
Metals Digestion - Liquid	50/50 A/B/S	07/31/97	1600	GDG
Ammonia Distillation	500/500	07/28/97	1100	KBW

Bottle Data for Sample 350221

Bottle	Derived in Lab From
#01 - Unpreserved Plastic	

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Analytical Chemistry • Utility Operations

TEST REPORT: 350221

Bottle Tracking for Sample 350221

Bottle #: 15 ICP Preparation

07/31/97	1600	GDG	Wet Lab - Bldg1
08/01/97	07:02	GDG	Instrument Room 1

CAS is Chemical Abstract Service Registry Number. EQL is Estimated Quantitation Limit, and is the minimum analytical level (MAL) or minimum quantitation level (MQL).

The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

I certify that the results were generated using the above specified methods.

C. H. Whiteside, Ph.D., President

CHEMICAL ANALYSIS

(1) Location:

RO Pilot Plant Location

(2) Sampling Point:

Permeate (Product Water) from RO Pilot Plant

(3) Date:

7/23/97

(4) Analysis:

Total Organic Carbon

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Analytical Chemistry • Utility Operations

NRS Consulting Engineers
P.O. Box 2544
Harlingen, TX 78550-
Attention: Jesus Leal

TEST REPORT: 352318

Sample Identification: ***RO Permeate***
Date & Time Taken: ***07/23/97*** ***1255***
Collected By: ***JAJ***
Sample Matrix: ***Liquid Aqueous***
Received: ***07/23/97*** *Client:* ***NRS*** *Report Date:* ***08/23/97***
Other Data:

Reference 350221

Results for Sample 352318

	Parameter	Results	Units	EQL
001	Total Organic Carbon	ND	mg/l	.4

Analytical Details for Sample 352318

	Parameter	CAS	Methods	Bottle	Analyzed	By
001	Total Organic Carbon		EPA 415.2	06	08/21/97 0900	WOB

Sample Preparation Steps for 352318

Parameter	Results	Date	Time	Tech
Fax This Report AS Soon As DONE!	FAXED	08/22/97	15:00	KEK

Bottle Data for Sample 352318

Bottle	Derived in Lab From
#01 - Unpreserved	
#02 - Unpreserved	
#03 - Unpreserved Glass	
#04 - Unpreserved Glass	
#05 - H2SO4 Preserved	
#06 - H2SO4 Preserved	
#07 - Unpreserved Glass	
#08 - Unpreserved Glass	

Continued

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P. O. BOX 9000 – KILGORE, TEXAS 75663-9000 – 903/984-0551 – FAX 903/984-5914

Analytical Chemistry • Utility Operations

TEST REPORT: 352318

Bottle Data for Sample 352318

Bottle	Derived in Lab From
#09 - Preserved with NaOH and Zinc Acetate	
#10 - Sm Plastic w/1+1 H2SO4	
#11 - Sm Plastic w/1+1 H2SO4	
#12 - NH3N TRAACS Autosampler Vial	06 (500 ml)
#13 - ICP Preparation	08 (50 ml)
#14 - ICP Preparation	08 (50 ml)
#15 - ICP Preparation	08 (50 ml)

Quality Assurance for the SET with Sample 352318

Sample	Description	Result	Value	Units	%
Total Organic Carbon (Analyzed: 08/21/97 0900 WOB Verified: 08/22/97 14:51 SAH)					
	Standard	10.3	10.0	MG/L	103
	Standard	10.5	10.0	MG/L	105
	Standard	9.4	10.0	MG/L	94
351786	Duplicate	36.2	36.7	MG/L	1
351892	Duplicate	8.3	8.4	MG/L	1
351788	Spike		10.0	MG/L	94
351789	Spike		10.0	MG/L	94
	LCS	4.98	4.90	MG/L	102

EQL is Estimated Quantitation Limit. The EQL takes into account the Instrument Detection Limit (IDL), Method Detection Limit (MDL), and Practical Quantitation Limit (PQL). Our analytical result must be above our EQL before we report a value for any parameter. Otherwise, we report ND (Not Detected above EQL).

I certify that the results were generated using the above specified methods.

Bill Peery, Jr., M.S., Lab Manager

APPENDIX C
OPERATIONAL DATA

SDI TEST

DATE	TIME	TRIALS	Tt (seconds)	Tf (seconds)	SDI
21-May-97	AM	1			
		2			
	PM 5:00	1			
		2	78	385	5.32
22-May-97	9:35 AM STARTED FILTER	9:40Am 1ST RUN	47	614	6.1
		10:10Am 2ND RUN	23	167	5.7
		10:35Am 3RD RUN	20	188	6.0
		4:20PM 4TH RUN	25	144	5.5
23-May-97	AM 11:20Am STOPPED FILTER	1			
		2			
	PM	1			
		2			
-May-97	AM	1			
		2			
	PM	1			
		2			

5-22-97 FILTER PSI

9:40Am IN 10
OUT 5

10:10Am IN 11.75
OUT 5.75

10:35Am IN 11.50
OUT 5.75

4:20PM IN 9
OUT 1

5-23-97 FILTER PSI

8:55Am IN 45
OUT 0

COULD NOT GET SDI, BOOSTER PUMP WENT OUT. WE BACKWASH FILTER AT 9:03Am FOR 10 MINUTES.

9:15Am IN 5.25
OUT 3.25

TURNED EVERYTHING OFF AT ABOUT 11:20Am

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI Ti (sec)	SDI Tf (sec)	
5-27-97	11:42Am	80	4.25	1	9.2	0.30	22	1830	START @ 10:45A
5-27-97	3:42Pm	80	14.75	1	9.9	0.21	19	372	
5-27-97	4:07Pm	78	16.00	1	8.6	0.19	19	252	STOPPED 4:40P
5-29-97	3:00Pm	GEL CLEENER AND GEL COATED FILTER							
(OFF THE GEL FILTER) 5-30-97	2:10Pm	50	29	27	7.2	0.30	20	99	STARTED 1:55Pm
5-30-97	2:29Pm	50	29.5	27	5.3	0.25	20	101	
5-30-97	2:52Pm	50	30.25	27.25	2.3	0.40	18	89	
(OFF THE BOOSTER PUMP) 5-30-97	3:25Pm	75	7.5	1	(BOOSTER PUMP OVER HEATED)		21		STOPPED @ 3:30
(OFF THE GEL FILTER) 6-3-97	3:55Pm	90	33.75	26.50	3.8	0.2	21	70	STARTED GEL FILTER
6-3-97	4:20Pm	90	33.75	25.25	6.3	0.17	18	70	
6-4-97	2:20Pm	80	38.0	26.25	1.2	0.2	17	63	Started Gel Filter
6-4-97	2:50Pm	80	37.75	25.50	1.3	0.2	17	60	
6-4-97	5:00Pm	80	38.00	22.00	BACKWASH TO HAVE READY FOR TOMORROW				
6-4-97	5:13Pm		36.25	34.50	STOPPED EVERY THING				
6-5-97	2:40Pm	125	29.00	25.50	2.0	0.4	20	96	

6-4-97 — Day is clear, hot + humid (temp. of ≈95°F), beautiful day to be on the beach, water at intake point is very clear. You can see the bottom. Two district operators worked on the intake piping and raised the screen from bottom. As of this day 04:30 pm the top of the screen at intake pipe is ≈2 ft from water surface and about 4 to 4.5 ft from bottom.

6-5-97 — 2:40PM DAY IS MILD WIND 5-8 MILES AN/HOUR, ABOUT 90° TEMP., WATER IS CLEAR BLUE AND CALM, NO WAVES, WE HAD A HARD TIME PRIMING INTAKE PUMP. WE WILL LEAVE IT ON 24/HR/DAY, GEL FILTER IS STARTED AT 2:40 PM

6-5-97 FILTER RAN WITH IN LET VALVE PINCHED TO FEED AT 80 GPM

6-5-97
6:20PM PSI IN 10
OUT 5

6-5-97
10:15PM PSI IN 13
OUT 4

6-6-97
1:10AM PSI IN 14
OUT 2

6-6-97
4:20AM PSI IN 17
OUT 1

6-6-97
6:00AM PSI IN 19
OUT 0

AS YOU CAN SEE THE OPERATOR TURNED OFF GEL FILTER AT 6:05AM

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbitity In (NTU)	Turbitiy Out (NTU)	SDI Ti (sec)	SDI Tf (sec)
6-5-97	3:00Pm	122	29.00	25.00	1.5	0.1	18	95
6-6-97	9:05Am	BACKWASHED	GEL FILTER		1.1	0.15		
6-6-97	9:45Am	120	28.75	25.00	1.1	0.15	23	127
6-6-97	10:10Am	120	28.75	24.75	1.0	0.1	20	114
6-6-97	3:01	118	30.00	24.50	0.9	0.2	21	142
6-6-97	3:25Pm	115	30.25	24.50	0.8	0.13	20	136
6-6-97	3:45Pm	STOPPED	EVERYTHING	FOR THE	WEEKEND.			
6-9-97	10:25Am	STARTED FILTER					29	
6-9-97	10:40Am	107	33.00	25.00	7.7	0.40	29	3MIN./150
6-9-97	11:08Am		35.00	24.00	BACKWASHED FILTER		10 MIN. ONLY.	
6-9-97	11:25Am	80 GPm	20.00	18.00	WILL CHECK S.D.I. AT 1:00Pm			
6-9-97	2:54Pm	216Pm	44.00	22.5	(LOOKS LIKE 0.5NTU	NEED TO B.W.)	28	(3:00Pm STOPP SDI TO B.W.W. HI PRES.
6-9-97	3:20Pm	130	27.75	24.00	5.0	0.40	30	578
6-9-97	3:55Pm	111	31.25	25.50	5.5	0.30	26	487
6-9-97	4:20Pm	109	32.50	22.00	5.5	0.30	READINGS ARE STOPPING	BEFORE EVERYTHING
	4:22Pm STOPPED EVERYTHING				9.3 LABORATORY TURB. METER	0.30		

6-6-97 Partly cloudy day at 9:00am, we have a High Tide (medium) clear water wind 5-10 miles an hour 85°
Put inlet valve to feed 80gpm to Gel Filter at 9:15am.
9:35 am put inlet valve open all the way to get ready for SDI. (120 gpm)
10:30 am put Gel Filter at 80 gpm. on inlet.

6-6-97 Sunny and clear in the afternoon at 3:00pm. water is very clear with no waves only very small waves and wind is about 10-15 miles/hr. Tides is still high. Temp is about 90°

6-9-97 Cloudy day with a little drizzle, about 75 to 80 degress temp, water is very murky and light brown color, looks like a ship is dredging the channel at the entrance of the Jetties, maybe stirring the sand. its not a windy day. 2-4 miles per hr. wind no big wave. 10:40am

6-9-97 3:00pm water is very calm no wave but the water is still to murky that we are backwashing again. wind is about 3 miles/hr. ~~Sunny and~~ partly cloudy. Heard there is an undertoe. current 10 min only

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbitity In (NTU)	Turbitiy Out (NTU)	SDI	
							Ti (sec)	Tf (sec)
6-10-97	STARTED AT 9:30A 9:45 Am	36	43.25	38.00	5.0	0.3	26	173
6:10-97	(AFTER FILTER) 10:40 Am	35	32.50	22.50	(STOPPED DUE TO PSI ON SDI GAUGE NOT WORKIN.)		22	
6-10-97	AFTER CARTRIDGE FILTER 10:56Am	35	30.50	19.00	4.6	.2 / .15	23	210
6-10-97	2:05Pm	37	31.00	11.00	BACKWASHED AT 2:07 Pm GEL CLEER FILTER			
6-10-97	2:20 Pm	48	16.00	15.00	AFTER BACKWASH, FOR 10 MIN.			
6-10-97	2:45Pm	42	15.75	14.75	2.60	0.18	21	193
6:10-97	3:40Pm	42	16.00	14.25	2.70	0.1	17	172
6-10-97	4:10 Pm	42	16.25	14.00	S E ——— 7		STOPPED	EVERYTHING
STARTED FILTER AT 8:30AM 6-11-97	8:35 Am	40						
6-11-97	8:58 Am	42	20.00	16.25	15.35	.37	23	212
6-11-97	10:35 Am	27	36.50	27.50	11.13	.33	24	142
6-12-97	10:40 Am	40	35.25	24.25	STARTED GEL FILTER.			
6-12-97	10:50 Am	40	35.25	24.00	4.0	0.22	25	152
6-12-97	1:55 Pm	40	36.00	16.50	2.5	0.21	22	129
6-12-97	3:00 Pm	35	36.25	15.00	3.0	0.12	STOPPED GEL FILTER TO BACKWASH	

6-10-97 SUNNY AND CLEAR SKY'S, WATER IS STILL MURKY NOT AS MUCH AS YESTERDAY, NO BIG WAVE, JUST UNDERTOE CURRENT
YOU CAN SEE A LITTLE THROUGH THE WATER. AT 11:00A

6-10-97 2:45PM SUNNY WATER IS GETTING MORE CLEHRER THAN THIS MORNING, NO WAVES AT ALL, YOU CAN STILL SEE UNDERTOE, BUT NOT STRONG CURRENT.

6-11-97 9:00AM SUNNY AND CLEAR SKY. WATER LOOKS MURKY ON THE EDGE OF THE ROCKS ALL TO THE INTAKE, DUE TO LARGE WAVES CRASHING ON THE ROCKS LOOKS LIKE WE HAVE A STRONG UNDERTOE. WE HAVE SOME GRASS FLOATING ON THE SURFACE OF WATER

6-12-97 WE HAVE PARTLY CLOUDY DAY AROUND 80°, WIND AT 15 MILES AN HOUR, NO BIG WAVES. BUT
10:50AM MANY SMALL WAVES LOOK LIKE A HIGH TIDE MEDIUM CLEAR WATER NOT TO MUCH CURRENT

6-12-97 3:00PM WE HAVE A CLEAR SUNNY DAY AROUND 85°, WIND AT 8-10 MILES AN HOUR, NO BIG WAVES ONLY SMALL WAVES AND SLIGHTLY SMALLER THAN THIS MORNING, CLEAR WATER, YOU CAN SEE THE BOTTOM ON TO 2-3 FT.

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI		
							Ti (sec)	Tf (sec)	
6-15-97	9:15 Am.	39	42.0	38.0	4.2	0.4	22	Started Gel Filter 140 8:30 Am	
6-17-97	300 Pm	38	42.5	20,0	5.4	0.2	22	138	3:20 B.W.
6-16-97	9:50 Am	40	37.5	35.0	6.41	0.64	21	172	
6-16-97	3.15 Pm	39	40	22.0	12.3	0.16	21	112	4:10 Pm B.W.
6-17-97	10:55 Am	39	41	39.0	7.99	0.17	18	110	
6-17-97	3:05 Pm	39	41	33.0	7.80	0.30	20	92	4:20 Pm B.W.
6-18-97	900 Am	42	34.5	32.4	12.7	.27	21	180	
6-19-97	400 Pm	41	37.0	35.0	13.5	.24	21	116	1 30 Pm B.W.
6-19-97	8:53 Am	43	37.0	36.0	STARTED GEL FILTER				
6-19-97	9:54 Am ★	55	7.0	0	16.70	.34	24	105	
6-19-97	10:22 Am ★	38	37.0	29.00	24.0	.19	22	100	
6-19-97	1:41 Pm	17	34.00	8.50 BEFORE CLEANING INTAKE SCREEN			FOR 10 MINUTES (2:00 Pm) BACKWASHED		2:00 Pm B.W.
		30	40.50	11.50 AFTER CLEANING INTAKE SCREEN					
6-19-97	2:12 Pm	42	20.00	19.25	STARTED GEL FILTER AGAIN				
6-19-97	2:32 Pm	42	19.50	18.50	17.9	0.35	21	115	
6-19-97	4:05 Pm	39.0	21.25	15.50	21.3	0.18	21	94	
6-19-97	22.00		16.00	STOPPED GEL FILTER AT 4:20 PM					

★ HAD TO OPEN THE VALVE ALL, GOING INTO R.O. FEED TANK, TO GET MORE WATER INTO R.O. UNIT BUT IT WAS INTAKE SCREEN THAT HAD CLOGGED UP WITH SEA GRASS.

6-13-97 8:30 am Partly Cloudy DAY around 78°, wind at 10-15 miles, many SMALL WAVES, Looks like high Tide.

6-13-97 3:00 pm Clear & Sunny DAY around 89°, windy & Choppy, Look like Tide Lower A little.

6-19-97 (10:00 AM) Cloudy DAY, WIND ABOUT 5 MILES/HR., WATER IS MURKY AND DIRTY BUT A GREEN COLOR, WITH SOME UNDERTOE CURRENT AND MEDIUM SIZE (ABOUT 2-3 FT) WAVE'S. AT 90° CANT SEE THE BOTTOM

6-19-97 (3:30 PM) BIG WAVES AND UNDERTOE CURRENT WATER IS MURKY CANT SEE THE BOTTOM WIND ABOUT 10-15 MILES/HR. Cloudy DAY ABOUT 90°

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI	
							Ti (sec)	Tf (sec)
	STARTED 9:15A	40			Before	After		
6-20-97	9:57 AM	38	34.50	13.00	16.00	0.19	21	116
	10:55A	44	21.00	20.25				
6-20-97	3:03 PM	38	25.50	15.00	18.8	.23	21	103
STOPPED @ 4:05 PM 6-20-97	3:30 PM	36.	26.50	13.00	22.5	.50	19	106
STARTED AT 9:05A 6-23-97	9:50 AM	58	34.0	31.25	20.5	.30	21	125
6-23-97	10:15 AM	57	34.0	30.50	27.0	.40	20	127
6-23-97	2:08 PM	28	39.25	8.50	BACKWASHED AT 2:10 PM; TURNED OFF TO FIX PH METER			
9:55AM STARTED GEL FILTER Tues 6-24-97	9:30 AM	49	23.75	22.75	16.1	0.30	21	112
Tues 6-24-97	9:58 AM	55	24.0	22.50	12.6	0.24	21	98
Tues 6-24-97	2:49 PM	41	26.25	18.0	11.4	0.16	20	82
3:55PM OFF Tues 6-24-97	3:10 PM	41	26.25	17.50	16.4	0.24	19	82
8:50 AM ON Wed 6-25-97	9:02 AM	48	28.25	27.25	6.40	0.25	19	115
Wed 6-25-97	9:27 AM	48	28.0	27.0	6.60	0.28	19	91
Wed 6-25-97	2:42 PM	47	27.50	24.0	8.10	0.33	19	81
Wed 6-25-97	3:23 PM	42	28.0	23.0			19	
6-25-97 3:30 PM	STOPPED	EVERY THING DUE TO		INTAKE	PUMP MOTOR	BURNED	up.	

10:30A B.W.

3:55PM B.W.

2:10PM B.W.

B.W. 3:45P IN 27 SEC TI

6-20-97 MURKY WATER, WINDY AT 15 MILES PER HOUR, SMALL WAVES 90 TEMP. WATER DOESN'T LOOK TOO GOOD. 9:57AM

6-20-96 ~~AB~~:05PM WATER IS MURKY LARGE SMOOTH WAVES ABOUT 90° TEMP 10 miles/hr WIND.

6-23-96 9:55AM WATER IS MURKY (LIGHT BROWN) LARGE SMOOTH WAVES ABOUT 85° (NO WIND) LOTS OF CURRENT MIXING SAND, IT'S RAINING, WITH OVERCAST

6-24-97 9:40 AM WATER IS MURKY (LIGHT BROWN) LARGE SMOOTH WAVE ABOUT 85° (NO WIND) ALOT OF CURRENT MIXING SAND, A LITTLE DRIZZLE WITH OVERCAST.

6-24-97 3:00PM WATER IS A LITTLE MORE CLEARER, YOU CAN SEE 1ST DOWN AND WE HAVE MEDIUM LARGE WAVES, BUT VERY SMOOTH. NOT TOO MUCH CURRENT. ABOUT 88° AND OVER CAST SKY WITH A LITTLE DRIZZLE, NO WIND.

6-25-97 9:15AM Cloudy DAY, NO WIND, NO WAVES AND NO CURRENT, WATER LOOKS CLEAN AND CLEAR TO 2-3 FT only. ABOUT 85° TO 90°

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

	Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In before (NTU)	Turbitiy Out after (NTU)	SDI Ti (sec)	SDI Tf (sec)	
STARTED T 10:30Am	6-27-97	10:50Am	47	26.75	25.00	4.00	0.33	19	126	
	6-27-97	11:10 A	46	26.75	24.25	4.90	0.25	19	90	
STOPPED 1:05PM	6-27-97	3:45p	46	27.75	21.50	3.64	0.09	18	63	4:10PM B.W.
STARTED 9:48A	6-30-97	10:00Am	50	26.25	23.75	3.32	0.24	21	93	
	6-30-97	10:30Am	47	26.50	23.25	3.88	0.35	19	70	
	6-30-97	3:28Pm	44	27.50	19.75	4.78	0.13	18	74	
STOPPED AT 4:15Pm	6-30-97	3:58Pm	44	27.50	19.00	6.00	0.20	18	74	
STARTED AT 9:21Am	7-1-97	9:52A	40	21.00	16.25	4.72	0.18	17	66	
	7-1-97	10:12Am	43	21.75	16.00	5.12	0.30	18	63	
	7-1-97	3:32Pm	45	34.00	21.00	5.44	0.18	18	69	
4:12Pm STOPPED GelC;	7-1-97	3:50Pm	45	34.00	20.00	8.54	0.22	18	66	4:13Pm B.W.
STARTED AT 10:30 Am	7-2-97	10:55Am	48	25.00	24.00	16.7	0.21	19	98	
	7-2-97	11:14Am	48	25.00	23.75	22.6	0.24	19	92	
	7-2-97	3:13Pm	39	28.00	15.25	9.5	0.16	18	69	
STOPPED AT 4:00Pm	7-2-97	3:35Pm	39	28.25	15.00	10.6	0.18	18	66	4:03Pm BW

★ 7-1-97 10:50am CLEANED CHANNEL INTAKE SCREEN. HAD LOTS OF SEA GRASS AND SOME ALGAE GROWTH.

6-27-97 BEAUTIFUL DAY 3-5 MILE PER HOUR WIND, NO WAVES AND NO CURRENT. WATER IS CLEAR CAN SEE 2 TO 4 FEET DOWN TO THE BOTTOM, ABOUT 85° TEMP 11:00 AM

6-27-97 BEAUTIFUL AFTERNOON WIND ABOUT 5-7 MILES AN HOUR, WATER IS BLUE GREEN CLEAR COLOR, NO WAVES, VERY CLEAR FROM 3-4 FT. AND SEE THE BOTTOM, NO CURRENT, 90°. 3:55 PM.

6-30-97 ITS A CLOUDY DAY, VERY NICE COOL BREEZE ABOUT 75°, NO BIG WAVE ONLY VERY SMALL LIKE (CHOPPY WAVES) WATER IS GREENISH CLEAR YOU CAN SEE LIKE 2 TO 3 FT DOWN TO BOTTOM, WIND IS ABOUT 5-10 MILES/HR. (10:15 AM)

6-30-97 VERY SUNNY DAY THIS AFTERNOON, LESS CLOUDS. THERE IS NO WAVES WATER IS CLEAR TO TWO FT. ONLY, A LITTLE GRASS FLOATING. WIND ABOUT 8 MILES/HR. 80° TEMP. (3:50 PM)

7-1-97 10:10 AM PARTLY CLOUDY DAY ABOUT 75-80° WITH COOL BREEZE ABOUT 5-8 MILES/HR NO BIG WAVES ONLY VERY SMALL WAVES WATER IS GREENISH CLEAR TO 1½ TO 2 FT LOTS OF GRASS FLOATING. WILL HAVE TO CLEAN THE INTAKE SCREEN.

7-1-97 3:40 PM VERY CALM, NO WAVES AT ALL, LOOKS LIKE CURRENT IS COMING IN CAN ONLY SEE FROM 1 TO 1½ FT. DOWN, ONE BOAT GOING BY CAUSING WAVES. WATER IS LESS CLEAR THAN THIS MORNING. IT'S ABOUT 90° WIND ABOUT 5 OR LESS MILES/HR, NO SEA GRASS FLOATING.

7-2-97 11:00 AM WATER IS MURKY AND LIGHT BROWN IN COLOR, LOTS OF SEA GRASS FLOATING, SOME CURRENT MIXING SAND, WAVES ARE 1½ FOOT HIGH-10 FEET APART, SKY IS PARTLY CLOUDY, 80°. CAN SEE ONLY ½ FT DOWN, WIND ABOUT 5 MILES/HR.

7-2-97 3:20 PM WATER IS DIRTY AND MURKY, A VERY STRONG CURRENT COMING IN, NO WAVES AT ALL, MORE OF CLEAR SKY ABOUT 85° WIND ABOUT 5 MILES/HR. OCCATIONAL WAVE COMING IN

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

	Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI	
								Ti (sec)	Tf (sec)
STARTED AT 10:00AM	7-3-97	10:33Am	43	22.00	21.00	7.9	0.24	19	60
	7-3-97	11:00Am	44	22.00	21.00	7.2	0.14	19	60
	7-3-97	3:20Pm	43	22.50	19.75	14.9	0.10	18	61
STOPPED AT 4:07Pm	7-3-97	3:43Pm	44	22.75	19.25	11.9	0.10	18	59
9:52A STARTED	7-7-97	10:20Am	47	24.00	22.75	4.6	0.20	18	88
STOPPED 4:14Pm	7-7-97	3:54Pm	44	24.50	21.00	5.4	0.11	18	68
STARTED AT 9:40Am	7-8-97	10:02Am	44	21.75	19.25	12.3	0.17	19	78
	7-8-97	10:22Am	44	21.75	19.00	12.0	0.16	19	68
STOPPED AT 3:45Pm	7-8-97	3:25Pm	38	23.75	15.60	10.36	0.15	18	60
STARTED 8:43Am	7-15-97	9:06Am	48	24.25	23.25	3.00	0.18	18	85
	7-15-97	9:45A	48	24.25	23.00	2.70	0.18	18	78
STOPPED AT 4:27Pm	7-15-97	3:42Pm	45	24.00	21.75	6.99	0.24	18	77

7-3-97 WATER IS MURKY AND LIGHT BROWN IN COLOR, SOME CURRENT, NO WAVES, WIND ABOUT 5mi/HR. 85° TEMP. CAN SEE 6" only (10:50Am) SOME SEA GRASS FLOATING, CLEAR SKY.

7-3-97 (3:50PM) WATER IS MORE MURKY BROWN LOOKS LIKE UNDERTOE CURRENT IS STRONG AND MIXING SAND, WIND AT 10 MILES/HR. NO BIG WAVES only VERY SMALL WAVES, VERY CLEAR SKY ABOUT 80°

7-7-97 (10:25Am) WATER IS MEDIUM MURKY LIGHT BROWN CAN SEE TO 1½FT DOWN. NO WAVE, SOME GLASSY CALM PLACES ON TOP OF WATER. WIND ABOUT 3 miles/HR. PARTLY CLOUDY, 85° TEMP. SOME SEA GRASS FLOATING

7-7-97 (4:15Pm) WATER IS MEDIUM MURKY LIGHT GREEN CAN SEE ABOUT 1 FT DOWN VERY SMALL WAVE WIND ABOUT 5mi/HR CLOUDY AFTERNOON LOOK LIKE IT MAY RAIN LATER 85° TEMP, NO SEA GRASS.

7-8-97 (10:35Am) WATER IS VERY MURKY LIGHT BROWN CAN SEE only 4 INCHES DOWN, MEDIUM WAVES, WIND 5-8 mi/Hr. Cloudy Day 80° Temp.

7-15-97 (10:30Am) CALM WATER MEDIUM CLEAR CAN SEE 2FT DOWN, NOT ANY CURRENT, WIND ABOUT 5-8 miles/HR., NO WAVES Temp 85° VERY LITTLE SEA GRASS FLOATING

7-15-97 (4:00Pm) WATER IS CALM, NO WAVES EXCEPT THE CURRENT IS STRONG AND WATER LOOKS A LITTLE MORE MURKY THIS AFTERNOON YOU CAN only SEE 1 FT DOWN TO BOTTOM, TEMP 90° SOME SEA GRASS FLOATING.

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

	Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI Ti (sec)	SDI Tf (sec)	
STARTED 9:30Am	7-16-97	10:00 Am	47	28.00	26.00	2.0	0.19	18	69	
4:13 Pm STOPPED	7-16-97	3:49 Pm	44	27.75	22.50	6.6	0.16	18	78	
9:40Am STARTED	7-17-97	10:00 Am	47	29.00	25.50	1.45	0.14	18	69	
4:09 Pm STOPPED	7-17-97	3:47 Pm	44	28.75	22.00	4.40	0.11	18	63	
10:12Am STARTED	7-18-97	10:30 Am	49	28.50	24.50	3.30	0.13	18	79	
4:06 Pm OFF	7-18-97	3:38 Pm	45	28.50	21.00	3.10	0.11	17	62	4:07 B.W.
8:35Am STARTED	7-21-97	8:55 Am	48	26.25	25.25	3.83	0.21	18	70	
4:17 Pm STOPPED	7-21-97	3:50 Pm	50	26.00	22.00	6.43	0.10	17	58	
8:45Am STARTED	7-22-97	9:05 Am	50	26.00	22.50	4.52	0.14	17	64	
STOPPED 4:06 Pm	7-22-97	3:43 Pm	42	26.00	17.25	9.01	.09	18	57	

7-16-97 (10:30Am) WATER IS CALM, NO WAVES NO CURRENT, WIND ABOUT 3 MILE/HR., WATER IS CLEAR TO 3 FT YOU CAN SEE A LOT VERY BEAUTIFUL DAY ABOUT 85° PARTLY CLOUDY.

7-16-97 (4:15PM) WATER IS LESS CLEAR, NO WAVES BUT A LITTLE CURRENT, CAN SEE TO 1½ FEET DOWN. A LITTLE MORE MURKY WATER THAN THIS MORNING 5MI/HR WIND ABOUT 90°

7-17-97 (10:20Am) WATER IS VERY CLEAR AND NO WAVES, WIND ABOUT 5MI/HR. YOU CAN SEE TO FOUR FEET DOWN SOME SEA GRASS FLOATING ABOUT 85° TEMP,

7-17-97 (3:55Pm) WATER IS CLEAR BUT ALL YOU CAN SEE DOWN IS 2½ TO 3FT, NO WAVES, SOME CURRENT OF TIDE GOING OUT 5MI/HR WIND. VERY SUNNY DAY SOME GRASS FLOATING, ABOUT 90°-95° TEMP.

7-18-97 (10:22Am) WATER IS CLEAR TO 3FT ONLY, WIND ABOUT 6-8MI/HR, NO WAVES, ABOUT 80°, NICE AQUA COLOR WATER, SOME GRASS FLOATING

7-18-97 (3:45Pm) WATER IS SAME CLARITY AS THIS MORNING AND EVERYTHING ELSE THE SAME AS THIS MORNING.

7-21-97 (9:00Am) WATER IS CLEAR TO 1FT DOWN, NO WAVES, WIND ABOUT 5MI/HR. NO CURRENT TEMP ABOUT 85°, NO SEA GRASS FLOATING.

7-21-97 (3:58Pm) WATER LOOKS THE SAME AS THIS MORNING 10-12 MI/HR WIND MORE SEA GRASS FLOATING, TEMP 80°.

7-22-97 (9:00Am) WATER IS NOT SO CLEAR, SEA GRASS FLOATING, WAVES ABOUT 1FT HIGH CAN SEE DOWN ¾FT ONLY VERY LITTLE CURRENT, WIND ABOUT 5 MI/HR.

7-22-97 (3:50Pm) WATER IS THE SAME AS THIS MORNING, LESS SEAGRASS FLOATING

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbility In (NTU)	Turbitiy Out (NTU)	SDI Ti (sec)	SDI Tf (sec)	
7-23-97	9:38Am	44	27.00	21.50	5.8	0.15	18	61	9:08A STARTED
7-23-97	9:56Am	48	27.00	20.50	6.7	0.12	18	59	
7-23-97	10:21Am	50	27.00	20.00	4.2	0.11	18	56	
7-23-97	2:23Pm	40	27.00	16.00	5.3	0.11	18	57	
7-23-97	2:43Pm	40	27.25	16.00	5.0	0.18	18	53	
7-23-97	3:01Pm	40	27.25	16.00	5.0	0.16	18	54	3:23 PM STOPPED
7-24-97	9:39Am	50	2225	21.50	9.3	0.21	18	108	9:30A STARTED; 9:18A B.W.
7-24-97	3:57Pm	44	22.00	19.75	5.3	0.11	18	70	STOPPED 4:20PM
7-25-97	10:04Am	47	21.00	19.00	3.1	0.17	18	74	STARTED 9:55A
7-28-97	2:25Pm	58	5.00	0	5.4	0.31	20	92	STARTED 2:16 PM; STOPPED AT 2:55PM
7-29-97	9:05Am	54	4.00	1.00	5.2	0.32	(DO NOT HAVE SDI KIT)		STARTED 8:50 PM
7-29-97	4:10Pm	48	10.00	0	6.34	0.20	22	95	STOPPED AT 4:29Pm
7-30-97	10:04Am	42	24.00	21.00	2.44	0.15	19	70	STARTED AT 9:10 Am
7-30-97	4:07Pm	42	26.00	16.00	(4:08 PM B.W. - STOPPED 4:18 PM)				
7-31-97	DIDN'T	START-UP							

B.W. = BACKWASHED.

7-22-97 (10:30AM) WATER IS CALM, NO WAVES, WIND 3 MI/HOUR, WATER IS CLEAR TO 1 1/2 FT DOWN.
TEMP 85° NO SEA GRASS FLOATING

7-23-97 (2:30PM) WATER IS CALM, NO WAVES, WIND 3-4 MI/HR, WATER IS CLEAR TO 1 1/2 FT DOWN.
TEMP 90°, VERY LITTLE SEA GRASS FLOATING, A LITTLE CURRENT

7-24-97 (9:50AM) WATER IS MURKY CAN SEE TO 6" ONLY WITH SEA GRASS FLOATING AFTER BIG SHIP PASSED BY LOTS OF SAND MIXING AND LOOKS MURKY. NO WAVES WIND ABOUT 3MI/HR. SHIPS ARE MAKING WAVES ONLY.

7-24-97 (4:05PM) EVERYTHING IS SAME AS THIS MORNING, NO SEA GRASS FLOATING.

7-25-97 (10:35AM) WATER IS CALM, CLEAR TO 1 1/2 FT DOWN, WIND ABOUT 3-5 MI/HR, NO CURRENT
THE ONLY WAVES COMING IN ARE FROM THE BOATS PASSING BY., 90° TEMP.
NO SEA GRASS!

7-28-97 (2:30PM) WATER IS CALM, NO WAVES, CLEAR TO 1 3/4 FT DOWN, WIND ABOUT 5-8 MI/HR

7-29-97 (9:20 AM) WATER IS CALM NO WAVES, SEA GRASS FLOATING, 88° TEMP

7-30-97 (10:15AM) WATER IS VERY CALM, NO WAVES, NO CURRENT, CAN SEE DOWN TO BOTTOM 3 1/2 FT.
SOME SEA GRASS FLOATING, ABOUT 5 miles per Hour WIND AND 85° TEMP.

Laguna Madre Water District
Seawater Pilot Study

GelCleer Filter Data Collection Sheet

	Date	Time	Flow to Filter (gpm)	Filter In (psi)	Filter Out (psi)	Turbidity In (NTU)	Turbitiy Out (NTU)	SDI Ti (sec)	SDI Tf (sec)	
9:00Am STARTED	8-1-97	9:20Am	48	16	15	3.4	.130	23	97	
STOPPED 4:18Pm	8-1-97	3:54Pm	47	17	14	2.7	.20	20	79	B.W. 4:18Pm

(9:29 AM) 7-31-97 WATER IS CLEAR TO 3 FT, VERY CALM NO WAVES ONLY WHEN BOATS GO BY. NO WIND, GLASSY WATER ON TOP, NO SEAGRASS. 90° TEMP.

8-1-97 (4:00 PM) WATER IS CLEAR, SMALL WAVES, MODERATE WIND, GLASSY WATER ON TOP NO SEAGRASS 90° TEMP.

Day	Hour Meter	PERM. Turb NTU	PERM Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	OUT OF GEL FILTER FEED NTU		
10:30AM 5-2-97 FRI	1277.4	0.16	22.4	37.5	31	640	635	625	3	21+	10	4.95	.558	0.16	6.85	START UP READING
5-2-97 Fri 2:00PM	1279.8		22.8	37.0	30.5	645	635	630	3	21+	10	4.96	.537		7.05	ADJUSTED PH FROM 6.9
11 Fri 4:00PM	1282.0		23.5	38.5	29.5	680	670	670	3	21+	10	4.97	.548	TURNED OFF S ACID PUMP	NETWORK 8.44	3:45PM BACKWASHED FROM 28 PSI TO 3 PSI (3 MIN.)
		TURNED	EVERY	THING	OFF			4:15PM								14 PSI ON FILTER 4:05PM
TUE 5-6-97	8:45AM 1282.4	0.08	23.9	39.0	31.0	710	705	700	4	21	11	4.98	.635	0.36	7.0	8:45AM STARTED PSI ON FEED FILTER 4
		FOUND R.O. BACKWASHED FILTER		OFF AT 1:30PM		FOR	10 MINUTES.	1283.6 IS ON HOUR METER AND STARTED R.O. AT				1:50PM.				1:30PM SYSTEM STOPPED 43 PSI ON FILTER
TUE 5-6-97	1:55PM 1283.8	0.04	24.6	38.5	29.0	710	690	685	2	21	11	4.98	.643	0.34	7.03	HAVING A LITTLE TROUBLE W.TH ACID FEED PUMP
		FOUND R.O. 4:25PM	OFF AT 4:20PM BACKWASHED FOR 10 min.			1286.0	ISON HOUR METER, STOPPED EVERYTHING AT 4:35PM			28.5PSI ON FILTER, COULDN'T GET SAMPLES.			WON'T START			FEED HIGH PRESSURE
WED 5-7-97	11:10AM 1286.1	0.04	24.1	39.5	31.5	710	700	690	4	21	11	5.00	.653	0.62	7.01	CLEANED FILTERS
		FOUND R.O.	OFF AT 1:35PM			1287.3	IS ON HOUR METER			39 PSI	ON FILTER,					

2:10PM STARTED RO. PLANT OPSI.

Comments: _____

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Laguna Madre Seawater RO Test Engineers: NRS Consulting Engineers (Jesus Leal) 423 7409
Boyle Engineering (Chris Martin, Travis Fisher) 805 325 7253

Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes	
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	out of GEL Filter FEED NTU		After Filter Turbidity	
WED 5-7-97	2:10 PM 1287.3	→ START 0 PSI	TED RO. on FILTER														
WED 5-7-97	2:20 PM 1287.5	0.01	24.3	39.75	29.25	695	680.50	680.25	4.0	21	11	5.04	.664	0.21	7.22	0.16	
Wed 5-7-97	4:25 PM 1289.5	0.04	24.7	39.0	28.50	715	705	700	4.0	21	11	5.04	.595	0.28	8.47	0.15	STOPPED R.O. AT 4:30 PM.
Thur. 5-8-97	9:50 AM 1290.0	0.01	23.5	39.50	29.25	710	700	690	4.0	21	11	5.02	.605	0.13	8.39	0.18	STARTED AT 9:35 AM
THUR 5-8-97	11:23AM 1291.5	0.02	23.6	39.50	24.0	715	705	695	4.0	21	11	5.02	.604	2.30	7.02	0.88	BACKWASHED 4 MINUTES 24 PSI TO 5 PSI ON FILTER
THUR 5-8-97	3:35 PM 1295.7	0.02	24.4	39.25	25.50	720	700	705	4.0	21	11	5.09	.631	0.34	7.35	.32	STOPPED R.O. AT 24.5 PSI 3:35 PM
TUE 5-13-97	9:55A 1295.7	0.01	23.9	39.50	28.5	665	650	645	4.0	21+	11	4.70	.559	0.20	6.9		BACKWASHED B:6 FILTER 9:45 FOR 10 MIN. 3 PSI
TUE 5-13-97	2:05PM 1299.8	0.01	24.6	39.00	24.5	665	650	645	4.0	21+	11	4.70	.551	0.18	7.0		2:00 PM PSI 5 ON FILTER
TUE 5-13-97	4:20PM 1302.1	0.04	24.5	38.5	23.0	665	655	645	4.0	21+	11	4.72	.534	0.14	7.1		4:30 PM PSI 10 ON FILTER STOPPED EVERYTHING 4:35 PM
We 5-14-97	9:40A 1302.7	0.01	25.2°	39.0	25.9	660	650	645	4.0	21+	11	4.74	.582	0.16	7.0		STARTED AT 9:15A — 6 PSI 7.5 PSI 9:40A
W 5-14-97	1:47P 1306.8	0.01	25.8°	39.0	23.5	660	645	640	4.0	21+	11	4.73	.553	0.16	7.1		1:45 PM FILTER PSI 23

Comments: (5-8-98 1.1 mg/L Cl_2 — LITTLE BAC. GROWTH, 1.4 mg/L Cl_2 LITTLE BAC GROWTH, 2 mg/L Cl_2 LOTS OF BAC. GROWTH 14T. HARDNESS, 200 CHLORIDE)

(5-13-97 CHLORIDE 200, 40 T. HARDNESS, 4.0 mg/L Cl_2 1QT NO GROWTH, 3.5 mg/L Cl_2 1QT — NO GROWTH, 3.5+ mg/L 1000mL — NO GROWTH)

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Day	Hour Meter	PERM Turb NTU	PERM Temp °C	Pressures, psig						Flow, gpm		Conductivity		out of 6el Filter FEED NTU	pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm			STOPPED AT 4:15 PM
WE. 5-17-97	8:03 A 1309.1	0.02	26.°0	38.9	22.5	665	645	645	4.0	21+	11.1	4.73	.551	0.20	7.0	PSI ON FILTER 32 BACKWASHED AT 4:16 PM
THUR. 5-21-97	4:12 PM		EVERY THING OFF FOR SDI TESTING													PSI 25 4:10 PM
5-27-97	CLEANED FILTERS				6-10-97		STARTED			R.O. UNIT TO TREAT WATER (CHRIS IS HERE)						
6-10-97	913193	0.1 / 0.11	23.7	38.5	35.0	730	715	710	3.8	21*	11	5.28	.742	0.26 / 0.23	? 6.8	CHANGED CARTRIDGE FILTERS
6-10-97	1322.5	0.1	24.8	38.5	35.0	720	705	700	4.0	21	11	5.30	.820	0.28	6.5	STOPPED AT 2:05 PM TO CHG GAC FILTER. STARTED AT 2:25 PM. R.O.
6-10-97	4:00 PM 1324.1	0.01	25.7	38.0	34.5	725	710	705	4.0	21	11	5.29	.800	0.19	6.8	(CHRIS LEFT TO CAL AT 3:00 PM (4PM 4/26 PM.)
6-10-97	AT 4:10 PM		STOPPED EVERYTHING						(600 TDS)	SAMPLE AT 4:00 PM						
6-11-97	STARTER		R.O. AT 8:42 AM											(OVERLOAD RELAY NOT GOOD 11:30 AM)	**	
6-11-97	8:50 AM 1324.3	0.06	25.0	38.5	35.5	720	705	700	3.9	21	11	5.24	.869	0.36	6.5	9:55 A LOOKS LIKE BOOSTER PUMP IS OVERHEATING AND WENT OFF

Comments: 6-10-97 4:00 PM 907 SQAL. SAMPLE ADDED 3.0 mg/L Cl_2 AND RAN TWO BACTERIOLOGICAL SAMPLES AND ARE NEGATIVE.

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Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	NTU OUT OF GEL FILTER		STARTED R.O. IN USA 6-12-97 ★
★ 6-12-97	AT 10:5[illegible] 1325.7	0.06	26.0	39.00	35.00	725	715	710	4.0	21	11	5.27	.855	0.22	6.8	
6-12-97	1:55PM 1328.6	0.02	26.5	38.25	34.50	735	725	715	4.0	21	11	5.27	.813	0.10	6.8	
6-12-97	3:00PM 1329.4	0.02	26.5	38.25	34.50	735	715	710	4.0	21	11	5.31	.804	0.13	7.09	STOPPED EVERYTHING TO BACKWASH GEL FILTER
6-13-97	9:10AM 1330.0	0.01	23.8	38.5	34.5	740	720	720	4.0	21	11	5.35	.790	0.2	6.5	STARTED R.O. AT 8:50A 6-13-97
6-13-97	2:50PM 1334.1	0.01	24.8	38.5	34.5	745	725	730	4.0	21	11	5.36	.775		6.7	STOPPED AT 3:20PM TO BACKWASH FILTER
6-16-97	9:50 AM 1334.5	0.05	24.6	39.0	35.5	740	739	722	4.0	21	11	5.44	.877	0.64	6.5	STARTED R.O. AT 9:40AM STARTED GEL FILTER 9:30A
6-16-97	2:00PM 1340.6	0.02	25.7	38.0	34.5	745	740	730	4.0	21	11	5.42	.828	0.16	7.0	STOP R.O. AT 4:00PM BACKWASH GEL FILTER 4:0[illegible]
6-17-97	10:50A 1340.9	0.01	24.6	38.5	35.0	750	740	730	4.0	21	11	5.42	.861	0.17	6.6	STARTED GEL FILTER 10:15AM STARTED R.O. AT 10:30 AM
6-17-97	4:15PM 1346.1	0.04	26.0	38.0	34.5	750	740	735	4.0	21	11	540	.844	0.17	7.0	STOP R.O. AT 4:17 PM BACKWASHED GEL FILTER 4:2[illegible] PM

Comments: _____

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Laguna Madre Seawater RO Test Engineers: NRS Consulting Engineers (Jesus Leal) 423 7409
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ay	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. OUT OF GEL FILTER	pH	
8-97	9:20A 1346.7	0.03	23.6	39.5	35.0	755	740	739	4.0	21	11	543	.828	0.27	6.6	STARTED GEL FILTER AT 8:30A STARTED R.O. AT 8:45A
8-97	1:30PM 1351.1		24.6	38.5	34.5	760	745	740	4.0	21	11	548	.779		6.8	STOP R.O. TO BACKWASH GEL FILTER PSI 30IN - 5OUT 1:30 BACKW
8-97	1:45PM 1351.1		25.1	38.5	34.5	750	730	722	4.0	21	11	538	.816			STARTED R.O. AT 1:45PM PSI 36IN 35OUT
8-97	3:30PM	STOP R.O.		BECAUSE OF		BLOWN OUT		GASKET		STARTED	R.O.	AT 3:30 PM				
8-97	1353.0	0.04	25.8	38.0	34.5	740	720	719	4	21	11	5.42	.853	0.24	7.6	STOP R.O. AT 4:30 PM
9-97	9:26AM 1353.2	0.14	24.7	38.0	34.5	738	720	719	4	21+	11	5.45	.883	0.20	6.7	STARTED R.O. AT 9:21A
9-97	10:43A 1354.5	0.13	24.4	38.25	34.50	745	730	725	4.0	21+	11	5.46	.829	0.23	7.0	
9-97	1:43PM 1356.8	FOUND GEL	R.O. FILTER	OFF DUE TO	DIRTY	/	2:20PM	STARTED	R.O.	AGAIN	AFTER	BACKWASHING	GEL	FILTER.		
9-97	2:28PM 1357.0	0.03	26.1	38.25	34.50	740	725	715	4.0	21+	11	5.45	.916	0.23	6.8	
9-97	4:08PM 1358.7	0.09	26.4	37.75	34.25	745	725	725	4.0	21+	11	5.45	.870	0.37	7.4	STOPPED R.O AT 4:30PM

Comments: _____

ay	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	(FEED) TURB. OUT OF GE/ FILTER	pH	
20.97	10:00Am 1359.3	0.01	24.3	38.25	34.25	745	730	725	4.0	21+	11	5.43	.880	0.19	6.5	STARTED R.O. AT 9:40Am STOPPED R.O. 10:25Am TO B.W.
2097	2:57Pm 1364.0	0.02	26.4	38.00	34.25	750	730	725	4.0	21+	11	5.41	.867	0.19	7.33	STARTED R.O. 10:50A
2097	3:27Pm 1364.5	0.06	26.1	37.75	34.00	750	730	725	4.0	21+	11	5.46	.856	0.90	7.51	STOPPED R.O. AT 3:50Pm
2397	9:34Am 1365.1	0.02	23.2	39.00	34.50	750	735	730	4.1	21+	11	5.42	.826	0.32	6.5	STARTED R.O. AT 9:22Am
2397	10:55Am 1366.1	0.05	23.0	38.75	34.00	730	720	720	4.1	21+	11	5.44	.771	0.33	6.5	
2497	2:15Pm	CHANGING PH METER ELECTRODE AND CARTRIDGE FILTERS										R.O.	OFF.			R.O. IS OFF AT 2:05Pm NEED B.W. GE/ FILTER
Tues 24-97	9:26Am 1369.0	0.01	23.0	38.50	34.50	750	735	730	4.0	21+	11	5.41	.839	0.22	7.0	R.O. IS STARTED AT 9:18Am
Thurs 24.97	10:02AM 1369.7	0.03	23.0	38.50	34.25	770	750	740	4.0	21+	11	5.40	.791	0.24	6.5	
Thurs 24-97	2:43Pm 1374.4	0.03	23.0	37.75	34.0	750	735	725	4.0	21+	11	5.39	.760	0.14	7.0	
Thurs 6-24-97	3:15Pm 1374.9	0.11	22.8	38.25	34.0	750	730	725	4.0	21+	11	5.43	.759	0.34	7.0	R.O. OFF AT 3:40Pm

Comments: 6-23-97 11:00Am ADDED MORE SULFURIC ACID AND SCALE INHIBITOR

6-24-97 11:00Am ADDED MORE SCALE INHIBITOR

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Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity (Feed)			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. OUT OF GE/ Filter	pH	
Wed 1-29-97	1375.5 9:05AM	0.02	23.2	38.50	34.50	750	730	730	4.0	21+	11	5.44	.824	0.24	6.8	R.O. STARTED 8:57A
Wed 6-29-97	1375.9 9.33 AM	0.02	23.2	38.25	34.25	750	730	730	4.0	21.+	11	5.44	.814	0.23	6.8	
Wed 1-29-97	1381.1 2:48 PM	0.02	23.5	37.75	34.0	750	730	730	5.0	21 +	11	5.44	.790	023	6.8	
6-2597	3:30PM	STOPPED EVERYTHING DUE TO BURNED UP INTAKE Pump MOTOR / CHANGED CARTRIDGE FILTERS														
6-2797	11:00AM 1382.0	0.04	25.3	37.75	34.50	745	725	720	4.0	21+	11	5.48	.893	0.25	7.0	STARTED R.O. AT 10:45AM
6-2797	11:25AM 1382.4	0.05	25.1	37.75	34.25	745	730	725	3.8	21++	11	5.46	.873	0.28	7.14	
6-2797	3:50A 1386.8	0.01	26.0	37.5	33.75	750	730	725	3.5	21++	11	5.49	.866	0.09	7.0	STOPPED R.O. AT 4:05PM
6-3097	10:17AM 1387.4	0.02	25.4	38.00	34.25	740	725	715	4.0	21+	11	5.39	.906	0.12	7.0	STARTED AT 9:55AM R.O.
6-3097	10:39AM 1387.8	0.04	25.7	37.75	34.25	740	725	720	4.0	21+	11	5.42	.887	0.18	6.9	
6-30-97	3:35PM 1392.7	0.00	26.6	37.50	34.00	745	725	715	4.0	21+	11	5.42	.890	0.12	6.9	
6-30-97	4:02PM 1393.2	0.02	26.0	37.50	34.00	745	725	720	4.0	21+	11	5.43	.873	0.20	6.9	STOPPED R.O. AT 4:45PM

Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. out of GE/ Filter	PH	
7-1-97	10:00A 1393.9	0.08	25.0	37.75	34.25	740	725	720	4.0	21+	11	5.40	.884	0.17	7.0	STARTED R.O. AT 9:32A
7-1-97	10:30A 1394.4	0.07	24.8	37.75	34.25	745	725	720	4.0	21+	11	5.43	.870	0.20	6.9	
7-1-97	3:34PM 1399.5	0.06	26.1	37.50	34.00	745	725	720	4.0	21+	11	5.43	.882	0.18	7.0	
7-1-97	3:54PM 1399.8	0.10	26.1	37.50	34.00	745	725	720	4.0	21+	11	5.44	.881	0.24	7.0	4:12PM STOPPED R.O.
7-2-97	10:58A 1400.2	0.01	25.7	38.25	34.25	740	725	715	4.1	21+	11	5.41	.932	0.22	6.9	10:50A STARTED R.O
7-2-97	11:16A 1400.6	0.01	25.3	37.75	34.00	740	725	715	4.0	21+	11	5.41	.903	0.22	6.8	
7-2-97	3:15PM 1404.6	0.01	26.0	37.50	34.00	745	725	720	4.0	21+	11	5.39	.879	0.11	6.9	
7-2-97	3:37PM 1404.9	0.03	25.7	37.50	34.00	745	725	720	4.0	21+	11	5.43	.868	0.12	7.0	STOPPED R.O AT 4:00PM
7-3-97	10:36A 1405.6	0.01	24.8	38.00	34.25	740	725	715	4.0	21+	11	5.45	.907	0.13	6.8	STARTED R.O. AT 10:10A
7-3-97	11:26A 1406.5	0.01	25.8	37.75	34.00	740	725	715	4.0	21+	11	5.44	.932	0.11	7.0	

Comments: _____

Engineers: NRS Consulting Engineers (Jesus Leal) 423 7409
Boyle Engineering (Chris Martin, Travis Fisher) 805 325 7253

Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. OUT OF GE/ Filter	pH	
3-97	3:23Pm 1410.4	0.00	26.2	37.50	23.75	745	725	723	4.1	21+	11	5.44	.890	0.13	7.0	
1-3-97	3:48Pm 1410.8	0.00	26.2	37.50	34.00	748	730	723	4.1	21+	11	5.44	.888	0.12	7.2	4:06 Pm STOPPED R.O.
2-7-97	10:28Am 1411.5	0.02	24.4	37.75	34.25	730	715	705	3.9	21+	11	5.49	.967	0.20	6.9	10:10A STARTED R.O.
3-7-97	3:58Pm 1417.0	0.01	25.8	37.75	34.00	745	725	720	4.0	21+	11	5.43	.925	0.11	7.2	STOPPED R.O AT 4:13 Pm
7-8-97	10:09Am 1417.5	0.02	24.2	38.25	34.00	745	730	725	4.0	21+	11	5.49	.964	0.17	6.6	STARTED R.O AT 9:58Am
7-8-97	10:25A 1417.7	0.02	24.4	38.00	34.00	745	728	725	4.0	21+	11	5.46	.934	0.16	6.9	
1-8-97	3:29Pm 1422.8	0.01	26.3	37.75	33.75	745	728	722	4.1	21+	11	5.43	.936	0.13	7.22	STOPPED R.O 3:44Pm
7-9-97	9:10Am 1423.3	0.01	24.2	37.50	34.00	748	735	725	4.0	21+	11	5.46	.942	0.17	6.7	STARTED R.O AT 8:53Am
7-9-97	10:28A 1424.6	0.01	24.4	37.50	34.00	753	738	730	4.0	21+	11	5.49	.878	0.16	7.2	
7-9-97	4:20Pm 1430.5	0.09	26.4	37.25	34.00	750	735	730	4.0	21+	11	5.46	.931	0.15	7.8	STOPPED R.O. 4:25Pm

Comments: 7-7-97 Looks Like High Pressure Hose is Leaking a Little more Than the usual

Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. out of GE Filter	PH	
7-16-97	10:08A 1431.1	0.01	24.9	37.75	34.00	7.50	735	728	4.1	21+	11	5.46	.994	0.19	6.86	9:35A STARTED R.O.
7-16-97	4:00P 1436.9	0.02	25.7	37.50	34.00	750	735	728	4.0	21+	11	5.45	.967	0.16	6.9	4:12P STOPPED R.O.
7-17-97	10:05A 1437.4	0.02	24.7	37.50	34.25	748	735	728	4.0	21+	11	5.50	.987	0.14	6.9	9:50A STARTED R.O.
7-17-97	3:50P 1443.2	0.02	25.8	37.50	34.00	750	735	730	4.0	21+	11	5.47	.947	0.10	6.8	4:08P STOPPED R.O.
7-18-97	10:35A 1443.7	0.01	24.3	37.75	34.25	750	738	730	4.0	21+	11	5.49	.997	0.12	6.8	10:20A STARTED R.O.
7-18-97	3:40P 1448.8	0.04	26.6	37.50	34.00	750	738	730	4.1	21+	11	5.47	.968	0.12	7.0	4:05P R.O. OFF
7-21-97	9:00A 1449.5	0.00	25.3	37.75	34.00	753	742	735	4.0	21+	11	5.46	.964	0.21	7.1	8:43A R.O. ON.
7-21-97	3:52P 1456.4	0.01	26.5	37.50	33.75	750	735	730	4.1	21+	11	5.44	.950	0.10	7.1	STOPPED RO 4:15P
7-22-97	9:08A 1457.0	0.02	25.5	37.75	34.00	745	735	728	4.05	21+	11	5.48	1.01	0.30	6.9	STARTED R.O. 8:53A
7-22-97	3:45P 1463.6	0.01	26.7	37.50	33.75	748	735	728	4.0	21+	11	5.50	.963	0.12	7.1	STOPPED RO AT 4:05P

Comments: _____

Laguna Madre Seawater RO Test Engineers: NRS Consulting Engineers (Jesus Leal) 423 7409
Boyle Engineering (Chris Martin, Travis Fisher) 805 325 7253

Day	Hour Meter	PERM. Turb NTU	PERM. Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. out of GET FILTER	PH	
7-23-97	9:43A 1464.3	0.01	25.3	37.50	34.00	750	735	730	4.0	21+	11	5.49	1.00	0.15	7.1	STARTED R.O. 9:24 AM
7-23-97	10:02A 1466.6	0.01	25.4	37.50	34.00	750	738	730	4.0	21+	11	5.49	.995	0.11	7.0	
7-23-97	3:30PM 1469.1	0.02	26.5	37.50	34.00	753	739	735	4.0	21+	11	5.48	1.03	0.09	6.6/7.0	STOPPED R.O. 3:22 PM.
7-24-97	10:00A 1470.4	0.00	25.6	37.50	34.00	750	738	732	4.0	21+	11	5.49	1.01	0.17	7.0	9:34 STARTED R.O.
7-24-97	4:00PM 1476.5	0.02	26.9	37.50	34.00	750	735	730	4.05	21+	11	5.49	.997	0.11	7.0	4:18 PM STOPPED R.O.
7-25-97	10:25A 1477.2	0.02	24.5	37.50	34.00	753	746	733	4.05	21+	11	5.49	.993	0.16	7.1	STARTED R.O 10:00AM
7-28-97	2:48PM 1483.1	0.01	26.1	37.75	34.25	745	732	725	4.05	21+	11	5.48	1.04	0.31	7.0	STARTED R.O. AT 2:20 PM STOPPED R.O. AT 2:54 PM
7-29-97	9:15AM 1483.3	0.09	24.0	37.75	34.00	745	737	725	4.0+	21+	11	5.49	1.02	0.32	6.5	STARTED R.O AT 9:00 AM
7-29-97	4:15PM 1490.5	0.01	27.1	37.50	34.00	745	730	725	4.0	21+	11	5.46	1.02	0.20	7.0	STOPPED RO. AT 4:28 PM
7-30-97	10:07A 1491.7	0.02	25.4	37.50	33.75	745	735	728	4.0	21+	11	5.45	1.01	0.15	7.1	STARTED RO AT 9:15A

Comments: 7-30-97 (4:00PM) FOUND EVERYTHING ON EXCEPT High Pressure Pump is OFF. I STOPPED R.O. AND RESET R.O. AND STARTED, THE High Pressure Pump DIDN'T START. JUST STOPPED R.O. 4:06PM.
7-31-97 DIDN'T START: NO ONE AVAILABLE TO CHECK ELECTRICAL PROBLEM.
8-1-97 TRIPPED High Pressure Pump FOUND By ELECTRICIAN

Day	Hour Meter	Turb NTU	Temp °C	Pressures, psig						Flow, gpm		Conductivity			pH	Notes
				Filter In	Filter Out	Feed	Inter-stage	Conc.	Perm.	Conc	Perm	Feed	Perm	TURB. OUT 66L FILTER		
8-1-97	9:25A 1496.9	0.02	24.9	37.50	33.75	752	740	735	4.0	21+	11	551	1.02	0.30	7.00	STARTED R.O. 9:08A
8-1-97	4:00P 1503.4	0.02	27.1	37.50	33.75	745	733	725	4.0	21+	11	549	1.06	0.25	7.0	STOPPED RO AT 4:15P

Comments: 8-1-97 RO UNIT TRIPPED HIGH PRESSURE PUMP BY ELECTRICIAN. STARTED AGAIN

Laguna Madre Seawater RO Test Engineers: NRS Consulting Engineers (Jesus Leal) 423 7409
Boyle Engineering (Chris Martin, Travis Fisher) 805 325 7253

APPENDIX D
PERMIT DOCUMENTATION

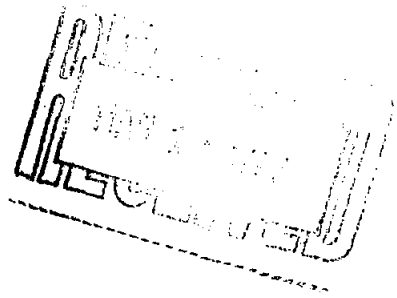
DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF:

March 4, 1997

Real Estate Division

SUBJECT: License No. DACW64-3-97-34, Brazos Santiago Pass and Jetties, Brazos Island Harbor Project, Texas



Mr. Jesus Leal
NRS Consulting Engineers
P.O. Box 2544
Harlingen, Texas 78551

Dear Mr. Leal:

We have enclosed a fully executed copy of the subject license which authorizes Laguna Madre Water District to conduct a Reverse Osmosis Pilot Study on Government property at the North Jetty - Brazos Santiago Pass, South Padre Island, Texas. Your check has been deposited with our Finance and Accounting Office.

We draw your attention to Condition 17 of the license. This license is valid only if you have also obtained the Department of the Army Permit addressed in 17.C.

Please call Ms. Joy Smith of my staff at 409-766-3144 if you have any questions. Thank you.

Sincerely,

Richard W. Harrison
Chief, Real Estate Division

Enclosure

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553-1229

REPLY TO
ATTENTION OF
Evaluation Section

March 24, 1997

SUBJECT: SWG-97-07-003

Laguna Madre Water District
105 Port Road
Port Isabel, Texas 78578

Gentlemen:

You may proceed with the installation of intake and outfall structures associated with an experimental reverse osmosis unit, which you proposed in your February 21, 1997, letter. A copy of your plans in five sheets is enclosed. Your letter resulted in the initiation of the pre-discharge notification procedure specified for Nationwide Permit 7. Your agent, Mr. Jesus Leal, NRS Engineering, was notified by telephone on March 21,1997, that the District Engineer has determined that the work is authorized under Nationwide Permit 7. The project is located in Brazos Santiago Pass, north jetty, Jetties Restaurant, South Padre Island, Cameron County, Texas.

Nationwide Permit 7 authorizes the construction of outfall structures and associated intake structures where the effluent from the outfall is authorized, conditionally authorized, or specifically exempted, or are otherwise in compliance with regulations issued under the National Pollutant Discharge Elimination System Program (section 402 of the Clean Water Act). This nationwide permit does not obviate the need to obtain other Federal, State, or local permits required by law nor does it authorize any injury to the property rights of others.

This verification is valid for 1 year. Please let me know when you complete your project by returning the enclosed pre-addressed post card. If you have any questions concerning this matter, please contact the Project Manager, Marcel Duronslet, at the letterhead address or by telephone at 409-766-3995.

Sincerely,

Robert W. Heinly
Leader, South Evaluation Unit

Enclosures

Copy Furnished: Mr. Jesus Leal, NRS Engineering, 1222 East Tyler, Suite C, Harlingen, Texas 78551

NO. DACW64-3-97-34

DEPARTMENT OF THE ARMY LICENSE

BRAZOS SANTIAGO PASS, BRAZOS ISLAND HARBOR PROJECT

CAMERON COUNTY, TEXAS

THE SECRETARY OF THE ARMY, hereinafter referred to as the Secretary, under authority of General Administrative Powers, hereby grants to LAGUNA MADRE WATER DISTRICT, Cameron County, Texas, hereinafter referred to as the grantee, a license to conduct a Reverse Osmosis Pilot Study at the North Jetty on the south end of South Padre Island, over, across, in and upon lands of the United States, as identified in Exhibits A, B and C, attached hereto and made a part hereof, hereinafter referred to as the premises.

THIS LICENSE is granted subject to the following conditions.

1. TERM

This license is granted for a term of **SIX (6) MONTHS**, beginning **24 February 1997** and ending **23 August 1997**, but revocable at will by the Secretary.

2. CONSIDERATION

The grantee shall pay in advance to the United States the amount of **ONE HUNDRED THIRTY FIVE AND NO/100 DOLLARS ($135.00)**, in full for the term hereof, payable to the order of the Finance and Accounting Officer, U.S. Army Corps of Engineers, and delivered to District Engineer, U.S. Army Engineer District, Galveston, ATTN: Real Estate Division (RE-M), P.O. Box 1229, Galveston, Texas 77553-1229.

3. NOTICES

All notices to be given pursuant to this license shall be addressed, if to the grantee, to Laguna Madre Water District, c/o Mr. Jesus Leal, NRS Consulting Engineers, P.O. Box 2544, Harlingen, Texas 78551; and if to the United States, to the District Engineer, Attention: Chief, Real Estate Division (RE-M), P.O. Box 1229, Galveston, Texas 77553-1229; or as may from time to time otherwise be directed by the parties. Notice shall be deemed to have been duly given if and when enclosed in a properly sealed envelope addressed as aforesaid, and deposited, postage prepaid, in a post office regularly maintained by the United States Postal Service.

4. AUTHORIZED REPRESENTATIVES

Except as otherwise specifically provided, any reference herein to "Secretary", "District Engineer", or "said officer" shall include their duly authorized representatives. Any reference to "grantee" shall include any duly authorized representatives.

5. SUPERVISION BY THE DISTRICT ENGINEER

The use and occupation of the premises shall be subject to the general supervision and approval of the District Engineer, Galveston District, hereinafter referred to as said officer, and to such rules and regulations as may be prescribed from time to time by said officer.

6. APPLICABLE LAWS AND REGULATIONS

The grantee shall comply with all applicable federal, state, county and municipal laws, ordinances and regulations wherein the premises are located.

7. CONDITIONAL USE BY GRANTEE

The exercise of the privileges herein granted shall be:

a. without cost or expense to the United States;

b. subject to the right of the United States to improve, use or maintain the premises.

c. subject to other outgrants of the United States on the premises.

d. personal to the grantee, and this license, or any interest therein, may not be transferred or assigned.

8. CONDITION OF PREMISES

The grantee acknowledges that it has inspected the premises, knows its condition, and understands that the same is granted without any representations or warranties whatsoever and without any obligation on the part of the United States.

9. PROTECTION OF PROPERTY

The premises shall at all times be protected and maintained in good order and condition by and at the expense of the grantee. The grantee shall be responsible for any damage that may be caused to the property of the United States by the activities of the grantee

under this license, and shall exercise due diligence in the protection of all property located on the premises against fire or damage from any and all other causes. Any property of the United States damaged or destroyed by the grantee incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the grantee to a condition satisfactory to said officer, or at the election of said officer, reimbursement made therefor by the grantee in an amount necessary to restore or replace the property to a condition satisfactory to said officer.

10. INDEMNITY

The United States shall not be responsible for damages to property or injuries to persons which may arise from or be incident to the exercise of the privileges herein granted, or for damages to the property of the grantee, or for damages to the property or injuries to the person of the grantee's officers, agents, servants or employees or others who may be on the premises at their invitation or the invitation of any one of them, and the grantee shall hold the United States harmless from any and all such claims not including damages due to the fault or negligence of the United States or its contractors.

11. RESTORATION

On or before the expiration date of this license or its termination by the grantee, the grantee shall vacate the premises, remove the property of the grantee, and restore the premises to a condition satisfactory to said officer. If, however, this license is revoked, the grantee shall vacate the premises, remove said property and restore the premises to the aforesaid condition within such time as the District Engineer may designate. In either event, if the grantee shall fail or neglect to remove said property and restore the premises, then, at the option of said officer, the property shall either become the property of the United States without compensation therefor, or said officer may cause the property to be removed and no claim for damages against the United States or its officers or agents shall be created by or made on account of such removal and restoration work. The grantee shall also pay the United States on demand any sum which may be expended by the United States after the expiration, revocation, or termination of this license in restoring the premises.

12. NON-DISCRIMINATION

The grantee shall not discriminate against any person or persons because of race, color, religion, sex, age, handicap, national origin in the conduct of operations on the premises.

13. TERMINATION

This license may be terminated by the grantee at any time by giving the District Engineer at least ten (10) days notice in writing provided that no refund by the United States of any consideration previously paid shall be made.

14. ENVIRONMENTAL PROTECTION

A. Within the limits of their respective legal powers, the parties to this license shall protect the premises against pollution of its air, ground and water. The grantee shall comply with any laws, regulations, conditions, or instructions affecting the activity hereby authorized if and when issued by the Environmental Protection Agency, or any Federal, state, interstate or local governmental agency having jurisdiction to abate or prevent pollution. The disposal of any toxic or hazardous materials within the premises is specifically prohibited. Such regulations, conditions, or instructions in effect or prescribed by said Environmental Protection Agency, or any Federal, state, interstate or local governmental agency are hereby made a condition of this license. The grantee shall not discharge waste or effluent from the premises in such a manner that the discharge will contaminate streams or other bodies of water or otherwise become a public nuisance.

B. The grantee will use all reasonable means available to protect the environment and natural resources, and where damage nonetheless occurs from the grantee's activities, the grantee shall be liable to restore the damaged resources.

C. The grantee must obtain approval in writing from said officer before any pesticides or herbicides are applied to the premises.

15. HISTORIC PRESERVATION

The grantee shall not remove or disturb, or cause or permit to be removed or disturbed, any historical, archeological, architectural or other cultural artifacts, relics, remains or objects of antiquity. In the event such items are discovered on the premises, the grantee shall immediately notify said officer and protect the site and the material from further disturbance until said officer gives clearance to proceed.

16. DISCLAIMER

This license is effective only insofar as the rights of the United States in the premises are concerned; and the grantee shall obtain any permit or license which may be required by Federal, state, or local statute in connection with the use of the premises. It is understood that the granting of this license does not preclude the necessity of obtaining a Department of the Army permit for

activities which involve the discharge of dredge or fill material or the placement of fixed structures in the waters of the United States, pursuant to the provisions of Section 10 of the Rivers and Harbors Act of 3 March 1899 (33 USC 403), and Section 404 of the Clean Waters Act (33 USC 1344).

17. SITE SPECIFICS

A. Before implementing the Pilot Study, the grantee must have a plan in place to completely remove the activity from the floodplain at the end of the six-month license period, or at the threat of flooding during the six-month period.

B. The wastes produced by the Reverse Osmosis process must be identified, and the intended containment and disposal methods and locations for the wastes must meet State standards.

C. A Department of the Army Regulatory Permit will also be required for this action. Please contact Mr. Marcel Duronslet at 409-766-3995.

THIS LICENSE is not subject to Title 10, United States Code, Section 2662, as amended.

IN WITNESS WHEREOF, I have hereunto set my hand by authority of the Secretary of the , this 5 day of March, 1997.

RICHARD W. HARRISON
Chief, Real Estate Division
U.S. Army Corps of Engineers
Galveston District
Galveston, Texas

THIS LICENSE is also executed by the grantee this 25th day of February, 1997.

LAGUNA MADRE WATER DISTRICT

By: E. Hernandez
Name: Eduardo Hernandez
Title: General Manager

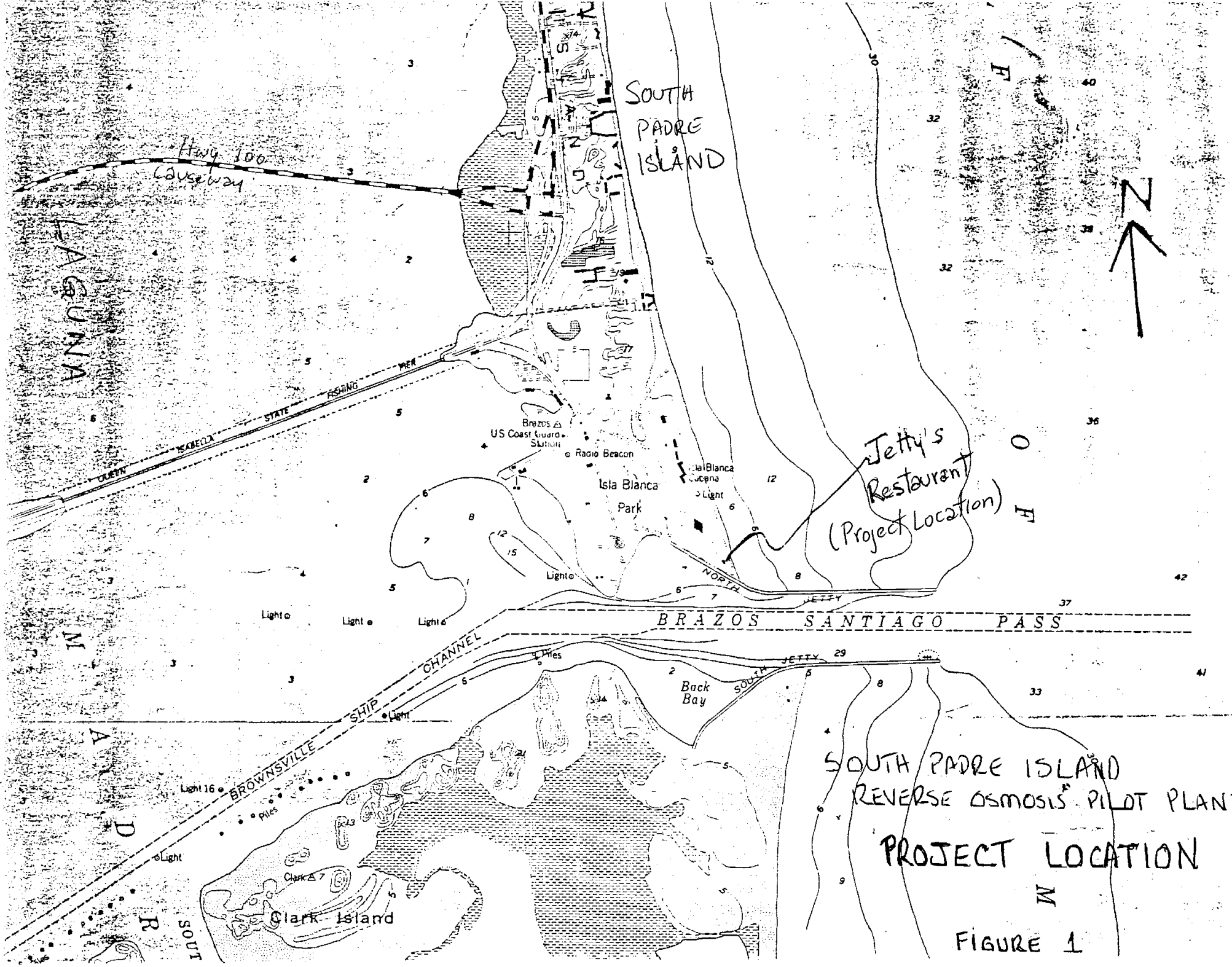

SOUTH PADRE ISLAND
Hwy 100
Causeway
LAGUNA MADRE
PIER
FISHING
STATE
QUEEN
ISABELLA
Brazos
US Coast Guard Station
Radio Beacon
Isla Blanca Park
Isla Blanca Light
Jetty's Restaurant (Project Location)
NORTH JETTY
BRAZOS SANTIAGO PASS
SOUTH JETTY
Back Bay
SHIP CHANNEL
BROWNSVILLE
Light 16
Piles
Clark Island
SOUTH PADRE ISLAND
REVERSE OSMOSIS PILOT PLANT
PROJECT LOCATION
N

FIGURE 1

BRAZOS SANTIAGO PASS
Jetty's Restaurant
Isla Blanca Park
Back Bay
CHANNEL
Light
Radio Beacon
U.S. Coast Guard Station
NORTH JETTY
SOUTH JETTY

EXHIBIT A

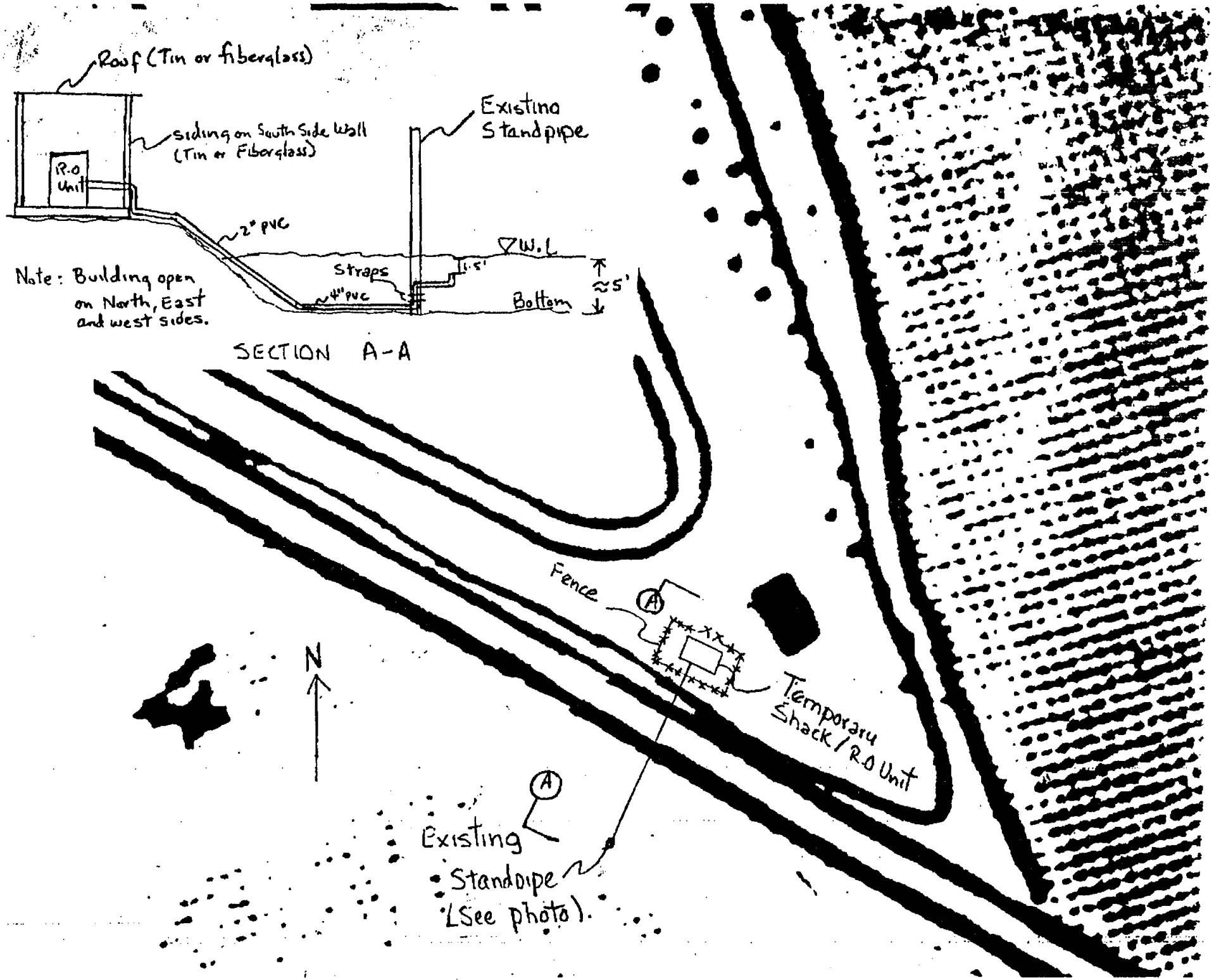
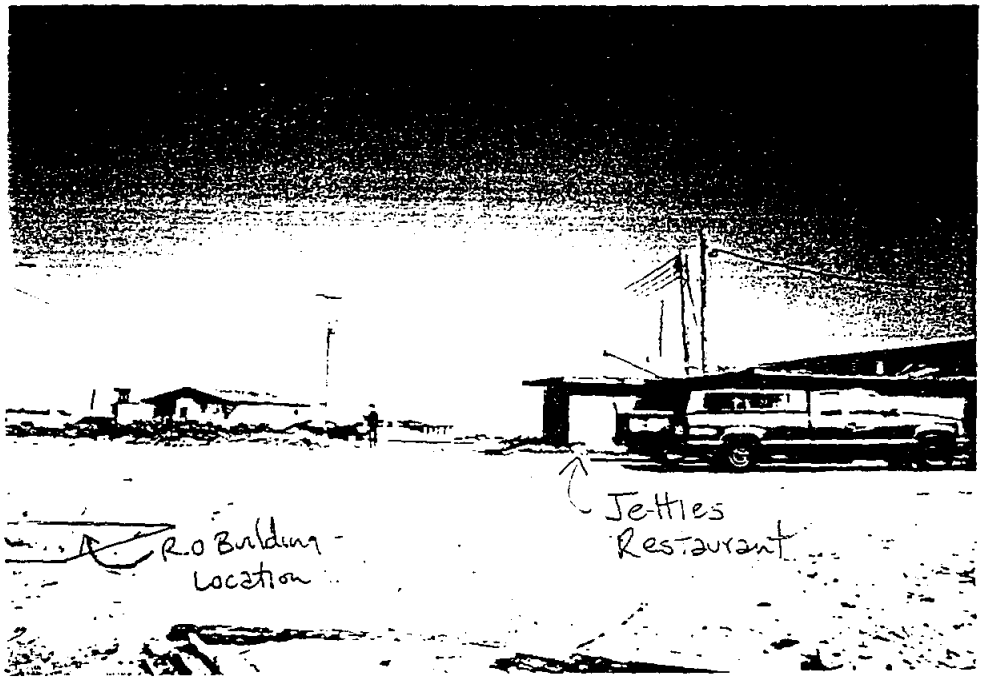

Roof (Tin or fiberglass)
siding on South Side Wall (Tin or Fiberglass)
R.O Unit
Existing Standpipe
2" pvc
W.L
Straps
1.5'
4" pvc
≈5'
Bottom
Note: Building open on North, East and west sides.
SECTION A-A
Fence
A
Temporary Shack / R.O Unit
N
A
Existing Standpipe (See photo).

EXHIBIT B


2" PVC
R.O Building
Location


R.O Building
Location
Jetties
Restaurant

NRS
CONSULTING ENGINEERS

Certified Mail
P 249 293 333

1222 E. Tyler, Suite C
P.O. Box 2544
Harlingen, Texas 78551
210 423-7409
FAX 210 423-7482

May 7, 1997

CF9611

Joe Rodriguez
Texas Natural Resource Conservation Commission
134 E. Van Buren, Suite 301
Harlingen, Texas 78550

Re: Laguna Madre Water District
Sea water Desalinization Pilot Plant Permit Request

Dear Mr. Rodriguez:

As previously discussed, the Laguna Madre Water District is in the process of conducting a sea water desalinization pilot study. Recent Drought conditions in the area of the Rio Grande Valley has created the need to alleviate potential shortages of surface raw water supply from the Rio Grande by possibly utilizing groundwater or sea water resources. The project is located in Brazos Santiago Pass, north jetty, Jetties Restaurant, South Padre Island, Cameron County, Texas. The site selected for this pilot study is under the jurisdiction of the U.S. Corps of Engineers. We have obtained a temporary permit to proceed with this project at this site.

The Reverse Osmosis Pilot Unit is mounted on a trailer bed. A temporary shack has been built to protect equipment. The reverse osmosis pilot unit consists of pressure vessels for membrane housing, high pressure pump, scale inhibitor feed system, acid feed system, and filtration system. A 4" PVC intake pipe was extended from the beach to a stand pipe located approximately 35 ft from the rock barrier. the pipe was run on the bottom and attached to the stand pipe. The intake pipe was run into the temporary shack and connected to the intake pump. The intake pipe will provide the feed to a 80 gpm filter which then provides the feed to a 50 gpm reverse osmosis pilot unit. The concentrate and product from the reverse osmosis pilot unit will be combined and directed to a 4" discharge line. The filter will be backwashed with seawater at a rate of 185 gpm at least twice a day and the flow directed also to the 4" discharge line. The flows will be discharged back into the ocean.

CF9611

Enclosed please find copies of the authorization letter from the U.S. Corps of Engineers for use of the Jetties site. Also find copies of the drawings provided to this agency for evaluation of the project. We will begin operations on May 7, 1997. The pilot unit will be in operation for a period of approximately 90-days. You have provided you verbal permission to proceed with the project. Please provide us with a written permission for record purposes. Please let me know if you have any questions or require additional information.

Sincerely,

NRS Consulting Engineers

Jesus Leal, P.E.

JL/bh

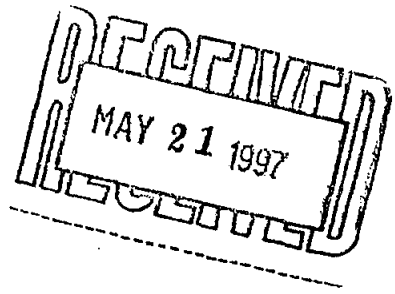
cc: Eddie Hernandez

file
CF 9611

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

May 19, 1997



Mr. Jesus Leal, P.E.
NRS Consulting Engineers
P.O. Box 2544
Harlingen, Texas 78551

Subject: Laguna Madre Water District; ID No. 0310005
Seawater Desalinization Pilot Plant

Dear Mr. Leal:

I have reviewed your permit request for the above referenced project previously discussed by telephone on March 12, 1997. The project, located in the Brazos Santiago Pass, north jetty, South Padre Island, Cameron County, Texas, consists of a reverse osmosis unit and related appurtenances which will treat seawater at a rate of 50 gpm and the discharge water will be placed back into the ocean. Based on information previously and currently provided, we voice no objection to the project. This letter serves to confirm permission previously given verbally.

Sincerely,

Jose A. Rodriguez, R.S.

Jose A. Rodriguez, R.S.
Environmental Investigator
Public Water Supply Section
Water Program

JAR/jar

NRS
CONSULTING ENGINEERS

1222 E. Tyler, Suite C
P.O. Box 2544
Harlingen, Texas 78551
210 423-7409
FAX 210 423-7482

August 29, 1997

CF9611

Wilma Turner (6WQ-CA)
Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Tx 75202-2733

Re: NPDES Application No. TX0116203
Laguna Madre Water District (R.O. Pilot Unit)
Withdrawal/Cancellation of Application

Dear Ms. Turner:

As per our phone conversation on August 28, 1997, the NPDES application previously submitted was a request for a temporary permit. We have completed our activities for this project and will not be necessary to continue processing of the permit application. We request withdrawal and cancellation of the above referenced permit application.

Sincerely

NRS Consulting Engineers

Jesus Leal, P.E.
Project Engineer

cc: Eddie Hernandez
Bill Norris

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

September 5, 1997

REPLY TO: 6WQ-CA

Mr. Eduardo Hernandez
General Manager
Laguna Madre Water District
105 Port Road
Port Isabel, TX 78578

Re: NPDES Application No. TX0116203-Laguna Madre Water District

Dear Mr. Hernandez:

In accordance with your request of August 29, 1997 from Mr. Jesus Leal of NRS Consulting Engineers, you are hereby notified that your National Pollutant Discharge Elimination System (NPDES) application for the above referenced facility has been discontinued and void.

Any resumption of the discharge or any new discharge from your facility without a permit will be unlawful. Should you again propose to discharge any pollutants from this facility to waters of the United States, it will be necessary to file a new NPDES application at least 180 days in advance of the proposed discharge.

If you have any questions, please do not hesitate to contact Wilma Turner at the above address or telephone (214) 665-7516.

Sincerely yours,

for Jayne Fontenot
Chief
Customer Service Branch

cc: Texas Natural Resources Conservation Commission

Mr. Jesus Leal, P.E.
NRS Consulting Engineers
P.O. Box 2544
Harlingen, Texas 78551

Post-it® Fax Note 7671	Date 9/10/97	# of pages ▶ 1
To Frank Ferris	From Mr. Hernandez	
Co./Dept.	Co.	
Phone #	Phone #	
Fax # 423-7482	Fax #	

TOTAL P.01

Form Approved.
OMB No. 2040-0086
Approval expires 7-31-88

FOR AGENCY USE

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
APPLICATION FOR PERMIT TO DISCHARGE WASTEWATER

STANDARD FORM A – MUNICIPAL

SECTION I. APPLICANT AND FACILITY DESCRIPTION

Unless otherwise specified on this form all items are to be completed. If an item is not applicable indicate 'NA.'

ADDITIONAL INSTRUCTIONS FOR SELECTED ITEMS APPEAR IN SEPARATE INSTRUCTION BOOKLET AS INDICATED. REFER TO BOOKLET BEFORE FILLING OUT THESE ITEMS.

Please Print or Type

1. Legal Name of Applicant (see Instructions)	101	Laguna Madre Water District
2. Mailing Address of Applicant (see Instructions) Number & Street	102a	105 Port Road
City	102b	Port Isabel
State	102c	Texas
Zip Code	102d	78578
3. Applicant's Authorized Agent (see Instructions) Name and Title	103a	Jesus Leal, P.E. NRS Consulting Engineers
Number & Street	103b	1222 E. Tyler, Suite C
City	103c	Harlingen
State	103d	Texas
Zip Code	103e	78550
Telephone	103f	210 (Area Code) 423-7409 (Number)
4. Previous Application If a previous application for a permit under the National Pollutant Discharge Elimination System has been made, give the date of application.	104	N/A YR MO DAY

I certify that I am familiar with the information contained in this application and that to the best of my knowledge and belief such information is true, complete, and accurate.

Eduardo Hernandez Printed Name of Person Signing	102e	General Manager Title
Signature of Applicant or Authorized Agent	102f	97 04 28 YR MO DAY Date Application Signed

18 U.S.C. Section 1001 provides that:

Whoever, in any matter within the jurisdiction of any department or agency of the United States knowingly and wilfully falsifies, conceals or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statement or representation, or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

FOR AGENCY USE

Received ____ ____ ____
YR MO DAY

OFFICE: ____ EPA Region Number
____ State

FOR AGENCY USE

5. Facility (see instructions)
Give the name, ownership, and physical location of the plant or other operating facility where discharge(s) presently occur(s) or will occur.

Name	105a	Temporary Reverse Osmosis Pilot Treatment Plant located on the Brazos Santiago Pass, North Jetty, Jetties Restraunt, South Padre Island, Cameron County Texas
Ownership (Public, Private or Both Public and Private).	105b	☒ PUB ☐ PRV ☐ BPP
Check block if a Federal facility	105c	☐ FED
and give GSA Inventory Control Number	105d	
Location: Number & Street	105e	Channelview Road on North Jetty
City	105f	Town of South Padre Island
County	105g	Cameron
State	105h	Texas

6. Discharge to Another Municipal Facility (see instructions)

a. Indicate if part of your discharge is into a municipal waste transport system under another responsible organization. If yes, complete the rest of this item and continue with Item 7. If no, go directly to Item 7.

106a ☐ Yes ☒ No

b. Responsible Organization Receiving Discharge

Name	106b	N/A
Number & Street	106c	
City	106d	
State	106e	
Zip Code	106f	

c. Facility Which Receives Discharge
Give the name of the facility (waste treatment plant) which receives and is ultimately responsible for treatment of the discharge from your facility.

106g N/A

d. Average Daily Flow to Facility (mgd) Give your average daily flow into the receiving facility.

106h N/A mgd

7. Facility Discharges, Number and Discharge Volume (see instructions)
Specify the number of discharges described in this application and the volume of water discharged or lost to each of the categories below. Estimate average volume per day in million gallons per day. Do not include intermittent or noncontinuous overflows, bypasses or seasonal discharges from lagoons, holding ponds, etc.

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OMB No. 2040-0086
Approval expires 7-31-88

FOR AGENCY USE

		Number of Discharge Points		Total Volume Discharged, Million Gallons Per Day
To: Surface Water	107a1	1	107a2	0.075 mgd
Surface Impoundment with no Effluent	107b1		107b2	
Underground Percolation	107c1		107c2	
Well (Injection)	107d1		107d2	
Other	107e1		107e2	
Total Item 7	107f1	1	107f2	0.075 mgd
If 'other' is specified, describe	107g1			

If any of the discharges from this facility are intermittent, such as from overflow or bypass points, or are seasonal or periodic from lagoons, holding ponds, etc., complete Item 8.

8. Intermittent Discharges

a. Facility bypass points Indicate the number of bypass points for the facility that are discharge points. (see instructions) — 108a: None

b. Facility Overflow Points Indicate the number of overflow points to a surface water for the facility (see instructions). — 108b: None

c. Seasonal or Periodic Discharge Points Indicate the number of points where seasonal discharges occur from holding ponds, lagoons, etc. — 108c: None

9. Collection System Type Indicate the type and length (in miles) of the collection system used by this facility. (see instructions) — 109a:

- Separate Storm: ☐ SST NONE
- Separate Sanitary: ☐ SAN
- Combined Sanitary and Storm: ☐ CSS
- Both Separate Sanitary and Combined Sewer Systems: ☐ BSC
- Both Separate Storm and Combined Sewer Systems: 109b ☐ SSC
- Length: _____ miles

10. Municipalities or Areas Served (see instructions)

	Name		Actual Population Served
110a		110b	
110a	NONE	110b	NONE
110a		110b	
110a		110b	
110a		110b	

Total Population Served — 110c:

FOR AGENCY USE

11. Average Daily Industrial Flow
Total estimated average daily waste flow from all industrial sources. 111 None mgd

Note: All major industries (as defined in Section IV) discharging to the municipal system must be listed in Section IV.

12. Permits, Licenses and Applications Not Applicable
List all existing, pending or denied permits, licenses and applications related to discharges from this facility. (see instructions)

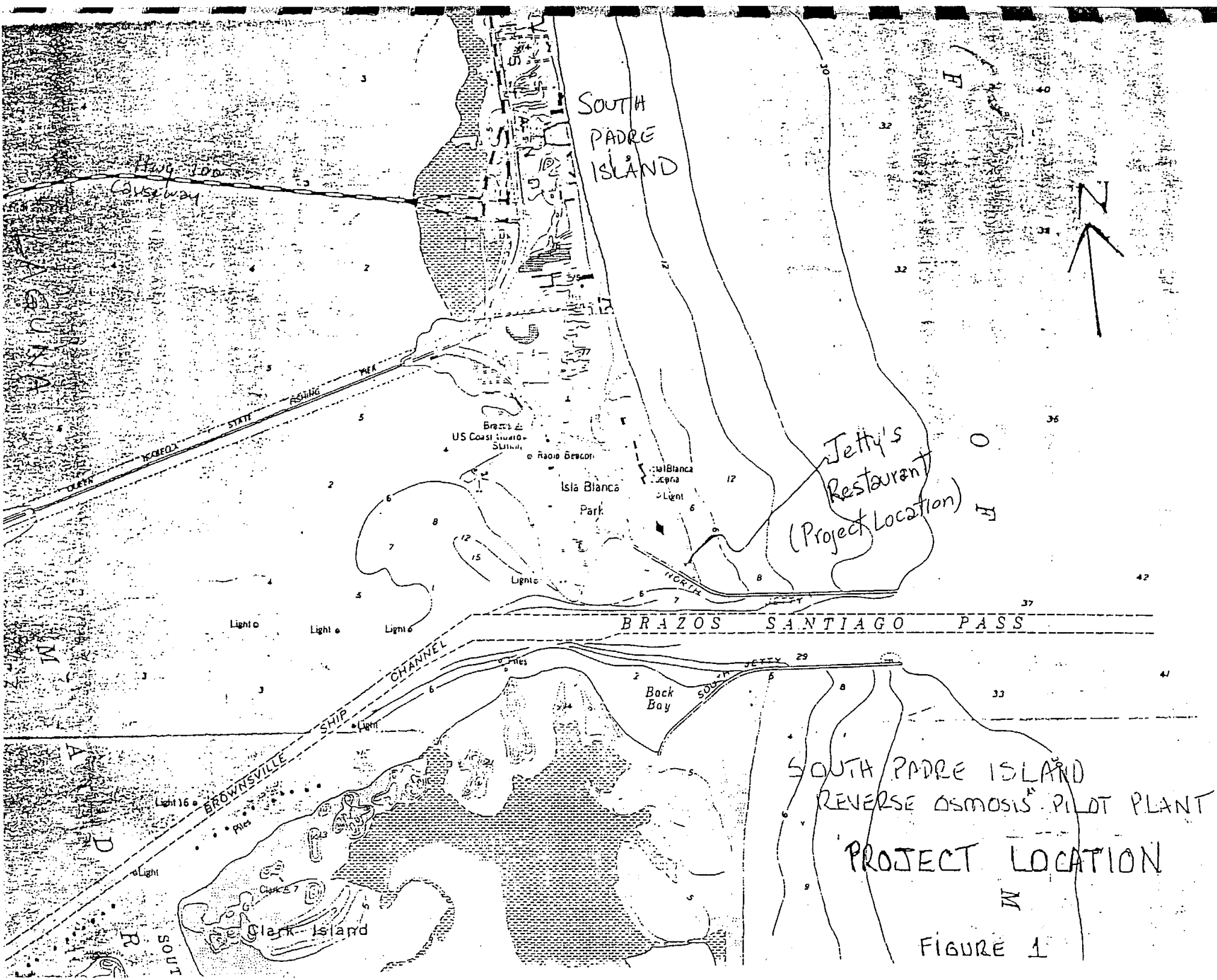
112	Issuing Agency (a)	For Agency Use (b)	Type of Permit or License (c)	ID Number (d)	Date Filed YR/MO/DA (e)	Date Issued YR/MO/DA (f)	Date Denied YR/MO/DA (g)	Expiration Date YR/MO/DA (h)
1.								
2.								
3.								

13. Maps and Drawings
Attach all required maps and drawings to the back of this application. (see instructions)

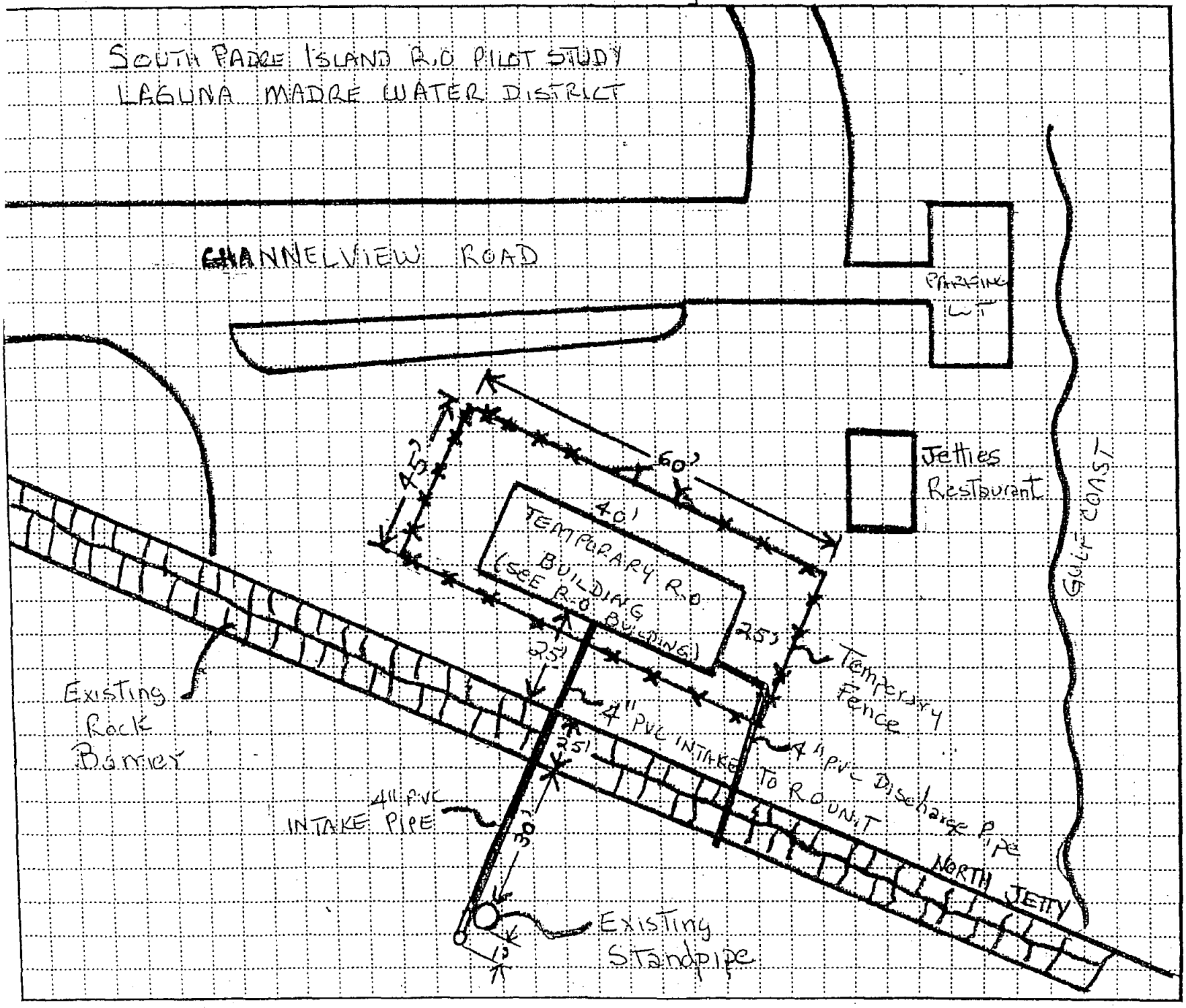
14. Additional Information

114 Item Number	Information
1	Project Location
2	Site Plan
3	Plan View
4	South Side Cross Section
5	West Side Cross Section

☆ U.S. GOVERNMENT PRINTING OFFICE: 1975-628-068/448 3-1


SOUTH PADRE ISLAND
Hwy 100
Causeway
N
Jetty's Restaurant (Project Location)
Isla Blanca Park
Radio Beacon
Light
BRAZOS SANTIAGO PASS
NORTH JETTY
SOUTH JETTY
CHANNEL
SHIP
BROWNSVILLE
Back Bay
Clark Island
Piles
Light 16
SOUTH PADRE ISLAND
REVERSE OSMOSIS PILOT PLANT
PROJECT LOCATION
FIGURE 1

SITE PLAN (Figure 2)



NRS CONSULTING ENGINEERS
1222 E. TYLER, SUITE C
HARLINGEN, TEXAS 78550
(210) 423-7409
FAX (210) 423-7482

JOB _____

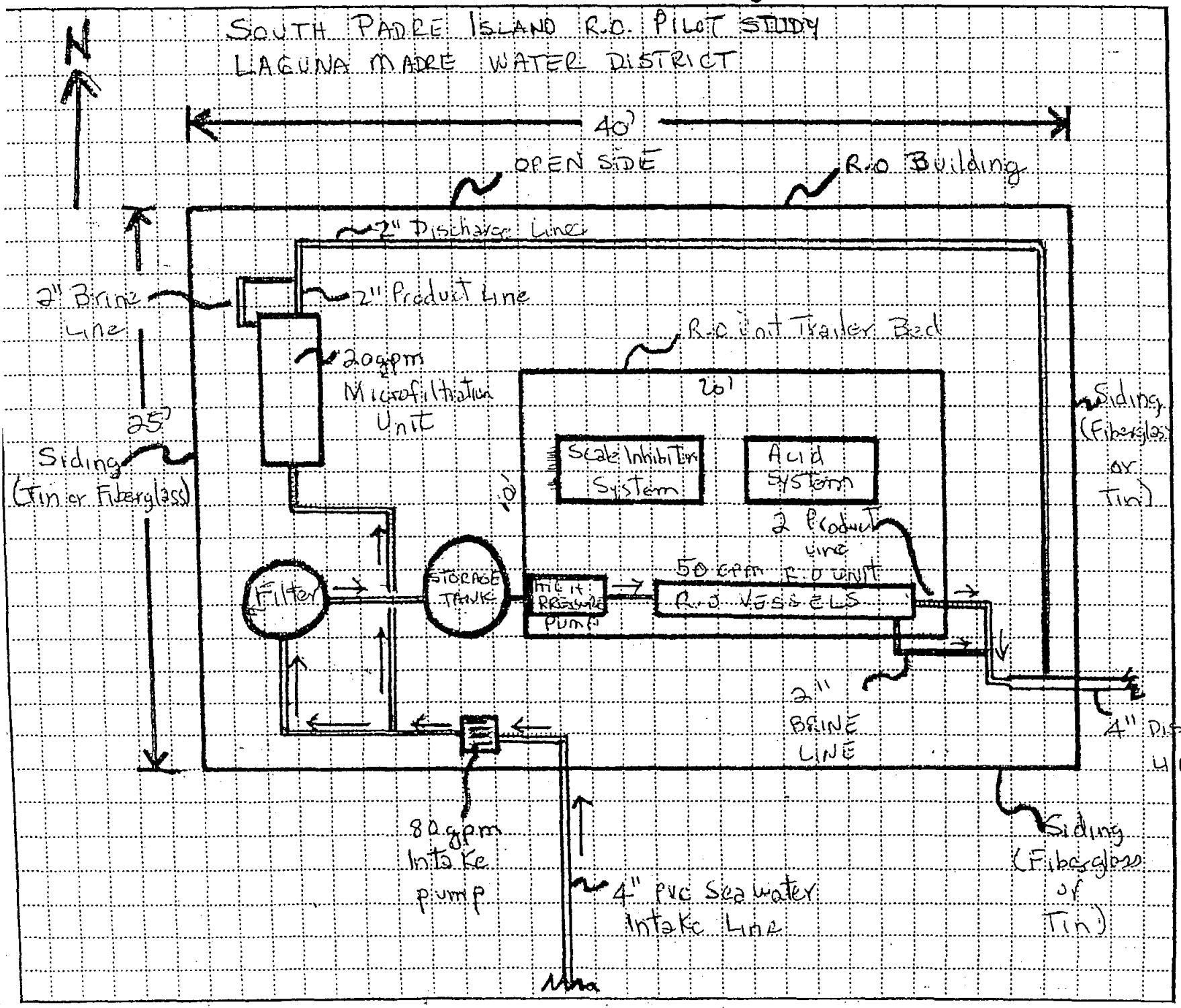
SHEET _____ OF _____

CALCULATED BY: _____ DATE _____

CHECKED BY: _____ DATE _____

SCALE: _____

PLAN VIEW (Figure 3)



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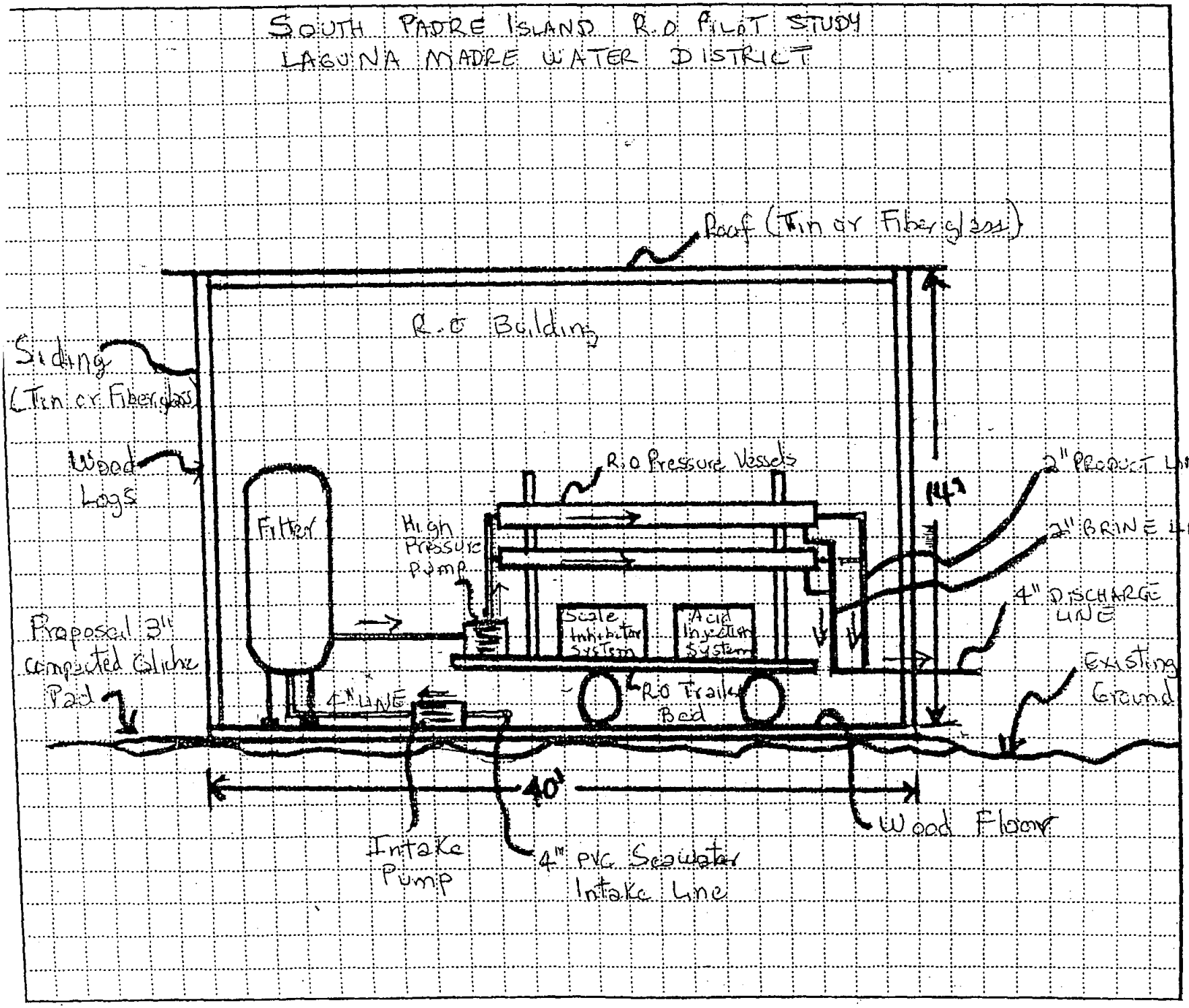
GULF COAST SIDE

JOB
SHEET OF
CALCULATED BY: DATE
CHECKED BY: DATE
SCALE:

SOUTH SIDE CROSS SECTION (Figure 4)

SOUTH PADRE ISLAND R.O PILOT STUDY
LAGUNA MADRE WATER DISTRICT



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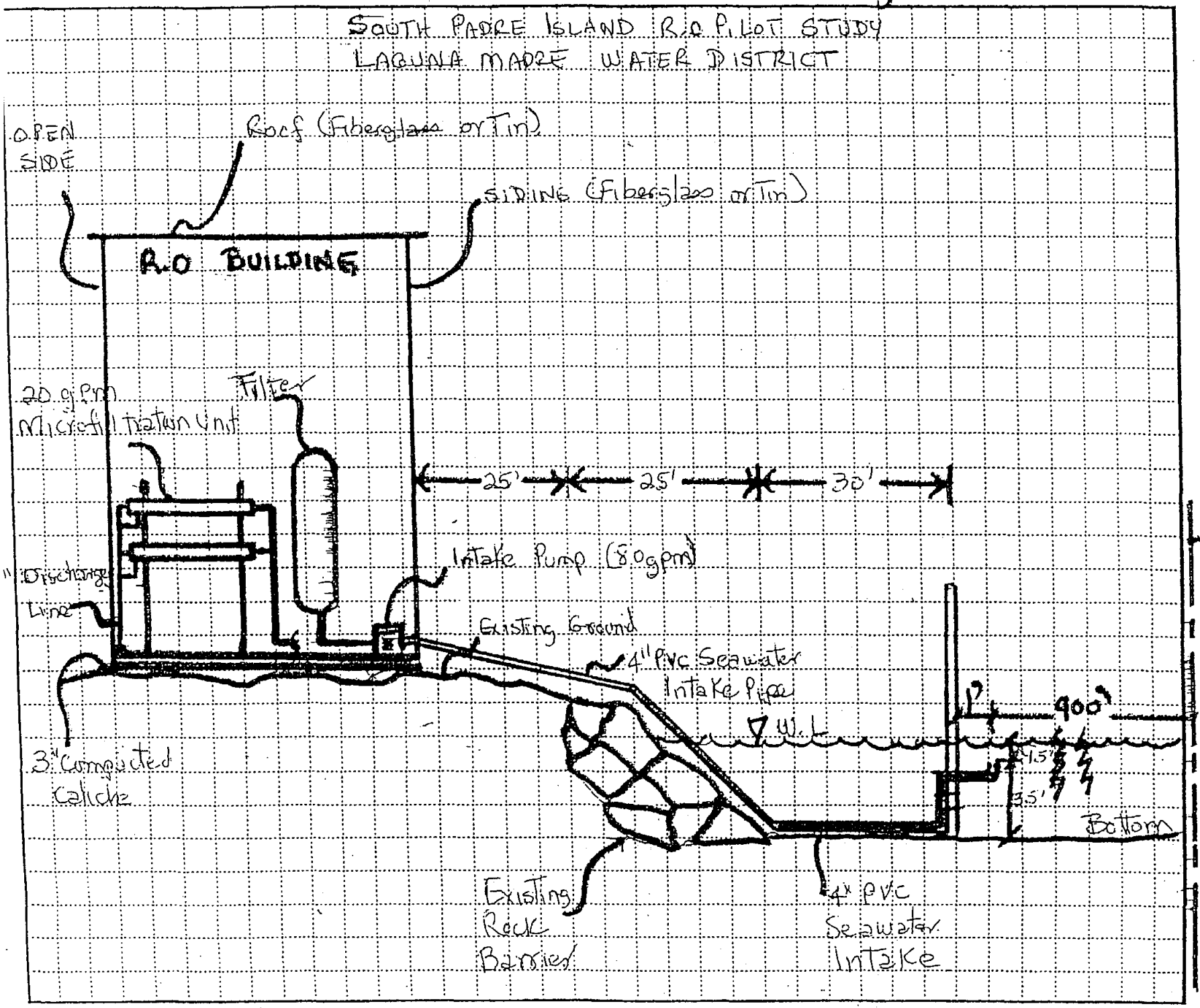
(210) 423-7409
FAX (210) 423-7482

JOB _____
SHEET _____ OF _____
CALCULATED BY: _____ DATE _____
CHECKED BY: _____ DATE _____
SCALE: _____

WEST SIDE CROSS-SECTION (Figure 5)

SOUTH PADRE ISLAND R.O PILOT STUDY
LAGUNA MADRE WATER DISTRICT



CONSULTING ENGINEERS
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HARLINGEN, TEXAS 78550
(210) 423-7409
FAX (210) 423-7482

JOB _____
SHEET _____ OF _____
CALCULATED BY: _____ DATE _____
CHECKED BY: _____ DATE _____
SCALE: _____

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OMB No. 158-R0100

STANDARD FORM A—MUNICIPAL

FOR AGENCY USE

SECTION II. BASIC DISCHARGE DESCRIPTION

Complete this section for each present or proposed discharge indicated in Section I, Items 7 and 8, that is to surface waters. This includes discharges to other municipal sewerage systems in which the waste water does not go through a treatment works prior to being discharged to surface waters. Discharges to wells must be described where there are also discharges to surface waters from this facility. Separate descriptions of each discharge are required even if several discharges originate in the same facility. All values for an existing discharge should be representative of the twelve previous months of operation. If this is a proposed discharge, values should reflect best engineering estimates.

ADDITIONAL INSTRUCTIONS FOR SELECTED ITEMS APPEAR IN SEPARATE INSTRUCTION BOOKLET AS INDICATED. REFER TO BOOKLET BEFORE FILLING OUT THESE ITEMS.

1. **Discharge Serial No. and Name**
   a. **Discharge Serial No.** (see instructions) — 201a: 001
   b. **Discharge Name** Give name of discharge, if any - (see instructions) — 201b: South Padre Island Reverse Osmosis Pilot Plant Outfall
   c. **Previous Discharge Serial No** If a previous NPDES permit application was made for this discharge (Item 4, Section I) provide previous discharge serial number. — 201c: N/A

2. **Discharge Operating Dates**
   a. **Discharge to Begin Date** If the discharge has never occurred but is planned for some future date, give the date the discharge will begin. — 202a: 97 (YR) 05 (MO)
   b. **Discharge to End Date** If the discharge is scheduled to be discontinued within the next 5 years, give the date (within best estimate) the discharge will end. Give reason for discontinuing this discharge in Item 17. — 202b: 98 (YR) 08 (MO)

3. **Discharge Location** Name the political boundaries within which the point of discharge is located

			Agency Use
State	203a	Texas	203 - 1
County	203b	Cameron	203c
(If applicable) City or Town	203e	South Padre Island	203f

4. **Discharge Point Description** (see instructions) Discharge is into (check one)

Stream (includes ditches, arroyos, and other watercourses)	204a	☐ STR
Estuary		☐ EST
Lake		☐ LKE
Ocean		☒ OCE
Well (injection)		☐ WEL
Other		☐ OTH
If 'other' is checked, specify type	204b	

5. **Discharge Point — Lat/Long.** State the precise location of the point of discharge to the nearest second. (see instructions)

Latitude	206a	97/26	DEG.	9/4	MIN.	22/6 SEC
Longitude	206b	____	DEG.	____	MIN.	____ SEC

DISCHARGE SERIAL NUMBER

FOR AGENCY USE

6. **Discharge Receiving Water Name** Name the waterway at the point of discharge (see instructions)

206a: Brownsville Ship Channel - Brazos Santiago Pass, Segment No. 2494

For Agency Use			206c	For Agency Use
Major	Minor	Sub		303c

206b: If the discharge is through an outfall that extends beyond the shoreline or is below the mean low water line, complete item 7.

7. **Offshore Discharge**

a. **Discharge Distance from Shore** 207a: N/A feet

b. **Discharge Depth Below Water Surface** 207b: N/A feet

If discharge is from a bypass or an overflow point or is a seasonal discharge from a lagoon, holding pond, etc., complete items 8, 9 or 10, as applicable; and continue with item 11.

8. **Bypass Discharge** (see instructions)

a. **Bypass Occurrence** Check when bypass occurs

Wet weather	208a1	☐ Yes ☒ No
Dry weather	208a2	☐ Yes ☒ No

b. **Bypass Frequency** Give the actual or approximate number of bypass incidents per year.

Wet Weather	208b1	_____ times per year	
Dry weather	208b2	_____ times per year	NONE

c. **Bypass Duration** Give the average bypass duration in hours.

Wet weather	208c1	_____ hours	
Dry weather	208c2	_____ hours	NONE

d. **Bypass Volume** Give the average volume per bypass incident, in thousand gallons.

Wet weather	208d1	_____ thousand gallons per incident	
Dry weather	208d2	_____ thousand gallons per incident	NONE

e. **Bypass Reasons** Give reasons why bypass occurs. 208e: _____

Proceed to item 11.

9. **Overflow Discharge** (see instructions)

a. **Overflow Occurrence** Check when overflow occurs.

Wet weather	209a1	☐ Yes ☒ No
Dry weather	209a2	☐ Yes ☒ No

b. **Overflow Frequency** Give the actual or approximate incidents per year.

Wet weather	209b1	_____ times per year	
Dry weather	209b2	_____ times per year	NONE

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DISCHARGE SERIAL NUMBER

FOR AGENCY USE

c. Overflow Duration Give the average overflow duration in hours.

Wet weather	209c1	_____hours
Dry weather	209c2	_____Hours

NONE

d. Overflow Volume Give the average volume per overflow incident in thousand gallons.

Wet weather	209d1	_____thousand gallons per incident
Dry weather	209d2	_____thousand gallons per incident

NONE

Proceed to Item 11

10. Seasonal/Periodic Discharges

a. Seasonal/Periodic Discharge Frequency If discharge is intermittent from a holding pond, lagoon, etc., give the actual or approximate number of times this discharge occurs per year.

210a N/A times per year

b. Seasonal/Periodic Discharge Volume Give the average volume per discharge occurrence in thousand gallons.

210b N/A
_____thousand gallons per discharge occurrence

c. Seasonal/Periodic Discharge Duration Give the average duration of each discharge occurrence in days.

210c N/A
_____days

d. Seasonal/Periodic Discharge Occurrence—Months Check the months during the year when the discharge normally occurs.

210d ☐JAN ☐FEB ☐MAR
☐APR ☐MAY ☐JUN
☐JUL ☐AUG ☐SEP
☐OCT ☐NOV ☐DEC

NONE

11. Discharge Treatment

a. Discharge Treatment Description Describe waste abatement practices used on this discharge with a brief narrative. (See Instructions)

211a This is a 90-day Reverse Osmosis (R.O.) Desalinization Pilot Study consisting of a 4" intake pipe, intake pump, filter, high pressure pump, 50 gpm R.O. Pilot unit, and 4" discharge pipe.

DISCHARGE SERIAL NUMBER

FOR AGENCY USE

b. Discharge Treatment Codes
Using the codes listed in Table I of the Instruction Booklet, describe the waste abatement processes applied to this discharge in the order in which they occur, if possible.
Separate all codes with commas except where slashes are used to designate parallel operations.

211b: WF, WR

If this discharge is from a municipal waste treatment plant (not an overflow or bypass), complete items 12 and 13

12. Plant Design and Operation Manuals
Check which of the following are currently available

a. Engineering Design Report — 212a: ☐

b. Operation and Maintenance Manual — 212b: ☐

N/A

13. Plant Design Data (see instructions)

a. Plant Design Flow (mgd) — 213a: _____ mgd

b. Plant Design BOD Removal (%) — 213b: _____ %

c. Plant Design N Removal (%) — 213c: _____ %

d. Plant Design P Removal (%) — 213d: _____ %

e. Plant Design SS Removal (%) — 213e: _____ %

f. Plant Began Operation (year) — 213f: _____

g. Plant Last Major Revision (year) — 213g: _____

N/A

DISCHARGE SERIAL NUMBER

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OMB No. 155-R5100

FOR AGENCY USE

14. Description of Influent and Effluent (see instructions)

Parameter and Code 214	Influent	Effluent						
	Annual Average Value (1)	Annual Average Value (2)	Lowest Monthly Average Value (3)	Highest Monthly Average Value (4)	Frequency of Analysis (5)	Number of Analyses (6)	Sample Type (7)	
Flow Million gallons per day 50050	0.075	0.075	-----	-----	5/5	60	G	*
pH Units 00400	XX	XX	7.0	8.5	5/5	60	G	*
Temperature (winter) ° F 74028	-----	-----	-----	-----	------	---	--	
Temperature (summer) ° F 74027	68	68	43	77	5/5	60	G	*
Fecal Streptococci Bacteria Number/100 ml 74054 (Provide if available)	XX	XX	XX					
Fecal Coliform Bacteria Number/100 ml 74055 (Provide if available)	XX	XX	XX					
Total Coliform Bacteria Number/100 ml 74056 (Provide if available)	XX	XX	XX					
BOD 5-day mg/l 00310								
Chemical Oxygen Demand (COD) mg/l 00340 (Provide if available)								
OR								
Total Organic Carbon (TOC) mg/l 00680 (Provide if available) (Either analysis is acceptable)								
Chlorine–Total Residual mg/l 50060								

- P.O. Pilot Plant

DISCHARGE SERIAL NUMBER

FOR AGENCY USE

14. Description of Influent and Effluent (see instructions) (Continued)

Parameter and Code 214	Influent	Effluent					
	Annual Average Value (1)	Annual Average Value (2)	Lowest Monthly Average Value (3)	Highest Monthly Average Value (4)	Frequency of Analysis (5)	Number of Analyses (6)	Sample Type (7)
Total Solids mg/l 00500	-----	-----	-----	----	-----	--	--
Total Dissolved Solids mg/l 70300	21,100	21,100	-----	----	5/90	5	G
Total Suspended Solids mg/l 00530	100	100	50	250	3/90	3	G
Settleable Matter (Residue) ml/l 00545	-----	----	----	-----	-----	--	--
Ammonia (as N) mg/l 00610 (Provide if available)	----	----	----	-----	-----	--	--
Kjeldahl Nitrogen mg/l 00625 (Provide if available)	-----	----	----	-----	-----	--	--
Nitrate (as N) mg/l 00620 (Provide if available)	-----	----	-----	------	-----	--	--
Nitrite (as N) mg/l 00615 (Provide if available)	-----	------	------	-----	------	--	--
Phosphorus Total (as P) mg/l 00665 (Provide if available)	-----	-----	----	-----	------	--	--
Dissolved Oxygen (DO) mg/l 00300		-----	-----	-----	------	---	--

FOR AGENCY USE

16. **Plant Controls** Check if the following plant controls are available for this discharge

	216	N/A
Alternate power source for major pumping facility including those for collection system lift stations	–	☐ APS
Alarm for power or equipment failure		☐ ALM

17. **Additional Information**

Item Number	Information

APPENDIX E
EXECUTIVE ADMINISTRATOR'S COMMENTS

ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD
Review Comments for Laguna Madre Water District
Contract No. 97-483-202

The Texas Water Development Board recommends the following additions and changes:

1. Page 2-6, 2nd para, last sentence, the word "analyses" is left out; the sentence should read "results of the laboratory analyses are compiled in Appendix B."

2. Also on page 2-6, 3rd para, first time that NTU is used, it should be written out with abbreviation in parentheses.

3. Figure 2.2, page 2-8, "GelCleer" is misspelled-also should there be a legend that says what P11, PE, PSL, P12, etc stands for.

4. In most places throughout the report reverse osmosis is abbreviated R.O. but on page 2.9, 2nd para (and maybe elsewhere too), RO is used. Abbreviation should be consistent.

5. On page 2-10, flux given as gallons per day per square foot and abbreviated gfd (lower case) but on page 2-12 its units are given as gallons per square foot per day and GFD (upper case). Be consistent. Units elsewhere in report are gfd in lower case.

6. Consistency needed, when first time units are given it needs to be spelled out with abbreviation in parentheses, and then abbreviations used afterward. Most of the time this is done correctly, but there were a few times units appeared the initial time as abbreviation and never spelled out.

7. Page 3-2, end of 2nd para, what does "derated" mean?

8. Page 4-4, 3rd para, "pre-treatment" typo.

9. In the cost estimate, the cost is reduced by $900,000 for less water rights value. Is this present rights that are to be sold or is this future water rights that would have to be purchased?

10. The use of reverse osmosis is a viable alternative, it is recommended that the cost of other alternatives be documented.

December 5, 1997

Mr. Eduardo Hernandez
General Manager
Laguna Madre Water District
105 Port Road
Port Isabel, Texas 78578

Re: Review Comments for Draft Report Submitted by Laguna Madre Water District, TWDB Contract No. 97-483-202

Dear Mr. Hernandez:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 97-483-202. As stated in the above referenced contract, the District will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The District must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. J.D. Beffort, the Board's Contract Manager, at (512) 463-7989, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles
Deputy Executive Administrator
for Planning

cc: J.D. Beffort, TWDB