Southmost Regional Water Authority Regional Desalination Plant

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The Southmost Regional Water Authority (SRWA) regional desalination plant, the largest such facility in Texas, is conserving precious surface water resources in the Lower Rio Grande Valley while ensuring participating communities of reliable, high-quality water for municipal and industrial use. The plant uses state-of-the-art RO (RO) technology to treat previously untapped and unusable brackish groundwater resources as an alternative water supply. At start-up, the plant is providing 7.5 million gallons per day (mgd) of high quality water, more than 40 percent of the annual needs of participating entities, thus reducing dependency on the over-allocated Rio Grande. Project components have been over-sized for cost effective expansion in the future.

Planning

The SRWA is a conservation and reclamation district created in 1981 and organized pursuant to Article XVI, Section 59 of the Texas Constitution. Its mission is to provide the most cost-effective and reliable alternative water supply to its members. The SRWA's operating history began in 2000, when it was activated to address long-term regional water supply issues in the Southern Cameron County Region

The SRWA was inactive until the idea of constructing a brackish groundwater treatment facility was proposed. With the planning, funded in part by the Texas Water Development Board in 1995, to study the feasibility to develop the brackish groundwater in the Brownsville area, the idea of converting the brackish groundwater into high quality drinking water had merits. In 1999, the Valley Municipal Utility District No. 2 (VMUD) used the information contained in the report to complete a .25 mgd brackish desalination plant to supplement their current surface water treatment capacity. The plant was constructed for $740,000 and realized a water right savings of over $400,000 at that time. Because of the success of the study and subsequent construction of the VMUD facility, the Brownsville Public Utilities Board (BPUB), VMUD and Laguna Madre Water District (LMWD) held a series of meetings to see if it was possible to work together with a common facility to save costs and utilize a common source.

It was soon realized that the SRWA was an existing organization that was not being used and included the entities that had been meeting together. It was reactivated for planning and feasibility of a regional brackish desalination facility in the summer of 2000. The SRWA retained NRS Consulting Engineers (NRS) in late 2000 to study the initial feasibility of using RO to treat local supplies of brackish groundwater. The results of that study indicated that if adequate supplies of brackish water were available at qualities of approximately 3,000 milligrams per liter (mg/l) total dissolved solids, (TDS), it would be less costly to each entity to work together and construct a brackish groundwater desalination plant than to expand their current surface water treatment plants. It would also provide an alternative source of water to supplement the over allocated water supplied by the Rio Grande.

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Subsequently in 2001, SRWA authorized NRS and R.W. Harden and Associates (Harden) to perform extensive aquifer testing to determine the actual long-term quality and quantity of brackish groundwater availability. The study determined that there is a reliable long-term supply of groundwater with relatively low salinity of 3,000 mg/l total dissolved solids.

The aquifer testing consisted of the drilling of ten test wells and one pilot production well, conversion of three test holes converted to Primary (upper zone) monitoring wells and one test hole converted to a Secondary Zone (lower zone) monitor well. Results of the month long test groundwater modeling indicated that the area of test wells could produce approximately 10 mgd of the supply from the Secondary Zone and could potentially produce additional supply with further testing and operation of the initial well production installation. Initial water quality indicated a TDS of less than 3,000 mg/l.

Member Entities

Brownsville Public Utilities Board

The BPUB operates an electric, water and wastewater system under ownership of the City of Brownsville. The BPUB's service area includes the City of Brownsville and certain contiguous areas of Cameron County. The BPUB was created and established by Article VI of the City Charter as a separate and distinct agency of the City, with authority to control, operate and manage the electric, water and wastewater system, and to expend and apply system revenues, subject to certain limitations. A combination of Revenue and General Obligation/Tax bonds are used to finance system improvements and expansions.

Figure 1 - Finished Water Pump Station and Degasifier

The BPUB owns 27,265 acre-feet of municipal water rights from the Rio Grande granted by the State of Texas. Representing one of the largest water utilities in South Texas, the water system contains a raw water transport system, a river rock weir, a river pump station, two high service pumping stations, two storage reservoirs clear wells, five elevated storage tanks, and transmission and distribution lines. Further, the BPUB maintains two surface water treatment plants to produce sufficient water to meet demand. Water Plant No. 1 and Water Plant No. 2 each have a rated capacity of 20.0 mgd, for a combined rated capacity of 40.0 mgd.

City of Los Fresnos

The City of Los Fresnos ("Los Fresnos") is located approximately midway between Brownsville and South Padre Island in Cameron County. The City has used Revenue Bonds to finance system improvements and expansions.

Los Fresnos' sole source of raw water is the Rio Grande. The City has purchased water rights in 1999 and 2000, bringing its current total to 912 acre feet. Raw water from the Rio Grande is transported to Los Fresnos by an open air canal owned by Cameron County District #6, which charges the City $0.05 per 1,000 gallons delivered.

While the City benefits from the influx of tourists to the South Padre Island region, its monthly water usage is much more consistent than other, more resort-oriented communities. Los Fresnos currently owns and operates a single surface Water Treatment Plant with a rated capacity of 1.0 mgd. The plant was originally built in the 1950s with a capacity of 0.5 mgd, and was expanded in the 1970s to its current size.

Valley Municipal Utilities District No. 2

The Valley Municipal Utilities District No. 2 ("VMUD") is located approximately ten miles north of the central downtown business district of Brownsville and fifteen miles south of the central downtown business district of Harlingen. VMUD lies partially within the town of Rancho Viejo, partially within the extraterritorial jurisdiction of Brownsville and within the boundaries of Brownsville Independent School District and Los Fresnos Independent School District. VMUD has primarily used general obligation tax bonds and bank loans to finance system improvements and expansions.

VMUD has two sources of raw water supply: surface water and ground water. It currently owns 898 acre-feet of municipal surface water rights from the Rio Grande and source-equivalent 112 acre-feet from an existing well, bringing its total to 1,010 acre-feet. VMUD also owns a state water permit authorizing it to take 7,800 acre-feet per year from the Rio Grande.

VMUD currently operates and maintains two water treatment plants in Rancho Viejo. One is a conventional surface water treatment plant with a current capacity of 1.0 mgd. The other is a recently constructed Reverse Osmosis Water Treatment Plant with a capacity of 0.25 mgd. The RO plant treats groundwater from a well recently constructed at the site of the surface water plant. The existing total treated water capacity of 1.25 mgd is adequate only to the year 2003.

Figure 2 - Reverse Osmosis Membrane System

Town of Indian Lake

The Town of Indian Lake ("Indian Lake") has a population of approximately 541, according to the 2000 Bureau of the Census report, with 229 households. Incorporated in the 1960s, Indian Lake is located off Farm Road 1575, one mile North of State Highway 100 and three miles northwest of Los Fresnos in central Cameron County. Indian Lake benefits greatly from the tourism industry, and its population tends to increase five-fold during the winter months with the influx of tourists seeking a warmer climate.

Indian Lake maintains no water treatment or supply facilities. Water service is provided by the East Rio Hondo Water Supply Corporation. Water Demand has increased 1% annually over the past four years, with 2004 demand estimated at 13.5 million gallons. Holding the current consumption growth rate of 1% constant, water demand is forecast to reach 14.9 million gallons by 2010.

Brownsville Navigation District

The Brownsville Navigation District's ("BND") purpose is to provide port facilities while promoting the growth and development of the Brownsville economic region. The BND owns approximately 47,409 acres of land adjacent to the Brownsville Port of Entry, which it markets via lease agreements to various enterprises involved in the agriculture, shipping and trade sectors. It also owns and operates the Brownsville Ship Channel, public wharves and related facilities, such as fences, slabs, buildings, and rail spurs. Lease fees are calculated based on a variety of factors including location, fair market value, and the presence of infrastructure. BND requires that each lessee connect to a sanitary sewer system and assesses charges pursuant to its sewer rate schedule.

Regional Planning Impacts

The Rio Grande Regional Planning Group (RPG) completed the regional water plan in 2001. The use of Brackish Groundwater Desalination was not a recommended strategy in that plan. Minimal interest by the water user groups, including cities, persuaded the RPG against adopting this as a strategy, even though it appeared to be a cost effective alternative. Subsequent to that plan, a survey of over 60 entities indicated that they would be in the planning, permitting, design or construction phase of brackish and seawater desalination strategies by 2005. The RPG prepared an amendment to the plan in 2003 to include the use of desalination as a recommended strategy.

The impacts of the use of a regional approach include cost savings associated with the economies of scale of a larger facility. This was evident in bidding alternates for oversized facilities to facilitate future growth and constructing similar but smaller facilities. Samples of cost components include the comparison of bids received in the last 18 months indicate a substantial savings for larger units. These include the cost of RO equipment, chemical feed and installation for similar feed waters and the construction of pre-stressed concrete water storage tanks. Economies of scale of a 1.0 mgd facility component compared to a 6.0 mgd component yields a 38 percent savings on RO equipment and a 46 percent cost savings on water storage tanks.

The cost of operation would be impacted by the number of personnel required to operate several plants as opposed to one. This would yield a much lower cost to individual participants in a regional plant.

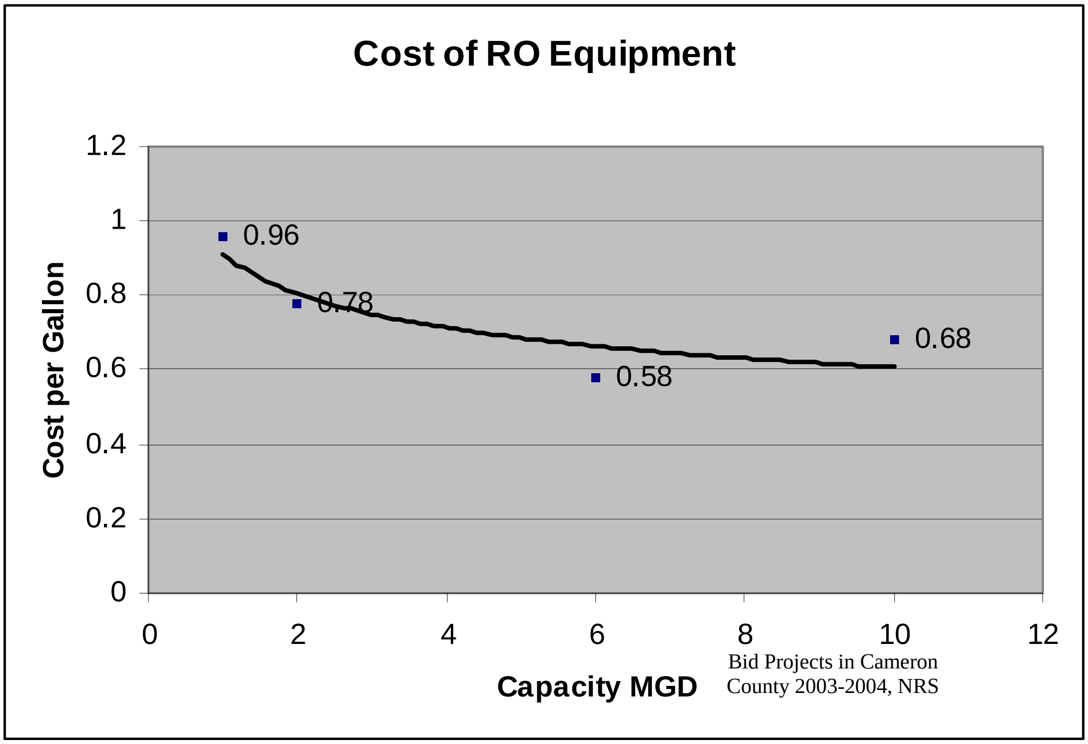

Figure 3 - RO Equipment Economies of Scale

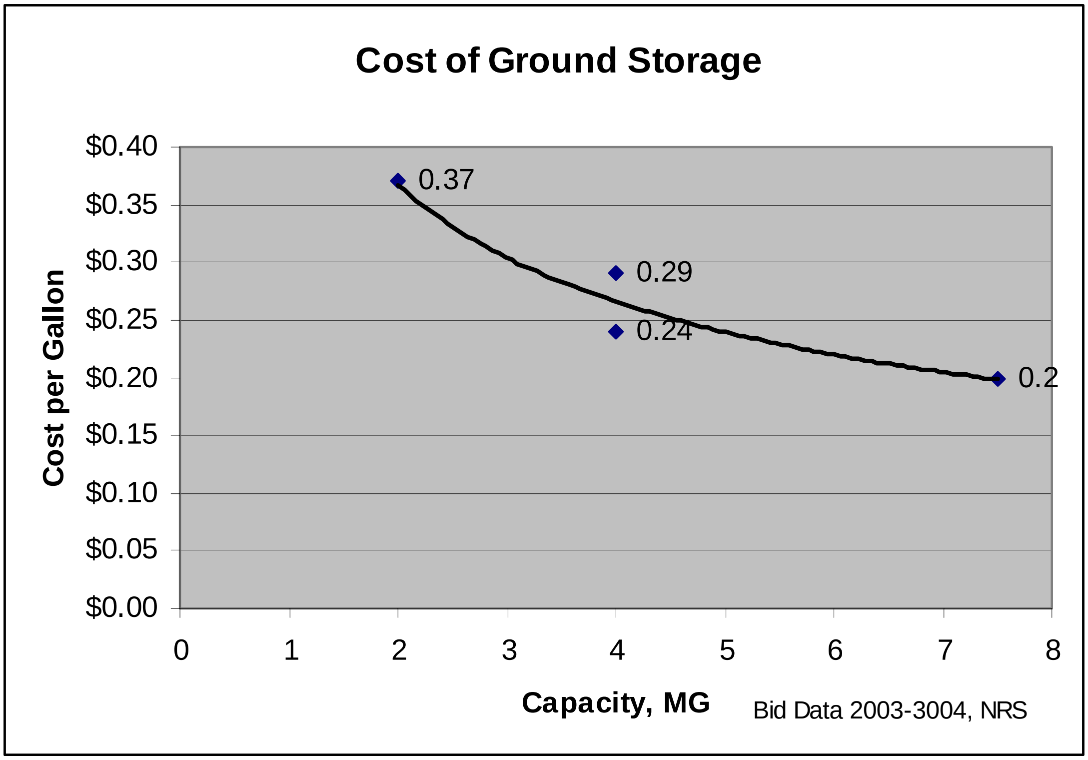

Figure 4 - Ground Storage Economies of Scale

Execution

Design Phase

In April 2002, NRS was authorized to complete the design of the proposed SWRA's facilities on a fast track basis. To facilitate the completion of the plant by the summer of 2003, multiple contracts were developed and phased for the most rapid completion. Approximately 80% of the construction tasks were bid by September 2002 in attempt to have treated water before the summer of 2003. Because of funding and issuance of bonds until December 2002, contracts could not be awarded until January 2003. Property issues resulted in a later than expected well field installation and subsequent well field distribution system.

The following contracts were issued to complete the project:

Contractor	Project	Contract Value	Start Date
Reyna Const.	Treated Transmission Line -Sect. 1	$551,579.32	1/27/03
AES	R.O. Equipment/Installa	$3,942,476.01	1/6/03
CSA	High Service Transfer Pump Stations	$2,996,256.00	1/13/03
Cubco	Raw Water Line & Treated Trans.	$3,104,275.00	2/24/03
DMG Underground	Well Field Distribution Lines	$1,509,268.75	8/11/03
G&T Paving	Installation of Flexbase Material	$860,419.83	7/13/03
Hurricane Fence	Fencing at Plant Site	$64,525.50	1/13/03
Layne-Texas	Groundwater Wells and	$2,917,348.00	3/1/03
Mercer & Ussery	Well Field Buildings	$1,550,654.00	9/18/03
Metro Electric	Electrical Interface	$687,222.52	6/9/03
Peacock Const.	Operations and Control Building	$1,264,674.00	1/27/03
Pederson Const.	Treated Transmission Line -Sect. 3	$570,042.55	6/18/03
Preload	7.5 MG Pre-stressed Ground Storage	$1,524,088.23	1/6/03
Ralph Ruby	Landscape and Irrigation	$128,918.90	10/1/03
Total		$21,671,748.61	

During the course of design and construction, permitting of the concentrate disposal continued to be an issue with regard to time. The longest lead time item of any portion of the project, this item took over 18 months to secure and was obtained well into the construction of the facility.

Construction Phase

As shown in the previous section, there were several construction contracts issued to complete the project. Most of the contracts were issued in early 2003. Those issued later were held up by procurement of rights of way for the well field and related distribution lines. The latest contract was the completion of the well field building and associated electrical. Heavy spring and summer rains made it impossible to complete the buildings too quickly. Not until the SCADA was installed could the facility operate automatically and to rated capacity. This item was added to the RO system supplier to assure proper interface compatibility.

Figure 5 Heavy Rain in Spring Well Field Construction

Much of the progress of construction was completed without incident in part due to good communications with the Engineer, Owner and Contractor. Weekly meetings between the Owner and Engineer minimized coordination problems and construction issues.

These projects were constructed by construction management by NRS. Contractors on site were give additional scopes of work to expedite minor items of work, within their limits of change orders allowed by contract.

Operation and Start Up Phase

Well Water Contamination and Flushing

Because of the great interest in the project, there was a sense of anxiousness to start up the facility as soon as possible. The official ribbon cutting was held on April 1, 2004 with one million gallons per day capacity. Only four of the twenty wells were in service at that time. Consequently, the water velocities were much lower than the design velocity. This allowed a contamination of the line with an iron related bacteria.

Figure 6 Aerial View of Plant Site

As wells were completed they were submitted to the Texas Commission on Environmental Quality (TCEQ) for approval. The SCADA system was being installed. An added difficulty was that there were multiple projects lagging behind. From August 16 through August 26, 2004, bacteria tests were conducted after disinfecting the well water conveyance system. The results indicated that the disinfecting had failed. . A second set of samples (total 15 samples/ set) had also failed, and some samples had developed a yellow color, during the 24 hour incubation period.

On August 26, 2004 the pressure vessels of RO units “C” and “D” were loaded with new membrane elements and it was the intent, to commission these two trains on August 27, 2004. However, based on the well water test results and color, it was decided to delay this action until the lab test samples results were available.

A well sampling process was performed to isolate and remove the contamination. Ultimately the wells and lines were cleaned and disinfected successfully. Permitting became an issue with the disinfection of the thirty-inch supply line. Once disinfected, the discharge of that water was not permitted and coordination with the TCEQ was critical.

SCADA System and Automatic Operation

It is the intent to operate the RO system 24 Hours per day however, as there were insufficient operators available to cover the 24 hour period, 7 days a week; the plant was operated unmanned for approximately 8 hours per day. During this time (September), final coordination was taking place between the electrical interface and SCADA system to enable automated remote control of the wells and system.

Ground Storage Tank Leakage

Another difficulty was the start up of the 7.5 million gallon treated water ground storage tank. The tank was completed in December 2003 but not filled and tested until March 2004. The tank marginally passed the leakage testing. Since the plant start up, the tank developed a leak that was greater than allowed for this type of tank. The final start up of the remaining wells and RO system had to wait for the tank to be repaired. The tank repair and bacteriological testing process takes about two weeks, once repaired the tank was back in service and the leak remained. A process of elimination by utilizing divers and uncovering of lines and connections pursued. The tank remained in service to allow final start up, operation and debugging of the full facility (October-November). The tank will be scheduled for repair in December.

Contract Operations

The Authority has contracted with the BPUB to operate the facility. The BPUB owns 93% of the facility. Budgets are approved by the board members of the participating entities. A total of four personnel operate this facility twenty-four hours, seven days per week. No problems have arisen from contract operations.

Power Supply

An advantage to BPUB operation is the furnishing of reduced rate power cost for the RO facility ranging from 4-5 cents per kWh. An energy recovery system was added during the construction to further reduce power cost and extend the life of the membrane system. The well field is located out of the service area of the BPUB and serviced by AEP/Central Power and Light

Company. Reduced costs for power in this area are obtained by one master meter servicing the well field.

Regional Approach

The regional approach has been key to making the project affordable. By joining together instead of building separate facilities, the partners realize lower building and personnel costs. Significant savings accrue from a single plant with a single set of operators. The project also enjoys low power costs from the BPUB. Design features also make for cost savings. The facility can be expanded easily to two or three times the initial capacity. The new plant is economical, delivering “bottle quality” water at standard treatment costs of approximately $1.60 to $1.80 per 1,000 gallons. Actual supply and treatment costs at the plant for debt service and operations total between $1.10 and $1.30 per 1,000 gallons. Pumping and distribution to each member’s site account for the additional costs. Subsequent phases will achieve even greater cost efficiencies.

Project Benefits and Implementation Issues

Good communication was key to successful completion of this project. The following is a list of items that were implemented to complete the project. Comments are added to their success or failure to accomplish the desired results.

Regional Approach

A regional multi-partner approach requires careful coordination between political bodies. The only negative to this approach is the feeling of loosing control of the entities destiny. This happened to the Laguna Madre Water District, an original project participant. They opted out of participation in the final project. For the most part, if a feeling of cooperation can be maintained through Board leadership, the regional process has great advantages to all members including, capital and operation cost benefits economies of scale. Leadership of the Board was instrumental through two Chairmen, Robert H. Lackner and Billy R. Bradford, Jr. Mr. Lackner’s pushed for the planning and construction of the facility and Mr. Bradford’s leadership through the construction and start up of the facility.

Construction Management

The construction management process applied to the design and construction of the plant resulted in estimated savings of over $4 million. Drawbacks to the approach include additional coordination efforts and potential for "finger pointing" of any problems. Proper contract by discipline and communications minimized these potential difficulties. For time management, change orders were issued to contractors on site to accomplish additional work. Actual bidding of every aspect would not have accomplished the time and cost goals of the project. Typically with this process change orders are not for errors or omissions but for additional work required to finalize the project.

Figure 7 - Administration and Operations Building

Weekly Planning, Design and Operation Meetings

The single most important aspect to the success of this project is a result of communications from the beginning of the project development. Owner's representatives were involved in planning, design, construction and operations of the plant. This provided for valuable input and pride of ownership of the team.

Time Line

An aggressive time-line was established early in the project. At the time of design, there was a desire to have treated water within 18 months from the design start date. Major portions of the project design and bidding were completed in the summer of 2002. Funding was not in place until December 2002. Contracts initiation could not be issued until January 2003. Additional delays for property acquisition delayed the well field completion and subsequent related projects. Heavier than normal spring and summer rains helped to delay some of the well completions. In spite of external difficulties, initial project start up was approximately 14 months after initiating construction. Final start up and operation took an additional 6 months. Realistic timelines should be communicated with the Owner to eliminate unrealistic expectations and disappointments.

Project Layout

Figure 8 - Cartridge Filtration Pretreatment

The plant site is situated on a 17 acre site, suitable for multiple cost effective expansions. A smaller site plan could be used if conventional methods of construction **were** used. Facilities were laid out to allow parallel construction of multiple contracts. Inside the plant building, additional room for expansion and maneuverability were keys to the current and future ease of operation.

Permitting

Permitting through the TCEQ took about eighteen months. Delays were due to inexperience in reviewing permits of this type. Continuous communication and education helped to move the process along. Objections to the permit by non affected parties added several months to the process. The permitting process is the longest lead time item to consider in this process. Another issue is that this is considered an industrial wastewater discharge and all that it implies. Work should take place to properly classify this as a water treatment by product. Permitting steps should be one of the first things to start in the planning process.

Land and Rights of Way

Land acquisition can be expensive and long lead time for acquisitions. Once the word gets out of a public entity in pursuit of property, cost escalates. Negotiations were completed for this project successfully but took substantial time. This, with the permitting process should proceed as soon as possible in the process. Options should be pursued in case well testing does not prove suitable sites

Partial Start Up

Because source water conveyance was designed to accommodate future production capacities at partial operation there are issues of low velocities. There does not seem to be many ways around this problem if partial supply is needed. Perhaps better timing of bringing all facilities on line simultaneously could be a goal, but for the most part this would have to be an ideal situation considering multiple contractors each having their own construction issues.

Construction Meetings

Even though there were fifteen construction contracts, monthly meetings were held to discuss accomplishments, schedules and issues related to construction. The project provided for an on site professional engineer, three project representative and a part time technician and graduate engineers. This procedure of monthly meetings should be implemented for all projects of this type.

Local Permitting

Overlooked as a requirement, the local ordinance required that the Authority apply for an industrial waste discharge permit to dispose of the backwash cleaning solution to the BPUB's wastewater treatment facilities. This minor amount of water, meeting all quality requirements, was subject to an application process that rivaled that of the State's concentrate disposal application. Developers of future projects should be aware of local permitting conditions, even though they are the beneficiaries.

Goals

At the onset of a project of this type and magnitude, set realistic goals for completion with proper projections of costs. This project set high goals to complete in 14 months but certain delays should be expected. These include funding, rights of way, permitting, weather and construction difficulties. Six to twelve months should be allowed for start up and the development of operational standards, especially if this is the first facility of this type for an organization.

Conclusions

The project is believed to be a huge success. This does not mean there is no room for improvements on issues that arise. Accomplished is that a regional desalination plant provides each entity with over 40% of their current water supply, supplementing the water from the Rio Grande. This is done to diversify resources for dependability. The new found source of water is of highest quality provided for comparable costs to conventional surface water treatment. Oversized facilities will provide cost effective expansions in the future.