Lower Rio Grande Valley-Brownsville Seawater Desalination Demonstration Project Executive Summary[1]

Introduction

No region of Texas has as great a need for additional water supplies or is as limited with regard to new supply options as the Texas-Mexico border. No region in Texas has the international, environmental, demographic or the economic challenges that this area possesses. It is a high growth area with an already overcommitted central water supply (the Rio Grande) that has been placed at further risk by international treaty compliance issues. It is a region struggling to retain existing jobs, including those in the agricultural sector, and to expand its economic base to include new economic activity. Its environmental challenges are complicated by the lack of water available for water uses traditionally identified with the natural environment and its needs.

- ***Because of the Lower Rio Grande geographic location, the only viable and dependable major source of new water to sustain, continue growth in the region is the Gulf of Mexico.***

- ***Furthermore, the quality of water available to many water users continues to degrade, increasing the cost of treatment and making desalination of seawater more feasible.***

All of these challenges could be eased by securing a new, drought proof, high quality water supply and by the right public policies and actions (including financial assistance) associated with this supply source. This water supply could be desalinated seawater.

The Lower Rio Grande area is better positioned to take advantage of this new supply than any other area of the state by virtue of its needs and its ability to find direct and indirect markets for this water. Water rights management in the Amistad-Falcon Reservoir system serving this area allows for enhanced ability to provide water supplies in ways unique to this part of Texas. No other region has the ability to internally “market” water made available from such a project.

There is also the possibility to provide water to Mexican cities with even greater needs, should the right financial, political and institutional arrangements be reached. Providing such service could create an indirect subsidy for U.S. water users by creating larger economies of scale, thereby reducing the unit cost of water for this project. Mexican governmental entities should bear the full cost of desalinated water service should they be allowed to participate in the project. As **Figure E-1** shows, all users gain by economies of scale. As the scale of the project is increased, the unit cost to produce water is reduced. All users benefit from increased

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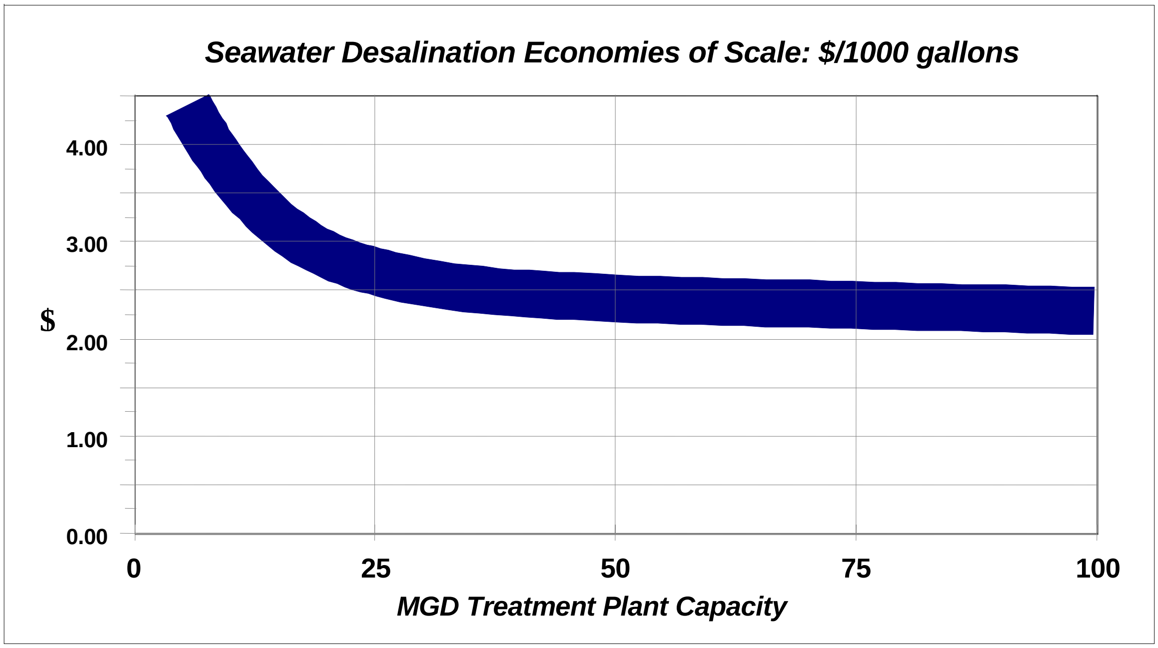
[1] Prepared by Dannenbaum Engineering Corporation (Professional Engineer seal of Tom Arndt) and URS Corporation for the Brownsville Public Utilities Board under a grant from the Texas Water Development Board, TWDB contract number 2004-483-515.

participation whether these users are other regional entities in the Texas portion of the region or some combination of Texas and Mexican communities.

Figure E-1 Unit Cost Relative to Project Size



Regional Needs/Options

The recently completed Rio Grande Water Availability Model (WAM) identified available firm supplies in drought of record conditions and current treaty compliance circumstances as approximately half of the demand for water. While municipalities are given priority for the delivery of water in the Lower Rio Grande, the consequences of this shortfall are reduced availability to irrigators, industry and the environment. Some municipalities, however, could also see their supply impacted since many municipal users secure their water through delivery arrangements with irrigators. Often, the "push water" needed to fill canals and allow for the transportation of municipal water is provided by irrigation water, which typically is the much greater volume being transported in the canal systems. **If there are insufficient volumes of irrigation water being transported in the canals, the ability to deliver water to many municipal users may be compromised.**

The current water deficit in the Lower Rio Grande Water Supply Planning Region (Region M) exceeds 1,000,000 acre-feet per year. Even with all identified water management strategies implemented, Region M will continue to have a water deficit for the foreseeable future. Further,

the existing water supply from the Rio Grande in Region M is projected to decline over 25% in the next 50 years.

In the current regional water plan, the primary option for securing additional new water for municipal, industrial and steam electric purposes in the area of the Lower Rio Grande Regional Planning Group is the transfer of water rights from irrigated agriculture. This transfer **would further exacerbate the deficit for agriculture identified above, and further reduce the economic viability of that important economic sector.**

New, local water supply options are limited and imported water supplies are subject to intense competition from other needy municipal users outside the Lower Rio Grande region. Imported water also suffers from the associated high cost of delivery. Locally available brackish groundwater is one option to bridge this gap but is, by definition, a finite resource and its extent not fully known. Supplies of brackish groundwater are still being characterized within the region.

New surface water supplies identified from within the region are limited to the proposed Brownsville Weir, which, while technically viable, requires bi-national approval to proceed to **implementation**. The prospects of bi-national approval for the weir project are far from certain.

New supplies **from** outside the region are distant and coveted by other potential users. Potentially available new surface water supplies in the Guadalupe and Colorado Basins are largely earmarked for Bexar County or in-basin users. Potential seawater desalination projects in Corpus Christi and Freeport are even farther from potential users than the proposed project of this study.

The only major new water supply source for the Rio Grande Basin that will satisfy the identified needs, have certain availability and provide a drought-proof supply is desalinated seawater. Desalination can be easily viewed as the most feasible technology to satisfy the growing industrial and domestic water demands while maintaining current supplies for agriculture in the region. This proven technology will provide the region with a drought independent source that can contribute to the growing and existing needs.

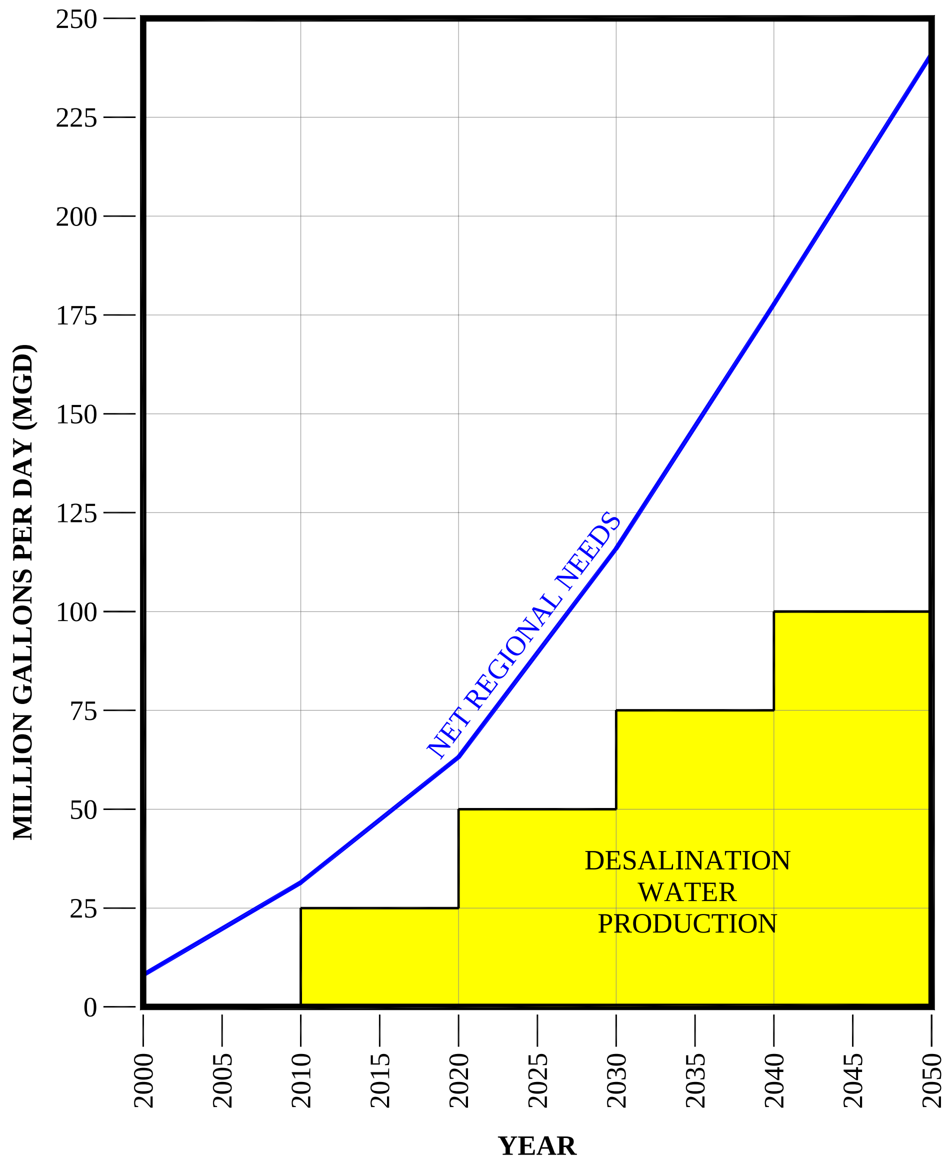
The major water user types that could *directly* benefit from a seawater desalination project include municipal, industrial and steam electric users. **The regional demand for new water supplies for these sectors is approximately 200mgd or some 184,000 acre-feet per year by 2050**. **No other identified supply source can satisfy this demand for new water**.

Local demand in the Brownsville system makes up a major portion of the need in the early years of the project and is a key foundation for project viability. However, in the long term the majority of the project demand is from the rest of the region. (See **Figure E-2**.) This is truly a regional project with the potential to address regional needs.

In addition to the new supplies to regional municipal and industrial users, **positive impacts to agricultural users and environmental flows** are indirectly benefited by the return flows of desalinated water, if so dedicated. The Rio Grande River environment could also be enhanced by dedicating some of the surface water currently used for municipal purposes, which could remain in the river due to the water made available by this project.

Such an undertaking can benefit the whole region's industry, agriculture and domestic use and provide for increased environmental flows. Even though the project will not meet the total Net Regional needs over the next 50 years, the project will be a fundamental element in an overall strategy to satisfy the region's future water demands.

Figure E-2 Net Regional Needs



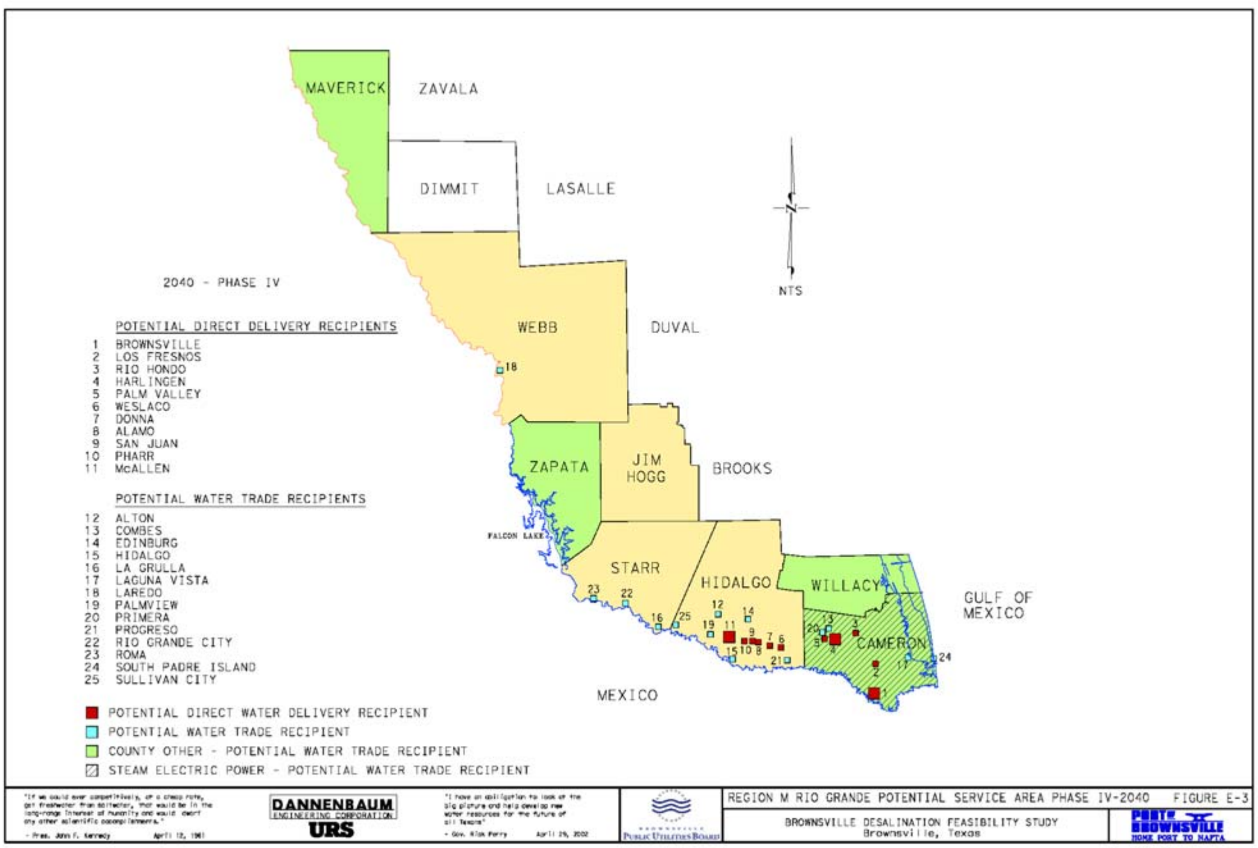
Note: Net Regional Needs are the Sum of Municipal and Steam Electric Power Water User Deficits from the Region M Water Plan.

3. Regional Partnerships

The major stumbling block to implementation of a seawater desalination project is ultimate delivery cost. Given the present water rate structure, subsidies are required for *any* seawater desalination project in Texas and throughout the United States. The Lower Rio Grande project proposed by Brownsville has **key competitive advantages** over other regions that will help limit the subsidy requirement. As described above, the pronounced water supply deficit, associated economies of scale and the presence of efficient and effective delivery mechanisms will facilitate the project's implementation.

Securing additional regional partnerships is critical to the project's success. Some forty-eight communities within the region have supported the desalination project in concept. Some of these communities—like Brownsville—could be served directly with water from the desalination plant. Other communities as far away from the project as Eagle Pass or Laredo could receive indirect benefits from the project by securing water freed up from use by project "direct delivery customers." Again, this management tool is available to the region because of the unique system, hydrology and legal characteristics of water supplies in the Lower Rio Grande.

Figure E-3 Lower Rio Grande Valley Water Planning (Region M) Potential Service Area



Description of Project

The project consists of the water desalination plant initially scaled to 25 MGD, the finished water transmission line and offsite storage, which integrates into the Brownsville PUB system, and the brine disposal system that safely discharges concentrate into the Gulf of Mexico. As additional customer cities are added into the project, treatment plant size, associated intake structures, additional pipeline capacities and other infrastructure will be expanded.

Figure E-4 Project Layout

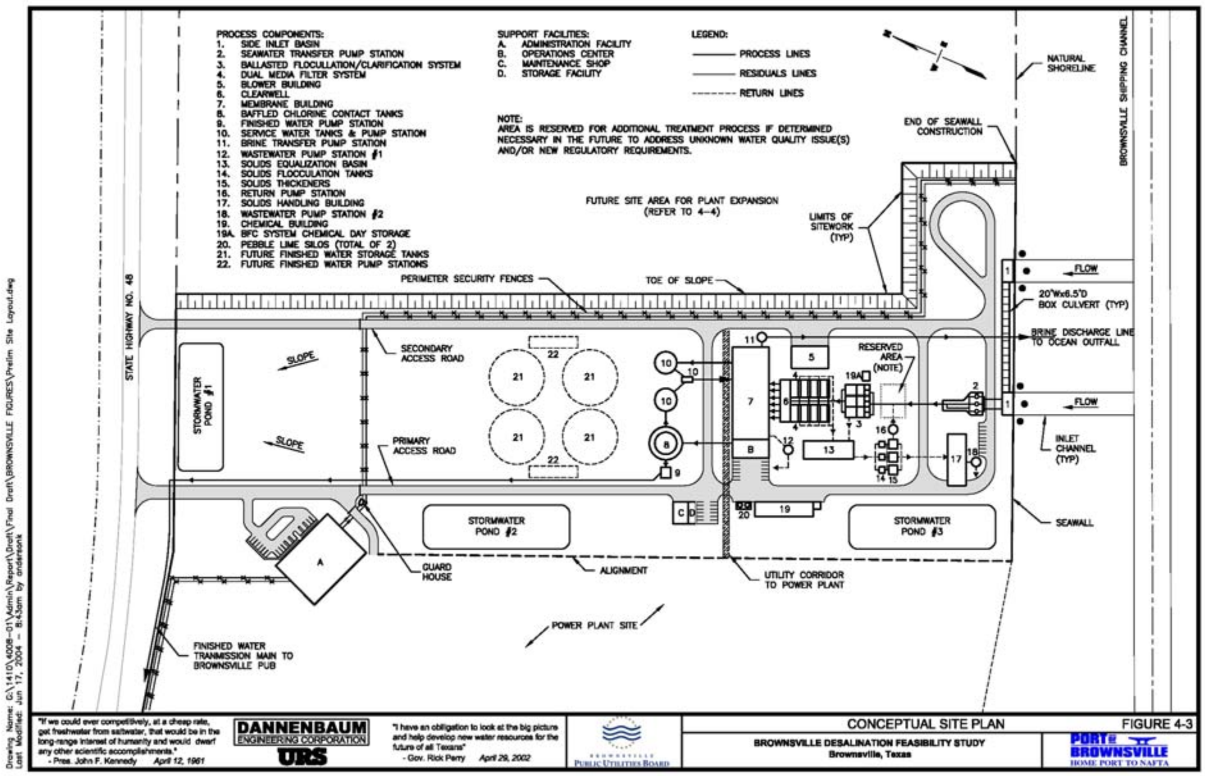
Water Treatment: A detailed alternatives analysis was conducted for all major treatment processes and plant components. (Please refer to **Section 3** of the report for a full discussion of the alternative analysis, the methodology used to conduct the analysis, and individual alternatives considered by the analysis.) In summary, the alternative analysis used weighted evaluation criteria for each alternative. Viable options were identified and a score assigned for each evaluation criteria. The option receiving the highest total weighted score was then selected as the recommended alternative. Based on the alternatives analysis, the following systems were selected for the conceptual design:

- Seawater Intake - Side channels from the Brownsville Ship Channel with screened intake assemblies;
- Pretreatment System - Ballasted flocculation, dual media filtration, cartridge filtration;
- Primary Treatment - High pressure reverse osmosis with energy recovery;

- Post-Treatment - Pebble lime stabilization, on-site generated sodium hypochlorite disinfection;
- Solid Handling - Flocculation basins, gravity thickeners, belt filter presses;

The above described system would reliably provide a high quality potable water complying with all current and anticipated standards for drinking water quality. It is also believed that permits could be obtained for the plant and concentrate disposal with appropriate study and permit applications.

Figure E-5 Conceptual Site Plan



Finished Water Transmission: The finished water transmission main will leave the pump station located at the treatment plant site and cross State Highway 48 (SH 48) to the north. It will then parallel SH 48 and run westerly to the proposed offsite storage near FM 511. From this point, the finished water will be pumped into the Brownsville system and in future phases, to other municipalities.

Brine Disposal: Several brine disposal alternatives were considered including industrial water reuse, ocean outfall into the Gulf of Mexico, discharge to the Brownsville Ship Channel, evaporation ponds, and deep well injection. Due to extreme logistical, environmental, and/or cost feasibility reasons, the viable options that could potentially be used for brine disposal for this project would be limited to an ocean outfall or a deep well injection solution. While both of these options can be considered in further detail in subsequent phases, conceptual level costing has indicated that an ocean outfall would be the most cost-effective approach for the management of this stream, especially as plant capacity is expanded through time. It should be noted that it is a foregone conclusion that additional studies and evaluations will be needed to properly support any disposal option. For the purpose of this initial conceptual-level study, the ocean outfall was adopted in order to address this important project component. The safety and reliability of offshore pipelines has been documented from the long history and the experience of the engineering community.

Power Generation: At the Statement of Interest and scoping phase of the project, it was believed by the project team that significant synergies could be realized from co-locating a power generation facility with the desalination plant. Since it was believed that a need existed for new generation capacity in the region, it made sense to consider locating these facilities adjacent to one another. It was believed that locating the power plant adjacent to the water plant would offer lower cost power for the water treatment plant and help ease the concentrate disposal problem by providing water for dilution.

Once the study was underway, it became clear that co-locating the power and water plants would neither reduce the power rate to the water treatment plant nor assist with the concentrate disposal, both previously assumed to offer significant synergies. There are still some synergies to be gained from co-locating the two plants, such as pre-heating the feedwater for the water treatment plant and demineralized make-up water for the power plant. These synergies, however, are small compared to what was originally anticipated.

Since there are limited synergies between the power and water facilities, the projects should largely be viewed independently. Should there be demand for both projects, there are arguments in favor of co-locating the facilities; however, neither one of these projects depends on the other for viability.

Regional Partnership Opportunities

The implementation of the proposed seawater desalination demonstration project should be phased so as to reduce operating costs and take advantage of existing supplies of lower priced water (like brackish groundwater) while they are available. **The following phasing concept is proposed only for demonstration purposes** and no communities have made firm commitments to such a proposal. However, it demonstrates a feasible series of options to address critical regional concerns. (**It is hoped that as a result of this study, further discussions with other potential regional teaming partners could progress.**) Preliminary concepts for phasing would appear to be as follows:

- Phase I (2010-2020)—direct delivery within the Brownsville system with water supply trades to other communities within the region. Desal use and available water for trade would be further phased in over time, as demand grows. Water trades could help offset some of the costs of providing desalinated seawater. Environmental enhancements from unused river water, high quality wastewater return flows or some combination of the two sources could be dedicated to maintaining a base level of instream flows for environmental health considerations in the Rio Grande. This project could serve additional users and free up some 12,600 ac-ft of water supply for trades elsewhere in the region.

- Phase II (2020-2030)—expanded direct deliver and associated expanded water trades. The PUB would not need all of the water from Phase II capacity of the Desalination Plant. A transmission pipeline to Harlingen could deliver water to five additional communities that will need additional water in 2020. In concept this delivery could be a pipeline from the treatment plant to customers along US Highway 77 to Harlingen.

- Phase III (2040-2050). The need for the construction of Phase III would be the water demands in Hildalgo County. A transmission pipeline to Pharr could deliver water to seven communities that will need additional water in 2030.

- The need for the construction of Phase IV would be the water demands in McAllen. A transmission pipeline to McAllen could deliver water to that community which will need additional water in 2040.

In addition to the desalinated seawater supplied directly through the project, a net of nearly 50,000 acre-feet of additional Rio Grande surface water could be traded to communities for which direct desalinated seawater is not a viable option (primarily because of the distance from the source).

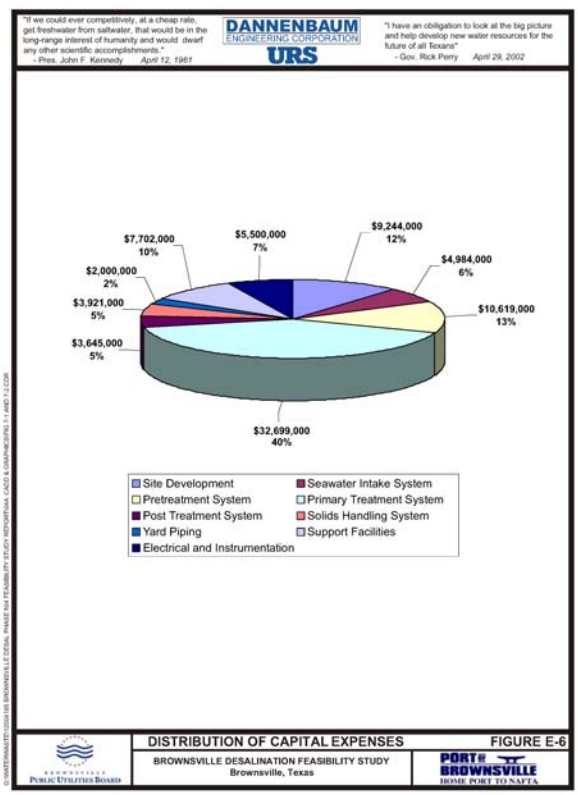
Greater specificity of phasing opportunities, partnerships and timelines will need to be developed as the project moves into subsequent stages of the implementation process and as communities consider both their own internal needs and project costs and subsidy levels.

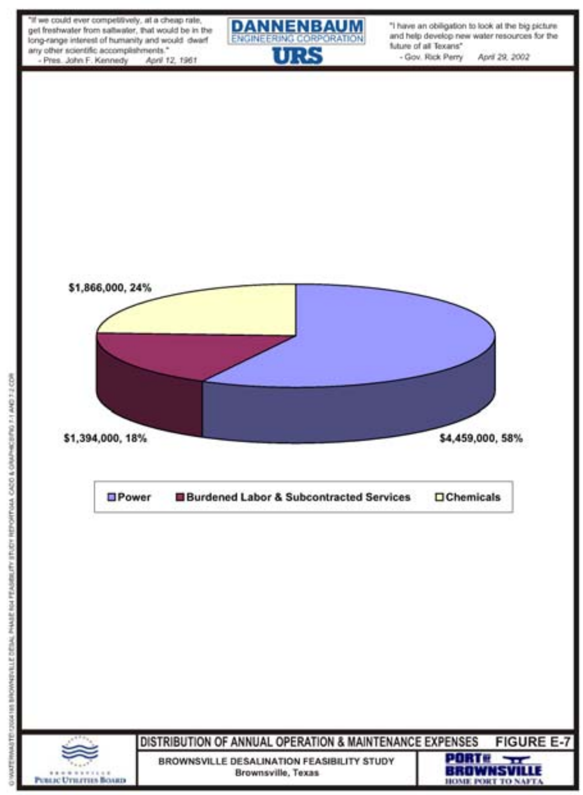
Financial Analysis/Financial Mechanism Recommendations

Implementing any new technology provides both opportunities and challenges. The desalination demonstration project is no exception. The opportunity is clear: a viable supply of new water that is a cost-effective alternative to other new regional supply options. The challenge is that like all viable new supplies, the cost will exceed the average cost that the region *currently* pays; though not what the region *must* pay if it wants to expand the supply available to it.

Like all of the demonstration desalination projects this project will likely require an external funding source in addition to revenues provided by local ratepayers to achieve financial viability. The exact amounts, timing and overall manner of that support cannot be precisely ascertained without further analysis to optimize the project's configuration, production levels and timing of phasing. Firm agreements with regional partners (which can only be made after all financial information is available) will determine the phasing of implementation and unit cost of water produced.

Table E-1 Total Project Costs	
Phase I - 25 MGD	
Desalination Plant	**$90,167,000**
Concentrate Discharge System	**$30,583,000**
Finished Water Transmission System	**$9,232,000**
Project Implementation Costs	**$21,406,000**
Total Capital Costs	**$151,388,000**





However, given these caveats, it should be noted that the costs for water from this project are highly competitive with other new sources and with other seawater desalination projects from around the U.S. The cost per 1000 gallons **without external subsidy** is anticipated to be in the **$2.36 to $2.44 range during the first project phase**. These numbers should be viewed as preliminary for the reasons noted above.

Further reducing costs through subsidies is necessary to make the project affordable. Such subsidies would have to come from government entities. It is highly unlikely that private water companies could provide such subsidies, thereby limiting their ability to implement such a project on their own. We know of no seawater desalination project that operates in the U.S. without some form of significant government subsidy.

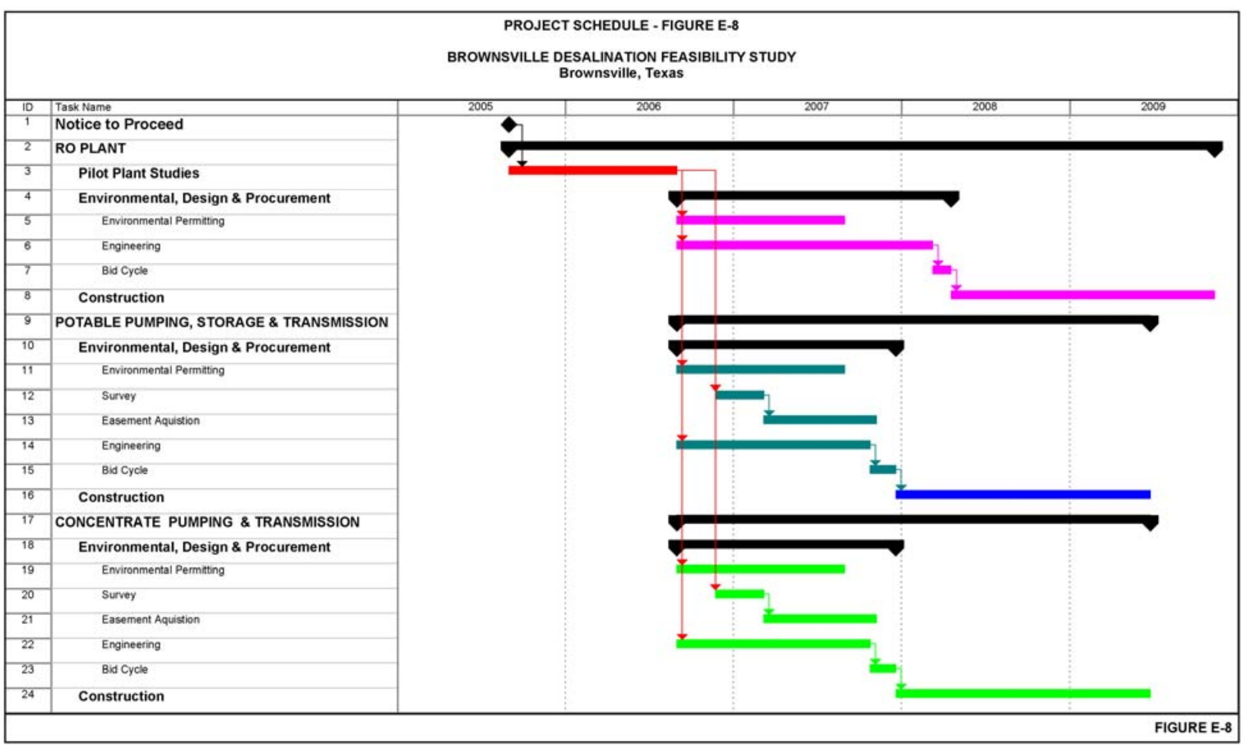
Subsidies may come in several forms: direct grants to offset capital or operating costs, low interest loans and deferred payment of capital costs by project owners and customers (until the project's customer base is sufficient to contribute all or part of the deferred payment over time). Some direct grant subsidy will likely be needed to move the unit cost for water for this project more in line with current average regional water costs (though the amount will depend on assumptions for the cost of new or replacement supplies). The exact magnitude of this direct subsidy will depend on other factors such as customer base, actual construction costs, etc.

The primary grant and subsidized loan mechanisms would be from bi-national institutions (the BECC or NADBank), from federal agencies (Bureau of Reclamation, U.S. Corp of Engineers, etc.) or the State of Texas through the Texas Water Development Board.

Further, less costly (to the government) is deferral of payments. These would have to be coupled with subsidies, but could reduce the near-term and long-term amounts of direct grant subsidies if properly structured to reflect ultimate customer bases for the project.

Schedule

The schedule below identifies the earliest possible completion of the Phase I project. This schedule anticipates beginning the project in the fall of 2005. Several factors could affect the schedule including environmental permitting, and timing and amount of financing.



Summary

The Lower Rio Grande Regional Seawater Desalination project offers the unique opportunity to assist all regional users with their water supply challenges. The project is the only major new water supply identified that can bring the volumes of new supplies to impact all water users in the region. Its costs are highly competitive with other potential supplies from outside of the region and with other desalination projects in the U.S. The region also possesses advantages over other desalination demonstration projects under Governor Rick Perry's Seawater Desalination initiative. It's unique regional needs, lack of practical alternatives, hydrology, and institutional arrangements that allow for water trading throughout the region, afford it an opportunity to succeed not possessed by the other demonstration projects.

The successful implementation of this project will be a function of State and/or Federal governmental financial subsidies that will have to be secured. There are no desalination plants within the United States that currently operate without significant government subsidies.