

The Future of Desalination in Texas

2012 Biennial Report
on Seawater Desalination



Texas Water 
Development Board

2012 Biennial Report on Seawater Desalination

December 1, 2012

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2012 Biennial Report on Seawater Desalination

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Section 16.060 of the Texas Water Code directs the Texas Water Development Board to undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state. The Texas Water Development Board shall prepare a biennial progress report on the implementation of seawater desalination activities in the state and shall submit it to the Governor, the Lieutenant Governor, and the Speaker of the House of Representatives not later than December 1 of each even-numbered year.

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December 1, 2012

To: The Honorable Rick Perry, Governor of Texas
The Honorable David Dewhurst, Lieutenant Governor of Texas
The Honorable Joe Straus, Speaker of the Texas House of Representatives

The Texas Water Development Board is pleased to present the fifth Biennial Report on Seawater Desalination, submitted to you in compliance with Texas Water Code §16.060. This report examines progress toward the goal of creating water supplies in Texas through seawater desalination.

In our previous report we discussed the status of the two projects closest to implementation, Brownsville Ship Channel and South Padre Island. These are two viable projects whose next phase is permitting, design, and construction. The implementation of these projects will serve as a tangible example for the development of seawater desalination supplies in the state.

In this report, we identify several areas where the financial support of the state could effectively expedite the advancement of seawater desalination in Texas. These include financial support to the Brownsville Public Utilities Board and the Laguna Madre Water District to bring the two proposed projects to their production phase and assistance for environmental and pilot plant studies needed to fill knowledge gaps in the implementation of seawater desalination projects.

On behalf of the citizens of Texas, the Texas Water Development Board respectfully submits to the Governor, the Lieutenant Governor, the Speaker of the House, and members of the 83rd Texas Legislature this document, including a progress report of and recommendations regarding the implementation of seawater desalination supplies in Texas.



Billy R. Bradford, Jr.
Chairman



Melanie Callahan
Executive Administrator

Our Mission : Board Members

To provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas

Billy R. Bradford Jr., Chairman
Joe M. Crutcher, Vice Chairman
Melanie Callahan, Executive Administrator

Lewis H. McMahan, Member
Edward G. Vaughan, Member

Monte Cluck, Member
F.A. "Rick" Rylander, Member

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Executive summary

In 2011 the state of Texas experienced its worst one-year drought in recorded history, highlighting once more the need to develop drought-resistant water supplies. It was this need to develop drought-resistant water supplies that led to the creation of the Seawater Desalination Initiative in 2002. The goal of the Seawater Desalination Initiative is to develop a new drought-proof water supply through seawater desalination. The initiative began with the identification of possible sites for seawater desalination and subsequent feasibility, pilot plant, and environmental scoping studies. These efforts have resulted in two proposals for construction of seawater desalination facilities: one at the Brownsville Ship Channel by the Brownsville Public Utilities Board and the other at South Padre Island by the Laguna Madre Water District.

This report, the 2012 Biennial Report on Seawater Desalination, is the fifth report of the series, and it marks the completion of 10 years of efforts to advance seawater desalination in Texas. The purpose of the report is to meet Texas Water Code requirements to (1) report on the results of the Texas Water Development Board's (TWDB's) studies and activities relative to seawater desalination during the preceding biennium; (2) identify and evaluate research, regulatory, technical, and financial impediments to implementing seawater desalination projects; (3) evaluate the role the state should play in furthering the development of large-scale seawater desalination projects in the state; and (4) identify the appropriation needed to continue water desalination activities in the state during the next biennium.

Key conclusions include:

- State funds to advance seawater desalination in Texas were exhausted in 2010; however, staff continues to pursue external opportunities.
- The relative high cost of seawater desalination continues to be an impediment as is the lack of a precedent plant in Texas; however, the Laguna Madre Water District is close to building a plant.
- Opportunities for continued state involvement [and appropriations] include (1) completing the Brownsville Ship Channel project [\$9.5 million, one-time], (2) supporting the implementation of the South Padre Island project and enhancing its demonstration value [\$5 million, one-time], (3) supporting research and pilot plant studies to advance seawater desalination [\$3.5 million a biennium], and (4) seeking partnership opportunities with the private sector.

Results of studies and activities

Lack of funding and competing priorities substantially lessened advancement of the state's seawater desalination efforts during the reporting biennium. In 2010, the TWDB exhausted the

remainder of \$2.5 million appropriated by the 79th Texas Legislature for desalination demonstration activities. Since then, the TWDB has not funded additional seawater desalination studies. During the reporting period, TWDB adopted the 2012 State Water Plan. Three regional water planning groups recommended seawater desalination management strategies that would generate 125,514 acre-feet per year of water supplies by 2060. The drought of 2011 has increased interest in seawater desalination, including possible projects that are not in the current state water plan.

We continued outreach activities through our Web site and involvement in various briefings, presentations, and white papers. TWDB staff is participating in two national studies funded by the WaterReuse Foundation. The first one is assessing regulatory challenges to seawater desalination, and the second—not yet started—will scope guidelines for desalination facilities in the United States. These studies will aid in the future implementation of seawater desalination projects.

Impediments to implementation

The relative high cost of desalination when compared to traditionally less expensive supplies is the greatest challenge to implementing a large-scale seawater desalination facility in Texas. As noted in all previous biennial reports, large-scale seawater desalination projects require substantial financial assistance to help sponsoring entities implement the projects. Adding to this challenge is the lack of a precedent for developing this new supply in Texas.

The two projects furthest ahead in the process and thus closest to setting that precedent are the Brownsville Public Utilities Board's Brownsville Ship Channel project and the Laguna Madre Water District's South Padre Island project. The Brownsville Public Utilities Board estimates that it cannot undertake its proposed seawater desalination project without financial assistance (grants) on the order of \$9.5 million. For its part, in 2011, the Laguna Madre Water District received voter authorization to issue bonds to fund its proposed seawater desalination project but has not set a time line for implementing this project.

In the meantime, desalination technology continues to improve and pilot studies completed during the past decade are becoming dated. For research and permitting, the lack of an operational seawater desalination production facility to serve as precedent means that there is a need for studies to fill in knowledge gaps regarding potential environmental impacts and projected performance of desalination facilities.

The role of the state

In spite of important investments and accomplishments to date, the efforts initiated in 2002 have yet to produce the desired large-scale demonstration of seawater desalination. In that light, the role of the state is to continue providing leadership and support to advance seawater desalination

in Texas. Fulfilling this role during the upcoming biennium would require consideration of the following needs and opportunities:

- Complete the Brownsville Ship Channel project: Completing this project would finish the efforts initiated in 2002 and make effective use of the studies and work conducted over the past 10 years. Implementing this project requires a grant of \$9.5 million to the Brownsville Public Utilities Board.
- Support the implementation of the South Padre Island project and seek to enhance its demonstration value: The Lower Rio Grande Valley Regional Water Plan indicates that the Laguna Madre Water District requires seawater desalination supplies in the 2010 (current) decade. As potentially the first seawater desalination production facility in the state, this project would effectively advance seawater desalination in Texas. The Laguna Madre Water District has not requested state financial assistance to implement the project nor has it adopted a firm time line for executing the project. However, state financial assistance on the order of \$5 million for permitting and design could help accelerate implementation of this project and serve to enhance its demonstration value.
- Support research and pilot plant studies to advance desalination: Several research topics listed in the 2010 Biennial Report are still pending and relevant today. An appropriation of \$2 million per biennium would allow the TWDB to fund research and pilot plant studies and continue advancing the technology in the future. Also, the state may wish to consider providing assistance to implement future pilot plant studies, a critical component of any seawater desalination project. A seawater desalination pilot plant study costs about \$1.5 million; an appropriation of \$1.5 million per biennium would continue to support pilot plant studies along the Texas coast.
- Seek partnering opportunities with the private sector: Public-private partnering is a common means of implementing large-scale seawater desalination projects around the world. Recent legislative changes in Texas make it easier for the private sector to develop public infrastructure, including water production facilities. The TWDB could provide programmatic support to facilitate private sector participation in the development of seawater desalination facilities.

Appropriations

The TWDB has exhausted previously appropriated funds to assist with desalination projects. In order to effectively advance the development of seawater desalination, the 83rd Texas Legislature may wish to consider the following appropriations:

- \$9.5 million to help the Brownsville Public Utilities Board construct a 2.5 million-gallons-per-day seawater desalination production plant at the Brownsville Ship Channel
- \$5 million to expedite implementation of the Laguna Madre Water District 1 million-gallons-per-day South Padre Island seawater desalination plant
- \$2 million a biennium to advance the science and implementation of seawater desalination
- \$1.5 million a biennium to assist with the implementation of pilot plant studies

Introduction

The Texas Water Code (TWC §16.060) requires the Texas Water Development Board (TWDB) to (1) undertake necessary steps to further the development of cost-effective water supplies from seawater desalination in the state and (2) report the results of its studies and activities relative to seawater desalination not later than December 1 of each even-numbered year. In this report, the Board is required to

- report results of the Board's studies and activities relative to seawater desalination during the preceding biennium;
- identify and evaluate research, regulatory, technical, and financial impediments to the implementation of seawater desalination projects;
- evaluate the role the state should play in furthering the development of large-scale seawater desalination projects in the state; and
- identify the anticipated appropriation from general revenues necessary to continue investigating water desalination activities in the state during the next biennium.

The 2012 Biennial Report on Seawater Desalination is the fifth report of the series and marks the completion of 10 years of efforts to advance seawater desalination in Texas. The initiative began in 2002 with the identification of possible sites for a seawater desalination demonstration project and subsequent feasibility studies on the best of these sites (TWDB, 2002). The initiative was expanded in 2006 through 2008 with the implementation of comprehensive pilot plant studies at the Brownsville Ship Channel by the Brownsville Public Utilities Board and at South Padre Island by the Laguna Madre Water District. Additional work conducted in 2009 and 2010 scoped environmental permitting issues to implement seawater desalination projects along the Texas Gulf Coast. Altogether, these efforts have generated proposals to build the first seawater desalination production facilities in Texas.

Lack of funding and competing priorities brought advancement of these projects by the state to a standstill during the reporting biennium. In the meantime, the state experienced its worst one-year drought in recorded history, highlighting once more the need to develop drought-resistant water supplies such as seawater desalination.

Section 1 - Results of the TWDB’s studies and activities relative to seawater desalination during the preceding biennium.

Studies

Since 2002, the TWDB has funded \$3.1 million in studies related to seawater desalination, including three feasibility studies (Brownsville Public Utilities Board, 2004; City of Corpus Christi, 2004; Brazos River Authority, 2004), guidance for seawater desalination pilot plant studies (Reiss Engineering Inc., 2009), guidance for permitting desalination facilities (R. W. Beck, 2004), two pilot plant studies (Brownsville Public Utilities Board, 2008; Laguna Madre Water District, 2010), and scoping of permitting issues for seawater desalination plants in Texas (Brownsville Public Utilities Board, 2011). In 2010, the TWDB exhausted the \$2.5 million appropriated by the 79th Texas Legislature for desalination demonstration activities. Since then, the Board has not funded additional seawater desalination studies.

Regional Water Plans

The 2012 State Water Plan published in January 2012 includes several recommendations on seawater desalination. Three regional water planning groups (Region H, South Central Texas (L), and Rio Grande (M)) recommended seawater desalination as one of the water management strategies that would produce 125,514 acre-feet per year of new water supplies by 2060. The 2012 State Water Plan projected that the strategy would represent 1.4 percent of all the new supplies in the state. Additionally, the Coastal Bend Regional Water Planning Group (N) included seawater desalination as an alternative strategy in its regional water plan. If implemented, this alternative strategy would produce 28,000 acre-feet per year of new water supplies by 2060.

Table 1—Seawater Desalination Water Management Strategies in the 2012 State Water Plan

Region	Project	2010	2020	2030	2040	2050	2060
H	Freeport					33,600	33,600
L	San Antonio						84,012
M	Brownsville				5,600	5,600	7,013
M	South Padre Island	125	125	143	449	821	889
N	Corpus Christi (Alternative)						

Source: All information derived from 2011 approved regional water plans and Brownsville Large-Scale Seawater Desalination Pilot Plant Study, 2008 (Region M)

Other activities

TWDB staff is participating as stakeholders and in a project advisory capacity in two national studies funded by the WaterReuse Foundation. The first one is assessing regulatory challenges to seawater desalination, and the second—not yet started—will scope guidelines for desalination facilities in the nation. These studies will aid in the future implementation of seawater desalination projects.

Prompted by the 2011 drought, the Brazosport Authority, Dow Chemical, and 16 other entities in the Brazoria County area are considering seawater desalination as part of a TWDB-funded regional water facility planning study. More recently, the Guadalupe-Blanco River Authority has expressed interest in conducting a preliminary study of a seawater desalination and power generation facility.

Section 2 - Identification and evaluation of research, regulatory, technical, and financial impediments to the implementation of seawater desalination projects.

In spite of the many improvements and increased cost-competitiveness of reverse-osmosis desalination, creating a new water supply from seawater is comparatively more expensive than developing supplies from existing fresh sources, if available. The relative high cost of desalination compared to traditionally less expensive supplies is the greatest challenge to implementing a large-scale seawater desalination facility in Texas. As noted in all previous biennial reports, large-scale seawater desalination projects require substantial financial assistance to help sponsoring entities implement the projects.

Compounding this challenge is the lack of precedent for developing this new supply in Texas. The two projects furthest ahead in the process and thus closest to setting that precedent are the Brownsville Public Utilities Board's Brownsville Ship Channel and the Laguna Madre Water District's South Padre Island projects.

Brownsville Ship Channel Project

The challenge to implementing this project is financial. The project originated in response to Governor Rick Perry's 2002 proposal to build a large-scale demonstration of seawater desalination as a means of accelerating the development of seawater desalination supplies in Texas. The need for financial incentives to execute large-scale projects in Texas has been discussed in all previous biennial reports. During the past three biennia, the Brownsville Public Utilities Board has explored increasingly smaller project formats in order to reduce the financial impact to its ratepayers and to the state. In the 2010 report, the project was reduced to a 2.5 million-gallons-per-day plant (smaller than the originally proposed 25 million-gallons-per-day plant) with an estimated cost of \$22.5 million. The amount of grant financial assistance requested from the 81st Texas Legislature for this project was \$9.5 million (TWDB, 2010). The request was unsuccessful. The project is currently at a standstill.

In the meantime, the Southmost Regional Water Authority, of which the Brownsville Public Utilities Board is a majority partner, is upgrading the Southmost Regional Water Authority Brackish Groundwater Desalination Plant to treat for arsenic. These improvements will allow for added blending and an increase of 2 million gallons per day to the plant's production capacity. Although this added supply is an important boost to the region, the area's reliance on the

increasingly more vulnerable Rio Grande River system remains a long-term challenge. A substantial influx of a drought-proof seawater desalination supply would provide long-term reliability to the region's water supply.

Over the past decade, the TWDB and the Brownsville Public Utilities Board have conducted feasibility and pilot plant studies and completed scoping of permitting issues and preliminary designs for a full-scale seawater desalination production facility. Implementing the Brownsville Ship Channel project would make effective use of those efforts and deliver on the goal of this program; it would enhance the drought reliability of the region's water supply; and since the project proposes to draw bay seawater from Laguna Madre, it would offer a valuable reference for other potential projects with similar profiles located along the Texas Gulf Coast. Implementing this project before it is strictly needed¹ will, however, require a grant.

South Padre Island Project

Although the Laguna Madre Water District was not one of the three original sites selected as part of the Seawater Desalination Initiative (TWDB, 2002), it benefited from the program's funding and momentum. To date, the project has completed feasibility and pilot plant studies and was part of the Environmental Scoping Study for Seawater Desalination Projects (Brownsville Public Utilities Board, 2011).

In May 2011, voters authorized Laguna Madre Water District to issue bonds to finance construction of a 1 million-gallon-per-day seawater desalination production facility with an estimated cost of \$13.2 million. Assuming the Laguna Madre Water District can sell the necessary bonds, funding to implement the project at its currently proposed scale is not a challenge. However, as in the case of the Brownsville Ship Channel project, there has been no tangible action toward construction during the present biennial reporting period.

The Laguna Madre Water District is currently adding a micro-filtration component to its existing surface water treatment plant to add 2 million gallons per day to its production capacity. This additional supply strengthens the water supply system, but because the original water source is the Rio Grande, it lacks the reliability that seawater desalination would provide. The Laguna Madre Water District plans to acquire land in 2013 for siting the seawater desalination plant and potentially begin construction in 2014. The Laguna Madre Water District has expressed interest in partnering with the private sector to build this plant and increase its capacity to provide a larger regional impact.²

¹ The Lower Rio Grande Valley Regional Water Plan projects that the Brownsville water system will need 5,600 acre-feet per year of seawater desalination supplies starting in 2040.

² Personal communication, Jorge Arroyo and Gavino Sotelo, General Manager, Laguna Madre Water District; September 21, 2012.

Implementing the South Padre Island project would provide a drought-proof water supply to the Laguna Madre Water District and would serve as a test for seawater desalination permitting issues in Texas.

Research

Seawater desalination projects are notably driven by site-specific conditions. In regions where there is a lack of experience or precedent, such as the case in the Texas Gulf Coast, there is a need for studies to fill gaps in our knowledge concerning potential environmental effects and projected performance of desalination facilities. A TWDB-funded study of regulatory issues undertaken by the Brownsville Public Utilities Board (Brownsville Public Utilities Board, 2011) identified a list of research needs specific to Texas, including the following topics named in the 2010 Biennial Report, that remain relevant today:

- Characterizing benthic fauna in areas that will be affected by concentrate discharges
- Determining the salinity tolerance of key aquatic species along the Texas Gulf Coast that may potentially be affected by desalination concentrate discharges
- Modeling currents and tides to determine impact on concentrate dispersion
- Improving thin-layer mixing models as part of far-field plume modeling
- Integrating desalinated seawater into existing drinking water distribution networks
- Revising regulatory bacteria and virus removal credits for reverse-osmosis membranes

Regulatory

The Brownsville Public Utilities Board environmental scoping study identified 26 potential permits that would apply to implementing the proposed projects (Brownsville Public Utilities Board, 2011). Although the report lists these permits, the actual need and length of some of these permitting processes will not be known until one or two permitting cycles are completed.

Technical

The Brownsville Ship Channel and the South Padre Island pilot plant studies tested technologies that are now three to four years old. As new technological advances come online, the results of the 2006 to 2008 pilot plant studies will become dated and may necessitate additional piloting to ensure that the most cost-effective technology will be used (Arroyo, 2004). Although additional piloting costs can be addressed in the design phase, it would add more time (and cost) to the process of making the production facilities operational.

Financial

As previously noted, the Brownsville Public Utilities Board has undertaken additional liabilities as part of its investment in the Southmost Regional Water Authority. However, as noted in this report, the Brownsville Public Utilities Board estimated that it would need financial grant assistance on the order of \$9.5 million to implement the project.

The Laguna Madre Water District has not requested financial support to implement the South Padre Island project nor has it set a time line for implementing the project; financial assistance from the state may serve to expedite implementation of this project while enhancing its demonstration value to the state.

Section 3 - Evaluation of the role the state should play in furthering the development of large-scale seawater desalination projects in the state.

The purpose of the Seawater Desalination Initiative is to accelerate the development of cost-effective seawater desalination supplies in Texas. Since its inception in May 2002, the goal of the program has been to install a large-scale seawater desalination plant to fully demonstrate the potential of this substantial source of new water. Furthermore, by identifying and addressing challenges to seawater desalination, the demonstration project could serve as a roadmap for future, more cost-effective projects.

In spite of important investments and accomplishments to date, the efforts initiated in 2002 have yet to produce the desired large-scale demonstration of seawater desalination. In that light, the role of the state is to continue providing leadership and support to advance seawater desalination in Texas. Fulfilling this role during the upcoming biennium would require consideration of the following needs and opportunities:

- Complete the Brownsville Ship Channel project
Completing this project would cap the efforts initiated in 2002 and make effective use of the studies and work accomplished over the past 10 years. The proposed 2.5 million-gallons-per-day demonstration and production facility could be expanded to a larger scale in the future to serve a greater portion of the Brownsville regional system. Implementing this project requires a grant of \$9.5 million to the Brownsville Public Utilities Board.
- Support the implementation of the South Padre Island project and seek to enhance its demonstration value
The Rio Grande Regional Water Plan indicates that the Laguna Madre Water District requires seawater desalination supplies in the 2010 (current) decade. As potentially the first seawater desalination production facility in the state, this project would effectively advance seawater desalination in Texas. The Laguna Madre Water District has not requested state financial assistance to implement the project nor has it adopted a firm time line for executing the project. However, state financial assistance on the order of \$5 million for permitting and design could help accelerate implementation of this project and serve to enhance its demonstration value. By being the first of its kind in Texas, this project could serve as a site for testing new technology, training operators, and conducting research. A testing facility would benefit both the public and private sectors in providing demonstration facilities for

new technologies to not only further advance the technologies but to support the development of the industry in Texas. State support for this project would have a wider benefit to future seawater desalination projects.

- Support research and pilot plant studies to advance desalination

Several research topics listed in the 2010 Biennial Report are still pending and relevant today. These studies would have a broad impact on facilitating seawater desalination at sites located along the Texas Gulf Coast. An appropriation of \$2 million per biennium would allow the TWDB to fund these studies and continue to advance the technology in the future.

Also, the state may wish to consider providing financial assistance to implement pilot plant studies, including the South Padre Island and Brownsville Ship Channel projects or any other project that may emerge in upcoming years. A seawater desalination pilot plant study costs approximately \$1.5 million. Thus, an appropriation of \$1.5 million per biennium would continue to support pilot plant studies along the Texas coast.

- Seek partnering opportunities with the private sector

Public-private partnering is a common means of implementing large-scale seawater desalination projects around the world. Recent legislative changes in Texas make it easier for the private sector to develop public infrastructure, including water production facilities. The TWDB could provide programmatic support to facilitate private sector participation in the development of seawater desalination facilities.

Section 4 - Anticipated appropriation from general revenues necessary to continue investigating water desalination activities in the state during the next biennium.

State financial assistance is an effective tool to help pioneer the application of new technologies, including the development of seawater desalination in Texas. The first few projects face greater risks and implementation costs due in large part to lack of completed reference projects in the state. The TWDB has exhausted previously appropriated funds to assist with desalination projects. In order to effectively advance the development of seawater desalination, the 83rd Texas Legislature may wish to consider the following financial needs:

- \$9.5 million to help the Brownsville Public Utilities Board construct a 2.5 million-gallons-per-day seawater desalination production plant at the Brownsville Ship Channel
- \$5 million to expedite implementation of the Laguna Madre Water District 1 million-gallons-per-day South Padre Island seawater desalination plant
- \$2 million per biennium to advance the science and implementation of seawater desalination
- \$1.5 million per biennium to assist with the implementation of pilot plant studies

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