

Updates on TWDB's Innovative Water Technology Programs

Jorge A. Arroyo P.E.
Texas Water Development Board
1700 North congress Avenue
Austin, Texas, 78711-3231

ABSTRACT

A summary of the 2011 Regional Water Plans projects that by 2060 the state will need 8.5 million acre-feet per year of new water supplies under drought of record conditions. Approximately 60 percent of those supplies are from conventional water sources, 24 percent from conservation and the rest, approximately 16 percent will be composed of non-conventional water supply sources such as reuse and desalination. Financial assistance for research studies and demonstration projects and technical and educational outreach assistance are part of the efforts of the TWDB to advance innovative water technologies in Texas. This paper and associated presentation provide an update on the TWDB's Innovative Water Technologies Programs.

KEYWORDS

Innovative water technologies, desalination, reuse, brackish groundwater, rainwater harvesting.

INTRODUCTION

Increasing water demands coupled with declining existing sources compel water planners to look for non-conventional water supply sources. The State of Texas, through the efforts of the Texas Water Development Board (TWDB) and its predecessor agencies, has kept an increasing focus on alternative water supply sources.

Beginning in 1961, the state has prepared water plans to guide the development of water resources in Texas. These plans provide a glimpse of the growing impact of non-conventional water supplies in the state water portfolio. Recently, regional water planning groups completed their 2011 regional water plans which provide the basis for the next State Water Plan, Water for Texas 2012. A preliminary report based on the 2011 regional water plans, indicates that nearly 40 percent of the supplies to be developed by 2060 will be the result of conservation and non-conventional or innovative water supplies (TWDB, 2011).

Over its six decades of existence, TWDB has provided nearly \$60 million in financial assistance water research studies. Through the Research and Planning Fund and the Seawater and Brackish Groundwater Desalination Initiative TWDB aims to advance innovative water supplies in the state.

Additionally, TWDB provides technical and educational outreach assistance on a variety of topics. TWDB's Innovative Water Technologies Programs aim to consolidate and provide a systematic approach to the agency's efforts at advancing Desalination, Rainwater Harvesting, Reuse and Aquifer Storage and Recovery water management strategies. The home page for the

Innovative Water Technologies Programs provides key reports, white papers and presentations on these strategies as well as contact information for its staff. The web site is located at <http://www.twdb.state.tx.us/iwt>.

DESALINATION-BRACKISH GROUNDWATER

Texas has an abundance of brackish groundwater, estimated at more than 2.7 billion acre-feet. Once only a potential resource, it is now becoming an important source of new water supply. In the 2007 State Water Plan, six of the 16 regional water planning groups recommended brackish groundwater desalination as a water management strategy to meet at least some of their projected shortages. In total, the regional water planning groups project that desalting brackish groundwater can create about 174,773 acre-feet of new water per year by 2060. Currently, Texas has an estimated total municipal desalination capacity of about 90 million gallons per day (about 100,800 acre-feet per year), which includes 63 million gallons per day (about 70,560 acre-feet per year) of brackish groundwater desalination.

To encourage and facilitate the development of brackish groundwater in the state, TWDB proposed the Brackish Groundwater Desalination Initiative in 2004. The goal of the initiative is to develop tangible examples or models of brackish groundwater desalination that illustrate the use of innovative and cost-effective technologies and offer solutions to practical issues. With financial assistance from the Texas Legislature, the TWDB has to date funded 12 projects for a total amount of about \$2.6 million.

Project	Short Description
City of Kenedy/San Antonio River Authority	The project will demonstrate the efficiencies gained by installing a new reverse osmosis system in an existing brackish groundwater desalination plant in the City of Kenedy, Karnes County.
City of San Angelo/Upper Colorado River Authority	The project assessed the feasibility of the Whitehorse aquifer in Irion County as a source of brackish water that can be desalinated and used by the City of San Angelo for municipal purposes.
North Cameron Regional Water Supply Corporation	The project involved preparing a brackish groundwater desalination guidance manual using the North Cameron Regional Water Supply Corporation's desalination plant in Cameron County as an example.
San Antonio Water System (SAWS)	SAWS conducted a pilot test to assess the cost and technical feasibility of the Vibratory Shear Enhanced Process as a tool for reducing the volume of desalination concentrate.
The University of Texas - Austin	The study will develop strategies that can be used to increase recovery in reverse osmosis desalination of brackish groundwater. The researchers will investigate two possible systems: 1) anti-scalant deactivation and precipitation, and 2) electro dialysis.

Project	Short Description
El Paso Water Utilities - PSB	Using the K.B. Hutchison desalination plant, El Paso Water Utilities is conducting large-scale testing to evaluate silica reduction in concentrate through the addition of lime, Vibratory Shear Enhanced Process, and seawater reverse osmosis.
Affordable Desalination Collaboration	This study will assess and demonstrate energy optimization strategies for brackish groundwater desalination.
City of Seminole	The City of Seminole plans to desalinate brackish water from the Dockum Aquifer in Gaines County using wind energy.
Texas Tech University	The primary objective of this project is to demonstrate a reverse osmosis system with a configuration of parallel elements for small-scale desalination with high recovery and energy efficiency.
Carollo Engineers	Permeate produced during desalination of brackish groundwater by reverse osmosis is corrosive in nature. This study will develop design criteria using upflow calcite contactors to treat the water.
CDM	An instruction manual will be developed that will include a road map for small utilities documenting the specific process to follow for permitting a Class II well for dual Class II and Class I purposes.
North Alamo Water Supply Corporation	The project will demonstrate the technical and economic viability of fiberglass well casing in water wells installed in brackish aquifers.

DESALINATION-SEAWATER

Texas is fortunate to have a 367-mile coastline along the Gulf of Mexico that provides the state access to a limitless supply of seawater. Although it has long been known that desalting seawater can produce usable water, the process is only now becoming economically attractive.

In the 2007 State Water Plan, regional water planning groups H, L, M, and N, which have direct access to the Gulf of Mexico, recommended seawater desalination as a water management strategy. In total, these strategies would create about 138,114 acre-feet of new water per year by 2060.

The Lower Rio Grande Regional Seawater Desalination Plant

The 2008 pilot plant study by the Brownsville Public Utilities Board indicated that the preferred location for a seawater desalination facility is the south bank of the Brownsville ship channel at a point located approximately 11 miles from the Gulf of Mexico. The raw water system to feed the plant would consist of an open canal off the ship channel. The recommended treatment process is a conventional settling system followed by membrane pretreatment and reverse-osmosis filtration.

The brine would be transported back to the ocean via a 14-mile pipe and discharged 0.5 miles into the Gulf. The projected cost of this project is \$184 million. The Brownsville Public Utilities Board proposes a phased approach to develop this facility. The first phase of the project would be a 2.5-million-gallon-per-day production and demonstration facility. Subsequent increments to the plant would be installed on the basis of increased demand over the next 40 years.

The projected cost of this first phase is \$22.5 million. The TWDB requested an exceptional item in its Legislative Appropriations Request for fiscal year 2013 to assist the Brownsville Public Utilities Board with implementing this project. The proposed facility and the recommended phased implementation approach could serve as a prototype for large seawater desalination development in Texas by demonstrating the permitting process and providing a tangible reference point for the design, construction, and operation of a seawater desalination facility at a Texas ship channel location. Toward this end, the TWDB provided a \$60,160 grant to the Brownsville Public Utilities Board to provide a science-based forum where environmental and permitting issues associated with the construction and operation of a full-scale seawater desalination facility can be identified and solutions integrated into the design process.

South Padre Island Seawater Desalination Study

In 2006, the TWDB awarded the Laguna Madre Water District a \$231,000 grant to conduct a seawater desalination feasibility and pilot plant study. The pilot plant study was completed in June 2010. The Laguna Madre Water District is now planning to construct a 1-million-gallon-per-day seawater desalination plant to meet municipal water needs on South Padre Island. The proposed cost for this facility is \$13.2 million.

RAINWATER HARVESTING

For centuries, people relied on harvested rainwater for household, landscape, livestock, and agricultural use. However, with the growth of centralized water treatment and distribution systems, this practice has been all but forgotten until recently. A renewed interest in collecting and using rainwater has emerged because the practice can provide water where other sources of water supplies are inadequate or of poor quality. Rainwater harvesting can also be used to conserve water from more traditional sources such as surface water and groundwater.

Rainwater harvesting is the capture, storage, and use of rainwater for landscape irrigation, potable indoor use, and/or non-potable indoor use. As a general rule of thumb, for every inch of rain that falls on a 2,000-square-foot roof about 1,000 gallons of water can be collected. In Austin, about 32,000 gallons of water can be collected annually. In El Paso, about 9,000 gallons of water can be collected annually. Austin receives approximately 32 inches of rain per year, and El Paso, about 9 inches.

Texas has passed several laws supporting rainwater harvesting. Texas Property Code § 202.007 prohibits homeowner's associations from implementing new covenants banning rainwater harvesting systems. The state also requires new state facilities to incorporate rainwater harvesting systems in their design (Texas Government Code § 447.004).

As the state's lead agency for rainwater harvesting, the TWDB provides information and education to the public on all aspects of rainwater harvesting. We do this through our Web site and with printed materials. For example, *The Texas Manual on Rainwater Harvesting* (3d edition, 2005), a popular guide published by the TWDB, provides an introduction to rainwater harvesting and to designing residential and small-scale commercial systems. Depending on the availability of funds, the TWDB also provides limited financial support (grants) for rainwater harvesting research studies.

An example of a recent TWDB-funded study is the University of Texas at Austin's study to assess the impact of roof-materials on the quality of harvested rainwater.

Texas Rain Catcher Award is a competition and recognition program established by the TWDB to promote rainwater harvesting and to recognize the contribution of individuals and entities pursuing it. The competition began October 1, 2007, and—with the exception of TWDB employees and Board members—is open to all individuals, companies, organizations, municipalities, and other local and state governmental entities in Texas. The deadline for applications each year is December 31.

REUSE

Water reuse will gain an increased share of Texas' water supply portfolio over the next fifty years. All but two of the 16 regional water planning groups recommend water reuse management strategies to meet future water supply needs. For the state as a whole, water reuse is projected to increase from a current 443,030 acre-feet per year to 1,261,579 acre-feet per year in 2060; a 185 percent increase over current levels.

TWDB's efforts to support the development of water reuse supplies include funding of studies through the Research and Planning Program. The more recent studies include:

Developing a baseline and a GIS tool to identify industrial water reuse potential in Texas

This study developed a prototype for identifying water-reuse sources and their proximity to potential customers. The tool relies on a geographic information system platform and can be used to facilitate analysis of water reuse water management strategies in the regional water planning process.

Stormwater Reuse as a Water Management Strategy

Stormwater reuse is an alternative water management strategy that is gaining serious consideration on a global basis. The TWDB Stormwater Reuse project developed information to aid regional water planning groups assess the viability of storm water reuse as a water management strategy. A guidance document was prepared that can be used by entities to develop stormwater reuse strategies in areas with favorable conditions.

Advancing Water Reuse in Texas

In the recent past, water rights issues have dominated the water reuse discussion in Texas; however, there is growing recognition among key stakeholders that, to achieve the expected supply goals for water reuse strategies, there is an even greater need to develop and implement a common agenda focusing on the science, technology and public awareness aspects of water

reuse. In fall 2008, the TWDB solicited statements of qualifications to conduct a research study examining Texas' rich history on water reuse; assess the state of existing and proposed water reuse supplies; and provide recommendations to inform and guide the state's efforts in research and implementation of water reuse. The TWDB anticipates that this effort will serve as an important component of the reuse discussion in the 2012 State Water Plan and also as a roadmap for future priority research in water reuse.

AQUIFER STORAGE AND RECOVERY

Aquifer Storage and Recovery (ASR) "...is the storage of water in a suitable aquifer through a well during times when water is available, and the recovery of water from the same well during times when it is needed" (Pyne, 2005) An almost similar term adopted by the National Research Council is Managed Underground Storage (National Research Council, 2008)

The source of water in an ASR system can be groundwater, surface water, or reclaimed water. While ASR does not itself produce new water it allows for the better use of existing supplies by capturing and storing water in times of abundance and making it available in times of need. It is proven, efficient, cost-effective, and involves minimal environmental impact.

ASR is rapidly becoming an important component of a water manager's toolbox. For example, the number of ASR projects in the US has grown from 3 in 1968 to more than 75 in 2005, with demand likely to grow into the future (National Research Council, 2008).

However, ASR has not yet been used to its full potential in Texas and the state is lagging other fast-growing states such as California and Florida in the number of new and proposed projects. Currently, there are only three ASR projects operating in Texas (less than four percent of all ASR projects in the US). These projects are located in Kerrville, San Antonio, and El Paso. Moreover, only one regional water planning group (Region L) included ASR as a water management strategy in the 2007 State Water Plan.

Clearly, there is a need to identify and address issues and challenges that may have hampered the growth of ASR in Texas and to help advance it as a viable water management strategy for regional water planning.

TWDB is currently funding a study to ascertain why ASR is not being implemented to a greater extent in Texas. When completed in March 2011, the study will provide important results that will help TWDB identify needs, address issues and challenges, and pursue strategies to make ASR a viable and more widely used water management tool for regional water planning in Texas.

CONCLUSION

Texas is blessed with ample surface and groundwater resources and a growing awareness about the need to conserve existing water supplies; however, providing for the increasing water needs of the state will require the use of all available, conventional and non-conventional, options.

WORKS CITED

National Research Council. (2008). *Prospects for Managed Underground Storage of Recoverable Water*. Washington, D. C.: The National Academy Press.

Pyne, R. D. (2005). *Aquifer Storage Recovery: A Guide to Groundwater REcharge Through Wells*. Gainesville, Fl: ASR Press.

TWDB. (2011). *Draft Summary of the 2011 Regional Water Plans*. Austin: TWDB.