Desalination: Where do we go from here?[1]

The State of Texas has taken important steps to advance seawater and brackish groundwater desalination during the last decade. In 2002 the state set a goal of installing a large scale demonstration of seawater desalination facility as a means to advance development of seawater desalination in the state. Although the goal has not been realized, there has been valuable incremental progress towards its fulfillment and construction of a production facility is projected for 2013. With regards to brackish groundwater desalination, key challenges to brackish desalination have been identified and solutions explored and demonstrated. While there are important remaining challenges to implementing desalination projects, such as the cost of desalination, there are compelling reasons for Texas to continue its pursuit of desalination. First and foremost, desalination offers an unparalleled potential to provide abundant supplies of new water in the face of the recurring droughts.

In this presentation, I examine the current state of water desalination in Texas, provide a brief assessment of the needs and opportunities for desalination, and discuss practical approaches to continue advancing desalination in the state.

State of desalination in Texas

Installed Capacity

According to the Texas Water Development Board (TWDB) Desalination Database, the installed desalination capacity in Texas today is 120 million gallons per day (134,500 acre-feet per year) (Shirazi & Arroyo, 2011). All of this capacity is based on brackish sources; approximately 60 percent from groundwater and 40 percent from surface water sources. There is currently no seawater desalination in the state. Ninety percent of the existing capacity is based on reverse-osmosis technology. Fifteen of 44 systems in the database discharge directly to surface water bodies and 14 do so indirectly through sewerage systems and wastewater treatment plant discharges. Eight plants dispose of the concentrate through irrigation systems, five use land application, seven use evaporation ponds, one uses underground injection, and one reuses the concentrate stream for industrial purposes.

Planned Capacity

In Texas, a state-lead regional water planning process guides the development of the state's water resources. The process covers a 50-yr planning horizon and uses the most severe drought in a 100-year period as the basis for the planning. Regional planners project demands, existing

[1] By Jorge Arroyo, Director of Innovative Water Technologies, Texas Water Development Board, to be presented at the 2011 WateReuse Symposium in Phoenix, Arizona, on September 14, 2011. This paper will be posted in the Innovative Water Technologies web page of the Texas Water Development Board.

supplies and availability under a drought of record scenario and then adopt water management strategies to ensure sufficient water supplies over the next 50 years.

According to the most current plans, Texas will add up to 9 million acre-feet per year of water supplies by the year 2060. Desalination accounts for a modest 3.44 percent of this volume, or 310,000 acre-feet per year of additional desalination supplies by 2060. Sixty percent of the added capacity will come from brackish desalination and 40 percent from seawater desalination (TWDB, 2011).

Desalination policies and funding

The mission of TWDB is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas. Advancing desalination supplies in Texas is part of the agency's mission. Specifically, the TWDB is required by statute to take all necessary actions to advance to development of seawater desalination supplies in Texas.

TWDB is Texas' water planning and water project financing agency. The TWDB's main responsibilities are threefold: collecting and disseminating water-related data; assisting with regional water planning and preparing the state water plan for the development of the state's water resources; and administering cost-effective financial programs for constructing water supply, wastewater treatment, flood control, and agricultural water conservation projects. Since 1957, the TWDB has been charged with addressing the state's water needs. The TWDB has both leadership and support roles in ensuring that sufficient, clean, and affordable water supplies are available to the citizens of Texas and that those water supplies foster a healthy economy and environment *(TWDB, 2010)*.

The TWDB supports the implementation of desalination projects, as appropriate, and also supports ongoing desalination research and technological information sharing to enhance brackish groundwater and seawater desalination activities throughout the state. Since 2000, the TWDB has awarded approximately $7 million for 32 desalination-related grants. Forty-eight percent of that amount was dedicated to seawater desalination projects, 49 percent to brackish groundwater desalination demonstration projects, and three percent to other desalination-related issues such as creating a desalination database and developing permitting guidance for desalination projects. The matching and in-kind funds from grant recipients leverage the investment value to approximately $15 million.

The future of desalination in Texas

Texas has wide diversity of fresh water resources to draw from and even under drought-of-record conditions water planners have determined that 84 percent of the new water supplies needed over the next 50 years can be addressed through conservation (agricultural and municipal), new

reservoirs and additional surface and groundwater development (Figure 1 and Table 1). Non-conventional supplies –reuse, desalination, aquifer recharge and others- account for approximately 16 percent of the recommended water management strategies.

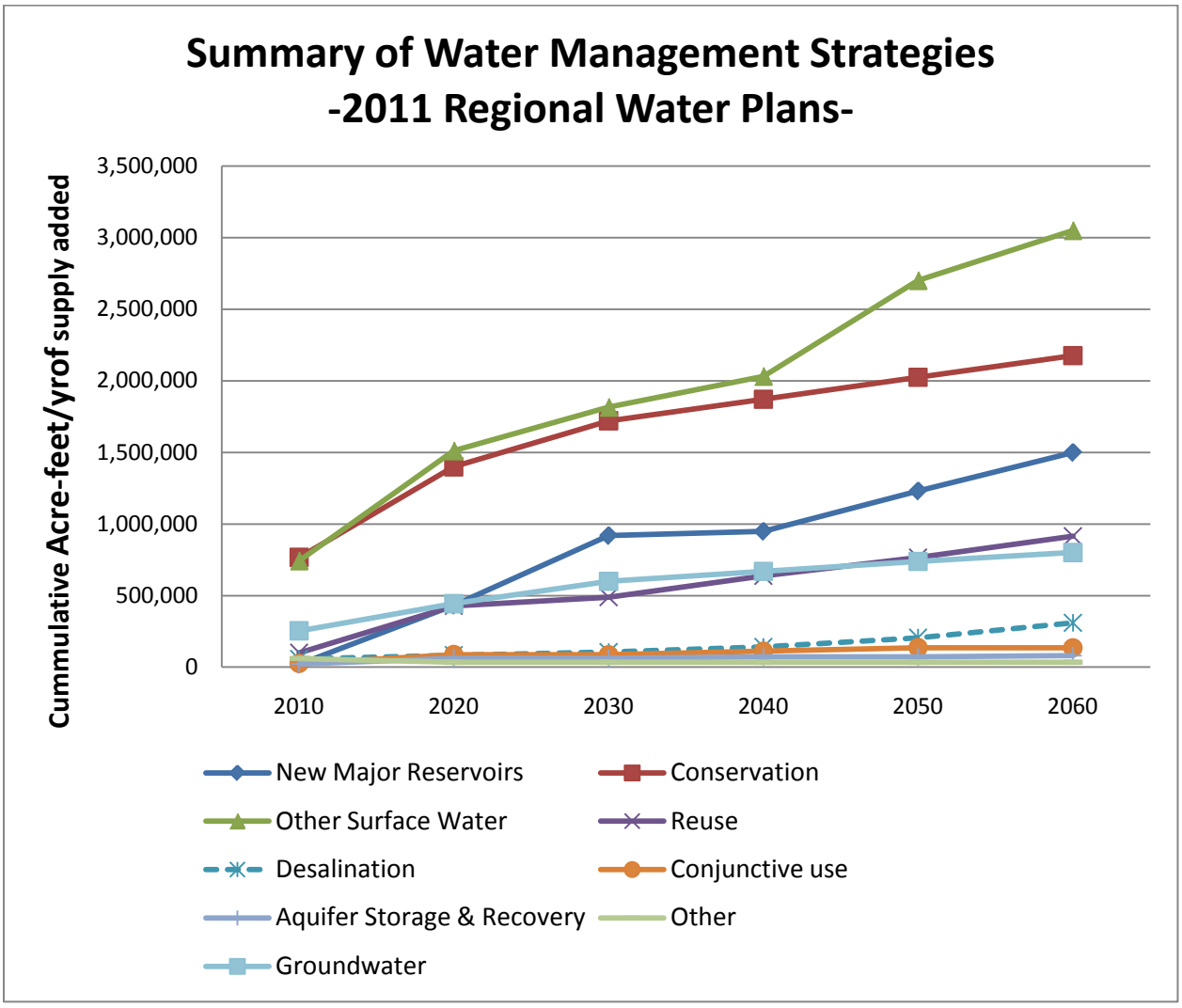


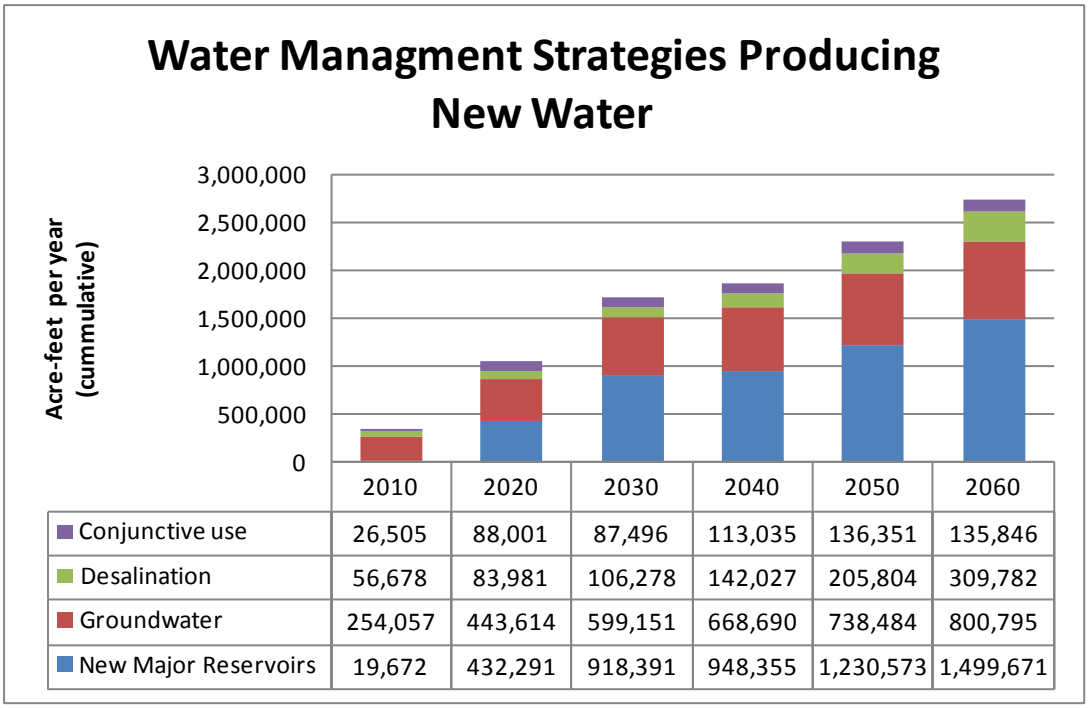
Figure 1 - All Water Management Strategies in the 2011 Regional Water Plans

Table 1 - Water Management Strategies in the 2011 Regional Water Plans (TWDB, 2011)

Water Management Strategies	2010	2020	2030	2040	2050	2060
	(Cummulative volumes in Acre-feet/year)					
Conservation						
Municipal Conservation	137,847	264,885	353,620	436,632	538,997	647,361
Irrigation Conservation	624,151	1,125,494	1,351,175	1,415,814	1,463,846	1,505,465
Other Conservation	4,660	9,242	15,977	18,469	21,371	23,432
Total Conservation	766,658	1,399,621	1,720,772	1,870,915	2,024,214	2,176,258
Reuse	100,592	428,263	487,795	637,089	766,402	915,589
Other Surface Water	742,447	1,510,997	1,815,624	2,031,532	2,700,690	3,050,049
Aquifer Storage & Recovery	22,181	61,743	61,743	72,243	72,243	80,869
Other						
Drought Management	41,701	461	461	461	461	1,912
Weather Modification		15,206	15,206	15,206	15,206	15,206
Brush Control	18,862	18,862	18,862	18,862	18,862	18,862
Total other	60,563	34,068	34,068	34,068	34,068	34,068
	New water					
New Major Reservoirs	19,672	432,291	918,391	948,355	1,230,573	1,499,671
Groundwater	254,057	443,614	599,151	668,690	738,484	800,795
Conjunctive use	26,505	88,001	87,496	113,035	136,351	135,846
Desalination						
Groundwater Desalination	56,553	81,156	103,435	133,278	163,083	181,568
Surface Water Desalination		2,700	2,700	2,700	2,700	2,700
Seawater Desalination	125	125	143	6,049	40,021	125,514
Total Desalination	56,678	83,981	106,278	142,027	205,804	309,782
Total WMS Supply Volumes	2,049,353	4,483,040	5,831,779	6,518,415	7,909,290	9,004,839

As noted above, conservation (considered a supply-side strategy in Texas regional water planning) is a substantial component of the state's projected water supply portfolio. Conservation is only exceeded in volume by "other surface water" which refers to the implementation of existing surface water supplies. Examples of "other surface water" are installing or increasing transmission capacity to tap into an existing reservoir or renewing a contract for use of existing reservoir capacity).

Although there are regions of the state where current and future reliance on desalination is more substantial, statewide desalination's projected contribution to the full water supply portfolio is nominal. However, the picture improves when we consider only those water management strategies that would generate new water. In that case, desalination represents an 11 percent of the volumes to be generated by 2060 (Figure 2).



	2010	2020	2030	2040	2050	2060
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Figure 2 - Water Management Strategies Producing New Water

Could that change? Could desalination become a more substantial source of water supply in Texas? A simple answer is that while less expensive, reliable and familiar sources are available, water planners and developers will naturally tap onto those sources first. Desalination supplies will be added at a moderate pace, supplementing conventional sources or supplanting conventional water management strategies that may prove unattainable beyond the regional planning phase.

A factor that could accelerate the development of desalination supplies is climate; as it did in Australia where a severe drought prompted a massive development of seawater desalination supplies. A similar event in Texas, the drought of the 1950s, was a catalyst for the construction of many of Texas' reservoirs. We are currently experiencing a severe drought rivaling the drought of record. In many parts of the state reservoirs are at historic lows. A prolonging of the current drought is likely to maintain desalination in the public's radar and provide fodder for policies [and funding] supporting desalination. However, the more substantive efforts –such as those that will result in water being produced- will need to follow the roadmap provided by the water management strategies recommended in the regional water plans which are, after all, predicated on drought-of-record conditions.

As regional plans move to implementation, some of the recommended water management strategies may prove to be unfeasible in which case planners would need to look for other options, including desalination. Every five years the regional planning groups produce a revised plan. The cyclical nature of the process allows planners to incorporate new data –such as

changes in population growth trends or failure to implement key pieces of previous plans- and to revise the adequacy of water management strategies to meet future water needs.

Contributions to advance desalination in Texas

Texas is only scratching at the surface of its water desalination potential. However, thanks to the relative abundance of historically inexpensive water sources, the statewide water planning shows a relative low need to develop desalination supplies. Nevertheless, unrelenting stress on traditional water sources casts doubts on the long-term reliability of these sources and heightens the need to diversify water supply portfolios with new water supply sources. In the meantime, increasing cost-competitiveness and other practical advantages of desalination technologies favor the continued, albeit moderate, growth of desalination supplies.

There are important, non-drought related, factors that can effectively contribute to the advancement of desalination in Texas: facilitating the permitting of concentrate disposal; improving brackish aquifer characterization; providing technology demonstration projects; and, education outreach.

- Permitting of desalination concentrate disposal
  Texas has made noteworthy progress in this area. Mandated by the 81st Texas Legislature, 2009, Texas adopted an expedited permitting process for authorizing non-hazardous Class I injection wells for desalination concentrate. This regulatory tool saves processing time and cost of obtaining authorization for Class I permits for desalination concentrate disposal.

  Another substantial and cost-effective tool to be pursued would be an expedited regulatory process to allow the use of existing Class II wells for desalination concentrate disposal. Class II wells, ubiquitous in Texas, are only permitted for oil and gas mining operations. However, a Class II well operator may accept desalination concentrate if used for the purpose of oil and gas operations. Allowing the use of existing Class II wells for the permanent disposal of desalination concentrate, without restriction that it be done only as part of an oil and gas operation, would save the cost of installing an entirely new well. Navigating the regulatory complexities of underground injection wells to enable the dual certification of Class II wells, for example, will probably require a multi-state concerted effort to succeed.

- Brackish aquifers characterization
  The TWDB Brackish Aquifer Characterization System is a reference for how to characterize the brackish portion of the aquifers in the state. Continuing this effort by focusing on areas likely to require development of brackish desalination supplies in the near future will be a substantial contribution to facilitate implementation of inland desalination projects.

- Technology demonstration projects

Demonstration projects serve to provide factual information about the applicability of newer technologies. This in turn lessens the risk of embracing new technologies and educates decision makers and the water community about their applicability. A majority of the grants awarded by TWDB during the last decade were for seawater and brackish groundwater desalination demonstration projects. The state funding for demonstration projects has now been eliminated.

Technology demonstration projects are of benefit to potential users of the technology, the regulatory community, and to technology manufacturers alike. State budget cuts limit the ability of the TWDB to fund these efforts during the next biennium. Therefore, collaborative technology demonstration efforts between industry, water utilities, research groups and government agencies need to be encouraged and supported to the extent possible.

- Education outreach
  Education outreach is needed to provide accurate, objective, reliable and accessible information about desalination technology, costs, energy requirements, impacts of concentrate disposal, and permitting. Providing information about successful reference projects, such as the Southmost Regional Water Authority, El Paso Water Utilities Public Service Board, North Alamos Water Supply Corporation is a low cost but effective way to acquaint the public and decision makers on the costs and benefits of desalination supplies. We need to continue these educational efforts.

Conclusion

Current planning projections indicate a tripling of the installed desalination capacity in the state over the next 50 years. This projected capacity is relatively modest when compared to the magnitude of the water supplies that will need to be generated over the next 50 years. However, the growing vulnerability of existing conventional water supply sources to droughts, paired with increasing water demands, favor the prospects of desalination increasing beyond the current estimates. Regardless, there are practical cost-effective steps that the State and the desalination community may take to advance desalination in Texas: Facilitating the permitting of concentrate disposal, improving the characterization of the brackish aquifers of the state, supporting technology demonstration projects and continuing educational outreach activities.

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