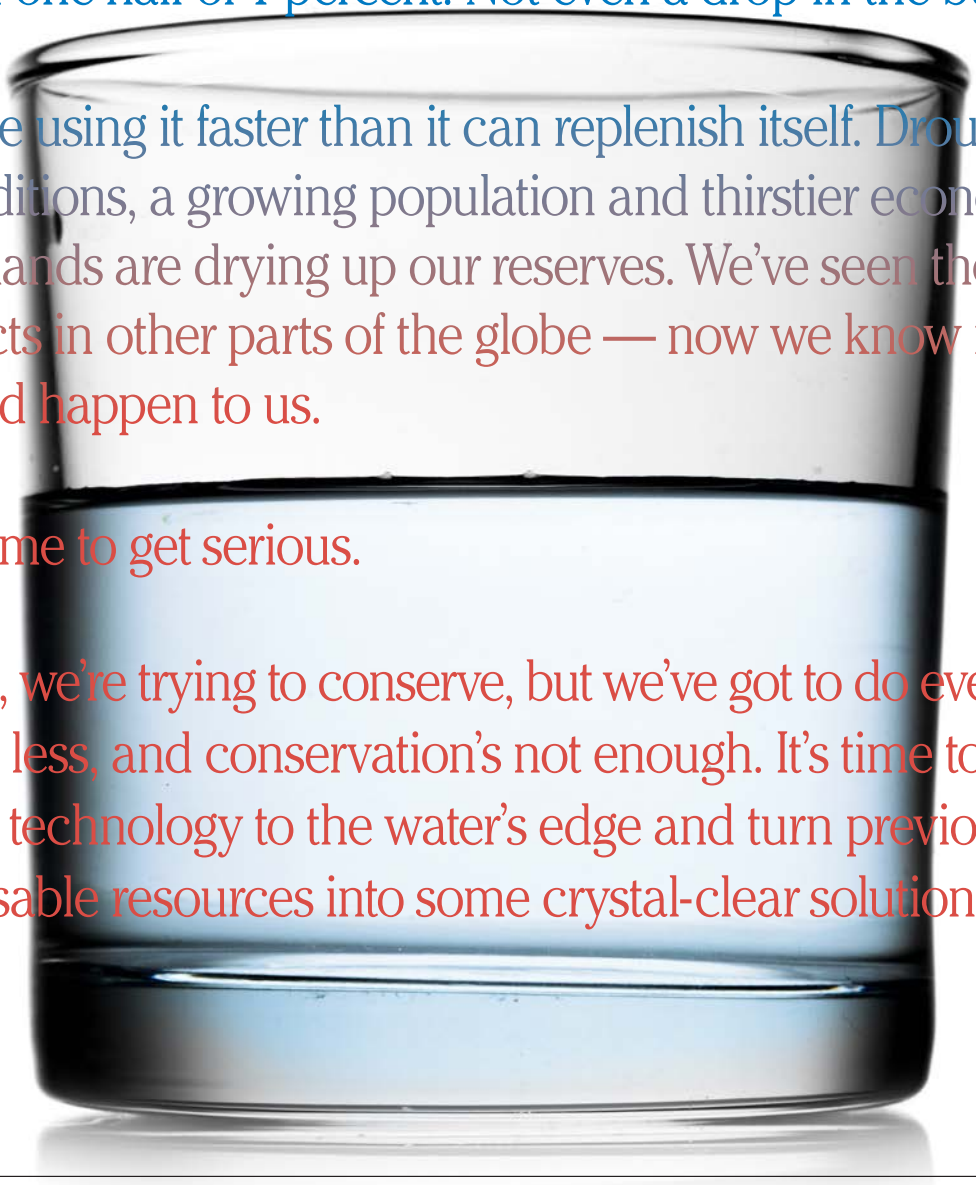
SUSAN COMBS • Texas Comptroller of Public Accounts

Texas Water Report:

GOING DEEPER FOR THE SOLUTION

"Water, water everywhere, nor any drop to drink."

Our planet is rich with oceans so deep we've scarcely seen the bottom, and vast underground supplies of water as well. But of all that water, clean drinkable water adds up to less than one-half of 1 percent. Not even a drop in the bucket.



We're using it faster than it can replenish itself. Drought conditions, a growing population and thirstier economic demands are drying up our reserves. We've seen the effects in other parts of the globe — now we know it could happen to us.

It's time to get serious.

Sure, we're trying to conserve, but we've got to do even more with less, and conservation's not enough. It's time to bring new technology to the water's edge and turn previously unusable resources into some crystal-clear solutions.

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Ladies and Gentlemen:

In early 2012, my office released **The Impact of the 2011 Drought and Beyond**, a report examining the impacts of the disastrous drought and fires that cost Texas lives and billions in revenue.

Today Texas is trapped in another terrible drought, though one not quite as bad as 2011's. Not yet, at least.

Texas has been prone to cycles of drought for centuries, and there's no reason to expect that basic pattern to change. But our state has changed, and its burgeoning population and economy are creating an increasingly unquenchable demand for water.

In this report, we revisit the issue of drought, with a new focus on the larger issue of Texas' water supplies, an essential resource that can bolster our economic growth — or limit it.

We examine the multiple sources of Texas' water, and the ways in which we fund the projects that develop these resources and deliver them where they are needed. We also discuss the $2 billion in new funding for water projects that voters approved on Nov. 5.

This additional funding offers no excuse for complacency, however. This is the moment to build on and harness this new momentum, and take further steps to ensure a steady supply of clean water for our children, and theirs.

We discuss promising new technologies and programs that can help us stretch our existing supplies further, as well as the state of play in the rapidly developing world of desalination, which promises to provide us with substantial new sources of fresh water.

Most importantly, this report makes a series of policy recommendations for our Legislature that could help provide water supplies ample enough to ensure that Texas can continue its remarkable growth and prosperity.

Texas' water problems can and will affect every facet of our economy. My office is ready to help state and local policymakers throughout Texas grapple with this complex and all-important challenge.

Susan Combs
Texas Comptroller

INTRODUCTION

The drought year of 2011 was catastrophic for Texas, costing **billions** in agricultural revenue — and **six lives** in fires across the state. These losses have made a deep and continuing impact on the way in which Texans think about the value — and the scarcity — of water.

Today, as we prepare for what could be another dry year, many of us feel a sense of foreboding. But we're hardly alone.

For most of the world, the need for dependable water supplies may well be the most challenging issue of the 21st century.

WATER EVERYWHERE, BUT NOT ENOUGH

Earth is a "blue marble," a water world. But about **97.5 percent** of that is salt water, unusable to us without thus-far expensive and energy-intensive desalination techniques.

The United Nations (UN) estimates that, of **1.4 billion** cubic kilometers (1 quadrillion acre-feet) of water on Earth, just **200,000** cubic kilometers (162.1 billion acre-feet) represent fresh water available for human consumption.

Many parts of the world are already experiencing shortages of this precious resource. Supplies are being strained by factors including a drier climate, population growth, increased urbanization and industrialization, pollution and even changing dietary patterns.

Texas is experiencing extended drought, and while the state may enjoy wetter conditions in the near future, a burgeoning population may already be reaching the limits of its available water. In many places, groundwater is being used more quickly than it can replenish.

COULD WE CHANGE THE GAME?

In many ways, the outlook concerning fresh water could mirror what has happend for oil, another finite resource. Oil markets have been upended in the last few years by vast new supplies brought to market by the application of new technologies, in this case the use of increasingly sophisticated horizontal drilling and hydraulic fracturing techniques.

It's possible — though not certain — that similar game-changers will affect the outlook for water. New techniques and technologies may help us conserve significant amounts of water in industrial and agricultural operations. And just as importantly, the rapidly evolving technologies of desalination, water reuse and aquifer storage and recovery may provide us with new supplies of fresh water from either wastewater or vast reserves of brackish (salty) water in Texas aquifers. These technologies may offer a way to head off the seemingly inevitable collision between Texas' rapid growth and its finite supplies of water.

HOW THE EARTH'S WATER IS DISTRIBUTED

SALT WATER **97.5%**

FRESH WATER **2.5%**

Of the world's fresh water, nearly **70 percent** is bound up in permanent ice and snow, in glaciers (including the polar icecaps) and on mountaintops. A bit more is in the atmosphere.

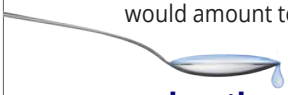
GLACIERS	**68.7%**
PERMAFROST	**0.8%**
GROUNDWATER	**30.1%**
SURFACE AND ATMOSPHERIC WATER	**0.4%**

Source: Global Water Security: Intelligence Community Assessment, February 2012.

Only a little more than one-half of 1 percent of that freshwater is available for human use.

If all of the planet's waters were represented by a standard **five-gallon water cooler bottle,**

the fresh water available for our use would amount to about a tenth of an ounce — **less than a teaspoon.**



Source: UN – Water

I. WATER DISTRIBUTION: GEOGRAPHY

Both climate and geology have distributed the world's fresh water unevenly across the planet. This simple fact is likely to have **serious implications** for the 21st century.

- According to the UN, today almost **one-fifth** of mankind — **1.2 billion people** — lives in regions affected by water scarcity.
- Estimates by the U.S. intelligence community indicate that world demand for fresh water will exceed supplies by **40 percent** by 2030. In that year, **3.9 billion people** — almost **half** the world population — may live in areas of "severe water stress."

WATER AND BORDERS: INTERCONNECTING COMPLEXITIES

Water **problems** do not respect political boundaries, as with the current drought savaging southern Texas and northern Mexico alike. But water **regulation and use** are **definitely** affected by such boundaries. As water becomes scarcer, will we see efforts to **transport** significant amounts of water across political boundaries?

- Canada, with one-fifth of the world's fresh water, has been characterized as a potential "OPEC of water," though many Canadians support banning bulk water transport.
- Alaska has authorized water exports; its city and borough of Sitka, for instance, is seeking proposals to export up to **29,235 acre-feet** of fresh water per year.

But even interstate water transfer can be highly controversial. The U.S. Supreme Court recently upheld Oklahoma's decision to block a **460,332 acre-feet transfer** of its water by Texas' Tarrant Regional Water District, which serves nearly **2 million** Metroplex-area residents.

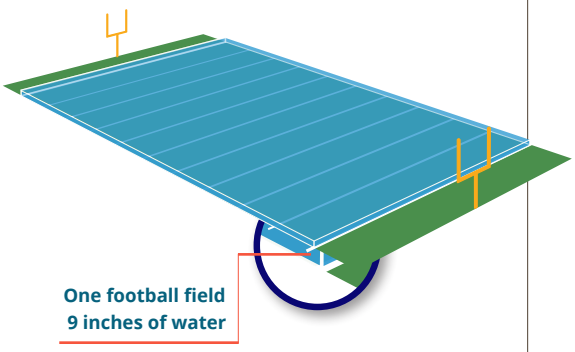
In addition to jurisdictional challenges involving national and regional self-interest, the **cost** of massive water transfers could be enormous, primarily due to the **infrastructure** needed.

- China's South-North Water Transfer Project will create an aqueduct from the water-rich south to its drought-plagued north, and will cost about **$65 billion.**
- Long-distance transport by ship is possible and does occur to a small degree, but it is unlikely to become commonplace due to cost and logistical constraints.

These factors make it **unlikely** that we will see mass transfers of water across political boundaries in the near future — unless the planet's water difficulties become significantly more severe.

WHAT IS AN ACRE-FOOT?

An **acre-foot** of water is equal to **one acre** covered with **one foot of water**. This is equivalent to a football playing field covered with **nine inches** of water.



Source: Texas Water Development Board

THE U.S.-MEXICO WATER DEFICIT

In South Texas, farmers and communities don't just depend on Mother Nature for their fresh water — they also rely on Mexico.

Under a **1944 treaty** between Mexico and the U.S., the Mexican government is obligated to release to the Rio Grande River **1.75 million acre-feet** every five years from Mexican tributary rivers. The current cycle began in 2010 and ends in 2015.

Mexico, however, does not have a history of consistent compliance with the terms of this treaty, causing hardship for farmers and communities on the river's U.S. side who depend on reliable water supplies. From 1992 to 2002, Mexico ran up a significant water-release deficit that reached 1.5 million acre-feet. Only after direct involvement from then-President George W. Bush was the debt repaid in full.

Unfortunately, this trend has continued into the present, despite the heavy rains across the southern Rio Grande Basin caused by Hurricane Ingrid, Hurricane Manuel and Tropical Storm Octave. Over the past six months, Mexican reservoir levels have increased by more than **50 percent**, and now hold 6.055 million acre-feet.

While recent releases have decreased the deficit somewhat, as of November 23, 2013, Mexico's water deficit is still more than **270,000 acre-feet**. As a result, Mexico is **more than nine months behind** in its releases to the Rio Grande. With its quickly rising reservoirs, Mexico could easily eliminate this deficit, which amounts to about 5 percent of the total amount of water they have in storage.

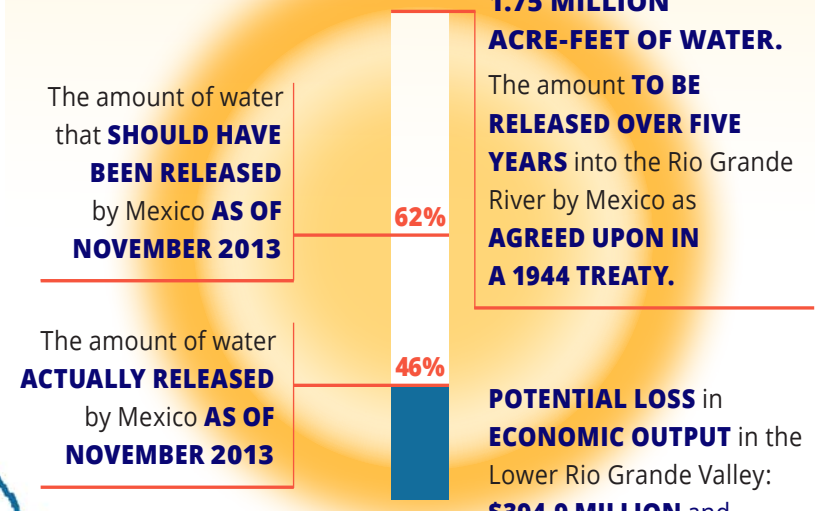
Irrigation water from the Rio Grande is vitally important to farmers in the Lower Rio Grande Valley, a key agricultural region. Texas Commission on Environmental Quality and the Texas Department of Agriculture recently estimated that the loss of Rio Grande irrigation could cost the region **$394.9 million** in lost economic output as well as **4,840 jobs** linked to agricultural production and sales.

THE RIVERS OF MEXICO FEEDING INTO THE RIO GRANDE

Source: The Center for Space Research, The University of Texas at Austin

THE U.S. MEXICO WATER DEFICIT

2010-2015



The amount of water that **SHOULD HAVE BEEN RELEASED** by Mexico **AS OF NOVEMBER 2013**

The amount of water **ACTUALLY RELEASED** by Mexico **AS OF NOVEMBER 2013**

1.75 MILLION ACRE-FEET OF WATER. The amount **TO BE RELEASED OVER FIVE YEARS** into the Rio Grande River by Mexico as **AGREED UPON IN A 1944 TREATY.**

POTENTIAL LOSS in **ECONOMIC OUTPUT** in the Lower Rio Grande Valley: **$394.9 MILLION** and **4,840 JOBS**.

Source: Texas Commission on Environmental Quality and Texas Department of Agriculture

DROUGHT AND THE WHOOPING CRANE

Persistent drought has spurred a conflict between the state and federal governments concerning the whooping crane, one of the most well-known endangered species.

South Texas is home to the world's only wild flock of whooping cranes, which winters in marshy areas along the Gulf Coast including the Aransas National Wildlife Refuge. An environmental group, The Aransas Project, has sued the Texas Commission on Environmental Quality (TCEQ), maintaining that the agency violated the Endangered Species Act by failing to ensure adequate water supplies for the birds' nesting areas. The group attributes the deaths of nearly two dozen whooping cranes in the winter of 2008 and 2009 to inadequate flows from the San Antonio and Guadalupe rivers.

In March 2013, a federal court ordered TCEQ to develop a habitat protection plan for the crane and to cease issuing permits for waters from the San Antonio and Guadalupe rivers. A judge amended the ruling to allow TCEQ to continue issuing permits necessary to protect the public's health and safety. An appeals court eventually granted a stay in the order during the appeals process.

The Guadalupe-Blanco and San Antonio river authorities have joined TCEQ in the lawsuit, and warn that restricting the use of their waters would have serious effects on the cities of New Braunfels and San Marcos as well as major industrial users along the coast.

The case threatens Texas' right to manage its rivers and could increase the cost and difficulty of delivering water to one of Texas' fastest-growing regions.

GO DEEPER: To see how environmental issues will increasingly complicate water planning, visit **www.TexasAhead.org/texasfirst/**.

TEXAS WATER SUPPLY

According to the Texas Water Development Board (TWDB), Texas had **8.4 million acre-feet** of surface water and about **8.1 million acre-feet** of available groundwater supplies as of 2010. In addition, about **482,000 acre-feet** of reclaimed or reused water were available at that time. Those figures, of course, do not reflect losses from the subsequent drought.

It will come as no surprise to Texans that the state's **eastern** regions have the largest fresh water concentrations, and have been the fastest to recover some reservoir capacity since 2011.

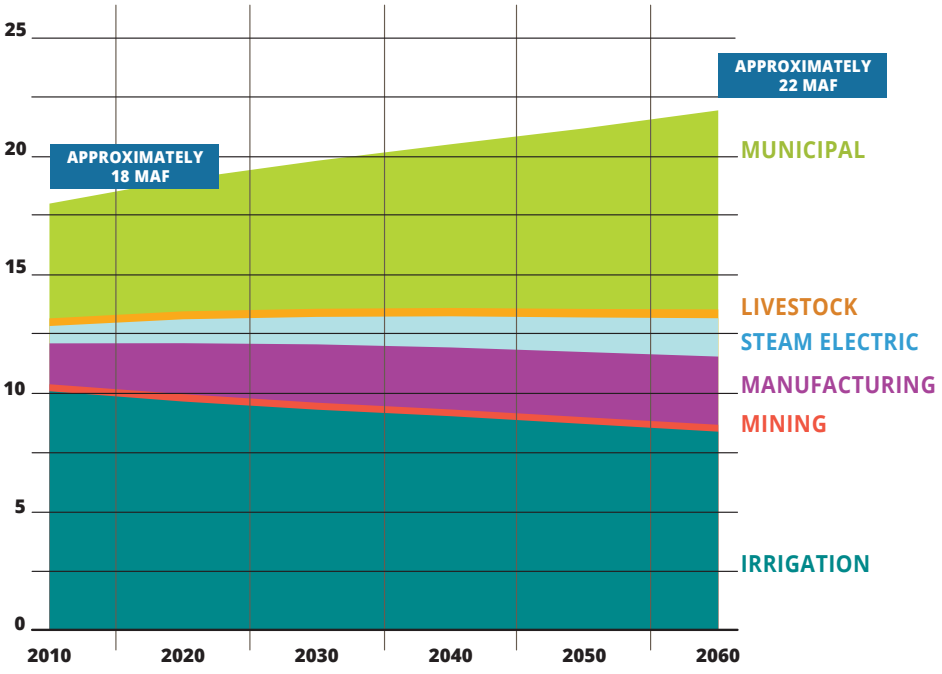
- Many surface reservoirs in East Texas are at **80 percent** capacity or better, and are much larger than those elsewhere in the state.

TEXAS WATER DEMANDS

The TWDB reports that the state's rapidly growing population will spur changes in our demand for and use of water. In 2010, irrigation was projected to account for **56 percent** of Texas' water use, followed by municipal use at **27 percent**. By 2060, municipal water use is expected to become the largest category, at **38.3 percent** of all water use, followed closely by irrigation at **38.1 percent**.

STATE WATER DEMAND PROJECTIONS, 2010-2060

WATER DEMAND PROJECTIONS — ACRE-FEET IN MILLIONS (MAF)

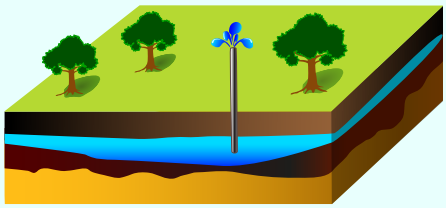


Source: Texas Water Development Board

WHO OWNS TEXAS WATER?

Untangling Texas water rights is no easy task. Ownership depends largely on where the water is located — underground, on the surface, or in the sea — and each of those sources is regulated differently. GO DEEPER: To find out who manages your water, visit www.TXWaterReport.org/distribution/controls.php

GROUNDWATER

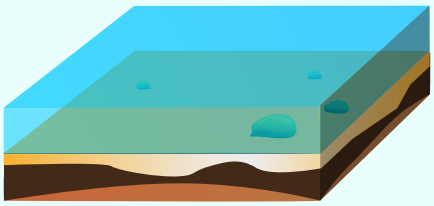


Texas recognizes that a landowner owns the groundwater (both fresh and brackish) underlying his or her land as real property. Known as the "Rule of Capture," this longstanding common-law rule allows landowners to draw as much water as they can capture — as long as water isn't wasted or taken maliciously — without liability for losses to neighbors' wells, subject to reasonable groundwater conservation district regulations.

SURFACE WATER

State government owns all waters flowing on the surface of Texas. The Texas Commission on Environmental Quality (TCEQ) issues and manages permits based on a "first in time, first in right" principle, meaning that those holding the oldest permits have first access to available water.*

SEA WATER

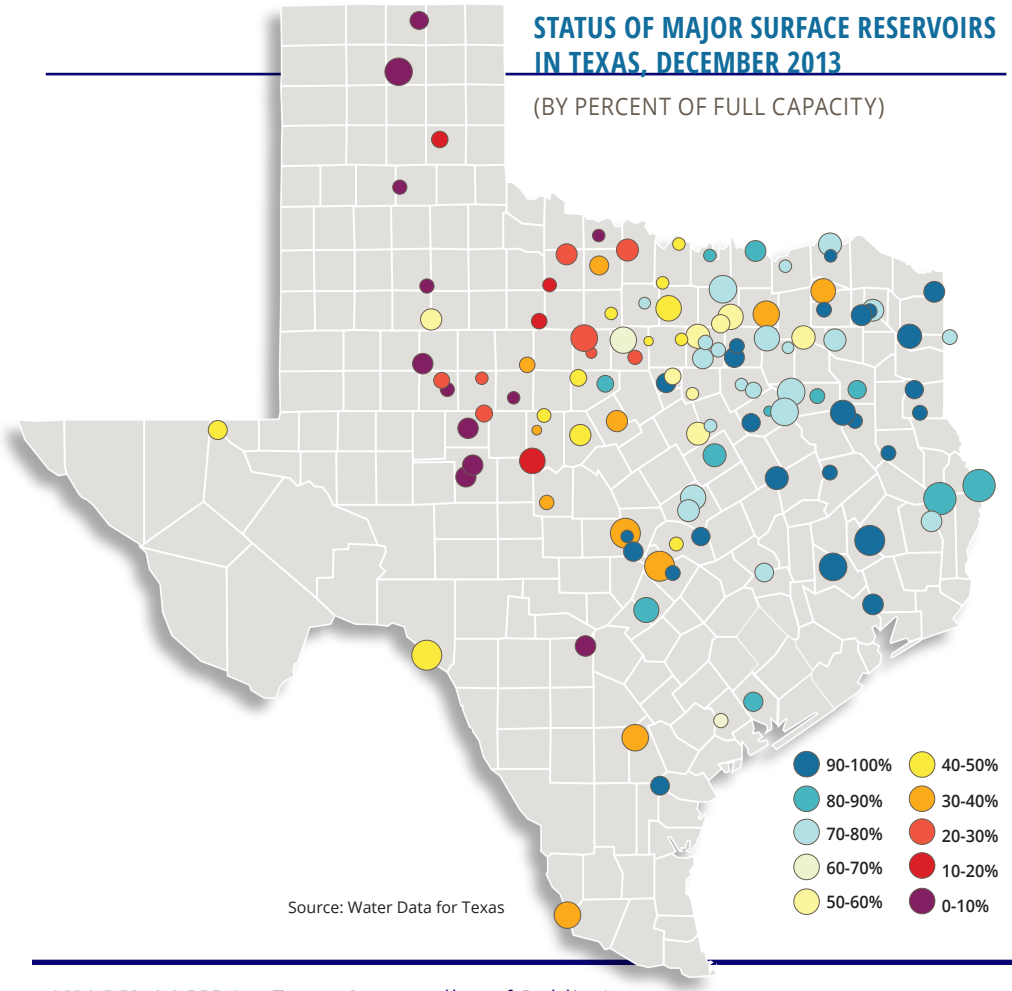


Texas owns its lands and the waters above them out to the limit of "three marine leagues" (about 10.3 miles) in the Gulf of Mexico.

* In June 2013, the 53rd Civil District Court upheld this principle, concluding that TCEQ does not have the authority to curtail water rights based on use instead of seniority of time. TCEQ was allowing junior rights holders such as municipalities ahead of senior agriculture rights holders.

STATUS OF MAJOR SURFACE RESERVOIRS IN TEXAS, DECEMBER 2013

(BY PERCENT OF FULL CAPACITY)



Source: Water Data for Texas

WEST BEAR CREEK

Waters flowing through Texas streams can belong either to the state or to property owners, depending on how they are classified. If stream beds meet criteria that would make them potentially useful for commercial purposes, they are considered "navigable" and belong to the state. Outside of limited exceptions, landowners must get permission to restrict or redirect water flow.

In principle, this distinction is intended to promote commerce, but it can create entanglements. The Texas Commission on Environmental Quality (TCEQ) recently fined a Kimble County rancher and ordered him to destroy a dam on his property after a review of General Land Office maps found West Bear Creek navigable.

TCEQ initiated its investigation after an anonymous complaint alleged that the rancher was impounding state water without the proper permit.

RAYMONDVILLE, TEXAS

Raymondville, county seat of Willacy County in South Texas, went into Stage III water restrictions — limiting nonessential water uses such as lawn watering and car washing — in February 2013. Its water provider, the Delta Lake Irrigation District (DLID), notified the city that the district could run out of agricultural water for area farmers. DLID provides both irrigation for agriculture and municipal water to cities in the Rio Grande Valley.

Typically, 90 percent of the water in DLID's canals is used for agriculture. Due to the drought, however, DLID was in danger of depleting its agricultural water allotment, meaning it would not have enough water in its canals to carry the municipal allotment.

When DLID reported that it would run out of agricultural water at the end of April 2013, Raymondville spent **$37,500** to purchase two months of extra water, called "push water," to carry its allotment through the canals after the agricultural water was depleted. Fortunately, spring rains bought the city some valuable time.

Without continued rainfall, however, DLID could run out of agricultural water in April 2014, leaving Raymondville with only its two months of push water. The city is working to rehabilitate a disused groundwater well but must acquire a filtration system estimated at **$3.6 million**.

For the past few years, water scarcity has become a troubling fact of everyday life in many regions. Texas' rapidly growing population and burgeoning economy have created new strains on an already precious resource. Recent drought conditions only underline the importance of planning for our future water needs.

DRY IN TEXAS

According to the U.S. Drought Monitor, a joint effort of the National Drought Mitigation Center, the U.S. Department of Agriculture and the National Oceanic and Atmospheric Administration, as of late October 2013, about **4 percent** of Texas remains in "extreme" or "exceptional" drought, the two most severe categories.

COMMUNITIES AT RISK

Since 2011, two small Central Texas communities, **Spicewood Beach** and **Barnhart**, have **run out of water**, the former in early 2012 and the latter in June 2013. **GO DEEPER:** Read about Spicewood Beach at **www.TXWaterReport.org/scarcity/spicewood.php**

Unfortunately, water problems aren't limited to small towns. Some of Texas' largest metro areas are feeling the pinch as well.

- The U.S. Drought Monitor reports that **Lubbock** has experienced the nation's **worst average level of drought** since the beginning of 2011. **McAllen, Harlingen, Brownsville** and **Corpus Christi** also ranked among the nine U.S. cities **most affected** by extreme drought.
- According to the Texas Commission on Environmental Quality (TCEQ), **46** of the state's **public water systems** were at risk of running out of water within **180 days** as of Jan. 8, 2014.
- Seven Texas communities could run out of water in **45 days or less**, which TCEQ classifies as an "emergency" level of drought. **GO DEEPER:** See cities that could run out of water at **www.TXWaterReport.org/scarcity/cities.php**

Source: Texas Commission on Environmental Quality

SHORT ON SUPPLY

URBAN AREAS AT MEDIUM OR HIGH VULNERABILITY FOR LIMITED WATER

Urban areas to be at a high vulnerability for limited water

TOTAL POPULATION:
2,003,355

Urban areas at a medium vulnerability for limited water

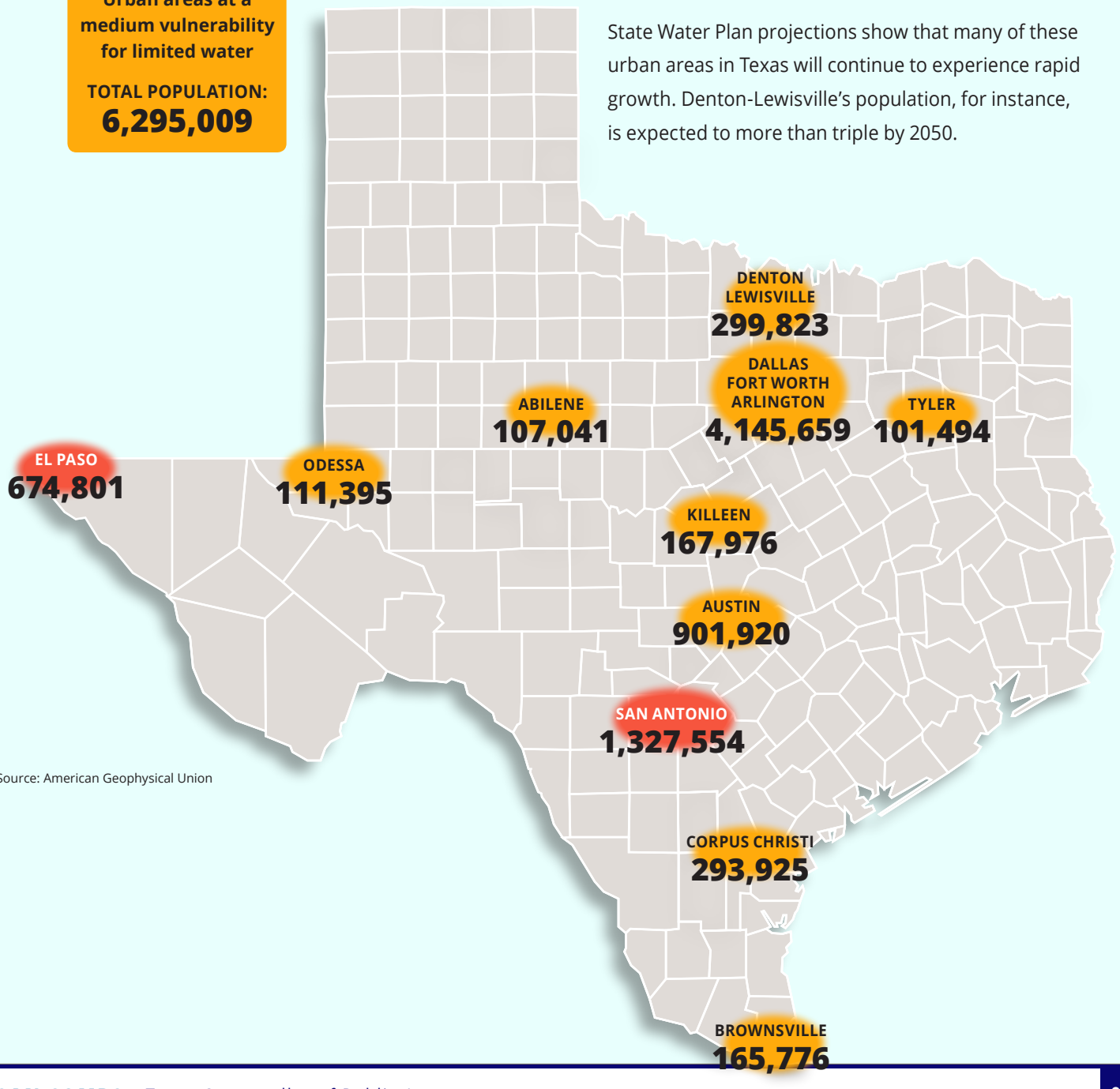
TOTAL POPULATION:
6,295,009

Urban areas throughout Texas are taking steps to secure their water futures. However, some of the state's largest urban centers are still vulnerable to water shortages.

A University of Florida report ranked daily per capita water availability for 225 large urban areas across the U.S. The study weighed fresh water available to cities from naturally occurring and constructed sources such as reservoirs, aquifers and imports.

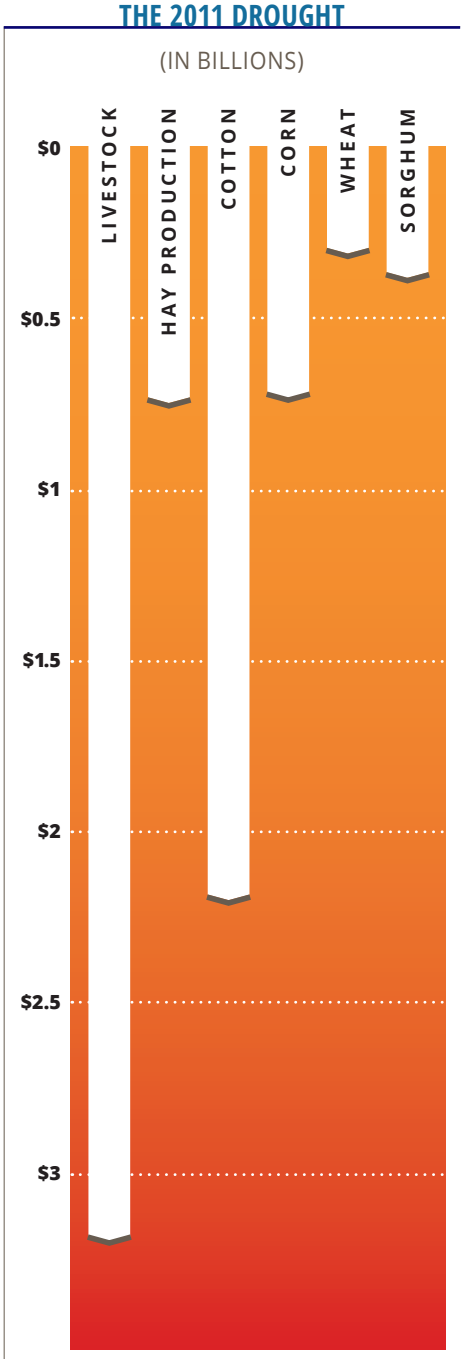
Of the cities reviewed, **San Antonio** ranked **last**, or most vulnerable, and **El Paso** ranked as **10th-worst**, though other Texas cities made the list.

State Water Plan projections show that many of these urban areas in Texas will continue to experience rapid growth. Denton-Lewisville's population, for instance, is expected to more than triple by 2050.



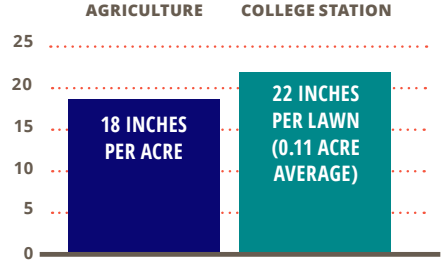
Source: American Geophysical Union

FINAL LOSSES DUE TO THE 2011 DROUGHT



Source: Texas A&M AgriLife Extension Service

ANNUAL IRRIGATION USE



Source: Texas Water Resources Institute

TOLL OF A DROUGHT YEAR

The 2011 drought was the worst one-year drought in Texas since 1895, causing billions of dollars in losses throughout the state economy.

AGRICULTURE

Farmers and ranchers were among those hardest hit by that year of drought. The Texas A&M AgriLife Extension Service estimates that Texas agricultural producers lost nearly **$7.6 billion** due to the drought, including:

- livestock — **$3.2 billion**
- hay production — **$750 million**
- cotton — **$2.2 billion**
- corn — **$736 million**
- wheat — **$314 million**
- sorghum — **$385 million**

Irrigated agriculture is a key contributor to our economic fortunes, pumping **$4.7 billion** into the Texas economy in 2007 alone. Improved irrigation technologies and production methods have allowed producers to greatly increase crop yields while reducing water consumption levels since the 1970s.

For example, Texas AgriLife Extension states that average per-acre corn yields have increased by **62 percent** since 1975. Cotton yields have more than doubled. Yet water used to irrigate Texas farmland **decreased** by **15 percent** between 1974 and 2011.

A recent report by the Texas Water Resources Institute found that agricultural irrigation averages less than **18 inches per acre annually**. In comparison, a city of College Station study found average households applied **22 inches annually** to lawns.

Water circumstances may differ from region to region, but one fact remains clear for growers throughout the state: Urban expansion will continue to gobble up farming acres and increase water demands.

Texas' **livestock losses** alone from the 2011 **drought** totaled **$3.2 billion**, and much of the **Panhandle's pasture** and **range** remains in **poor condition**.

Source: Texas A&M AgriLife Extension Service

To successfully balance their needs, all stakeholders must improve water efficiency. Cities such as San Antonio increase utility rates for top water users, for example, and the farming community can further ease water needs through greater use of methods such as:

- **irrigation audits**, sometimes offered by groundwater conservation districts, which can provide producers with critical information about their irrigation systems' efficiency and identify problems before they affect the entire system;
- **variable rate irrigation**, in which individual sprinklers on a center-pivot system can be turned on and off to vary the amounts of water applied in various sections of a field;

- **soil moisture sensors**, wireless nodes that collect soil moisture data; and
- **irrigation scheduling**, which employs soil moisture measurements to make decisions on when to irrigate.

HIGH PLAINS PINCH

Before the drought, the Texas High Plains region produced **65 percent** of the state's cotton (about a fifth of the entire nation's output) and **63 percent** of its corn, but agriculture relies heavily on groundwater irrigation.

- The near-total absence of rain in 2011 resulted in a **43 percent** increase in water use for irrigation in that year.
- High Plains agriculture endured a major part of Texas' **$7.6 billion** in 2011 losses, and is still struggling to recover.
- Wheat production in particular was **67 percent** lower than the previous decade's average. Farmers can grow crops in the High Plains without irrigation, but "dryland" farming yields less and provides fewer profits. GO DEEPER: Visit **www.TXWaterReport.org/gamechangers/dryland.php** to learn more.

THE OGALLALA AQUIFER

The more than 150 million acre-feet taken from the Texas portion of the Ogallala aquifer from 1950 to 2011 could cover Dallas in about **690 FEET OF WATER**.

341 SQUARE MILES

Source: U.S. Geological Survey

Most Texas High Plains agriculture relies on irrigation from the enormous Ogallala aquifer, which underlies 36,515 square miles of Texas across 48 counties, as well as portions of seven other states.

Since the 1940s, however, substantial pumping from the Ogallala has drawn the aquifer down more than **300 feet** in some areas. Producers have taken steps to reduce their reliance on irrigated water. Streamlined operations allow them to produce significantly greater yield using roughly the same amount of water needed four decades ago. Still, losses to the aquifer between 2001 and 2011 equated to a **third** of its cumulative depletion **during the entire 20th century**.

Although many High Plains communities rely on the Ogallala as their main source of drinking water, in Texas about **95 percent** of the waters taken from the aquifer are used for irrigation.

The Ogallala is recharged primarily by rainwater, but only about **one inch** of precipitation actually reaches the aquifer annually. Rainfall in most of the Texas High Plains is minimal, evaporation is high and infiltration rates are slow.

CONSERVATION DEMONSTRATION PROJECTS

In 2004, the Texas Water Development Board (TWDB) began offering Agricultural Water Conservation Demonstration Initiative (AWCDI) grants to support projects to increase agricultural water conservation while maintaining or increasing profitability.

TWDB has awarded about 50 AWCDI grants totaling more than **$4.4 million**. **Texas Alliance for Water Conservation** and **Texas Project for Ag Water Efficiency** are the two largest projects.

Texas Alliance for Water Conservation is a producer-driven demonstration project designed to extend the life of the Ogallala aquifer. More than 20 working farms in Floyd and Hale Counties demonstrate production practices, technologies and management tools to maximize water use. Producers make all the growing decisions, from grazing and tillage methods to technology integration.

After eight growing seasons, researchers have woven the results into a series of recommendations and assistance methods. An online toolkit helps growers track their daily balance of soil moisture and estimate yield profitability after irrigation costs.

Texas Project for Ag Water Efficiency promotes the efficient management of irrigation systems, which can significantly reduce water loss while increasing profits and crop quality.

The project provides resources including inexpensive classes and workshops on the best irrigation techniques, showing farmers how to link the techniques with soil moisture sensors, evapotranspiration networks and other technologies.

Source: Texas A&M Forest Service

Source: Texas A&M AgriLife Extension Service and National Oceanic and Atmospheric Administration

Photo Courtesy of Texas Parks and Wildlife.

TIMBER

The 2011 drought killed an estimated **5.6 million** trees in urban areas and **301 million** rural trees.

- The commercial timber area of **East Texas** was hit particularly hard, with direct economic losses of **$824 million**.

In addition, the drought spurred more than **21,000** wildfires that consumed **one-third** of the state's forestry crop.

- In East Texas alone, **2,151** fires destroyed **15 million cubic feet** of timber — enough lumber to build a six-foot privacy fence around the world **1.5 times**, according to the Texas A&M Forest Service.
- The lost timber could have produced **$1.6 billion** worth of forest products, resulting in a **$3.4 billion** economic impact in East Texas.

GOVERNMENT

Many state entities reported significant costs or revenue losses due to the drought. According to the Legislative Budget Board (LBB), the drought cost state agencies and institutions of higher education more than **$253.1 million** in fiscal 2011 and nearly **$131.9 million** in fiscal 2012, including **$1.3 million** in revenue losses related to the drought.

These figures, moreover, do not reflect the costs of restoration following the 2011 Labor Day fires in Bastrop State Park; LBB estimates those at an additional **$4.9 million**.

In addition, state and local governments were forced to grapple with infrastructure repairs, as drought-baked soils buckled building foundations, cracked streets and highways and burst water pipelines.

- LBB reports the drought cost Texas state government **$34.1 million** in additional infrastructure costs in 2011 (no 2012 figures are available).

TOURISM AND RECREATION

When Texas' lakes and rivers lose water, industries related to fishing, boating, water skiing, tubing and camping suffer.

- In 2011, the drought and wildfires contributed to a **$4.6 million gap** in the Texas Parks and Wildlife Department's operating budget.

Local economies across Texas felt similar impacts due to reduced tourism and recreational activity.

The outlook suggests continuing water problems in Texas and an ever-greater need for conservation. What could break the pattern?

One obvious avenue for improvement is the introduction of better conservation techniques.

- If Texas could reduce its municipal water use by **10 percent,** for instance, the state could save nearly **487,000 acre-feet** of water annually.
- If the state's manufacturing, mining, steam-electric, irrigation and livestock sectors reduced their water use by **10 percent,** Texas could save **1.3 million acre-feet** of water annually.

MUNICIPAL CONSERVATION

A number of Texas cities have developed comprehensive water conservation programs that use the latest conservation techniques and incentives to maximize water supplies. The best of these offer incentives as well as penalties to encourage water conservation.

GRAYWATER SYSTEMS

Water from bathtubs or showers, sinks and washing machines — graywater — can be used for landscaping.

- Many cities in California offer **subsidies** for graywater kits and permit application fees, but residential use of graywater is rare in Texas due to strict permit requirements and difficulties with code compliance.
- For example, after strict requirements caused Austin to issue only one residential graywater permit since 2010, a working group formed to streamline the permitting process. In 2013, the city created new code that has eased the requirements, resulting in four more permits.
- **Nine Texas cities** allow or are planning to allow graywater systems.
- Considering its low cost and large potential for savings, graywater use could become **much more common** for water conservation in Texas.

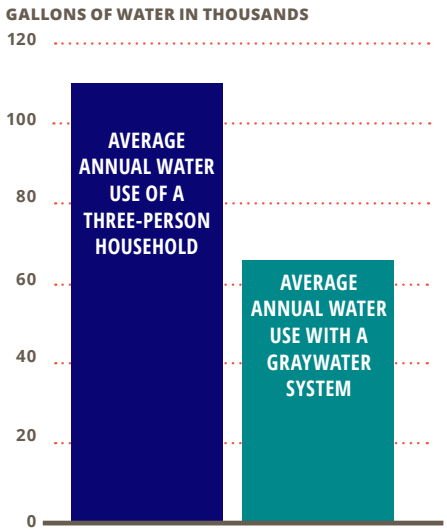
WATER REUSE

Cities recycle wastewater for purposes such as irrigation and air conditioning cooling towers, reducing the demand for fresh water.

- **El Paso** uses reclaimed water to help recharge the Hueco Bolson aquifer it relies on for much of its drinking water.
- **Austin** Water Utility's Water Reclamation Initiative saves **1.2 billion gallons of water** per year. As one example of many, the booming Austin-Bergstrom International Airport utilizes reclaimed water for its irrigation system.
- In the North Texas-area water planning Region C — which serves a quarter of Texas' population — conservation and reclaimed water use are projected to generate **23 percent** of the region's water supply by 2060. **GO DEEPER:** See steps that **Austin** and **San Antonio** are taking to conserve water at **www.TXWaterReport.org/gamechangers/twocities.php**

GRAYWATER COSTS

Graywater systems are relatively inexpensive. Installation can cost as little as $100-$400 and could save an average family of three 43,000 gallons of water annually.



Source: Texas Water Development Board

GIVEN PROPER TREATMENT, RECLAIMED WATER CAN EVEN BE REUSED AS TAP WATER.

The Colorado River Municipal Water District recently completed construction of a **$13 million plant** — the first of its kind in the nation — to generate nearly **2 million gallons of drinking water daily** from treated wastewater.

This plant, sited in Big Spring, uses treated wastewater that otherwise would have been pumped into the area's creeks and lakes. Instead, it is fed directly into the new plant, where it is treated and then piped to a regular water treatment facility for further processing.

AQUIFER STORAGE AND RECOVERY

Aquifer storage and recovery (ASR) involves the storage of water in an existing aquifer during times of relative plenty so that it can be recovered in times of need. Underground storage protects water supplies both from contamination and evaporation. It also has a very low environmental impact compared to other storage methods such as reservoirs.

ASR technology is used around the world and has proven to be cost-effective and efficient.

- El Paso, Kerrville and San Antonio all use ASR. San Antonio stores drinking water in its Carrizo ASR facility, which contains more than **91,000 acre-feet** of water and has a maximum capacity of **120,000 acre-feet**.

ECONOMIC CONSIDERATIONS

A 2012 Florida study comparing the costs of ASR and reservoir storage found that unit costs for water are similar, but the capital costs involved in creating an ASR are considerably lower.

- At an average capital cost of **$1.25** per gallon per day of recovery capacity, ASR is about half as expensive as other methods of water storage.
- Larger facilities typically have even lower costs. San Antonio's ASR facility, for instance, incurred capital costs of just **87 cents** per gallon per day.

Treatment costs, which vary depending on geological conditions, existing infrastructure and water conditions, can offset lower capital costs. Water being injected into an aquifer must meet or exceed existing water conditions, and once recovered, it must again be treated to meet minimum standards for municipal use. In effect, the water often must be treated twice. As a whole, though, the Florida study supported the viability of ASR as a component of an overall water supply strategy.

At an average capital cost of $1.25 per gallon per day of recovery capacity, ASR is about half as expensive as other methods of water storage.

BARRIERS TO ASR

A 2010 Texas Water Development Board (TWDB) survey of Texas water utilities found four primary objections to ASR:

- legal and physical limitations;
- the quality of the recovered water;
- cost-effectiveness; and
- the potential for other pumpers to capture the utility's stored water.

TWDB reports that concerns about cost-effectiveness are not supported by the experiences of existing Texas ASR systems. Of course, the cost-effectiveness of ASR will vary from site to site.

INTERBASIN TRANSFERS

Interbasin transfers (IBTs), as the name suggests, involve the physical conveyance of surface water between river basins via canals or aqueducts.

IBTs have been used around the world to supplement local and regional water supplies. Due to the large capital costs involved, IBTs generally are used to transfer large amounts of water to fast-growing urban areas. Texas' Coastal Bend region, for instance, relies on IBTs from the Lavaca to the Nueces River basin to meet its water needs.

ECONOMICS

A 2007 TWDB report analyzed the costs and benefits of IBTs in Texas, concluding that while some are essential, other, more cost-effective means of securing water are available in the near term. The report cites barriers to IBTs including **cost, resistance to new reservoir construction** and **environmental impacts**. Residents opposed to IBTs argue that siphoning water from donor basins causes unforeseen harm to local economies and environments. In 2011, residents of Liberty and Harris Counties who opposed an IBT from Trinity River to Lake Houston noted that water levels in the river are already low, and questioned if "…the city of Houston [had] the right to absolutely drain the Trinity River."

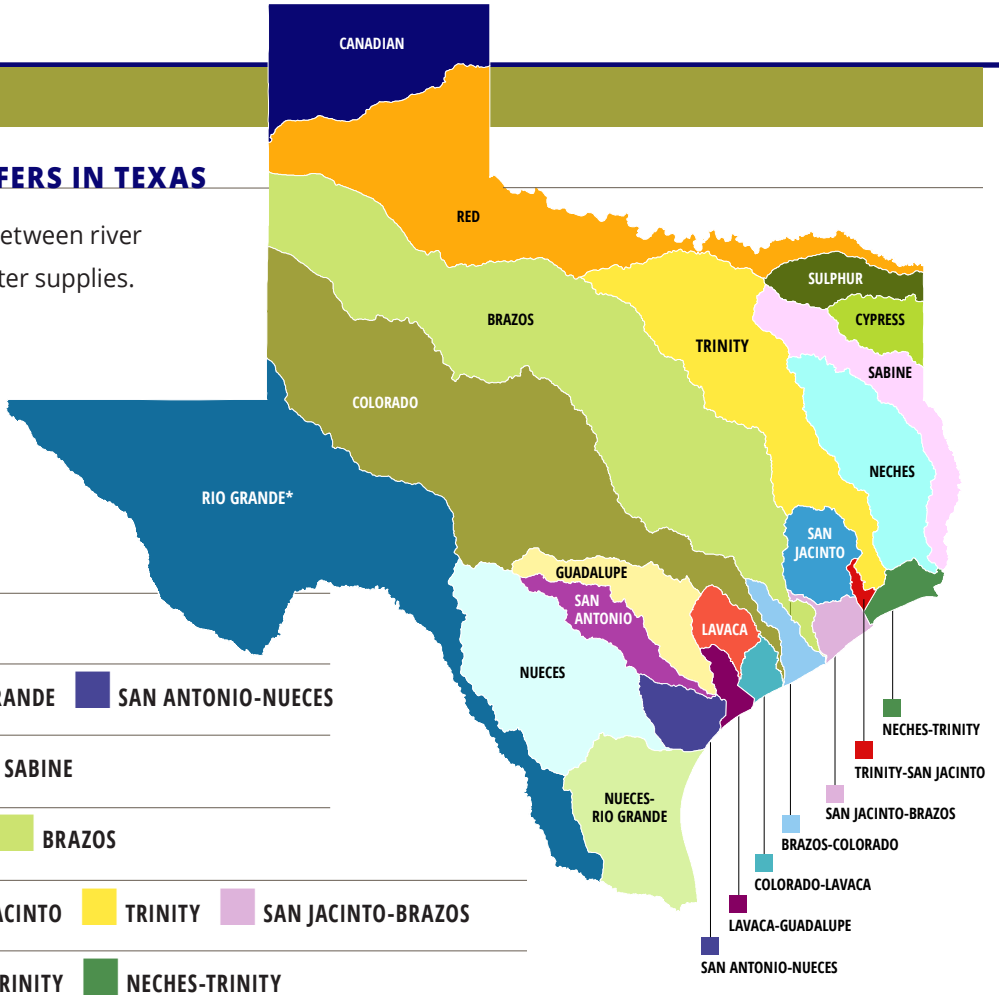
While no other method of securing water can provide the sheer volume of water offered by IBTs, the report characterizes them as a last resort due to these barriers.

Despite the costs and other concerns involved, IBTs play an essential role in the State Water Plan's 50-year planning horizon. Of 44 recommended ground and surface water conveyance and transfer projects included in the 2012 State Water Plan, 15 would rely on IBTs.

GO DEEPER: To see a map of Texas aquifers, visit **http://www.window.state.tx.us/specialrpt/tif/water.html**.

AUTHORIZED INTERBASIN TRANSFERS IN TEXAS

Interbasin transfers convey surface water between river basins to supplement local and regional water supplies.



BASIN OF ORIGIN	CONVEYS TO
LAVACA-GUADALUPE	LAVACA
NUECES	NUECES-RIO GRANDE, SAN ANTONIO-NUECES
CYPRESS	SULPHUR, SABINE
SAN JACINTO-BRAZOS	SAN JACINTO, BRAZOS
SAN JACINTO	TRINITY-SAN JACINTO, TRINITY, SAN JACINTO-BRAZOS
NECHES	SABINE, TRINITY, NECHES-TRINITY
SABINE	NECHES, TRINITY, SULPHUR
SAN ANTONIO-NUECES	GUADALUPE, NUECES, SAN ANTONIO
CANADIAN	RED, BRAZOS, COLORADO
SULPHUR	TRINITY, SABINE, CYPRESS, RED
RED	TRINITY, SABINE, SULPHUR, BRAZOS
LAVACA	LAVACA-GUADALUPE, SAN ANTONIO, SAN ANTONIO-NUECES, NUECES-RIO GRANDE, NUECES
BRAZOS	SAN JACINTO, SAN JACINTO-BRAZOS, COLORADO, TRINITY, BRAZOS-COLORADO
SAN ANTONIO	NUECES, GUADALUPE, SAN ANTONIO-NUECES, LAVACA, LAVACA-GUADALUPE
GUADALUPE	COLORADO, COLORADO-LAVACA, LAVACA, LAVACA-GUADALUPE, SAN ANTONIO, SAN ANTONIO-NUECES
TRINITY	RED, SULPHUR, BRAZOS, NECHES, NECHES-TRINITY, SAN JACINTO, TRINITY-SAN JACINTO, SAN JACINTO-BRAZOS
COLORADO	BRAZOS, BRAZOS-COLORADO, COLORADO-LAVACA, LAVACA, SAN ANTONIO, NUECES, LAVACA-GUADALUPE, SAN ANTONIO-NUECES, NUECES-GUADALUPE, GUADALUPE

Source: Water for Texas 2012 State Water Plan

*Rio Grande Basin Not Included.

INDUSTRY WATER USE
BY THE NUMBERS

$1 BILLION —
Amount the semi-conductor industry spends annually on water and wastewater systems in the U.S.

- Manufacturing a large integrated circuit requires approximately **2,200 GALLONS** of water, of which **1,500 GALLONS** is costly "ultrapure" water.

40 MILLION GALLONS —
Annual water saved by GE, working with National Semiconductor Ltd., by improving **reverse osmosis systems** and increasing water recovery to **99 PERCENT** in a single plant.

INDUSTRY

Water is vital to Texas' economic growth. Nearly every economic sector relies on it to operate. Rising water costs and increased public scrutiny have encouraged companies across all sectors to look for ways to reduce their water use. Texas Water Development Board data show that by 2011, the state's manufacturing sector had **reduced** its water consumption by **32 percent** since 1974, saving about **165 billion gallons** of water. Municipal water use **grew** by **152 percent** during the same period.

- The textile industry is exploring new production methods to reduce its dependence on water to process, dye and finish fabric.
- The San Antonio Frito-Lay plant has **saved 1 billion gallons** of water **a year** since implementing water conservation efforts in 1999. These conservation practices include recycling the water used in production.
- Texas Instruments' recycling and reuse practices in 2009 saved enough water to fill **1,802 Olympic-sized swimming pools**. That year, 14 percent of the company's total water use, or about **1.2 billion gallons**, was recycled.

GREENER GROCERY

H-E-B recently opened a "green" store in Austin that pilots a number of innovative energy- and water-saving technologies, and expects a **65 percent** reduction in water consumption — a savings of about **2.4 million gallons annually** — compared to stores built to the company's 2010 design standards.

ENERGY: HYDRAULIC FRACTURING WITHOUT WATER

Few technological innovations have transformed the Texas economy recently as much as the use of hydraulic fracturing to access oil and natural gas in shale formations. The process typically involves injecting enormous quantities of fresh water deep underground at high pressure to break up rock formations, allowing oil and gas to accumulate.

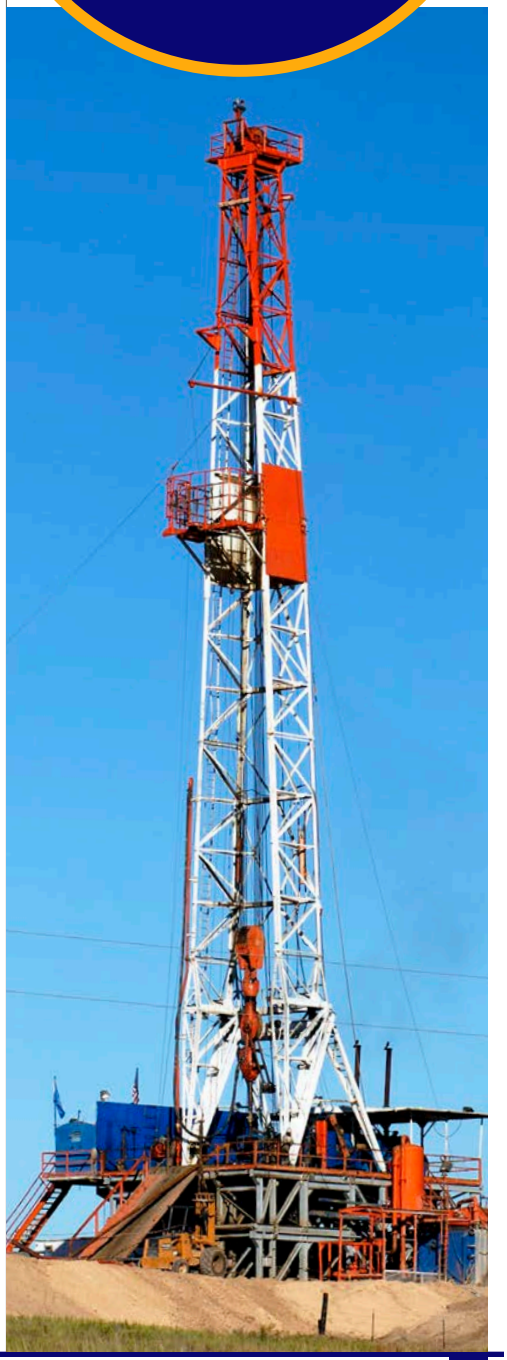
A recent report by IHS CERA states that in 2012, the hydraulic fracturing-driven boom in U.S. energy production supported **2.1 million jobs**, generated **$283 billion in gross domestic product** and **raised household income by more than $1,200**.

In Texas, the **Eagle Ford Shale alone** is expected to continue driving enormous economic benefits. A 2011 report released by the Institute for Economic Development at UT-San Antonio estimates that by 2020, the play is expected to produce **nearly $11.6 billion in gross state product**, support **$21.6 billion in total revenues** and provide for nearly **68,000 full-time jobs**.

In November 2013, more than **$2.5 billion** of oil and natural gas revenues was transferred from the General Revenue to the Economic Stabilization Fund (or "Rainy Day Fund"). This transfer put the Rainy Day Fund balance at approximately **$6.69 billion** after voters approved moving **$2 billion** to the newly created State Water Infrastructure Fund for Texas (see page 20 for details).

- While hydraulic fracturing has given a boost to U.S. and Texas energy production, it does use considerable amounts of water. According to the Environmental Protection Agency (EPA), about 35,000 wells are fractured each year across the U.S., consuming **70 to 140 billion** gallons of water — roughly the amount used by **40 to 80 cities** of 50,000 people in a year.
- Some shale energy producers have developed **low-water and water-free hydraulic fracturing techniques** that could greatly reduce the industry's need for water. GO DEEPER: To learn more about them, visit **www.TXWaterReport.org/gamechangers/fracturing.php**
- In March 2013, the Railroad Commission of Texas adopted new rules to encourage Texas operators to continue their efforts to reduce fresh water use in the hydraulic fracturing process. Major changes to the commission's water recycling rules include an amendment that eliminates the need for a recycling permit if operators recycle fluid on their own leases or transfer their fluids to another operator's lease for recycling.

In fiscal year **2010** alone, taxes on **natural gas** production contributed **$1.5 billion** to the state's **Rainy Day Fund**.



WHAT IS BRACKISH WATER?

Brackish water is **saltier than fresh water**, but **not as salty as sea water**. Texas does not, however, precisely demarcate the point at which fresh water becomes brackish, complicating regulation of brackish water's withdrawal.

DESALINATION

Nearly all of Earth's water is salt water. Converting these waters into fresh water — the process called desalination — may prove to be the **most important component** of any solution to America's water shortages.

Texas is **uniquely positioned** to take advantage of advancements in desalination. The state lies beside a sea — and above another.

- According to Texas Water Development Board (TWDB), Texas aquifers contain about **2.7 billion acre-feet** of brackish groundwater. It's an amount that **dwarfs** the state's supply of fresh water — enough to **cover Texas to a depth of more than 15 feet**.
- If this brackish groundwater were converted to fresh water, it could maintain Texas' current consumption levels for **about 150 years**.

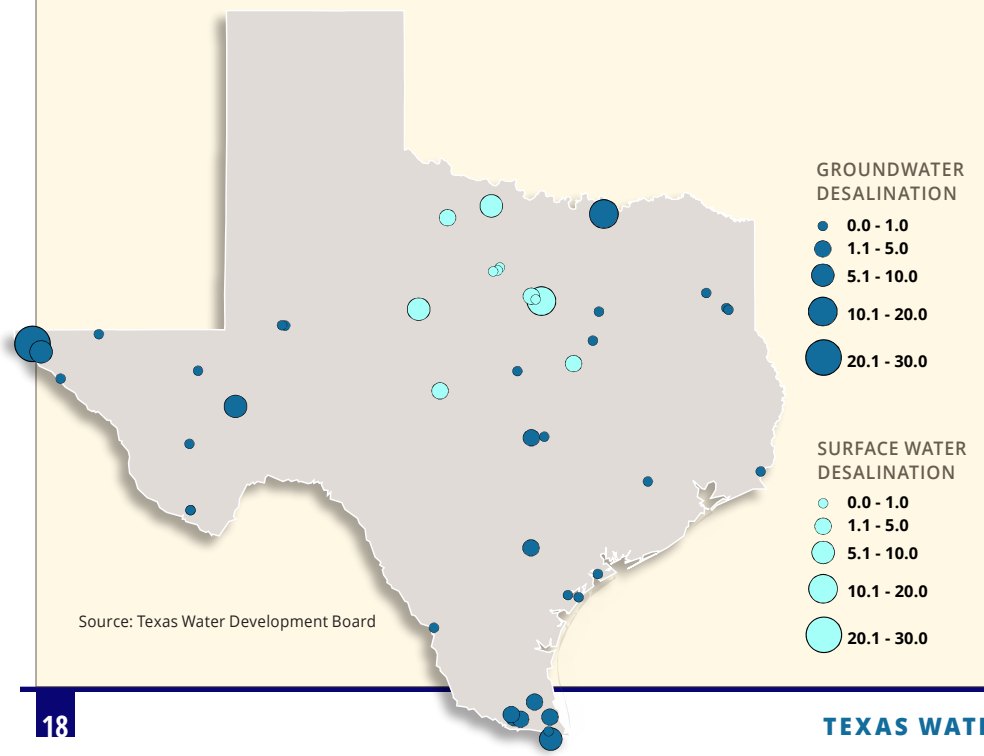
Desalination is already in use around the world, at about **15,000 plants in 120 countries**, including about **250 in the U.S.** and **46 in Texas**.

- The largest desalination plants are found in the Middle East and employ seawater; **El Paso** has the world's largest inland desalination plant, processing brackish water.
- **San Antonio** is building an inland desalination plant that, in its first phase, could produce **10 million gallons** (nearly **31 acre-feet**) of fresh water daily; further expansion could ultimately lift its daily output to **25 million gallons (77 acre-feet)**.

TEXAS DESALINATION PLANT CAPACITY

PRODUCTION DESIGN — MILLIONS OF GALLONS PER DAY (MGD)

Of these 46 desalination plants, 12 facilities use brackish surface water as a source of raw water while the remaining 34 plants use brackish groundwater.



Source: Texas Water Development Board

EL PASO WATER UTILITIES PRODUCTION COST COMPARISON

In 2008, El Paso conducted a study gauging the costs of water from sources including desalination and reclamation. While these are 2008 prices, they provide perspective on the relative expense of desalinated water.

SUPPLY SOURCE	COST PER ACRE-FOOT/YEAR
Surface Water	$300
Groundwater Not Desalinated	$163
Desalinated Water	$534
Reclaimed Water	$706

Source: Stratus Consulting, Inc. and El Paso Water Utilities

Note: Production costs are figured in 2008 dollars.

Today, desalination is a relatively **expensive and energy-intensive** process. In addition, the process leaves behind concentrated brine that must be disposed of safely.

Loose definitions of brackish water — not to mention variations in its quality and accessibility — will further complicate desalination efforts across much of the state. Cheaply extracting brackish water without sullying existing fresh-water supplies could prove challenging, and will most likely require hydrological analyses.

ECONOMICS

Costs for desalinating water vary considerably, depending on factors including the salinity of the water, the size of the plant and available brine disposal methods.

At this writing, Texas has no **seawater** desalination plants. While TWDB has projected seawater desalination to cost **$800 to $1,400** per acre-foot in Texas, current plants in California and Florida produce water at **$1,140 to $2,800** per acre-foot.

Despite recent technological advancements, desalination remains relatively expensive, primarily due to energy requirements that can account for up to **half** the cost of the process.

In 2012, the Texas Water Development Board found the total production costs for desalinating brackish water at recently completed plants ranged from **$357** to **$666 per acre-foot**.

Desalinating **brackish** water through reverse osmosis requires **289 to 815** kilowatt-hours per acre-foot, while **seawater** desalination requires **3,260 to 4,890** kilowatt hours per acre-foot. By comparison, it takes roughly **800** kilowatt-hours to power a computer and monitor for eight hours every day for a year.

If **brackish groundwater** were converted to **fresh water**, it could **maintain** Texas' **current** consumption levels for about **150** years.

Source: Texas Water Development Board

Since the 1970s, however, increasingly efficient membranes have reduced the energy requirements for reverse osmosis to about **10 percent** of energy originally required.

GO DEEPER: Find out more details on El Paso's Kay Bailey Hutchison Desalination Plant at **www.TXWaterReport.org/desalination/elpaso.php**

DESALINATION COST VARIABILITY IN TEXAS

FACILITY	COST PER ACRE-FOOT
Kay Bailey Hutchison-Fort Bliss **El Paso**	$489
Southmost Regional Water Authority **Brownsville**	$666
North Cameron Regional WSC (at 2.5 MGD) **Rio Hondo**	$579
Owassa **San Juan**	$431
Doolittle **Rio Hondo**	$357
Lasara **Raymondville**	$518

Source: Texas Water Development Board

While costs can vary considerably depending on local conditions, brackish desalination is often more affordable than importing water through pipelines. A 2011 study looking at El Paso's available water supply options found that importing water would cost $1,309-$2,535 per acre-foot, compared to $534 per acre-foot for brackish desalination.

Geography and weather conditions also impact the salinity of water in the Gulf Coast, meaning the cost of desalinating even seawater can vary from season to season based on factors such as rainfall and evaporation rates.

IV. THE NEW FACE OF WATER PROJECT FUNDING: A PRIMER

In recognition of Texas' increasingly severe water problems, the 2013 Legislature made sweeping changes to **Texas' administration of water projects**. The new legislation alters the makeup of the Texas Water Development Board (TWDB) and, now that this has been approved by voters, will provide additional state funding for water projects and create a system for prioritizing them.

For a definition of acronyms and other important terminology, refer to the glossary on the right side of page 21.

1 THE NEW STRUCTURE

In 2013, Texas lawmakers passed House Bill 4, which made changes to **Texas' administration of water projects**. HB 4 **changes the governance structure** of **TWDB** as shown below:

NEW TWDB BOARD STRUCTURE

- Three appointed, full-time, salaried members.
- Must have expertise in engineering, finance, law or business.
- Must represent diverse regions of the state.

PREVIOUS TWDB BOARD STRUCTURE

- Six appointed, part-time volunteer members.
- No requirements for any member to possess special expertise or represent diverse regions of the state.

Governor Rick Perry appointed the new board members August 13, 2013.

2 PROPOSITION 6

On Nov. 5, voters approved Proposition 6, moving **$2 BILLION** from the **RAINY DAY FUND** to the State Water Implementation Fund for Texas **(SWIFT)** and the State Water Implementation Revenue Fund for Texas **(SWIRFT)**.

The funds will be used to finance projects on the **STATE WATER PLAN (SWP)**, compiled from 16 regional plans developed every five years.

HB4 also requires **TWDB** to prioritize these regional water project proposals using a point system to rate projects based on the size, diversity and needs of the population they would serve.

3 THE NEW CRITERIA:

SWIFT legislation requires **TWDB** to use more rigorous criteria when evaluating proposed water projects:

TIMEFRAME: When is the project needed?

FEASIBILITY: Are water rights available? How easily can the water be transported? Will the project do enough? How will we know?

SUSTAINABILITY: How long will this project provide a solution?

COST-EFFECTIVENESS: What's the return on investment?

LOCAL CONTRIBUTIONS: Who's going to pitch in? How much can they afford? Can they find other backers? What happens if they run into problems?

ADVISORY COMMITTEE

The legislation creates a seven-member advisory committee to guide **SWP** projects.

The committee includes:

- the comptroller or a designee
- three state senators appointed by the lieutenant governor
- three state representatives appointed by the speaker of the House

4 THE SWIFT/SWIRFT

HOW EXACTLY DO THEY WORK?

The **SWIFT/SWIRFT** funds were created to provide a state of Texas revolving loan program that ultimately reduces borrowing costs for local entities. Without assistance from the state, local water entities would have to borrow money or issue bonds backed only by their own locally generated revenues, usually at a much higher cost. **TWDB** may issue General Obligation (GO) bonds using its existing $6 billion bonding authority or it may issue revenue bonds to help local entities access cheaper financing.

SCENARIO 1

Interest Rate Subsidy

TWDB can use the $2 billion from the SWIFT/ SWIRFT to support lower interest rates for GO or revenue bonds and provide a subsidy that can reduce the costs of borrowing for local entities.

BOND MARKET

↓

will purchase bond at **market interest rate based on state* and/ or local entity credit.**

↓

TWDB

will loan proceeds of bond to local entity at less than market interest rate

↓

SWIFT

will provide subsidy to reduce interest rate up to 50% less than market interest rate

↓

LOCAL WATER ENTITY

SCENARIO 2

Additional Security

TWDB can use the $2 billion from the SWIFT/ SWIRFT to provide additional security for revenue bonds that can reduce the costs of borrowing for local entities.

BOND MARKET

↓

will purchase bond at **market interest rate based on local entity credit, plus additional security set aside**

↓

TWDB

will loan proceeds of reduced-cost bond to local entity

↓

SWIFT

will set aside additional security to reduce the overall bond issuance

↓

LOCAL WATER ENTITY

SCENARIO 3

Debt Service

TWDB can use the $2 billion from the SWIFT/ SWIRFT to provide support for debt service payments during deferral or incremental repayment terms on GO or revenue bonds that can reduce the costs of borrowing for local entities even further.

BOND MARKET

↓

will purchase bond at **market interest rate based on state* or local entity credit**

↓

TWDB

will loan proceeds of bond to local entity at less than market and/or proceeds of reduced-cost bond to local entity

↓

SWIFT

Will set aside debt service amounts to cover deferral/ incremental repayment periods, creating self-supporting bonds

↓

LOCAL WATER ENTITY

*GO bonds are backed by the full faith and credit of Texas.

BOND ENHANCEMENT AGREEMENTS

TWDB does not loan **SWIFT** funds directly to local water entities. Instead, it uses the **SWIRFT** to lower borrowing costs for these local water entities. Funds are disbursed semiannually from the **SWIFT** to the **SWIRFT** using a **BOND ENHANCEMENT AGREEMENT**, which is an agreement for professional services. **TWDB** directs the transfer of money from the **SWIFT** to the **SWIRFT** to support bonds, the proceeds of which are used as loans to local water entities to lower interest rates, finance a facility with more favorable repayment terms, defer loan repayments and allow incremental repayments.

THE GLOSSARY:

RAINY DAY FUND: Otherwise known as the Economic Stabilization Fund, this pool of money serves as the state's bank account to protect against budget downturns or other needs. It is filled mostly by oil and gas production taxes and excess general revenue. Tapping into it requires a two-thirds majority of the Legislature.

TEXAS WATER DEVELOPMENT BOARD (TWDB): The state agency charged with creating and administering Texas' water plan. Think of it as a bank for funding water infrastructure projects. Its governing body was overhauled by the Legislature this year.

STATE WATER IMPLEMENTATION FUND FOR TEXAS (SWIFT): A new fund that lowers the cost of borrowing for regional water projects. Voters were asked Nov. 5 to amend the Texas Constitution to allow $2 billion to flow from the Rainy Day Fund to SWIFT. Lawmakers expect this money to help finance more than $25 billion in water projects over the next 50 years.

STATE WATER IMPLEMENTATION REVENUE FUND FOR TEXAS (SWIRFT): A fund used to issue revenue bonds, meaning bonds repaid through income generated by the project. SWIRFT secures lower cost financing for regional water providers that couldn't otherwise afford costly infrastructure projects.

STATE WATER PLAN (SWP): A massive blueprint for balancing the sometimes-conflicting water needs of cities, agriculture, ranching, manufacturing and other users. It is compiled mostly from 16 regional water plans submitted to the TWDB.

GO DEEPER: FOR DETAILS ON HOW BONDS PAY FOR TEXAS WATER PROJECTS, VISIT www.TXWaterReport.org/water/fund.php

CONCLUSION

Texans' approval of Proposition 6 is a positive step toward assuring our water supplies — but it's only a step.

This additional funding for water projects will help enormously, but it cannot and will not provide a permanent solution. We can't afford to become complacent now.

The current drought will end eventually, but the challenge of providing clean water to support our remarkable growth will continue. That's why it is vital that we maintain our focus, moving forward with multifaceted strategies including increased conservation efforts and innovative technologies, to ensure that Texas remains a vibrant place for businesses and homeowners alike.

1 The Texas Legislature should consider establishing a program providing grants to water authorities and major water users to help them achieve meaningful increases in water efficiency due to conservation activities.

This program would award grants to local water authorities, including cities, counties, river authorities, water conservation districts, municipal water utilities, municipal utility districts, irrigation districts and water supply corporations, as well as major industrial water users, for improved water efficiency, particularly **verifiable reductions in total annual water use driven by conservation efforts**.

Efforts could include **water reuse** and **reductions in water loss** due to infrastructure improvements.

The program should consider both **the percentage** and **volume** of water reduction, to ensure that it can recognize the efforts of both small and large entities.

The Legislature should consider setting aside **$25 million** for this grant program, to be distributed over a **five-year period**, with a maximum of **$10 million** in grants awarded in any one year.

The Texas Water Development Board (TWDB) should set appropriate targets for water efficiency. Its advisory board could assist and oversee the establishment of these targets.

Grant funds could be spent at **local discretion** so long as they are used for water and wastewater projects.

To further encourage efficiency, the Legislature should consider revising the way that water infrastructure projects — especially those using SWIFT funding — are financed with a goal of making these projects **more reactive to drought conditions**. This should encourage municipalities to more readily implement drought plans.

2 The Texas Legislature should consider increasing state funding for innovative demonstration projects.

The major barrier to more widespread adoption of new water technology is **cost**. Thus **cost reduction** should be the goal of sustained, state-supported research.

Demonstration projects are vital to the widespread adoption of any innovative technology. Water planners need to know the risks of embracing new technologies; demonstration projects help planners make informed decisions.

TWDB has grant programs for research, but their expenditures are relatively small. Inadequate investment in demonstration projects will be an obstacle in any effort to scale up innovative technologies that could ultimately help make water more affordable.

3 The Texas Legislature should consider establishing a prize framework to award research dollars for successful achievements in innovative technology.

A prize structure for technologies should be awarded for innovations with **direct and demonstrable commercial applications in Texas**.

- A prize structure would set **objectives** rather than **methods**, allowing innovators to proceed in their own ways toward the goal.
- Prize structures eliminate the appearance of "**picking winners**" that has dogged recent grant programs.

A prize program should be funded with **$25 million** in state funds. The program should be structured carefully, providing **specific, realistic objectives in price reduction**.

According to the Higher Education Coordinating Board, of $519 million in research and development expenditures at our four-year universities in fiscal year 2012, only $28.7 million went to water-related issues.

Prizes would be awarded for the successful achievement of **milestones** along the way to the ultimate goal: **a price point for water as close as possible to the production cost of fresh groundwater, surface water or reclaimed water**.

NATIONAL RESEARCH UNIVERSITY FUND ENCOURAGES GROWTH

Texas has recently, and successfully, used a prize structure to encourage a desired result: growing academic research activity at its public universities.

In 2009, the Legislature created the National Research University Fund (NRUF), offering financial assistance to universities with potential to match the research output of Texas' three Tier One institutions (the University of Texas at Austin, Texas A&M and Rice University).

These universities, designated by the Texas Higher Education Coordinating Board, become eligible to tap into NRUF funding once they meet benchmarks designed to increase their national research prominence. The benchmarks measure factors such as endowment size, research spending, doctorate graduations, graduate research and freshman class achievement.

Creation of NRUF sparked immediate action among the eight universities named emerging research institutions: Texas State University — San Marcos, Texas Tech University, The University of Texas at Arlington, The University of Texas at Dallas, The University of Texas at El Paso, the University of Texas at San Antonio, University of Houston and The University of North Texas.

In May 2012, **Texas Tech** and the **University of Houston** became the first universities to gain access to NRUF — then valued at approximately **$620 million** — each receiving more than **$8 million** over the first biennium for research support and faculty hiring. Other emerging universities have made strides to qualify for NRUF, demonstrating that the Legislature achieved its goal of stimulating relatively rapid advancements in Texas' academic research.

PRIZES SPUR ADVANCEMENT

The use of prizes to **spur advancements in scientific and technical research** has a long and distinguished history.

- Perhaps most famous is the **Orteig Prize**, a $25,000 prize established in 1919 for the first nonstop transatlantic flight. Charles Lindbergh earned the prize in 1927.
- The Orteig prize directly inspired the creation of the **X Prize**, a **$10 million** prize created in 1998 for the development of the first privately financed manned space vehicle. This prize generated **$100 million in private investment**, and helped create the burgeoning "New Space" industry.
- It also spurred interest in the use of **similar prizes by government**.

Since then, **federally funded prize programs** have included:

- The Defense Advanced Research Projects Agency's **"challenge prizes"** for projects such as self-driving robotic vehicles;
- NASA's **Centennial Challenges Program**, offering cash prizes for achievements such as highly fuel-efficient aircraft (**$1.35 million**) and robotic geological sampling devices (**$1.5 million**); and
- The U.S. General Services Administration's **Challenge.gov**, an online prize challenge platform used by at least 45 federal agencies to award more than **$13.9 million** in prize money in dozens of separate challenges.

Robots participate in the Sample Return Robot Challenge as part of NASA's Centennial Challenges.

NASA initiated Centennial Challenges in 2005 to tap the expertise of independent inventors, offering prizes for novel solutions to technological challenges that so far have included wireless power transmission, lunar landing and oxygen generation.

RESOURCES

TEXAS WATER DEVELOPMENT BOARD (TWDB)

http://www.twdb.state.tx.us/
TWDB is the state's water supply and infrastructure planning agency, responsible for updating the State Water Plan every five years.

TEXAS WATER DEVELOPMENT BOARD – 2012 STATE WATER PLAN

http://www.twdb.state.tx.us/waterplanning/swp/2012/index.asp

TEXAS WATER DEVELOPMENT BOARD – WATER USE SURVEY

http://www.twdb.state.tx.us/waterplanning/waterusesurvey/estimates/index.asp
The TWDB conducts annual surveys of ground and surface water use by municipal and industrial entities. Through these Water Use Survey reports, Texans can discover how much water their city, county, planning region and state uses each year.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TCEQ)

http://www.tceq.state.tx.us/
As the agency responsible for the health of Texas' public water systems, air and soil, TCEQ is the best source for state environmental information.

THE TEXAS ECONOMY – NATURAL RESOURCES

http://www.thetexaseconomy.org/natural-resources/articles/article.php?name=mapDrought
This website is a one-stop shop combining data from the U.S. Drought Monitor, TWDB and TCEQ, allowing Texans to explore drought conditions, check the water levels of Texas reservoirs and monitor public water supply across the state.

SAN ANTONIO WATER SYSTEM (SAWS)

http://www.saws.org/conservation/
Learn how SAWS' conservation programs have become a cornerstone of San Antonio's long-term water management strategy.

TEXAS AHEAD

http://www.texasahead.org/texasfirst/species/
This website provides specific information on endangered species on the Current Watch List and offers an interactive at-a-glance map showing the concentration of endangered species in each Texas county.

LIQUID ASSETS: THE STATE OF TEXAS' WATER RESOURCES

http://www.window.state.tx.us/specialrpt/water/PDF/96-1360-Liquid Assets.pdf
This report examines current and future water resources in Texas.

THE IMPACT OF THE 2011 DROUGHT AND BEYOND

http://www.window.state.tx.us/specialrpt/drought/
This report examines the impacts of the disastrous drought and fires that cost Texas lives and billions in revenue.

TEXAS A&M AGRILIFE

http://agrilife.org/
As part of The Texas A&M University System, Texas A&M AgriLife programs work on issues in agricultural production and economics, environmental stewardship, animal and public health and energy development for the future.

BUREAU OF ECONOMIC GEOLOGY

http://www.beg.utexas.edu/
As the oldest research unit at The University of Texas at Austin, the bureau provides research on energy and environmental issues, and serves as the State Geological Survey.

THE ENERGY INSTITUTE

http://www.energy.utexas.edu/
The Energy Institute at the University of Texas at Austin studies critical worldwide energy policies.

This document can be found on the Web:
www.TXWaterReport.org
Texas Comptroller of Public Accounts

Data Services Division
P.O. Box 13528
Austin, Texas 78711-3528

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