Down to the Last Drop

Wasting Water Endangers Texas' Rivers, Fish and Wildlife

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Executive Summary

Excessive water withdrawals threaten many of Texas' most important and beloved rivers. Rivers are a central element of our natural heritage, but wasteful water use is harming wildlife, economically important estuaries, and the basic well-being of our communities.

Major water users waste billions of gallons each year, even though we have the technology and know-how to use water more efficiently. Unfortunately, the state's proposed plan for satisfying future water demand favors increased water withdrawals that will further harm our rivers. In many cases, the state has given permission for more water to be withdrawn from rivers than is actually available.

To keep water in our rivers—where it supports wildlife and recreation—Texas should prioritize using water wisely. The five rivers highlighted in this report illustrate the harm to wildlife and ecosystems from water withdrawals. Some rivers have already been devastated by wasteful water use; others are under threat from new water projects that would withdraw more water or fundamentally change the river. Water conservation and efficiency can help protect Texas' rivers.

Wasteful water use occurs across Texas and throughout the economy, imperiling Texas' water supply.

- Agricultural, municipal and industrial water consumers withdraw more water from rivers and aquifers than is necessary to irrigate crops, maintain landscaping, and produce electricity. At least 500 billion gallons of water are wasted each year, enough to meet the municipal water needs of 9 million Texans.
- In the past three years, drought has magnified the impacts of wasteful water use. Lack of rain, coupled with withdrawals, has caused river levels to drop.

Demand for river water is projected to increase in the coming decades.

- Demand for water is expected to rise as Texas adds 21 million residents by 2060. The Texas Water Development Board anticipates that 51 percent of new water supplies will have to come from rivers and streams as the state's aquifers are increasingly depleted.
- To capture new surface water supplies, the Water Development Board proposes building 26 new reservoirs and constructing new pipelines to tap into existing reservoirs.

Excessive water withdrawals harm rivers by limiting habitat along riverbanks, lowering water quality, and depriving coastal estuaries of the freshwater they need to maintain healthy ecosystems. Rivers across Texas are already suffering from these problems, yet the state is considering new proposals to withdraw more water from rivers.

- Water withdrawals from the **Guadalupe River** have led to the deaths of 23 birds in the world's only remaining flock of migrating whooping cranes. Despite flows that are already inadequate, the 2012 water plan includes proposals for more diversions from the river.

- Water withdrawals from the **Rio Grande** for irrigation and municipal use cause the river to run dry in places. Undiluted pollution and high salinity have created conditions unsuitable for native fish. Though it would seem that the river has no more water to offer, the International Boundary and Water Commission estimates that municipal and industrial withdrawals will increase in the coming years.

- Poor management and overuse cause the **San Saba River**, a tributary of the Colorado River, to go dry for up to five months each year. Wild pecan trees growing on the banks have died, and the rare Texas pimpleback freshwater mussel is at risk.

- The **Trinity River** provides half of the freshwater in Galveston Bay, which supports an economically important oyster fishery. Dredging and industrial activity have made the bay vulnerable by increasing salinity levels. Adequate flows from the Trinity River are essential to protecting the bay, but the Houston region has proposed withdrawing more water from the river.

- The **Sulphur River** has not been damaged by water withdrawals but is threatened by a proposal to create the Marvin Nichols Reservoir to meet growing demand for water from the Dallas-Fort Worth region. Building the reservoir would inundate the river basin upstream from the dam and alter downstream ecosystems.

Investing in water efficiency and conservation measures will help protect Texas' rivers and is a better choice for meeting the state's water needs than building new reservoirs and adding pipelines to transfer water to distant consumers.

Texas should prioritize water conservation above increasing supply. The state of Texas should prioritize efficiency improvements over the construction of new reservoirs or pipelines. In turn, regional water authorities should reevaluate their options for meeting projected increases in demand to maximize the use of efficiency measures.

In addition, the state should:

- **Establish environmental flows as an official category of water use.** The water planning process should include environmental flows as a water need that must be satisfied, on par with other categories of use. In the Guadalupe River, for example, water to support the whooping crane population must be treated as an essential component of the region's water needs.

- **Provide adequate funding for water conservation programs**. Recent voter approval of using money from the "rainy day fund" to implement the state water plan and to jumpstart investments in efficiency programs is a strong first step. Half of the funding from the newly created State Water Implementation Fund for Texas should be used for efficiency and conservation improvements. In addition, Texas should use a portion of the fines paid by BP for the Deepwater Horizon oil spill for estuary restoration and to purchase water rights to ensure adequate freshwater flows.

- **Improve knowledge of water use and identify savings opportunities** through research and data collection.

Photo: Earl McGehee

Proposals in Texas' 2012 water plan for new reservoirs and water transfer projects suggest that the state values rivers overwhelmingly for their ability to provide water for municipal, agricultural and industrial use. The plan largely proposes continuing business-as-usual water consumption practices, withdrawing billions of gallons from rivers, and imperiling aquatic ecosystems.

Introduction

Texas has a choice about how to treat its rivers. It can value rivers as a source of maximum water for human use, or as an integral part of the environment and landscape.

Proposals in Texas' 2012 water plan for new reservoirs and water transfer projects suggest that the state values rivers overwhelmingly for their ability to provide water for municipal, agricultural and industrial use. The plan largely proposes continuing business-as-usual water consumption practices, withdrawing billions of gallons from rivers, and imperiling aquatic ecosystems.

For example, to serve water demand in the Dallas-Fort Worth Metroplex, regional water planners have proposed construction of four new reservoirs, including the Marvin Nichols Reservoir on the Sulphur River, which would destroy native bottomland hardwood forest and the riverbank habitat it creates in order to provide 472,000 acre-feet of water each year.[1]

A better alternative would be to invest in water efficiency measures and leave more water in rivers to support vibrant aquatic communities. A strong commitment to conservation would establish aggressive regional goals and include greater funding to implement a broad range of programs to reach those goals. With reduced water consumption in cities, on farms, and in industry, Texas will be able to protect the rivers that are a critical part of its environment.

Texans recently made a commitment to invest in conservation with approval of a constitutional amendment that dedicates up to 30 percent of funds for implementing the state water plan to water efficiency.[3] As the state explores the water savings that will be possible with such a jump in investment, it must prioritize using the saved water to protect rivers and estuaries. By choosing to support water conservation, Texas can ensure the continued vitality of our rivers for years to come.

Water Waste Hurts Texas Rivers

Wasteful water use, coupled with drought, has lowered water levels in Texas' rivers. Demand for water from rivers will increase in the coming years as the state struggles to provide water to a growing population and can no longer rely as extensively on aquifers.

Inefficient Use Wastes Water

Efficient water use is critical to ensuring that we keep water in our rivers while also ensuring that the water needs of Texas communities are met—especially during times of drought. However, some of the largest water users in Texas are wasting billions of gallons of water, forgoing common-sense measures to save water.

Agriculture is Texas' largest user of water, accounting for 56 percent of water demand, compared to 27 percent for municipal users, which include both residential users and commercial users on municipal systems.[4] Manufacturing activities account for 10 percent and mining is responsible for 2 percent. The electric sector also withdraws large amounts of water.[5]

Water waste occurs in many sectors of the economy.

- In agriculture, much of the water withdrawn evaporates from the ground, is consumed by weeds, or seeps into the ground from unlined ditches or overwatered fields. This water is wasted in that it fails to meet the purpose of helping to produce crops.
- Power plants withdraw large amounts of water at a time when waterless, renewable energy technologies could be employed to produce a much larger share of the state's electricity. Existing fossil fuel power plants generally fail to employ more modern technologies that reduce the use of water, such as dry or hybrid cooling, combined cycle operation, or combined heat and power systems.
- Oil and gas drilling—conducted in part to support water-consuming electricity generation—also uses a significant amount of water. Fracking a single gas well can consume as much as 4.4 million gallons of water per year (enough water to supply about 150 homes), but very little recycling of fracking water occurs in Texas.[6] Water used for fracking is too polluted to be used for other activities and is therefore permanently removed from the water cycle.

At least 500 billion gallons of water are wasted in Texas each year, enough to meet the municipal water needs of 9 million Texans.[7]

Water-efficient technologies can significantly reduce water waste. Prioritizing the use of these technologies is an essential step towards creating water-secure communities today and into the future.

Drought Has Reduced River Levels

Drought has worsened the damage from wasteful water use. Since late 2010, most of Texas has been suffering from drought.[8] By the summer of 2011, Texas was in the middle of the worst single-year drought in its history, with 97 percent of the state in extreme or exceptional drought.[9] Since then, the situation has improved

little—the severity of the drought has abated, but 85 percent of Texas continued to experience drought as of fall 2013.[10]

Lack of rainfall has caused river levels to drop. Half of measurements taken in August 2013 by the U.S. Geological Survey showed river water levels were less than 25 percent of normal.[11] Just one measurement out of more than 100 indicated above-average flows, while multiple measurements showed record-low water levels. Lower water levels hurt habitat, threaten wildlife, strain drinking water supplies, and disrupt outdoor recreational activities.

A Growing Demand for Water from Rivers

Texas' water challenges will grow in the years to come. Recent water shortages foreshadow more severe problems in the decades to come as demand rises and supplies shrink. The state's official plan for meeting rising demand relies heavily on withdrawing more water from rivers.

Population increases are expected to drive up demand for water. According to projections from the Texas Water Development Board (TWDB), the state's population will grow 82 percent by 2060, increasing from 25.4 million to 46.3 million.[12] The TWDB predicts that total water supply needs will increase by 22 percent by 2060.[13]

At the same time, water supplies are likely to decline as historically important aquifers are exhausted and global warming-induced changes exacerbate drought.

Texas has relied heavily on aquifers since the 1950s, withdrawing water from groundwater faster than it has been replenished.[14] As a result, groundwater resources are increasingly limited. In 2008, 60 percent of all water used in the state came from groundwater, mainly for agriculture.[15] The TWDB projects that the amount of water that can be pumped out of aquifers will decline by 30 percent by 2060. (See Figure 1.) The declining availability of water from aquifers is the result of two factors: first, historic

Figure 1. Less Groundwater Will Be Available to Meet Future Water Demand[16]

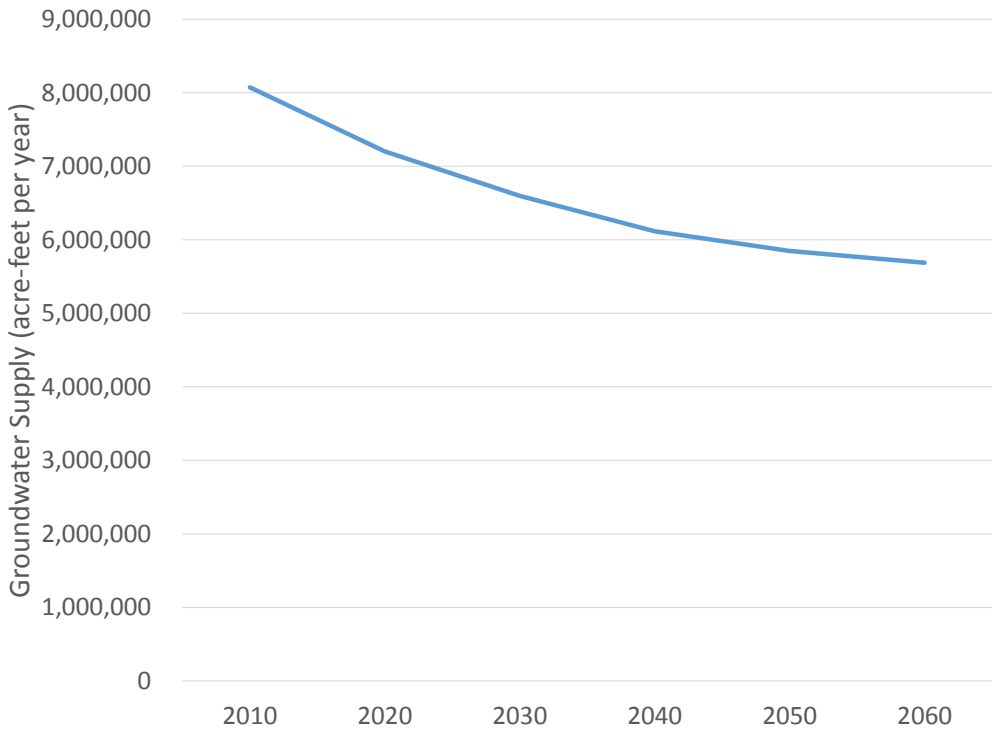
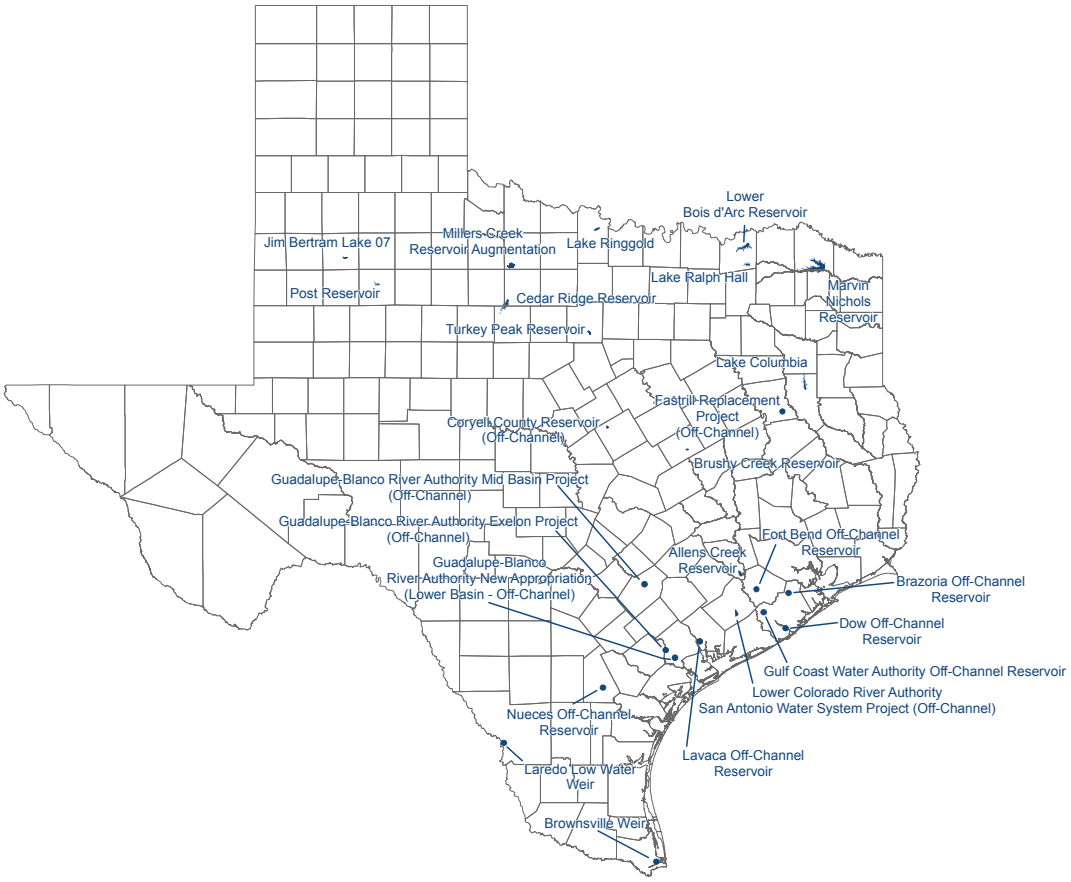


Figure 2. New Major Reservoirs in 2012 State Water Plan[21]



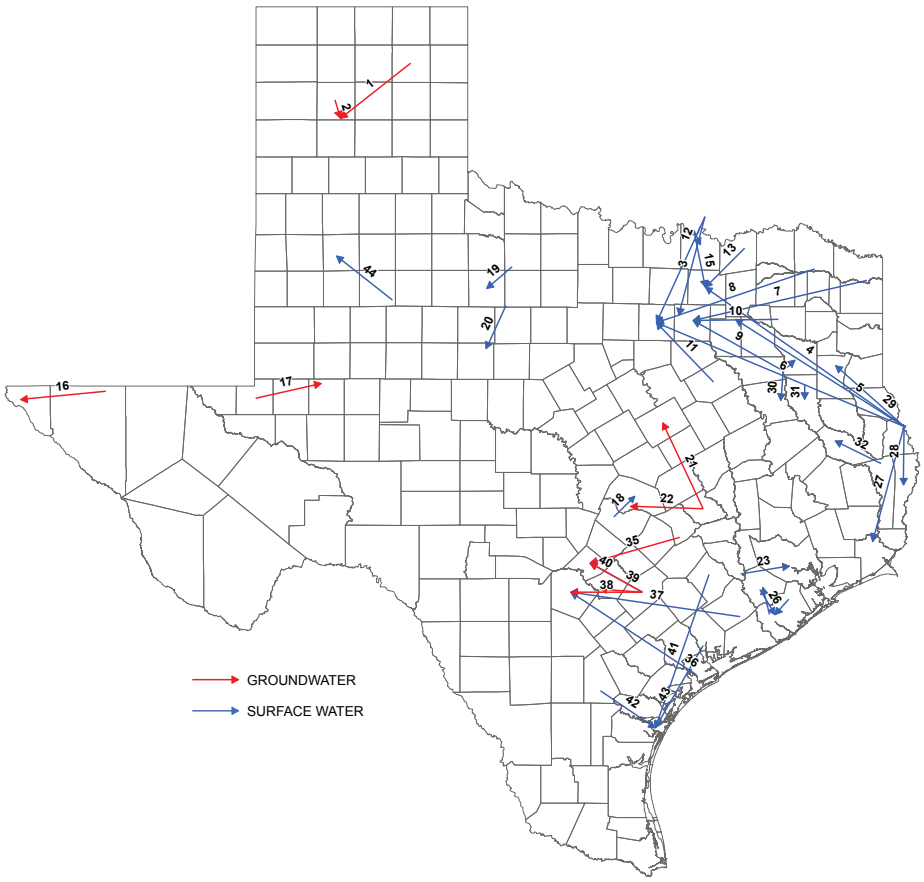
over-pumping has depleted major aquifers such as the Edwards-Trinity (High Plains), Gulf Coast, Ogallala and Seymour aquifers, and they can provide less water now. Second, over-pumping has caused the ground above some aquifers to sink, leading to limits on further pumping from those aquifers to prevent additional sinking that could damage infrastructure.

In addition to limiting how much water can be withdrawn from aquifers for human use, declining groundwater supplies also affect river flows. In many regions, groundwater creates the headwaters of rivers and feeds tributaries along the length of the river. As groundwater levels fall, river flows will decline.

The impacts of global warming will further strain water supplies. Climate projections indicate that temperatures will increase, making drought increasingly likely in Texas' future while increasing demand for water.[17] According to the U.S. Global Change Research Program, rising temperatures are likely to cause more frequent extreme drought events in the Great Plains, including the Texas Panhandle, adding more stress to already strained water resources.[18]

To address the state's rising demand for water and in acknowledgement of declining groundwater availability, the TWDB anticipates Texas will need to obtain more water from surface water supplies such as rivers. The state's 2012 water plan focuses on developing new water supplies rather than on ag-

Figure 3. Water Transfer Projects 2012 State Water Plan[22]



gressively pursuing water conservation and efficiency opportunities. The TWDB anticipates that 51 percent of new water supplies will come from surface water.[19] Groundwater will provide just 9 percent. Desalination, conservation, water reuse and other strategies will provide the rest.

To obtain this surface water, Texas plans to build new reservoirs and water transfer infrastructure. Twenty-six new major reservoirs are planned that would provide 17 percent of all new water supplies by 2060.[20] (See Figure 2.) The larger share of new water surface water supplies—34 percent—will come from other strategies, including the transfer of water from existing reservoirs to distant users, such as from Lake Palestine to users 100 miles away in Dallas. Figure 3 shows proposed water transfer projects.

The proposed major reservoirs and transfer strategies would remove millions of acre-feet of water from rivers every year by 2060. Water withdrawals already cause some Texas rivers to run dry each year. Others that do not run dry nonetheless are damaged by the amount of water withdrawn. Removing more water will cause extensive ecological damage to rivers and the estuaries they feed, and will damage Texas' natural heritage.

Rivers at Risk

There are 191,000 miles of rivers and streams in Texas, which support diverse ecosystems, feed economically important estuaries, create opportunities for recreation, and provide water for household use and irrigation.[23] In too many river basins, however, Texas fails to balance these uses and withdraws so much water that rivers can no longer fulfill ecological functions.

For rivers to be healthy enough to support ecologically important species and economically important fish and shellfish, they require adequate water flows. Maintaining key species requires fostering the entire range of plants and animals that create an ecosystem. Texas' current and proposed water management strategies fail to enable rivers to meet these basic criteria.

Examples from across Texas illustrate the existing impacts of wasteful water use on the state's rivers and show that the state nonetheless continues to seek to withdraw more water. Water withdrawals cause the Rio Grande and the San Saba River to run dry at times. The Guadalupe and Trinity rivers are stressed by water withdrawals and their estuaries suffer from lack of fresh water, yet water planners want to withdraw more. A segment of the Sulphur River that has been largely untapped as a water supply could be flooded with construction of a new water supply reservoir.

Figure 4. Rivers Highlighted in the Following Section

Guadalupe River

With white plumage and red heads, and standing nearly 5 feet tall, whooping cranes are remarkable—and rare—birds.[24] The world's only naturally migrating flock of whooping cranes spends its winters in the marshes of Texas' San Antonio Bay. Insufficient freshwater from the Guadalupe River threatens the survival of whooping cranes by destroying their food supply.

Whooping cranes spend the winter months at the Aransas National Wildlife Refuge, eating blue crabs and gaining weight for their 2,500-mile spring migration to breeding grounds in Canada.[25] The birds' preferred food is blue crabs, though they also consume wolfberries, crayfish, frogs, fish and acorns.[26] A single bird can consume up to 80 blue crabs a day.[27]

An adequate supply of crabs is critical for the birds' survival. In years when crabs have been in short supply, flock mortality has risen.[28] In the winter of 2008-2009, when the blue crabs were scarce, 23 whooping cranes died at Aransas National Wildlife Refuge due to lack of food.[29]

The loss of even a few birds is a serious blow because the total population of whooping cranes is so small. Flock size peaked in 2011 with 279 birds, up from 16 individuals in 1941 when the birds were on the brink of extinction.[30] In 2008-2009, the 23 birds that died reduced the flock by 8.5 percent.

Photo: Betty Rizzotti

A whooping crane in Guadalupe Bay preparing to eat a blue crab.

The health of the blue crab population relies on adequate flows of freshwater into the estuary to maintain low salinity levels. Blue crabs prefer salinity of 5 to 15 parts per thousand, far below the 35 parts per thousand salinity of seawater.[31] To achieve the crabs' preferred salinity, the tributaries of San Antonio Bay have to deliver sufficient freshwater to mix with seawater from the Gulf of Mexico. Low freshwater flows allow salinity levels in San Antonio Bay to rise above the levels tolerated by blue crabs.

In a typical year, the Guadalupe River provides the majority of the water flowing into San Antonio Bay, delivering 64 percent of the bay's freshwater compared with the San Antonio River's 23 percent.[32] Flow from the Guadalupe River into San Antonio Bay is strongly determined by upstream water use, beginning with the river's headwaters in the Edwards and Trinity aquifers. The amount of groundwater pumped from the aquifers influences how much flows into the streams and rivers that lead to the Guadalupe.[33] In three of the past five years, the Guadalupe River upstream from Canyon Reservoir has dried up.[34] Withdrawals for municipal and manufacturing use along the length of the river, including Canyon Reservoir, also influence freshwater flows at the river's mouth.

Water withdrawals upstream in the Guadalupe River Basin in recent years have curtailed freshwater flows to the bay—and prompted legal action in defense of whooping cranes. In March 2013, a federal district court ruled that mismanagement of water supplies in the Guadalupe and San Antonio rivers contributed to the deaths of whooping cranes in the 2008-2009 season by damaging their food supply.[35]

In addition to harming the whooping crane population, excessive water withdrawals and inadequate freshwater in the bay have the potential to create economic harm by damaging important fisheries. The bay supports a $162 million per year commercial seafood industry, $24 million worth of recreational fishing, and $29 million worth of wildlife-viewing activity.[36]

New Threats to the Guadalupe River

Though water withdrawals already harm whooping cranes and other animals that depend on freshwater from the Guadalupe River, the situation could grow worse due to proposed increases in water withdrawals.

The river cannot sustain healthy fish and wildlife populations if withdrawals increase significantly. If more holders of water rights in the basin use their rights, strain on the river will rise. A stakeholder group appointed to develop better management guidelines for the Guadalupe River basin and its bays concluded that if all existing water rights on the Guadalupe River are exercised, then it would not be possible to maintain a "sound ecological environment" in the Guadalupe River and San Antonio Bay.[37]

Several new reservoirs and diversions have been included in the state's 2012 water plan that would develop existing water rights and increase withdrawals from the Guadalupe River.[38] The proposed Mid-Basin Project would capture 25,000 acre-feet from the Guadalupe River each year.[39] That's slightly more than what the town of Victoria (with 60,000 residents) on the Lower Guadalupe currently withdraws in a non-drought year.[40] In the lower basin, another new diversion project would capture 11,300 acre-feet per year.[41] (A third project that would have provided cooling water for a nuclear power plant has been scratched after plans for the nuclear plant were cancelled.[42])

At the same time that water withdrawals might rise, the volume of water entering the river could fall. Greater withdrawals of groundwater from the Trinity Aquifer, which feeds tributaries of the Guadalupe River, have been proposed, which would reduce water in the river. Officials for Groundwater Management Area 9, in the upper reaches of the Guadalupe River, have suggested increasing pumping of groundwater from the Trinity Aquifer by 40,000 acre-feet per year above current levels. This would decrease the amount of water flowing from groundwater into springs, creeks and rivers by 10 percent.[43]

Finally, changes due to global warming may reduce the amount of water in rivers. Small changes in rainfall patterns induced by global warming could reduce water flow in the Guadalupe and other rivers, cutting freshwater flows to estuaries. The projected effects of global warming on Texas include a 3.6°F increase in air temperature and 5 percent decline in rainfall by 2050.[44] For the area that includes the Guadalupe-San Antonio River Basin, this would cause freshwater flows into downstream estuaries to decline by 25 percent during normal conditions. During times of drought, flows could drop by 42 percent.[45]

Rio Grande

The Rio Grande, the fifth-longest river in the U.S., forms the entire border between Mexico and Texas and runs through some of the most drought-prone areas in the nation.[46] Millions of people on both sides of the border depend on the river for drinking water and for irrigation. This heavy demand causes the river to run dry at times, has changed ecosystems within the river, and has wiped out many species of fish. Rising demand for water will further strain the river.

Photo: Hank Prinsen/www.hankprinsen.nl

In this summer 2008 picture of the Rio Grande in Big Bend National Park, little water flows in the river.

Six million people in the U.S. and Mexico rely on the river for drinking water, and water from the river irrigates 2 million acres.[47] Fed by snowpack in Colorado and New Mexico, the Rio Grande enters Texas near El Paso. By the time it reaches Texas, the river is already shrunken by withdrawals upstream in New Mexico. El Paso has historically relied more on groundwater than on the Rio Grande for municipal water supplies. However, decades of groundwater pumping have allowed brackish water to intrude into freshwater aquifers. To protect its freshwater aquifers, the city has relied more heavily on the river for water since the early 1990s. The river now provides half the city's drinking water.[48]

In addition, large amounts of water are withdrawn from the Rio Grande near El Paso for irrigation.[49] Common crops include cotton, pecans and alfalfa.[50] Because of these diversions, the river often runs dry for 250 miles from El Paso to Presidio, just before Big Bend National Park.[51]

The river resumes flowing at the confluence with the Rio Conchos, where the Rio Grande flows through Big Bend National Park. For 196 miles, the river is a federally designated Wild and Scenic River, the only official Wild and Scenic River in Texas, selected for not only for its scenic value but also its geologic value, fish and wildlife, and recreational values.[52]

However, low water levels compromise the quality of habitat provided by the river. Without adequate water in the river, pollution and salts are more concentrated. Salinity in the river has increased so much that marine species of fish that thrive in saltwater now inhabit the river and have been found nearly 250 miles upstream from the Gulf of Mexico.[53] Many of the 69 species of fish native only to the Rio Grande are at risk of extinction, such as the Big Bend gambusia and the silvery minnow.[54] The silvery minnow once inhabited the full length of the river, but today it exists in just 5 percent of the river and all of those sections are in New Mexico.[55]

At times, the Rio Grande contains so little water that it does not flow all the way to the Gulf of Mexico. In 2001, lack of water caused the river to stop flowing at sand dunes near the gulf.[56]

Though it would seem that the river has no more water to offer, the International Boundary and Water Commission estimates that withdrawals will increase in the coming years. Municipal demand for water is projected to double in the next 50 years and industrial demand for water from the Rio Grande is projected to grow 40 percent.[57]

San Saba River

Poor management practices threaten the well-being of the San Saba River on the edge of the Edwards Plateau. Excessive withdrawals for irrigation have left the river dry for months at a time.

The clear waters of the San Saba flow through a typical Hill Country landscape. Pecan trees, oaks, sycamores, elms, cedars, yuccas and cacti thrive on the banks of the river, beyond which lies ranchland.[58] In its upper reaches, the river is pristine and "no pollution is visible," according to the Texas Parks and Wildlife Department. For the first 30 miles, from its headwaters to Menard, the river is too shallow to allow for much recreational use, but farther downstream it deepens and becomes suitable for recreation. Eventually, it feeds into the Colorado River above the Highland Lakes.

However, pumping for irrigation, livestock and domestic use near Menard typically dries up a 50-mile stretch of the San Saba for five months each year.[59] Not only do irrigators downstream not have access to water, but this stretch of the river cannot support wildlife.

Almost all irrigation water in Menard County comes from the San Saba River, and multiple users have rights to withdraw water.[60] The Menard Irrigation

Photo: Rana Williamson

When water withdrawals have not caused the river to run dry, the San Saba flows through a typical Hill Country landscape.

Canal Company operates a canal to deliver water to agricultural users and holds approximately half of all permitted water use rights from the San Saba River in Menard County.[61] In addition to permitted users, others who do not hold permits are allowed to withdraw water if they rely on it for household purposes, or for watering a garden or livestock. Water use is not closely monitored, and much of it is inefficient: approximately 30 percent of water pumped from the San Saba into irrigation canals is lost to evaporation and leaks.[62] The demands placed by all users on the river have caused it to run dry in many years, beginning in 2000.[63]

A rancher who lives downstream from Menard has witnessed the effects of heavy pumping from the river: many of the pecan trees on the riverbanks have died and he no longer finds Guadalupe bass, the state fish, in the river.[64] Changes to the river have harmed the Texas pimpleback, a rare freshwater mussel, which lives in the Guadalupe and Colorado basins, including the San Saba River.[65] The mussels are an important link in the food chain, providing food for birds, fish and mammals, but researchers say they are highly sensitive to changes in water quality and habitat. Their disappearance would ripple through the ecosystem.

In August 2011, the Texas Commission on Environmental Quality (TCEQ) ordered a stop to some irrigation withdrawals in Menard and Schleicher counties so as to protect downstream users who have senior water rights.[66] The river was already dry in places due to drought, but after upstream withdrawals stopped and before rains came water began to flow in the river again. In the fall, ranchers who have water rights downstream from Menard reported that the river through their properties carried water.[67]

In the summer of 2012, however, when dry conditions once again prompted downstream landowners to request an end to upstream water withdrawals, the TCEQ declined to order a halt.

Already strained to the breaking point by water withdrawals, the San Saba faces further pressure from declining water flows region-wide. Across the Colorado Basin, the amount of water in streams and rivers in the period from 1980 to 2010 was lower than from 1940 to 1998.[68] The river requires better management to balance agricultural, household and wildlife needs.

Trinity River

Thousands of people earn their livings harvesting the oysters, blue crabs and shrimp that thrive where the freshwater of the Trinity River mixes with saltwater in Galveston Bay. Growing demand for municipal water, however, threatens the river and the bay.

Galveston Bay, covering 600 square miles, supports healthy populations of oysters, blue crabs, shrimp, Atlantic croaker, flounder and spotted sea trout.[69] As a result, the bay is the second most productive estuary in the nation.[70] The oyster harvest is the nation's largest, and accounts for 80 percent of Texas' oyster fishery.[71] Other commercial fisheries include blue crab, Southern flounder, black drum, brown shrimp and white shrimp.[72]

The bay's beauty, size and productivity support recreational use, too. Half of all recreational fishing expenditures in Texas are in Galveston Bay, thanks in part to the 10,000 recreational boats registered in the region.[73] In total, bay-related activity generates $1 billion worth of economic activity annually.[74]

Economic activity might be greater if the bay's ecosystems were less stressed. Dredging to create shipping channels has caused extensive damage by creating wider openings between the bay and the Gulf of Mexico, allowing more saltwater into the bay. Sea grasses have declined from extensive boat traffic. Wetlands across the bay have been lost to subsidence, development, dredging and hurricanes.[75] Water quality has declined due to urban runoff from Dallas-Fort Worth, far upstream on the Trinity River, and from the Houston-Galveston area.

Planned Water Transfer from the Trinity River

An additional threat to Galveston Bay is rising demand for municipal water supplies, which has Houston turning to the Trinity River to supply more water. Houston has two reasons to seek more water from the Trinity. First, population is driving up water demand: officials project that Harris County will grow from 4 million people in 2010 to 6 million in 2040.[76] At the same time, Houston is seeking to reduce its reliance on groundwater.[77] The region has pumped out so much groundwater that the land has sunk, causing extensive damage to industrial and transportation infrastructure.[78] Subsidence has also damaged wetlands in Galveston Bay by allowing seawater to inundate wetlands and other transitional shoreline ecosystems.[79]

To reduce its reliance on groundwater and to provide water for its growing population, Houston plans to withdraw more water from the Trinity River, source of half the freshwater flowing into Galveston Bay.[80]

Houston currently obtains one-third of its water supply from the Trinity River, but would increase its reliance further.[81] The Luce Bayou Interbasin Transfer Project would move water from the Trinity River to Lake Houston on the San Jacinto River. The project would carry 450 million gallons of water per day through three miles of pipeline and 24 miles of earthen canal.[82] The $254 million project is scheduled for completion in 2020.[83]

Harm from Water Withdrawals

Transferring such a large amount of water from the Trinity River would harm Galveston Bay, the Trinity River and the San Jacinto River.

Adequate freshwater flow into an estuary is essential to providing habitat, including salt marshes, grass flats and oyster bars.[84] These habitats, fed with nutrients delivered along with freshwater, serve as nurseries for juvenile fish and shrimp. An estuary needs enough freshwater in the spring to ensure productivity and adequate flows later in the year to keep key species alive. Reducing the flow of freshwater into an estuary allows salinity to rise, harming plants and animals.[85] In addition, lower inflows mean that pollutants are flushed out to sea more slowly.

An analysis conducted by the National Wildlife Federation of conditions in Galveston Bay suggests that increasing withdrawals of freshwater from the Trinity,

Photo: Matthew Metcalf

Shrimp trawlers anchored in Galveston Bay.

San Jacinto and other tributaries would threaten the health of the bay. If all existing water rights are exercised and re-use of water rises (which reduces how much treated water is returned to rivers), freshwater flows into the bay could drop below minimum levels necessary for ecosystem health for six months at a time during drought periods.[86] This would deprive bay ecosystems of sufficient freshwater to maintain healthy populations of key species.

A second way in which Houston's increasing reliance on the Trinity River could harm Galveston Bay is by changing where water enters the bay. Not all the water that Houston withdraws from the Trinity is consumed; some is released as treated wastewater and enters Galveston Bay through the San Jacinto River and Houston Ship Channel. Increasing the freshwater flow from the San Jacinto and decreasing it from the Trinity could alter salinity concentrations throughout Trinity Bay (part of Galveston Bay) and change circulation patterns.[87]

The Luce Bayou Interbasin Transfer Project would also directly harm the Trinity River by destroying wetlands that provide habitat and help filter pollutants from the water. Building the infrastructure to transfer water from the Trinity River would destroy more than 200 acres of wetlands.[88]

Finally, the water transfer project risks introducing invasive zebra mussels into the San Jacinto River, threatening that river's health. The mussels, which have already gained a toehold in the upper Trinity River basin, have the potential to harm water quality, outcompete native species of mussels and trigger declines in fish and bird populations.[89] Because many measures to control zebra mussels are too toxic for use in drinking water supplies, water transferred from the Trinity River to Lake Houston cannot be treated to prevent the spread of zebra mussels, and therefore could transport zebra mussel larvae.

Sulphur River

Unlike the other Texas rivers discussed in this report, water withdrawals have not harmed the Sulphur River. However, growing water demand in the Dallas-Fort Worth metro region presents a threat to the river. A proposal to build a dam and create a reservoir on the river would destroy a section of the river by submerging it and would change the downstream ecosystem.

Northeast of the Dallas-Fort Worth metro area, the Sulphur River flows eastward through bottomland hardwood forest before joining the Red River. Seasonal flooding from the river is critical for maintaining this habitat, which is home to a wide variety of animals. Construction of the proposed Marvin Nichols Reservoir would destroy this habitat upstream from the dam and change the flow of the river downstream.

Since the 1960s, various North Texas water supply districts have proposed building a reservoir for water supply on the Sulphur River.[90] The Marvin Nichols Reservoir is included in the latest state water plan as a $3.4 billion project to supply water for municipal and industrial use in the Dallas-Fort Worth region.[91] Up to 475,000 acre-feet of water per year could be piped from the reservoir to customers 115 miles away.

The dam, located near where Interstate 30 crosses the river, would be 8 miles across, creating a reservoir that would flood 70,000 acres.[92] Approximately 40 percent of the flooded land would be bottomland hardwood forest, 20 percent upland deciduous forest, 20 percent grassland, and 10 percent marsh.[93]

Native bottomland hardwood forest includes elm, hackberry, sweet gum, water hickory, ash, water oak, willow oak and overcup oak, species that tolerate frequent floods.[94] Regular flooding helps these species outcompete other trees that cannot

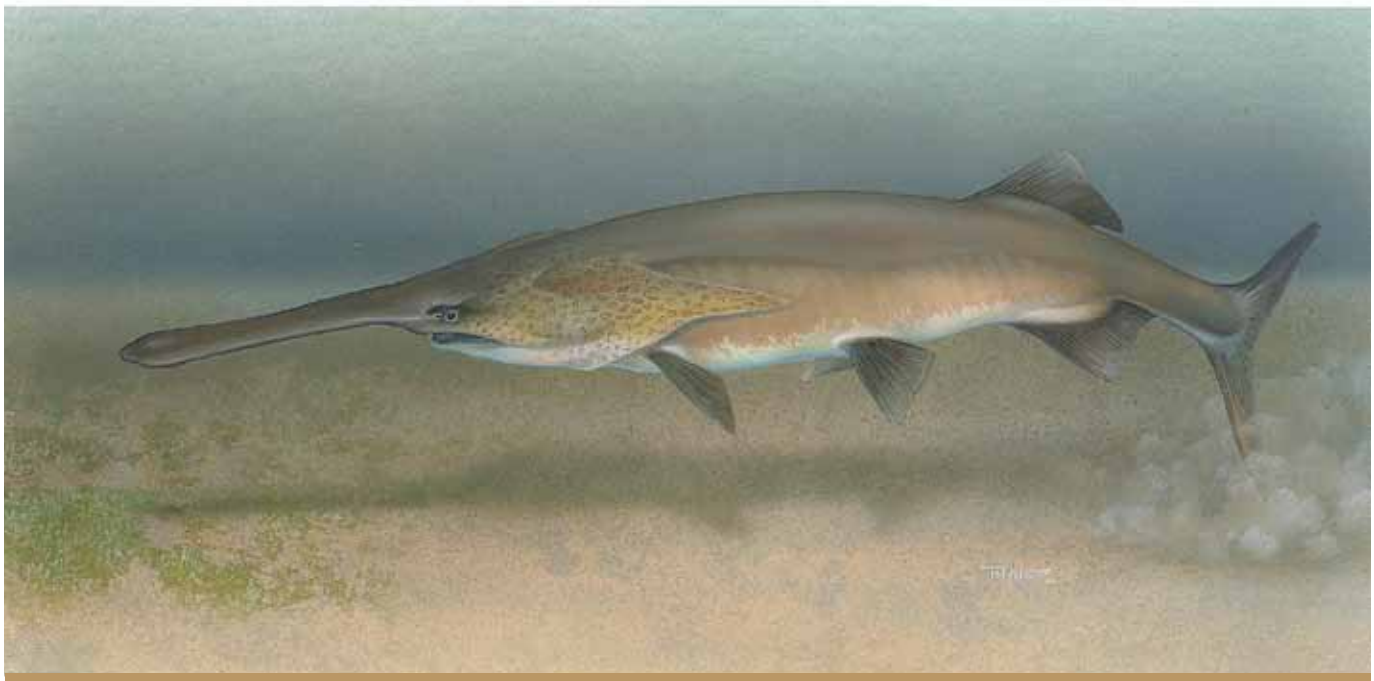
Photo: Jason McCreight

A pile of oyster shells outside a restaurant on Galveston Bay provides evidence of the bay's bounty and the economic activity that depends on it.

withstand prolonged periods in saturated soil.[95] In conjunction with wetlands and sloughs along the river, bottomland hardwood forest supports waterfowl, beavers, river otters, deer and squirrels. Migratory birds such as Cerulean warblers, Kentucky warblers and American redstarts nest in the area.[96] The abundance of wildlife along the Sulphur River draws hunters, who pursue deer, hogs and birds.[97]

The U.S. Fish and Wildlife Service considers 94,000 acres of the hardwood forest along the Sulphur River to be "excellent quality bottomlands of high value to key waterfowl species."[98] Compared with two other bottomland hardwood forests studied in northeast Texas, the forest along the Sulphur River extends farther from the river and has been less disturbed.[99] The Marvin Nichols Reservoir would flood some of

Image: Timothy Knepp/USFWS



The Sulphur River has historically been home to paddlefish, which are the oldest existing animal species in North America, pre-dating dinosaurs on the continent.

this Priority 1 habitat.[100] More than 75 percent of all bottomland hardwood forest in Texas has already been destroyed through conversion to pine plantations or agricultural land, logging, or inundation from reservoirs.[101] Today, one of the biggest threats to the remaining sections of this habitat is flooding from new reservoirs.[102]

Downriver from the proposed dam and reservoir, the Sulphur River has historically been home to paddlefish, a state-listed threatened species.[103] Paddlefish are the oldest existing animal species in North America, pre-dating dinosaurs on the continent.[104] The fish prefer to live in slow-moving rivers and require a large volume of stream flow for spawning. Once common throughout the U.S., paddlefish are now limited to a relatively small range. In Texas, with more than 7,000 dams across the state, one of the biggest threats to paddlefish is reservoir construction.[105]

Construction of the Marvin Nichols Reservoir as a water source would flood valuable habitat and alter the natural flow of the river that is critical to maintaining ecosystems downstream.

Policy Recommendations

Wasteful water use has harmed the rivers profiled in this report. Many other streams and rivers across the state are under similar stress from overuse and the recent drought. Protecting the state's rivers requires leaving water in rivers where it can provide habitat, support estuaries, offer recreational possibilities, and enhance our communities. Building new reservoirs and adding pipelines to transfer water to distant consumers will further imperil the state's rivers.

To protect the rivers that are so important to the state's natural heritage, Texas should:

Prioritize water conservation above increasing supply.

- The state of Texas should prioritize efficiency improvements over development of supply side resources. This clarity will motivate regional water authorities to evaluate and invest in water efficiency opportunities.
- In 2014, regional water groups are required to submit lists to the TWDB of priority projects from the 2011 Regional Water Plans for which they seek funding. At least 30 percent of their funding requests should be for conservation and reuse projects. Regional water planning groups should investigate additional water efficiency opportunities that were not included in their 2011 water plans, such as repairing leaky water mains, and offering incentives for xeriscaping and purchase of efficient appliances.
- The TWDB should adopt a policy to consider environmental impacts as a factor in funding decisions, avoiding funding projects with significant harm to the environment.
- Setting statewide efficiency standards for water-using products would help ensure that investments in new buildings, appliances and landscape irrigation equipment—all long-lived products that will influence water use for years to come—do not undermine efforts to improve water efficiency. Strong water efficiency standards will promote market transformation and new innovations.

Establish environmental flows as an official category of water use.

- The water planning process should include environmental flows as a water need that must be satisfied, on par with other categories of use. In the Guadalupe River, for example, water to support the whooping crane population must be treated as an essential component of the region's water needs.
- In rivers where there is no unappropriated water available for environmental flows, the state could seek donation or purchase of existing water rights. Environmental flow protections could also be established when an existing permit changes hands.
- Other elements of water plans, such as increased reuse, should be evaluated for their impacts on environmental flows and on fish and wildlife, and minimize their impacts.

Provide adequate funding for water conservation programs.

- Recent voter approval for allocating $2 billion to jumpstart investments in efficiency programs is a strong first step. The newly passed law requires at least 20 percent of the money in the State Water Implementation Fund for Texas (SWIFT) be spent on water conservation or reuse, and another 10 percent for rural or agricultural conservation programs. To better protect its rivers, the state should aim to spend half of SWIFT funds on efficiency and conservation improvements.
- HB 4 directs TWDB to apply not less than 20 percent of funding for water conservation and another 10 percent for rural or agricultural water conservation projects. The TWDB should treat those set-asides as two distinct mandates, such that conservation projects aren't double counted, thereby reducing the total funding for conservation.
- A portion of the fines paid by BP for the Deepwater Horizon oil spill should be used for estuary restoration and to purchase water rights to ensure adequate freshwater flows.
- To provide ongoing funding, Texas should collect a small fee on water sales. The small additional charge paid by consumers for each gallon of water delivered would help provide reliable funding for financial and technical assistance to cut water use.

Improve understanding of water use and identify savings opportunities.

- Better data are needed on how water is used and what opportunities exist to reduce consumption. Water authorities should collect uniform data on water use for compilation into a database on statewide water use to provide easier comparison between regions and to identify opportunities and best practices.
- The TWDB should conduct a statewide feasibility analysis of water efficiency potential. The state water plan includes regional estimates of water conservation possibilities, but conducting a statewide feasibility analysis would provide a comprehensive tally of water-saving opportunities—and a clear vision for what the state might achieve if it prioritized conservation.

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