6

Water supplies

Quick facts

Total surface water and groundwater availability are lower by approximately 4 percent in 2020 and 5 percent in 2060 than in the 2012 State Water Plan.

Texas' existing water supplies—those that can already be relied on in the event of drought— are expected to decline by approximately 11 percent between 2020 and 2070, from 15.2 to 13.6 million acre-feet per year.

Texas is endowed with extensive surface water and groundwater resources that are conveyed and delivered throughout the state to provide water supply. To plan for sufficient water during drought of record conditions, regional water planning groups must answer two questions: how much water do we already have and how much more do we need during a drought? To answer these questions, planning groups have to evaluate how much existing water supply each of the approximately 2,600 water user groups has access to in the event of drought.

6.1 Evaluating water resources for planning

Estimating how much water Texans will have to meet their water demands is a two-step process that examines both water availability and existing supply. Those two terms have very specific, and not necessarily intuitive, meanings in the water planning process.

Water availability refers to the maximum volume of raw water that could be withdrawn annually from each source (such as a reservoir or aquifer) during a repeat of the drought of record. Availability does not account for whether the supply is connected to or legally authorized for use by a specific water user group. Water availability is analyzed from the perspective of the source and answers the question: *How much water from this source could be delivered to water users as either an existing water supply or, in the future, as part of a water management strategy?* Determining water availability is the first step in assessing potential water supply volumes for a planning group.

Second, planning groups evaluate the subset of the water availability volume that is already connected to water user groups. This subset is defined as existing supply. Existing water supplies are based on legal access to the water as well as the infrastructure (such as pipelines and treatment plant capacity) already in place to treat and deliver the water to the "doorstep" of water user groups. Existing supply is analyzed from the perspective of water users and answers the question: *How much water supply could each water user group already rely on should there be a repeat of the drought of record?*

For example, the firm yield of a surface water reservoir may be 100,000 acre-feet per year. Of that 100,000 acre-feet per year in supplies available at the source, the current pipeline to that source could only convey 60,000 acre-feet per year to users as an existing supply. There remains, therefore, an additional 40,000 acre-feet per year in available water that could serve as the basis for a future water management strategy. Within a county, for another example, there may be a modeled available groundwater volume of 50,000 acre-feet per year, but because water users' current permits and pumping facilities are only able to pump 20,000 acre-feet per year for existing supplies, there remains 30,000 acre-feet per year in available groundwater that could support water management strategies.

Because existing supplies are a subset of the availability of water sources, existing supplies cannot exceed a source's availability without the risk of a water user running short of water in a drought of record. If existing supplies exceed availability it is called an over-allocation. To ensure that planning groups did not assign more water supply to a water source than the source could provide in a drought, the TWDB performed a detailed, statewide accounting of all assigned existing water supply volumes and notified planning groups of over-allocations. Planning groups then made adjustments to their draft plans so that supplies did not exceed the availability of any source in the final plans.

6.2 Surface water availability within river basins

Surface water in Texas comes from 188 major reservoirs and numerous river diversions, known as run-of-river supplies, Texas' 15 major river basins, and eight coastal basins (Figure 6.1).

Surface water availability is determined with the Texas Commission on Environmental Quality's surface water availability models, which are based on permitted water supplies within each river basin. These models determine the monthly and annual water volumes that could be diverted each

Figure 6.1 - Major river and coastal basins and major surface water supply reservoir locations

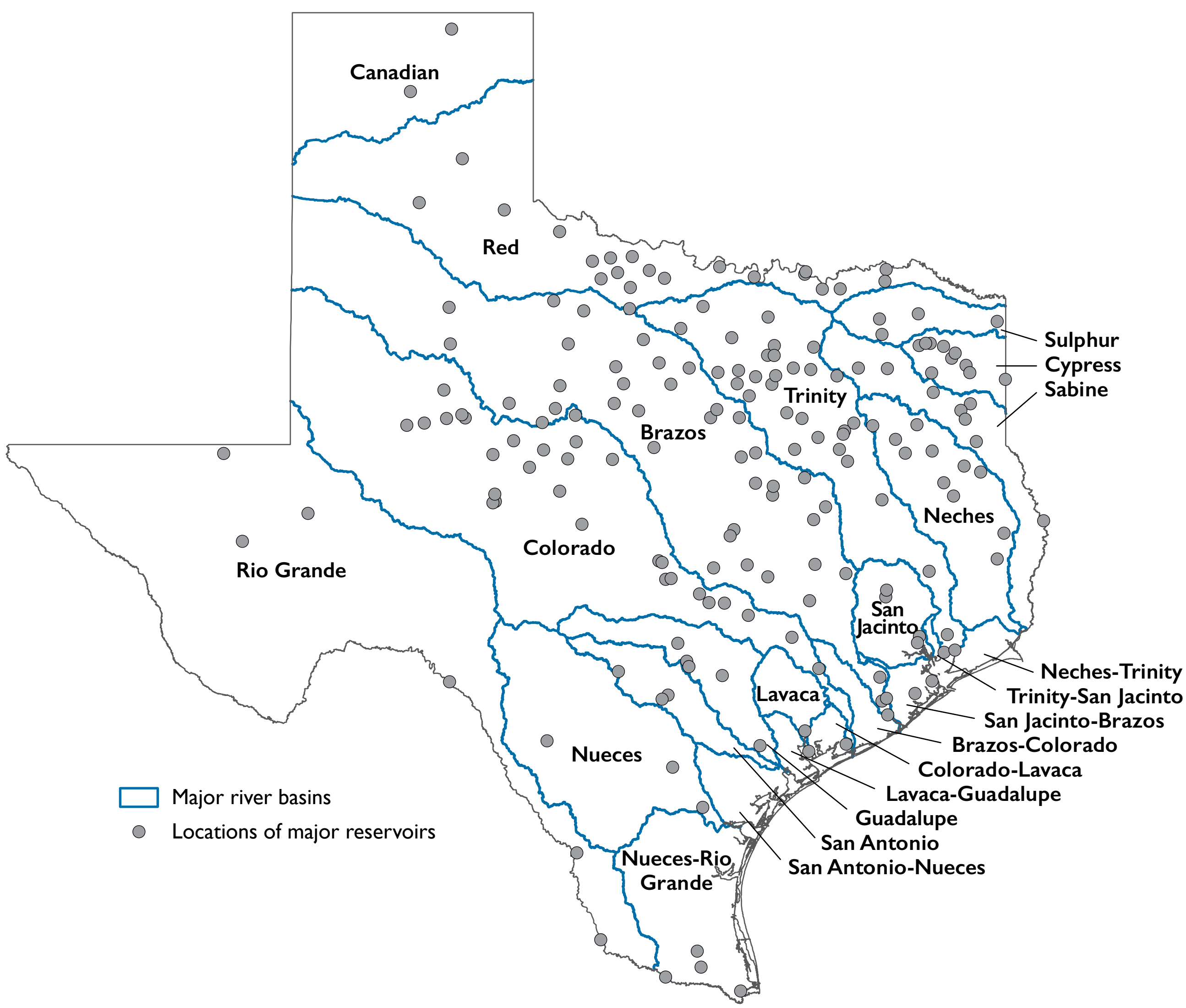
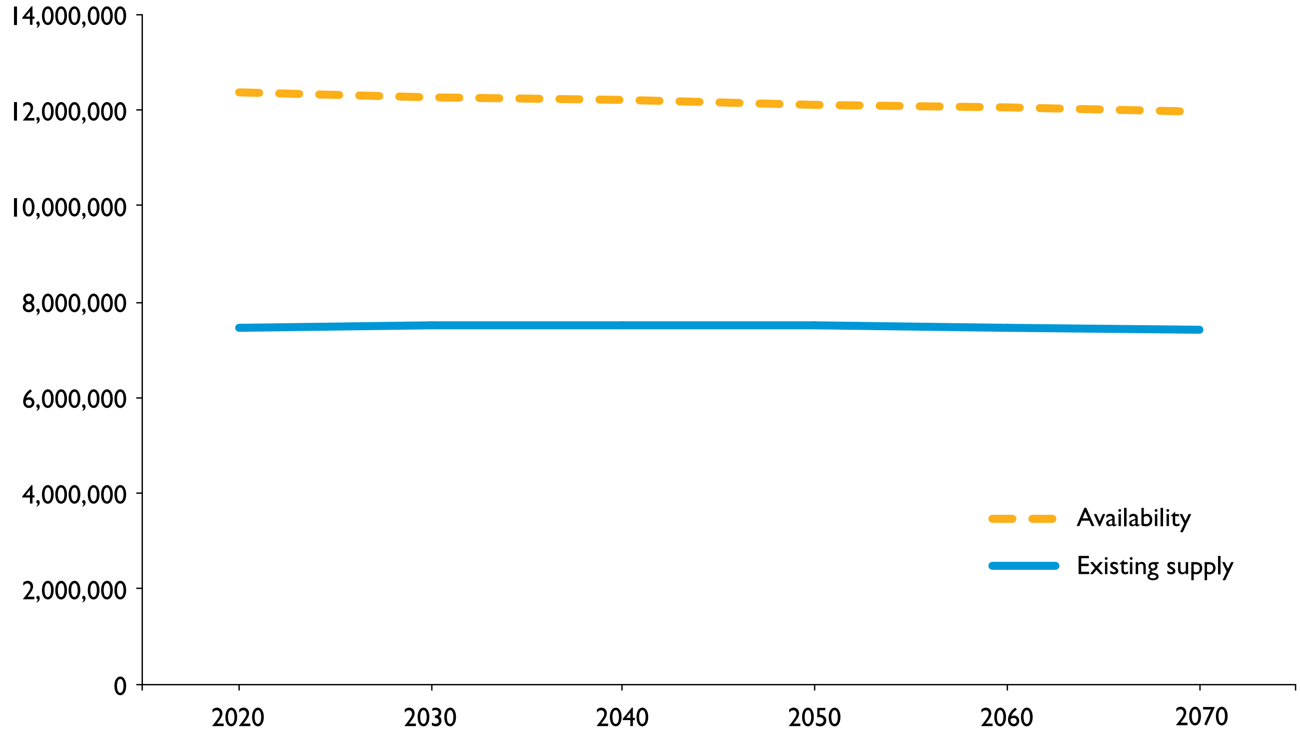


Figure 6.2 - Texas' annual surface water availability and existing surface water supply (acre-feet)



year in drought of record conditions, regardless of whether or not the water is actually connected to any water user groups. The models also incorporate all existing water rights and their relative seniority dates and apply accounting procedures to historical data, such as naturalized streamflow volumes, to estimate the availability of each water right over the historic modeling period.

The default surface water availability model assumes that all existing water right holders fully use their water rights without returning any flows to the river unless their permit requires them to do so. With approval by the executive administrator of the TWDB, planning groups are allowed to modify the default model when evaluating existing water supplies but are required to ensure that any such modifications accurately reflect the hydrologic conditions anticipated to occur under drought of record conditions.

Surface water availability in Texas is anticipated to decline by approximately 3 percent from 2020 to 2070 (Figure 6.2). The decline is due to sedimentation, which reduces reservoir storage.

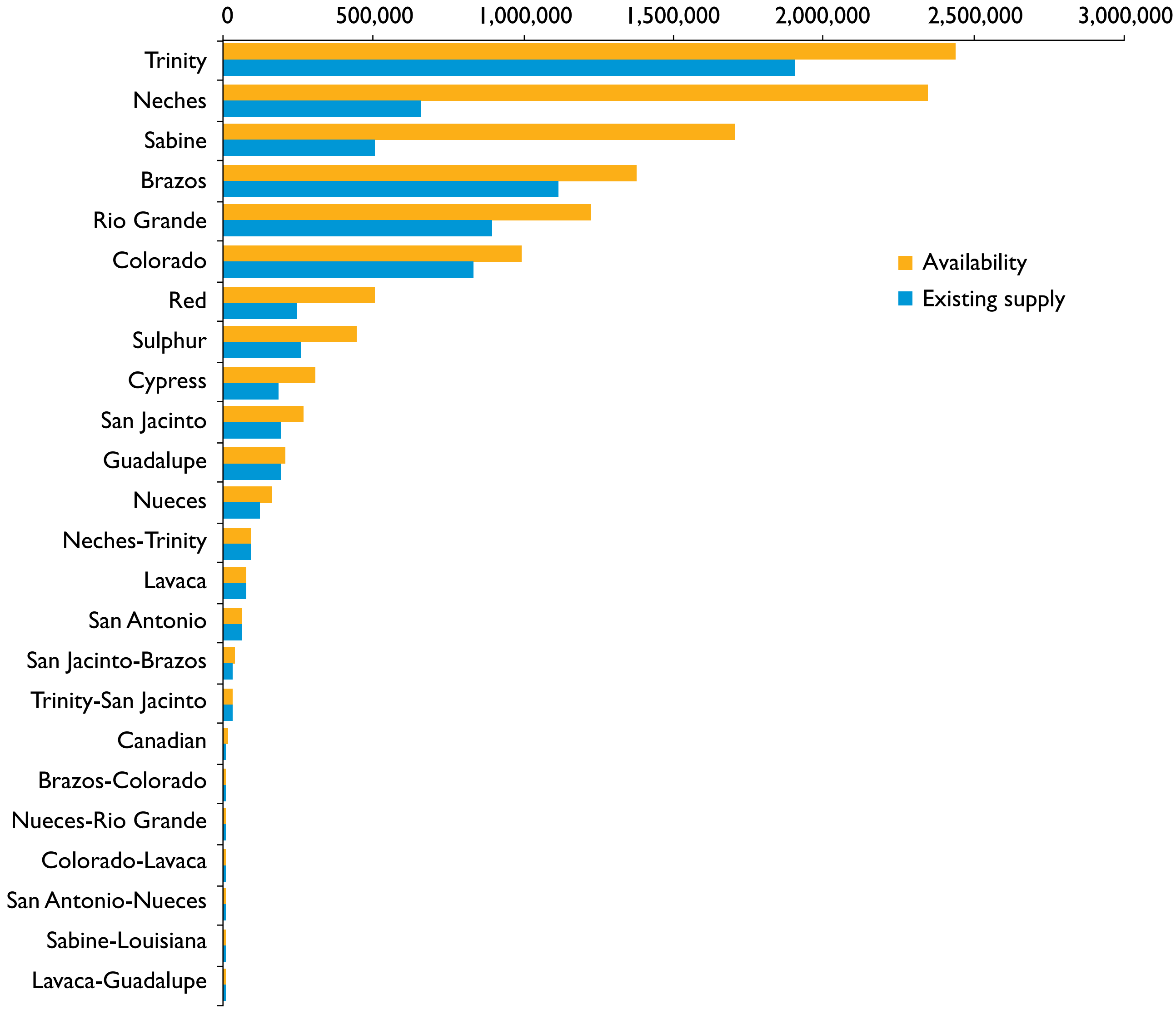
More than half of the annual statewide surface water availability of 12.4 million acre-feet in 2020 occurs within the Trinity, Neches, and Sabine river basins (Figure 6.3, Appendix B.1).

6.3 Future surface water availability

Surface water availability may be increased by implementing certain types of water management strategies. By capturing and storing streamflows, for example, the construction of a new reservoir can increase the reliable volume of permitted water available for annual diversion by water users during drought.

Future surface water availability to support projects may also be limited to account for environmental needs, such as environmental flows. Senate Bill 3, passed by the 80th Texas Legislature, led to an accelerated, science-based process with stakeholder input for addressing environmental flow needs in Texas. The result was the development and adoption of environmental flow standards.

Figure 6.3 - Annual surface water availability and existing surface water supplies by river and coastal basin in 2020 (acre-feet)



Environmental flow standards adopted by the Texas Commission on Environmental Quality balance water supply needs with environmental uses, which can reduce water availability by setting aside surface water that cannot be considered available for water projects permitted after adoption of the standards. Although previous state water plans utilized Consensus Criteria for Environmental Flow Needs or other means to balance uses, this is the first state water plan that directly incorporates recently adopted environmental flow standards into water availability models for estimating water management strategy supplies.

In cases where no environmental flow standards were adopted by the Texas Commission on Environmental Quality, planning groups were required to model diversions based on the Consensus Criteria for Environmental Flow Needs or by utilizing more detailed site-specific studies when available. Many recommended water management strategies remain subject to permitting requirements, regardless of the approach taken to estimate project yields or to consider environmental flow needs during the planning process.

6.4 Groundwater availability of aquifers

Groundwater in Texas comes from nine major and 21 minor aquifers as well as other formations around the state. Major aquifers produce large amounts of water over large areas (Figure 6.4), whereas minor aquifers produce minor amounts of water over large areas or major amounts of water over small areas (Figure 6.5). Groundwater availability is estimated through a combination of policy decisions, made primarily by groundwater conservation districts, and the ability of an aquifer to transmit water to wells.

Groundwater is generally governed by the rule of capture, which may be modified where groundwater conservation and groundwater subsidence districts exist (Figure 6.6). Districts may issue permits that regulate pumping of groundwater and spacing of wells within their jurisdictions.

In 2005, the 79th Texas Legislature passed House Bill 1763, which fundamentally changed the process of how groundwater availability is determined. Prior to House Bill 1763, planning groups determined groundwater availability with input from groundwater conservation districts. House Bill 1763 shifted that responsibility to groundwater

Figure 6.4 - Major aquifers of Texas

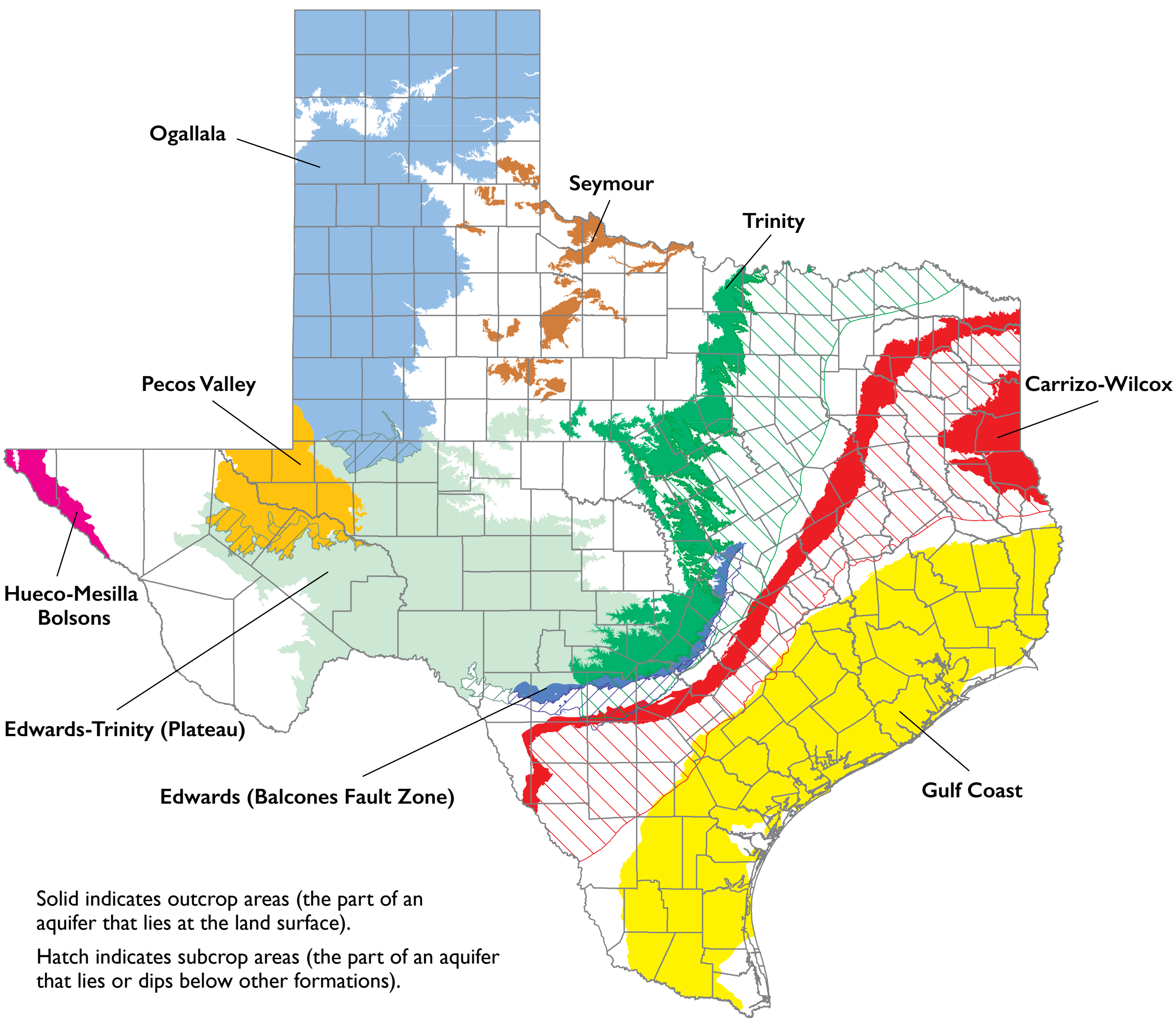
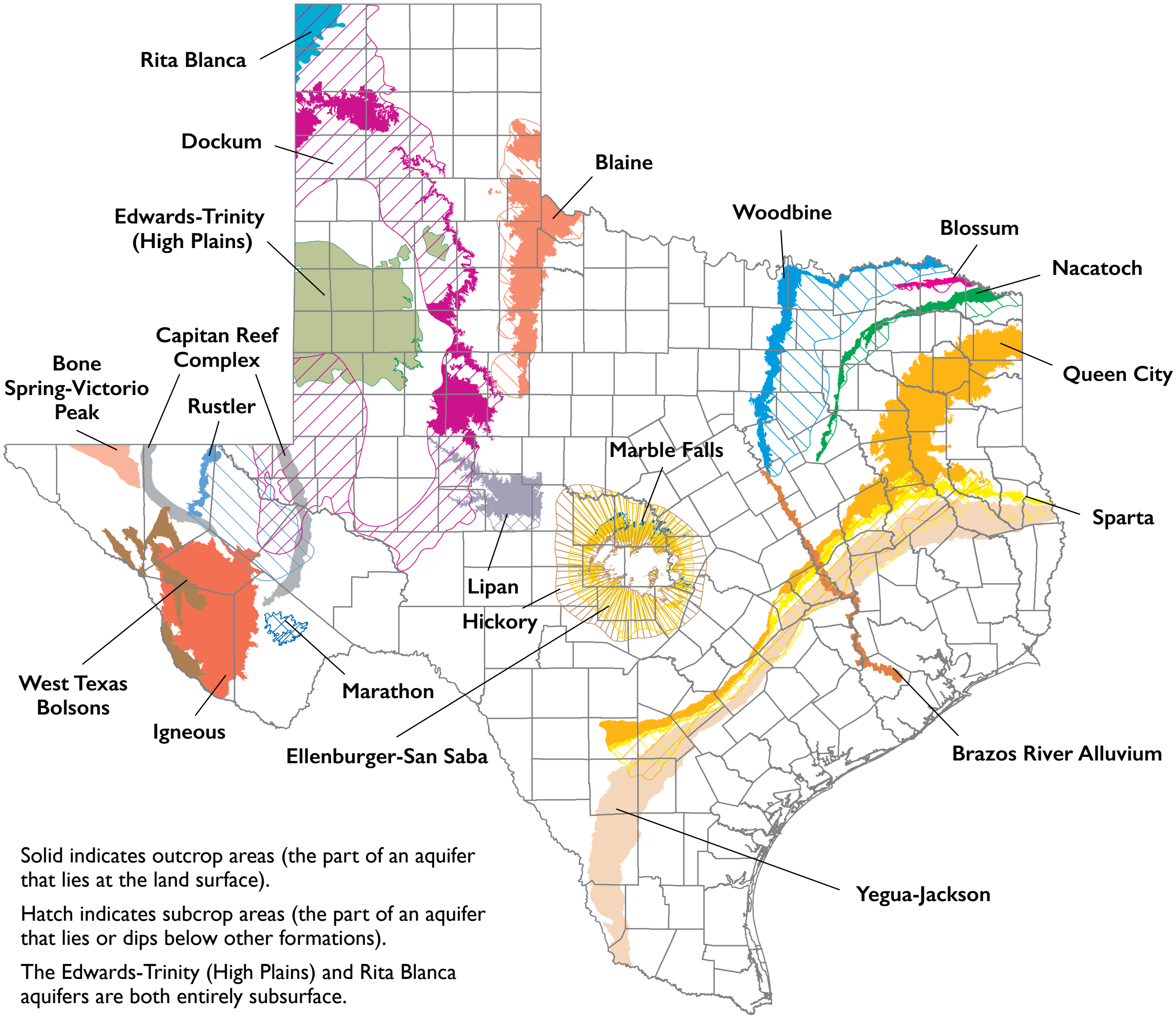


Figure 6.5 - Minor aquifers of Texas



conservation districts by requiring districts within groundwater management areas to work together to establish the desired future conditions of relevant aquifers within that area.

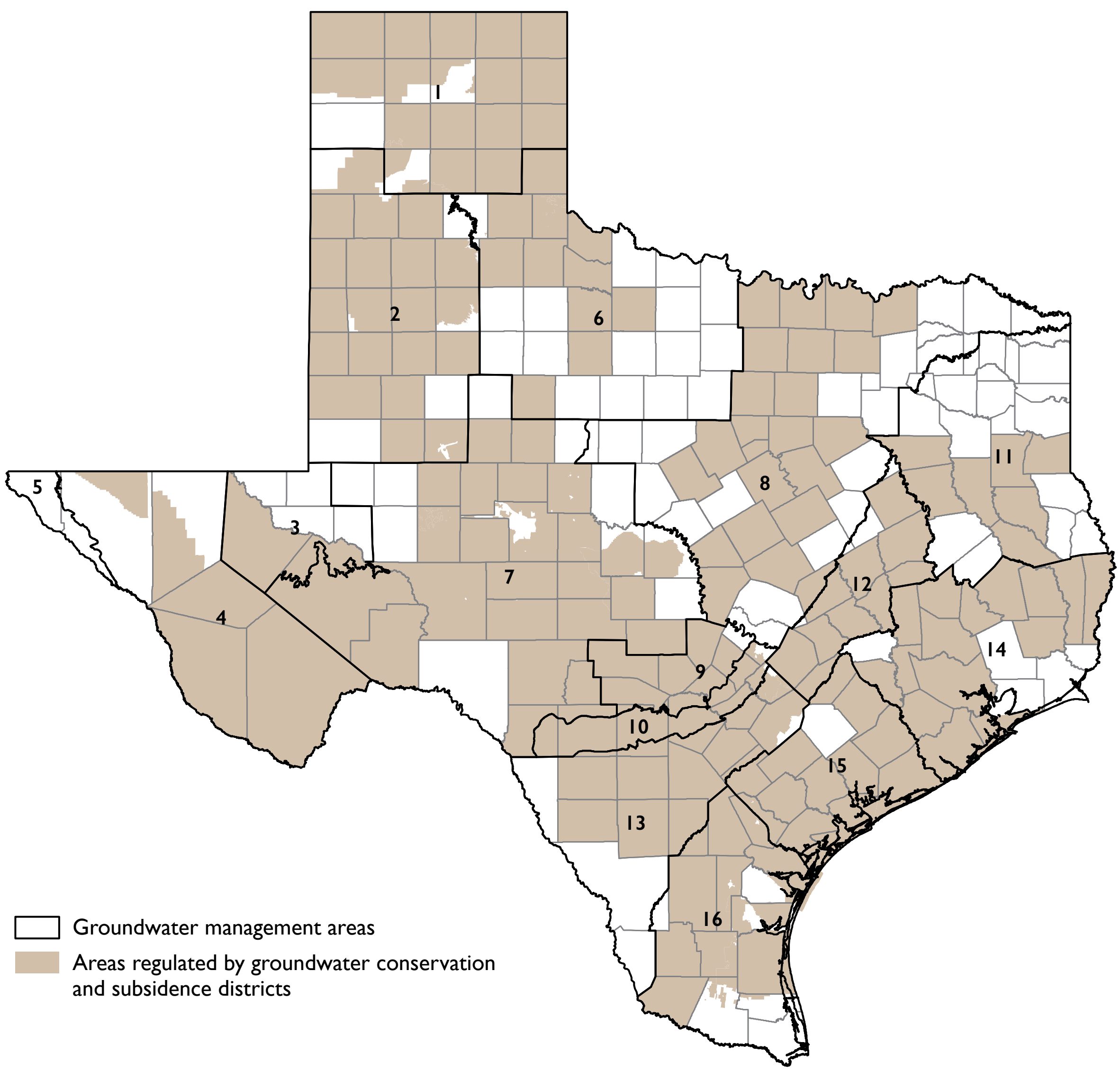
Desired future conditions are the desired, quantified conditions of groundwater resources (such as water levels, water quality, spring flows, or storage volumes) at a specified time in the future or in perpetuity. The TWDB uses desired future conditions to determine a modeled available groundwater value for an aquifer or part of an aquifer in the groundwater management area. A modeled available groundwater value is the volume of groundwater production, on an average annual basis, that will achieve the desired future condition. These values are independent of existing pumping permits and may, depending on the aquifer characteristics and how the desired future conditions are defined, include a variety of water quality types, including brackish groundwater. Depending on the aquifer and location, the inclusion of brackish groundwater in modeled available groundwater values might be subject to local and regional supply evaluations.

This is the first state water plan that is based on modeled available groundwater volumes for all relevant aquifers, statewide. Modeled available groundwater volumes account for the vast majority of groundwater availability considered in this plan. For aquifers and portions of aquifers that did not have modeled available groundwater values, planning groups determined availability with input from groundwater conservation districts. Senate Bill 1101, passed by the 84th Texas Legislature in 2015, allows a regional water planning group to define all groundwater availability as long as there are no groundwater conservation districts within the regional water planning area. This applies to Region D only.

On a statewide basis, total groundwater availability is projected to decline by approximately 20 percent from 2020 to 2070 (Figure 6.7). This decrease is primarily due to declines in the Ogallala and Gulf Coast aquifers.

Annual statewide groundwater availability in 2020 is estimated to be 12.3 million acre-feet. More than half of that comes from the Ogallala and Gulf Coast aquifers (Figure 6.8, Appendix B.2).

Figure 6.6 - Locations of groundwater conservation or subsidence districts and 16 groundwater management areas



6.5 Future groundwater availability

For planning purposes, future groundwater availability cannot be increased by implementing water management strategies other than aquifer recharge-type projects. Groundwater availability may increase or decrease in the future, typically through changes in groundwater management policy (revised desired future conditions) or improvements in technical evaluation approaches (new or updated groundwater availability models).

6.6 Availability of other sources

In addition to river basins and aquifers, which make up the vast majority of Texas' water resources, there are other types of water that are widely available for use, including seawater and treated wastewater from reuse. Seawater availability is generally limited only by the ability to legally access it along the coast. The availability of wastewater treated for reuse, on the other hand, changes over time and is limited only by the amount of wastewater generated by water users at any given time unless a source water permit or agreement states otherwise.

6.7 Existing supplies

Based on the volume of water that was determined to be available at each source, planning groups evaluated the share of those supplies that can already be relied on to meet water demands in the event of drought. The analysis considered the legal and physical limitations to supplies of each of the water user groups. For example, even if a reservoir has a large water availability volume, the existing water supplies that can actually be delivered from the reservoir to water users are limited by the current pipeline and treatment plant capacities that connect communities to the water resource.

The reliance on different water sources and combinations of sources varies greatly by water user category and location. Statewide, surface water makes up more than two-thirds (8.8 million acre-feet per year)

Figure 6.7 - Texas' annual groundwater availability and existing groundwater supplies (acre-feet)

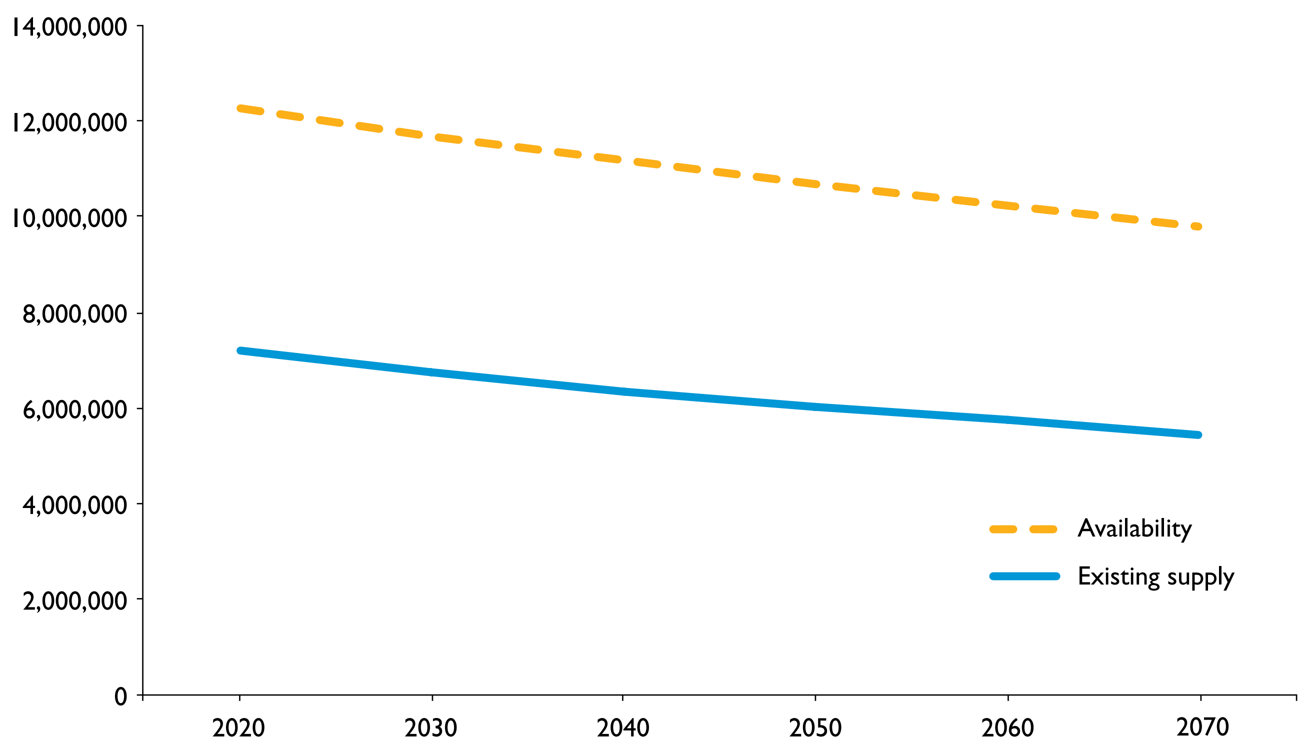
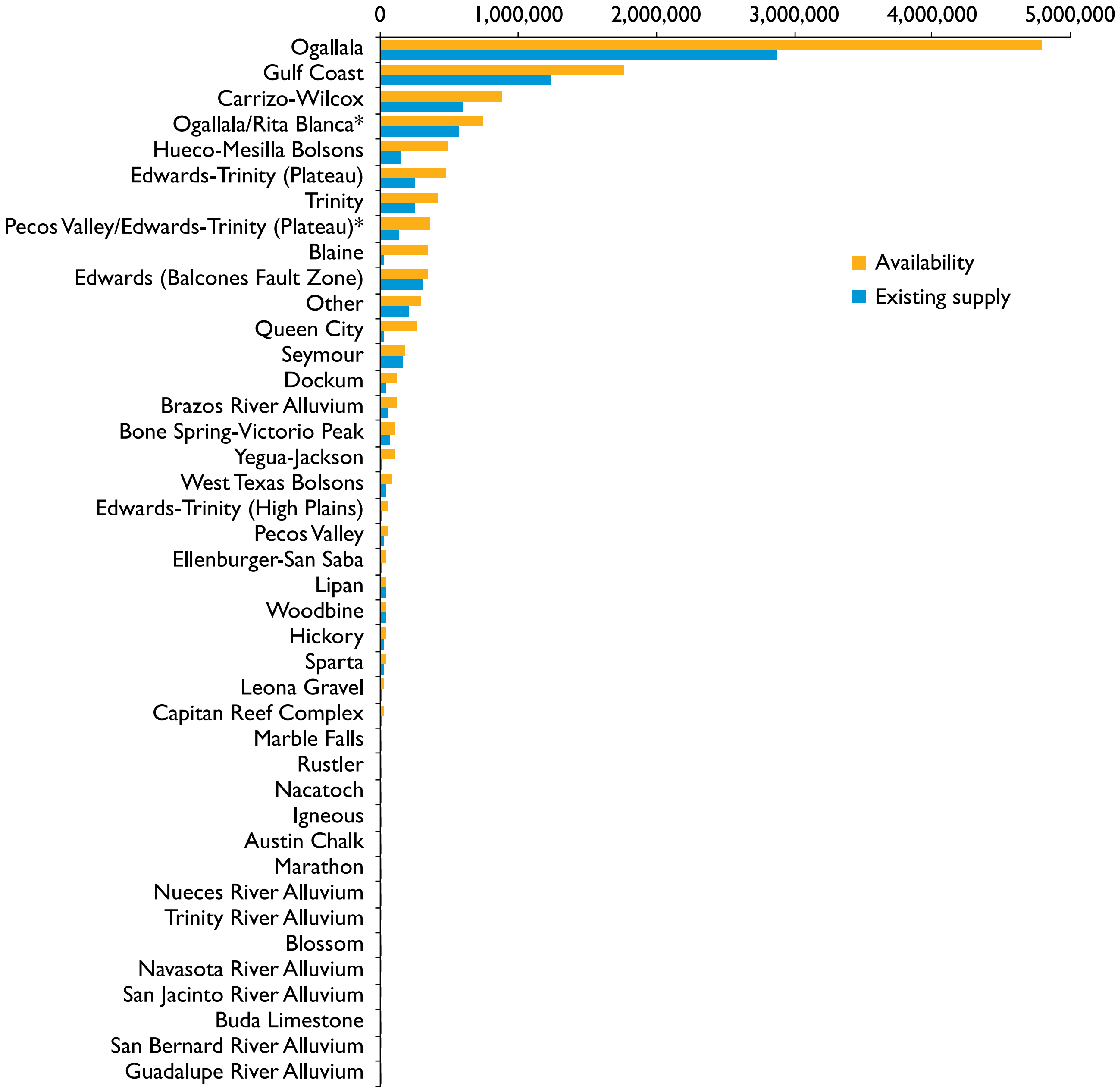
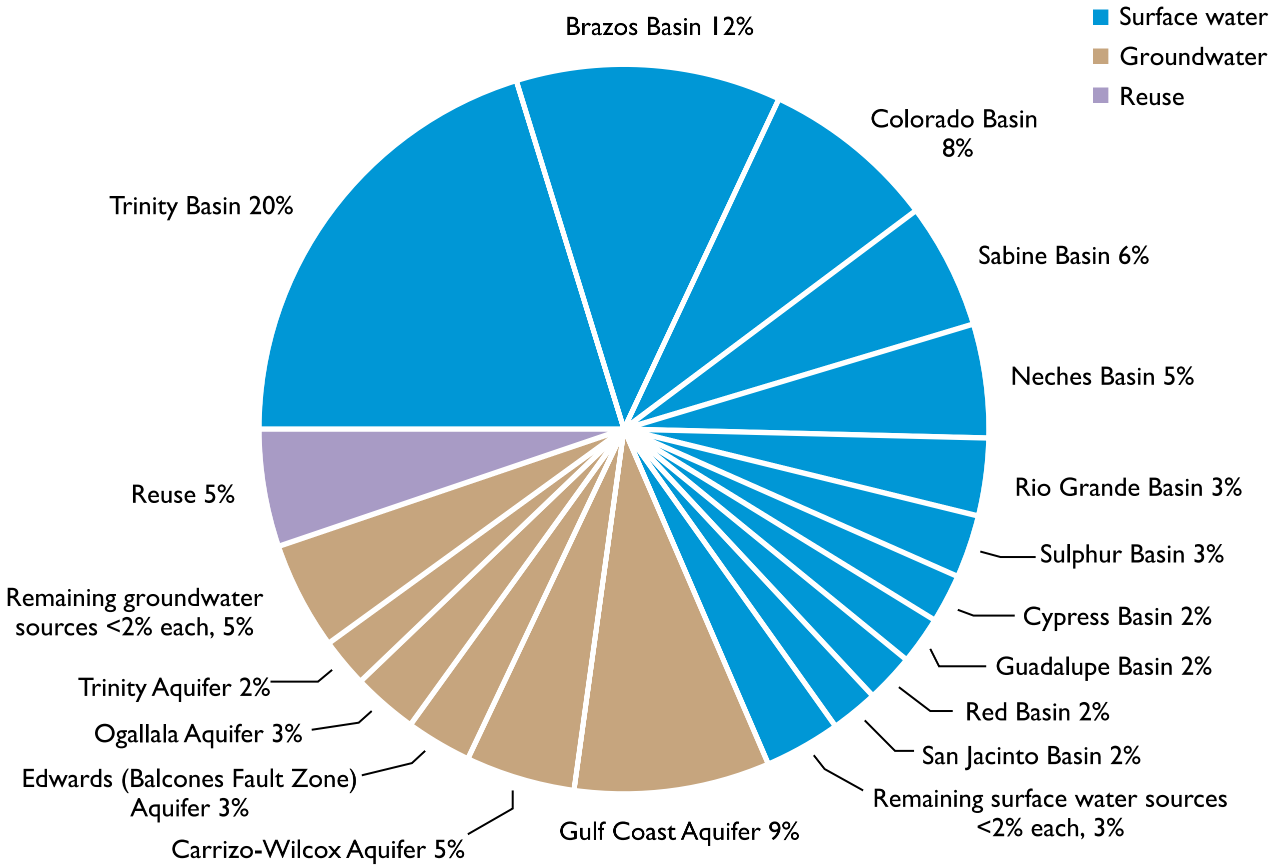


Figure 6.8 - Annual groundwater availability and existing groundwater supplies by aquifer in 2020 (acre-feet)



** The Ogallala/Rita Blanca and the Pecos Valley/Edwards-Trinity (Plateau) are aquifer combinations that reflect specific and mutual aquifer properties, undifferentiated groundwater usage, and groundwater availability model characteristics. In these cases, the modeled available groundwater and existing supply values have likewise been developed to honor these aquifer combinations.*

Figure 6.9 - Shares of existing municipal, steam-electric, manufacturing, and mining supply by water source in 2020



of the existing water supply for municipal, manufacturing, steam-electric, and mining users (Figure 6.9). However, irrigation and livestock water users rely on groundwater for more than 75 percent (6.4 million acre-feet per year) of their existing water supply (Figure 6.10).

The total annual volume of Texas' existing water supplies for all water user groups is projected to decline by approximately 11 percent from 2020 to 2070 (Figure 6.11), although changes vary significantly by location and water user.

In 2020, Texas' existing water supply of approximately 15.2 million acre-feet consists roughly of half surface water and half groundwater and is projected to decline to approximately 13.6 million acre-feet per year by 2070 (Table 6.1).

The overall reduction in water supply is due primarily to declining groundwater availability in the Ogallala and Gulf Coast aquifers and, in some areas, declining surface water availability due to reservoir sedimentation. Other factors, unrelated to water source availability but that can also reduce the existing water supply of specific water users, include declines in groundwater levels relative to current well pump intake, shallow reservoir intake levels, groundwater quality degradation, and expiring water supply contracts.

The share of surface and groundwater availability that can actually be legally produced and delivered based on existing infrastructure—the existing supply—during a repeat of the drought of record is influenced by many factors. For example, existing supply can be limited to the amount of water already being conveyed by pipeline from a reservoir to users or to the amount of water that existing well pumps are capable of delivering under current permits.

The share of availability that is considered existing supply varies by water resource. For example, more than three-fourths of the Trinity River Basin availability is committed as existing surface water supplies, but only about one-third of the Sabine and Neches basins' availability is connected to specific water user groups (Figure 6.3). Ninety percent or more of the availability of the Edwards (Balcones Fault Zone), Seymour, and some other, smaller aquifers is connected as existing supply, whereas less than 10 percent of the availability of the Blaine, Edwards-Trinity (High Plains), Marathon, and Queen City aquifers is connected as existing supply (Figure 6.8). The remaining surface water and groundwater availability in each river basin and aquifer could, in concept, be the basis for recommended water management strategies, subject to many factors including its proximity to identified water needs and costs.

Surface water supply

The total annual surface water supply remains roughly stable from 2020 to 2070, with a slight increase between 2020 and 2030 due to certain surface water delivery contracts. Over the 50-year period, sedimentation is anticipated to decrease the storage capacity of many reservoirs (Figure 6.2).

Groundwater supply

The total annual groundwater supply is anticipated to decline about 24 percent from 2020 to 2070 due primarily to reduced availability from the Ogallala Aquifer, based on its managed depletion, and the Gulf Coast Aquifer, based on regulatory limits aimed at reducing groundwater pumping in the long-term to limit land surface subsidence (Figure 6.7).

Reuse supply

The total annual reuse supply makes up less than 4 percent of total supplies in 2020, with 41 percent of this supply occurring in Region C. Reuse supplies are estimated to increase about 28 percent from

Figure 6.10 - Shares of existing irrigation and livestock supply by water source in 2020

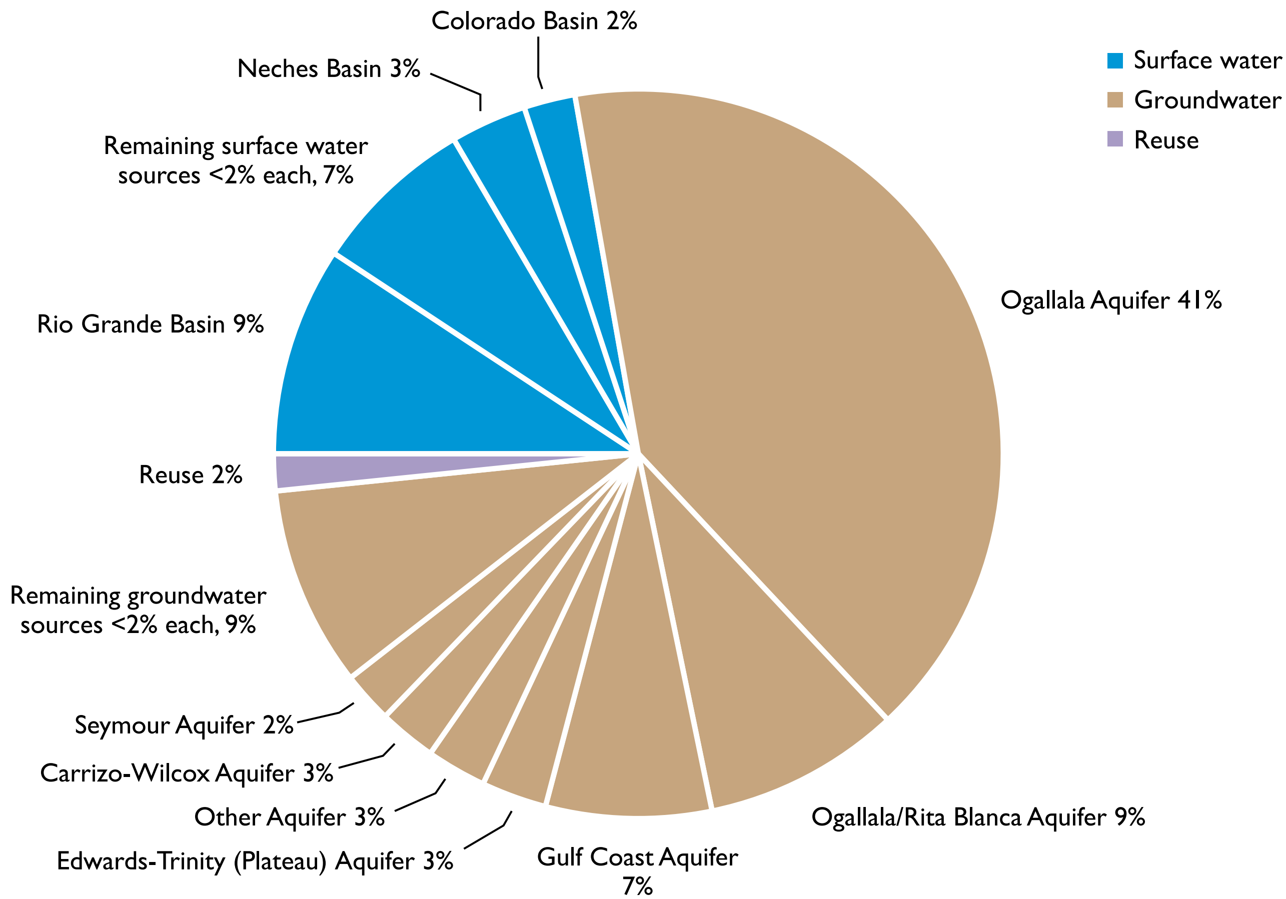
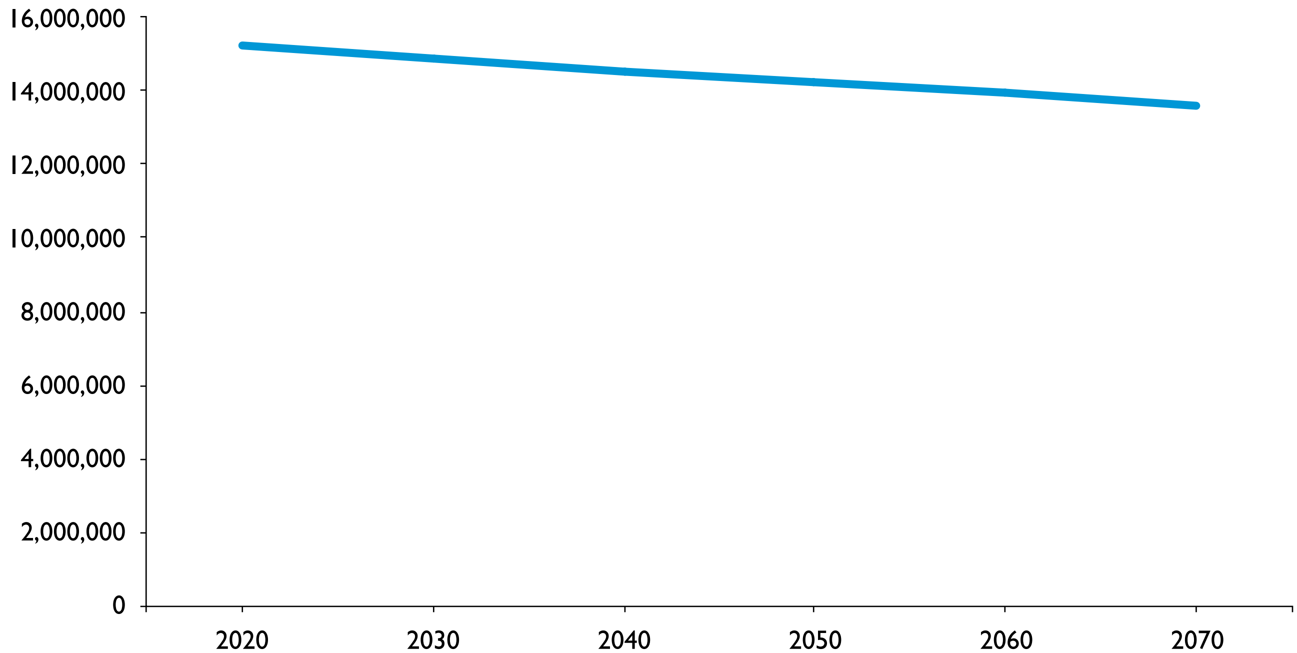


*Figure 6.11 - Texas' projected annual existing water supply (acre-feet)**



** Does not reflect some portions of existing supplies that are associated with purely saline water sources such as untreated seawater*

2020 to 2070. The increase in reuse existing supply is primarily due to an increase in wastewater flows associated with an increasing population and the capacity of existing reuse facilities.

6.8 Comparison to the 2012 State Water Plan

There are many factors that impacted estimates of water availability and the existing water supply since adoption of the 2012 State Water Plan, including policy decisions, modeling assumptions, accumulated historical streamflow data, additional information regarding physical and legal constraints to supplies, and implementation of water supply projects during the intervening years.

When comparing the planning decades of 2020 through 2060 statewide, changes range greatly by water source location and user.

Surface water

There is less surface water availability and existing surface water supply statewide, although this varies significantly by location (Figure 6.12). The greatest relative change was an approximate 17 percent

Table 6.1 - Texas' annual existing water supply (acre-feet)

Source	2020	2030	2040	2050	2060	2070	Percent change
Surface water	7,463,000	7,520,000	7,505,000	7,491,000	7,468,000	7,417,000	-1
Groundwater	7,191,000	6,770,000	6,367,000	6,048,000	5,776,000	5,432,000	-24
Reuse	564,000	602,000	631,000	671,000	710,000	723,000	28
Texas[a]	**15,218,000**	**14,892,000**	**14,503,000**	**14,210,000**	**13,954,000**	**13,572,000**	**-11**

[a] *Does not reflect some portions of existing supplies that are associated with purely saline water sources such as untreated seawater*

Tom Miller Dam, Austin, Texas

Figure 6.12 - Changes from the 2012 State Water Plan in annual surface water availability in 2020

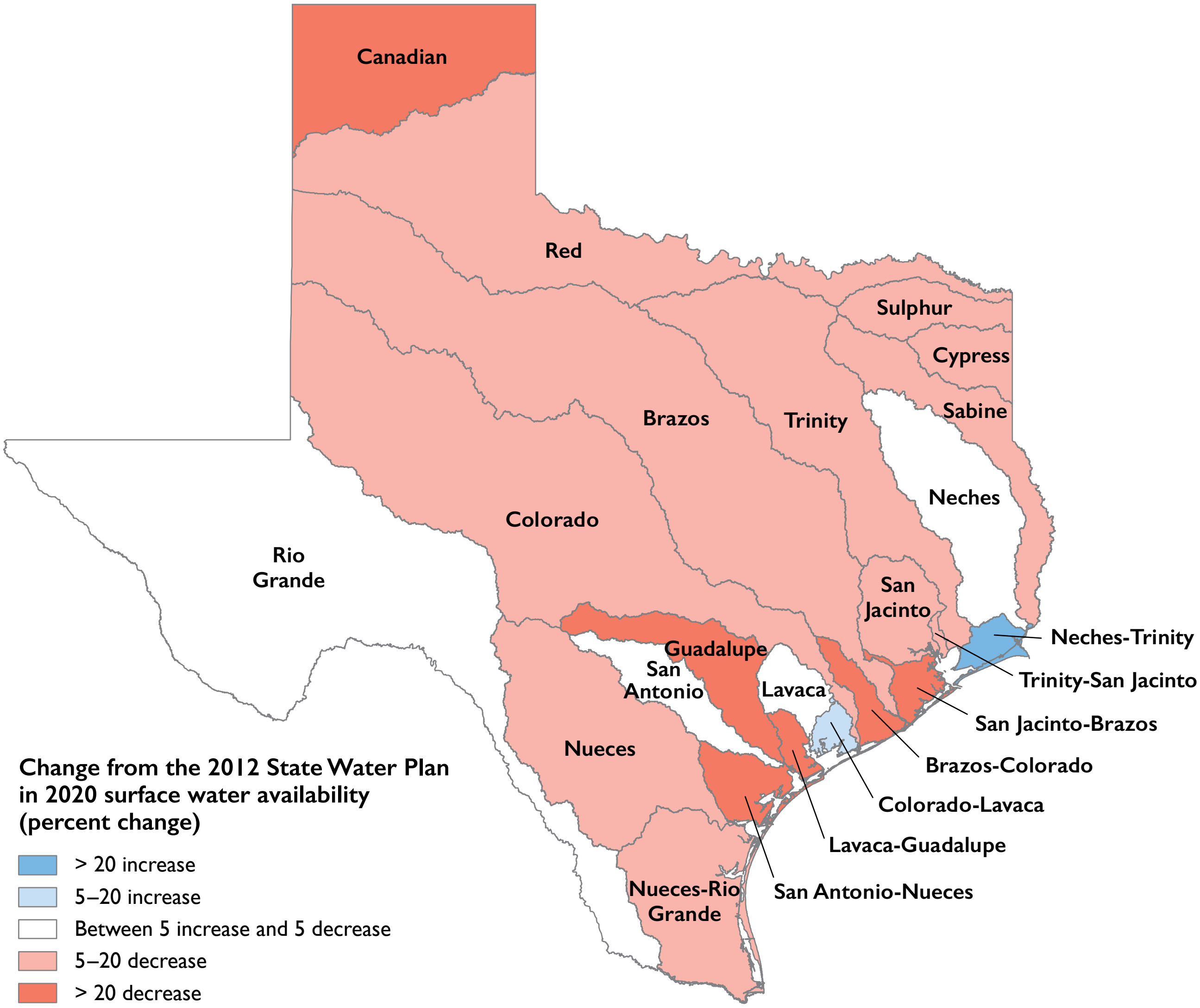
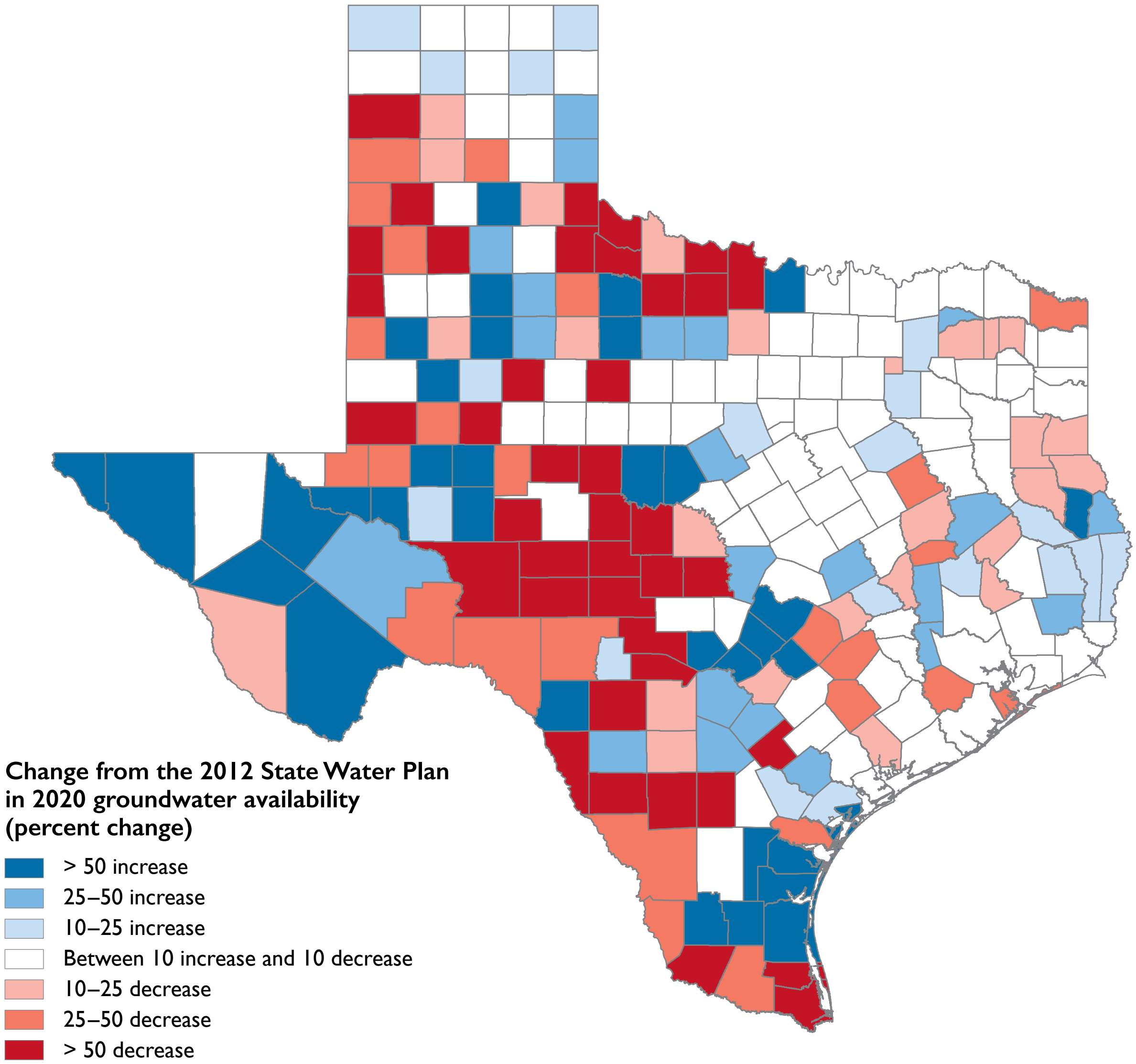


Figure 6.13 - Changes from the 2012 State Water Plan in annual groundwater availability in 2020



decrease in existing surface water supplies in 2060 due partly to reduced availability estimates based on updated historical drought conditions.

Groundwater

There is slightly less groundwater availability statewide in 2020, with considerable variations by county, including relatively more decreases in central/western and southern counties (Figure 6.13). The statewide existing groundwater supply is close to the supply in the 2012 State Water Plan, although it is somewhat higher for the decades from 2030 to 2060. The greatest relative change was an approximate 3 percent increase in statewide groundwater availability in 2040 due to policy decisions made as part of the groundwater management area joint planning process.

Reuse

The existing reuse supply is higher than the supply from the 2012 State Water Plan in each decade from 2020 to 2060.

6.9 Uncertainty of our future water supply

Because hydrology—the study of water in the natural environment—is highly complex, there will always be significant uncertainty over the future timing and quantity of available water resources. Precipitation, temperature, evaporation, wind, and soil moisture conditions all play roles in determining how much water moves in and through Texas' streams, reservoirs, and aquifers. In some cases, snowfall in southern Colorado and rainfall in northern Mexico impact our water supplies. Mexico's compliance with the 1944 water treaty also affects water supplies along the Rio Grande. Because each of these inter-related variables is difficult to quantify and predict, it is not possible to foresee exactly when hydrologic events will occur, where they will occur, and to what degree they will impact our water supply. Other abrupt events, including the introduction and spread of invasive species, can also result in unexpected restrictions on the use of certain water sources.

Texas' water plans are based on benchmark drought of record conditions using historical hydrological data. While we recognize that the full sequence of hydrologic events in our history will never be repeated exactly, the droughts that have occurred have been of such severity that it is reasonable to use them for the purpose of planning. There are currently no forecasting tools capable of providing reliable estimates of changes to future water resources in Texas at the resolution needed for water planning. In order to provide the best available, actionable science, grounded in historical data and patterns, the TWDB continues to collect data and consider potential ways to improve estimates of water supply reliability in the face of drought.

Rio Grande at dawn