Quick Facts

Recommended water management strategies to improve source water quality, through saltwater barriers or removal of contaminants, are expected to provide over 400,000 acre-feet of water per year by 2060.

8 Impacts of Plans

Regional water plans take into account potential impacts on water quality and consistency with long-term protection of the state's water, agricultural, and natural resources.

During preparation of their plans, regional water planning groups evaluate how the implementation of recommended and alternative water management strategies could affect water quality in Texas. Each regional water plan includes a description of the potential major impacts of recommended strategies on key parameters of water quality, as identified by the planning group as important to the use of the water resource within their regions. The plans compare current conditions to future conditions with the recommended water management strategies in place.

Each regional water plan must also describe how it is consistent with long-term protection of the state's water, agricultural, and natural resources. To accomplish this task, planning groups estimate the environmental impacts of water management strategies and identify specific resources important to their planning areas, along with how these resources are protected through the regional water planning process.

8.1 WATER QUALITY

Water quality is an important consideration in water supply planning. Water quality affects the suitability of water for drinking, agriculture, industry, or other uses. Water quality concerns may determine how much water can be withdrawn from a river or stream without causing significant damage to the environment. These issues are important to planners and water providers because of the impact existing water quality can have on the cost of treating water to drinking water standards. The quality of surface water and groundwater is affected by its natural environment as well as by contamination through human activity.

The implementation of recommended water management strategies can potentially improve or degrade water quality. In their evaluation and choices of water management strategies, each planning group must consider water quality in the region. This includes identifying current water quality concerns, as well as the impacts that recommended water management strategies may have on water quality parameters or criteria.

8.1.1 SURFACE WATER QUALITY

Water quality is an integral component of the overall health of surface water bodies and impacts the treatment requirements for the state's water supply. The state surface water quality programs are based on the federal Clean Water Act and the Texas Water Code, with the Texas Commission on Environmental Quality having jurisdiction over the state's surface water quality programs, as delegated by the U.S. Environmental Protection Agency.

The Texas Commission on Environmental Quality sets surface water quality standards as goals to maintain the quality of water in the state. A water quality standard is composed of two parts: a designated use and the criteria necessary to attain and maintain that use. The three basic designated water uses for site-specific water quality standards are

- domestic water supply (including fish consumption),
- recreation, and
- aquatic life.

Surface Water Quality Parameters

The regional water planning groups use parameters from the Texas Surface Water Quality Standards to evaluate water quality impacts of the recommended water management strategies. These standards include general criteria for pollutants that apply to all surface waters in the state, site-specific standards, and additional protection for classified water bodies that are defined in the standards as being of intermediate, high, or exceptional quality. The following parameters are used for evaluating the support of designated uses:

- **Total Dissolved Solids (Salinity):** For most purposes, salinity is considered equivalent to total dissolved solids content. Salinity concentration determines whether water is acceptable for drinking water, livestock, or irrigation. Low salinity is considered 'fresh' water and is generally usable for all applications. Slightly saline water may be used to irrigate crops, as well as to water livestock, depending on the type of crop and the levels of solids in the water. Several river segments in the state have relatively moderate concentrations of salts including the upper portions of the Red and Wichita rivers in Region B; the Colorado River in Region F; and the Brazos River in Regions G and O. These regions have recommended water management strategies to address salinity issues.
- **Nutrients:** A nutrient is classified as a chemical constituent, most commonly a form of nitrogen or phosphorus, that can contribute to the overgrowth of aquatic vegetation and impact water uses in high

concentrations. Nutrients from permitted point source discharges must not impair an existing, designated, presumed, or attainable use. Site-specific numeric criteria for nutrients are related to the concentration of chlorophyll *a* in water and are a measure of the density of phytoplankton.

- **Dissolved Oxygen:** Dissolved oxygen concentrations must be sufficient to support existing, designated, presumed, and attainable aquatic life uses in classified water body segments. For intermittent streams with seasonal aquatic life uses, dissolved oxygen concentrations proportional to the aquatic life uses must be maintained during the seasons when the aquatic life uses occur. Unclassified intermittent streams with perennial pools are presumed to have a limited aquatic life use and correspondingly lower dissolved oxygen criteria.
- **Bacteria:** Some bacteria, although not generally harmful themselves, are indicative of potential contamination by feces of warm-blooded animals. Water quality criteria are based on these indicator bacteria rather than direct measurements of pathogens primarily because of cost, convenience, and safety. An applicable surface water use designation is not a guarantee that the water so designated is completely free of disease-causing organisms. Even where the concentration of indicator bacteria is less than the criteria for primary or secondary contact recreation, there is still some risk of contracting waterborne diseases from the source water without treatment.
- **Toxicity:** Toxicity is the occurrence of adverse effects to living organisms due to exposure to a wide range of toxic materials. Concentrations of chemicals in Texas surface waters must be maintained at sufficiently low levels to preclude adverse toxic effects on aquatic life, terrestrial life, livestock/domestic animals, and human health resulting from contact recreation, consumption of aquatic organisms, consumption of drinking water, or any combination of the three. Surface waters with sustainable fisheries or public drinking water supply uses must not exceed applicable human health toxic criteria, and those waters used for domestic water supply must not exceed toxic material concentrations that prevent them from being treated by conventional methods to meet federal and state drinking water standards.

Surface Water Quality Monitoring and Restoration Programs

The Texas Commission on Environmental Quality coordinates the cooperative multi-stakeholder monitoring of surface water quality throughout the state, regulates and permits wastewater discharges, and works to improve the quality of water body segments that do not meet state standards.

To manage the more than 11,000 named surface water bodies in the state, the Texas Commission on Environmental Quality has subdivided the most significant rivers, lakes, wetlands, and estuaries into classified segments. A segment is that portion of a water body that has been identified as having homogenous physical, chemical, and hydrological characteristics. As displayed in the *Atlas of Texas Surface Waters* (TCEQ, 2004) classified segments are water bodies (or a portion of a water body) that are individually defined in the state surface water quality standards.

Water body segments that exceed one or more water quality standards are considered to be impaired. A list of these impaired segments is submitted to the U.S. Environmental Protection Agency, as required under Section 303(d) of the Clean Water Act. The *2008 Texas Water Quality Inventory and 303(d) List* (TCEQ, 2011) identifies 386 impaired water body segments in Texas (Figure 8.1).

Several state programs have been developed by the Texas Commission on Environmental Quality in partnership with stakeholders to determine whether water quality standards have been attained in individual water bodies and to plan and implement best management practices in an effort to restore impaired water resources. These include the Surface Water Quality Monitoring program, the Clean Rivers program, the Total Maximum Daily Load program, and the Nonpoint Source Pollution program. The regional water planning groups use information and data from these programs during their water management strategy evaluation processes.

8.1.2 GROUNDWATER QUALITY

Groundwater accounts for almost 60 percent of the water used in Texas. In its natural environment, groundwater slowly dissolves minerals as it recharges and flows through an aquifer. In many cases, these dissolved minerals are harmless at the levels in which they are naturally present in the groundwater. However, in some cases, groundwater may dissolve excessive amounts of certain minerals, making it unsuitable for some uses.

Other groundwater contamination may also result from human activities, such as leakage from petroleum storage tank systems, salt water disposal pits, pipelines, landfills, and abandoned wells, as well as infiltration of pesticides and fertilizers. These types of contamination are often localized but can also be widespread, covering large areas that are used for agriculture or oil and gas production.

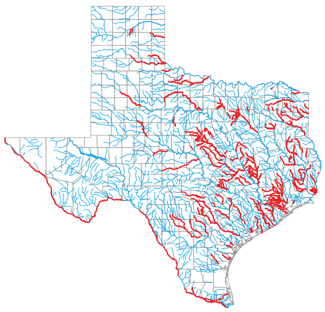
Although there are no equivalent water quality standards for groundwater as exists for surface water, the Texas Water Code provides general powers to groundwater conservation districts to make and enforce rules to prevent degradation of water quality.

Common Groundwater Quality Parameters

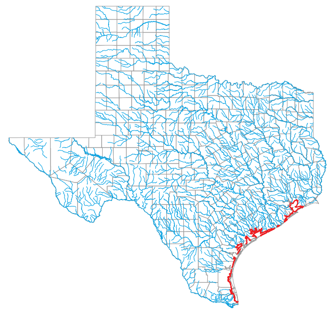
Below are a few of the more common drinking water parameters used in assessment of public water supplies that are applicable to groundwater quality:

- **Total Dissolved Solids (Salinity):** As was noted with surface water, total dissolved solids are a measure of the salinity of water and represent the amount of minerals dissolved in water. Moderately saline groundwater is defined as 'brackish' and is a viable potential water source for desalination treatment to make it suitable for public consumption. Much of the groundwater in the state's aquifers is fresh; however, brackish groundwater is more common than fresh in the southern Gulf Coast Aquifer and in aquifers in many parts of west Texas.
- **Nitrates:** Although nitrates exist naturally in groundwater, elevated levels generally result from human activities, such as overuse of fertilizer and improper disposal of human and animal waste. High levels of nitrates in groundwater often coexist with other contaminants. Human and animal waste sources of nitrates will often contain bacteria, viruses, and protozoa; fertilizer sources of nitrates usually contain herbicides and pesticides. Groundwater in Texas that exceeds this drinking water standard for nitrates is located mostly in the Ogallala and Seymour aquifers, although parts of the Edwards-Trinity (High Plains), Dockum, and Trinity aquifers are also affected.
- **Arsenic:** Although arsenic can occur both naturally and through human contamination, most of the arsenic in Texas groundwater is naturally occurring. Most of the groundwater supplies in Texas that exceed standards occur in the southern half of the Ogallala Aquifer, the Hueco-Mesilla

BACTERIA IMPAIRMENT



BACTERIA IMPAIRMENT FOR OYSTERS



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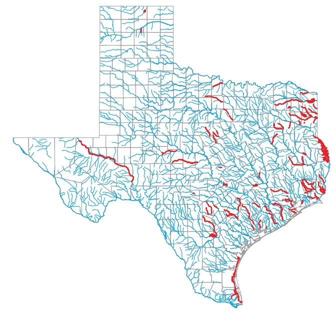
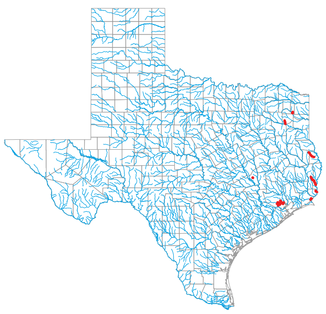


TOXICITY IMPAIRMENT



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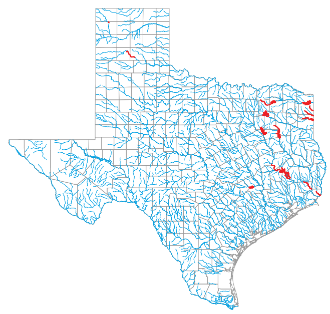
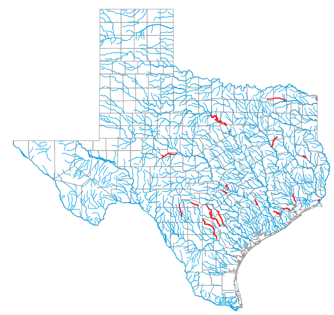
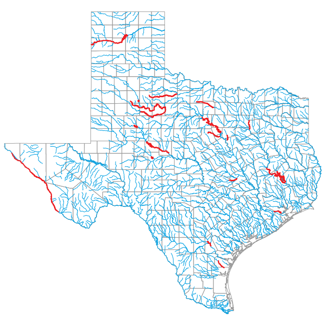


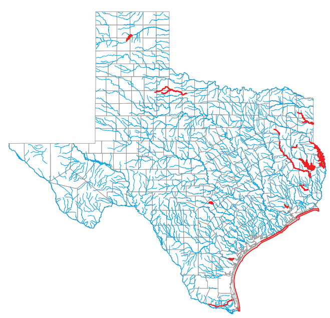
BIOLOGICAL INTEGRITY IMPAIRMENT



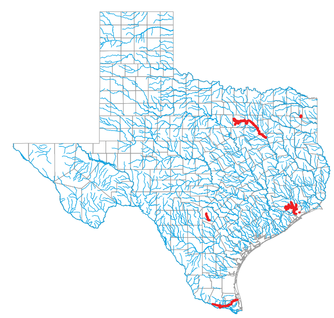
DISSOLVED SOLIDS IMPAIRMENT



METALS IMPAIRMENT



ORGANICS IMPAIRMENT



NITRATE AND NITRITE IMPAIRMENT

FIGURE 8.1. IMPAIRED RIVER SEGMENTS AS DEFINED BY SECTION 303(D) OF THE CLEAN WATER ACT (TCEQ, 2008).

Bolsons, and the West Texas Bolsons located in the western portions of Texas, as well as in the Gulf Coast Aquifer in southeast Texas (Figure 8.2).

- **Radionuclides:** A radionuclide is an atom with an unstable nucleus that emits radiation. Most groundwater in Texas with gross alpha radiation greater than the maximum acceptable level is found in the Hickory Aquifer in central Texas and the Dockum Aquifer of west Texas (Figure 8.3). The Edwards-Trinity (Plateau), Gulf Coast, and Ogallala aquifers also have significant numbers of wells with high levels of gross alpha radiation. Although contamination from human activity can be a source of radionuclides, most of the radionuclides in Texas groundwater occur naturally. Where radionuclides are found in drinking water supplies, communities and water providers must provide additional levels of water treatment to remove the radionuclides, blend the groundwater with surface water to dilute the radionuclide concentration, or find an alternative source of drinking water.

Groundwater Quality Monitoring and Restoration Programs

The Texas Groundwater Protection program, administered by the Texas Commission on Environmental Quality, supports and coordinates the groundwater monitoring, assessment, and research activities of the interagency Texas Groundwater Protection Committee, made up of nine state agencies as well as the Texas Alliance of Groundwater Districts. The Texas Groundwater Protection Committee publishes an annual report describing the status of current groundwater monitoring programs to assess ambient groundwater quality and also contains current documented regulatory groundwater contamination cases within the state and the enforcement status of each case. As part of its efforts to monitor groundwater quality, TWDB is currently funding research on the effects of natural and human influences on groundwater quantity.

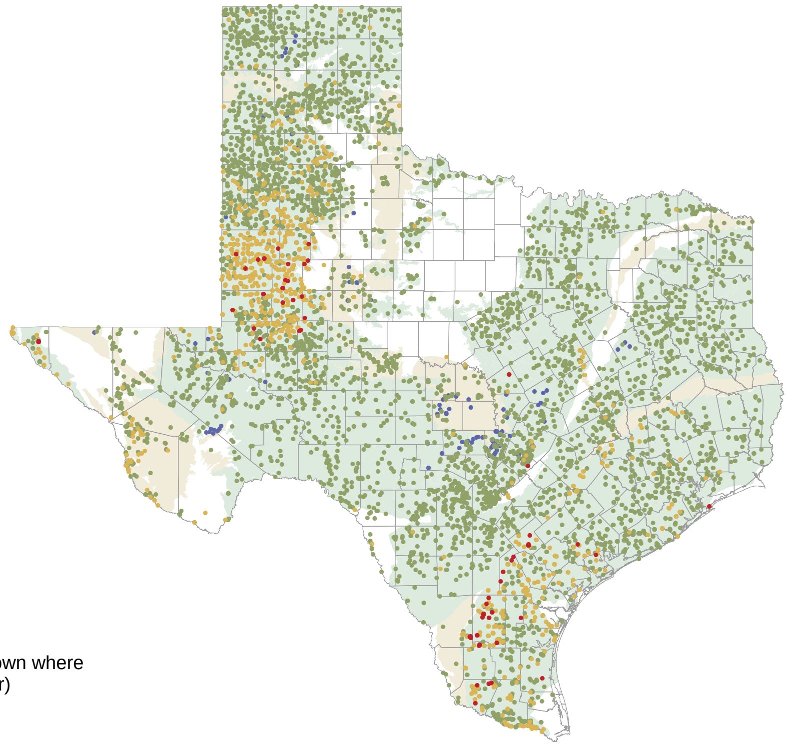
8.1.3 POTENTIAL IMPACTS OF RECOMMENDED WATER MANAGEMENT STRATEGIES ON WATER QUALITY

To assess how the implementation of water management strategies could potentially affect water quality, planning groups identified key water quality parameters within their regions. These parameters were generally based on surface and groundwater quality standards, the list of impaired waters developed by the Texas Commission on Environmental Quality, and input from local and regional water management entities and the public.

Regional water planning groups presented high-level assessments of how the implementation of strategies could potentially affect the water quality of surface water and groundwater sources. Regions used different approaches, including categorical assessments (such as "low" "moderate," or "high"), or numerical impact classifications such as "1-5." Statewide, about a third of the recommended water management strategies were designated by the regional water planning groups to have no adverse impacts, while more than half were estimated to only have low or minimum impacts. Approximately 10 percent were classified as having medium or moderate impacts to water quality. No water management strategies recommended by the regional water planning groups were expected to have a high impact on water quality.

Although many recommended water management strategies include water treatment as part of the project implementation, seven regional water planning areas recommended water management strategies whose primary goal is to improve the quality of the source water. These include saltwater barriers to reduce

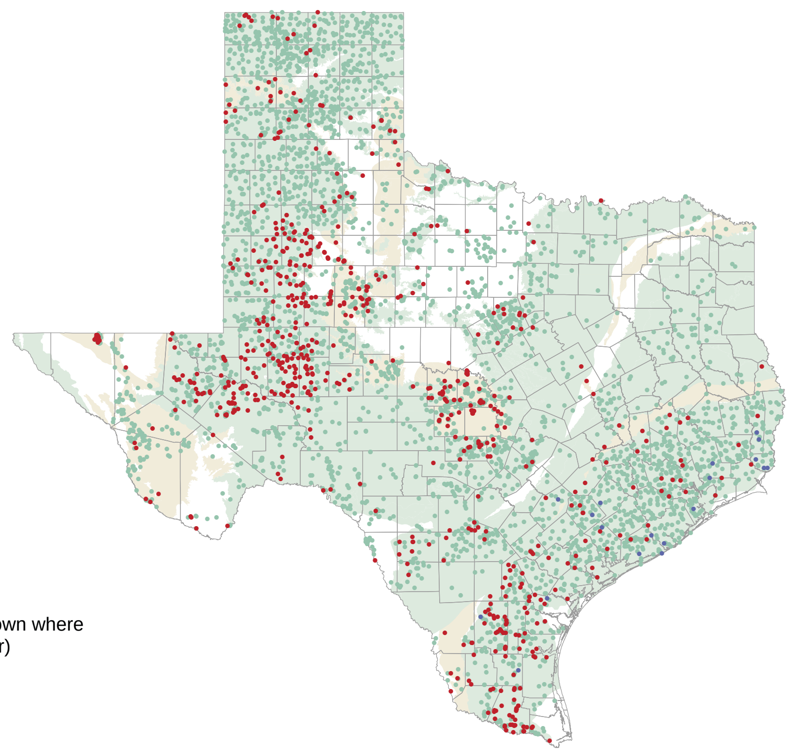
FIGURE 8.2. IMPAIRED GROUNDWATER WELLS/AQUIFERS FOR ARSENIC.



Arsenic concentrations in micrograms per liter

- less than 1
- 1 to 10
- 10 to 50
- greater than 50
- Major aquifers
- Minor aquifers (only shown where there is no major aquifer)

FIGURE 8.3. IMPAIRED GROUNDWATER WELLS/AQUIFERS FOR RADIONUCLIDES.



Gross alpha radiation in picocuries per liter

- less than 0.1
- 0.1 to 15
- greater than 15
- Major aquifers
- Minor aquifers (only shown where there is no major aquifer)

inflow of saline waters into receiving streams as well as removal of contaminants such as nitrates, arsenic, and radionuclides from surface water and groundwater. Statewide, these strategies will improve over 400,000 acre-feet of water per year by 2060 (Table 8.1).

Several other recommended water management strategies are anticipated to have a secondary benefit of improving the quality of the source water, primarily by reducing the volume of high total dissolved solids effluent flows and contaminants into receiving waters. Examples of these strategies include on-farm reuse, irrigation scheduling, and direct and indirect reuse.

8.2 POTENTIAL IMPACTS TO THE STATE'S WATER, AGRICULTURAL, AND NATURAL RESOURCES

In addition to considering the potential impact of strategies on water quality, planning groups also evaluated the potential impacts of each water management strategy on the state's water, agricultural, and natural resources. In analyzing the impact of water management strategies on the state's water resources, the planning groups honored all existing water rights and contracts and considered conservation strategies for all municipal water user groups with a water supply need. They also based their analyses of environmental flow needs for specific water management strategies on Consensus Criteria for Environmental Flow Needs or site-specific studies (Chapter 5, Water Supplies). In addition, planning groups were required to consider water management strategies to meet the water supply needs of irrigated agriculture and livestock production.

Planning groups determined mitigation costs and quantified the potential of impacts for all water management strategies considered. Some used categorical assessments describing impacts as "high," "moderate," and "low." These ratings were based on existing data and the potential to avoid or mitigate impacts to agricultural and natural resources. For example, a "low" rating implied that impacts could be avoided or mitigated relatively easily. In contrast, a "high" rating implied that impacts would be significant and mitigation requirements would be substantial. Other planning groups used a numerical rating that indicated the level of impact. Many planning groups based their ratings on factors such as the volume of discharges a strategy would produce or the number of irrigated acres lost. Another approach relied on identifying the number of endangered or threatened species listed in a county with a proposed water source.

In general, most planning groups relied on existing information for evaluating the impacts of water management strategies on agricultural and natural resources. However, some regions performed region-wide impact analyses to evaluate potential cumulative impacts. For example, because of the close connection between the Edwards Aquifer, spring and river flows, and bay and estuary inflows, Region L developed an overall impact analysis that took into account many factors including draw-down of aquifers, impacts on spring flows, ecologically significant stream segments, bay and estuary inflows, vegetation and habitat, cultural resources, as well as endangered and threatened species.

REFERENCES

TCEQ (Texas Commission on Environmental Quality), 2004, Atlas of Texas Surface Waters: Texas Commission on Environmental Quality Publication Number GI-316, http://www.tceq.texas.gov/publications/gi/gi-316/gi-316_intro.html/at_download/file.

TABLE 8.1. WATER MANAGEMENT STRATEGIES DESIGNED TO IMPROVE SOURCE WATER QUALITY

Region	Water Management Strategy Name	Description	Annual Volume in 2060 (acre-feet)
B	Nitrate removal plant	Removal of moderate to high levels of nitrate from the Seymour Aquifer	50
B	Wichita Basin chloride control project	Designed to reduce the amount of salt contamination from eight of the Red River Basin's natural salt sources; three of which lie within the Wichita River Basin.	26,500
C	Lake Texoma - authorized (blend)	Blending groundwater with surface water to decrease total dissolved solids concentration.	113,000
C	Tarrant Regional Water District Wetlands Project	Additional tertiary treatment via wetlands for conventionally treated wastewater prior to release into receiving reservoir (Richland-Chambers and Cedar Creek Reservoir)	105,500
E	Arsenic removal facility	Removes naturally occurring arsenic from groundwater that exceeds newly revised drinking water standards	276
E	Integrated water management strategy for the City and County of El Paso - desalination of agricultural drain water	Surface water quality improvement (new this planning cycle): will treat agricultural drain water at the end of the irrigation season, when the level of dissolved salts becomes too high for conventional treatment	2,700
F	Bottled water program	Water quality improvement - no cost effective resolution for current poor quality groundwater source	1
F	Develop Ellenburger Aquifer supplies	Blending groundwater with surface water to decrease concentration of naturally occurring radionuclides	200
F	Develop Hickory Aquifer supplies	Blending groundwater with surface water to decrease concentration of naturally occurring radionuclides	12,160
G	Groundwater-Surface Water Conjunctive Use (Lake Granger Augmentation)	Blending groundwater with surface water to decrease concentration of contaminants	70,246
G	Stonewall, Kent, and Garza Chloride Control Project	Improve surface water quality by using brine recovery wellfields for saline aquifers; this will decrease amount of salt leaching into tributaries to the Brazos River; market brine products to cover annual costs; volume of water with improved water quality undetermined at this time	n/a
H	Brazos Saltwater Barrier	Improve surface water quality in the lower Brazos Basin during low flow periods, by preventing seawater intrusion at raw water intake structures; volume of water with improved water quality undetermined at this time	n/a
I	Saltwater Barrier Conjunctive Operation with Rayburn/Steinhagen	Improve surface water quality by impeding salt water intrusion into the Neches River downstream of reservoirs so released water remains salt free for downstream diversion.	111,000
	Total		**441,663**

TCEQ (Texas Commission on Environmental Quality), 2011, 2008 Texas Water Quality Inventory and 303(d) List; Texas Commission on Environmental Quality, http://www.tceq.texas.gov/waterquality/assessment/08twqi/twqi08.html.