2009

Tensas River Basin

Characterization Report

Louisiana State Reservoir Priority
and Development Program

moffatt & nichol

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2009

Tensas River Basin

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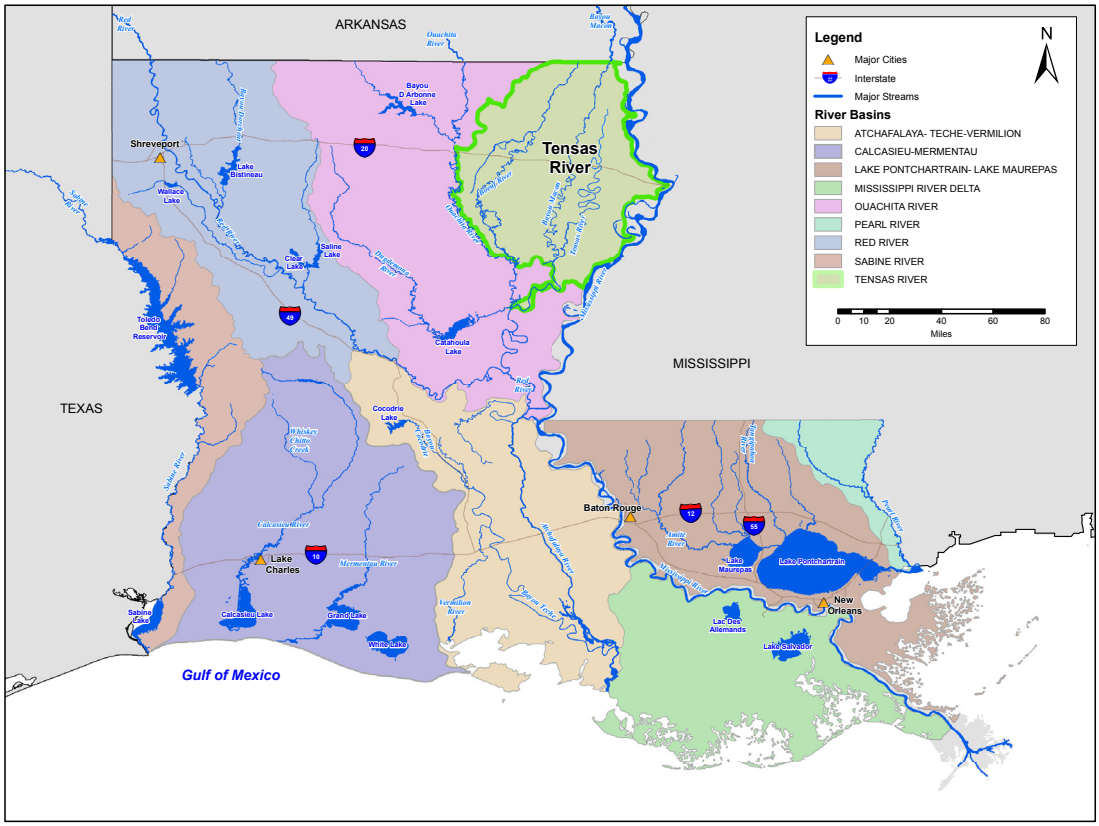
BASIN CHARACTERIZATION REPORT FOR THE TENSAS RIVER BASIN

The Louisiana Department of Transportation and Development (DOTD) is responsible for reviewing and prioritizing proposed reservoir projects for which State of Louisiana (State) funding is being sought, and then recommending projects to the State Legislature. To support reservoir project review, prioritization, and recommendation efforts, DOTD has prepared characterization reports of water resources conditions in each of the nine principal surface water basins in the State. These characterization reports provide an overview of water uses, needs, and concerns, and can be used by applicants for State funding, and by State agencies as they evaluate the applications. The basin characterization reports also contain extensive references that interested parties can use to find more information from Federal, State, and local agencies or other sources. The reports represent a "snapshot" of conditions in early 2009 (or when the references cited in the reports were published).

Based on available data, this basin characterization report provides an overview of the water uses, needs, and key water resources concerns for the Tensas River Basin (TRB) (**Map 1**). Additional technical information on important issues may be provided in separate technical reports.

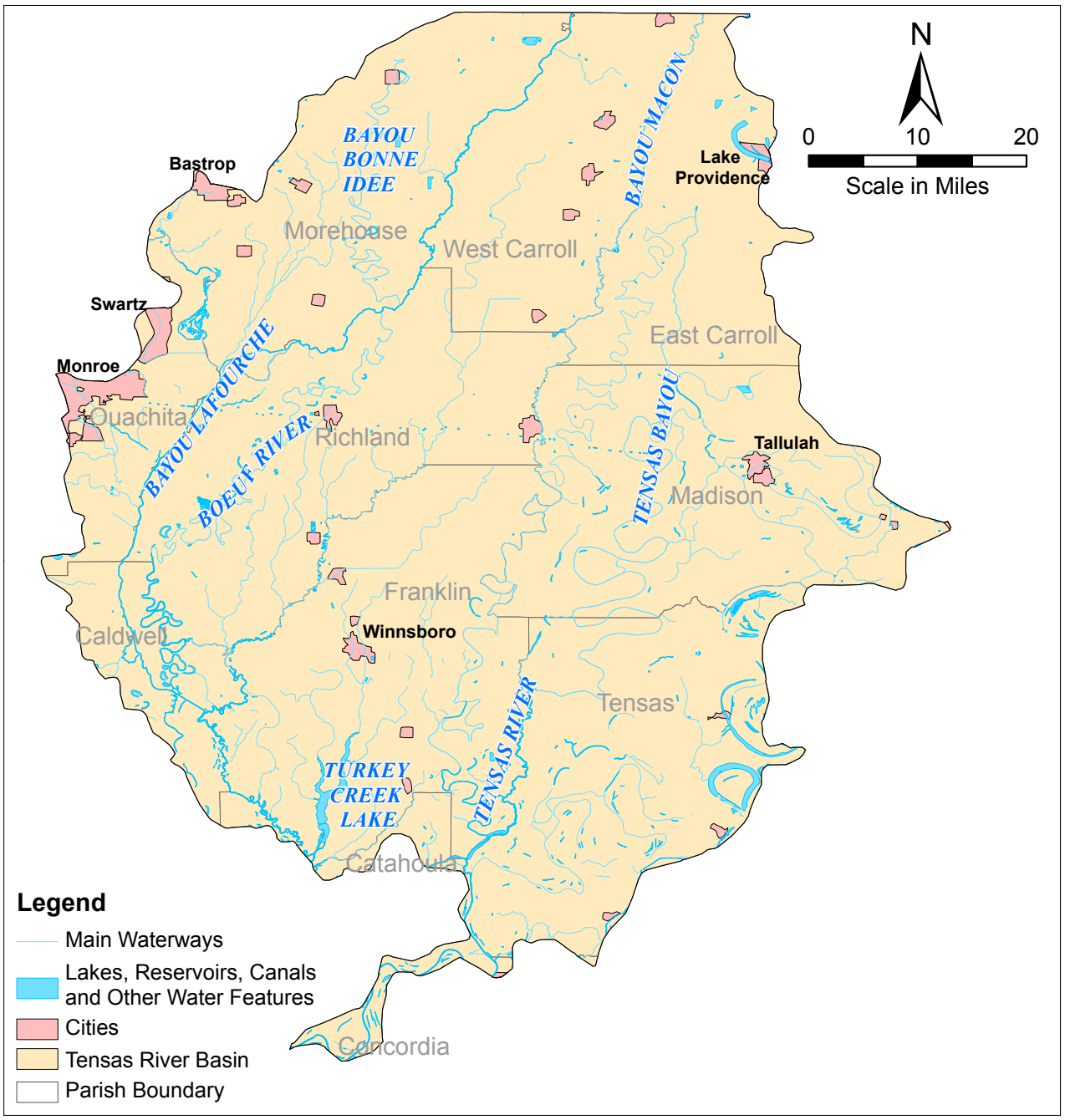
Report Topics **Page**



Map 1. Major Surface Water Basins of Louisiana[1]

BASIN OVERVIEW

The TRB is located in northeastern Louisiana and has an area of 3,978 square miles (see **Map 2**).[2] The TRB is bounded by the Arkansas-Louisiana state line on the north, the Ouachita River Basin (ORB) on the west, and the Atchafalaya-Teche-Vermilion River Basin on the south. The eastern boundary of the TRB is the Mississippi River levee. The TRB is characterized by flat-lying alluvial deposits in the east and slightly higher, terrace-like deposits in the west. Main waterways draining the TRB are Bayou Macon, the Tensas River, and the Boeuf River.[3]



Map 2. Parishes, Main Waterways, and City Boundaries[4]

Eleven parishes are either completely or partly encompassed by the TRB. Little urbanization and industrialization exists in the TRB. Other than the city of Monroe, which extends into the ORB, no other major cities are found in the TRB. **Table 1** shows 2005 population distribution in the TRB by parish. Estimated total population in the TRB in 2005 was 151,345. **Figure 1** shows change in basin population from 1960 to 2005. TRB population has decreased by about 10 percent since 1980.

Principal economic activities in the TRB include agriculture- and forestry-related industries as well as manufacturing.[6] Primary future economic growth areas in the TRB are manufacturing and wholesale and retail businesses. The healthcare industry is also expanding throughout the southern TRB.[7]

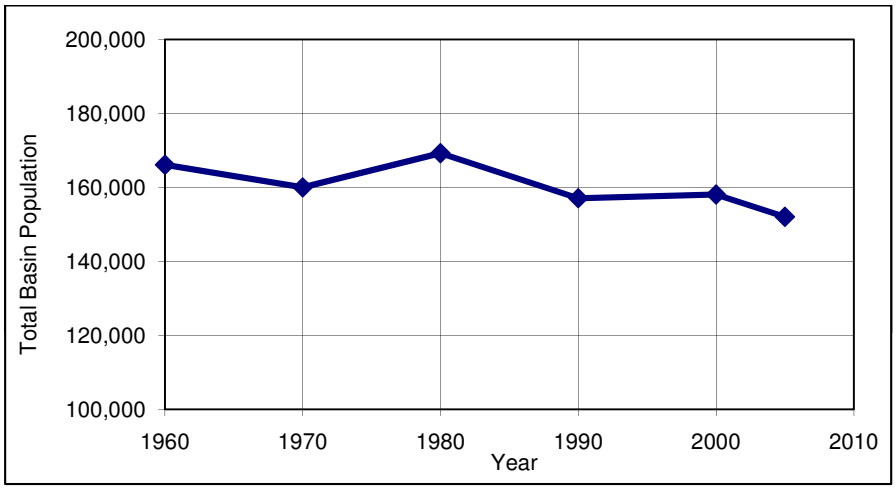


Figure 1. Historical TRB Population

Table 1. TRB Basin Population by Parish in 2005[5]

Parish	Population
Caldwell	1,786
Catahoula	1,021
Concordia	597
East Carroll	7,812
Franklin*	20,060
Madison	11,665
Morehouse	18,764
Ouachita	51,770
Richland*	20,469
Tensas	5,847
West Carroll*	11,553
TOTAL	151,345

*Entire parish located within TRB. Other parishes are located in more than one basin; population estimated for the area within the TRB.

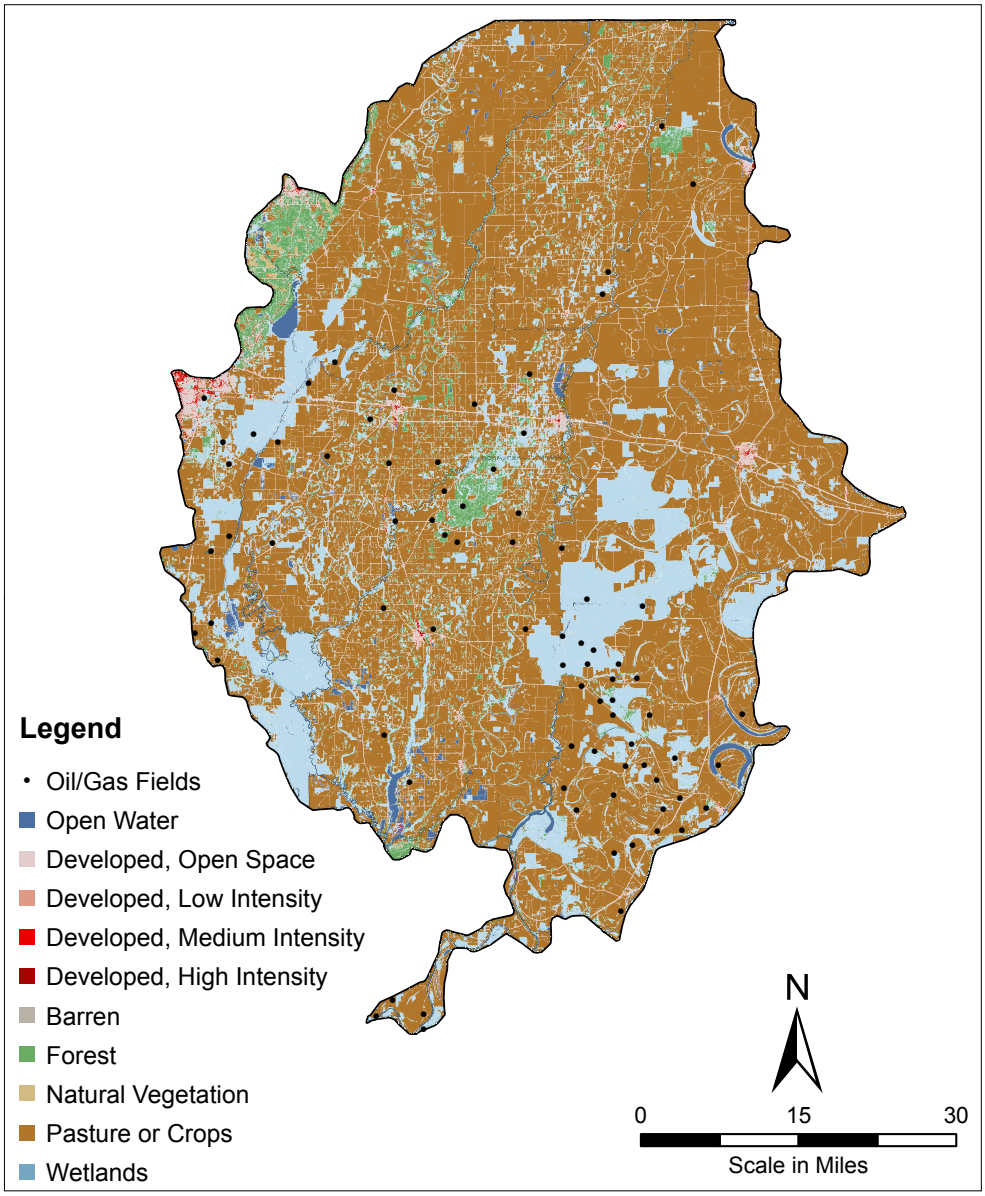
TRB = Tensas River Basin

LAND USE AND LEGAL ENTITIES

Map 3 shows 2003 land uses in the TRB. Principal land uses are pasture and crops, dominate the entire basin. According to a 1984 Louisiana Water Resources Study Commission report, "virtually all suitable lands are now being used for agriculture" and "urbanization and industrialization are of little significance in this basin as compared with others."[8] Economic modeling for the 1992 to 2020 period indicates that forested land uses may decrease slightly in the TRB in the future, and that negligible change in urban land uses is expected.[9]

The TRB contains significant areas of land considered Prime Farmland by the Federal Natural Resources Conservation Service (NRCS).[11] The NRCS must be contacted regarding the proposed irreversible conversion of any Prime Farmland for reservoir construction and water storage.

Oil and gas fields have been drilled in the southern and central TRB (**Map 3**). Oil and gas drilling can require large amounts of water for extraction, which then needs to be disposed, either to surface or groundwater. Existing oil and gas infrastructure and mineral rights holdings may present potential impediments to development of surface water resources. **Table 2** lists legal entities in the TRB that may affect or be affected by water resources development.



Map 3. TRB Land Uses in 2003[10]

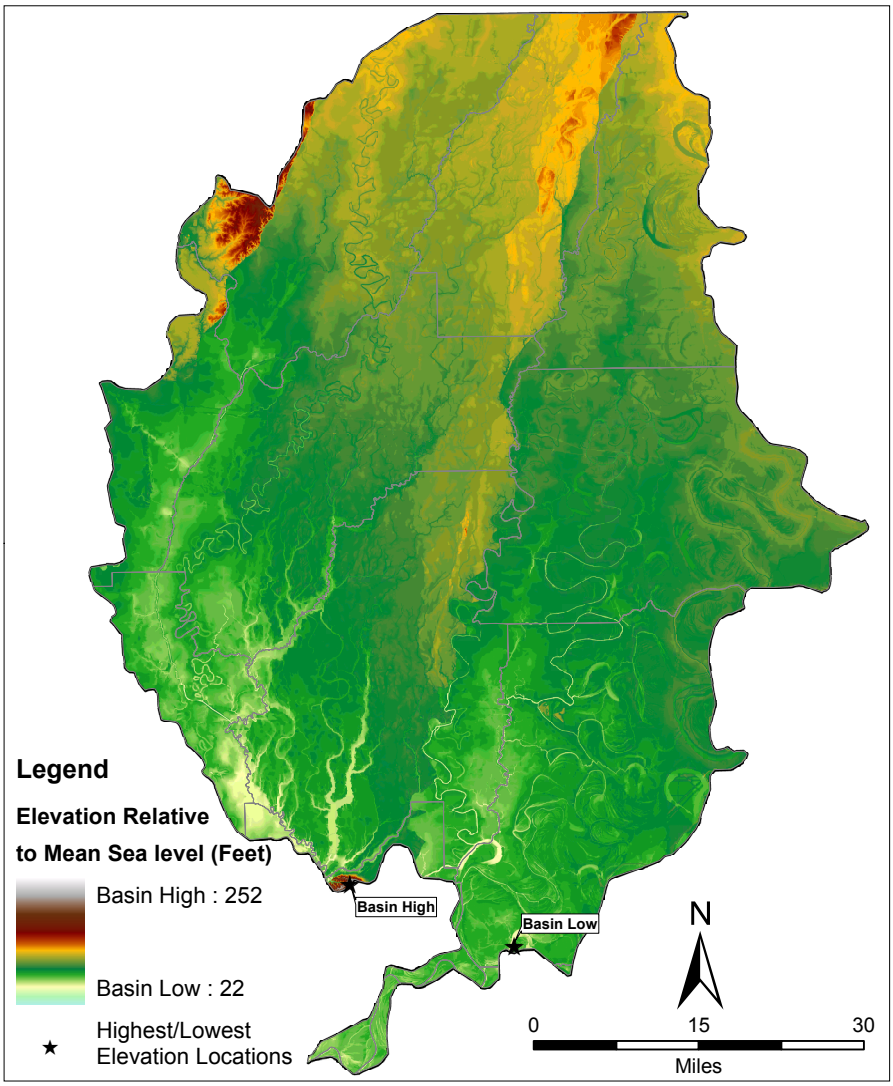
Table 2. TRB Water Resources Legal Entities

Legal Entity	Responsibilities
North Delta Regional Planning and Development District	Planning and development in northeastern Louisiana
Sparta Ground Water Conservation District	Studying ways to put Sparta water to the highest beneficial use in terms of public welfare

TRB = Tensas River Basin

PHYSIOGRAPHIC AND CLIMATIC INFORMATION

Map 4 shows general basin topography. Most of the TRB is low-lying, with a ridge running north to south between the Boeuf and Bayou Macon watersheds in the northern TRB. The TRB is dominated by the Alluvial Plains physiographic division, which is characterized by flat land with interconnecting streams allowing flow between some river basins. The lowest elevation within the TRB is 22 feet above mean sea level, located in Tensas Parish. The highest elevation, 252 feet above mean sea level, is located in Catahoula Parish, on the southern basin boundary.



Map 4. TRB Topography[12]

Soils in the Alluvial Plains physiographic region in the TRB are dominated by loamy, clayey, sandy, and alluvial deposits. Soil types and geomorphic features found in the TRB include loamy and clayey alluvial natural levees and low terraces, sandy alluvial terraces and floodplains, and mixed loess.[13]

Average annual rainfall throughout the TRB varies geographically from 55 to 60 inches per year, increasing from north to south.[14] **Figure 2** shows historical annual precipitation at Winnsboro, which varies between about 30 and 80 inches per year, with a historical average of about 55 inches. Although rainfall and the resulting runoff is plentiful in the TRB, the historical record shows that extended dry periods have occurred, such as in the 1960s. Extended dry periods can increase water demand, particularly for irrigation water, and stress surface water and groundwater supplies. Average annual temperature generally increases from north to south from 63 to 66 degrees Fahrenheit (°F) in the TRB.[14] Average annual high temperature at Monroe in the warmest months, July and August, is 94°F; average annual low temperature in the coldest month, January, is 33°F.

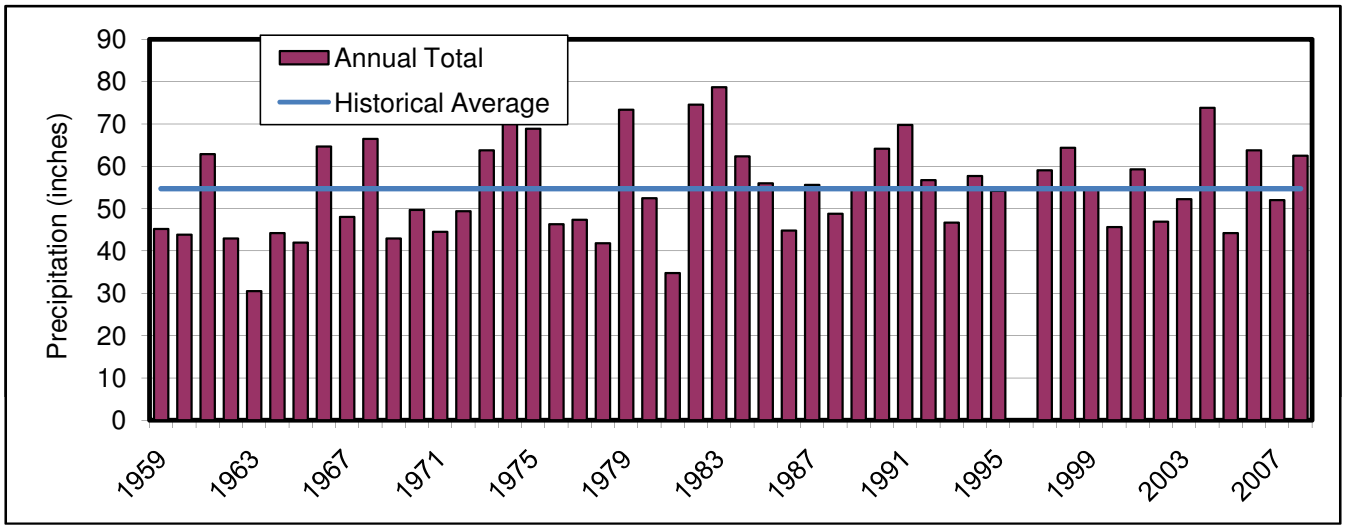


Figure 2. Historical Annual Precipitation at Winnsboro[14]

WATER USE

Water use in the TRB is summarized in **Table 3** by sector, water type, parish, and surface water body, as reported for 2005. **Table 3** is based on water withdrawal data, which may be greater than total water consumptive use. For example, water withdrawn for irrigation is not entirely consumed by the crops to which it is applied, allowing a percentage of the withdrawn water to return to a waterway. In 2005, total water use was about 300 million gallons per day (mgd). This water demand was mainly met using groundwater, with an additional, smaller amount of surface water. General irrigation used the largest volume of water, totaling over 150 mgd, followed closely by rice irrigation (almost 100 mgd) and more distantly by public supply (nearly 28 mgd). Total irrigation use comprised 83 percent of total TRB water use in 2005. Morehouse Parish used the largest amount of water (greater than 68 mgd), followed by Franklin and East Carroll parishes, each using over 40 mgd. The city of Monroe was the single municipal water supplier in the TRB that reported surface water use exceeding 2 mgd in 2005. In that year, Monroe reported total surface water use of 11 mgd, some of which was withdrawn from Bayou de Siard, located on the border between the TRB and ORB. Other water sources reported by Monroe are located outside the TRB.[16]

In 2005, total groundwater use was nearly 237 mgd, nearly 80 percent of the total reported water use in the TRB. Because groundwater use is not reported by surface water basin, individual parish groundwater use was estimated by multiplying total parish groundwater use by the percentage of

total parish population within the TRB (**Table 3**); actual groundwater use by parish may differ from this estimation. In 2005, at least half of total reported groundwater withdrawals were from the Mississippi River Alluvial Aquifer. Most of the reported water withdrawn from this aquifer was by the agriculture and aquaculture sectors. Total Mississippi River Alluvial Aquifer use in the TRB was estimated by summing groundwater use in parishes with populations located almost entirely within the TRB. This estimate is 162 mgd, with the following breakdown by parish:[17]

- East Carroll – 34 mgd
- Franklin – 46 mgd
- Madison – 19 mgd
- Richland – 25 mgd
- Tensas – 15 mgd
- West Carroll - 23 mgd

General and rice irrigation used the majority of surface water withdrawn in the TRB in 2005. Public supply used about 12 mgd, 18 percent of total surface water use. Bayou Macon, Bayou de Siard, and the Boeuf River served as major surface water sources in 2005. The Mississippi River does not serve as a major source of surface water in the Louisiana in the TRB.[18]

Figure 3 shows trends in groundwater and surface water use in the TRB at 5-year intervals from 1990. Use of groundwater for irrigation increased from 89 mgd in 1990 to nearly 200 mgd in 2005. Public supply use of groundwater fluctuated between 13 and 16 mgd during this same period. Use of surface water for irrigation increased, from 19 mgd in 1990 to 54 mgd in 2005. Other substantial surface water uses, aquaculture and public supply, remained steady during this period.

Per capita water use in 2005 (based on reported rural domestic and public supply uses by parish, and estimated parish population) for TRB parishes varied from 106 gallons per capita (person) per day (gpcd) in Morehouse Parish to 196 gpcd in Caldwell Parish. The reason for this substantial difference in per capita water use between parishes is unclear.

Availability and reliability of water supplies to meet agricultural demand in the northern TRB is the primary water use concern in the basin.[2] Potential increase in oil and gas extraction could result in additional future water use and raise future water availability concerns.

Table 3. Water Use in the TRB in 2005[17]

Sector	Surface Water (mgd)	Groundwater (mgd)
Aquaculture	0.2	14.0
General irrigation	33.1	118.0
Industrial	0.1	7.4
Livestock	0.2	0.3
Power generation	0.0	0.0
Public supply	11.6	16.0
Rice irrigation	20.4	79.1
Rural domestic	0.0	1.5
TOTAL	65.5	236.5

Surface Water Body	Use (mgd)
Bayou de Siard	11.1
Bayou Lafourche	5.2
Bayou Macon	12.0
Big Creek	3.1
Big Cypress Creek	4.5
Boeuf River	8.0
Joes Bayou	1.5
Lake Bruin	1.2
Other (not listed)	19.0
TOTAL	65.5

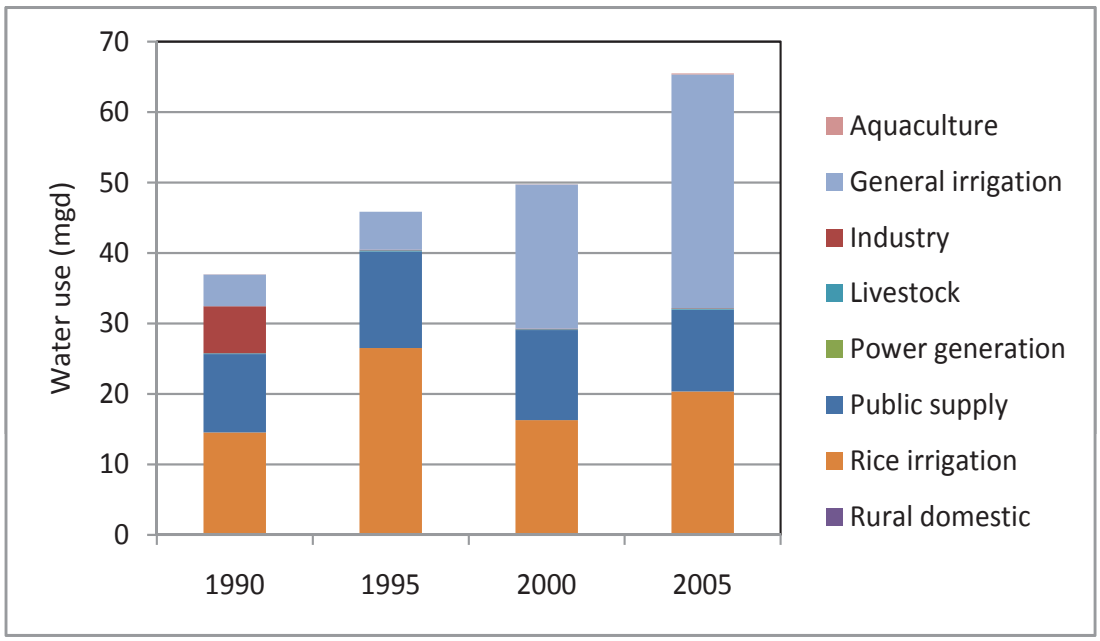
Sector	Surface Water (mgd)	Groundwater* (mgd)
Caldwell	1.5	0.4
Catahoula	0	1.9
East Carroll	9.3	33.7
Franklin	5.2	46.1
Madison	1.2	18.6
Morehouse	6.5	61.7
Ouachita	22.6	8.1
Richland	13.0	26.2
Tensas	1.9	14.9
West Carroll	4.3	24.9
TOTAL	65.5	236.5

*Groundwater use estimated for parishes with at least five percent of their population within the TRB.

mgd=million gallons per day

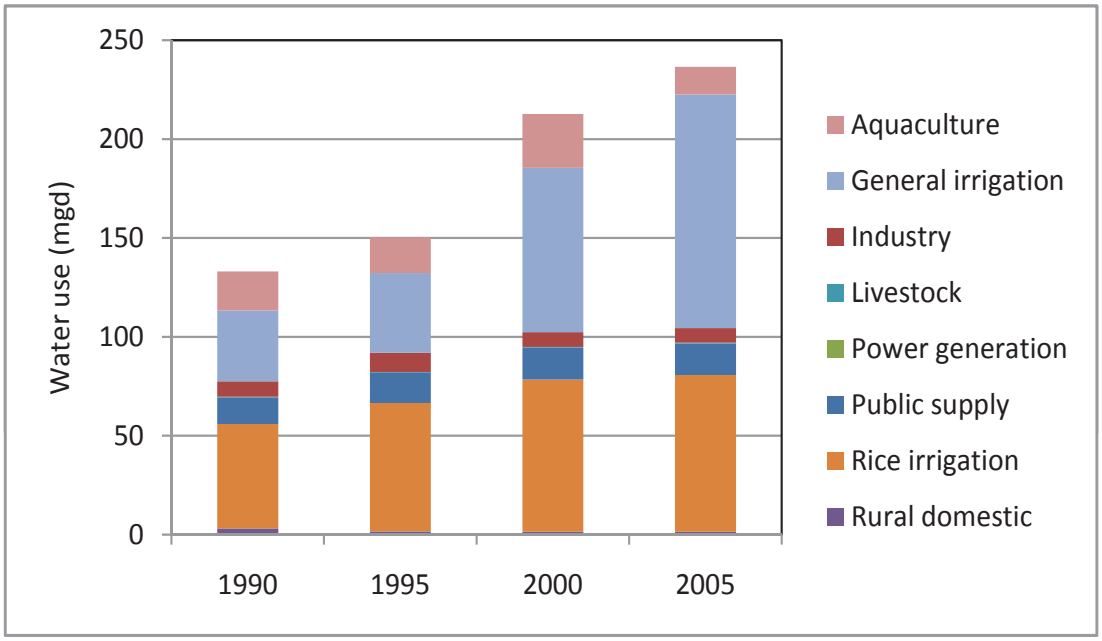
TRB = Tensas River Basin

Recent Historical Surface Water Use



mgd=million gallons per day

Recent Historical Groundwater Use

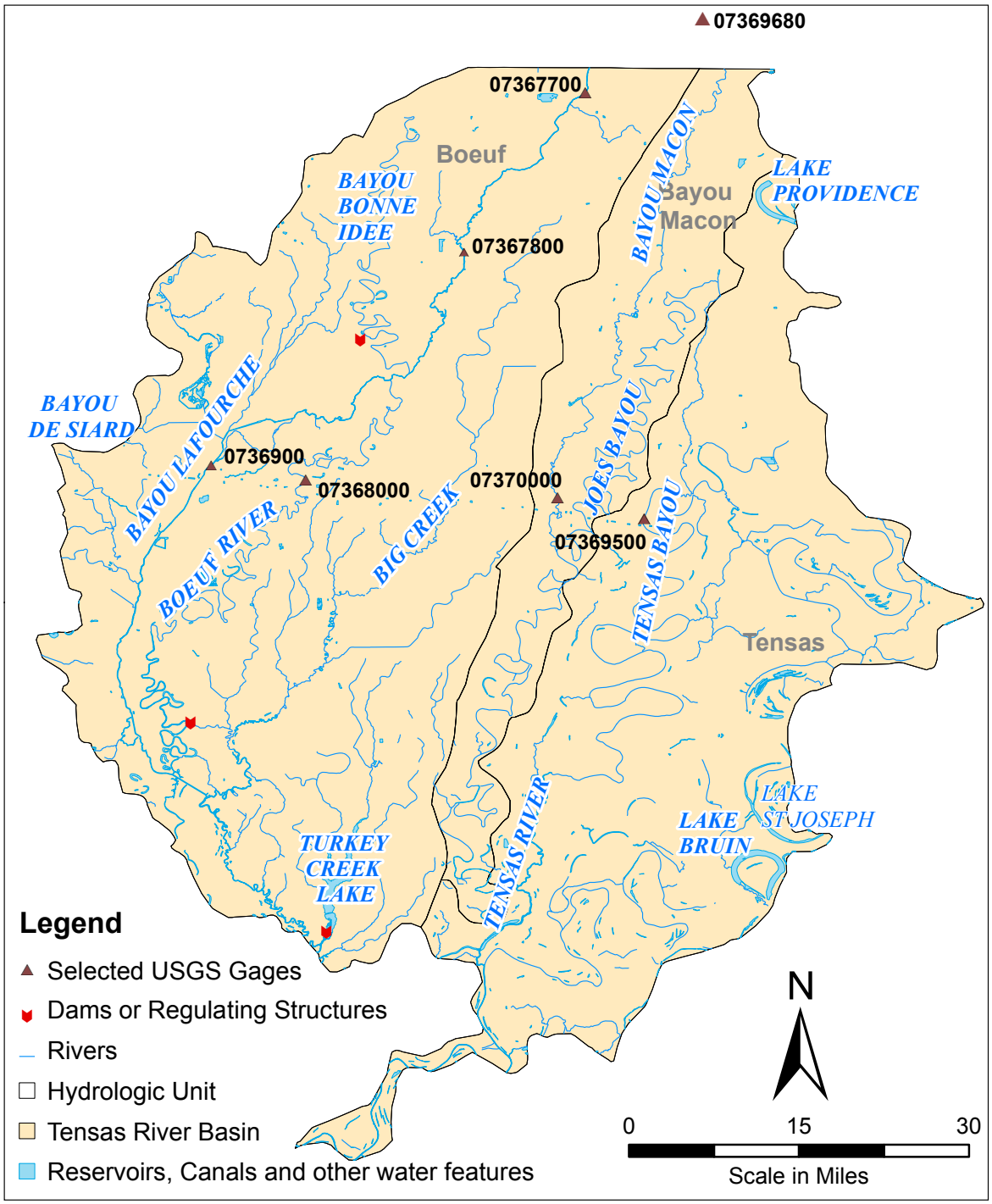


mgd=million gallons per day

Figure 3. Trends in Water Use in TRB[19]

SURFACE WATER

Primary surface water features in the TRB include streams, bayous, rivers, reservoirs, and canals such as the Tensas River, Boeuf River, Bayou Lafourche, and Bayou Macon, as shown in **Map 5**. **Map 5** also shows the three subwatersheds, or hydrologic units, delineated by the U. S. Geological Survey (USGS), and stream gages referenced in this report. An interconnecting system of bayous and drainage ditches allows exchange of flows between streams and bayous, depending on hydrologic conditions and river stages. Baseflow of many streams is provided by the Mississippi River Alluvial Aquifer, which underlies most of the TRB.[8] The TRB does not contain any streams designated under Louisiana's Natural and Scenic River System.



Map 5. Surface Water Features[20]

Extensive surface water and groundwater data for Louisiana, including gaged streamflows and lake levels, is available through the USGS National Water Information System (NWIS) Web site.[21] Some gages in the TRB only measure stage, with undefined stage-discharge relationships. Streamflow statistics for selected TRB gages with long-term streamflow records are summarized in **Table 4**.

Statistics summarized in **Table 4** can be useful for various purposes. The 7-day low flow with a recurrence interval of 10 years (7Q10) is the statistic used to calculate available dilution in surface water discharge permits. Water bodies with low 7Q10 flows, less than a few cubic feet per second (cfs), have extended periods of low flows. For example, the Boeuf River near the State line has a 7Q10 flow of 0 cfs, and several instances of flows of 0 cfs have been gaged at both the State line and at Girard. Similarly, several instances of flows of 0 cfs, as well as some instances of reverse flows, have been gaged on Bayou Lafourche near Crew Lake, although the 7Q10 flow has not been calculated (**Table 4**). Streams like these, with periods of low or no flow, would not be good candidates for reliable water supplies without the construction of storage reservoirs. Peak flows, including maximum instantaneous discharge, and streamflow exceeded by only 10 percent of flows, are useful for characterizing flooding and high-flow conditions on a stream.

Figure 4 shows monthly average flows for selected gages in the TRB. All summarized streams display considerable seasonal variation, which is most apparent in larger rivers. Bayou Lafourche near Crew Lake and Bayou Macon near Dehli show considerable seasonal variation in streamflow, with monthly average flows in late summer of less than 500 cfs, and monthly average flows in spring exceeding 3,000 and 1,000 cfs, respectively. Bayou Macon at Eudora, the Boeuf River, and the Tensas River have monthly average flows of about 100 cfs in the fall, though flows exceed 400 cfs in winter and early spring.

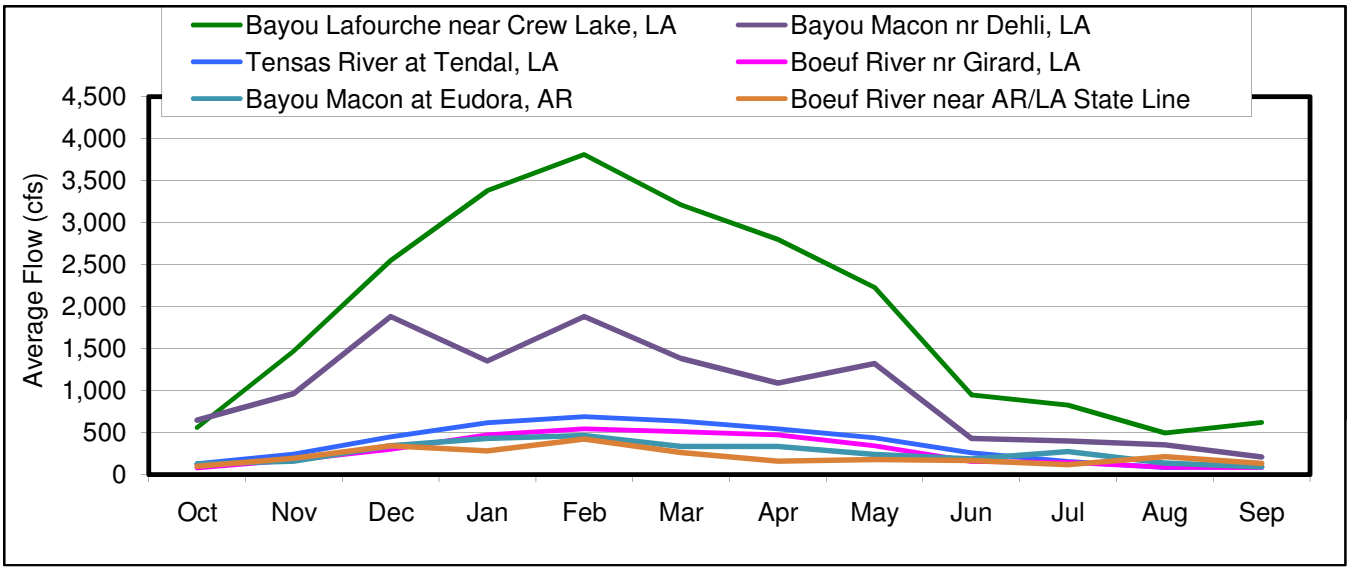
Published characteristics of four major lakes and reservoirs in the TRB are summarized in **Table 5**. Lake Providence, Lake St. Joseph, and Lake Bruin are all oxbow lakes. Turkey Creek Lake is a reservoir with normal storage of 34,000 acre-feet.

Table 4. Historical Streamflow Statistics for Selected Gages[22]

Stream Gage Informaiton			Period of Record Streamflow Statistics (cfs)				Percent of Streamflows Exceed (cfs)		
				Instantaneous					
Location (USGS Gage)	Drainage Area (mi^2)	Period of Record	Annual Average	Max. Peak (date)	Low Flow (date)	7Q10[23]	10	50	90
Tensas River at Tendal, LA (07369500)	309[a]	1935 - present	329[b]	4,610 12/19/48	1.1 9/20/00	4.1	NA	NA	NA
Boeuf River near State line (07367700)[c]	785[a]	1957 present	340[d]	16,500 2/11/66	0 several	0	NA	NA	NA
Boeuf River near Girard, LA (07368000)[e]	1,226[a]	1938 – present	285	3,070 5/2/58	0 several	NA	924	83	13
Bayou Macon at Eudora, AR (07369680) [6 miles upstream of State line]	500	1988 - present	258	4,280 4/23/95	5.1 4/29/91	NA	618	99	52
Bayou Macon near Delhi, LA (07370000)	782[a]	1935-1992[f]	975[b]	12,600 4/29/91	0 several	24	NA	NA	NA
Bayou Lafourche near Crew Lake, LA (07369000)[e]	361[a]	1938 - present	1,866[b]	38,700 12/2/91	0 (RF) several	NA	NA	NA	NA

[a] Interconnecting system of bayous and drainage ditches produces an interchange of flow under varying conditions – drainage basin limits are somewhat arbitrary.
b Average discharge for period of record
c Since 1986, records daily discharge below 3,950 cfs only. In extreme floods, considerable flow bypasses station
d Based on incomplete data (due to limitations in recording flow) on USGS website for years 1984 - 2008
e Boeuf River and Bayou Lafourche connected by a canal upstream of gages
f Since 1992 only gage height and annual maximum discharge recorded

7Q10=7-day low flow with 10-year recurrence
Avg.=average
cfs=cubic foot per second
LA=Louisiana
Max.=maximum
mi^2=square mile
NA=not available in reference
RF=reverse flow noted at times
USGS=U.S. Geological Survey



cfs=cubic feet per second

Figure 4. Historical Monthly Average Streamflow for Selected Gages[24]

Table 5. Characteristics of Major TRB Lakes and Reservoirs

Name	Surface Area (acres)	Normal Storage (acre-feet)[25]
Lake Bruin	2,340	NA
Lake Providence	1,230	NA
Lake St. Joseph	1,200	NA
Turkey Creek Lake	2,100	34,000

TRB = Tensas River Basin

Surface Water Quality

The 303(d) list (named after Section 303(d) of the Federal Clean Water Act) included in Louisiana's Integrated Water Quality Report provides an overview of surface water locations where water quality standards are not met.[26] In these cases, designated uses of the water bodies, such as fish and wildlife propagation and recreation, may be impaired. Stream and lake sub-segments on the 2006 303(d) list in the TRB are shown in **Map 6**.

Table 6 summarizes the number of stream and lake sub-segments in the TRB that are on the 2006 303(d) list, and identifies impaired uses and parameters causing impairment. Water quality standards for fish and wildlife propagation, the most frequently affected use, are not met in 47 sub-segments in the TRB. Turbidity and total suspended solids, both indicators of water clarity, are the most common parameters causing impairment. Carbofurans (insecticides), DDT (insecticide), and dissolved oxygen are also common causes of impairment for aquatic life.

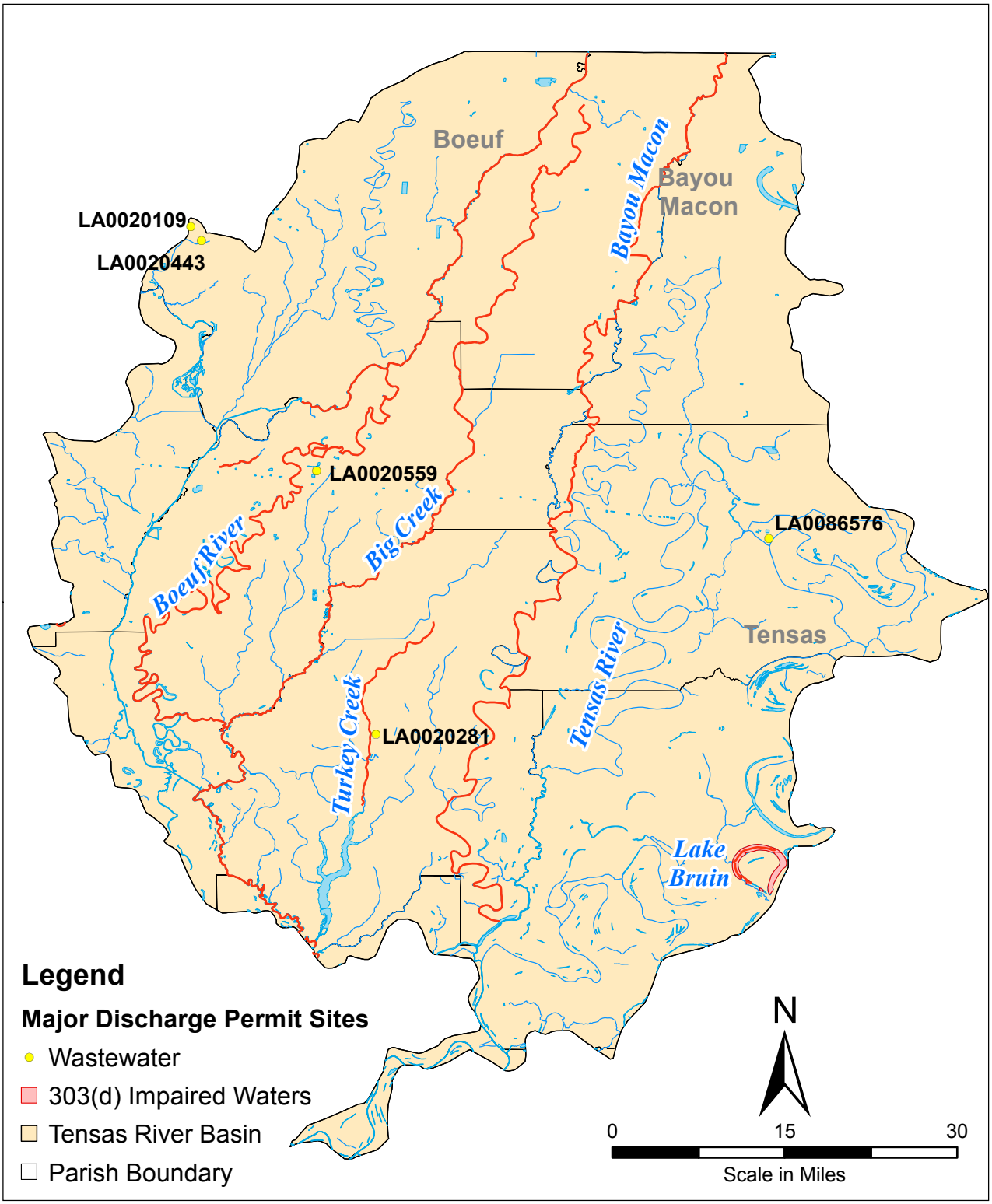
Water quality issues of turbidity, low dissolved oxygen, pesticides, and insecticides in the TRB have been attributed to agricultural land use.[26] Elevated suspended solids concentrations in TRB surface waters are thought to result from slight to severe erosion that occurs on agricultural lands throughout the basin. The chemical composition of local soils is thought to make them particularly vulnerable to erosion.[8] Dioxin impairments in the TRB have been attributed to industrial point source discharge.[26]

Table 6. Summary of TRB Surface Water Quality Impairments[26]

Impaired Use	Sub-segments
Fish and wildlife propagation	47
Limited aquatic life and wildlife	3
Primary contact recreation	1
Secondary contact recreation	1

FWP=fish and wildlife propagation
LAL=limited aquatic life and wildlife
PCR=primary contact recreation (swimming)
SCR=secondary contact recreation (boating)
TRB=Tensas River Basin

Parameter Causing Impairment (affected use)	Sub-segments
Turbidity (FWP)	9
Suspended solids (FWP)	8
Dissolved Oxygen (FWP and LAL)	7
Carbofuran (insecticide) (FWP)	5
DDT (insecticide) (FWP)	5
Nutrients (FWP)	4
Dioxin (FWP and LAL)	3
Mercury (FWP)	2
Fecal coliform (PCR and SCR)	2
Toxaphene (insecticide) (FWP)	2
Atrazine (herbicide) (FWP)	1
Sedimentation/siltation (FWP)	1
Chloride (FWP)	1
Methyl Parathion (insecticide) (FWP)	1



Map 6. SRB Impaired Waters from 303(d) List and Major Permitted Discharge Sites[27]

Permitted Surface Water Discharges

The Louisiana Department of Environmental Quality (LDEQ) issues permits for discharges of municipal and industrial wastewater. Permitted discharge locations categorized by the U.S. Environmental Protection Agency (USEPA) as "major" in the TRB are shown in **Map 6**. Major municipal wastewater discharges are summarized in **Table 7**; no major industrial discharges have been permitted in the TRB. Additional information on all dischargers in Louisiana can be obtained from LDEQ through their public records request process.[28]

The city of Bastrop wastewater treatment facility has the largest municipal discharge at 4 mgd, followed by city of Tallulah at 2.6 mgd. Discharge permit conditions are based on receiving-water low-flow quantity and quality. Future water development projects that change low-flow quantity or quality at the discharge location could affect the ability of permit holders to comply with permit conditions.

Table 7. Major Municipal Wastewater Discharge Permits in the TRB[29]

Discharger	Permit Number	Permitted Flow (mgd)	Receiving Water	Parish
Bastrop, City of	LA0020443	4	Staulkinghead Creek	Morehouse
Bastrop, City of, West Pond	LA0020109	0.4	Tributary to Boeuf River	Morehouse
Tallulah, City of	LA0086576	2.6	Panola Bayou to Roundaway Bayou	Madison
Rayville, Town of	LA0020559	1.5	Boeuf River	Richland
Winnsboro, Town of	LA0020281	1.2	Turkey Creek Lake	Franklin

Information presented in this table is directly from USEPA (2009a). For detailed explanation, this reference should be consulted.
mgd =million gallons per day
TRB = Tensas River Basin

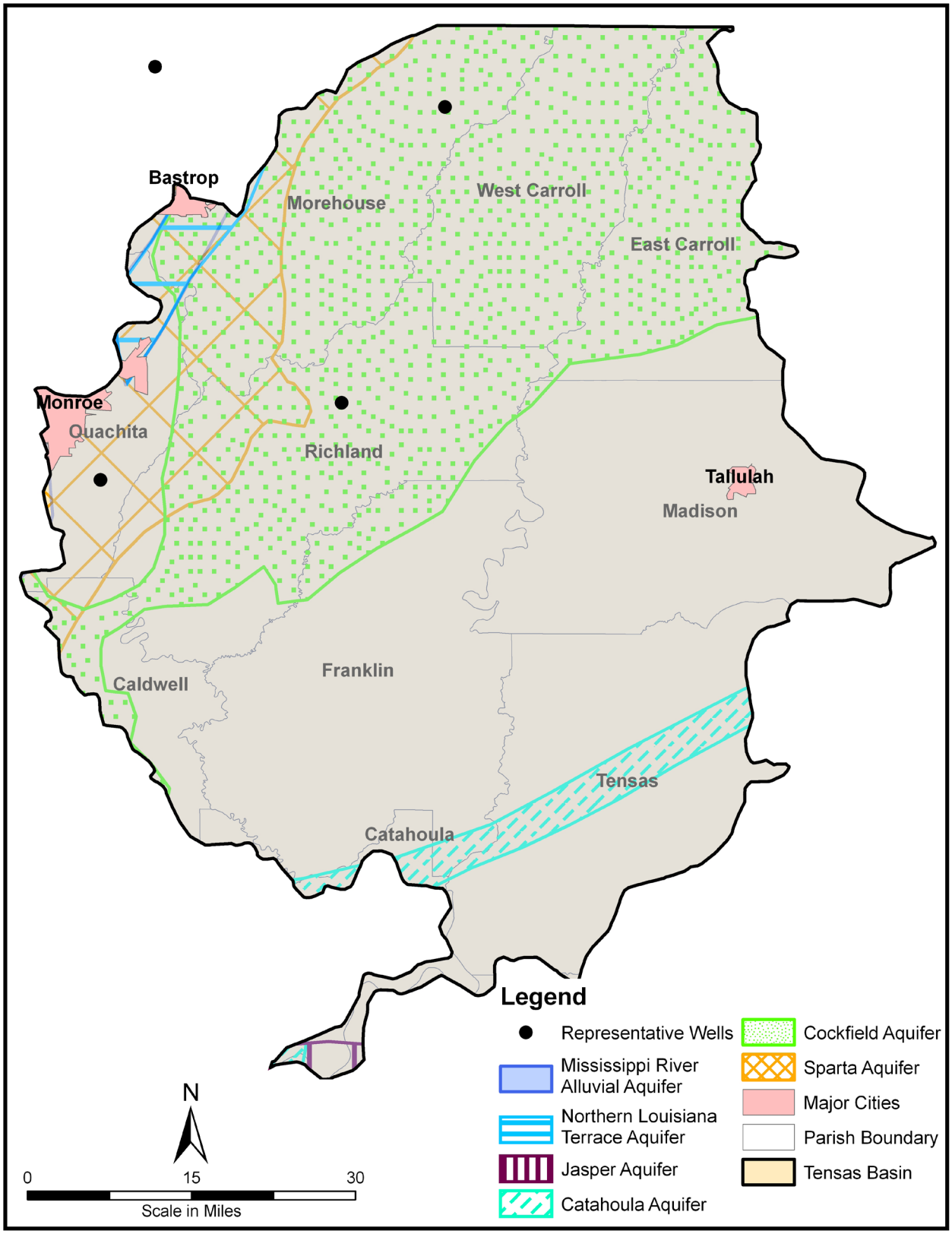
GROUNDWATER

The State has registered about 2,800 water wells in the TRB.[21] Most wells are completed in the following major aquifers underlying parts of the TRB:

- Mississippi River Alluvial Aquifer
- Northern Louisiana Terrace Aquifer
- Jasper Aquifer
- Catahoula Aquifer
- Cockfield Aquifer
- Sparta Aquifer

Major aquifers in the TRB are shown in **Map 7** and their characteristics are summarized in **Table 8**. Aquifer areas overlap because the aquifers occur at different depths. Although the Northern Louisiana Terrace, Jasper, and Catahoula aquifers extend into the TRB, they are not heavily utilized in the basin and are not discussed in this report.

Figure 5 shows water levels in the most heavily used aquifers in the TRB. Historical data from well Ou-401A, completed in the Sparta Aquifer in Ouachita Parish, show a 1-foot to 3-foot annual decline in groundwater levels from 1995 to 2006. Historical data from well Mo-350, also completed in the Sparta Aquifer, suggest a similar decline in groundwater levels in Morehouse Parish. Comparison of USGS data from 1996 and 2005 indicates that groundwater levels decreased by about 10 feet in the eastern Sparta Aquifer in the TRB during this period.[31] The Sparta Aquifer has been pumped extensively across northern Louisiana and Arkansas for public supply and industrial use. Long-term pumping of large amounts of groundwater can reduce the volume of groundwater in aquifer storage and cause localized areas of significant drop in groundwater levels, resulting in decreased well yields. Eventually, this can lead to subsidence, the irreversible loss of aquifer storage capacity. Since the mid-1990s, declining water levels in the Sparta Aquifer in southern Arkansas and northern Louisiana have been problematic, leading to declaration by the Louisiana Department of Natural Resources (LDNR) Commissioner of Conservation of three Areas of Groundwater Concern in the Sparta Aquifer in neighboring ORB.[32] Implementation of conservation



Map 7. Spatial Extent of Principal TRB Aquifers[30]

Table 8. Overview of TRB Major Aquifer Characteristics[2]

Aquifer	Range of Thickness of Freshwater Interval (feet)	Typical Well Yields (gpm)	Hydraulic Conductivity (feet/day)	Specific Capacity (gal/min/ft of drawdown)	Depth to Groundwater in 2005 (feet)[21]
Mississippi River Alluvial	50 - 500	500 – 4,000 7,000 (large capacity)	10 - 530	5 - 90	8 - 24
Northern Louisiana Terrace	25 – 240	100 - 1700	150 – 270	1 – 50	NA
Jasper	50 – 2,400	40 – 800 3,000 (large capacity)	20 – 260	2 – 30	NA
Catahoula	50 – 450	50 – 400	20 – 260	2 – 30	NA
Cockfield	50 – 600	50 – 500 700 (large capacity)	25 – 100	1.5 – 7.5	9 - 33
Sparta	50 – 700	100 – 1,800	25 – 100	1.5 – 7.5	115 - 180

gpm=gallons per minute
gal/min/ft=gallons per minute per foot of drawdown
NA=not available
TRB = Tensas River Basin

measures has reduced groundwater use, and groundwater levels have increased in recent years, particularly in the portion of the Sparta aquifer underlying Arkansas.[33] Furthermore, a joint study between the USGS and the Sparta Groundwater Conservation District was conducted to monitor groundwater levels and groundwater quality, as well as to develop a groundwater model.

Historical data from well Mo-708, completed in the Cockfield Aquifer in Morehouse Parish, suggest that groundwater levels have remained relatively stable since the late 1980s, despite a slight decline and recovery before and after 1999, respectively. Historical data from well Ri-89, completed in the Cockfield Aquifer in Richland Parish, also indicate that groundwater levels have remained stable since the 1980s. in the TRB, the Cockfield Aquifer is mainly recharged by infiltration from the Mississippi River Alluvial Aquifer, particularly where the two aquifers are in direct contact east of the Ouachita River. Consequently, levels in the Cockfield Aquifer closely parallel those of the overlying alluvial aquifer.[34]

The Mississippi River Alluvial Aquifer is primarily used for irrigation and aquaculture in the TRB.[17] The aquifer is hydraulically connected with the Mississippi River and its major streams, and is recharged by direct infiltration of rainfall, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. Groundwater levels fluctuate seasonally in response to precipitation and river stage.[35] Because of rapid recharge from overlying surface water, this aquifer does not show long-term groundwater level decline.

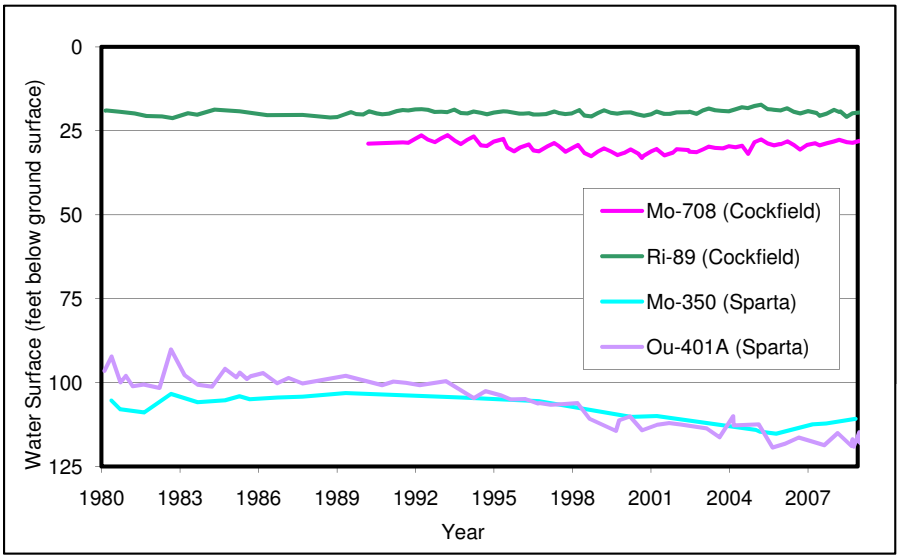


Figure 5. Historical Trends in TRB Groundwater Levels in Representative Wells[21]

Groundwater Quality

Groundwater quality issues identified in the 2005 and 2006 LDEQ Baseline Monitoring Program reports are summarized by aquifer in Table 9. Water in five wells in the Mississippi River Alluvial Aquifer exceeded the Federal primary drinking water standard for arsenic in 2006; however, only one well, located in Franklin Parish, is located within the TRB. This well was subsequently resampled, and the more recently measured arsenic level was below the Federal standard. Water in no other tested wells in the major TRB aquifers exceeded Federal primary drinking water standards. As shown in Table 9, water in some wells in major TRB aquifers exceed secondary standards for pH, total dissolved solids (TDS), color, chloride, and iron.

Groundwater quality is highly spatially variable within the Sparta Aquifer. TDS in the aquifer varies from less than 100 parts per million (ppm) in the western aquifer to over 1,000 ppm in the eastern aquifer.[36] Elevated TDS concentrations can render groundwater less suitable for drinking water supply and irrigation.

Table 9. Secondary Drinking Water Standards Exceedences in Major TRB Aquifers

Aquifer	pH	TDS	Color	Chloride	Iron
Mississippi River Alluvial	■	■	■		■
Northern Louisiana Terrace	■	■		■	■
Jasper: Williamson Creek Carnahan Bayou	 ■	 ■	 ■ ■		 ■
Catahoula					■
Cockfield	■	■	■		■
Sparta	■	■	■	■	■

■ – One or more wells exceeded the secondary standard
TDS=total dissolved solids
TRB = Tensas River Basin

FLOODING

Tensas Parish is subject to backwater flooding as a result of the generally low relief found throughout the lower Mississippi alluvial valley.[37] The northern TRB is affected by headwater flooding from the Boeuf and Tensas rivers and their tributaries; the southern TRB is affected by headwater flooding from the Tensas and Ouachita rivers. Although levees extend along the entire length of the TRB's eastern boundary with the Mississippi River, the southern TRB is also affected by flooding from backwater of the Mississippi River. Flooding is exacerbated within Madison Parish due to the many undefined drainage canals and broad, flat floodplains.[38]

Two major flood control projects located in the TRB include:

- Boeuf and Tensas Rivers and Tributaries – This project provides protection against headwater floods in both Arkansas and Louisiana.
- Red River Backwater Area – This project provides protection to large areas in east-central Louisiana from the effects of backwater flooding from the Mississippi, Red, Ouachita, and Black rivers.

The U.S. Army Corps of Engineers (USACE) has noted a significant citizen concern regarding flooding in Franklin

Parish. However, several plans to improve channels in the TRB were not implemented due to concerns about adverse environmental impacts, particularly loss of bottomland hardwood forest. USACE continues to study regional flooding problems in the TRB and to evaluate benefits and drawbacks of proposed solutions.[3]

Three parishes located in the TRB (Madison, Richland, and Tensas) have become participants in the National Flood Insurance Program (NFIP) offered through the Federal Emergency Management Agency (FEMA). As part of the NFIP, FEMA prepares Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRM) for rivers and bayous prone to damaging floods in a parish; member communities regulate development in floodplains. These studies and maps document flooding problems within parishes and delineate 100-year flood zones along major waterways. Some 100-year flood zones are currently available as geographic information system layers; detailed maps and reports can be obtained from FEMA.[39]

USGS estimated flood flow magnitudes for different return periods at streamflow gages throughout the state, including two gage in the TRB with adequate historical data. This gage is listed in **Table 10**, along with its estimated peak discharges for various recurrence intervals. The USGS analysis is only valid for rural, un-altered waterways. Also included in **Table 10** are peak discharges for major waterways, as reported in the FISs reviewed as a part of this basin characterization.

Table 10. Estimated Peak Flow Discharges of TRB Streams[40]

Source	Location		Flood Magnitude (cfs)			
	Gage Number	Name	2-year	10-year	100-year	500-year
USGS	07367800	Boeuf River near Oak Grove, LA	10,500	17,200	25,600	31,500
	07369500	Tensas River at Tendal, LA	2,880	4,360	6,170	7,290
FIS	Mothiglam Bayou at confluence of Panola Bayou		NA	5,200	6,920	8,150
	Bayou Macon at Highway 80		NA	NA	12,800	NA

cfs=cubic feet per second
FIS= Flood Insurance Studies
LA=Louisiana
NA=not available
USGS=U.S. Geological Survey
TRB = Tensas River Basin

ENVIRONMENTAL AND CULTURAL ISSUES

Environmental and cultural resources are important elements of the quality of life in Louisiana, and can affect siting and operation of water resources facilities, as regulated by State and Federal permitting requirements.

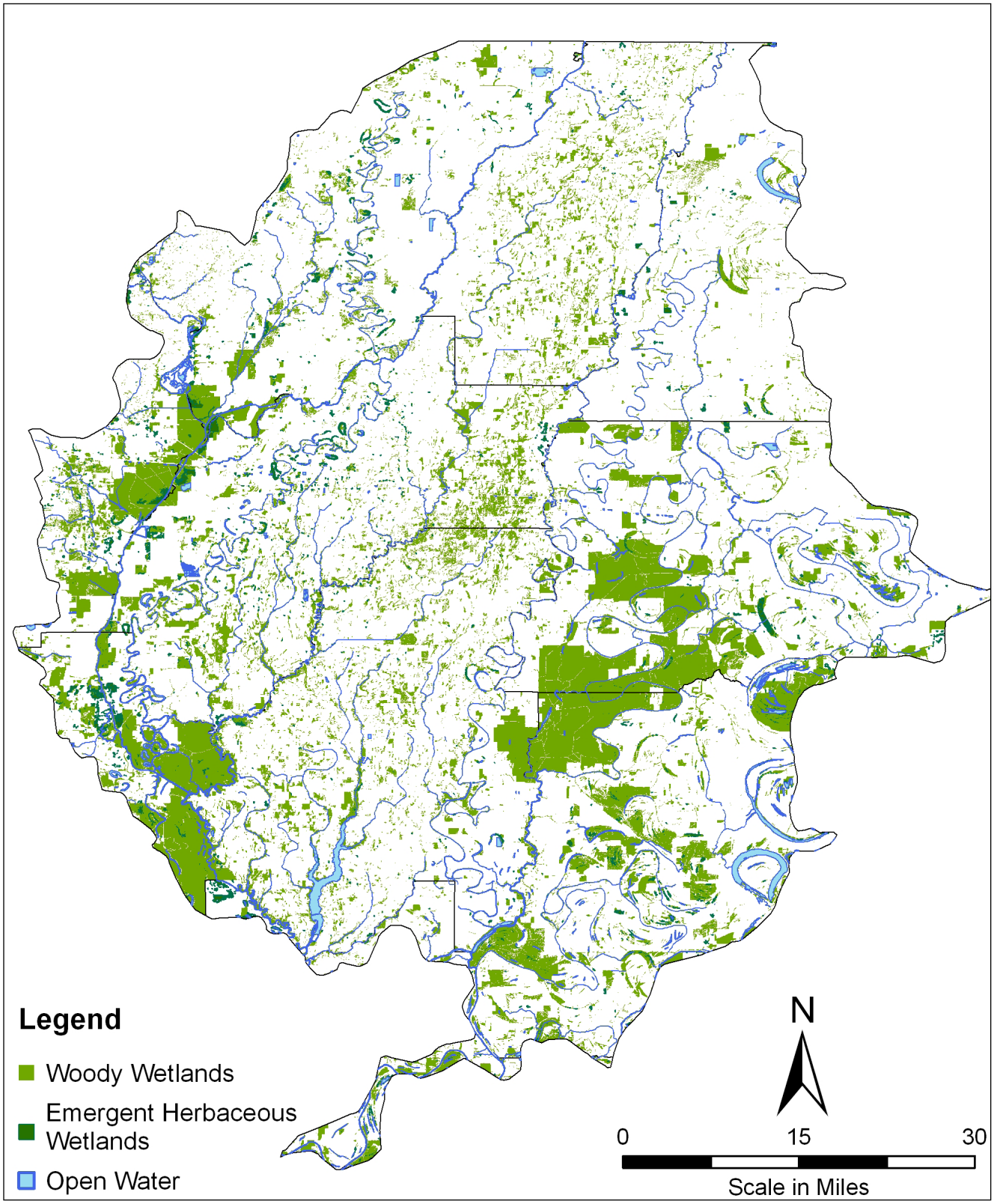
Habitat and Wildlife

The TRB is within the Mississippi River Alluvial Plain ecoregion, as designated by USEPA.[41] Each ecoregion contains a range of habitats, some of which are associated with species of conservation concern. The Louisiana Comprehensive Wildlife Conservation Strategy (Wildlife Action Plan) prioritizes particular terrestrial habitat types within each ecoregion for conservation.[42]

Terrestrial species Federally listed as threatened or endangered that may reside in the TRB are the Louisiana black bear, interior least tern, red-cockaded woodpecker, brown pelican, piping plover, Louisiana pine snake, and earth fruit.[43] The TRB is home to the largest known population of Louisiana black bear in the country.[44]

Aquatic habitats in the TRB support about 118 species of freshwater fishes, 49 species of mussels, and 19 species of crawfish.42 State species of concern in the TRB are two crustacean, four freshwater fish, 16 mussel, and two reptile species. The State regulates aquatic habitat through surface water quality standards in water bodies designated for fish and wildlife propagation.[45] Unlike other surface water basins in northern Louisiana, the U.S. Fish and Wildlife Service (USFWS) has not identified particular surface waters within the TRB that are important for conservation of species Federally listed as threatened or endangered.[46] Simlarly, the Louisiana Department of Wildlife and Fisheries has not yet prioritized aquatic habitats for conservation.

Wetlands are an important environmental resource throughout the United States, particularly in Louisiana. Alteration of these areas often requires a Federal Section 404 permit through USACE. **Map 8** shows areas of wetlands in the TRB. About 19 percent of the TRB's surface area, or 724 square miles, is woody wetlands (i.e., areas where forest or shrubland vegetation accounts for a large portion of the cover, and the soil is periodically saturated or inundated). Less than 1 percent is emergent herbaceous wetlands (i.e., areas where perennial herbaceous vegetation accounts for most of the cover, and the soil is periodically saturated or inundated).[47]

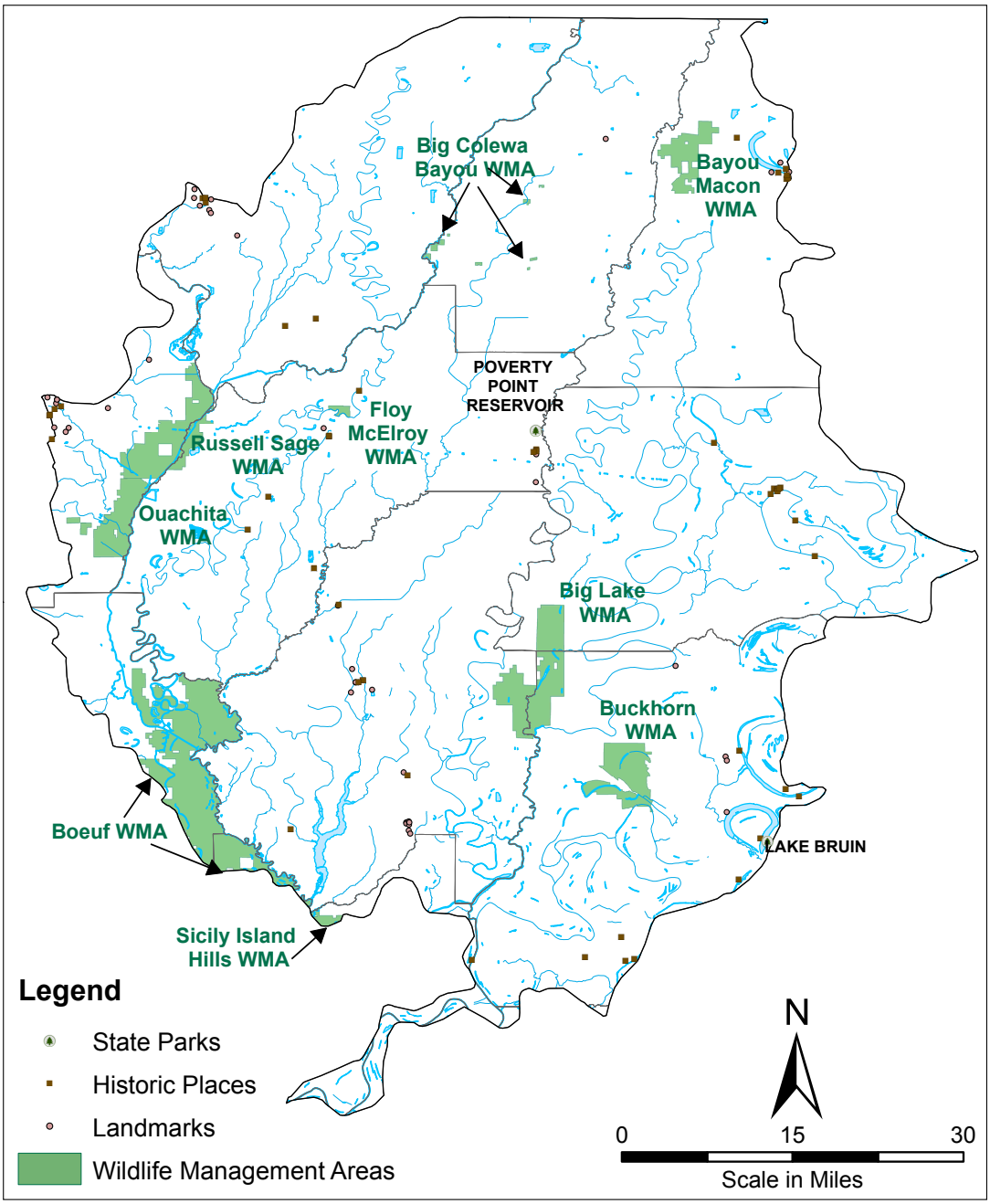


Map 8. Wetlands in the TRB[48]

Cultural Resources

Information on cultural issues and resources is provided by parish-level organizations. Prehistorical (before European colonization) and historical sites are registered with the Louisiana Department of Culture, Recreation, and Tourism (LCRT) and the National Register of Historic Places (NRHP). Featured historic sites in the basin include churches, plantations, lakes, post offices, and schools. Forty-five historic points and seven historic districts are found in the TRB, as shown in **Map 9**. Generalized locations of known cultural resources that could affect reservoir siting or operations are available from the NRHP. Three archaeological sites located in Madison, Richland, and West Caroll parishes are listed on the NRHP in the TRB.[49] Additional information is available from the LCRT, Office of Cultural Development, and Division of Historic Preservation.

No Federally recognized American Indian Tribal Reservations or Service Areas are found in the TRB. The single State-recognized tribe is the Louisiana Choctaw tribe, located in Lasalle and Catahoula parishes.[50] Potentially affected Native American tribes must be notified of any proposed reservoir plans.



Map 9. Cultural and Recreational Resources and Navigable Waterways in the TRB[51]

RECREATION, NAVIGATION, AND HYDROPOWER

Water resources development projects, particularly surface water reservoirs, can provide opportunities for creating and maintaining regional recreation resources. The TRB is widely used for water-oriented recreation, including fishing, swimming, and boating.[8] Nine Wildlife Management Areas and one state park in the TRB serve as hunting and camping grounds for the general public. Specific recreational resources of regional value are shown in **Map 9**.

No major navigable waterways or ports are found within the TRB.

No hydropower projects exist in the TRB. The U.S. Department of Energy has identified several potential sites for microhydropower generation (less than 100 kilowatts) and low power hydropower generation (less than 1 megawatt) on several streams in the TRB.[52] Proposed reservoir projects should evaluate the potential for hydroelectric energy generation.

INTERBASIN AND INTERSTATE ISSUES

The Red River Compact (Compact) is an interstate agreement entered into by the states of Louisiana, Oklahoma, Texas, and Arkansas with the consent of the U.S. Congress that provides for distribution of the waters of the Red River Basin, including the waters of the TRB. The principal purposes of the Compact are the following:

- To promote interstate comity and remove causes of controversy between each affected states by governing the use, control, and distribution of the interstate waters of the Red River and its tributaries.
- To provide an equitable apportionment among the signatory states of the water of the Red River and its tributaries.
- To promote an active program for the control and alleviation of natural deterioration and pollution of the waters of the Red River Basin and to provide for enforcement of the laws related thereto.
- To provide the means for an active program for the conservation of water, protection of lives and property from floods, improvement of water quality, development of navigation, and regulation of flows in the Red River Basin.
- To provide a basis for state or joint state planning and action by ascertaining and identifying each state's share in the interstate waters of the Red River Basin and the apportionment thereof.

SUMMARY OF MAJOR WATER RESOURCES NEEDS

To identify and prioritize statewide water resources issues, a needs assessment of each of the nine major surface water basins within Louisiana was performed. Because the needs assessment provides the foundation for developing reservoir priority evaluation criteria, it focuses on needs that can be addressed by surface water reservoirs. At the same time, the integrated nature of water resources management requires evaluating issues that could not necessarily be solved by, but could be affected by, a reservoir.

Based on the existing compiled information, eight categories of State water resources needs that could be addressed or affected by construction of surface water reservoirs were identified and evaluated. Evaluation criteria were developed for each category to allow interbasin comparison of the needs. To maintain objectivity in the evaluation process, evaluation criteria were developed based on factors that could be evaluated as quantitatively as possible across all basins. High, medium, and low levels of current need were defined based on differences in these factors between basins. Future needs in each basin were assessed by determining whether each current need is increasing, constant, or decreasing. The evaluation criteria are described in detail in the main body of the Statewide Perspective on Water Management Report, to which this basin characterization is an appendix.

The assessed needs in the TRB are summarized below. Details of the assessed needs for all nine major Louisiana surface water basins, as well as a comparison of statewide needs by issue, are presented in the Statewide Perspective on Water Management Report.

Assessed needs in the TRB are shown in **Table 11**, and are discussed below in general order of need, from high-level needs (colored red in **Table 11**) to low-level needs (colored green in **Table 11**).

Due to long-term decline in the Sparta aquifer, the major aquifer in the TRB, groundwater supply was evaluated as a high-level need in the TRB. Declining water levels in the Sparta Aquifer threaten the sustainability of potable water supplies for the area around Monroe in the TRB. Sparta Aquifer issues are complicated by the fact that the aquifer extends into Arkansas, so water development and management activities in one state can affect the other. Furthermore, the possibility of expanded oil and gas production could further stress regional groundwater resources. However, the designation of parts of the Sparta Aquifer as an Area of Groundwater Concern has resulted in adoption of management strategies specified by LDNR, including aggressive water conservation programs and investigation of alternative water sources. With continued implementation of these activities in Louisiana and concurrent actions in Arkansas, the Sparta Aquifer is expected to recover, making groundwater supply of decreasing concern in the future.

Surface water supply was ranked as a medium-level need, with continuing importance in the future. Surface water flows in the TRB in late summer and fall are only 21 to 35 percent of the annual average flow, and there are indications that there is not enough water available to fulfill agricultural demand in the northern TRB. The interconnectedness of surface water systems in the flat terrain makes traditional hydrology and yield studies difficult.

Surface water quality is good in the basin, with relatively few surface water impairments and no drinking water impairments. Surface water and groundwater quality degradation due to agricultural and industrial use may result in constraints to using certain supplies in the future, particularly in high agricultural use areas.

Groundwater quality was ranked as a medium-level need with decreasing

Table 11. Assessed Water Resources Needs in the TRB

Category	Current	Future
Surface Water Supply	medium	–
Surface Water Quality	low	↑
Groundwater Supply	high	↓
Groundwater Quality	medium	↓
Flood Control	medium	–
Environmental Protection and Enhancement	low	↑
Recreation	medium	↓
Navigation	low	–

TRB = Tensas River Basin
Red = high-level need; Yellow=medium-level need; Green=low-level need
↑ = increasing importance
– = same importance
↓ = decreasing importance

importance in the future. Federal secondary drinking water standards have been exceeded in water in some wells in all major TRB aquifers, and groundwater quality has degraded in the Sparta aquifer in particular.

Flood control was ranked as a medium-level need relative to other basins. Areas of potential flooding are present particularly in the southern TRB, although flooding is assumed to affect few population centers. Flood control and floodplain management measures are needed to protect existing land uses and minimize future flood damages. However, previous flooding studies by USACE have not resulted in projects acceptable to local stakeholders.

Environmental protection was ranked as a low-level need. Environmental issues that threaten protection of existing water resources and/or constrain future development of additional water supplies include the presence of wetland areas, Prime Farmlands, and habitat and recreation areas. However, land uses related to native vegetation occupy less area in the TRB than in most other basins.

Recreation was ranked as a medium-level need with decreasing importance in the future. One state park on the Mississippi River, Mississippi River access on the east margin of the basin, and six wildlife refuges provide recreational facilities in the TRB. Given the declining population trend in the TRB, it is expected that these facilities will continue to be adequate in the future.

ABBREVIATIONS

°F	degrees Fahrenheit
7Q10	7-day low flow with a recurrence interval of 10 years
cfs	cubic feet per second
Compact	Red River Compact
DOTD	Louisiana Department of Transportation and Development
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
LCRT	Louisiana Department of Culture, Recreation, and Tourism
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
mgd	million gallons per day
NFIP	National Flood Insurance Program
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWIS	National Water Information System
ORB	Ouachita River Basin
ppm	parts per million
State	State of Louisiana
TDS	total dissolved solids
TRB	Tensas River Basin
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Wildlife Action Plan	Louisiana Comprehensive Wildlife Conservation Strategy

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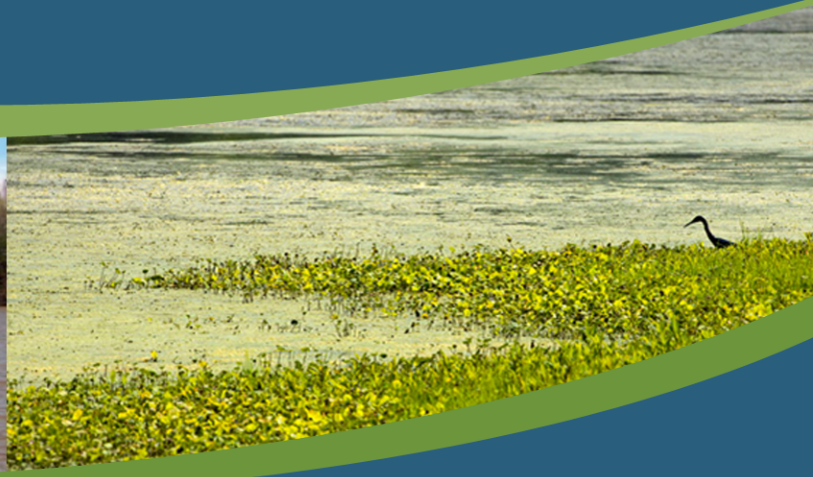

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