2009

Sabine River Basin

Characterization Report

Louisiana State Reservoir Priority
and Development Program

moffatt & nichol

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2009

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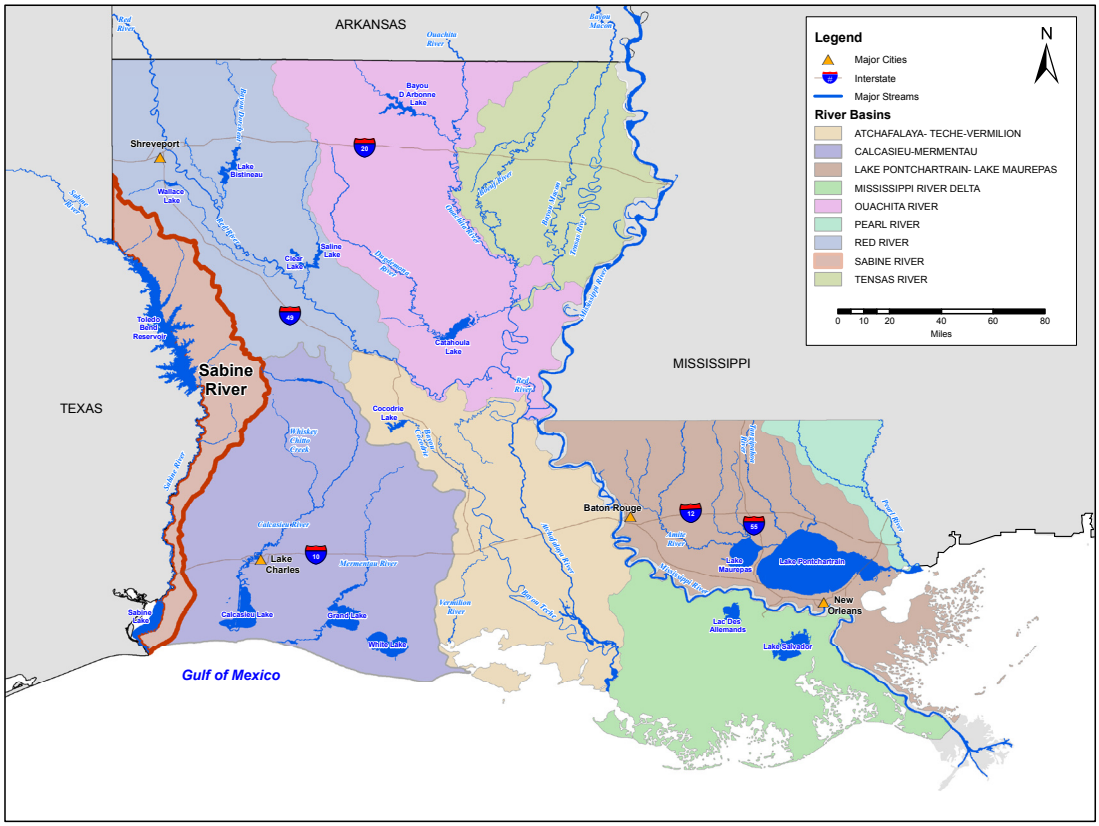
BASIN CHARACTERIZATION REPORT FOR THE SABINE RIVER BASIN

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 Sabine River Basin (SRB) (**Map 1**). Additional technical information on important issues may be provided in separate technical reports.

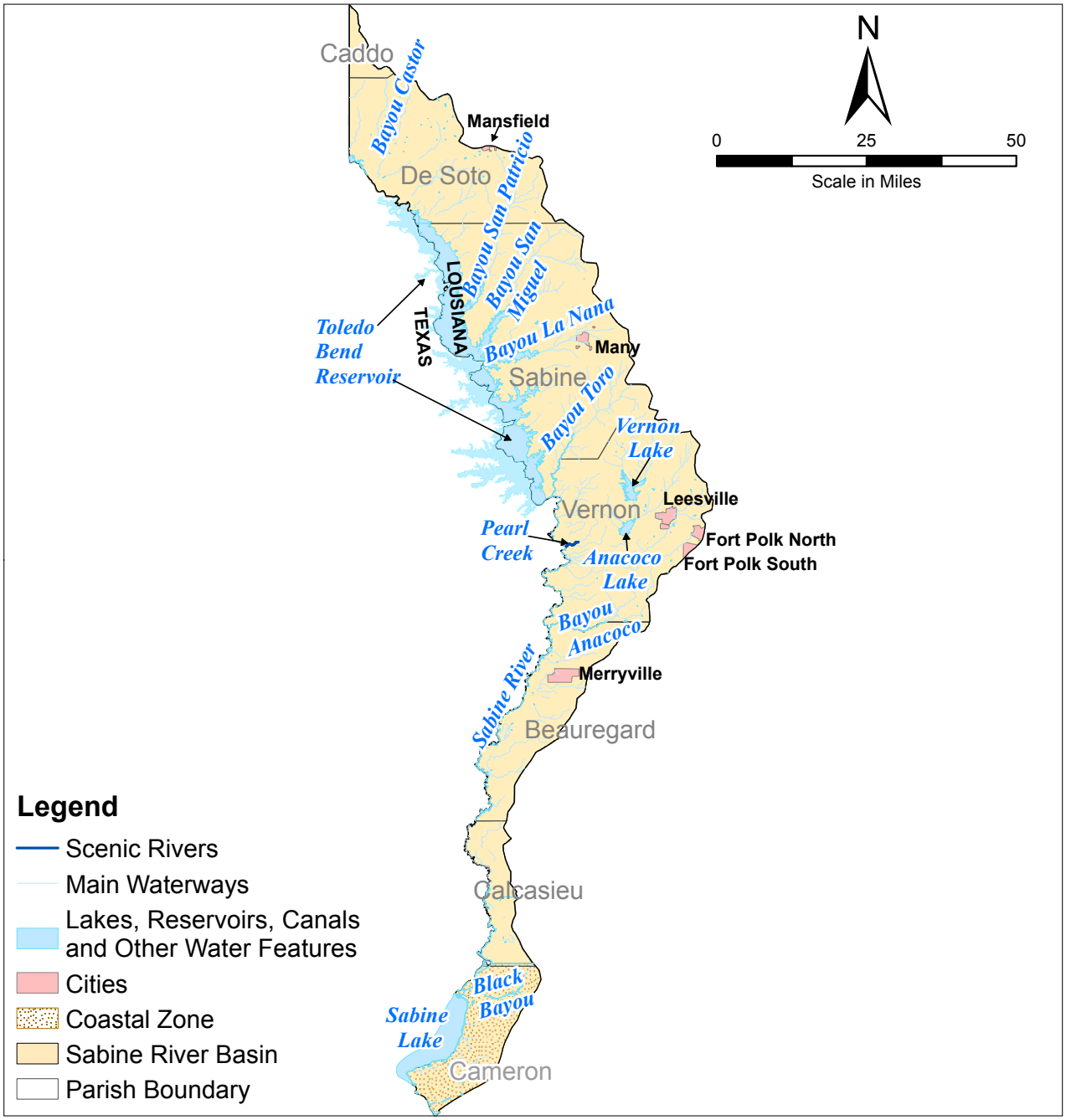
Report Topics **Page**



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

BASIN OVERVIEW

The SRB is located along the western border of Louisiana and has an area of 2,560 square miles (see **Map 2**).[2] The SRB is bounded by the Red River Basin to the north and east, the Texas-Louisiana state line on the west, the Calcasieu-Mermentau Basin to the east, and the coast of the Gulf of Mexico to the south. The basin includes the areas drained by the Sabine River in Louisiana. It extends 190 miles north to the south, and is 25 miles wide at its widest point. The southern tip of the SRB is in the Coastal Zone, as delineated by the Louisiana Department of Natural Resources (LDNR).



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

Eight parishes are either completely or partially located in the SRB; there are no major cities (**Map 2**). Fort Polk is one of the largest populated areas, with a total population of over 13,000 people in the north and south communities. Smaller communities in the SRB include Merryville and Leesville. Estimated total population in the SRB in 2005 was 87,597. **Table 1** shows the 2005 population distribution in the SRB by parish. Historical population in the SRB is shown in **Figure 1**. Population in the SRB increased from 1960 to 1990, but decreased slightly from 1990 to 2005. To encourage local economic activity, a goal of the Sabine River Authority of Louisiana (SRAL) is to increase the number of retirees residing in and relocating to the Toledo Bend area.[3] Future population growth could increase demand for high quality potable water sources.

Principal economic activities in the SRB include oil and gas, and agriculture- and forestry-related business such as cotton, timber, and timber-related industries; manufacturing is also strong in the SRB. Agricultural development could increase demand for irrigation water supply. Defense-related businesses and contractors support Fort Polk.[6] All of these economic activities are expected to grow in the SRB.

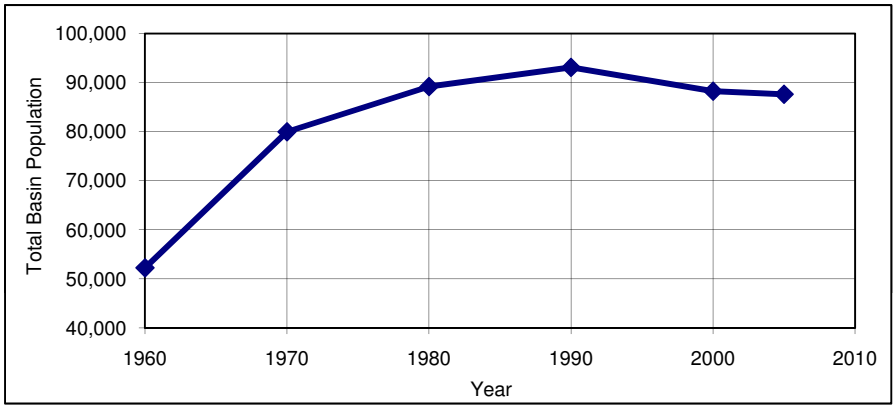


Figure 1. Historical SRB Population

Table 1. SRB Population by Parish in 2005[5]

Parish*	Population
Beauregard	4,233
Caddo	2,449
Calcasieu	3,053
Cameron	489
De Soto	13,387
Natchitoches	15
Sabine	24,543
Vernon	39,429
Basin Total	87,597

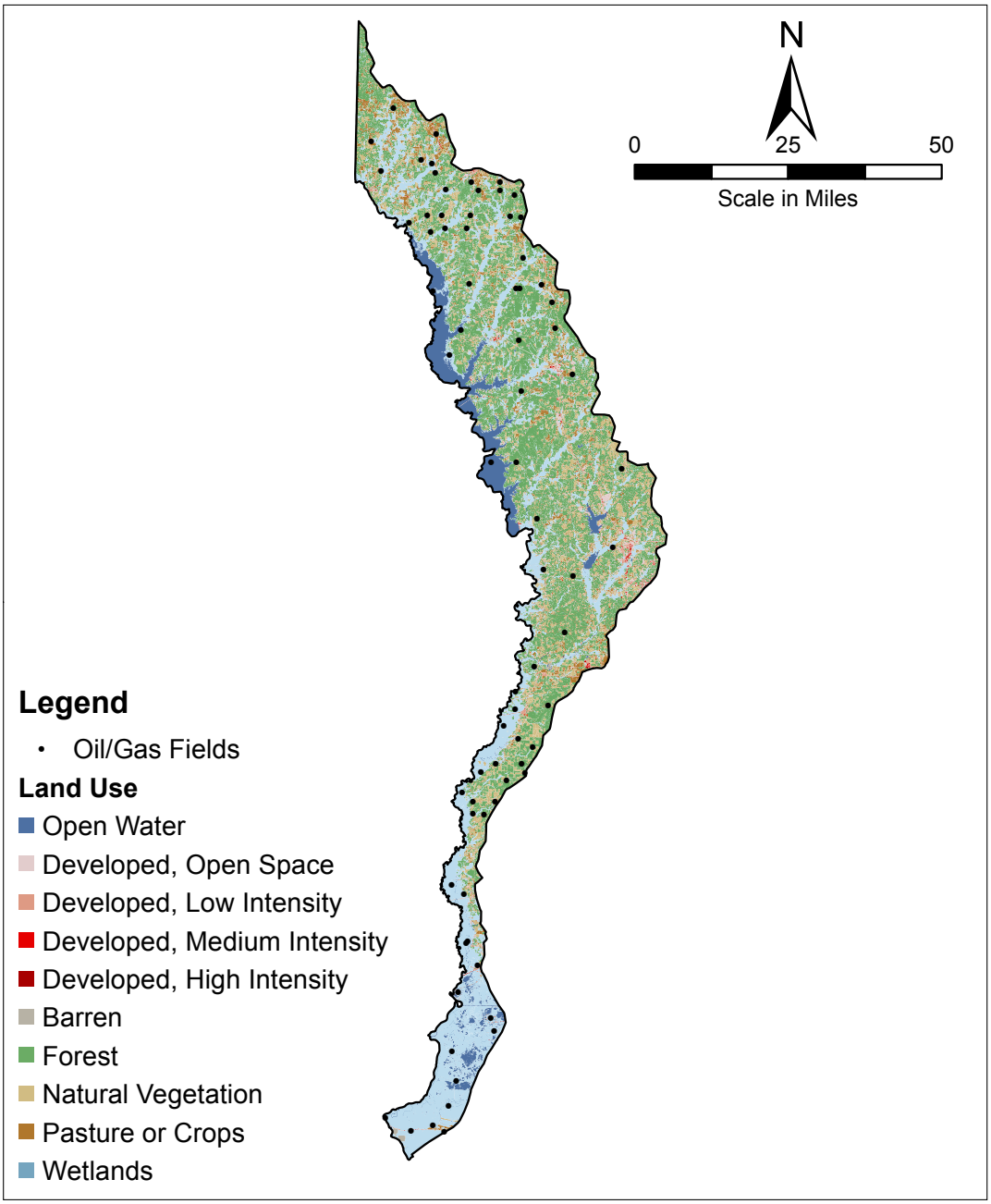
*All parishes are located in more than one basin; population estimate is for the area within the SRB.
SRB = Sabine River Basin

LAND USE AND LEGAL ENTITIES

Map 3 shows 2003 land uses in the SRB. The principal land use is forest; wetlands dominate the southern end of the basin. There is little urban development in the SRB. Economic modeling for the 1992 to 2020 period indicates that forested land uses may decrease slightly in the SRB, and that negligible change in urban land uses is expected.[7]

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

Oil and gas fields are widely distributed throughout the basin, as shown in **Map 3**. Oil and gas drilling can require large amounts of water for extraction, which then needs to be disposed, either to surface water 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 SRB that may affect or be affected by water resource development.



Map 3. RRB Land Uses in 2003[10]

Table 2. SRB Water Resources Legal Entities

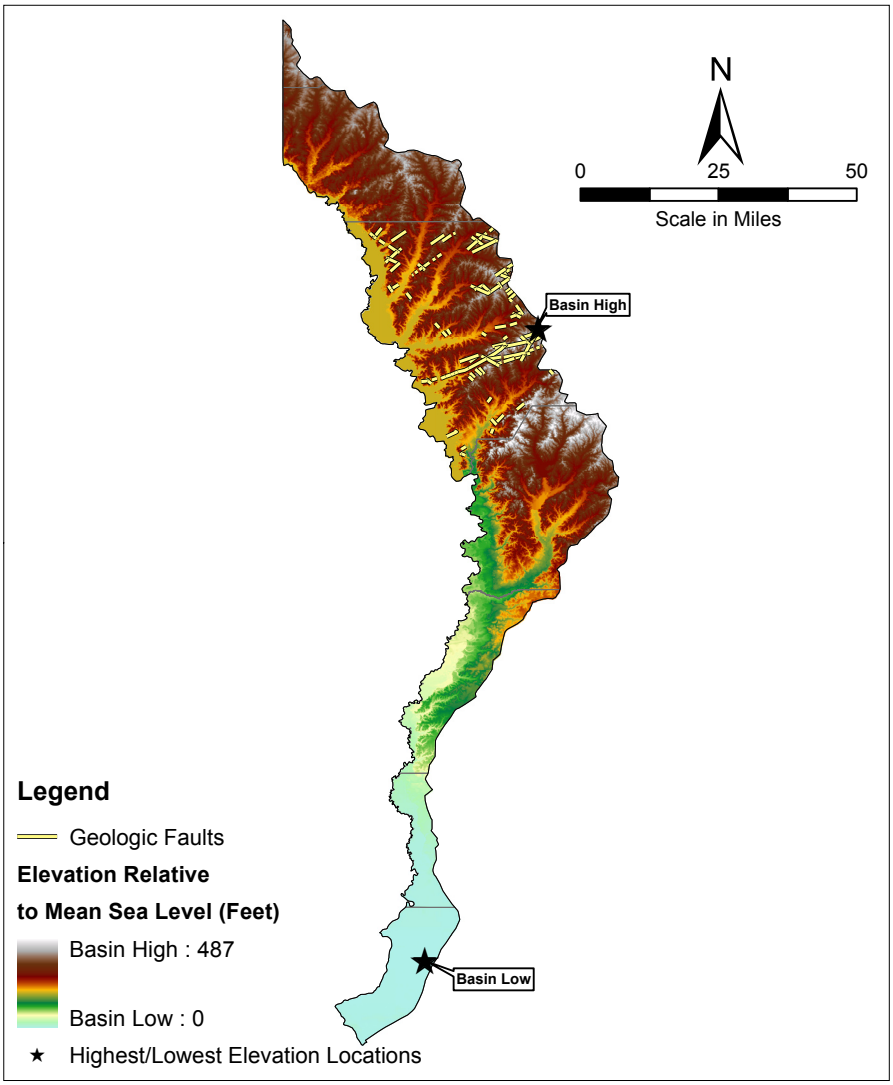
Legal Entity	Responsibilities
Imperial-Calcasieu Regional Planning and Development Commission	Planning and development in southwest Louisiana
Kisatchie-Delta Regional Planning and Development District	Planning and development in central Louisiana
Sabine River Authority of Louisiana	Providing for economic use and preservation of waters of the Sabine River and its tributaries, by promoting economic development, irrigation, navigation, improved water supply, drainage, public recreation, and hydroelectric power for the citizens of Louisiana3
Sparta Groundwater Conservation District	Studying ways to put Sparta water to the highest beneficial use in terms of public welfare

SRB = Sabine River Basin

PHYSIOGRAPHIC AND CLIMATIC INFORMATION

Map 4 shows general basin topography. Because of its long, narrow shape, the SRB extends across multiple physiographic regions and climates. The northern SRB is dominated by the Pine Hills physiographic region, which is characterized by undulating hills covered by pine and hardwood forests. In the southern SRB, prairies transition to coastal marshes. The lowest elevation within the SRB is at mean sea level, in Cameron Parish. The highest point, 487 feet above mean sea level, is located in Sabine Parish, on the eastern basin boundary. Geologic faults are found throughout Sabine Parish. Soils in the Pine Hills area of the northern SRB are dominated by brackish organic and mineral coastal deposits; the southern SRB has loamy, silty, and fluvial (river)-deposited soils.[10]

Average annual rainfall throughout the SRB varies from 50 to 60 inches per year, increasing from north to south.[11] **Figure 2** shows historical annual precipitation at Logansport, in the northern SRB, and DeRidder, in the south. Total annual precipitation varies between about 30 and 90 inches per year, with a historical average of about 52 inches per year at Logansport and 59 inches per year at DeRidder. Although rainfall and resulting runoff are plentiful in the SRB, the historical record shows that extended dry periods can occur (e.g., 1961 to 1966), stressing water supplies. Average annual temperature in the SRB generally increases from north to south from 65 to 69 degrees Fahrenheit (°F).11 Average high temperature for Logansport in the warmest month, July, is 93°F; the average low temperature is 35°F during the coldest month, January.



Map 4. SRB Topography[12]

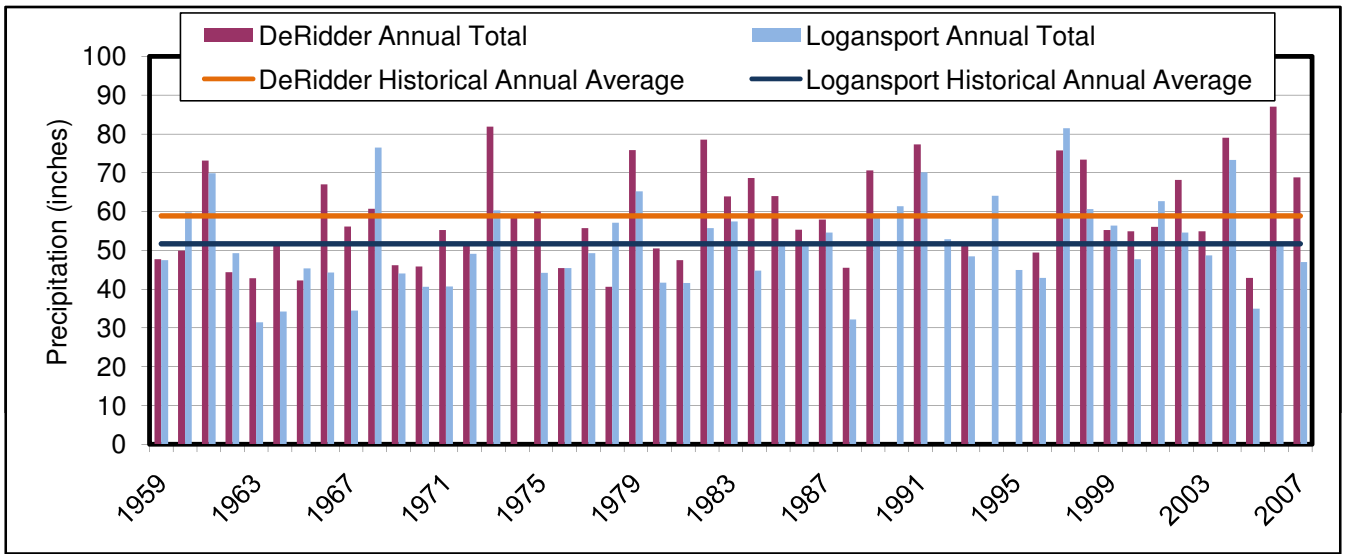


Figure 2. Historical Annual Precipitation at Logansport and DeRidder[11]

WATER USE

Water use in the SRB is summarized in **Table 3** by sector, water type, and parish, as reported for 2005. **Table 3** is based on water withdrawal data, which may be greater than total water consumptive use. For example, the power generation sector withdraws water for both steam generation and cooling, uses that do not entirely consume the withdrawn water, and allow a large percentage of the water to be returned to a waterway.

In 2005, SRB water use was divided between surface and groundwater sources. Total surface water use was 22.1 million gallons per day (mgd); Toledo Bend Reservoir was the sole reported surface water source. The paper products industry used the most surface water in the SRB, over 16 mgd, followed by public supply and power generation uses. Individual municipal water suppliers in the SRB are generally small, supplying less than 2 mgd.[13]

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 SRB (**Table 3**); actual groundwater use by parish may differ from this estimation. Based on this method, Vernon Parish used the largest amount of groundwater, 5.1 mgd, 4 mgd of which was used for public water supply. Most remaining groundwater in Vernon Parish was used by the paper products industry. The paper products industry also used about 3.8 mgd of groundwater in Beauregard Parish in 2005.

Figure 3 shows trends in surface water and groundwater use in the SRB at 5-year intervals from 1990. During this period, some public water supplies moved away from groundwater use to surface water use. Additionally, industrial use of surface water slightly increased from 14.2 mgd in 1990 to 16.7 mgd in 2005.

Per capita water use in 2005 (based on rural domestic and public supply uses) for the most populated SRB parishes varied from 127 gallons per capita (person) per day (gpcd) in Vernon Parish to 141 gpcd in Sabine Parish.[16] An objective of the recent SRAL Strategic Plan is to develop surface water supply to be the primary source of revenue supporting the Toledo Bend Project by 2018. The project's current revenue source is hydroelectric power production. The SRAL's stated strategy is to identify and develop markets to use SRB surface water supplies for municipal, industrial, and agricultural purposes.[17] This may result in increased future surface water demand in the SRB.

Table 3. Water Use in the SRB in 2005[14]

Sector	Surface Water (mgd)	Groundwater (mgd)
Aquaculture	0.0	0.1
General irrigation	0.1	0.1
Industry	16.7	3.4
Livestock	0.4	0.1
Power generation	1.9	0.0
Public Supply	3.0	6.4
Rice irrigation	0.0	0.6
Rural domestic	0.0	2.4
TOTAL	22.1	13.1

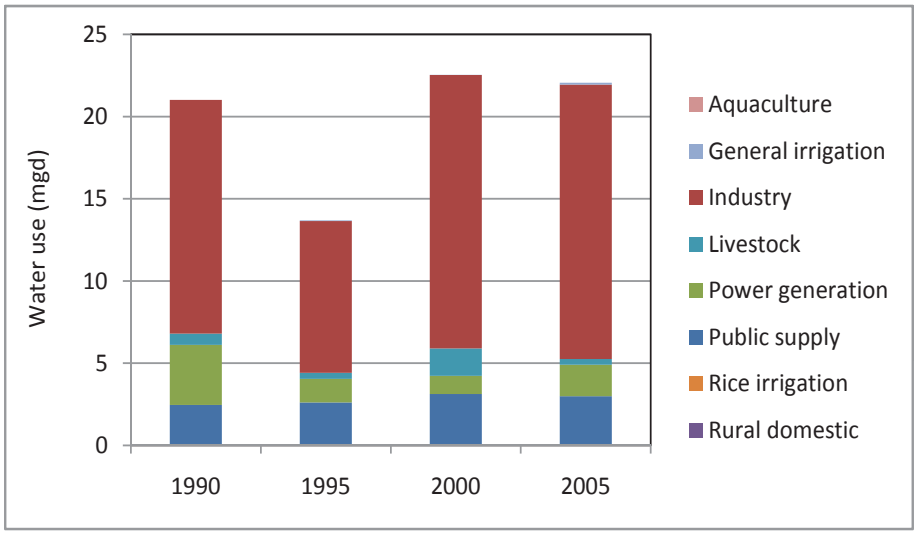
Parish	Surface Water (mgd)	Groundwater* (mgd)
Beauregard	0.0	3.8
Cameron	0.0	0.3
DeSoto	18.4	1.8
Sabine	3.5	2.2
Vernon	0.2	5.1
TOTAL	22.1	13.1

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

mgd=million gallons per day

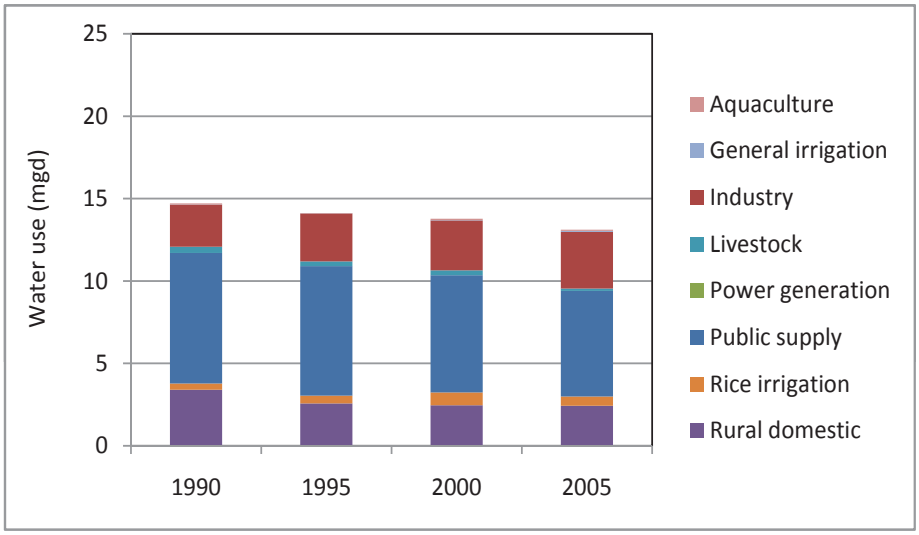
SRB = Sabine River Basin

Recent Historical Surface Water Use



mgd=million gallons per day

Recent Historical Groundwater Use

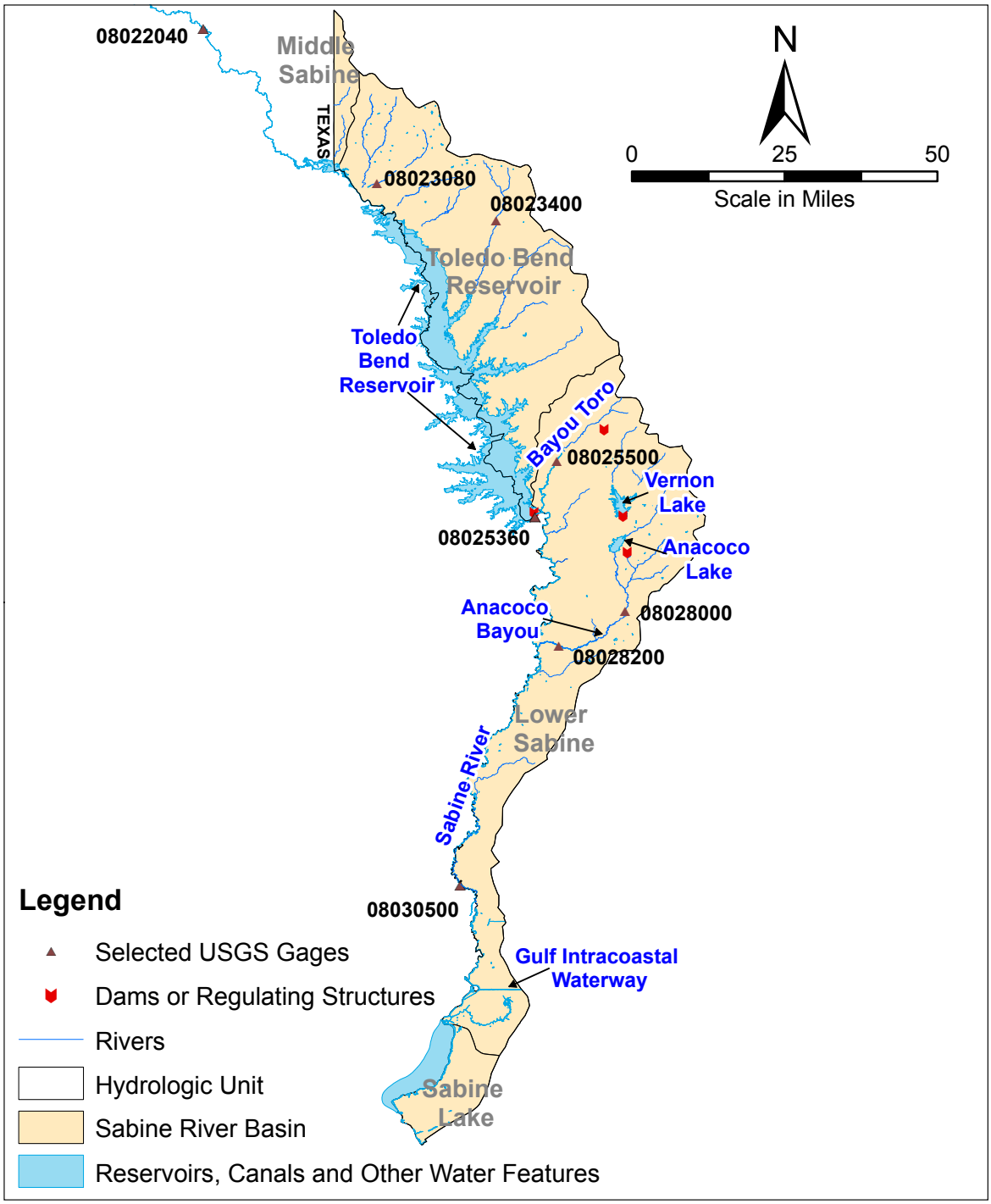


mgd=million gallons per day

Figure 3. Trends in Water Use in SRB[15]

SURFACE WATER

Primary surface water features in the SRB include streams, rivers, bayous, reservoirs, and canals, such as the Sabine River, Toledo Bend Reservoir, and Bayou Anacoco, as shown in **Map 5**. This map also shows the three subwatersheds, or hydrologic units, delineated by the U.S. Geological Survey (USGS) in the SRB, and stream gages referenced in this report. Pearl Creek is designated by LDNR as a Natural and Scenic River (shown in **Map 2**) under the Louisiana Natural and Scenic River Act. As such, this waterway is protected by a permit process and certain restrictions, including prohibitions against channelization, impoundment construction, and channel realignment.[18]



Map 5. Surface Water Features[19]

Extensive surface water and groundwater data for Louisiana, including gaged streamflows and lake levels, are available through the USGS National Water Information System (NWIS) Web site.[20] Streamflow statistics for selected SRB 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 small 7Q10 flows, less than a few cubic feet per second (cfs), will have extended periods of low flows. Peak flows, including the maximum instantaneous discharge, and the streamflow exceeded by only 10 percent of flows, are useful for characterizing flooding and high-flow conditions in a water body.

Figure 4 shows historical monthly average flows for selected gages in the SRB. Flows in the Sabine River are an order of magnitude larger than flows in other water bodies in the basin, and are shown on a separate graph.

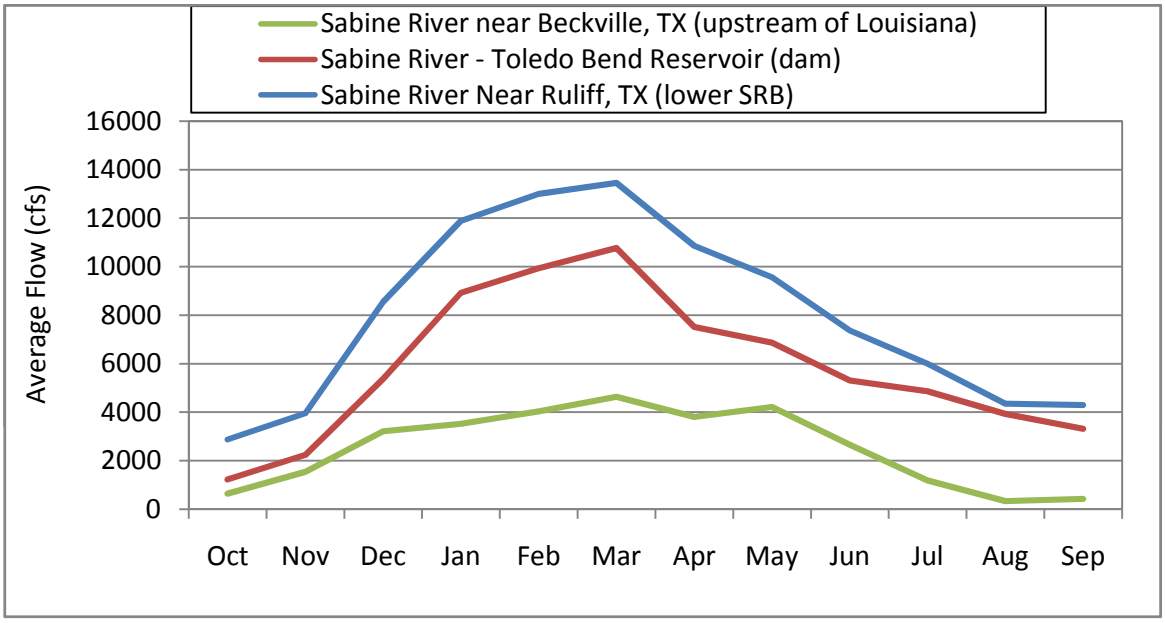
Streamflow in the Sabine River in Louisiana is affected by Toledo Bend Reservoir. Storage in the reservoir can create backwater conditions upstream into Texas, and reservoir releases affect streamflows downstream. Over half of the total drainage area of the Sabine River is upstream from the Louisiana-Texas State line (3,500 square miles). Upstream of the State line, the Sabine River is regulated by several on- and off-stream reservoirs, including Lake Tawakoni, located on the mainstem river. Annual average and median streamflows at this point are greater than 5,000 cfs and 800 cfs, respectively, as measured at the Beckville, Texas, gage. Downstream from Toledo Bend Reservoir, flows are also comparatively high: median stream flow just below the dam is 3,660 cfs, and median streamflow in southern Louisiana (as measured at the Ruliff, Texas, gage) is 4,780 cfs. Surface water is so plentiful in the SRB that the 1984 Report declared, "abundant surface water resources of this basin could play a vital role in the future economic development of western Louisiana."[24]

Streamflow in Bayou Anacoco is occasionally regulated from July to September because of temporary decreases in volume of upstream reservoirs (see **Map 5**). Flow in Bayou Anacoco is affected both by releases from an upstream reservoir, and discharges from a paper mill. Flows in Bayou Anacoco are perennial, with median and minimum flows of about 147 cfs and 7 cfs, respectively.

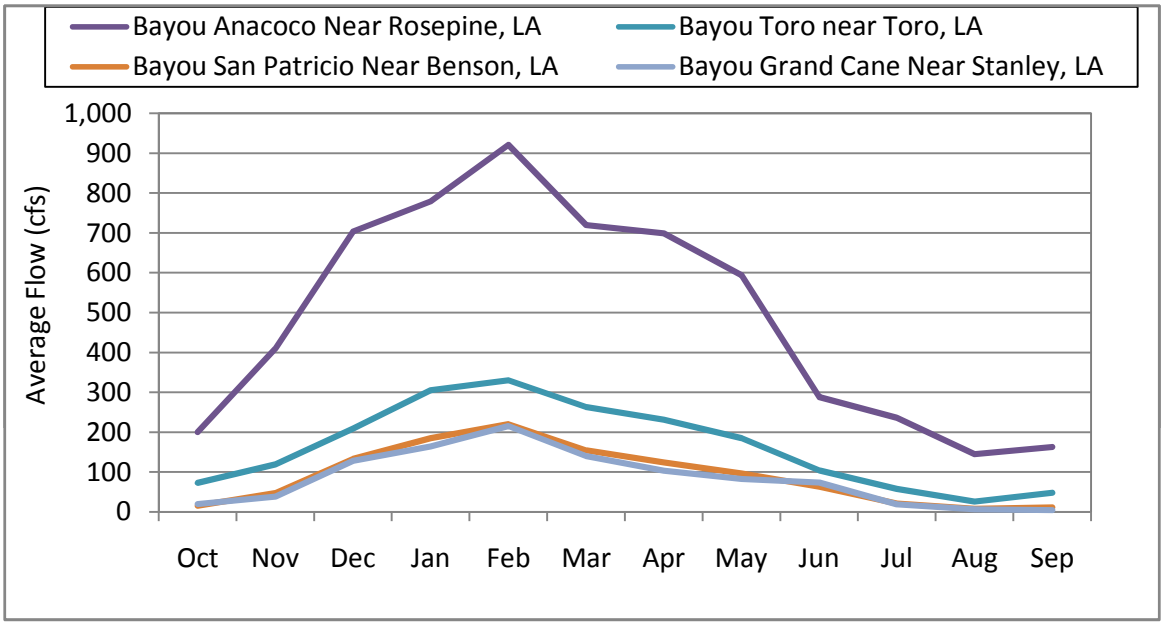
Table 4. Historical Streamflow Statistics for Selected Gages[21]

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[22] (date)	10	50 (median)	90
Sabine River near Beckville, TX (30 miles upstream from LA border) (08022040)	3,589	1938 - present[a]	5,103	49,400 (5/2/66)	2.4 (8/11/64)	3.8 (8/7/64)	7,520	845	94
Sabine River at Toledo Bend Reservoir (at dam) (08025360)	7,178	1971 - present	5,837	NA	30[b] (10/1/72)	34[c] (11/21/75)	14,800	3,660	164
Sabine River near Ruliff, TX (08030500)	9,329	1924 – present[a]	7,993	109,000 (7/6/89)	278[b] (10/28/67)	282[c] (10/9/67)	18,600	4,780	1,190
Bayou Grand Cane near Stanley, LA (08023080)	72.5	1980 - present	82.2	9,740 (1/29/99)	0-At times most years	0	172	5	0
Bayou San Patricio near Benson, LA (08023400)	80.2	1954- present	89.1	21,300 (9/20/58)	0-At times most years	0	177	7.2	0
Bayou Toro near Toro, LA (08025500)	148	1955-2005	162	31,200 (4/9/68)	0.10 (Several)	1.2	303	33	5.7
Bayou Anacoco near Rosepine, LA (08028000)	365	1951 - present	486	64,300 (5/19/53)	4.9 (9/7/00)	7.4	1,110	147	20

[a] Statistics since 1961 (after dam construction)
[b] Lowest daily mean (not instantaneous)
[c] Annual 7-day minimum (7Q10 not available)
7Q10=7-day low flow with 10-year recurrence
cfs = cubic feet per second
LA = Louisiana
mi^2 = square miles
NA = not applicable (gage measures reservoir releases)
TX = Texas



cfs=cubic feet per second



cfs=cubic feet per second

Figure 4. Historical Monthly Average Streamflow for Selected Gages[21]

Streamflows tend to be lower in Bayou Toro, Bayou Grand Cane, and Bayou San Patricio. In Bayou Grand Cane and Bayou San Patricio, periods without flow occur regularly, particularly during the late summer and early fall. In Bayou Toro, 10 percent of flows are less than 5.7 cfs.

Published characteristics of major lakes and reservoirs in the SRB are listed in **Table 5**. With a surface area of 181,600 acres and capacity of about 4.5 million acre-feet, Toledo Bend Reservoir is the largest reservoir in the SRB.[23] It is located on the Sabine River and is shared between the states of Louisiana and Texas. Toledo Bend Reservoir is used for multiple purposes, including conservation, recreation, water supply, and power generation. It is owned and operated by the Sabine River authorities of Louisiana and Texas. The 1984 Water Resources Study Commission Report to the State Legislature (1984 Report) suggested that managing Toledo Bend Reservoir to serve its multiple purposes was the only major water resource concern in the SRB.[24] In 1999, the Texas Sabine River Authority reported that Toledo Bend Reservoir had over 747,000 acre-feet per year of uncommitted supply within its water rights permit, and that an additional 293,300 acre-feet per year of potential supply was available through the unpermitted yield of the reservoir.[25]

Anacoco Lake and Lake Vernon, in Vernon Parish, have usable capacities of 41,300 acre-feet and 58,000 acre-feet, respectively.[14] Both reservoirs are managed by the Anacoco Prairie Game and Fish Commission, and maintained by DOTD.[25] Lake Vernon was constructed in 1963 for recreation and industrial water supply, and Anacoco Lake was constructed in 1951 for recreational use.

The Louisiana Sabine River Diversion Canal System provides water for local industries and irrigators in southwestern Louisiana. It is located on the Old Sabine River, in Calcasieu Parish, and water is primarily used by industries in the Lake Charles area (east of the SRB) and farms along the canal route.[25] Water use from the canal is considered to be in the Calcasieu-Mermentau River Basin, and is not accounted for in this report.

The potential benefits and drawbacks of one potential reservoir site in the SRB, Bon Wier Reservoir, located downstream from Toledo Bend Reservoir, are discussed in the Texas Sabine River Authority Comprehensive Plan.[25]

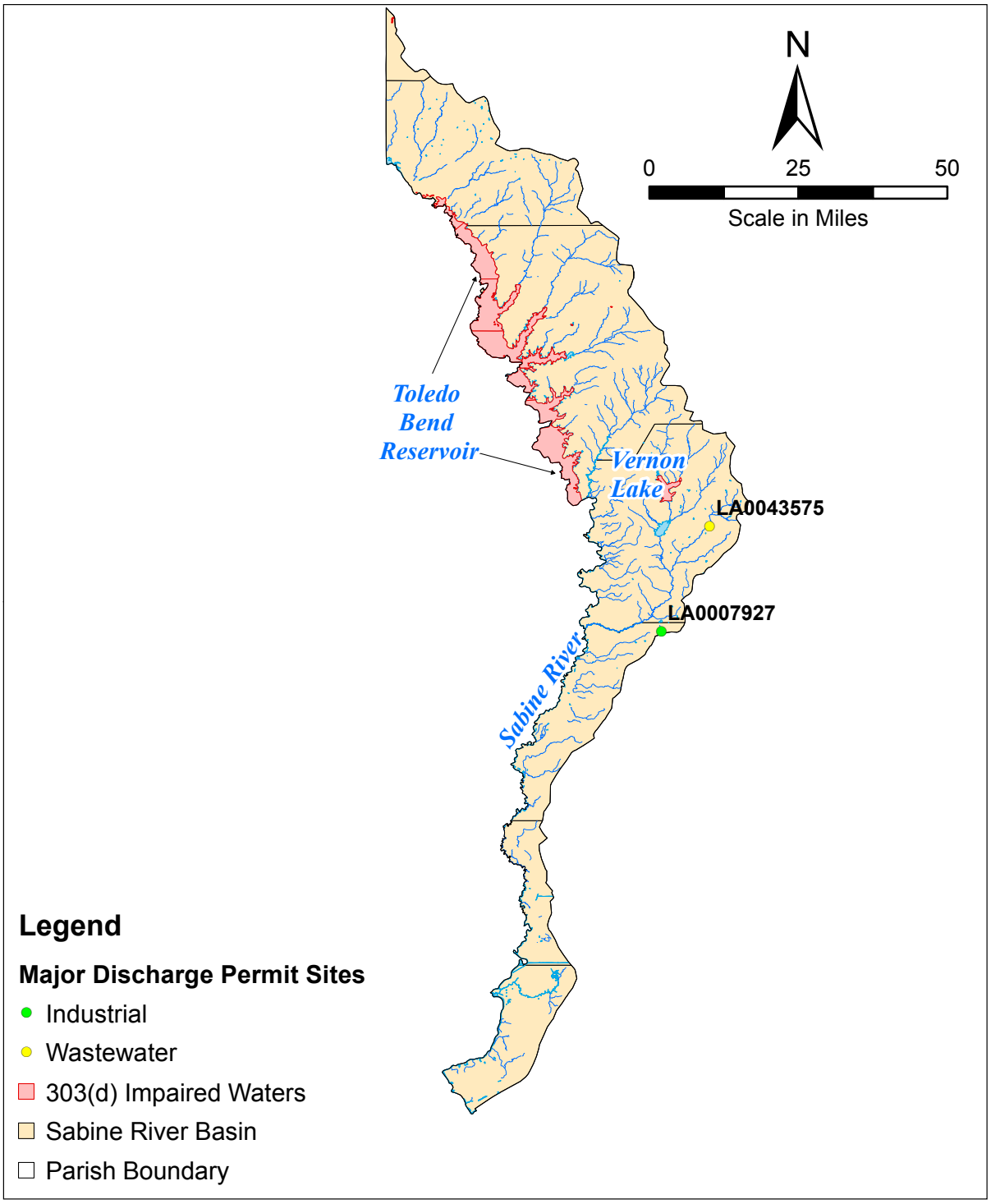
Table 5. Characteristics of Major Lakes and Reservoirs in the SRB

Name	Surface Area (acres)	Usable Capacity (acre-feet)
Anacoco Lake	NA	41,300
Lake Vernon	NA	58,000
Toledo Bend Reservoir	181,600	4,500,000

SRB = Sabine River Basin
NA=not available

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, recreation, or drinking water supply may be impaired. Stream sub-segments on the 2006 303(d) list for the SRB are shown in **Map 6**. Design of new reservoirs either impounding impaired waters or discharging to impaired waters would need to consider these water quality challenges and any ongoing or planned water quality improvement projects.



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

Table 6 summarizes the number of stream and lake sub-segments in the SRB that are on the 2006 303(d) list, and identifies impaired uses and parameters causing the impairments. Compared to other surface water basins in Louisiana, there are relatively few water quality impairments in the SRB. Fish and wildlife propagation and primary contact recreation are principal affected uses in the SRB. Toledo Bend Reservoir is impaired by nonnative aquatic plants and elevated mercury levels in fish tissue. Vernon Lake is also considered impaired because of elevated mercury levels in fish tissue. The presence of bacteria from discharges of managed pasture grazing and other wildlife, as indicated by fecal coliform, affects recreational uses of several surface waters in the SRB.[27] Drainage of naturally low dissolved oxygen water from swamp areas may affect attainment of dissolved oxygen standards in some parts of the SRB.[28]

Impaired Use	Sub-segments
Fish and wildlife propagation	6
Primary contact recreation	5

FWP=fish and wildlife propagation
PCR=primary contact recreation (swimming)
SRB = Sabine River Basin

Parameter Causing Impairment (affected use)	Sub-segments
Fecal coliform (PCR)	5
Dissolved oxygen (FWP)	3
Mercury (FWP)	2
Non-native aquatic plants (FWP)	1

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 SRB are shown in **Map 6** and **Table 7**.

Additional information on all dischargers in Louisiana can be obtained from LDEQ through their public records request process.[29]

There are relatively few major permitted discharges in the SRB. The City of Leesville wastewater treatment facility is the only major municipal discharge in the basin, with a permitted flow of 2.1 mgd. The only major industrial discharger in the SRB is a large paper mill, with a permitted discharge of 39 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 discharge locations could affect the ability of permit holders to comply with permit conditions.

Table 7. Major Municipal and Industrial Discharge Permits in the SRB[30]

Discharger	Permit Number	Permitted Flow (mgd)	Receiving Water	Parish
Boise Packaging and Newsprint – DeRidder Paper Mill	LA0007927	39	Cypress Creek to Bayou Anococo	Beauregard
Leesville, City of, Wastewater Treatment Facility	LA0043575	2.1	Castor Bayou/Bayou Anacoco	Vernon

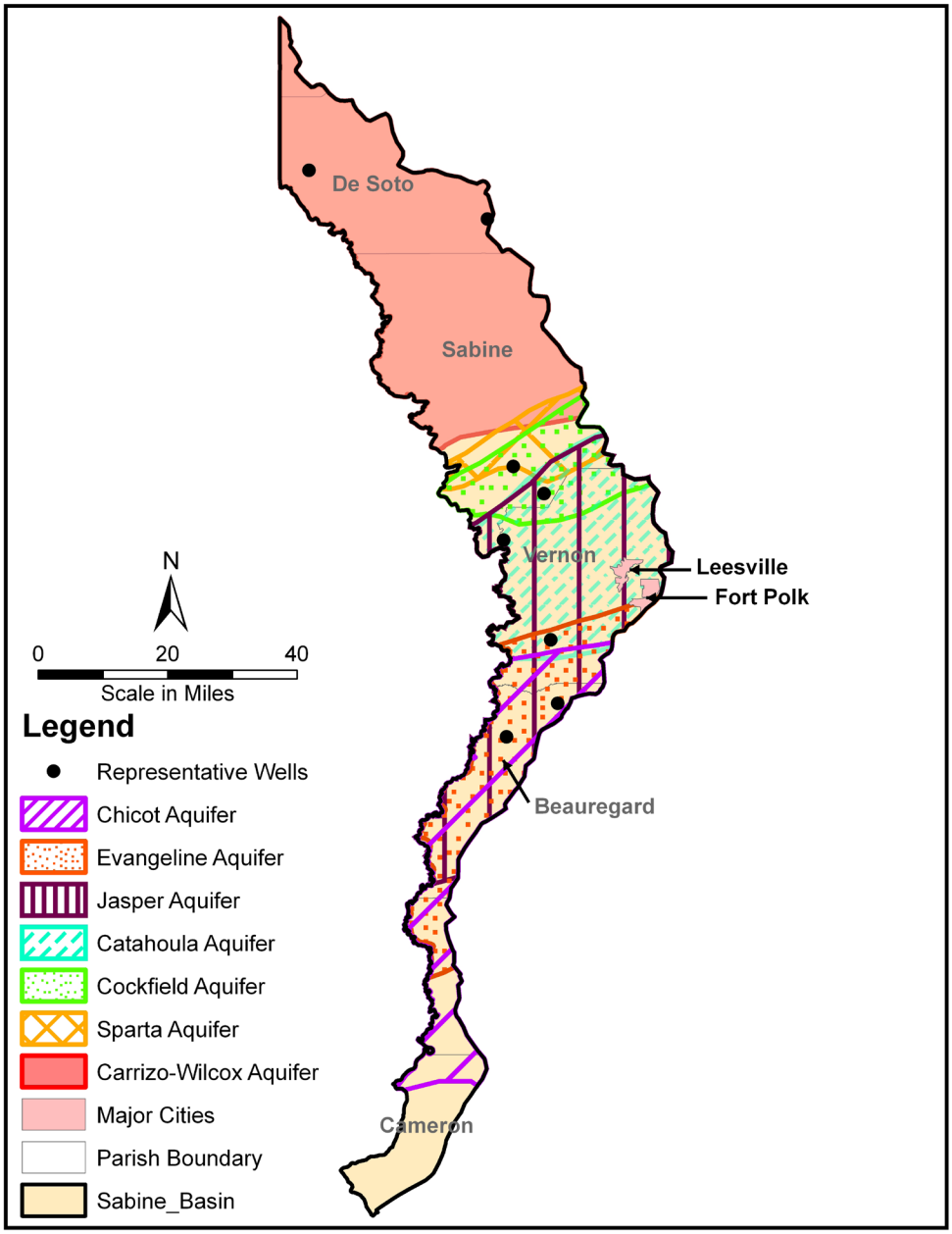
Information presented in this table is directly from USEPA (2009a). For detailed explanation, this reference should be consulted.
mgd=million gallons per day
SRB=Sabine River Basin

GROUNDWATER

The State has registered about 1,000 wells in the SRB.[31] These wells are completed in the following major aquifers that underlie parts of the SRB:

- Chicot Aquifer
- Evangeline Aquifer
- Jasper Aquifer
- Catahoula Aquifer
- Cockfield Aquifer
- Sparta Aquifer
- Carrizo-Wilcox Aquifer

In addition, shallow alluvial aquifers are present along stream channels in the SRB. Major aquifers in the SRB are shown in **Map 7**, and their characteristics are summarized in **Table 8**. Although the Cockfield and Sparta aquifers partially underlie the SRB, they are not heavily used. In fact, groundwater withdrawal in the SRB has decreased since the early 1980s, partially because of construction of the Sabine River Diversion Canal. When the canal was completed in 1982, many industries in the SRB began using surface water from the canal to supplement groundwater withdrawals.[20] Figure 5 shows groundwater levels in the most heavily used aquifers in the SRB.



Map 7. Spatial Extent of Principal SRB Aquifers[32]

Table 8. Overview of SRB 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)[20]
Chicot	50 – 1,050	500 – 2,500 4,000 (large capacity)	40 – 220	2 – 35	20 – 45
Evangeline	50 – 1,900	200 – 1,000 3,000 (large capacity)	20 – 180	2 – 38	10 – 35
Jasper	50 – 2,400	40 – 800 3,000 (large capacity)	20 – 260	2 – 30	135 – 175
Catahoula	50 – 450	50 – 400	20 – 260	2 – 30	15 – 25
Cockfield	50 – 600	50 – 500 700 (large capacity)	25 – 100	1.5 – 7.5	NA
Sparta	50 – 700	100 – 1,800	25 – 100	1.5 – 7.5	NA
Carrizo-Wilcox	50 – 850	30 – 150 400 (large capacity)	2 – 40	0.5 – 4	15 – 110

gal/min/ft = gallons per minute per foot
gpm = gallons per minute
NA = not available
SRB = Sabine River Basin

Historical data from Well Be-443, completed in the Chicot Aquifer in Beauregard Parish, shows that the groundwater level in this aquifer has changed very little in the SRB since the early 1980s. However, parishes east of the SRB use the Chicot Aquifer extensively for rice irrigation, and groundwater withdrawals in those areas increased substantially from 1990 to 2000, causing localized drawdown of the Chicot Aquifer east of the SRB near Lake Charles.

Historical data from Well Be-377, completed in the Evangeline Aquifer in Beauregard Parish, show that groundwater levels have been stable since 2002. Well data from the neighboring Calcasieu-Mermentau River Basin, east of the SRB, show that groundwater levels declined about 2 feet per year from 1980 to 2000, but have remained stable since 2000.

Historical data from Wells Sa-386 and Sa-392, both completed in the Catahoula Aquifer in Sabine Parish, show that groundwater levels is this aquifer have been stable in the SRB since 2000.

Groundwater levels in the Carrizo-Wilcox Aquifer in De Soto Parish (Wells Ds-517 and Ds-445 in **Figure 5**) have been stable over time. A similar trend has been reported for this aquifer in the neighboring Red River Basin to the northeast. Although areas in Texas have experienced groundwater level decline in the Carrizo-Wilcox Aquifer, groundwater levels in this aquifer in most of Louisiana have remained stable. This is because 1) Carrizo-Wilcox Aquifer is less heavily used in Louisiana than in Texas, and 2) it is directly recharged by rainfall where it outcrops in northern Louisiana.

The Jasper Aquifer comprises the Williamson Creek and Carnahan Bayou aquifer units. Groundwater levels declined from 1995 to 2000 in the Williamson Creek aquifer unit in the SRB (Well V-196 in **Figure 5**), followed by several years of relatively steady water levels. Comparison of additional USGS data from 1996 and 2003 suggests that groundwater levels declined 4 to 8 feet in Beauregard Parish in the Williamson Creek aquifer unit over this period.[33] Historical data from Well V-413, completed in the Carnahan Bayou aquifer unit in Vernon Parish, indicate that groundwater levels declined in this aquifer unit from 1980 to 1990. Historical data since 1990 are not available for this aquifer unit in the SRB; however, data from wells to the east of the SRB indicate that groundwater levels declined about 5 feet per year from 1980 to 1995, but have remained stable from 1995 to the present.[20]

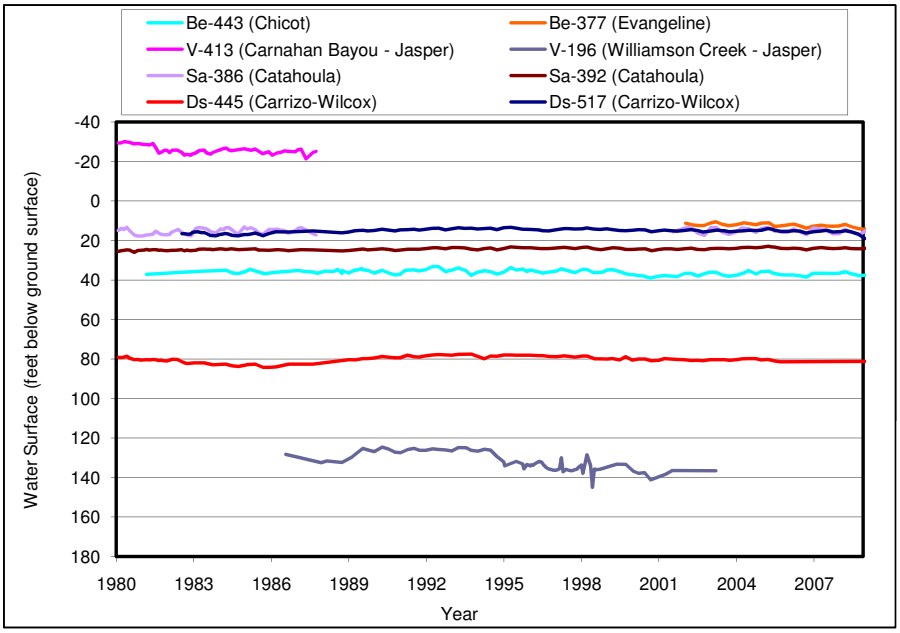


Figure 5. Historical Trends in SRB Groundwater Levels in Representative Wells[20]

Groundwater Quality

Groundwater quality issues identified in the 2005 and 2006 LDEQ Baseline Monitoring Program (BMP) reports are summarized by aquifer in **Table 9**.[34] Water in none of the wells in the major SRB aquifers measured as part of the BMP exceeded Federal primary drinking water standards. As shown in **Table 9**, water in some wells in these aquifers exceeded secondary standards for pH, total dissolved solids (TDS), color, chloride, and iron. Lead was detected at concentrations below the primary drinking water standard in two Chicot Aquifer wells, but neither is located within the SRB boundaries.

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

Aquifer	pH	TDS	Color	Chloride	Iron
Chicot	■	■	■		■
Evangeline	■	■			■
Jasper:					
Williamson Creek			■		■
Carnahan Bayou	■	■	■		
Catahoula					■
Cockfield	■	■	■		■
Sparta	■	■	■	■	■
Carrizo-Wilcox		■	■		■

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

FLOODING

Limited information is available regarding flooding problems in the SRB, and no major U.S. Army Corps of Engineers (USACE) flood control projects are present in the basin.[35] Flooding that does occur in the SRB is generally the result of overbank flooding because of intense rainfall events.[35] Four of the parishes partially located in the Sabine River Basin (Beauregard, Calcasieu, Cameron, and Sabine) have become participants in the National Flood Insurance Program (NFIP), offered through the Federal Emergency Management Agency (FEMA).[36] 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; member communities regulate development in floodplains. These studies and maps, which can be obtained from FEMA, document flooding problems within parishes, and delineate 100-year flood zone maps along major waterways. Some 100-year flood zone maps are available as digital geographic information system layers and the detailed maps and reports can be obtained from FEMA.[37]

USGS estimated flood flow magnitudes for different return periods at streamflow gages throughout the State. Gages in the SRB where significant historical data have been collected are listed in **Table 10**, along with their estimated peak discharges for various recurrence intervals. The USGS analysis is only valid for rural, unaltered waterways. Also included in **Table 10** are peak discharges for major waterways, as reported in the FISs reviewed as part of this basin characterization.

Table 10. Peak Flow Discharges in the SRB[38]

Source	Location		Flood Magnitude (cfs)			
	Gage Number	Name	2-year	10-year	100-year	500-year
USGS	08025500	Bayou Toro near Toro, LA	4,150	12,900	32,700	53,500
	08023400	Bayou San Patricio near Benson, LA	3,540	10400	23700	36000
	0802800	Bayou Anacoco near Rosepine, LA	8,150	28,700	74,100	119,400
	0802250	Sabine River at Logansport, LA	18,100	43,600	86,600	122,900
FIS	Harpoon Bayou at Kansas City Railroad		NA	NA	22,800	NA
	Bayou Scie at US Route 171		NA	NA	19,400	NA

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

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 Federal and State permitting requirements. As shown in **Map 2**, the southern SRB is designated by LDNR as Coastal Zone. Existing environmental issues in the Coastal Zone, such as loss of wetlands and land subsidence, can affect water resources facilities, such as reservoirs.[39]

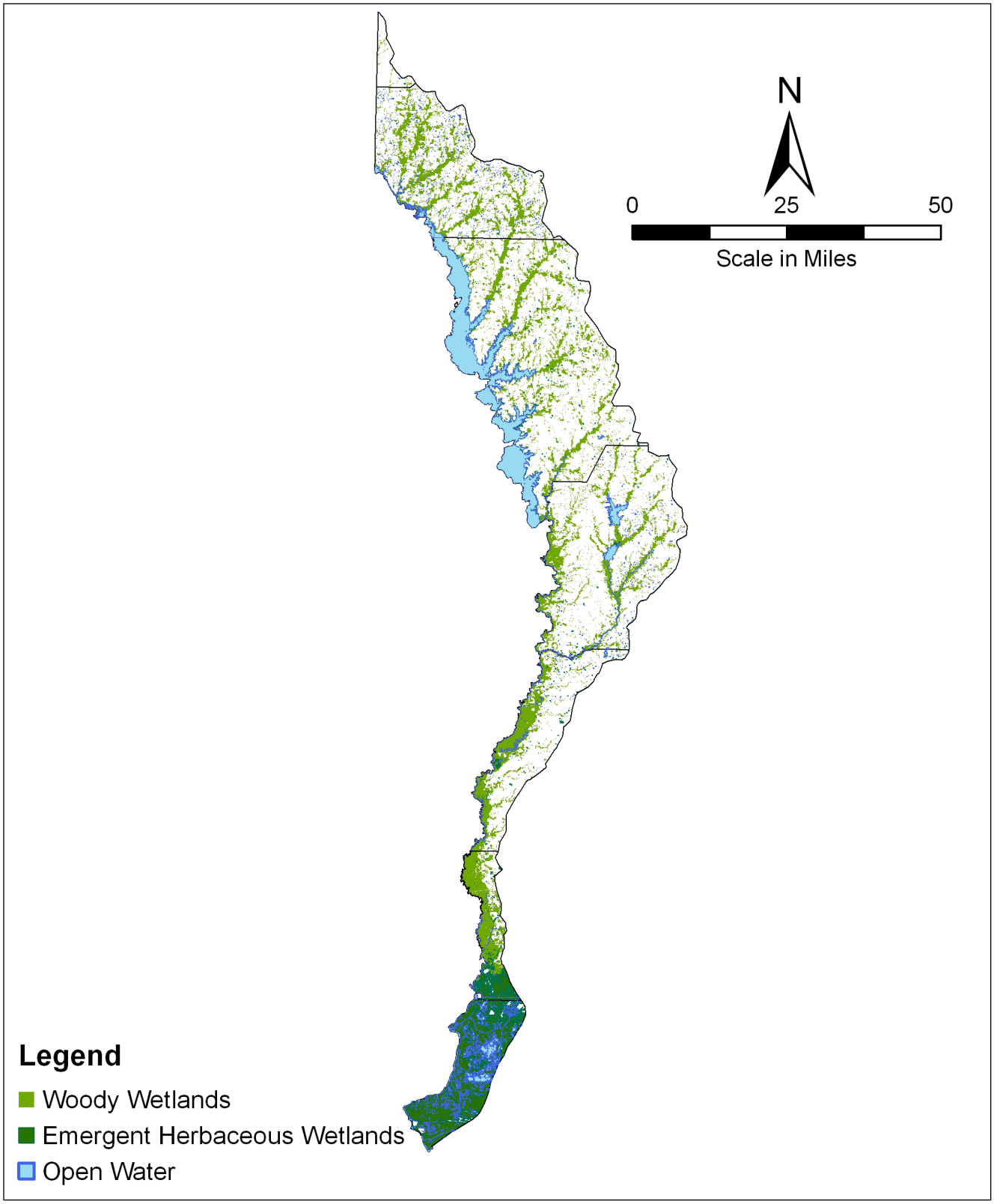
Habitat and Wildlife

The SRB includes parts of the Western Gulf Coastal Plain and the South Central Plains ecoregions, as designated by the U.S. Environmental Protection Agency.[40] Each ecoregion comprises a range of habitats, some of which are associated with species of conservation concern. The Louisiana Wildlife Action Plan prioritizes particular terrestrial habitat types within each ecoregion for conservation.[18]

Terrestrial species Federally listed as threatened or endangered that may reside in the SRB are the red-cockaded woodpecker, brown pelican, and piping plover.[41] The Endangered Species Act gives the U.S. Fish and Wildlife Service (USFWS) the authority to protect listed species and their habitat. USFWS has mapped critical habitat in the SRB for the piping plover.[42]

Aquatic habitats in the SRB support about 89 species of freshwater fishes, 33 species of mussels, and 13 species of crawfish.[18] The SRB is associated with three crustacean, four freshwater fish, four mussel, and three reptile State species of concern. The State regulates aquatic habitat through surface water quality standards in water bodies designated for fish and wildlife propagation.[43] USFWS has not identified any particular surface waters within the SRB as important for conservation of species Federally listed as threatened or endangered.[44] The Louisiana Wildlife Action Plan also does not prioritize 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 wetland areas in the SRB. About 16 percent of the SRB surface area, or 470 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). About 7 percent of the SRB area 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).[45]

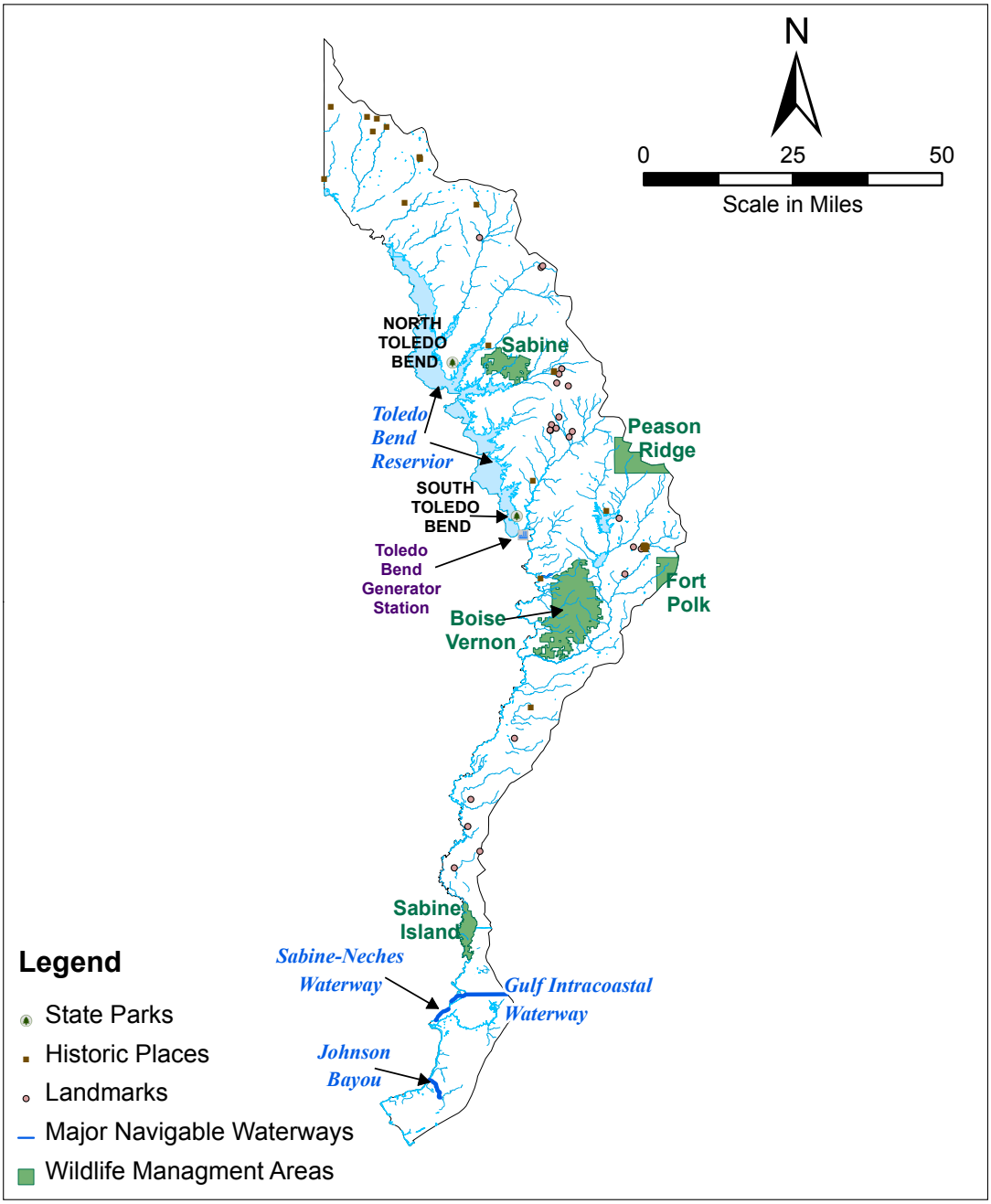


Map 8. Wetlands in the SRB[30]

Cultural Resources

Information on cultural issues and resources is provided by parish-level organizations. Prehistoric (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, a lighthouse, bridges, post offices, and schools. There are 28 historic points in the SRB, as shown in **Map 9**. Generalized locations of known cultural resources that could affect reservoir siting or operations are available from the NRHP. No archaeological sites in the SRB are listed in the NRHP.[46] Additional information is available from the LCRT, Office of Cultural Development, Division of Historic Preservation.

No Federally recognized American Indian Tribal Reservations or Service Areas are found in the SRB. State-recognized tribes include the Adai Caddo Tribe, the Four Winds Tribe, and the Choctaw-Apache Community of Ebarb.[47] Potentially affected Native American tribes must be notified of any proposed reservoir plans.



Map 9. Cultural and Recreational Resources and Navigable Waterways in the SRB[48]

RECREATION, NAVIGATION, AND HYDROPOWER

Water resources development projects, particularly surface water reservoirs, can provide opportunities for creating and maintaining regional recreation resources. The SRB is widely used for water-oriented recreation, particularly at Toledo Bend Reservoir. Hunting, fishing, swimming, and boating are popular throughout the reservoir area.[24] Five Wildlife Management Areas serve as hunting and camping grounds for the general public in the SRB. Specific recreational resources of regional value distributed throughout the basin are shown in **Map 9**.

Navigable waterways are important to regional and state economics, and would have to be maintained by any future water development projects. Three major navigable waterways are located in the SRB, as shown in **Map 9**. Waterway navigable lengths and depths are listed in **Table 11**. Average annual tonnage of each waterway from 1986 through 1995 is published by USACE.[35] No major ports are located in the SRB.

The single operating hydropower project in the SRB, the Toledo Bend Dam and Generating Station, is located at the southern end of Toledo Bend Reservoir. It consists of two hydroelectric power generators with a generating capacity of 92,000 kilowatts. Estimated annual energy output is 205 million kilowatt-hours.[50] The U.S. Department of Energy has identified many potential sites for microhydropower projects (less than 100 kilowatts) on tributaries east of Toledo Bend Reservoir. Potential sites for low hydropower projects (less than 1 megawatt) and small hydropower projects (between 1 and 30 megawatts) exist in the southern SRB.[51]

Table 11. Summary of Navigable Waterways in the SRB[49]

Waterway	Outflow	Navigable Depth (feet)	Navigable Length (miles)
Gulf Intracoastal Waterway	NA (traverses SRB)	12	7.6
Johnson Bayou	Sabine Lake	6	4
Sabine-Neches Waterway, Louisiana and Texas	Gulf of Mexico	40	15

NA = not applicable
SRB = Sabine River Basin

INTERBASIN AND INTERSTATE ISSUES

The Sabine River Compact (Compact) is an interstate agreement entered into by the states of Louisiana and Texas (States), granted by act of the U.S. Congress, that provides for an equitable apportionment of the waters of the Sabine River and its tributaries between the States. The compact also establishes a basis for cooperative planning and action by the States for the construction, operation and maintenance of projects for water conservation and utilization purposes on that reach of the Sabine River bordering both States, and for apportionment of the benefits therefrom.[52]

The Chicot, Evangeline, Jasper, and Carrizo-Wilcox aquifers, grouped as the Gulf Coast Aquifer System, extend across the border with Texas. The Gulf Coast Aquifer System is used for municipal, industrial, and irrigation purposes. Over-pumping in the Gulf Coast Aquifer System has led to land subsidence in several counties in Texas. In 2006, the city of Houston used approximately 170 mgd of groundwater, the majority of which was withdrawn from the Gulf Coast Aquifer System. The population of Houston is expected to more than double between 2000 and 2060, and water demand is expected to increase by 27 percent by 2060. Groundwater availability models estimate that groundwater supply will decrease by 32 percent between 2010 and 2060.

Some groundwater in the Carrizo-Wilcox aquifer underlying Texas exceeded health-based water quality standards in 2005 and 2006. Of 331 wells sampled, two wells exceeded the Texas Commission on Environmental Quality maximum contaminant level for fluoride, four wells exceeded the maximum contaminant level for nitrate, and 20 wells exceeded the maximum contaminant level for lead. Water quality issues in Texas do not appear to affect the portion of the aquifer that underlies Louisiana at present.

The Texas Water Development Board has prepared a water management plan with several strategies to reduce dependency on groundwater to meet future water resources needs. However, groundwater will account for 9 percent of the total projected volume to be provided by all recommended water management strategies on a statewide basis in 2060.[53] Because groundwater levels in the Gulf Coast Aquifer System have been declining, and demand is projected to increase because of population growth, further investigations into the effects of Houston-area groundwater use on the parts of the aquifer system underlying Louisiana may be warranted.

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, 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 SRB 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 SRB are shown in **Table 12**, and are discussed below in general order of need, from high-level needs (colored red) to low-level needs (colored green). With a small population and little commercial or industrial development, no high-level needs were identified in the basin (**Table 12**).

Flood control was ranked as a medium-level need. As mentioned, four parishes partially located in the SRB are participants in the National Flood Insurance Program offered through FEMA. Related studies and maps document flooding problems within parishes, and delineate the 100-year flood zone along major waterways.

Surface water supply was evaluated as a low-level need with increasing importance in the future. Surface water supply is more reliable in the SRB than in other upland basins because of Toledo Bend Reservoir, a large surface water resource in this area of Louisiana with relatively low population. Water supplies are currently sufficient, but future Texas demand could decrease surface water flows in the Sabine River. Furthermore, if population grows according to the goals of the SRAL, potable water supplies will need to

Table 12. Assessed Water Resources Needs in the SRB

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

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

increase accordingly. SRAL aims to market Toledo Bend Reservoir water, but current Louisiana demand is less than available supply.

Surface water quality was ranked as a low-level need with increasing importance in the future. Relatively few surface waters are impaired in the SRB, and no drinking water impairments have been identified. Common constituents causing impairment are fecal coliform and dissolved oxygen; Toledo Bend Reservoir is impaired by nonnative plants and mercury.

Groundwater supply and quality are currently adequate, and were ranked as low-level needs. The current trend of increasing withdrawals from the Chicot Aquifer in Louisiana, combined with a trend of decreasing groundwater levels in the Carrizo-Wilcox Aquifer in Texas, could compromise future use of these aquifers to meet demands in Louisiana. However, groundwater use is low in the SRB, and surface water is expected to continue to provide the major supply in the future.

Environmental protection was ranked as a low-level need with increasing importance in the future. No species Federally listed as threatened or endangered inhabit the SRB, and only a short sub-segment of a State-designated Natural and Scenic River is present. Environmental issues that threaten future protection of existing water resources and/or constrain development of additional water supplies include the presence of wetland areas and Coastal Zone. Environmental challenges in the Coastal Zone make reservoir development in the southern SRB improbable.

Recreation was ranked as a low-level need with increasing importance in the future. Toledo Bend Reservoir is a major recreation destination that adequately serves the current local population. However, the population of Sabine Parish, which surrounds the reservoir on the Louisiana side, has considerably increased in population in recent years.

Navigation was also ranked as a low-level need with increasing importance in the future. Navigation waterways are well-maintained, and three ports on the Sabine-Neches Ship Channel in Texas conveyed 118 million tons of cargo in 2004. To accommodate further commercial traffic, widening of the Sabine-Neches Ship Channel to 500 feet in width and 50 feet in depth is expected to be completed in 2009. With increased traffic through the SRB, an estimated $4.7 billion in revenue is anticipated for Louisiana and Texas.

ABBREVIATIONS

°F	degrees Fahrenheit
7Q10	7-day low flow with a recurrence interval of 10 years
BMP	Baseline Monitoring Program
cfs	cubic feet per second
DOTD	Louisiana Department of Transportation and Development
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
gpcd	gallons per capital per day
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
SRAL	Sabine River Authority of Louisiana
SRB	Sabine River Basin
State	State of Louisiana
TDS	total dissolved solids
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

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BUILDING A BETTER WORLD