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LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

Prepared in cooperation with the Louisiana Department of Transportation and Development

Water Resources of Bienville Parish, Louisiana

Introduction

Information concerning the availability, use, and quality of water in Bienville Parish, Louisiana (fig. 1), is critical for proper water-supply management. The purpose of this fact sheet is to present information that can be used by water managers, parish residents, and others for stewardship of this vital resource. In 2014, about 13.03 million gallons per day (Mgal/d) of water were withdrawn in Bienville Parish, including about 12.88 Mgal/d from groundwater sources and 0.15 Mgal/d from surface-water sources[1] (table 1). Withdrawals for industrial use accounted for about 78 percent (10.18 Mgal/d) of the total water withdrawn (table 2). Other categories of use included public supply, which accounted for about 18 percent of the total water withdrawn (2.33 Mgal/d); agriculture, composed of general irrigation and livestock, which accounted for about 1 percent (0.18 Mgal/d); and rural domestic (0.33 Mgal/d), which accounted for about 2 percent. Water-use data collected at 5-year intervals from 1960 to 2010 and again in 2014 indicated that water withdrawals peaked in 1995 at more than 17 Mgal/d (fig. 2).

[1]Water-withdrawal data are based on estimated or reported site-specific data and aggregated data, which are distributed to sources. For a full description of water-use estimate methodology, see "Data Collection" in Collier and Sargent (2018). Tabulation of numbers in text and tables may result in different totals because of rounding; nonrounded numbers are used for calculation of totals.

Groundwater Resources

The primary freshwater-bearing aquifer in Bienville Parish is the Sparta aquifer. Additional groundwater resources include the Carrizo-Wilcox aquifer and, to a minor extent, the Upland terrace aquifer (table 1). In the eastern part of Bienville Parish, the Sparta aquifer provides the primary freshwater source, whereas the Carrizo-Wilcox provides the source in the west (figs. 1 and 3). The altitude of the base of fresh groundwater (water with a chloride concentration of 250 milligrams per liter [mg/L] or less) ranges from about 0 feet (ft) to 500 ft below the National Geodetic Vertical Datum of 1929 (NGVD 29) along the western border towards the central part of the parish in the Carrizo-Wilcox aquifer and from about 200 ft to greater than 400 ft below NGVD 29 from the central part of the parish towards the east-northeastern part of the parish in the Sparta aquifer (Smoot, 1988). The Cockfield aquifer underlies Bienville Parish narrowly in the northwestern parish corner.

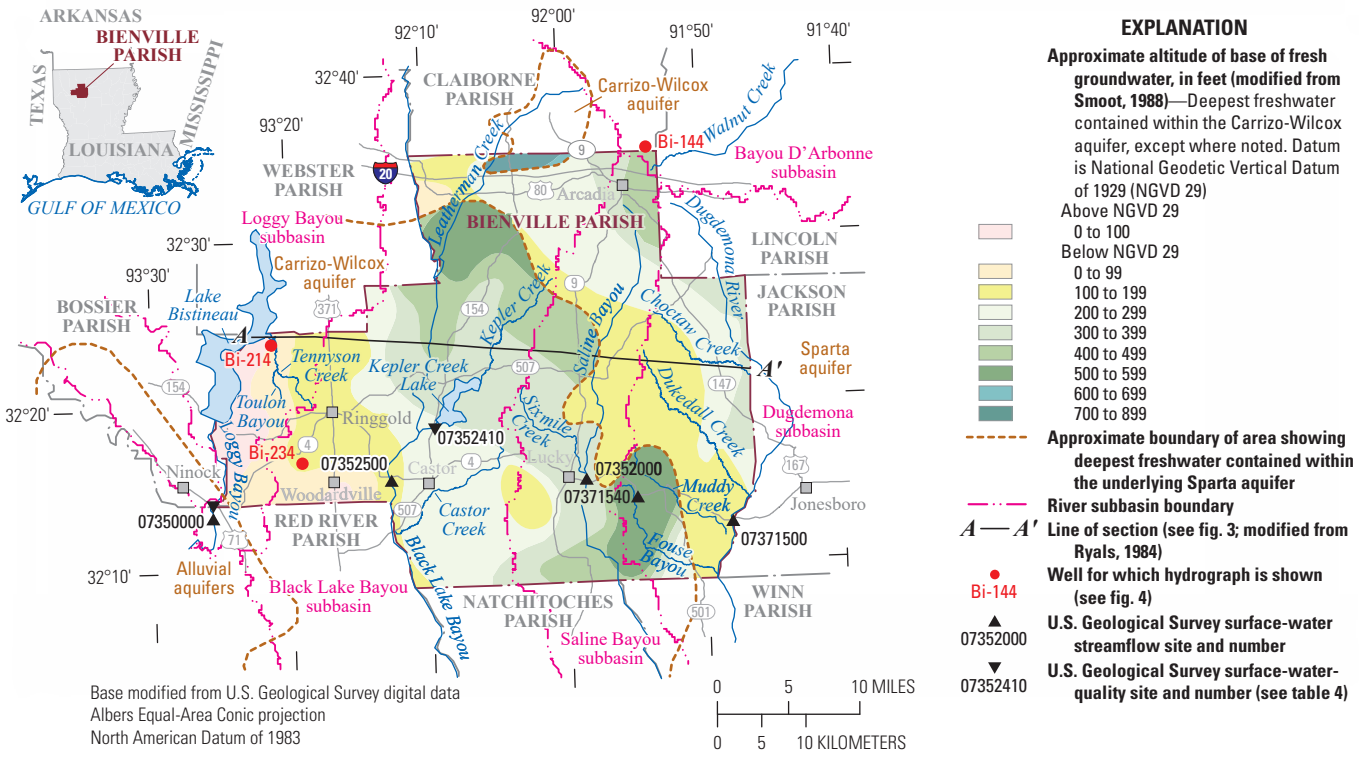

Figure 1. Location of study area, Bienville Parish, Louisiana.

Table 1. Water withdrawals, in million gallons per day, by source in Bienville Parish, Louisiana, 2014 (Collier, 2018).

Aquifer or surface-water body	Groundwater	Surface water
Sparta aquifer	12.09	
Carrizo-Wilcox aquifer	0.76	
Upland terrace aquifer (northern Louisiana)	0.03	
Miscellaneous streams		0.15
Total	**12.88**	**0.15**

Table 2. Water withdrawals, in million gallons per day, by use category in Bienville Parish, Louisiana, 2014 (Collier, 2018).

Use category	Groundwater	Surface water	Total
Public supply	2.33	0.00	2.33
Industry	10.18	0.00	10.18
Rural domestic	0.33	0.00	0.33
Livestock	0.03	0.02	0.06
General irrigation	0.00	0.12	0.12
Total	**12.88**	**0.15**	**13.03**

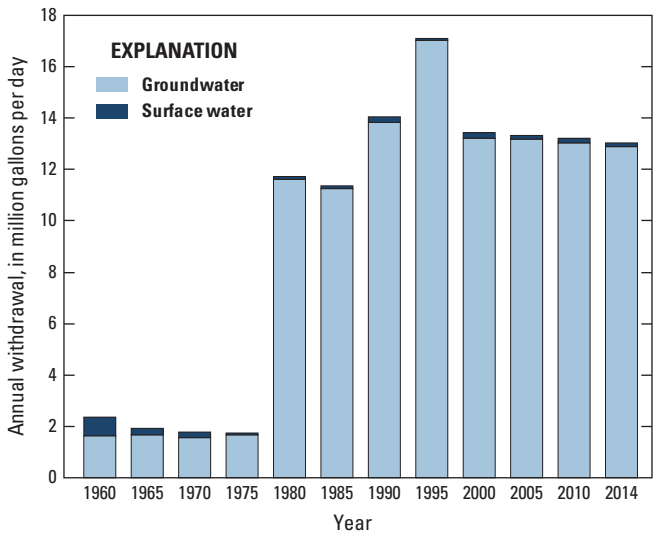

Figure 2. Water withdrawals in Bienville Parish, Louisiana, 1960–2014 (Collier, 2018; U.S. Geological Survey, 2018b).

Sparta Aquifer

The Sparta aquifer is an extensive regional aquifer which is present and contains freshwater in about two-thirds of Bienville Parish. The aquifer, which is composed of very fine to medium sand with silt and clay lenses, outcrops in the central part of the parish. The thickness of the Sparta aquifer ranges from 0 ft along its western border, in central Bienville Parish, to greater than 800 ft in the northeastern corner of the parish, near Arcadia. The altitude of the base of the aquifer ranges from greater than 150 ft above NGVD 29 along the aquifer's western border to greater than 400 ft below NGVD 29 along the eastern and northeastern parts of the parish (Brantly and others, 2002).

The primary sources of recharge for the Sparta aquifer include the infiltration of precipitation in the outcrop area and leakage from overlying aquifers. In Bienville Parish, water in the Sparta aquifer generally moves in a northeastward direction, towards a major pumping center located in the city of West Monroe in Ouachita Parish (McGee and Brantly, 2015). Groundwater discharges by way of well withdrawals and through leakage into adjacent aquifers (Payne, 1968).

In 2012, water levels measured in wells screened in the Sparta aquifer ranged from about 220 ft above NGVD 29 in the southwestern part of the parish to about 40 ft above NGVD 29 in the northeastern part of the parish (McGee and Brantly, 2015). Water levels in the Sparta aquifer at well Bi-144 (figs. 1 and 4) indicate a long-term decreasing trend from 1970 to 2014, with a steady decline of about 48 ft from 1970 to 2009 and a sharp decline of about 10 ft from 2010 to 2012. Since 2012, however, water levels have been increasing, and were about 70 ft above NGVD 29 in 2016.

State well-registration records listed 367 active water wells screened in the Sparta aquifer in Bienville Parish in 2017: 253 domestic wells, 56 public-supply wells, 33 industrial wells, and 25 irrigation wells. Well depths ranged from 30 to 760 ft below land surface, and reported yields ranged from 2 to 2,500 gallons per minute (gal/min) (Louisiana Department of Natural Resources, 2017). In 2014, about 12.09 Mgal/d were withdrawn from the Sparta aquifer, with use categories including 10.18 Mgal/d for industry, 1.70 Mgal/d for public supply, 0.18 Mgal/d for rural domestic, and 0.02 Mgal/d for livestock (Collier, 2018).

Carrizo-Wilcox Aquifer

Sand and gravels within the Carrizo aquifer and the Wilcox aquifer are hydraulically connected and are considered to be a single aquifer referred to as the Carrizo-Wilcox aquifer (Ryals, 1983). The Carrizo-Wilcox aquifer underlies all of Bienville Parish but only provides a small percentage of the groundwater withdrawn in the parish because much of the water is saltwater. The transition from freshwater to saltwater occurs in the central part of the parish, with freshwater present in the southwestern part of the parish and saltwater present in the northeastern part.

The aquifer outcrops in southwestern Bienville Parish. The thickness of the Carrizo-Wilcox aquifer deepens from west to east, ranging from 0 to 1,500 ft across the entire parish and reaching its maximum thickness in the southeastern corner. The majority of the aquifer underlying the parish is from 500 to 1,000 ft thick. The altitude of base of freshwater in the aquifer ranges from 0 to 99 ft below NGVD 29 in the west to greater than 500 ft below NGVD 29 in central Bienville Parish (Ryals, 1984).

The primary source of recharge for the Carrizo-Wilcox aquifer is the infiltration of precipitation in western Bienville Parish. Discharge usually results through the pumping of wells and through leakage into adjacent aquifers. Groundwater in the Carrizo-Wilcox aquifer in Bienville Parish generally moves towards the towns of Castor and Woodardville which are areas of localized depression caused by heavy pumping (Fendick and Carter, 2015).

Water levels measured in well Bi-214, about 6 miles northwest of Ringgold and screened in the Carrizo-Wilcox aquifer (figs. 1 and 4), indicate little if any long-term increasing or decreasing trend, with water levels that typically fluctuated about 0.5 ft annually.

State well-registration records listed eight active water wells screened in the Carrizo-Wilcox aquifer in Bienville Parish in 2017: six domestic wells and two public-supply wells. Well depths ranged

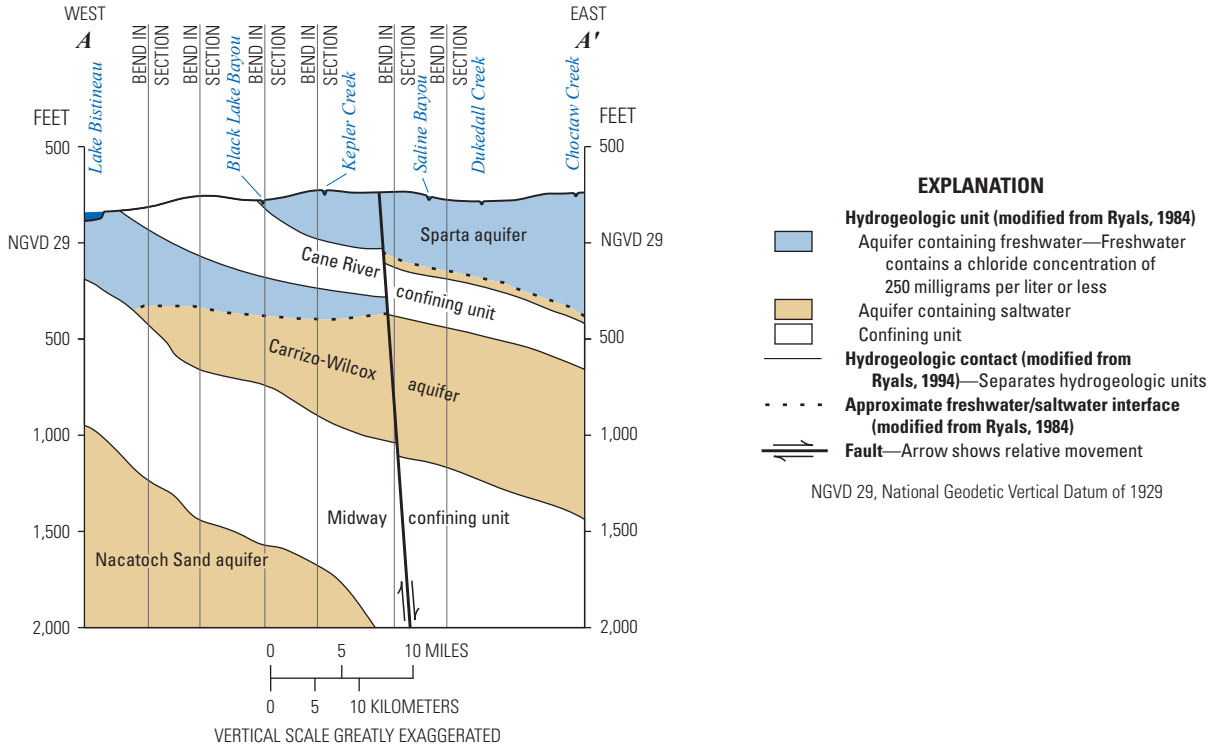

Figure 3. Idealized west-to-east hydrogeologic section through Bienville Parish, Louisiana, showing aquifer and confining unit intervals (individual sand and clay layers not shown). Modified from Ryals (1984); base of freshwater from Smoot (1988). Trace of section shown on figure 1.

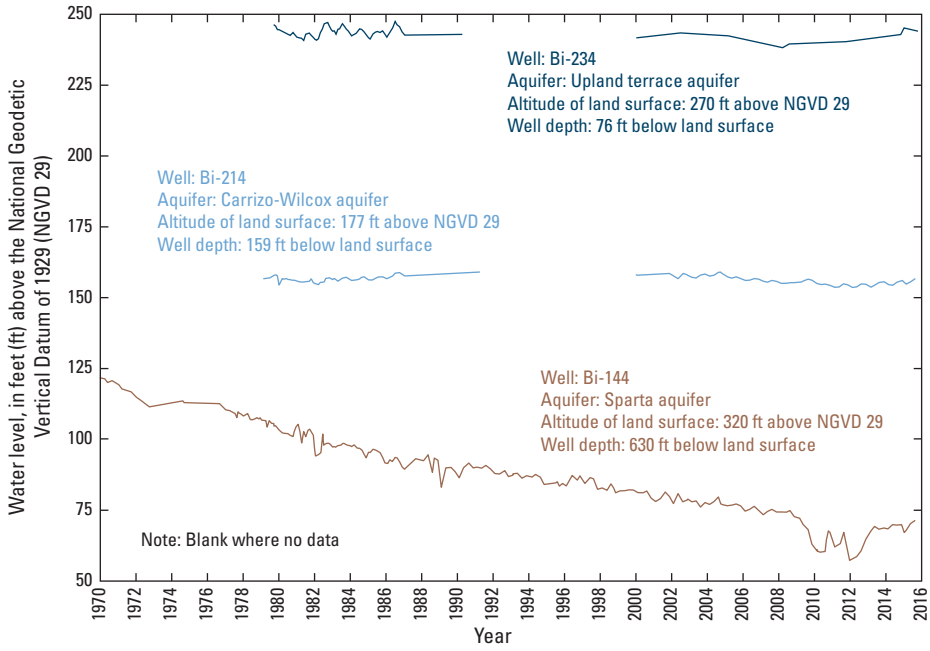

Figure 4. Water levels in well Bi-144 screened in the Sparta aquifer, well Bi-214 screened in the Carrizo-Wilcox aquifer, and well Bi-234 screened in the Upland terrace aquifer, Bienville Parish, Louisiana (see fig. 1 for well locations; U.S. Geological Survey, 2018a).

from 140 to 335 ft below land surface, and reported yields ranged from 42 to 100 gal/min (Louisiana Department of Natural Resources, 2017). In 2014, about 0.76 Mgal/d were withdrawn from the Carrizo-Wilcox aquifer, including 0.63 Mgal/d for public supply and 0.13 Mgal/d for rural domestic (Collier, 2018).

Upland Terrace Aquifer

The Upland terrace aquifer is adjacent to the Red River alluvial aquifer, underlying the western third of Bienville Parish (roughly the area southwest of Kepler Creek Lake). Basal sands and gravel are generally present near the bottom of the Upland terrace aquifer,

and finer materials, such as sand and clay, are near the top (Snead and McCulloh, 1984). The terrace deposits in Bienville Parish average about 100 ft thick (Boswell and others, 1968). The primary source of recharge for the Upland terrace aquifer is the infiltration of precipitation (Snider and Sanford, 1981).

Water levels at well Bi-234 (fig. 4), located about 2 miles northwest of Woodardville and screened in the Upland terrace aquifer, were measured from 1980 to 2016. Water levels declined about 4 ft between 1987 and 2008 and increased about 5 ft from 2009 to 2016.

State well-registration records listed 26 active water wells screened in the Upland terrace aquifer in Bienville Parish in 2017: 19 domestic wells, 6 irrigation wells, and 1 public-supply well. Well depths ranged from 40 to 160 ft below land surface, and reported yields ranged from 25 to 600 gal/min (Louisiana Department of Natural Resources, 2017). In 2014, about 0.03 Mgal/d were withdrawn from the Upland terrace aquifer, with use categories including about 0.02 Mgal/d for rural domestic and less than 0.01 Mgal/d for livestock (Collier, 2018).

Groundwater Quality

Samples of fresh groundwater were collected during 1940–2014 from 112 wells screened in the Sparta aquifer and during 1941–2004 from 59 wells screened in the Carrizo-Wilcox aquifer in Bienville Parish as part of an ongoing, long-term monitoring program for the State's groundwater resources (table 3). The analytical results for the groundwater samples were generally within the U.S. Environmental Protection Agency's Secondary Maximum Contaminant Levels[2] (SMCLs) for chloride, sulfate, manganese, and dissolved-solids concentrations. The median hardness values of 13.7 mg/L for the Sparta aquifer and 20 mg/L for the Carrizo-Wilcox aquifer were both within the soft[3] range. The median values for pH exceeded the SMCL of 6.5–8.5 in more than 60 percent of samples from the Sparta aquifer and in about 35 percent of samples from the Carrizo-Wilcox aquifer. Iron concentrations exceeded the SMCL of 300 micrograms per liter (µg/L) in more than 70 percent of samples from the Sparta aquifer.

Surface-Water Resources

Numerous surface-water resources in Bienville Parish are present in five drainage subbasins: the Black Lake Bayou subbasin (Hydrologic Unit Code [HUC] 11140209), the Dugdemona subbasin (HUC 08040303), the Saline Bayou subbasin (HUC 11140208), the Loggy Bayou subbasin (HUC 11140203), and a small part of

[2]The SMCLs are Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration), aesthetic effects (such as taste, odor, or color), or technical effects (such as damage to water equipment or reduced effectiveness of treatment for other contaminants) of potential constituents of drinking water. SMCLs were established as guidelines by the U.S. Environmental Protection Agency (2016).

[3]Hardness ranges, expressed as milligrams per liter of calcium carbonate, are as follows: 0–60, soft; 61–120, moderately hard; 121–180, hard; greater than 180, very hard (Hem, 1985).

Table 3. Summary of selected water-quality characteristics for freshwater from 112 wells screened in the Sparta aquifer and 59 wells screened in the Carrizo-Wilcox aquifer in Bienville Parish, Louisiana (U.S. Geological Survey, 2018a).

[Values are in milligrams per liter, except as noted. °C, degrees Celsius; PCU, platinum cobalt units; µS/cm, microsiemens per centimeter; SU, standard unit; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; NA, not applicable; SMCL, Secondary Maximum Contaminant Level established by the U.S. Environmental Protection Agency (2016)]

	Temperature (°C)	Color, (PCU)	Specific conductance, field (µS/cm at 25 °C)	Dissolved oxygen	pH, field (SU)	Hardness (as $CaCO_3$)	Chloride, filtered (as Cl)	Sulfate, filtered (as SO_4)	Iron, filtered (µg/L as Fe)	Manganese, filtered (µg/L as Mn)	Dissolved solids, filtered
Sparta aquifer, 112 wells (1940–2014)											
Median	21.0	5	76	0.2	6.2	13.7	4.4	7	853	24	83
10th percentile	19.5	0	38	0.1	5.2	5.2	2.0	0.9	48.0	4.0	35.9
90th percentile	23.3	30	298	7.7	7.5	53.2	16	19.2	3,430	95	182.6
Number of samples	69	70	84	21	110	143	144	119	88	66	100
Percentage of samples that do not exceed SMCLs	NA	73	NA	NA	39	NA	100	100	28	77	100
Carrizo-Wilcox aquifer, 59 wells (1941–2004)											
Median	23.0	20	710	NA	8.1	20	13	2.3	130	20	370
10th percentile	20.6	0	311	NA	6.8	3	5.4	0	42	0	196.4
90th percentile	26.4	60	1,440	NA	8.8	100	112	30.6	1,340	104	770.2
Number of samples	43	53	51	NA	54	68	68	60	43	29	55
Percentage of samples that do not exceed SMCLs	NA	47	NA	NA	65	NA	93	98	79	76	62
SMCLs	NA	15	NA	NA	6.5–8.5	NA	250	250	300	50	500

the Bayou D'Arbonne subbasin (HUC 08040206). Surface waters flow in a general southerly direction. In 2014, 0.15 Mgal/d were withdrawn from miscellaneous streams in these subbasins for agricultural purposes, including about 0.12 Mgal/d for general irrigation and 0.02 Mgal/d for livestock (tables 1 and 2) (Collier, 2018).

Black Lake Bayou Subbasin

The Black Lake Bayou subbasin covers the western part of central Bienville Parish, covering nearly 50 percent of the total surface parish area. The major streams in the subbasin in the parish include Black Lake Bayou, Leatherman Creek, Kepler Creek, and Castor Creek (fig. 1). The annual average streamflow during 1941–57 was 549 cubic feet per second (ft^3/s) at the Black Lake Bayou near Castor (USGS site number 07352500). During this period, the highest monthly average streamflow was 1,152 ft^3/s in February, and the lowest was 549 ft^3/s during September (U.S. Geological Survey [USGS], 2018a).

Saline Bayou Subbasin

The Saline Bayou subbasin covers the eastern part of central Bienville Parish. Major streams in the subbasin in the parish include Saline Bayou and Sixmile Creek. The annual average streamflow during 1941–2018 was 171 ft^3/s at the Saline Bayou near Lucky (USGS site number 07352000; fig. 1). During this period, the highest monthly average streamflow was 322 ft^3/s in February, and the lowest was 171 ft^3/s during August (USGS, 2018a).

Dugdemona Subbasin

The Dugdemona subbasin covers eastern Bienville Parish. Major streams in the subbasin include the Dugdemona River, Dukedall Creek, Fouse Bayou, Muddy Creek, and Choctaw Creek (fig. 1). The annual average streamflow during 1939–2002 was 460 ft^3/s at the Dugdemona River near Jonesboro (USGS site number 07371500; fig. 1). During this period, the highest monthly average streamflow was 1,130 ft^3/s in February, and the lowest was 31 ft^3/s during September (USGS, 2018a).

Loggy Bayou Subbasin

The Loggy Bayou subbasin is present in the westernmost parts of Bienville Parish. Major streams in the subbasin in the parish include the Loggy Bayou (which partially aligns with the western border of the parish), Toulon Bayou, and Tennyson Creek (fig. 1). Lake Bistineau is a large lake (also present along the western border) used for recreation (Louisiana Department of Wildlife and Fisheries, 2019). The annual average streamflow during 1949–84 was 1,718 ft^3/s at the Loggy Bayou near Ninock (USGS site number 07350000). During this period, the highest monthly average streamflow was 4,415 ft^3/s in May, and the lowest was 237 ft^3/s during September (USGS, 2018a).

Table 4. Summary of selected water-quality characteristics for samples from Loggy Bayou near Ninock and Kepler Lake near Castor, Bienville Parish, Louisiana (U.S. Geological Survey, 2018a).

[Values are in milligrams per liter, except as noted. µS/cm, microsiemens per centimeter; °C, degrees Celsius; SU, standard units; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter; NA, not applicable; SMCL, Secondary Maximum Contaminant Level established by the U.S. Environmental Protection Agency (2016)]

	Specific conductance, field (µS/cm at 25 °C)	Dissolved oxygen	pH, field (SU)	Hardness (as $CaCO_3$)	Calcium, filtered (as Ca)	Magnesium, filtered (as Mg)	Sodium, filtered (as Na)	Chloride, filtered (as Cl)	Sulfate, filtered (as SO_4)	Iron, filtered, (µg/L as Fe)
Loggy Bayou near Ninock (1954–81)[1]										
Median	247	6.8	6.9	46	13	3	20	54	13	200
10th percentile	121	5.1	6.2	26	6	2.0	10	21	5	40
90th percentile	458	10.4	7.7	120	31	11	42	205	65	418
Number of samples	46	32	92	46	46	46	46	92	92	13
Percentage of samples that do not exceed SMCLs	NA	NA	75	NA	NA	NA	NA	94	100	77
Kepler Lake near Castor (1959–74)[2]										
Median	41	7.6	6.4	9	2.3	0.7	3	4.3	3.4	310
10th percentile	34	6.0	5.7	7.5	1.8	0.6	2.4	2.9	1.1	150
90th percentile	46	9.5	6.7	14	4	1	3.2	6	4.6	755
Number of samples	11	9	16	16	11	11	11	16	16	6
Percentage of samples that do not exceed SMCLs	NA	NA	31	NA	NA	NA	NA	100	100	50
SMCLs	NA	NA	6.5–8.5	NA	NA	NA	NA	250	250	300

[1]U.S. Geological Survey site number 07350000 (see fig. 1).

[2]U.S. Geological Survey site number 07352410 (see fig. 1).

Bayou D'Arbonne Subbasin

The Bayou D'Arbonne subbasin is present only in a small area at the northeastern corner of Bienville Parish. Walnut Creek is the only major stream present in the subbasin in Bienville Parish, and the creek flows to the east into Lincoln Parish.

Surface-Water Quality

Water samples were collected from Loggy Bayou near Ninock (USGS site number 07350000) during 1954–81 and Kepler Lake near Castor (USGS site number 07352410) during 1959–74 (fig. 1) as part of an ongoing program to monitor the State's surface-water resources. The analytical results for these samples were generally within SMCLs for concentrations of chloride and sulfate (table 4). The median hardness values of 46 mg/L in Loggy Bayou and 9 mg/L in Kepler Lake were within the soft range. Median values for dissolved-oxygen concentrations were greater than 6.8 and 7.6 mg/L for Loggy Bayou and Kepler Lake, respectively; 5 mg/L is considered the minimum value for a diverse population of fresh, warmwater biota, including sport fish (Louisiana Department of Environmental Quality, 2017).

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This fact sheet has been prepared by the U.S. Geological Survey (USGS), in cooperation with the Louisiana Department of Transportation and Development (DOTD), as part of a program to document water use, availability, and quality in the parishes of Louisiana. Information on the availability, past and current water use, use trends, and water quality from groundwater and surface-water sources in the parish is presented here. Previously published reports (see References Cited section) and data stored in the USGS National Water Information System (USGS, 2018a) are the primary sources of the information presented here. Special thanks are given to Doug Taylor, Director, and Zahir "Bo" Bolourchi (retired), DOTD Cooperative Program with the USGS.

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