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LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

Prepared in cooperation with the Louisiana Department of Transportation and Development

Water Resources of Avoyelles Parish, Louisiana

Introduction

Information concerning the availability, use, and quality of water in Avoyelles 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 In 2014, about 70 million gallons per day (Mgal/d) of water were withdrawn in Avoyelles Parish, including about 59.27 Mgal/d from groundwater sources and 10.95 Mgal/d from surface-water sources[1] (table 1). Withdrawals for agricultural use—composed of aquaculture, general irrigation, livestock, and rice irrigation—accounted for 93 percent (65.59 Mgal/d) of the total water withdrawn (table 2). Other categories of use included public supply and rural domestic. Water-use data collected at 5-year intervals from 1960 to 2010 and again in 2014 indicated that water withdrawals peaked in 2014 (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 Sargent (2011). 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 aquifers in Avoyelles Parish are the alluvial and terrace aquifers and Evangeline aquifer (figs. 1 and 3). The Jasper aquifer system, which is composed of the Carnahan Bayou aquifer and the Williamson Creek aquifer, and the Jasper equivalent aquifer system also may contain freshwater, but few withdrawals are made from these systems by comparison. In the central part of the parish, the base of fresh groundwater (water with a chloride concentration of 250 milligrams per liter [mg/L] or less) is present in the alluvial aquifers at altitudes of less than 100 feet (ft) below the National Geodetic Vertical Datum of 1929 (NGVD 29) to greater than 150 ft below NGVD 29 (fig. 1). In the eastern part of the parish, the base of fresh groundwater is present in the Jasper equivalent aquifer system at altitudes of less than 200 ft below NGVD 29 to greater than 1,000 ft below NGVD 29 (fig. 1) (Smoot, 1988). In the northwestern corner of the parish, the base of freshwater is present in the Jasper aquifer system at less than 150 ft to greater than 400 ft below NGVD 29. In the southwestern part of the parish, the base of freshwater is present in the Evangeline aquifer at altitudes of less than 300 ft below NGVD 29 to greater than 1,000 ft below NGVD 29.

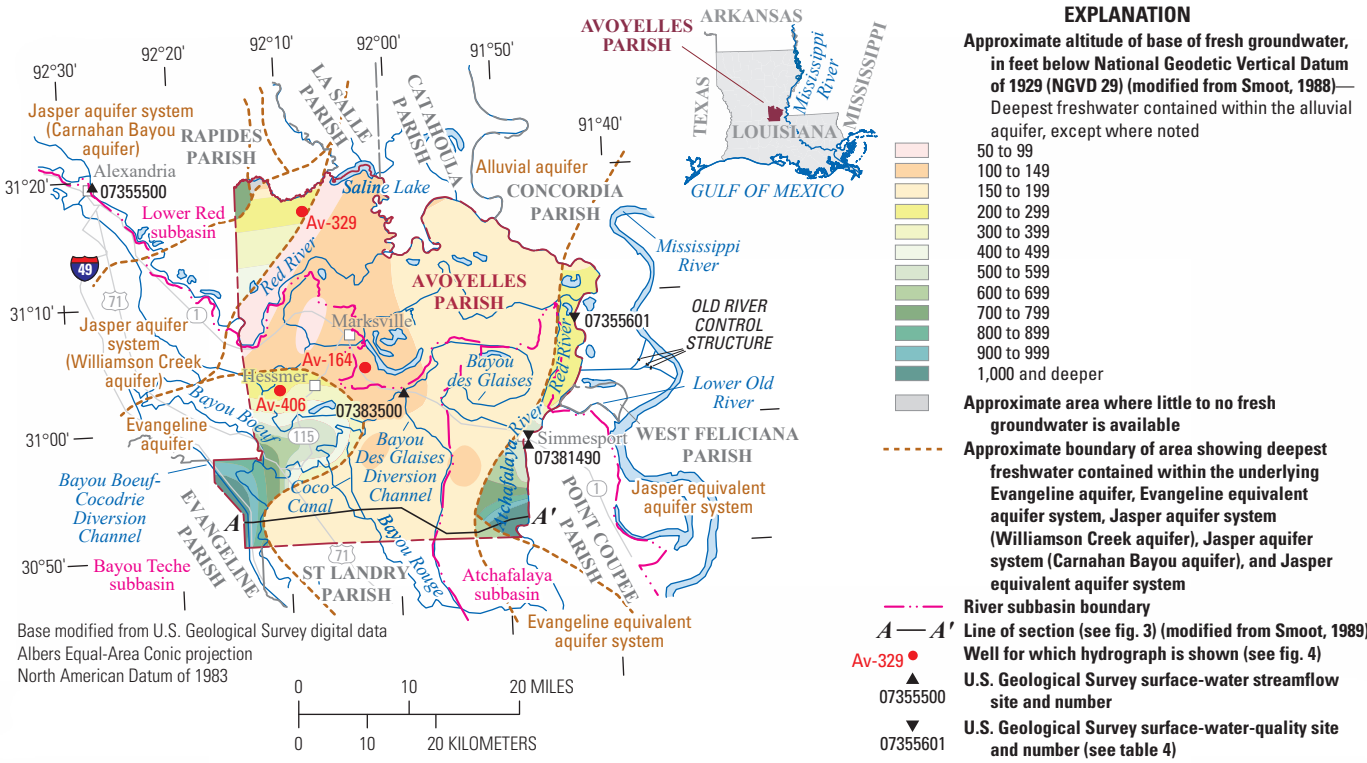

Figure 1. Location of study area, Avoyelles Parish, Louisiana.

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

Aquifer or surface-water body	Groundwater	Surface water
Alluvial aquifers	47.45	
Terrace aquifers	7.50	
Evangeline aquifer	4.32	
Jasper aquifer system	0.01	
Miscellaneous surface waters		10.95
Total	**59.27**	**10.95**

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

Use category	Groundwater	Surface water	Total
Aquaculture	18.43	6.14	24.58
Public supply	4.45	0.00	4.45
Rural domestic	0.18	0.00	0.18
Livestock	0.15	0.00	0.15
Rice irrigation	21.35	1.12	22.47
General irrigation	14.72	3.68	18.39
Total	**59.27**	**10.95**	**70.22**

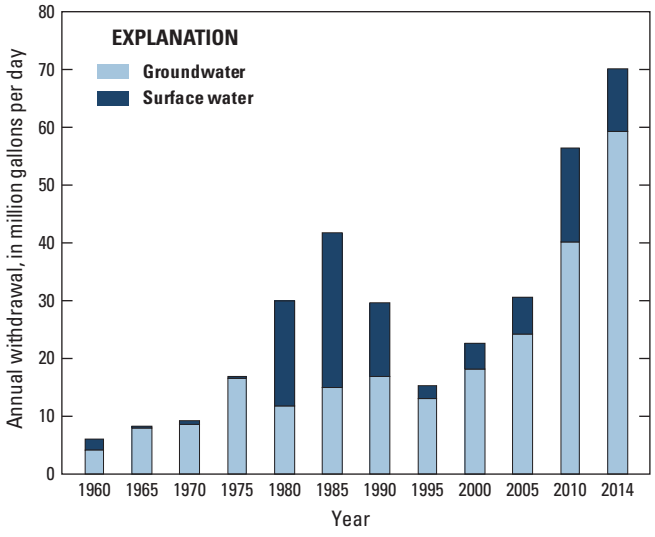

Figure 2. Water withdrawals in Avoyelles Parish, Louisiana, 1960–2014 (U.S. Geological Survey, 2017a; Collier, 2018).

Alluvial and Terrace Aquifers

The alluvial aquifers are composed of the Mississippi River alluvial and Red River alluvial aquifers, and the terrace aquifers are composed of the Upland and Prairie terrace aquifers. The terrace aquifers are present in the upland areas of the parish, and the alluvial aquifers are present in the lowlands. The alluvial and terrace aquifers are composed of the lower part of riverine and deltaic deposits (Fisk, 1940) that generally grade from clay and silt at the surface to sand and gravel at the base. The aquifers are composed of the sand and gravel layers. Although referred to

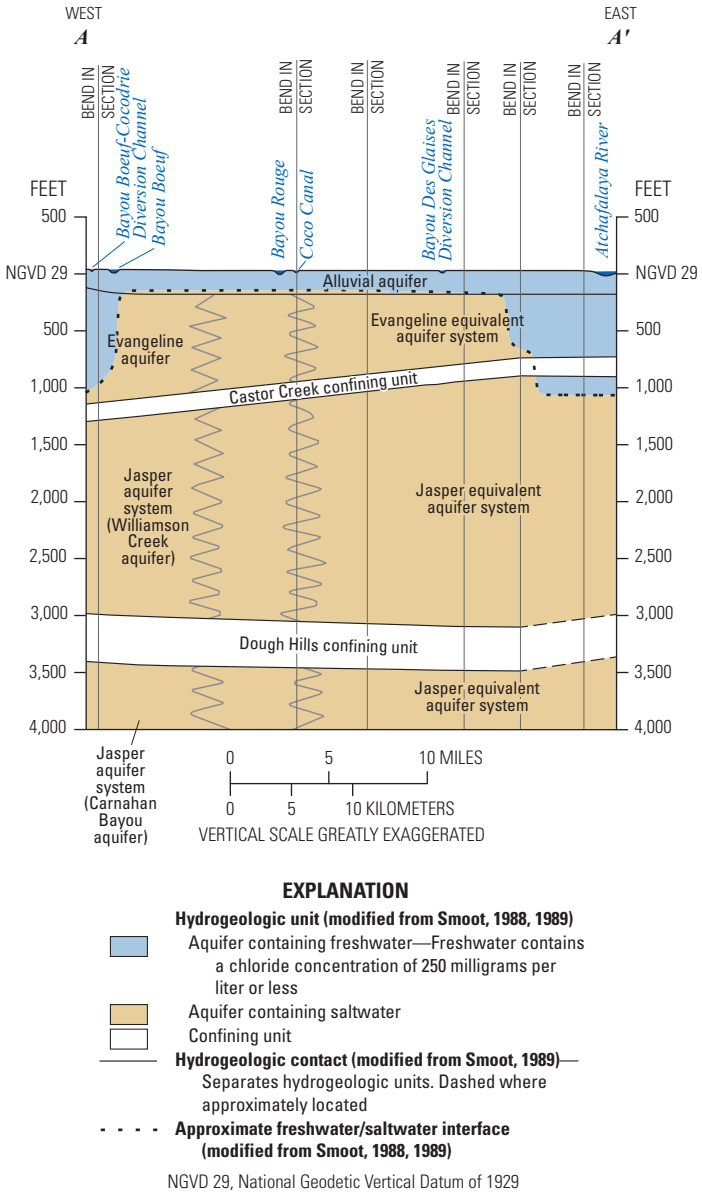

Figure 3. Idealized west-to-east hydrogeologic section through Avoyelles Parish, Louisiana, showing aquifer and confining unit intervals (individual sand and clay layers not shown). Trace of section shown on figure 1.

by different names, because of the differences in deposition and erosion, the Mississippi River alluvial, Red River alluvial, and Prairie and Upland terrace aquifers act as a system because of the hydraulic connection of the sand and gravel layers. The system ranges from 50 to 150 ft thick within the parish. The upper part of the alluvial deposits, composed of silt and clay, forms a confining layer that ranges from less than 5 to 50 ft thick and is absent in some locales. The altitude of the base of the system of aquifers ranges from less than 100 to greater than 150 ft below NGVD 29 (Marie, 1971).

The primary source of recharge for the alluvial and terrace aquifers is the infiltration of precipitation, with secondary sources of recharge from streams and rivers and from underlying aquifers when hydraulic pressure in underlying aquifers is high enough to result in upward groundwater flow. In the 1960s, groundwater in the alluvial aquifer moved towards the Red River in the north and northeastern parts of the parish, the Atchafalaya River in the southeast, and Evangeline Parish in the southwest (Marie, 1971).

Groundwater withdrawals in Avoyelles Parish have increased from 3.99 Mgal/d in 1960 to 59.27 Mgal/d in 2014 (fig. 2), and the direction of flow may have changed since the 1960s. Groundwater may flow from one aquifer into another and discharges by way of flow into streams and rivers, evapotranspiration, and well withdrawals (Marie, 1971).

Water levels at well Av-329 (U.S. Geological Survey [USGS] site number 311708092073701), located in the northern part of the parish and north of the Red River (fig. 1), fluctuated annually with a period of lower water levels during approximately 1980–2002, but overall have remained stable during 1968–2012 (fig. 4). Water levels at well Av-164 (USGS site number 310453092022901), located south of Marksville and screened in the Upland terrace aquifer, have fluctuated seasonally and declined by less than 5 ft during 1966–2017 (fig. 4).

State well-registration records listed 468 active water wells screened in the alluvial aquifers in Avoyelles Parish in 2017: 334 irrigation wells, 119 domestic wells, 7 industrial wells, and 8 public-supply wells. Well depths ranged from 15 to 205 ft below land surface, and reported yields ranged from 10 to 7,500 gallons per minute (gal/min) (Louisiana Department of Natural Resources, 2017). In 2014, about 47.45 Mgal/d were withdrawn from the alluvial aquifers, with use categories including 0.59 Mgal/d for public supply, 0.07 Mgal/d for rural domestic, 0.08 Mgal/d for livestock, 19.64 Mgal/d for rice irrigation, 13.24 Mgal/d for general irrigation, and 13.82 Mgal/d for aquaculture (Collier, 2018).

State well-registration records listed 115 active water wells screened in the terrace aquifers in Avoyelles Parish in 2017: 44 irrigation wells, 50 domestic wells, 3 industrial wells, and 18 public-supply wells. Well depths ranged from 39 to 200 ft below land surface, and reported yields ranged from 6 to 4,000 gal/min (Louisiana Department of Natural Resources, 2017). In 2014, about 7.50 Mgal/d were withdrawn from the terrace aquifers, with use categories including 0.83 Mgal/d for public supply, 0.03 Mgal/d for rural domestic, 0.02 Mgal/d for livestock, 1.28 Mgal/d for rice irrigation, 0.74 Mgal/d for general irrigation, and 4.61 Mgal/d for aquaculture (Collier, 2018).

Evangeline Aquifer

In Avoyelles Parish, freshwater is present in the Evangeline aquifer in the southwestern and southeastern parts of the parish (where it is also called the Evangeline equivalent aquifer system), but not in the south-central part of the parish. The aquifer subcrops in southern Avoyelles Parish and dips and thickens to the south. Altitudes of the top of the aquifer range from about NGVD 29 to less than 200 ft below NGVD 29 (Whitfield, 1975). The aquifer is composed of individual sand layers that are separated by clay layers (Whitfield, 1975). Total aquifer thickness ranges from greater than 500 ft to greater than 1,000 ft, whereas the aggregate thickness of freshwater-bearing sands ranges from less than 200 ft to greater than 600 ft (Whitfield, 1975). Generally, individual sand layers within the aquifer are less than 50 ft thick, but some are 100 ft thick or greater. The aquifer is recharged by indirect infiltration of precipitation through overlying terrace aquifers in Avoyelles Parish (Whitfield, 1975). The Evangeline aquifer is separated from the underlying Jasper aquifer system by the Castor Creek confining unit (fig. 3), which is composed primarily of clay (Whitfield, 1975). Water levels at well Av-406 (USGS site number 310305092101202), screened in the Evangeline aquifer in Avoyelles Parish west of Hessmer, have declined since the first measurement of about 30 ft above NGVD 29 in 1979 to about 16 ft above NGVD 29 in 2016; the water-level decline is partially due to seasonal variation (fig. 4).

State well-registration records listed 135 active water wells screened in the Evangeline aquifer in Avoyelles Parish in 2017: 104 domestic wells, 2 industrial wells, 5 irrigation wells, and 24 public-supply wells. Depths of these wells ranged from 210 to 925 ft below land surface, and reported yields ranged from 1 to 690 gal/min (Louisiana Department of Natural Resources, 2017). In 2014, about 4.32 Mgal/d were withdrawn from the Evangeline

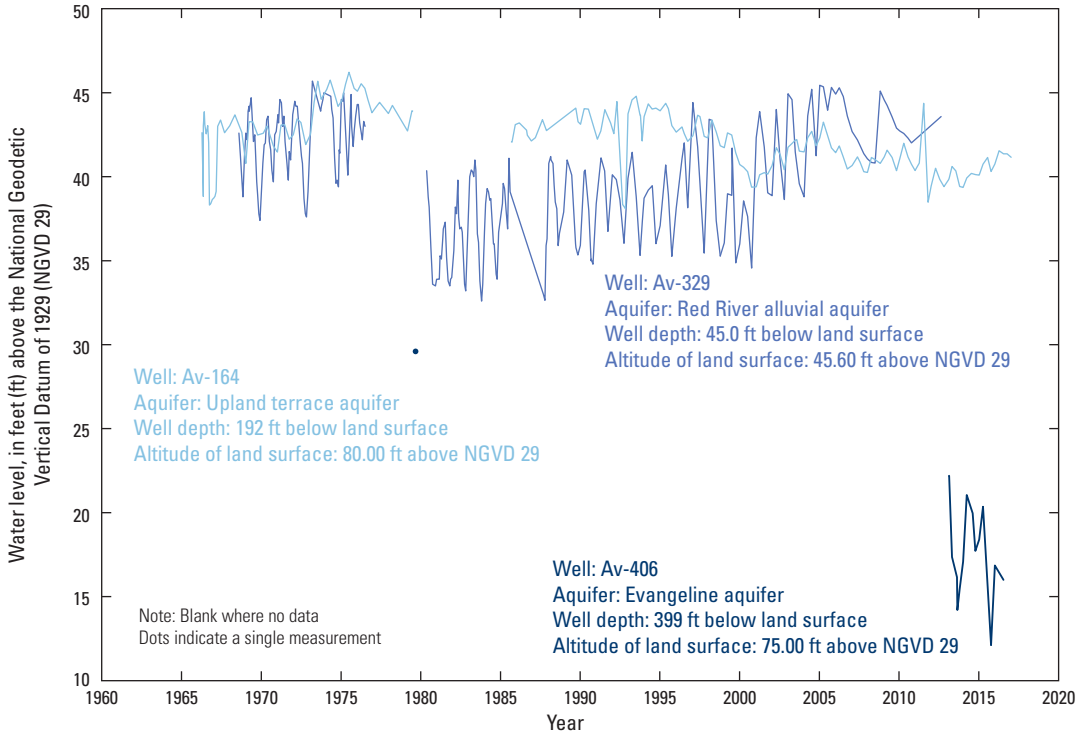

Figure 4. Water levels in well Av-329 screened in the Red River alluvial aquifer, well Av-164 screened in the Upland terrace aquifer, and well Av-406 screened in the Evangeline aquifer in Avoyelles Parish, Louisiana (see fig. 1 for well locations; U.S. Geological Survey, 2017b).

aquifer in Avoyelles Parish with use categories including 3.04 Mgal/d for public supply, 0.07 Mgal/d for rural domestic, 0.04 Mgal/d for livestock, 0.43 Mgal/d for rice irrigation, and 0.74 Mgal/d for general irrigation (Collier, 2018).

Groundwater Quality

Groundwater samples were collected during 1937–2014 from 137 wells screened in the alluvial aquifers, during 1938–87 from 74 wells screened in the terrace aquifers, and during 1938–2013 from 64 wells screened in the Evangeline aquifer as part of an ongoing program to monitor the State's groundwater resources (table 3) (USGS, 2017b). Median values for hardness were within the very hard[2] range for the alluvial and terrace aquifers and within the soft range for the Evangeline aquifer. Chloride and sulfate concentrations were below the U.S. Environmental Protection Agency's Secondary Maximum Contaminant Levels[3] (SMCLs) for

[2]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).

[3]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).

Table 3. Summary of selected water-quality characteristics for 137 freshwater wells screened in the alluvial aquifers, 74 freshwater wells screened in the terrace aquifers, and 64 freshwater wells screened in the Evangeline aquifer in Avoyelles Parish, Louisiana (U.S. Geological Survey, 2017b).

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

	Temperature (°C)	Color (platinum cobalt units)	Specific conductance, field (µS/cm at 25 °C)	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)	Manganese, filtered (µg/L as Mn)	Dissolved solids, filtered
Alluvial aquifers (1937–2014)													
Median	20.5	5	979	6.9	410	99	37	39	36	6.4	11,000	600	568
10th percentile	20	0	699	6.5	270	60	23	17	8	<0.4	850	155	406
90th percentile	22	20	1,470	7.2	757	190	65	110	88	89.4	19,000	1,850	906
Number of samples	189	127	233	307	454	200	201	125	481	359	287	286	119
Percentage of samples that do not exceed SMCLs	NA	87	NA	92	NA	NA	NA	NA	100	98	6	2	30
Terrace aquifers (1938–87)													
Median	21	5	786	6.8	220	54	19	63.5	74	18	200	125	416
10th percentile	20.3	0	141	6.2	55	13.4	4.8	20	12	0.6	<8	<20	156
90th percentile	22.9	30	1,110	7.6	409	89.6	32.5	128.8	140	156	13,000	1,140	597
Number of samples	27	49	47	58	82	35	36	34	91	41	31	20	36
Percentage of samples that do not exceed SMCLs	NA	76	NA	74	NA	NA	NA	NA	100	95	52	40	67
Evangeline aquifer (1938–2013)													
Median	22	17	989	8.1	17	5.5	0.95	193	113	1	100	30	584
10th percentile	21	5	683	7.4	5	1.8	0.31	140	38	0	43	10	371
90th percentile	24	47	1,550	8.5	50	14.1	1.84	352	200	3.4	206	104	892
Number of samples	34	44	50	46	80	44	44	43	82	52	35	25	42
Percentage of samples that do not exceed SMCLs	NA	50	NA	91	NA	NA	NA	NA	100	100	97	64	38
SMCLs	NA	15	NA	6.5–8.5	NA	NA	NA	NA	250	250	300	50	500

at least 95 percent of samples in each aquifer. Iron and manganese concentrations exceeded SMCLs in the alluvial aquifers for more than 90 percent of samples. Median values for dissolved-solids concentration exceeded the SMCL (500 mg/L) for the alluvial aquifers and the Evangeline aquifer.

Surface-Water Resources

Numerous surface-water resources in Avoyelles Parish are present in three regional drainage subbasins. The Atchafalaya subbasin (Hydrologic Unit Code [HUC] 08080101) covers the southeastern part of the parish, the Lower Red subbasin (HUC 08040301) covers the northern part of the parish, and the Bayou Teche subbasin (HUC 08080102) covers the southwestern part of the parish (USGS, 2017b). In 2014, 10.95 Mgal/d were withdrawn from miscellaneous surface waters in Avoyelles Parish (table 1): 6.14 Mgal/d for aquaculture, 3.68 Mgal/d for general irrigation, and 1.12 Mgal/d for rice irrigation (Collier, 2018).

Lower Red and Atchafalaya Subbasins

The Red River flows into Avoyelles Parish from Rapides Parish and eventually follows the northeastern and eastern borders of Avoyelles Parish. The Red River ends along the eastern border of the parish where it merges with Mississippi River water to form the Atchafalaya River. This merge point is also a transition point into the Atchafalaya subbasin. The Old River Control Structure, located in neighboring Concordia Parish (fig. 1), directs approximately 30 percent of the combined flow of the Mississippi River and Red River above the structure to the Atchafalaya River (U.S. Army Corps of Engineers, 2009). The average streamflow, upstream from Avoyelles Parish, for the Red River at Alexandria (USGS site number 07355500; fig. 1) was 30,770 cubic feet per second (ft^3/s) during 1928–82 (Carlson and others, 1983). The annual average streamflow for the Atchafalaya River at Simmesport (USGS site number 07381490) was 218,400 ft^3/s during 2009–2015. During this period, the highest monthly average streamflow at Simmesport occurred during May (354,300 ft^3/s) and the lowest during November (105,600 ft^3/s) (USGS, 2017b).

Table 4. Summary of selected water-quality characteristics for samples from the Red River near Simmesport and the Atchafalaya River at Simmesport, Louisiana (U.S. Geological Survey, 2017b).

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

	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)	Dissolved solids, filtered
Red River near Simmesport, La. (1977–86)[1]											
Median	328	7.5	7.1	74	21	6	33	50	28	80	187
10th percentile	158	5.5	6.6	42	12	3	12	18	13	20	98
90th percentile	867	10.4	7.7	172	49	14	87	136	70	246	488
Number of samples	79	78	79	76	76	76	76	78	78	35	77
Percentage of samples that do not exceed SMCLs	NA	NA	92	NA	NA	NA	NA	100	100	94	90
Atchafalaya River at Simmesport, La. (1952–77)[2]											
Median	325	8	7.6	110	32	9.3	19.5	23.5	36	30	197
10th percentile	258	6.5	6.9	93	25.7	6.8	12	14.1	28	<10	161
90th percentile	471	10.4	8.1	160	42.3	13	33.3	42	59	75	279
Number of samples	60	55	62	61	58	59	58	62	62	16	61
Percentage of samples that do not exceed SMCLs	NA	NA	98	NA	NA	NA	NA	100	100	100	100
SMCLs	NA	NA	6.5–8.5	NA	NA	NA	NA	250	250	300	500

[1]U.S. Geological Survey site number 07355601 (see fig. 1).

[2]U.S. Geological Survey site number 07381490 (see fig. 1).

Bayou Teche Subbasin

The Bayou Teche subbasin covers the southwestern part of Avoyelles Parish. Compared to the streams in the Lower Red and Atchafalaya subbasins, the streams in the Bayou Teche subbasin are relatively small. Multiple streams and diversions are present in the Bayou Teche subbasin, including Bayou Rouge, Coco Canal, Bayou des Glaises, Bayou Boeuf, and the Bayou des Glaises Diversion Channel. USGS streamflow data for this area are limited, however, the annual average streamflow for Bayou des Glaises Diversion Channel at Moreauville (USGS site number 07383500) was 426.9 ft^3/s during 1943–2015 from a drainage area of 270 square miles. During this period, the highest monthly average streamflow occurred during February (797 ft^3/s) and the lowest during August (137 ft^3/s) (USGS, 2017b).

Surface-Water Quality

Water samples were collected from the Red River near Simmesport (USGS site number 07355601) during 1977–86 and from the Atchafalaya River at Simmesport (USGS site number 07381490) during 1952–77 (fig. 1) as part of an ongoing program to monitor the State's surface-water resources (table 4). Samples from both sites had median values for hardness that were within the moderately hard range. Chloride, sulfate, iron, and dissolved-solids concentrations and pH were below SMCLs for at least 90 percent of samples. Median values for dissolved-oxygen concentrations were greater than 7.0 mg/L; generally 5 mg/L is considered the minimum value for a diverse population of fresh, warmwater biota, including sport fish (Louisiana Department of Environmental Quality, 2008).

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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, 2017) 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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