

Bayou Serpent (Subsegment 030701), Louisiana,
Draft TMDL for Dissolved Lead

Prepared for:

Louisiana Department of Environmental Quality, Water Quality Assessment Division,
Total Maximum Daily Load Program

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CONTENTS

EXECUTIVE SUMMARY	iii
1. Introduction	1
2. Study Area Description	3
2.1 Calcasieu River Basin—Bayou Serpent	3
2.2 Water Quality Data	5
2.3 Water Quality Standards and Criteria	5
2.4 Flow	6
2.5 Identification of Sources	6
3. TMDL Load Calculations	7
3.1 Load Determination for Bayou Serpent (030701)	7
3.2 Wasteload Allocation (WLA)	8
3.3 Seasonal Variability	9
3.4 Margin of Safety (MOS)	9
3.5 Load Allocation (LA)	9
4. Monitoring Plan	9
5. Public Participation	10
6. References	10
Appendix A. Hardness and Lead Monitoring Data	12

Tables

Table 2-1. Subsegment 030701 land use (NLCD 2001)	3
Table 2-2 Summary of LPDES permits in subsegment 030701	6
Table 3-1. WLA summary for subsegment 030701 for total lead	8
Table A-1. Hardness data	12
Table A-2. Hardness summary statistics	12
Table A-3. Dissolved lead data	13
Table A-4. Dissolved lead summary statistics	13

Figures

Figure 1-1. Subsegment 030701 (Bayou Serpent) location and monitoring	2
Figure 2-1. Land use in subsegment 030701 (Bayou Serpent)	4
Figure 2-2. Dissolved lead data at station 840	5

EXECUTIVE SUMMARY

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's Water Quality Planning and Management Regulations (Title 40 of the *Code of Federal Regulations* Part 130) require states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily loads (TMDLs) of pollutants for those waterbodies. A TMDL establishes the amount of a pollutant that a waterbody can assimilate without exceeding its water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources in order to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

$$TMDL = \sum WLAs + \sum LAs + MOS.$$

This dissolved lead TMDL has been developed for Bayou Serpent, in the Calcasieu River Basin in southwest Louisiana. Bayou Serpent drains into the Calcasieu River 7 to 8 miles north of Lake Charles.

For the purpose of TMDL development, the dissolved lead numerical criteria were calculated using the freshwater chronic value for aquatic life protection using the average hardness values from 2005, 2008, and 2009 from Station 0840 (located on the creek southeast of Hecker, Louisiana). The dissolved lead numerical criterion for Bayou Serpent was determined to be 0.84 micrograms per liter. For the purpose of this TMDL, dissolved lead was considered to be a conservative parameter. Using the 7Q10 flow at the end of subsegment 030701 and the calculated lead criterion, a TMDL of 0.00293 lb/day was calculated. The TMDL was then allocated to its WLA, MOS, and LA components.

1. Introduction

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop total maximum daily loads (TMDLs) of pollutants for waterbodies that are not supporting their designated uses, even if pollutant sources have implemented technology-based controls. A TMDL establishes the maximum allowable load (mass per unit of time) of a pollutant that a waterbody is able to assimilate and still support its designated uses. The maximum allowable load is determined on the basis of the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

$$TMDL = \sum WLAs + \sum LAs + MOS.$$

This dissolved lead TMDL has been developed for Bayou Serpent, which is in the Calcasieu River Basin in southwest Louisiana (Figure 1-1).

The Louisiana Department of Environmental Quality (LDEQ) placed Bayou Serpent on the state's 303(d) list in 2000 and identified it as not supporting its designated use of fish and wildlife propagation because of organic enrichment and low dissolved oxygen. Suspected sources of the impairment were agriculture and hydromodification (LDEQ 2001). The state's 2002 303(d) list continues to list Bayou Serpent as impaired from low dissolved oxygen (LDEQ 2003). The state's 2004 *Louisiana Water Quality Inventory: Integrated Report (Integrated Report)* also lists the subsegment as impaired because of low dissolved oxygen but lists the sources as flow alteration from water diversions, irrigated crop production, and non-irrigated crop production (LDEQ 2005). The state's 2006 *Integrated Report* continues to list low dissolved oxygen but adds lead to the list of impairments to the fish and wildlife propagation designated use. The suspected source of lead is unknown (LDEQ 2007a). Bayou Serpent was included on the state's draft 2008 *Integrated Report* because it was found as not supporting its designated use of fish and wildlife propagation because of lead and total dissolved solids (LDEQ 2008).

Bayou Serpent was also included in the 2000 and 2002 305(b) reports. It was found that the bayou was not supporting its designated use of fish and wildlife propagation because of low oxygen. Bayou Serpent was found to be fully supporting its other uses of primary and secondary contact recreation and agriculture. Bayou Serpent was also found to be in partial support of fish and wildlife propagation because of the pesticide, Fipronil. The insecticide is used in rice farming to control the rice weevil and might be toxic to crawfish. Fipronil is suspected as a causative agent in declining crawfish populations (LDEQ 2004). LDEQ and EPA undertook modeling analyses for Bayou Serpent and developed TMDLs for organic enrichment/dissolved oxygen impairment and the pesticide, Fipronil. The LDEQ completed the TMDL for Bayou Serpent in 2001, after an intensive survey in July 2000. The TMDL addresses biochemical oxygen-demanding pollutants for the watershed (LDEQ 2004).

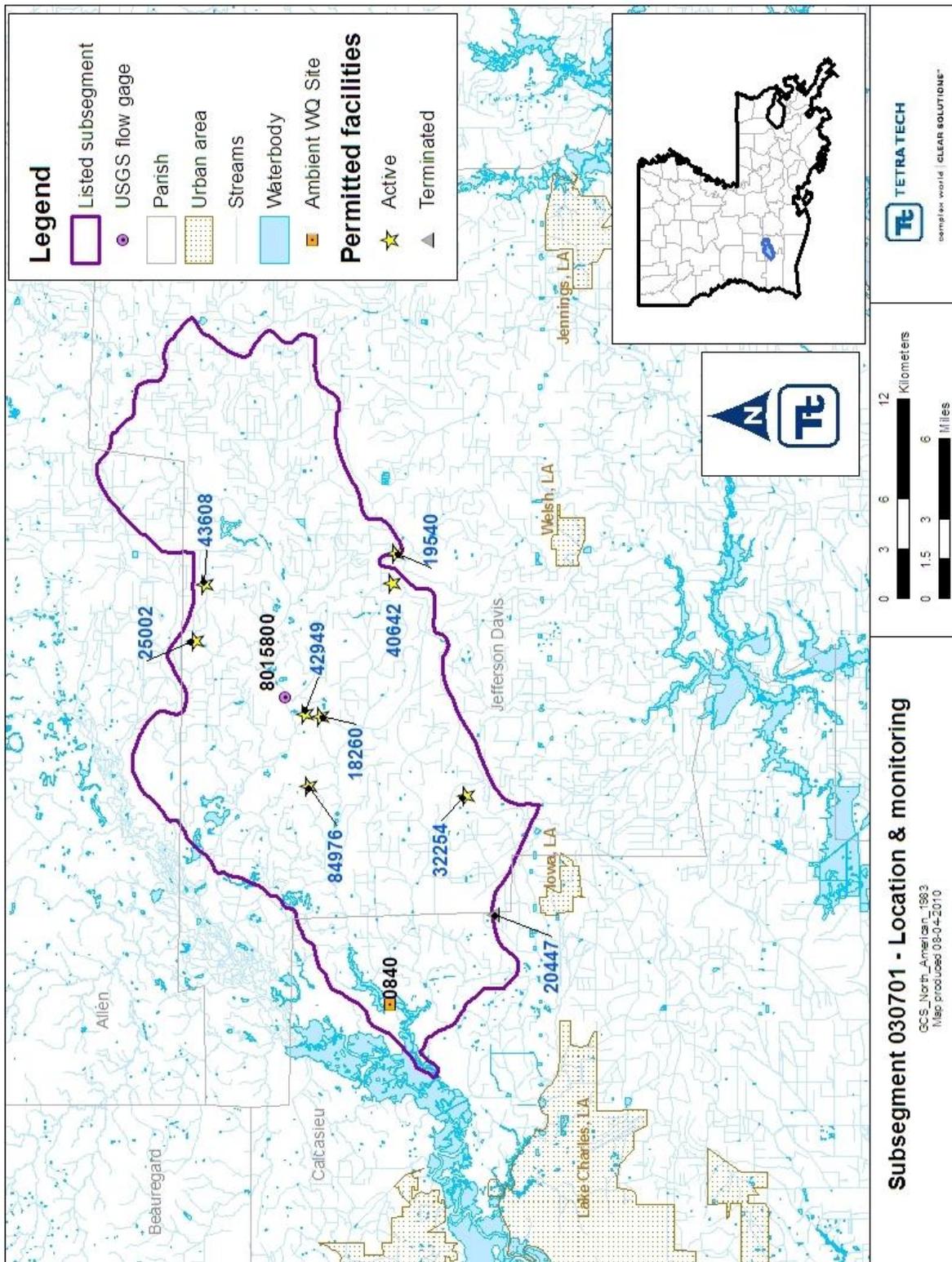


Figure 1-1. Subsegment 030701 (Bayou Serpent) location and monitoring.

2. Study Area Description

2.1 Calcasieu River Basin—Bayou Serpent

Bayou Serpent is in southwest Louisiana, where it drains into the Calcasieu River 7 to 8 miles north of Lake Charles. It covers 218 square miles and includes LDEQ water quality subsegment 030701. Bayou Serpent runs through the parishes of Allen (at its headwaters), Jefferson Davis, and Calcasieu. The main urban areas in the Bayou Serpent watershed are Fenton, Woodlawn, Indian Village, Hecker, and Lauderdale. The largest of those is the Village of Fenton, which had 380 inhabitants in the 2000 census. Less than 1 percent of the watershed is urbanized (LDEQ 2004).

Bayou Serpent is used mostly as a conveyance for agricultural and stormwater run-off as well as a source of irrigation water. It has been heavily dredged and has numerous weirs. The entire subsegment is extensively cultivated. From 2003 LDEQ land use data, most of the land is agricultural (over 75 percent) and forest land (12 percent) (LDEQ 2004). Approximately half of the agricultural land is pasture land and 22 percent is rice-aquaculture (LDEQ 2004). The forested areas in the Bayou Serpent watershed are primarily along the main stem of the Bayou Serpent and its tributaries: Bayou Arceneaux, Little Bayou, Cow Bayou, and Gum Bayou (LDEQ 2004).

Land use data from the 2001 National Land Cover Database (NLCD) were used in Table 2-1 and Figure 2-1. NLCD 2001 is a land-cover database composed of land cover, impervious surface, and canopy density data. NLCD 2001 uses improved classification algorithms, which result in data with more precise rendering of spatial boundaries between the 16 classes than those obtained using NLCD 1992 (USEPA 2007). The differences in the 2001 and 2003 land use results could be from the differing land use assessment approaches. Both sources have the majority of the land use in the watershed as agriculture.

Table 2-1. Subsegment 030701 land use (NLCD 2001)

Land use	Percent
Open water	0.60%
Developed	6.28%
Barren land	0.09%
Forest	5.94%
Grass/shrub	6.63%
Pasture/hay	13.70%
Cultivated crops	53.15%
Woody wetlands	13.28%
Emergent herbaceous wetlands	0.33%

Source: USEPA 2007

Bayou Serpent is subject to saltwater encroachment in the lower reaches, near its confluence with the Calcasieu River. It is also affected by backwater flows from the Calcasieu River. It has been heavily dredged and has little or no canopy over most of its length (LDEQ 2004).

Soils in the Bayou Serpent watershed are poorly drained to moderately well drained. The mainstem of Bayou Serpent is mostly floodplain. The surroundings are level to moderately sloping. A loam surface layer is underlain by a clayey and loamy subsoil throughout much of the watershed (LDEQ 2004).

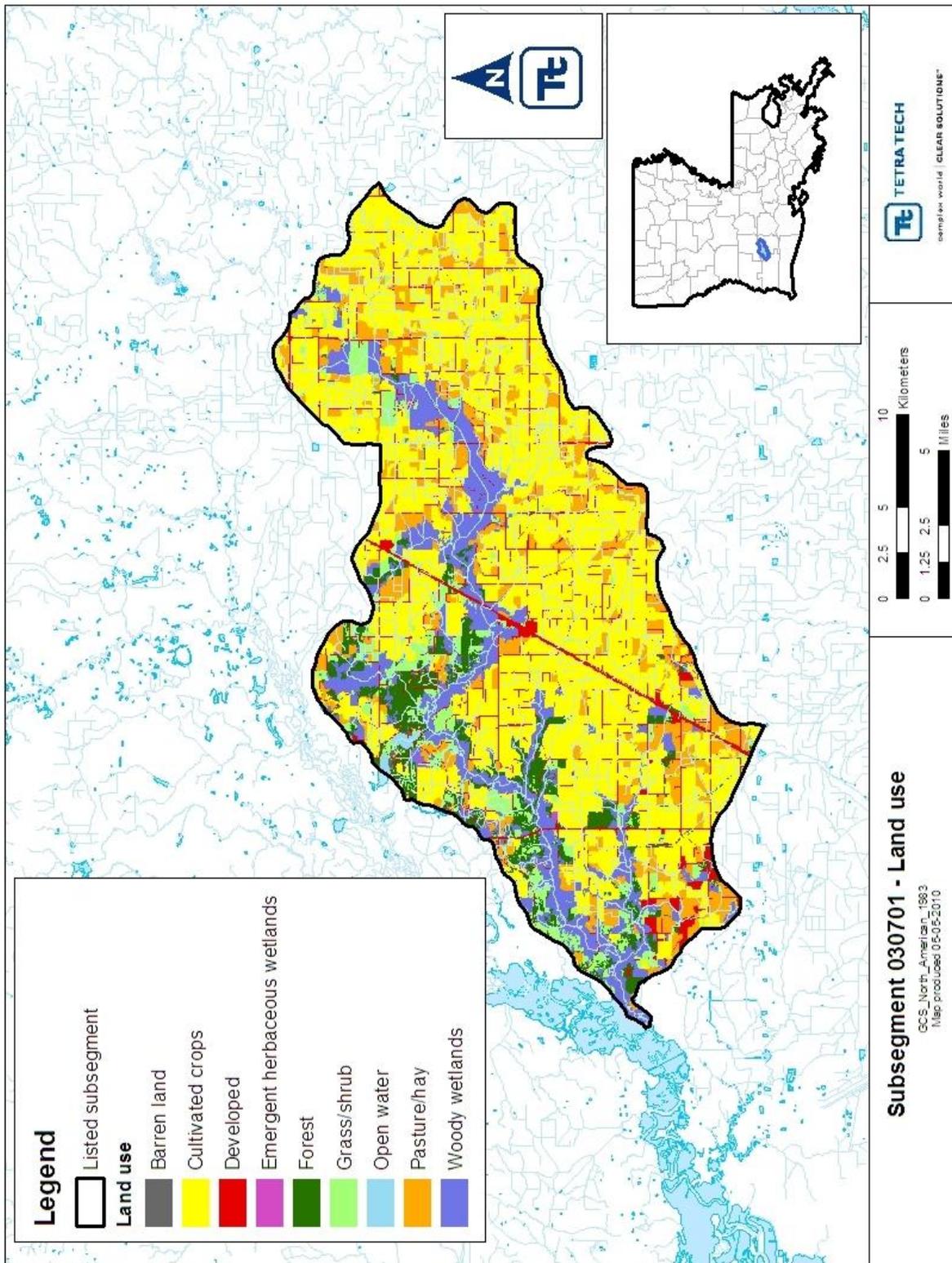


Figure 2-1. Land use in subsegment 030701 (Bayou Serpent).

2.2 Water Quality Data

One water quality station in the bayou (station 0840: Bayou Serpent southeast of Hecker, Louisiana) records dissolved lead observations (Figure 1). Station 0840 has nine current dissolved lead observations. Of those observations, 67 percent exceed the chronic dissolved lead criterion of 0.84 microgram per liter ($\mu\text{g/L}$). Appendix A contains the raw water quality data.

The dissolved lead data were plotted over time for subsegment 030701 (Figure 2-2). The exceedances occurred in January, March, April, July, and September. No distinct seasonal trends or patterns can be seen in the water quality data.

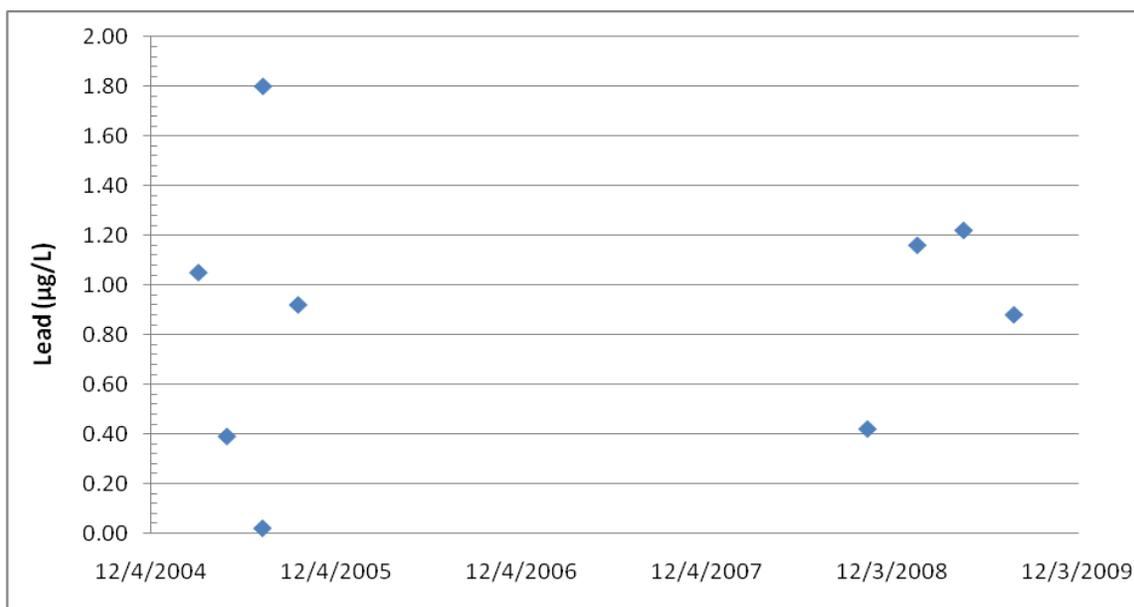


Figure 2-2. Dissolved lead data at station 840.

2.3 Water Quality Standards and Criteria

The designated uses for subsegment 030701 include primary and secondary contact recreation, propagation of fish and wildlife, and agriculture. Primary contact recreation includes any recreational or other water contact activity involving prolonged or regular full-body contact with the water and in which the probability of ingesting appreciable amounts of water is considerable. Examples of that type of water use include swimming, water skiing, and diving (LDEQ 2007b). Secondary contact recreation includes any recreational or other water contact activity in which prolonged or regular full-body contact with the water is either incidental or accidental, and the probability of ingesting appreciable amounts of water is minimal. Examples of that type of water use include fishing, wading, and boating (LDEQ 2007b). The criteria for protection of aquatic life are based on acute and chronic concentrations in fresh and marine waters and are developed primarily for attainment of the fish and wildlife propagation use.

The aquatic life criterion was used for this TMDL along with the 7Q10 flow for the waterbody. Metals criteria are based on hardness concentrations in ambient waters. The criterion was calculated from the freshwater chronic criteria equation (LDEQ 2009):

$$\text{Criterion} = e^{((1.2730 \times \ln(\text{hardness})) - 4.7050)} \times (1.46203 - (0.145712 \times \ln(\text{hardness})))$$

Hardness concentrations from the past 5 years at station 0840 were averaged and used in calculating the lead criteria. The average hardness concentration for the subsegment 030701 is 37.1 milligrams

per liter (mg/L). The applicable chronic lead criterion, therefore, is 0.84 µg/L. The criterion applies at all times. The available dissolved lead data and the sample exceedances are shown in Appendix A.

The Louisiana water quality standards also include an antidegradation policy (*Louisiana Administrative Code* Title 33, Part IX, Section 1109.A), which states that state waters exhibiting high water quality should be maintained at that high level of water quality. If that is not possible, water quality of a level that supports the designated uses of the waterbody should be maintained. The designated uses of a waterbody may be changed to allow a lower level of water quality only through a use attainability study. LDEQ has developed this TMDL to be consistent with the state's antidegradation policy (LDEQ 2000).

2.4 Flow

There are no active U.S. Geological Survey (USGS) flow monitoring gages in subsegment 030701. USGS gage 08015800 (Bayou Serpent near Fenton, Louisiana) is in the subsegment, however only annual peak stream flow from 1954 through 1963 and miscellaneous field discharge measurements from 1954 through 1968 are available. The critical (7Q10) flow at this gage is 0.28 cubic feet per second (cfs) on the basis of a partial record at gage 08015800 with correlation to USGS gage 08012000 (Bayou Nezpique near Basile) (Ensminger and Wright 2003).

2.5 Identification of Sources

LDEQ has established a group of reference streams throughout the state that exhibit near-pristine characteristics and have no man-made sources discharging or contributing runoff into them. Two of the reference streams in the Calcasieu Basin—Six Mile Creek and Beckwith Creek—were found as not supporting the lead criteria during the 2000 305(b) assessment. Therefore, LDEQ concluded that natural background loading is the dominant source of lead in Bayou Serpent (LDEQ 2004).

Information on point source dischargers in the subsegment was obtained from LDEQ files. According to the LDEQ discharger database, eight point sources permitted to discharge into subsegment 030701 (Table 2-2). In addition, there is one facility with a terminated permit.

Table 2-2 Summary of LPDES permits in subsegment 030701

Al #	Permit #	Outfall	Facility name	Exp. date	Facility type	Outfall type	Receiving waterbody
19540	LAG380088	001	Jefferson Davis Central Waterworks District	07/17/12	Water Treatment and Pumping Facility	treated sanitary wastewater	Hwy 99 ditch to Bayou Serpent
		002	Central Water Treatment & Pumping Plant			filter backwash wastewater	Hwy 99 ditch to Bayou Serpent
25002	LAG480262	001/101	Tennessee Gas Pipeline Co - Compressor Station 823	06/17/04	Electric, Gas, and Sanitary Services	stormwater, washwaters, drainage, condensate, hydrostatic test water, treated sanitary wastewater	Bayou Serpent via Gum Bayou and Missouri Pacific Railroad Ditch
32254	LAG532967	001	Texas Gas Transmission LLC - Woodlawn Compressor Station	11/08/12	Electric, Gas, and Sanitary Services	stormwater	ditch to unnamed stream to Bayou Arceneaux to Bayou Serpent
		002				treated sanitary wastewater	
		003				stormwater	
42949	LAG540826	001	Quiet Oaks RV Park	6/30/13	Hotels, Camps, And Other Lodging Places	treated sanitary wastewater	unnamed drainage ditch to Bayou Serpent
40642	LAG540880	001	Total Environmental Solutions Inc - Sandy Ridge Subdivision	07/01/13	Electric, Gas, and Sanitary Services	treated sanitary wastewater	Little Bayou to Bayou Serpent

AI #	Permit #	Outfall	Facility name	Exp. date	Facility type	Outfall type	Receiving waterbody
18260	LAG560102	001	Fenton, Village of - STP	06/01/14	Electric, Gas, and Sanitary Services	treated sanitary wastewater	ditch to Little Bayou to Bayou Serpent
43608	LAR05M490		Transit Mix Concrete - Indian Village #284	05/01/11	Min. & Quarrying of Nonmet. Min., Exc. Fuels	MSGP - stormwater	unnamed tributaries to Bayou Serpent
84976	LAR10B045	001	Shoreline Southeast LLC - Rices Acre, Inc. No1/Hayes 11-1 Production Facility, West Fenton Field		Oil and Gas Extraction	construction stormwater only. No current discharge.	
20447	LAR05N394		Iowa Gas Plant	Permit terminated	Oil and Gas Extraction	Permit for treated sanitary wastewater terminated	ditch to irrigation to Bayou Arceneaux

3. TMDL Load Calculations

A TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis for establishing water quality-based controls.

A TMDL for a given pollutant and waterbody is composed of the sum of individual WLAs for point sources, LAs for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit MOS to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

$$TMDL = \sum WLAs + \sum LAs + MOS.$$

TMDLs are typically expressed as a mass loading (e.g., pounds per day).

Both section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for uncertainty in available data or in the actual effect that controls will have on the loading reductions and receiving water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly using conservative assumptions in establishing the TMDL. For a more detailed discussion of the MOS, see Section 3.4.

3.1 Load Determination for Bayou Serpent (030701)

The sampling events used as the basis for this TMDL were performed to meet the needs of the state to develop the *Integrated Report*, which includes the biennial section 305(b) report (*Water Quality Inventory*) and the section 303(d) list of impaired waters. The data are adequate for a conservative TMDL according to the assumption that no fate and transport mechanisms are present in the waterbodies. Data gathering did not include any flow measurements, any hardness measurements, nor any upstream sampling and measurements for background conditions. Without such data, fate and transport modeling and calculating reductions required from current loads are not possible.

Calculating the TMDL

Dissolved lead was treated as a conservative parameter. The following equation was used to calculate the dissolved lead TMDL. The TMDL calculations are shown below.

$$TMDL \text{ (lb/day)} = (\text{lead criterion [mg/L]}) \times (\text{critical flow [mgd]}) \times 8.345$$

where 8.345 is a conversion factor. Only observed data from during 2005 and after were used in this TMDL. The critical flow from USGS gage 08015800 was area weighted to obtain the flow for this subsegment. The drainage area of the USGS gage is 89 square miles, and the area of the subsegment is 204.8 square miles making the critical flow 0.644 cfs.

Lead criterion = 0.84 µg/L = 0.00084 mg/L
 Critical flow (7Q10) = 0.644 cfs = 0.416 mgd
 TMDL = (0.00084 mg/L) × (0.416 mgd) × 8.345 = 0.00293 lb/day

3.2 Wasteload Allocation (WLA)

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. The point sources in subsegment 030701 include sanitary and industrial wastewater, and industrial stormwater. Stormwater loading is usually based on average annual rainfall, while the TMDL is calculated at critical low (7Q10) flow. Since these two conditions are not compatible, LDEQ assumes that stormwater runoff is zero when developing a TMDL at critical low flow. None of the individual point source facilities identified in Section 2.4 are permitted to discharge lead to subsegment 030701. The facility with permit LAG480262 is required to monitor for lead only from discharges from pipes, vessels, or tanks that have been used for storing or transporting liquid or gaseous petroleum hydrocarbons, and the facility's outfall 001 discharges through a holding pond. It is believed that permits without lead limits contain negligible discharges and are assumed to operate at their current levels. As long as the point source discharges contain lead concentrations at or below water quality criteria, they should not be a cause of exceedances of water quality criteria.

WLAs are calculated at each outfall for all permitted point sources (Table 3-1). The equation for WLA calculation is:

$$WLA \text{ (lbs/day)} = (\text{limit [mg/L]}) \times (\text{flow [gpd]}) \times 0.000008345$$

where 0.000008345 is a conversion factor. The WLA is 0.0 lbs/day.

Table 3-1. WLA summary for subsegment 030701 for total lead

Al #	Permit #	Outfall	Facility name	Outfall type	Flow type	Flow (gpd)	Limit type	Lead (µg/L)	Lead (lb/d)
19540	LAG380088	001	Jefferson Davis Central	treated sanitary wastewater	DMR average	450	none		0
		002	Waterworks District Central Water Treatment & Pumping Plant	filter backwash wastewater	DMR average	300,000	none		0
25002	LAG480262	001	Tennessee Gas Pipeline Co - Compressor Station 823	stormwater, washwaters, drainage, condensate, hydrostatic test water, treated sanitary wastewater	expected	360,000	none		0 ^a
32254	LAG532967	001	Texas Gas Transmission LLC - Woodlawn Compressor Station	stormwater	DMR 30-day max	23,285	none		0
		002		treated sanitary wastewater	expected	500	none		0
		003		stormwater	DMR 30-day max	9,705	none		0
42949	LAG540826	001	Quiet Oaks RV Park	treated sanitary wastewater	expected	6,250	none		0
40642	LAG540880	001	Total Environmental Solutions Inc - Sandy Ridge Subdivision	treated sanitary wastewater	DMR average	8,513	none		

AI #	Permit #	Outfall	Facility name	Outfall type	Flow type	Flow (gpd)	Limit type	Lead (µg/L)	Lead (lb/d)
18260	LAG560102	001	Fenton, Village of - STP	treated sanitary wastewater	DMR average	34,772	none		0
43608	LAR05M490		Transit Mix Concrete - Indian Village #284	MSGP - stormwater	not avail.		none		0 ^a
84976	LAR10B045	001	Shoreline Southeast LLC - Rice Acres, Inc. No1/Hayes 11-1 Production Facility, West Fenton Field	construction stormwater	not avail.		not avail.		0 ^a

^a This TMDL is being developed for critical low-flow conditions (7Q10). Under low-flow conditions, the WLA for all stormwater discharges will be 0.0 lb/d because the flow will be 0.0 mgd. However, existing stormwater permits limits continue to apply to all stormwater discharges.

LPDES permitted discharges without lead effluent limitations have been determined to not be sources of lead. For these dischargers, LDEQ is not providing allocations or permit limits. If at some point in the future, LDEQ determines that any of the discharges may contain lead, wasteload allocations may be provided along with the appropriate permit conditions.

3.3 Seasonal Variability

Because ambient monitoring data indicate that there is little variability of trace metals levels throughout the year, LDEQ has not defined a critical season.

3.4 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration an MOS. The MOS is the portion of the pollutant loading reserved to account for any uncertainty in the data. There are two ways to incorporate the MOS. One is to implicitly incorporate it by using conservative model assumptions to develop allocations. The other is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations (USEPA 1991). For this TMDL, an explicit MOS of 20 percent was used. The MOS is 0.00059 lb/day.

3.5 Load Allocation (LA)

The LA is the portion of the TMDL assigned to natural background loadings, nonpoint sources, urban runoff, and other anthropogenic sources. The LA was calculated for this TMDL by subtracting the WLA and MOS from the total TMDL. LAs were not allocated to separate nonpoint sources because of the lack of available source characterization data. The LA includes natural background sources. LDEQ recognizes that stormwater may contribute to the lead impairments for subsegment 030701, however, LDEQ cannot provide an allocation for stormwater with a TMDL developed for critical, low-flow conditions.

$$\sum LAs = TMDL - \sum WLAs - MOS$$

$$\sum LAs = 0.00293 - 0 - 0.00059$$

$$\sum LAs = 0.00234 \text{ lbs/day}$$

4. Monitoring Plan

LDEQ uses funds provided under section 106 of the Clean Water Act and under the authority of the Louisiana Environmental Quality Act to run a program for monitoring the quality of the state's

surface waters. The LDEQ Surveillance Section collects surface water samples at various locations using appropriate sampling methods and procedures to ensure the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, develop a long-term database for water quality trend analysis, and monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program are used to develop the state's biennial *Water Quality Inventory* and the section 303(d) list of impaired waters. This information is also used to establish priorities for LDEQ's nonpoint source program.

LDEQ has implemented a watershed approach to surface water quality monitoring. Through that approach, the entire state is sampled on a 4-year cycle. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the 4-year cycle. Sampling is conducted monthly to yield approximately 12 samples per site during each year the site is monitored. Sampling sites are where they are considered representative of the waterbody. Within each basin, all monitored subsegments will be sampled over the year or years specified under each cycle period. Bayou Serpent was monitored with the Calcasieu River Basin in 2004, 2005, 2008, and 2009. Water quality assessments for the 305(b)/303(d) *Integrated Report* will be conducted for each basin following the last year of its monitoring period. Usually 125 waterbody subsegments are monitored each month under the program. Under the current monitoring schedule, approximately one-half of the state's waters are newly assessed for section 305(b) and section 303(d) listing purposes for each biennial cycle, with sampling occurring statewide each year. The 4-year cycle follows an initial 5-year rotation that covered all basins in the state according to the TMDL priorities. Monitoring allows LDEQ to determine whether any improvement has occurred in water quality after the TMDLs have been implemented. When LDEQ evaluates monitoring results at the end of each year, it may add waterbodies to or remove them from the section 303(d) list of impaired waterbodies.

In addition to ambient water quality sampling in the priority basins, LDEQ has increased compliance monitoring in those basins. The goal set by LDEQ was to inspect all those facilities on the list and to sample one-third of the minors and one-third of the majors.

5. Public Participation

Federal regulations require LDEQ to notify the public and seek comments concerning the TMDLs it prepares. This TMDL was developed under contract to LDEQ, and LDEQ will hold a public review period seeking comments, information, and data from the public and any other interested party. The notice for the public review period will be published in local and state newspapers and on LDEQ's electronic notification system. The TMDL report will be available on LDEQ's TMDL Web site at www.deq.louisiana.gov/portal/default.aspx?tabid=1563. The public review period will last for 30 days. LDEQ will review all comments received, and this TMDL might be revised to reflect comments if appropriate.

6. References

- Ensminger, P.A., and L.S. Wright. 2003. *Low-flow Characteristics of Louisiana Streams*. U.S. Geological Survey Water Resources Technical Report Number 70. Louisiana Department of Transportation and Development, Baton Rouge, LA.
- LDEQ (Louisiana Department of Environmental Quality). 2000. *Environmental Regulatory Code*, Part IX. Water Quality Regulations. LAC33:IX.1109.A. Louisiana Department of Environmental Quality, Baton Rouge, LA.

- LDEQ (Louisiana Department of Environmental Quality). 2001. *2000 Louisiana Water Quality Inventory: Integrated Report*. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/tabid/2201/Default.aspx>>. Accessed June 9, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2003. *2002 Louisiana Water Quality Inventory: Integrated Report*. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/tabid/2201/Default.aspx>>. Accessed June 9, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2004. *Watershed Implementation Plan, Bayou Serpent, Subsegment 030701*. Nonpoint Source Unit. <<http://nonpoint.deq.louisiana.gov/wqa/links/watershedplan/calcasieu/Bayou%20Serpent%20Implementation%20Plan.pdf>>. Accessed April 14, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2005. *2004 Louisiana Water Quality Inventory: Integrated Report*. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/tabid/2201/Default.aspx>>. Accessed June 9, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2007a. *2006 Louisiana Water Quality Inventory: Integrated Report*. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/tabid/2201/Default.aspx>>. Accessed June 22, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2007b. *Environmental Regulatory Code*. Part IX, Water Quality Regulations. Chapter 11. Surface Water Quality Standards. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/Portals/0/planning/regs/title33/33v09.pdf>>. Accessed April 14, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2008. *2008 Final Louisiana Water Quality Inventory: Integrated Report*. Louisiana Department of Environmental Quality, Baton Rouge, LA. <<http://www.deq.louisiana.gov/portal/LinkClick.aspx?fileticket=I4PibcgdTUA%3d&tabid=2986>>. Accessed June 14, 2010.
- LDEQ (Louisiana Department of Environmental Quality). 2009. *Environmental Regulatory Code*. Part IX, Water Quality Regulations. Section 1113. Surface Water Quality Standards. Louisiana Department of Environmental Quality, Baton Rouge, LA.
- USEPA (U.S. Environmental Protection Agency). 1991. *Guidance for Water Quality-Based Decisions: The TMDL Process*. EPA 440/-4-91-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- USEPA (U.S. Environmental Protection Agency). 2007. Multi-Resolution Land Characteristics Consortium (MRLC). 2001 National Land Cover Database (NLCD 2001). <<http://www.epa.gov/mrlc/nlcd-2001.html>>. Accessed May 5, 2010.

Appendix A. Hardness and Lead Monitoring Data

Table A-1. Hardness data

Site	Collection date ^a	Result (mg/L)
Bayou Serpent southeast of Hecker, Louisiana	1/20/99	14.8
Bayou Serpent southeast of Hecker, Louisiana	2/18/99	33.6
Bayou Serpent southeast of Hecker, Louisiana	3/17/99	21.4
Bayou Serpent southeast of Hecker, Louisiana	4/21/99	5
Bayou Serpent southeast of Hecker, Louisiana	5/19/99	42.6
Bayou Serpent southeast of Hecker, Louisiana	6/16/99	30.7
Bayou Serpent southeast of Hecker, Louisiana	7/21/99	26
Bayou Serpent southeast of Hecker, Louisiana	8/18/99	30.7
Bayou Serpent southeast of Hecker, Louisiana	9/22/99	33.7
Bayou Serpent southeast of Hecker, Louisiana	10/20/99	44.2
Bayou Serpent southeast of Hecker, Louisiana	11/17/99	94.1
Bayou Serpent southeast of Hecker, Louisiana	12/22/99	22.8
Bayou Serpent southeast of Hecker, Louisiana	1/26/05	24.6
Bayou Serpent southeast of Hecker, Louisiana	2/15/05	14
Bayou Serpent southeast of Hecker, Louisiana	3/8/05	27.2
Bayou Serpent southeast of Hecker, Louisiana	3/29/05	39.9
Bayou Serpent southeast of Hecker, Louisiana	4/12/05	89.2
Bayou Serpent southeast of Hecker, Louisiana	5/3/05	71.5
Bayou Serpent southeast of Hecker, Louisiana	5/23/05	28.5
Bayou Serpent southeast of Hecker, Louisiana	6/14/05	43.1
Bayou Serpent southeast of Hecker, Louisiana	7/13/05	37.3
Bayou Serpent southeast of Hecker, Louisiana	8/2/05	29
Bayou Serpent southeast of Hecker, Louisiana	8/23/05	41.7
Bayou Serpent southeast of Hecker, Louisiana	9/20/05	61.6
Bayou Serpent southeast of Hecker, Louisiana	10/14/08	21.7
Bayou Serpent southeast of Hecker, Louisiana	11/17/08	38.4
Bayou Serpent southeast of Hecker, Louisiana	12/16/08	10.1
Bayou Serpent southeast of Hecker, Louisiana	1/20/09	27.3
Bayou Serpent southeast of Hecker, Louisiana	2/10/09	30.2
Bayou Serpent southeast of Hecker, Louisiana	3/24/09	30.3
Bayou Serpent southeast of Hecker, Louisiana	4/21/09	Non-detect ^b
Bayou Serpent southeast of Hecker, Louisiana	5/19/09	32
Bayou Serpent southeast of Hecker, Louisiana	6/23/09	44
Bayou Serpent southeast of Hecker, Louisiana	7/29/09	34
Bayou Serpent southeast of Hecker, Louisiana	8/12/09	42
Bayou Serpent southeast of Hecker, Louisiana	9/22/09	36

a. Data from before 2005 were not included in TMDL analysis.

b. Detection limit not known.

Table A-2. Hardness summary statistics

Statistic	Value
Minimum (mg/L)	10.1
Maximum (mg/L)	89.2
Average (mg/L)	37.1
Count	23

Table A-3. Dissolved lead data

Site	Collection date	MDL (µg/L)	Validation qualifier/ comments	Type	Result (µg/L) ^a
Bayou Serpent southeast of Hecker, Louisiana	2/18/99			Filtered	5
Bayou Serpent southeast of Hecker, Louisiana	5/19/99			Filtered	5
Bayou Serpent southeast of Hecker, Louisiana	8/18/99			Filtered	5
Bayou Serpent southeast of Hecker, Louisiana	11/17/99			Filtered	5
Bayou Serpent southeast of Hecker, Louisiana	3/8/05	0.01		Filtered	1.05
Bayou Serpent southeast of Hecker, Louisiana	5/3/05	0.01		Filtered	0.39
Bayou Serpent southeast of Hecker, Louisiana	7/12/05	0.02		Filtered	0.02
Bayou Serpent southeast of Hecker, Louisiana	7/13/05	0.01		Filtered	1.8
Bayou Serpent southeast of Hecker, Louisiana	9/20/05	0.015	HK	Filtered	0.92
Bayou Serpent southeast of Hecker, Louisiana	10/14/08			Filtered	0.42
Bayou Serpent southeast of Hecker, Louisiana	1/20/09			Filtered	1.16
Bayou Serpent southeast of Hecker, Louisiana	4/21/09		J	Filtered	1.22
Bayou Serpent southeast of Hecker, Louisiana	7/29/09			Filtered	0.88

Notes: MDL = method detection limit

a. Exceedances of the calculated standard are bold. Data from before 2005 were not included in TMDL analysis.

Table A-4. Dissolved lead summary statistics

Statistic	Value ^a
Minimum (µg/L)	0.02
Maximum (µg/L)	1.8
Average (µg/L)	0.873
Count	9
Percentage of data that violate the standard	67%

a. Data from before 2005 were not included in TMDL analysis.