# MERCURY TMDL FOR BAYOU DORCHEAT IN THE RED RIVER BASIN, LOUISIANA

DRAFT
SEPTEMBER 20, 2007

# MERCURY TMDL FOR
# BAYOU DORCHEAT IN THE
# RED RIVER BASIN, LOUISIANA

Prepared for

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# EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily loads (TMDLs) for those waterbodies. A TMDL is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standards for that pollutant. Through a TMDL, pollutant loads can be allocated to point sources and nonpoint sources discharging to the waterbody.

This report presents a TMDL developed for mercury in fish for Bayou Dorcheat (Subsegment 100501). This TMDL was developed because Bayou Dorcheat is subject to a mercury fish consumption advisory in Louisiana. Subsegment 100501 covers 491.5 $mi^2$ that is primarily covered by forest and shrubs.

Subsegment 100501 was included on the Louisiana Department of Environmental Quality (LDEQ) final 2004 303(d) list as not supporting its fish and wildlife propagation designated uses, and was ranked as priority No. 1 for TMDL development. Atmospheric deposition of mercury was identified as the suspected cause of impairment for the subsegment. The Mercury Action Level in Louisiana for fish consumption advisories is 0.5 mg/kg. EPA has recently promulgated a methyl mercury criterion for fish tissue of 0.3 mg/kg. There have been no known violations of the numeric mercury water quality standard in the subsegment.

The estimated mercury load to Subsegment 100501 included mercury atmospheric deposition from local emission sources, regional atmospheric deposition, mercury previously deposited in the watershed and transported to the water body via erosion, inflows from upstream subsegments, and point sources. The largest sources of mercury load to the subsegment were atmospheric deposition and erosion.

The wasteload allocation (WLA) for point source contributions was set to the Louisiana mercury water quality criterion multiplied by the point source flow. The margin of safety was implicit due to conservative assumptions in the TMDL calculations. A 10% future growth component was included in the TMDL. The TMDL and percent reduction needed are summarized in Table ES.1.

Table ES.1. Summary of TMDL and percent reduction.

| Subsegment | Stream Name | Load (g/yr of mercury) | | | | | Percent Reduction Needed |
|---|---|---|---|---|---|---|---|
| | | WLA | LA | FG | MOS | TMDL | |
| 100501 | Bayou Dorcheat from Arkansas state line to Lake Bistineau | 65.5 | 335,277 | 41,918 | 41,918 | 419,178 | 69% |

This TMDL report indicates that current mercury loadings to the listed subsegment are primarily from regional and global atmospheric sources. The mercury load reduction necessary to achieve the target fish tissue concentration of 0.5 mg/kg is 69%. Consequently, significant reduction in atmospheric deposition within and outside the study area will be necessary. A combination of ongoing and future activities under the Clean Air Act are expected to achieve reductions in atmospheric deposition of mercury that will enable reductions in fish tissue mercury concentrations.

It may be appropriate to revise this TMDL at some point in the future based on new information gathered and analyses performed. An adaptive management approach allows the United States (US) Environmental Protection Agency (EPA) or the State to use the best information available at the time to establish the TMDL at levels necessary to implement applicable water quality standards and to make the allocations to the pollution sources. EPA recognizes that additional data and information may be necessary to validate the assumptions of the TMDL and to provide greater certainty that the TMDL will achieve the applicable water quality standards. The adaptive management approach is appropriate for this TMDL because information on the actual contributions of mercury from both point and nonpoint sources will be much better characterized in the future. EPA expects point source loadings of mercury to be reduced primarily through mercury minimization programs developed and implemented by some point sources.

During implementation of this TMDL, EPA expects the following activities to occur:

1. NPDES point source discharges will develop and implement mercury minimization plans as appropriate;
2. Air emissions of mercury will be reduced through implementation of the Clean Air Act regulation;
3. LDEQ will collect additional ambient data on mercury concentrations in water, sediment, fish, and soil; and
4. LDEQ will develop and implement a mercury risk reduction plan that assesses all sources of mercury.

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# 1.0 INTRODUCTION

This report presents a mercury total maximum daily load (TMDL) for Bayou Dorcheat from the Arkansas state line to Lake Bistineau (Subsegment 100501). This subsegment was listed as impaired on the final 2004 303(d) List for Louisiana dated August 17, 2005 (Louisiana Department of Environmental Quality (LDEQ) 2005a). Table 1.1 shows the suspected sources and suspected causes for impairment in the 303(d) List, as well as the priority ranking.

Table 1.1. Summary of 303(d) listings addressed in this TMDL Report (LDEQ 2005a).

| Waterbody Description | Suspected Sources | Suspected Causes | Priority Ranking (1 = highest) |
|---|---|---|---|
| Bayou Dorcheat from Arkansas state line to Lake Bistineau | Atmospheric deposition of toxics | Mercury | 1 |

The TMDL in this report was developed in accordance with Section 303(d) of the Federal Clean Water Act and the United States (US) Environmental Protection Agency's (EPA's) regulations at 40 CFR 130.7. The 303(d) Listings for other pollutants in this subsegment are being addressed by the EPA and LDEQ in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), future growth (FG), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern. The LA is the load allocated to nonpoint sources, including natural background. The MOS is a percentage of the TMDL that takes into account any lack of knowledge concerning the relationship between pollutant loadings and water quality. The FG is the portion of the TMDL that allows for future increases in loads to the waterbody.

# 2.0 BACKGROUND INFORMATION

## 2.1 General Information

Bayou Dorcheat (Subsegment 100501) is located in North Central Louisiana in the Red River basin (see Figure A.1 in Appendix A). This subsegment consists of Bayou Dorcheat, from Bayou Dorcheat at the state line to Lake Bistineau and lies entirely in Webster Parish. The subsegment area is 491.5 $mi^2$. Bayou Dorcheat begins near the Nevada-Columbia county line in Arkansas and travels south for 32 miles to the state line. Bayou Dorcheat then extends approximately 43.5 miles, from the state line south to its confluence with Lake Bistineau near Minden, LA. Bayou Dorcheat drains a total of 1,443 $mi^2$, of which 502 $mi^2$ are in Arkansas. As shown in Figure A.1, the subsegment does not include Caney Creek (a tributary of Bayou Dorcheat) or Caney Lake (they are in a separate subsegment since they have a different designated uses than Bayou Dorcheat, see Section 2.3).

## 2.2 Land Use

Land use characteristics for the Bayou Dorcheat drainage area were compiled from the US Geological Survey (USGS) 2001 National Land Cover Database (USGS 2006a). These data are the most recent land use data that are currently available for this area. The spatial distribution of these land uses is shown on Figure A.2 (located in Appendix A) and land use percentages are shown in Table 2.1. These data indicate that the primary land use in this subsegment is forest. It should be noted that a portion of the watershed has been incorrectly identified as wetlands and should be classified as water, but in many areas Bayou Dorcheat bifurcates and enters swamps.

Table 2.1. Land uses in Subsegment 100501.

| Land Use Type | Area, $m^2$ | % of Total Area |
|---|---|---|
| Water | 10407600 | 1.0% |
| Urban/Transportation | 23135400 | 9.2% |
| Barren | 16461000 | 0.1% |
| Forest | 1020831300 | 61.2% |
| Shrubland/grassland | 352800 | 13.2% |
| Pasture/hay | 64184400 | 4.5% |
| Cultivated crops | 70334100 | 0.2% |
| Wetlands | 60768900 | 10.6% |
| **TOTAL** | **1266475500** | **100.0%** |

## 2.3 Water Quality Standards and Fish Tissue Action Levels

Water quality standards for Louisiana are included in the Title 33 Environmental Regulatory Code (LDEQ 2005b). Designated uses for Subsegment 1000501 are primary contact recreation, secondary contact recreation, propagation of fish and wildlife, agriculture water supply, and outstanding natural resource water. The chronic numeric criterion for mercury in water to protect aquatic life in Louisiana is 0.012 μg/L.

The mercury fish consumption Action Level in Louisiana is 0.5 mg/kg (wet weight). EPA has promulgated a criterion of 0.3 mg/kg (wet weight) for methyl mercury in fish tissue.

The Louisiana water quality standards also include an antidegradation policy (LAC 33: IX.1109.A). This policy states that waters exhibiting high water quality should be maintained at that high level of water quality. If this is not possible, water quality of a level that supports designated uses of the waterbody should be maintained. Changing the designated uses of a waterbody to allow a lower level of water quality can only be achieved though a use attainability study.

## 2.4 Point Sources

A list of point sources in selected portions of the Red River basin was developed using data from LDEQ's internal point source databases with additional information obtained from LDEQ's Electronic Document Management System (EDMS). Using this information, 35 NPDES permits were identified within Subsegment 100501 and discharging to directly or indirectly to Bayou Dorcheat. The point sources are listed in Table B.1 in Appendix B. The locations of these point source discharges are shown on Figure A.3 (Appendix A). None of the NPDES discharges had permit limits for mercury. Clean sampling of municipal wastewater discharges in Arkansas found measurable mercury concentrations in the effluent of all facilities tested. Therefore, municipal wastewater discharges were considered as possible sources of mercury in this TMDL. To be consistent with previous Louisiana mercury TMDLs, mercury loads were calculated only for municipal wastewater discharges with flow greater than 0.1 mgd. Based on available information, there are five discharges permitted in Subsegment 100501 that match these criteria (Table 2.3).

Table 2.3. Municipal wastewater discharges included in TMDL.

| Permit Number | Facility Name | Receiving Stream | Flow, mgd |
|---|---|---|---|
| LA0020401 | Town of Cotton Valley | Little French Creek | 0.15 (design) |
| LA0032301 | Town of Cullen WWTP | Bradley Creek | 0.25 |
| LA0033227 | City of Springhill STP | Crooked Creek | 0.95 |
| LA0038130 | City of Minden WWTP | Bayou Dorcheat | 2.44 (design) |
| LA0075396 | Town of Sibley STP | Brushy Creek | 0.16 |

## 2.5 Nonpoint Sources

Atmospheric deposition is the only mercury source specified for Subsegment 100501 in the 2004 303(d) List. Significant proportions of mercury emissions are deposited locally, within 100 km of emission sources. There are approximately 16 mercury emission sources within 100 km of the subsegment. However, mercury can also be transmitted much farther, regionally or globally, before deposition. Local and regional mercury emission sources were considered in these TMDLs. In addition, mercury is often present in watershed soils, as a result of current and historical atmospheric deposition, and possibly naturally occurring, and can be transported to surface water bodies via soil erosion. Mercury also enters the subsegment from upstream (Arkansas).

# 3.0 EXISTING CONDITIONS

## 3.1 Mercury in Water

There are two LDEQ water quality monitoring stations in this subsegment; Station 0061 (Bayou Dorcheat west of Minden, Louisiana) and Station 0274 (Bayou Dorcheat west of Sibley, Louisiana). They are both long term stations, with Station 0061 collecting data from June 1958 to December 2002 and Station 0274 collecting data from February 1990 to April 1998. It should be noted that Station 0061 was discontinued from 1990 to 2001. The locations of these monitoring stations are shown in Figure A.1 in Appendix A and a complete tabular listing of all the data for both stations is shown in Tables C.1 and C.2 in Appendix C. These data were obtained from LDEQ.

Table 3.1 summarizes the mercury data collected from these stations, including percentages of values above the mercury criterion of 0.012 μg /L. It should be noted that prior to 2002 the detection level for mercury in water was greater than the mercury water quality criterion. Starting in 2002 samples were collected and analyzed using “clean” techniques to prevent sample contamination. Results from sampling prior to 2002 are believed to reflect sample contamination rather than actual conditions in the water bodies sampled. All results from 2002 and later were less than the mercury water quality criterion.

Table 3.1. Mercury in water at Bayou Dorcheat LDEQ monitoring stations.

| **LDEQ Station Number** | **0061** | **0274** |
|---|---|---|
| **Station Description** | Bayou Dorcheat west of Minden, Louisiana | Bayou Dorcheat west of Sibley, Louisiana |
| **Period of Record** | Apr 14, 1981 - Jan 29, 2007 | Feb 12, 1990 - Apr 13, 1998 |
| **Number of Values** | 59 | 46 |
| **Minimum** | 0.00037 | < 0.05 |
| **Median**[A] | 0.20 | 0.085 |
| **Average**[A] | 0.312 | 0.121 |
| **Maximum** | 1.3 | 0.20 |
| **No. Values from clean sampling > 0.012 ug/L** | 0 | NA |

Note: [A]-For these calculations, less than detection values were assumed to be equal to the detection values, which ranged from 0.2 to 0.05 μg/L.

## 3.2 Other Water Quality Parameters

Measurements of sulfate, total organic carbon (TOC), and pH have also been collected at these water quality monitoring stations (Appendix C). These data were also obtained from LDEQ. These three constituents have been demonstrated to be correlated with fish tissue mercury concentrations, and can affect the bioavailability of mercury for methylation and subsequent uptake and bioaccumulation of methyl mercury through the food chain (Armstrong et al., 1995, EPA 1998). Water bodies with moderate sulfate (5 to 25 mg/L) and TOC (5 to 10 mg/L) concentrations provide an environment conducive to microorganisms that methylate mercury and tend to have fish with higher tissue mercury concentrations (Armstrong et al., 1995). Waterbodies with lower pH values (<5.5 su) can experience chemical mercury methylation. Both water quality monitoring stations had pH values that were predominately greater than 5.5 su so chemical methylation would not be expected. There are occasions when sulfate and TOC concentrations are supportive of methylating microorganisms (Table 3.2).

Table 3.2. Summary of pH, sulfate, and TOC data from Bayou Dorcheat.

| **LDEQ Station Number** | **0061** | **0274** |
|---|---|---|
| **Period of Record** | Jun 1, 1958 - Jul 30, 2007 | Feb 12, 1990 - Apr 13, 1998 |
| **No. pH values** | 383 | 50 |
| **No. pH values < 5.5 su** | 5 | 1 |
| **No. sulfate values** | 260 | 50 |
| **No. sulfate values 5 to 25 mg/L** | 181 | 35 |
| **No. TOC values** | 133 | 50 |
| **No. TOC values 5 to 10 mg/L** | 63 | 28 |

## 3.3 Fish Tissue Data

LDEQ collected and analyzed fish samples for mercury in fish tissue from Bayou Dorcheat between 2003 and 2005. Two fish sampling sites are located in Subsegment 100501. The locations of these sampling sites are shown in Figure A.1 (Appendix A). Table 3.3 summarizes the fish tissue data that are available for the subsegment. A table of all the data is included in Appendix D.

Table 3.3. Summary of LDEQ fish tissue mercury data for Subsegment 100501.

| Site | Description | Species | No. Fish | Average Hg (ppm) | Years |
|---|---|---|---|---|---|
| 0061 | Bayou Dorcheat west of Minden, Louisiana | Black Crappie | 3 | 0.58 | 2003 |
| | | Bowfin | 6 | 1.12 | 2003 |
| | | Freshwater Drum | 3 | 1.10 | 2003 |
| | | Largemouth Bass | 15 | 1.03 | 2003 |
| | | Spotted Bass | 9 | 1.35 | 2003 |
| | | White Bass | 1 | 0.34 | 2003 |
| | | American Eel | 2 | 0.28 | 2003 |
| | | Black Crappie | 10 | 0.65 | 2004, 2005 |
| 2302 | Bayou Dorcheat near Sarepta, Louisiana | Bowfin | 16 | 0.95 | 2004, 2005 |
| | | Channel Catfish | 2 | 0.49 | 2005 |
| | | Flathead Catfish | 5 | 1.63 | 2004, 2005 |
| | | Freshwater Drum | 7 | 0.72 | 2004, 2005 |
| | | Largemouth Bass | 20 | 1.03 | 2004, 2005 |
| | | Spotted Bass | 3 | 0.86 | 2004, 2005 |
| | | White Crappie | 4 | 0.46 | 2004 |

# 4.0 TMDL DEVELOPMENT

## 4.1 TMDL Method

### 4.1.1 Conceptual Framework

Mercury is unlike many other metals because it has a volatile phase at ambient temperatures and can be transported in a gaseous, soluble, or particulate form (Figure 4.1). Mercury is emitted to the atmosphere in both elemental gaseous Mercury(0) and divalent Mercury(II) forms. Anthropogenic direct emissions, natural emissions, and indirect re-emission of previously deposited mercury are major sources of mercury to the atmosphere (Figure 4.1). Gaseous Mercury (0) is relatively insoluble and is capable of being transported long distances and contribute to regional and global background concentrations.

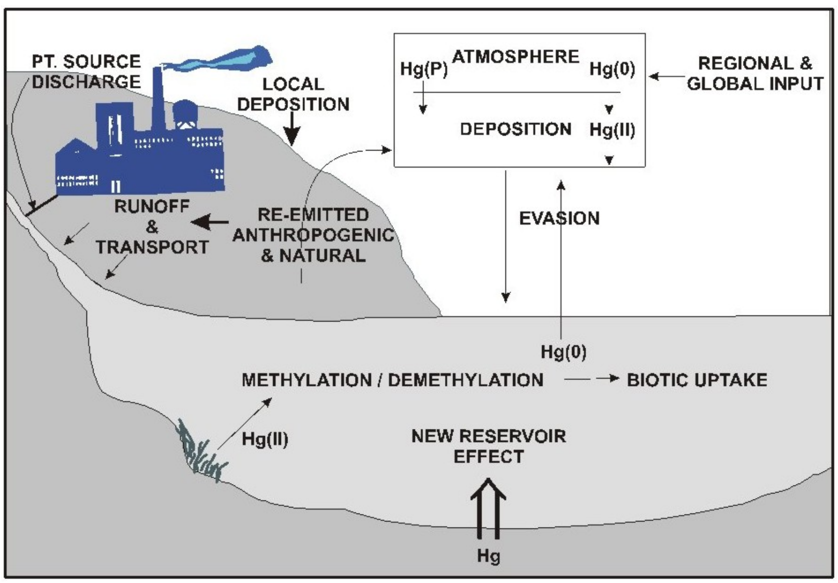


Figure 4.1. General mercury cycle showing atmospheric transport and deposition, point, nonpoint source and natural background contributions, and the effects of new reservoirs on mercury release into the environment.

Mercury(II) is much more soluble and can sorb onto particulates, so it tends to be removed from the atmosphere by both wet and dry mercury deposition closer to emission sources, within local and regional areas (EPRI 1994). Ozone or other oxidizing agents in the atmosphere can convert Mercury(0) to Mercury(1), and some Mercury(II) can also be chemically reduced to Mercury(0). Mercury(0) can be transported long distances Local sources of deposited mercury are typically within about a 100 km radius of a site (EPA 2001). Regional sources are loosely defined as other sources within a geographical area such as the Southeast, South, or Upper Midwest, while global sources include intercontinental contributions of mercury. Atmospheric mercury deposition can include contributions from all three sources. In addition to atmospheric deposition, mercury can also enter waterbodies from point source effluent discharges and watershed nonpoint source contributions. These watershed nonpoint sources include both naturally occurring mercury (e.g., geology, soils) and atmospherically deposited mercury that can be transported to the waterbody (Figure 4.1).

The primary mercury species of concern for bioaccumulation and biomagnification through the food chain, however, are not the inorganic mercury species, but the organic form methyl mercury (Figure 4.2). Inorganic mercury deposited in waterbodies can be converted to methyl mercury. Sulfate reducing bacteria are thought to be the agent responsible for the majority of methyl mercury production in aquatic systems (Beyers et al., 1999, Compeau and Bartha 1987, Gilmour and Henry 1991), and in situ production is often a significant source of methyl mercury in aquatic systems (Benoit et al., 1998, Gilmour et al., 1998, Mason et al., 1999).

Methyl mercury binds with protein in muscle tissue of fish and other living organisms. Methyl mercury is lost very slowly from fish tissue, on the order of years (Trudel and Rasmussen 1997). Therefore, methyl mercury concentrations continue to biomagnify or increase in concentration throughout the life of the fish as long as methyl mercury is in the environment and in its prey species. Older, larger fish typically have higher mercury concentrations than younger, smaller fish. Several factors can affect the availability of inorganic mercury for conversion to methyl mercury. If sulfides or dissolved organic matter are present, they can bind inorganic mercury so that it is not available for conversion to methyl mercury (Benoit et al., 1999; Ravichandran 2004). Inorganic mercury can also join with more complex polysulfides or other chemicals and become easier for methylating bacteria to use (Benoit et al., 1999, 2000, 2001). In addition, recent research indicates that inorganic mercury tends to become less likely to be converted to methyl mercury the longer it is in a waterbody (Hintelmann et al., 2002); more recently deposited inorganic mercury is more reactive.

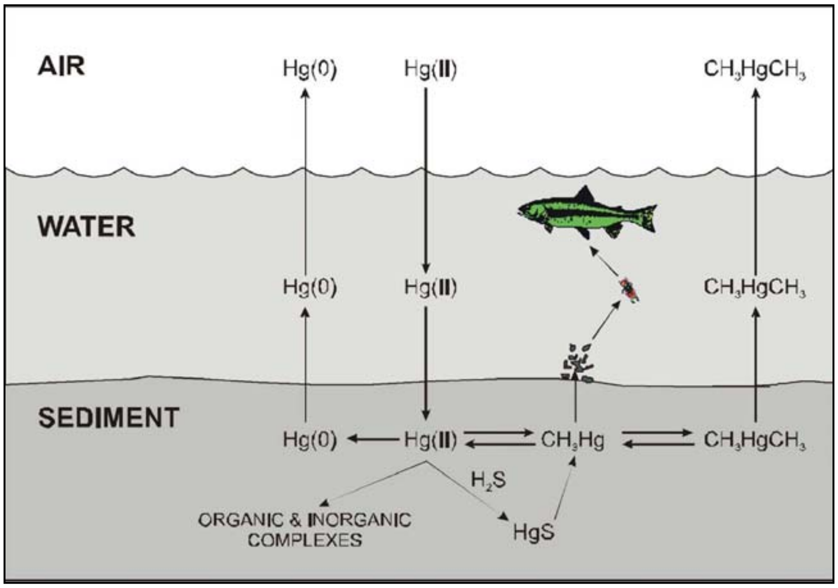


Figure 4.2. Pathways for mercury species through the aquatic ecosystem, including methylation and demethylation, evasion or loss from the water to the atmosphere, and sedimentation and burial in the sediment (after Winfrey and Rudd 1990).

Methylating microorganisms, such as sulfur reducing bacteria, live in anaerobic (zero dissolved oxygen) environments in the sediments of wetlands, streams, rivers, and lakes or reservoirs. New reservoirs (i.e., less than 15 to 20 years old) create environments that are particularly suitable for methylating bacteria so fish tissue mercury concentrations in new reservoirs are typically higher than fish tissue mercury concentrations in older reservoirs.

In summary, TMDLs for mercury must consider that mercury can exist as a gas as well as a solution or particulate forms. Mercury loads arise from atmospheric deposition contributed by both local and regional/global emission sources, point source effluent discharges, natural geological formations, and soils. However, after deposition or loading to the system, it can also be lost through volatilization and re-enter the atmospheric pool. It is the organic form as methyl mercury that is biologically accumulated and magnified through the food chain. Once in fish, it is lost very slowly and continues to accumulate through time.

### 4.1.2 Loading Capacity

The loading capacity of waterbodies differ based on a site specific basis due to (1) inputs or load of mercury to the waterbody, (2) environmental conditions within the waterbody that mediate methylation and bioaccumulation, and (3) the food web or food chain through which mercury bioaccumulates (Armstrong et al., 1995).

### 4.1.3 TMDL Formulation

A three-step approach was used to estimate loading capacity and the reductions required to achieve the designated fishable use in Subsegment 100501. In the first step, required load reductions were estimated based on existing and target fish tissue mercury concentrations. In the second step, mercury loading to the study areas was estimated. In the third step, the TMDLs were estimated by applying the estimated required load reductions to the estimated existing mercury loads to the study areas.

## 4.2 Required Load Reductions

The target for the TMDL in this report is the Louisiana fish consumption action level (0.5 mg/kg). The average tissue concentration for the fish species with the highest value was used to calculate the mercury load reduction factor. In Bayou Dorcheat, the fish species with the highest average tissue mercury concentration was Flathead Catfish. The Bayou Dorcheat load reduction factor of 0.31 was calculated by dividing the target fish tissue concentration by the average measured Flathead Catfish tissue concentration (1.63 mg/kg). This number is essentially the portion of the existing load that would be the target load, or one minus the percent reduction. Therefore, the percent mercury load reduction required for Bayou Dorcheat is 69%.

## 4.3 Existing Loads

The existing mercury load to Subsegment 100501 was assumed to consist of loads from both point and nonpoint sources. Point sources were NPDES permitted municipal wastewater treatment plants either with flow greater than 0.1 mgd. Nonpoint sources load included tributary inputs, atmospheric deposition inputs from local and regional/global emission sources, and watershed soil erosion inputs. Estimated loads from these sources are summarized in Table 4.1. The methods used to estimate these loads are described below.

Table 4.1. Existing subsegment mercury load.

| Source | Mercury Load (g/yr) |
|---|---|
| Point Sources | 65.5 |
| Upstream Inflow | 6,509 |
| Local Source Atmospheric Deposition | 35.7 |
| Regional Source Atmospheric Deposition | 1,330,965 |
| Subsegment Erosion | 15,672 |
| Total | 1,352,186 |

### 4.3.1 Point Sources

None of the NPDES permitted discharges identified in the subsegment were found to have a mercury permit limit. However, because measurable mercury levels have been found in discharge from municipal wastewater treatment plants, mercury loads were calculated for all NPDES discharges identified as municipal wastewater treatment plants (including LAG56 and LAG57 permits) with a flow of greater than 100,000 gpd. EPA believes it is appropriate to assume that these discharges contain mercury levels equal to 0.012 μg/L. Information for the discharges included in the TMDL (Table 4.2) was obtained by FTN Associates, Ltd. from LDEQ’s Electronic Data Management System. Facility mercury load was estimated by multiplying expected or design flow (whichever was available) by 0.012 μg/L. Table 4.2 shows the estimated point source mercury loads.

Table 4.2. Point source mercury loads.

| Facility Name | NPDES No. | Flow MGD | Mercury Load (g/yr) | Mercury Load (lb/day) |
|---|---|---|---|---|
| Town of Cotton Valley | LA0020401 | 0.15 (design) | 2.49 | 1.50E-5 |
| Town of Cullen WWTP | LA0032301 | 0.25 | 4.15 | 2.51E-5 |
| City of Springhill STP | LA0033227 | 0.95 | 15.8 | 9.52E-5 |
| City of Minden WWTP | LA0038130 | 2.44 (design) | 40.5 | 0.24E-5 |
| Town of Sibley STP | LA0075396 | 0.16 | 2.65 | 1.60E-5 |
| **Total** | | | **65.5** | **3.96E-5** |

### 4.3.2 Nonpoint Sources

#### 4.3.2.1 Upstream Inputs

Subsegment 100501 receives inflow from Arkansas. These inflows have mercury loads associated with them that contribute to the mercury load in the subsegment. Historical measurements of total and dissolved mercury in water are available for the Arkansas portion of Bayou Dorcheat (from 1971 through 1995). However, the detection level for these measurements is greater than the Arkansas mercury water quality criterion (0.012 µg/L). Also, during this period “clean” sample collection and analysis methods were not used, so those measurements greater than the detection level are believed to reflect sample contamination, rather than the actual mercury concentrations in Bayou Dorcheat. Since the Louisiana clean sampling results for Bayou Dorcheat indicate that mercury concentrations are less than the mercury water quality criterion, the value 0.012 µg/L was used to calculate a conservative estimate of the upstream load. The flow used to estimate the upstream load was based on the historical average flow (607.2 cfs) at Bayou Dorcheat near Springhill, LA (USGS Gage 07348700). An average flow per unit area was calculated for the USGS gaging station and multiplied by the drainage area for Bayou Dorcheat upstream of the Arkansas state line (506 sq mi) to estimate the upstream flow (508 cfs). The concentration 0.012 µg/L was multiplied by this estimated upstream flow to get the estimated upstream load to Subsegment 100501 (6,509 g/yr).

#### 4.3.2.2 Regional Atmospheric Deposition

Data for atmospheric deposition of mercury was obtained from the National Atmospheric Deposition Program (NADP) website. There are NADP mercury deposition monitoring stations reasonably close to Subsegment 100501 (for a map showing locations of all of the NADP monitoring sites, see http://nadp.sws.uiuc.edu/mdn/sites.asp). Data from monitoring stations TX21 and LA23 were used to represent atmospheric deposition of mercury in the subsegment. Data were available from both of these stations for 2001 through 2005. The average value of the wet deposition at these sites for this period was 11.7 µg/m$^2$/yr (Table 4.3). An estimate of the total atmospheric deposition was based on the assumption that dry deposition is about 50% to 60% of wet deposition (Auwarter 2000) resulting in a total atmospheric deposition of 18.7 µg/m$^2$/yr. Wet deposition is the mercury removed from the atmosphere during rain events. Dry deposition is the mercury removed from the atmosphere on dust particles, sorption to vegetation, gaseous uptake by plants, or other input during non-rainfall periods (EPA 1997).

Table 4.3. Estimated total atmospheric mercury deposition rate.

| NADP Station | Year | Mercury Deposition (µg/m$^2$/yr) |
|---|---|---|
| TX21 | 2001 | 15.0 |
| TX21 | 2002 | 8.6 |
| TX21 | 2003 | 9.2 |
| TX21 | 2004 | 12.5 |
| TX21 | 2005 | 7.6 |
| LA23 | 2001 | 14.5 |
| LA23 | 2002 | 12.3 |
| LA23 | 2003 | 11.6 |
| LA23 | 2004 | 17.4 |
| LA23 | 2005 | 8.3 |
| | Average = | 11.7 |
| | Dry + Wet = Average x 1.6 = | 18.7 |

The total direct atmospheric deposition mercury load to Bayou Dorcheat (1,331 kg/yr) was calculated by multiplying the total atmospheric deposition rate (18.7 mg/m$^2$/yr) by the sum of the areas of wetland and water land uses for the subsegment (71,176,500 m$^2$). The part of the atmospheric deposition load coming from regional or global emissions sources was estimated by subtracting the local emissions load from the total atmospheric deposition load (Table 4.1).

#### 4.3.2.3 Local Emissions Atmospheric Deposition

The data from the TX21 and LA23 deposition monitoring stations includes both local emission sources similar to those in Texas and Louisiana, and regional/global input. Local atmospheric deposition for Subsegment 100501 was estimated based on data from the 2002 National Emissions Inventory (NEI). The NEI is a complete national inventory of stationary and mobile sources that emit hazardous air pollutants (HAPs). County summaries of NEI point source emissions data from 2002 were downloaded from the NEI web site (www.epa.gov/ttn/chief/net/2002inventory.html).

In this TMDL, local sources are defined as sources within the subsegment and within a distance of 100 km around the subsegment boundary. The area within which these local sources are located is referred to as the “airshed”. The NEI reports sources listed by county; therefore the airshed boundary is determined by county boundaries and if a portion of a county falls within 100 km of the subsegment, then the entire county is included as part of the airshed. The airshed boundary for Subsegment 100501 is shown in Figure A.3 (Appendix A). The mercury emissions for each source found within the airshed are included in Appendix E.

The NEI reports emissions of total mercury. As discussed in Section 4.1.1 Mercury(II) is the form that is most likely to be removed by wet and dry deposition closer to emission sources (i.e., within 100 km).Therefore, we want to use just the Mercury(II) emissions when estimating atmospheric deposition of mercury from local emissions. A number of studies have been done characterizing mercury emissions from a variety of sources and the portion of those emissions that occur as Mercury(II). Table 4.4 shows the Mercury(II) emissions for each source category that contributes to the local atmospheric deposition for the subsegment, calculated from the NEI data using Mercury(II) percentages from EPA (2005a). The total mercury emissions load for the airshed was converted to an areal load by dividing by the area of the airshed. The local emissions direct atmospheric deposition mercury load to Bayou Dorcheat (Table 4.1) was calculated by multiplying the areal load by the sum of the wetland and water land uses for the subsegment (Table 2.2).

The distance from the emission source, the forms of the mercury in the emissions, other pollutants in the emissions and the atmosphere, and the weather patterns of precipitation and prevailing wind are important factors in determining where mercury released to the air will deposit.

Table 4.4. Local source emissions for Bayou Dorcheat Subsegment 100501.

| Source Category | Total Mercury Emissions (tons/yr) | % Particulate Mercury(II) | % Gaseous Mercury(II) | Mercury(II) Emissions (tons/yr) |
|---|---|---|---|---|
| Electricity Generation | 0.0012 | 20 | 30 | 0.00062 |
| Industrial Boilers | 0.0053 | 20 | 30 | 0.0026 |
| Steel Manufacture | 0.063 | 10 | 10 | 0.013 |
| Paper Production (Kraft Pulping) | 0.0051 | 20 | 30 | 0.0025 |
| Miscellaneous Manufacturing | 0.046 | 20 | 30 | 0.023 |
| **Total** | | | | **0.041** |

#### 4.3.2.4 Mercury Load Associated with Soil Erosion

The mercury load for subsegment 100501 associated with transport of eroded material into Bayou Dorcheat was calculated using literature erosion rates for forest, pasture, and cropland land uses. The land use areas for the subsegment were based on USGS 2001 National Land Cover Dataset (http://gisdata.usgs.net/website/MRCL/viewer.php) data as presented in Section 2.2. The erosion rates for pasture and cropland were set to average erosion rates reported for these land uses for Louisiana in the 1997 National Resources Inventory (NRI); these values were 0.2 tons/acre/year for pasture and 3.3 tons/acre/year for cropland. The NRI was conducted and published by the US Department of Agriculture (USDA) National Resources Conservation Service (USDA 2000). Forest erosion rates were not available for the study area parishes in the NRI, therefore the forest erosion rate was set 0.2 tons/acre/year based on information from other sources (Bloodworth and Berc 1981, Novotny and Chesters 1981, USDA Forest Service 1999).

Erosion rates for barren land were not available, so barren land was assumed to have an erosion rate that is similar to cropland. The resulting estimates of tons of sediment per year transported to the water bodies were multiplied by average sediment total mercury concentrations measured in the subsegment (0.072 mg/kg) to estimate study area mercury loads associated with soil erosion (Table 4.5).

Table 4.5. Mercury load associated with erosion in Bayou Dorcheat Subsegment 100501.

| Land Use | Area ($m^2$) | Area (acres) | Erosion Rate (ton/ac/yr) | Sediment Load (ton/yr) | Mercury Load (g/yr) |
|---|---|---|---|---|---|
| Barren | 2.21E8 | 54,561 | 3.3 | 18,0053 | 11,753 |
| Forest | 0.72E8 | 17,891 | 0.2 | 3,578 | 234 |
| Shrub/grass | 0.53E8 | 13,038 | 0.2 | 2,608 | 170 |
| Pasture/Hay | 10.11E8 | 249,768 | 0.2 | 49,954 | 3,261 |
| Row Crops | 0.048E8 | 1,181 | 3.3 | 3,897 | 254 |
| **Total** | | | | | **15,672** |

## 4.4 TMDL

The total allowable mercury loads for Subsegment 100501 (i.e., the TMDL) were calculated based on the existing load, assuming a linear relationship between mercury loads to Bayou Dorcheat and mercury concentrations in fish tissue. In other words, it was assumed here that reducing the mercury loads to Bayou Dorcheat by a factor of 2 (for example) would eventually result in a reduction of mercury concentrations in fish tissue by a factor of 2. The assumption of this linear relationship between mercury load and fish tissue mercury concentration is consistent with steady-state assumptions and the use of bioaccumulation factors, and has been demonstrated in field experiments in the Florida Everglades (Atkeson et al., 2003) and Canada (Orihel et al., 2006). Based on this assumption, the TMDL was calculated as the existing mercury loads multiplied by the reduction factor (Section 4.2). The TMDL components and load reductions are summarized in Table 4.6.

Table 4.6. Mercury TMDL for Bayou Dorcheat Subsegment 100501.

| Load Source | Mercury Load (g/yr) |
|---|---|
| TMDL | 419,178 |
| MOS | 41,918 |
| FG | 41,918 |
| WLA | 65.5 |
| LA: | 335,277 |
| Upstream inflow | 1,351 |
| Local Source Atmospheric Deposition | 8.9 |
| Regional/Global Source Atmospheric Deposition | 330,031 |
| Subsegment Erosion | 3,886 |

### 4.4.1 MOS and FG

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between LAs and water quality. In this case, it accounts for uncertainty and variability related to fish tissue mercury concentrations, estimates of loading, and assumption of a linear relationship between watershed mercury load and fish tissue mercury concentration. The MOS for this TMDL is implicit due to the following conservative assumptions made in calculating the TMDL:

1. Calculations of mercury load associated with soil erosion assume no loss of mercury from any mechanism during transport.
2. Mercury loading to Bayou Dorcheat is considered 100% available for uptake.
3. For municipal wastewater treatment plants with flows greater than 100,000 gpd, it was assumed that 0.012 μg/L of mercury was discharged from each facility, however, actual discharge of mercury from these facilities may be less.

An additional 10% of the TMDL was set aside to account for uncertainty associated with FG.

### 4.4.2 WLA

Point sources of mercury were not numerous in the listed subsegments, and accounted for significantly less than 1% of the mercury loads. Therefore, point source loads were not reduced in these TMDLs. The WLA for point source contributions was set to the design flow multiplied by the mercury water quality criterion (0.012 μg/L).

### 4.4.3 LA

The LA for nonpoint sources was set to the TMDL minus the FG and the WLA. Since tributary mercury concentrations are already below the Louisiana mercury criterion, no changes were anticipated to the tributary loads. The reduction in the nonpoint source mercury loads would result from reductions in the atmospheric deposition and sediment loads.

### 4.4.4 Seasonality

Wet deposition is greatest in the winter and spring seasons. Mercury loads fluctuate based on the amount and distribution of rainfall, and variability of localized and regional/global sources. While an average daily load is established here, the average annual load is of greatest significance because mercury bioaccumulates over the life of the fish and the resulting risk to human health from fish consumption is a long-term phenomenon. Thus, daily or weekly inputs are less meaningful than total annual loads over many years. The use of annual loads allows for integration of short-term and seasonal variability. Inputs should continue to be estimated through wet deposition and additional monitoring.

Mercury methylation is expected to be highest during the summer. High temperatures promote biological activity and reservoirs are stratified with anoxic hypolimnions. Based on the enhanced methylation and higher predator feeding rates during this period, mercury bioaccumulation is expected to be greatest during the summer. However, given the long depuration times for fish and relatively mild winters in Louisiana, seasonal changes in fish tissue mercury body burden are expected to be relatively small. Inherent variability of mercury concentrations between individual fish of the same and/or different size categories is expected to be greater than seasonal variability.

# 5.0 ONGOING AND FUTURE POLLUTANT LOADING REDUCTIONS

Table 4.1 shows that existing mercury loadings to Subsegment 100501 are primarily from nonpoint sources. As discussed in Section 4.2, mercury load to the subsegment will need to be reduced 17% to 68% to achieve the TMDL target of 0.5 mg/kg mercury in fish tissue.

## 5.1 Atmospheric mercury

There is good evidence that reducing atmospheric deposition loads of mercury can reduce fish tissue mercury concentrations. Results from the METAALICUS project suggest that fish tissue concentrations are most responsive to changes in mercury loads entering waterbodies through direct deposition to the water surface (compared to changes in mercury deposition to the watershed that may be transported to the waterbody) (Blanchfield et al., 2005). Reduction of mercury emissions within Florida is believed to be the cause of a more than 60% decline in mercury concentrations in Everglades' fish (Atkeson et al., 2003). The EPA study of the benefits of the Clean Air Mercury Rule suggests that the reduction of mercury deposition resulting from the Rule would result, on average, in about a 6% reduction in fish tissue mercury concentrations in Louisiana by 2020 (EPA 2005b). Because the majority of the mercury load to Subsegment 100501 is from erosion of previously deposited mercury and direct atmospheric deposition, the fish mercury concentrations may take decades to decline in response to decreased mercury emissions and deposition (Chen et al., 2005).

### 5.1.1 National and State

In 1997, EPA reported that approximately 60% of the atmospheric mercury deposited in the US was emitted from US sources (EPA 1997). Facilities in Louisiana are subject to both state (LAC 33: III. Chapter 51) and federal mercury air emission rules. As rules and standards pursuant to the Clean Air Act have been developed, proposed, and promulgated since 1990, compliance by emitting sources as well as actions taken voluntarily have already begun to reduce emissions of mercury to the air across the US (www.epa.gov/air/mercuryrule/charts.html). The

EPA expects a combination of ongoing activities will continue to reduce mercury emissions to the air over the next decade.

The EPA currently regulates emissions of mercury and other HAPs under the maximum achievable control technology ("MACT") program of Section 112 of the Clean Air Act, and under a corresponding new source performance standard ("NSPS") program under Sections 111 and 129 of the Act. Section 112 authorizes the EPA to address categories of major sources of HAPs, including mercury, by issuing emissions standards that, for new sources, are at least as stringent as the emissions control achieved by the best performing similar source in the category, and for existing sources, are at least as stringent as the average of the best performing top 12% (or five facilities – whichever is greater) of similar sources. The EPA may also apply these standards to smaller area sources, or choose to apply less stringent standards based on generally available control technologies ("GACT"). Sections 111 and 129 direct the EPA to establish MACT-equivalent standards for each category of new and existing solid waste incineration units, regulating several specified air pollutants, including mercury.

Based on the EPA's National Toxics Inventory, the highest emitters of mercury to the air include coal-burning electric utilities, municipal waste combustors, medical waste incinerators, mercury cell chlor-alkali plants, and hazardous waste combustors. The EPA has issued a number of regulations under Sections 111, 112, and 129 to reduce mercury pollution from several of these source categories. Relevant regulations that the EPA has established to date under the Clean Air Act include those listed below.

1. Coal-burning electric utilities accounted for the greatest percentage of US mercury air emissions in 1990. In 1999 they accounted for over 40% of the US mercury air emissions. In March 2005, the EPA issued the Clean Air Intestate Rule and the Clean Air Mercury Rule. When fully implemented these rules will reduce mercury emissions from coal-burning electric utilities by nearly 70% from 1999 emissions levels.
2. Medical waste incinerators (MWIs) accounted for about 24% of US mercury air emissions in 1990. The EPA issued emission standards under Sections 111 and 129 for MWIs on August 15, 1997. The implementation deadline for these standards was September 2002. This rule reduced mercury emissions from MWIs by about 97% from 1990 emission levels.

3. The source category of municipal waste combustion (MWC) accounted for about 20% of US mercury air emissions in 1990. The EPA issued final regulations under Sections 111 and 129 for large MWCs on October 31, 1995. Large combustors or incinerators were required to be in compliance with the rule by December 2000. These regulations reduce mercury emissions from these facilities by about 90% from 1990 emission levels.
4. Mercury cell chlor-alkali plants accounted for about 4.5% of US mercury air emissions in 1994 to 1995. In December 2003, the EPA issued mercury emission standards for these facilities under Section 112. When fully implemented, these standards will reduce mercury emissions from mercury cell chlor-alkali plants by about 50%.
5. Hazardous waste combustors (HWCs) accounted for about 2.5% of US mercury air emissions in 1990. In February 1999, the EPA issued emission standards under Section 112 for these facilities, which include incinerators, cement kilns, and lightweight aggregate kilns that burn hazardous waste. This regulation has not been implemented, pending resolution of a lawsuit. This regulation is expected to reduce mercury emissions from HWCs by more than 50% from 1990 emission levels.

These promulgated regulations, when fully implemented and considered together with actions discussed below that will reduce the mercury content of waste, are expected to reduce national mercury emissions caused by human activities by about 50% from 1990 levels.

There are also several national programs for reducing mercury emissions from the waste stream. In 1996 the US eliminated the use of mercury in most batteries under the Mercury Containing and Rechargeable Battery Management Act. In 2006 EPA initiated the National Vehicle Mercury Switch Recovery Program, a program to reduce mercury emissions by up to 75 tons over the next 15 years by removing mercury-containing light switches from scrap vehicles before they are recycled into steel. In addition, voluntary measures to reduce use of mercury containing products, such as the voluntary measures committed to by the American Hospital Association, also will contribute to reduced emissions from waste combustion.

It is possible that the cumulative effect of additional standards and voluntary actions will reduce mercury emissions from human activities in the US by more than 50% from 1990 levels. In 1999, mercury emissions had already dropped 45% from 1990 levels. Mercury deposition modeling of the influence of the Clean Air Interstate Rule suggests that mercury deposition in the Louisiana study areas would be reduced less than 5 μg/m$^2$ by 2020 (EPA 2005b).

### 5.1.2 International

Mercury emitted to the air can travel the globe and be deposited outside national boundaries, contributing to mercury issues in other countries. The United Nations Environment Programme established its Mercury Programme in 2003. This program has the long term objective "to substantially reduce or eliminate uses and anthropogenic releases of mercury through the implementation of national, regional and global actions, thereby significantly reducing global adverse impacts on health and the environment" (UNEP 2006). Through this program, a number of global partnerships for mercury reduction have been initiated, dealing with global sources such as chlor-alkali plants, products, artisanal and small scale gold mining, and coal fired utilities. In addition, a global partnership for research into mercury fate and transport has also been initiated under this program. The US participates in these global partnerships.

The US is also a member of the Commission of Environmental Cooperation (CEC), with Canada and Mexico, under the North American Agreement on Environmental Cooperation. The CEC has developed the North American Regional Action Plan on Mercury. This plan has the goal of reducing anthropogenic mercury emissions through international and national initiatives, and has provisions regarding waste management; risk management approaches to address mercury emissions, processes, operation and products; and research, monitoring, modeling, inventory, and communication activities.

## 5.2 Municipal dischargers

This TMDL focuses on those facilities likely to be discharging mercury. EPA expects LDEQ to systematically identify any dischargers that are significant sources of mercury. EPA will work with LDEQ to establish mechanisms for demonstrating that the WLAs in these TMDLs are met.

If a facility is found to discharge mercury at levels above 0.012 µg/L, a mercury minimization plan may be required. EPA expects that the State of Louisiana, as the duly authorized permitting authority, will determine any additional necessary elements of a mercury characterization/minimization plan, considering the size and nature of the affected facility. Local characteristics such as water velocity, bed substrate, oxygen content, and microbial community structure all contribute to methylation potential. Since these characteristics have not been defined for each of the discharges in each subsegment, there exists the potential that effluent containing mercury may cause localized exceedances of the criteria and therefore, minimization plans and/or numeric limits may be necessary to assure that the discharge does not cause and/or contribute to an exceedance of the applicable water quality standards. In conclusion, due to uncertainty in the TMDL analysis, mercury minimization plans and/or numeric limits may be necessary to assure compliance with the water quality standards. Through these actions, over long-term, it can be demonstrated that WLAs are being met.

## 5.3 Pollution Prevention

Source reduction, through product and innovation, is the key element to pollution prevention. The US industrial demand for mercury dropped 75% from 1988 to 1997 (http://www.epa.gov/mercury). Reductions in mercury use are driven by voluntary efforts and by increasingly strict federal and state regulations, such as increasing regulation of mercury in products or outright bans on the use of mercury in products for which alternatives are available. For example, in 1996 EPA eliminated the use of mercury in most batteries under the Mercury Containing and Rechargeable Battery Management Act. Other voluntary measures such as the commitment by the American Hospital Association to reduce the use of mercury-containing products will continue to decrease the amount of mercury available in the waste stream. Next to source reduction, recycling is fundamental to mercury pollution prevention. When mercury must be used and recycling is not a possibility, proper disposal is critical to reducing the potential of dispersion to the environment.

## 5.4 LDEQ Statewide Mercury Program

The LDEQ has identified mercury as one of its priorities and is addressing mercury risk through a statewide mercury initiative. It is the intent of LDEQ to assess all sources of mercury to the environment in the state and to develop strategies to reduce public health risks associated with mercury. A series of public meetings were held with participation from various industry sectors and non-governmental organizations. In addition, meetings on risk communication have been, and continue to be, conducted for the purpose of enhancing public awareness relative to mercury and mercury exposure.

The approach of this initiative is intended to be exhaustive and comprehensive, looking at all sources of mercury with consideration given to methods of controlling releases to the environment. Potential action items include pollution prevention strategies, waste minimization, non-essential mercury-containing device phase-outs, recycling enhancements through rule development (such as Universal Waste Rule), remediation of known sites of mercury contamination, comprehensive approaches to locating and remediating legacy sites, rule development to minimize permitted mercury emissions and discharges, and enhanced public outreach to educate the public on efforts that can be conducted locally and within the home to enjoin the mercury reduction initiative. This approach, used in the Louisiana Mercury Risk Reduction Plan, will result in the greatest environmental benefit when applied on a regional and national scale. The LDEQ and EPA will continue to develop this statewide mercury reduction strategy to its fullest potential, promoting and supporting its use in adjacent states and regions.

LDEQ continues its aggressive commitment to implementing a comprehensive statewide mercury program. The following excerpts from the recent LDEQ publication *Resource Guide to Understanding Mercury in Louisiana's Environment: 2003 Mercury Report* highlight some of the management strategies that will advance attainment of the reduction goals defined by this TMDL (LDEQ 2003).

- Design and construction regulations for landfills to help ensure that mercury-laden materials do not leak from them.
- Historically, electrical switches in some natural gas meters contained mercury. Spills from these meters contaminated the ground and became sources of mercury to the environment. Since 1991, several natural gas pipeline companies with oversight from LDEQ, voluntarily cleaned the mercury from the environment around contaminated natural gas meter sites. To date, approximately 5,000 sites have been checked for mercury contamination and 2,500 that were contaminated have been cleaned.

- Recycling played a large part in not only reducing the amount on mercury used by industries, but also reducing the amount released to the environment. LDEQ's Recycling Section maintains a current list of all recyclers in the state, sorted by commodity.

Over the past 5 years LDEQ has worked to expand its statewide mercury monitoring program. The primary objective of this program was to determine statewide mercury contamination levels of fish commonly eaten in Louisiana, as well as mercury concentrations in sediments, water, and epiphytic plant material, and mercury loadings from atmospheric deposition.

Continued fish tissue data collection provides input for analyses of risks to human health due to consumption of mercury-contaminated fish. This allows Louisiana Department of Health and Hospitals (LDHH) and LDEQ to address public concerns regarding the safety of fish consumption from many waterbodies. Epiphytic plant material is used to help further define the significance of atmospheric sources of mercury. Results of the epiphytic plant material analyses, together with fish tissue, water and sediment concentration information, will continue to help address questions regarding sources of mercury. Additional local and statewide remedial actions can be more effectively targeted to reduce mercury sources by combining data generated from this and previous projects and the knowledge of LDEQ field personnel. This project will also provide baseline data that can be used for ongoing trend analysis.

LDEQ's sampling site selection continues to evolve and is based on several needs. New sits are sampled to expand the number of waterbodies tested. Recently, sites were selected in basin subsegments in which no previous sampling has occurred. Currently, nearly all waterbodies with fish populations sufficient to support human health risk assessment inputs have been sampled for mercury contamination . Waterbodies are resampled if LDHH determines additional samples are needed to make a decision regarding fish consumption advisories.

Beginning in October 1998, LDEQ implemented an air monitoring program designed to assess the geographical extent and quantity of atmospheric mercury deposition. Air monitors currently exist at the Southeastern University Campus in Hammond, Louisiana; McNeese State University in Lake Charles, Louisiana; at the Louisiana State University in Chase, Louisiana;

and in Alexandria, Louisiana in Rapides Parish. Samples are tested for wet deposition of total mercury during rainfall events. If rainfall occurs samples are collected weekly. LDEQ's air monitoring sites are part of the NADP Mercury Deposition Network. Weekly data from October 1998 through present are available. The data show mercury levels are being regularly detected in rainwater. The data are analyzed by the NADP. Any interested party may access the data at the following website: http://nadp.sws.uiuc.edu/mdn.

LDEQ adheres to well-defined sampling procedures when collecting mercury data. This program is an important tool for LDEQ in evaluating the progress of the mercury reductions prescribed by these TMDLs. LDEQ's targeted data collection efforts in subsegments with fish consumption advisories will provide the data necessary to ultimately remove the fish consumption advisory or revise the TMDL at some point in the future, if warranted.

# 6.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, federal regulations require EPA to publish a public notice and seek comment concerning the TMDL. The TMDLs in this report were prepared under contract to EPA. EPA is seeking comments, information, and data from the general and affected public concerning this draft TMDL. If comments, data, or information are submitted during the public comment period, EPA will address the comments and revise these TMDLs accordingly. EPA will then transmit the final TMDLs to LDEQ for implementation and for incorporation into LDEQ's current water quality management plan.

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# APPENDIX A

## Maps

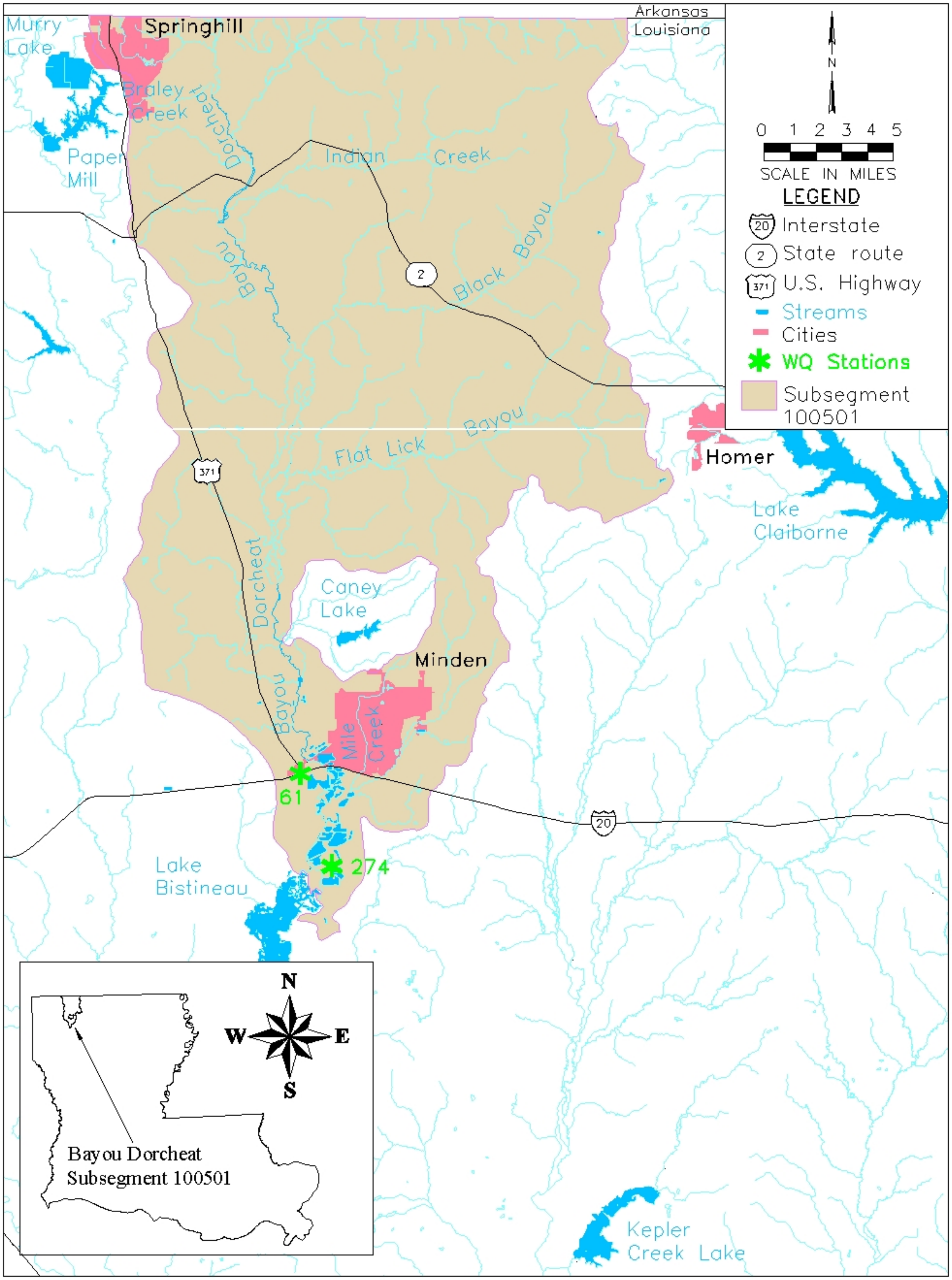



Figure A.1. Bayou Dorcheat watershed map.

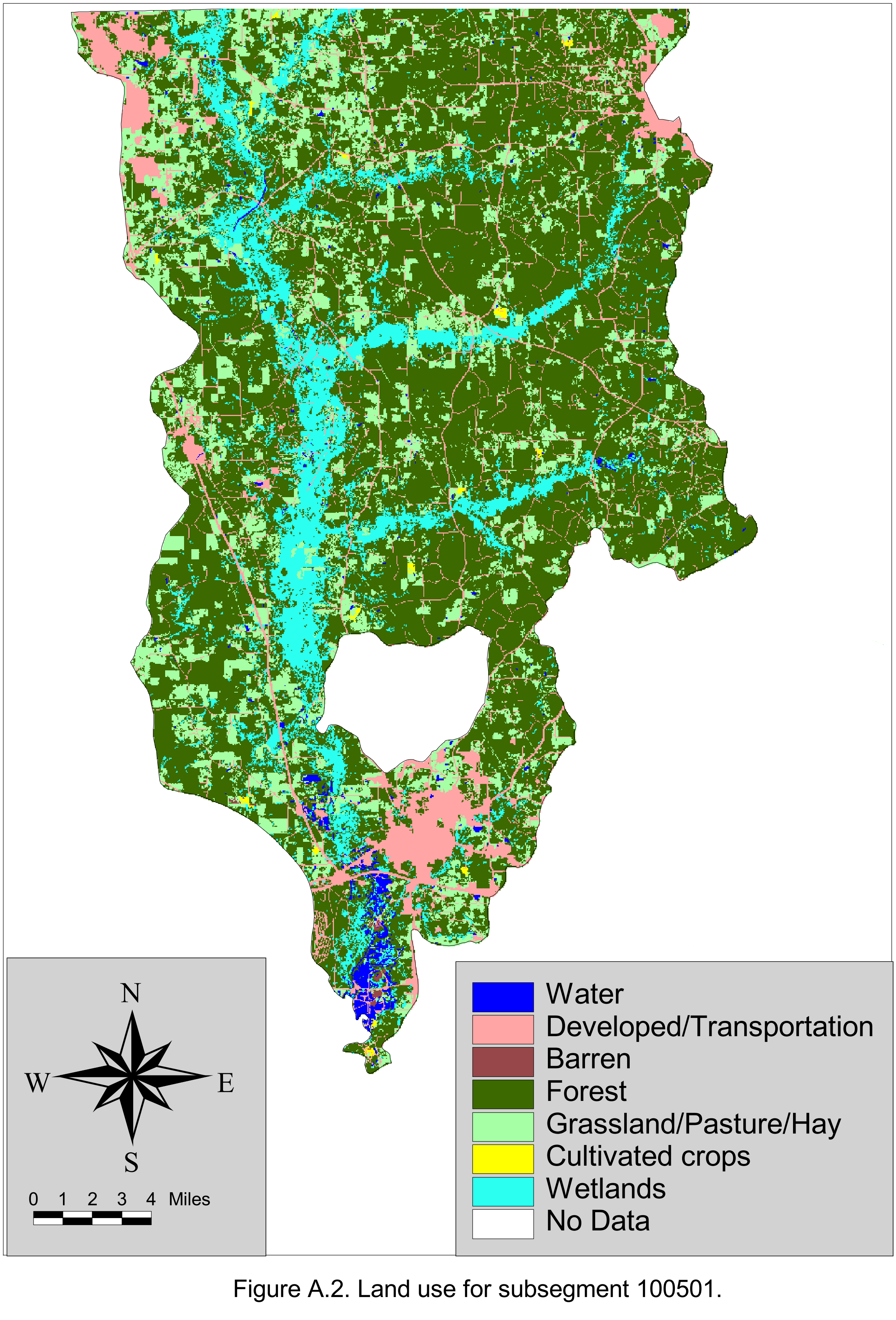
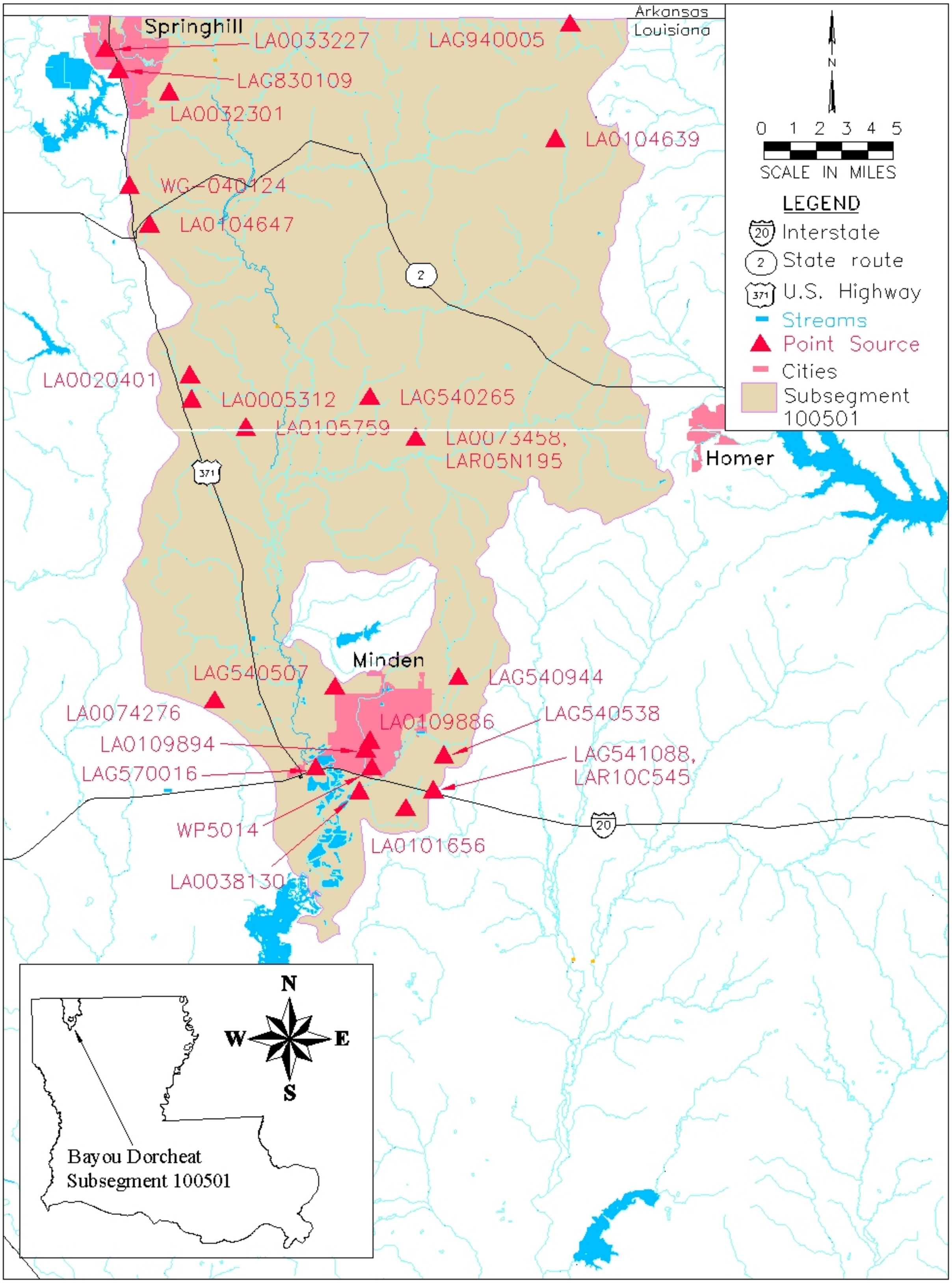



Figure A.2. Land use for subsegment 100501.




A.3. Point sources in Subsegment 100501.

# APPENDIX B

## Point Source Discharges

Appendix B. Summary of Point Source Discharges in Subsegment 100501.

| NPDES | Facility Name | Company name | Facility Type (SIC Code) | Receiving Stream | outfall | flow | Used in TMDL |
|---|---|---|---|---|---|---|---|
| LA0005312 | COTTON VALLEY REFINERY | CALUMET LUBRICANTS CO | REFINERY | FRENCH CREEK | 001 | 0.27 mgd | no |
| | | | | FRENCH CREEK | 002 | 0.392 mgd | no |
| | | | | FRENCH CREEK | 003 | Intermittent | no |
| | | | | FRENCH CREEK | 004 | Intermittent | no |
| | | | | FRENCH CREEK | 005 | Intermittent | no |
| LA0020401 | MUNICIPAL SEWAGE TREATMENT FACILITY | COTTON VALLEY TOWN OF | MUNICIPAL STP | LITTLE FRENCH CREEK-FRENCH CREEK | 001 | design 0.150 mgd | yes |
| LA0032301 | CULLEN WWTP | CULLEN, TOWN OF | MUNICIPAL STP | BRALEY CREEK - BAYOU DORCHEAT | 001 | 0.25 mgd | yes |
| LA0033227 | SPRINGHILL WASTEWATER TREATMENT FAC | SPRINGHILL, CITY OF (STP) | POTW | CROOKED CREEK-BAYOU DORCHEAT | 001 | 0.95 mgd | yes |
| LA0038130 | MINDEN WWTP | MINDEN CITY OF | MUNICIPAL STP | BAYOU DORCHEAT TO LAKE BISTINEAU | 001 | design 2.440 mgd | yes |
| LA0045969 | WTR PLT | SAREPTA WTR WORKS DIST | WATER PLANT | DITCH-HOWELL CREEK-BAYOU DORCHEAT | | | no |
| LA0073458 LAR05N195 | FKA ASSOCIATED NAT GAS | DUKE ENERGY FIELD | NATURAL GAS PROCESSING | FLAT LICK BAYOU-BAYOU DORCHEAT | 001 003 | Report | no |
| LA0074276 | BFI Waste Systems of North America Inc- Webster Parish Solid Waste Landfill | WEBSTER PARISH POLICE JURY | Municipal Solid Waste Landfill | SAUSMAN CR-BAYOU DORCHEAT-LK BISTINEAU | 101 | design 0.0894 mgd | no |
| | | | | SAUSMAN CR-BAYOU DORCHEAT-LK BISTINEAU | 001 | design 0.448 mgd | no |
| LA0075396 | SIBLEY WASTEWATER TREATMENT PLANT | SIBLEY, TOWN OF (STP) | OXID. POND/ROCK REED FILTER | BRUSHY CREEK-LAKE BISTENAU | 001 | 0.16 mgd | yes |
| LA0100862 | | FOWLER TRUCKING INC | TRUCK TERMINAL/WASH RACK | PARISH DITCH-SPRING BRANCH | | | no |
| LA0101656 | ROAD MAINTENANCE BARN-UNIT I | WEBSTER PH POLICE JURY | WASH RACK/MTCE FACILITY | MILES CREEK-BAYOU DORCHEAT | | | no |
| LA0103306 | WEBSTER PH C/D DEBRIS LANDFILL | WEBSTER PAR POLICE JURY | C/D LANDFILL | BAYOU DORCHEAT-LAKE BISTINEAU | | | no |
| LA0104639 | HAYNESVILLE PUMP STATION | MID VALLEY PPLN CO | PUMP STA/BRKOUT TANKAGE FACIL | BLACK BAYOU-B DORCHEAT | | | no |
| LA0104647 | SAREPTA WWTP | SAREPTA TOWN OF | 2 CELL OX POND | DITCH-HOWELL CREEK-BAYOU DORCHEAT | | | no |
| LA0105759 | Cotton Valley Gas Plant | | | | | | no |
| LA0109886 | MINDEN DIESEL POWER PLT | LA ENERGY & POWER AUTH (LEPA) | ELECTRIC GENERATOR & DISTRIBUT | MILE CREEK-BAYOU DORCHEAT | | | no |
| LA0109894 | MINDEN STEAM POWER PLT | LA ENERGY & POWER AUTH (LEPA) | ELECTRIC GENERATOR & DISTRIBUT | MILE CREEK-BAYOU DORCHEAT | | | no |
| LAG380030 | Caddo Parish Water District #1 WTP | | | | | | no |
| LAG530901 | COTTON VALLEY LOADING RACK | MARATHON OIL CO | OFFICES-GAS TRUCK TERMINAL | FRENCH CREEK-DAVIS SLOUGH | | | no |

Appendix B. Summary of Point Source Discharges in Subsegment 100501.

| NPDES | Facility Name | Company name | Facility Type (SIC Code) | Receiving Stream | outfall | flow | Used in TMDL |
|---|---|---|---|---|---|---|---|
| LAG540265 | Community Rehabilitation Center | DAYSPRING INC | HOSPITAL | HOLDER CREEK | | | no |
| LAG540507 | TWIN OAKS SUBDIVISION | MILLER DEVELOPMENT CO | OXID POND | UNNAMED TRIB-BAYOU DORCHEAT | | | no |
| LAG540538 | OAKETREE APTS | OAKETREE INVESTMENT LTD | EXTENDED AERATION PLANT | DRAIN-COOLEY BRANCH-BAYOU DORCHEAT | | | no |
| LAG540944 | | MOUSERS HOME PL LLC | MHP | COOLEY BRANCH | | | no |
| LAG541088, LAR10C545 | Minden Truck Center LLC - Oasis Truck Stop & Casino | Minden Truck Center, LLC | Truck Stop and Casino | BAYOU DORCHEAT | 001 | 7200 gpd | no |
| LAG560195 | Haynesville Town of - WWTP (002) | HAYNESVILLE, TOWN OF | Municipality | CYPRESS CREEK | 001 | design 50,000 gpd | no |
| LAG570016 | DIXIE INN SEWER TREATMENT | DIXIE INN, VILLAGE OF (STP) | POTW | DORCHEAT BAYOU-LAKE BISTINEAU | 001 | design 75,000 gpd | no |
| LAG750202 | WASH N GO CARWASH & LAUNDROMAT | COTTON VALLEY, 21385 HWY 371 | CARWASH & LAUNDROMAT | FRENCH CREEK | | VARIABLE | no |
| LAG830092 | SAREPTA MOBILE | SMITH OIL CO | ICAPC PETROLEUM UST | HOWELL CREEK | | | no |
| LAG830109 | | WALLER OIL CO | ICAPC PETRO UST | LITTLE CROOKED CREEK | | | no |
| LAG940005 | HAYNESVILLE GAS PLANT | DUKE ENERGY FIELD SERVICES INC | GROUNDWATER REMEDIATION | EVENTUALLY INTO LAKE BISTINEAU | | | no |
| LAR05N195 | | | | | | | no |
| LAR10C545 | | | | | | | no |
| WG-040124 | | SAREPTA MOBIL | USTGWR | DITCH-HOWELL CREEK-BAYOU DORCHEAT | | | no |
| WP4824 | | ROADMASTER, INC | TRUCK TERMINAL | COLLEY CREEK | | | no |
| WP5014 | | LDI SIDE WINDER | FARM IMPLEMENT MFG | COOLEY BRANCH-BAYOU DORCHEAT | | | no |

# APPENDIX C

## Water Quality Data

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| | | Sample Depth | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| Collection Date | Collection Time | (meters) | | ug/L | su | mg/L | mg/L |
| 01-JUN-1958 | 12:00 | 1.0 | | | 6.00 | | |
| 01-JUL-1958 | 12:00 | 1.0 | | | 6.50 | | |
| 01-SEP-1958 | 12:00 | 1.0 | | | 6.60 | | |
| 01-OCT-1958 | 12:00 | 1.0 | | | 6.00 | | |
| 01-NOV-1958 | 12:00 | 1.0 | | | 6.40 | | |
| 01-DEC-1958 | 12:00 | 1.0 | | | 6.00 | | |
| 01-JAN-1959 | 12:00 | 1.0 | | | 6.60 | | |
| 01-FEB-1959 | 12:00 | 1.0 | | | 6.70 | | |
| 01-MAR-1959 | 12:00 | 1.0 | | | 6.50 | | |
| 01-APR-1959 | 12:00 | 1.0 | | | 6.90 | | |
| 01-MAY-1959 | 12:00 | 1.0 | | | 6.20 | | |
| 01-JUL-1959 | 12:00 | 1.0 | | | 6.20 | | |
| 01-AUG-1959 | 12:00 | 1.0 | | | 6.00 | | |
| 01-OCT-1959 | 12:00 | 1.0 | | | 6.60 | | |
| 01-NOV-1959 | 12:00 | 1.0 | | | 6.60 | | |
| 01-DEC-1959 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JAN-1960 | 12:00 | 1.0 | | | 6.00 | | |
| 01-FEB-1960 | 12:00 | 1.0 | | | 6.10 | | |
| 01-MAR-1960 | 12:00 | 1.0 | | | 5.40 | | |
| 01-APR-1960 | 12:00 | 1.0 | | | 6.40 | | |
| 01-MAY-1960 | 12:00 | 1.0 | | | 6.40 | | |
| 01-JUN-1960 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JUL-1960 | 12:00 | 1.0 | | | 6.60 | | |
| 01-AUG-1960 | 12:00 | 1.0 | | | 6.80 | | |
| 01-SEP-1960 | 12:00 | 1.0 | | | 6.60 | | |
| 01-OCT-1960 | 12:00 | 1.0 | | | 7.20 | | |
| 01-NOV-1960 | 12:00 | 1.0 | | | 6.80 | | |
| 01-DEC-1960 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JAN-1961 | 12:00 | 1.0 | | | 6.00 | | |
| 01-FEB-1961 | 12:00 | 1.0 | | | 6.00 | | |
| 01-MAR-1961 | 12:00 | 1.0 | | | 6.60 | | |
| 01-APR-1961 | 12:00 | 1.0 | | | 6.80 | | |
| 01-MAY-1961 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JUN-1961 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JUL-1961 | 12:00 | 1.0 | | | 6.80 | | |
| 01-SEP-1961 | 12:00 | 1.0 | | | 6.40 | | |
| 01-OCT-1961 | 12:00 | 1.0 | | | 6.60 | | |
| 01-NOV-1961 | 12:00 | 1.0 | | | 6.60 | | |
| 01-DEC-1961 | 12:00 | 1.0 | | | 6.00 | | |
| 01-JAN-1962 | 12:00 | 1.0 | | | 6.40 | | |
| 01-FEB-1962 | 12:00 | 1.0 | | | 6.20 | | |
| 01-APR-1962 | 12:00 | 1.0 | | | 6.60 | | |
| 01-MAY-1962 | 12:00 | 1.0 | | | 6.40 | | |
| 01-JUN-1962 | 12:00 | 1.0 | | | 6.20 | | |
| 01-JUL-1962 | 12:00 | 1.0 | | | 6.60 | | |
| 01-AUG-1962 | 12:00 | 1.0 | | | 6.80 | | |
| 01-SEP-1962 | 12:00 | 1.0 | | | 7.00 | | |
| 01-OCT-1962 | 12:00 | 1.0 | | | 6.60 | | |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| | | Sample Depth | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| Collection Date | Collection Time | (meters) | | ug/L | su | mg/L | mg/L |
| 01-NOV-1962 | 12:00 | 1.0 | | | 6.80 | | |
| 01-DEC-1962 | 12:00 | 1.0 | | | 6.70 | | |
| 01-JAN-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-FEB-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-MAR-1963 | 12:00 | 1.0 | | | 6.60 | | |
| 01-APR-1963 | 12:00 | 1.0 | | | 6.60 | | |
| 01-MAY-1963 | 12:00 | 1.0 | | | 6.00 | | |
| 01-JUN-1963 | 12:00 | 1.0 | | | 7.00 | | |
| 01-JUL-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-AUG-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-SEP-1963 | 12:00 | 1.0 | | | 7.00 | | |
| 01-OCT-1963 | 12:00 | 1.0 | | | 7.80 | | |
| 01-NOV-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-DEC-1963 | 12:00 | 1.0 | | | 6.80 | | |
| 01-JAN-1964 | 12:00 | 1.0 | | | 6.80 | | |
| 01-FEB-1964 | 12:00 | 1.0 | | | 7.00 | | |
| 01-MAR-1964 | 12:00 | 1.0 | | | 6.60 | | |
| 01-APR-1964 | 12:00 | 1.0 | | | 6.40 | | |
| 01-MAY-1964 | 12:00 | 1.0 | | | 6.20 | | |
| 01-JUN-1964 | 12:00 | 1.0 | | | 6.80 | | |
| 01-JUL-1964 | 12:00 | 1.0 | | | 6.80 | | |
| 01-AUG-1964 | 12:00 | 1.0 | | | 7.00 | | |
| 01-SEP-1964 | 12:00 | 1.0 | | | 6.80 | | |
| 01-OCT-1964 | 12:00 | 1.0 | | | 6.40 | | |
| 01-NOV-1964 | 12:00 | 1.0 | | | 6.60 | | |
| 01-DEC-1964 | 12:00 | 1.0 | | | 6.80 | | |
| 01-JAN-1965 | 12:00 | 1.0 | | | 6.40 | | |
| 01-FEB-1965 | 12:00 | 1.0 | | | 6.60 | | |
| 01-MAR-1965 | 12:00 | 1.0 | | | 6.40 | | |
| 01-APR-1965 | 12:00 | 1.0 | | | 6.20 | | |
| 01-MAY-1965 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 01-JUN-1965 | 12:00 | 1.0 | | | 6.60 | | 6.0 |
| 01-JUL-1965 | 12:00 | 1.0 | | | 6.60 | | 7.0 |
| 01-AUG-1965 | 12:00 | 1.0 | | | 7.00 | | 7.0 |
| 01-SEP-1965 | 12:00 | 1.0 | | | 7.20 | | |
| 01-OCT-1965 | 12:00 | 1.0 | | | 6.80 | | |
| 01-NOV-1965 | 12:00 | 1.0 | | | 6.80 | | 7.0 |
| 01-DEC-1965 | 12:00 | 1.0 | | | 7.00 | | 10.0 |
| 01-JAN-1966 | 12:00 | 1.0 | | | 6.80 | | 14.0 |
| 01-FEB-1966 | 12:00 | 1.0 | | | 6.60 | | 6.0 |
| 01-MAR-1966 | 12:00 | 1.0 | | | 6.80 | | 12.0 |
| 01-APR-1966 | 12:00 | 1.0 | | | 7.00 | | 6.0 |
| 01-MAY-1966 | 12:00 | 1.0 | | | 6.60 | | 8.0 |
| 01-JUN-1966 | 12:00 | 1.0 | | | 6.60 | | 2.0 |
| 01-JUL-1966 | 12:00 | 1.0 | | | 6.90 | | 3.0 |
| 01-AUG-1966 | 12:00 | 1.0 | | | 6.80 | | 9.0 |
| 01-SEP-1966 | 12:00 | 1.0 | | | 7.00 | | 6.0 |
| 01-OCT-1966 | 12:00 | 1.0 | | | 7.00 | | 2.0 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | ug/L | PH, FIELD su | T.O.C. mg/L | SO4, TOTAL mg/L |
|---|---|---|---|---|---|---|---|
| 01-NOV-1966 | 12:00 | 1.0 | | | 7.00 | | 13.0 |
| 01-DEC-1966 | 12:00 | 1.0 | | | 7.20 | | 11.0 |
| 01-JAN-1967 | 12:00 | 1.0 | | | 6.40 | | 15.0 |
| 01-FEB-1967 | 12:00 | 1.0 | | | 6.60 | | 12.0 |
| 01-MAR-1967 | 12:00 | 1.0 | | | 6.60 | | 8.0 |
| 01-APR-1967 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 01-MAY-1967 | 12:00 | 1.0 | | | 6.80 | | 7.0 |
| 01-JUN-1967 | 12:00 | 1.0 | | | 6.40 | | 12.0 |
| 01-JUL-1967 | 12:00 | 1.0 | | | 6.60 | | 2.0 |
| 01-AUG-1967 | 12:00 | 1.0 | | | 6.80 | | 3.0 |
| 01-SEP-1967 | 12:00 | 1.0 | | | 6.80 | | 4.0 |
| 01-OCT-1967 | 12:00 | 1.0 | | | 6.80 | | 2.0 |
| 01-NOV-1967 | 12:00 | 1.0 | | | 6.80 | | 21.0 |
| 01-DEC-1967 | 12:00 | 1.0 | | | 6.80 | | 6.0 |
| 01-JAN-1968 | 12:00 | 1.0 | | | 6.60 | | 22.0 |
| 01-FEB-1968 | 12:00 | 1.0 | | | 6.60 | | 17.0 |
| 01-MAR-1968 | 12:00 | 1.0 | | | 6.60 | | 15.0 |
| 01-APR-1968 | 12:00 | 1.0 | | | 6.60 | | 12.0 |
| 01-MAY-1968 | 12:00 | 1.0 | | | 6.60 | | 12.0 |
| 01-JUN-1968 | 12:00 | 1.0 | | | 6.20 | | 12.0 |
| 01-JUL-1968 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-AUG-1968 | 12:00 | 1.0 | | | 6.60 | | 11.0 |
| 01-SEP-1968 | 12:00 | 1.0 | | | 6.40 | | |
| 01-OCT-1968 | 12:00 | 1.0 | | | 6.60 | | 10.0 |
| 01-NOV-1968 | 12:00 | 1.0 | | | 6.80 | | 16.0 |
| 01-DEC-1968 | 12:00 | 1.0 | | | 6.60 | | 15.0 |
| 01-JAN-1969 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-FEB-1969 | 12:00 | 1.0 | | | 6.60 | | 20.0 |
| 01-MAR-1969 | 12:00 | 1.0 | | | 6.80 | | 18.0 |
| 01-APR-1969 | 12:00 | 1.0 | | | 6.40 | | 17.0 |
| 01-MAY-1969 | 12:00 | 1.0 | | | 6.60 | | 17.0 |
| 01-JUN-1969 | 12:00 | 1.0 | | | 6.60 | | 11.0 |
| 01-JUL-1969 | 12:00 | 1.0 | | | 7.20 | | 6.0 |
| 01-AUG-1969 | 12:00 | 1.0 | | | 6.40 | | 8.0 |
| 01-SEP-1969 | 12:00 | 1.0 | | | 7.00 | | 3.0 |
| 01-OCT-1969 | 12:00 | 1.0 | | | 7.00 | | 5.0 |
| 01-NOV-1969 | 12:00 | 1.0 | | | 7.00 | | 12.0 |
| 01-DEC-1969 | 12:00 | 1.0 | | | 6.80 | | 27.0 |
| 01-JAN-1970 | 12:00 | 1.0 | | | 6.60 | | 17.0 |
| 01-FEB-1970 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-MAR-1970 | 12:00 | 1.0 | | | 6.60 | | 17.0 |
| 01-APR-1970 | 12:00 | 1.0 | | | 6.60 | | |
| 01-MAY-1970 | 12:00 | 1.0 | | | 6.60 | | |
| 01-JUN-1970 | 12:00 | 1.0 | | | 6.60 | | 13.0 |
| 01-JUL-1970 | 12:00 | 1.0 | | | 7.00 | | 10.0 |
| 01-AUG-1970 | 12:00 | 1.0 | | | 6.90 | | |
| 01-SEP-1970 | 12:00 | 1.0 | | | 6.80 | | 21.0 |
| 01-OCT-1970 | 12:00 | 1.0 | | | 7.00 | | 25.0 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| | | Sample Depth | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| Collection Date | Collection Time | (meters) | | ug/L | su | mg/L | mg/L |
| 01-NOV-1970 | 12:00 | 1.0 | | | 6.80 | | 20.0 |
| 01-DEC-1970 | 12:00 | 1.0 | | | 6.70 | | 19.0 |
| 01-JAN-1971 | 12:00 | 1.0 | | | 6.80 | | 19.0 |
| 01-FEB-1971 | 12:00 | 1.0 | | | | | 15.0 |
| 01-MAR-1971 | 12:00 | 1.0 | | | 6.60 | | 15.0 |
| 01-APR-1971 | 12:00 | 1.0 | | | 6.60 | | 17.0 |
| 01-MAY-1971 | 12:00 | 1.0 | | | 6.60 | | 18.0 |
| 01-JUN-1971 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-JUL-1971 | 12:00 | 1.0 | | | 7.00 | | 47.0 |
| 01-AUG-1971 | 12:00 | 1.0 | | | 6.60 | | 26.0 |
| 01-SEP-1971 | 12:00 | 1.0 | | | 7.00 | | 8.0 |
| 01-OCT-1971 | 12:00 | 1.0 | | | 6.80 | | 9.0 |
| 01-NOV-1971 | 12:00 | 1.0 | | | 6.80 | | 11.0 |
| 01-DEC-1971 | 12:00 | 1.0 | | | 6.80 | | 10.0 |
| 01-JAN-1972 | 12:00 | 1.0 | | | 6.00 | | 13.0 |
| 01-FEB-1972 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-MAR-1972 | 12:00 | 1.0 | | | 6.60 | | 19.0 |
| 01-APR-1972 | 12:00 | 1.0 | | | 6.40 | | 12.0 |
| 01-MAY-1972 | 12:00 | 1.0 | | | 6.60 | | 9.0 |
| 01-JUN-1972 | 12:00 | 1.0 | | | 6.40 | | 3.0 |
| 01-JUL-1972 | 12:00 | 1.0 | | | 6.00 | | 16.0 |
| 01-AUG-1972 | 12:00 | 1.0 | | | 6.80 | | 7.0 |
| 01-SEP-1972 | 12:00 | 1.0 | | | 7.00 | | 7.0 |
| 01-OCT-1972 | 12:00 | 1.0 | | | 6.80 | | |
| 01-NOV-1972 | 12:00 | 1.0 | | | 6.80 | | 19.0 |
| 01-DEC-1972 | 12:00 | 1.0 | | | 6.60 | | 21.0 |
| 01-JAN-1973 | 12:00 | 1.0 | | | 7.00 | | |
| 01-FEB-1973 | 12:00 | 1.0 | | | 6.40 | | 3.0 |
| 01-MAR-1973 | 12:00 | 1.0 | | | 6.40 | | 10.0 |
| 01-APR-1973 | 12:00 | 1.0 | | | 6.20 | | 9.0 |
| 01-MAY-1973 | 12:00 | 1.0 | | | | | 15.0 |
| 01-JUN-1973 | 12:00 | 1.0 | | | | | 2.0 |
| 01-JUL-1973 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 01-AUG-1973 | 12:00 | 1.0 | | | | | 5.0 |
| 01-SEP-1973 | 12:00 | 1.0 | | | 7.00 | | 6.0 |
| 01-OCT-1973 | 12:00 | 1.0 | | | 7.30 | | 3.0 |
| 01-NOV-1973 | 12:00 | 1.0 | | | 6.40 | | 5.0 |
| 01-DEC-1973 | 12:00 | 1.0 | | | 6.30 | | 6.0 |
| 07-JAN-1974 | 12:00 | 1.0 | | | 6.50 | | 5.0 |
| 04-FEB-1974 | 12:00 | 1.0 | | | 6.30 | | 11.0 |
| 12-MAR-1974 | 12:00 | 1.0 | | | 6.00 | | 7.0 |
| 01-APR-1974 | 12:00 | 1.0 | | | 6.60 | | 0.7 |
| 01-MAY-1974 | 12:00 | 1.0 | | | 6.60 | | 4.0 |
| 10-JUN-1974 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 02-JUL-1974 | 12:00 | 1.0 | | | 6.60 | | 6.0 |
| 01-AUG-1974 | 12:00 | 1.0 | | | 6.60 | | 9.0 |
| 04-SEP-1974 | 12:00 | 1.0 | | | 6.00 | | 13.0 |
| 01-OCT-1974 | 12:00 | 1.0 | | | 6.60 | | 25.0 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | ug/L | su | mg/L | mg/L |
| 14-NOV-1974 | 12:00 | 1.0 | | | 6.40 | | 3.0 |
| 03-DEC-1974 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 02-JAN-1975 | 12:00 | 1.0 | | | 6.00 | | 7.0 |
| 04-FEB-1975 | 12:00 | 1.0 | | | 6.75 | | 2.0 |
| 02-APR-1975 | 12:00 | 1.0 | | | 7.00 | | 4.0 |
| 01-MAY-1975 | 12:00 | 1.0 | | | 6.70 | | 2.0 |
| 02-JUN-1975 | 12:00 | 1.0 | | | 6.80 | | 1.0 |
| 02-JUL-1975 | 12:00 | 1.0 | | | 7.30 | | 2.0 |
| 04-AUG-1975 | 12:00 | 1.0 | | | 6.60 | | 8.0 |
| 01-SEP-1975 | 12:00 | 1.0 | | | 7.20 | | 12.0 |
| 01-OCT-1975 | 12:00 | 1.0 | | | 6.60 | | 3.0 |
| 03-NOV-1975 | 12:00 | 1.0 | | | 6.60 | | 8.0 |
| 05-DEC-1975 | 12:00 | 1.0 | | | 6.70 | | 10.0 |
| 06-JAN-1976 | 12:00 | 1.0 | | | 6.60 | | 10.0 |
| 06-FEB-1976 | 12:00 | 1.0 | | | 6.80 | | 16.0 |
| 01-MAR-1976 | 12:00 | 1.0 | | | 6.20 | | 4.0 |
| 01-APR-1976 | 12:00 | 1.0 | | | 6.60 | | 4.0 |
| 01-JUN-1976 | 12:00 | 1.0 | | | 6.60 | | 11.0 |
| 02-JUL-1976 | 12:00 | 1.0 | | | 6.40 | | 8.0 |
| 02-AUG-1976 | 12:00 | 1.0 | | | 6.60 | | 2.0 |
| 06-SEP-1976 | 12:00 | 1.0 | | | 6.80 | | |
| 04-OCT-1976 | 12:00 | 1.0 | | | 6.60 | | 5.0 |
| 02-DEC-1976 | 12:00 | 1.0 | | | 7.00 | | |
| 06-JAN-1977 | 12:00 | 1.0 | | | 6.80 | | 12.0 |
| 04-FEB-1977 | 12:00 | 1.0 | | | 6.40 | | 15.0 |
| 01-MAR-1977 | 12:00 | 1.0 | | | 6.40 | | 8.0 |
| 05-APR-1977 | 12:00 | 1.0 | | | 6.20 | | 6.0 |
| 03-MAY-1977 | 12:00 | 1.0 | | | 6.00 | | 4.0 |
| 01-JUN-1977 | 12:00 | 1.0 | | | 6.60 | | |
| 05-JUL-1977 | 12:00 | 1.0 | | | 6.80 | | 5.0 |
| 04-AUG-1977 | 12:00 | 1.0 | | | 6.90 | | 5.0 |
| 02-SEP-1977 | 12:00 | 1.0 | | | 7.10 | | 3.0 |
| 03-OCT-1977 | 12:00 | 1.0 | | | 7.00 | | 4.0 |
| 02-NOV-1977 | 12:00 | 1.0 | | | 6.60 | | 5.0 |
| 02-DEC-1977 | 12:00 | 1.0 | | | 6.60 | | 5.0 |
| 03-JAN-1978 | 12:00 | 1.0 | | | 7.00 | | 13.0 |
| 06-MAR-1978 | 08:00 | 1.0 | | | 6.60 | | 18.0 |
| 10-APR-1978 | 08:00 | 1.0 | | | 6.40 | | 13.0 |
| 08-MAY-1978 | 05:00 | 1.0 | | | 6.20 | | 3.5 |
| 12-JUN-1978 | 06:00 | 1.0 | | | 6.80 | | 6.0 |
| 10-JUL-1978 | 06:00 | 1.0 | | | 6.80 | | |
| 14-AUG-1978 | 06:00 | 1.0 | | | 6.40 | | |
| 11-SEP-1978 | 06:00 | 1.0 | | | 7.00 | | |
| 06-OCT-1978 | 08:00 | 1.0 | | | 6.80 | 19.00 | 14.0 |
| 13-NOV-1978 | 07:00 | 1.0 | | | 6.90 | | |
| 11-DEC-1978 | 05:00 | 1.0 | | | 6.60 | 12.50 | |
| 08-JAN-1979 | 08:00 | 1.0 | | | 6.80 | 13.50 | 6.0 |
| 12-FEB-1979 | 07:00 | 1.0 | | | 6.20 | 9.00 | |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | ug/L | su | mg/L | mg/L |
| 13-MAR-1979 | 08:00 | 1.0 | | | 6.00 | 14.00 | |
| 16-APR-1979 | 07:00 | 1.0 | | | 6.60 | 15.50 | |
| 14-MAY-1979 | 07:00 | 1.0 | | | 6.60 | | |
| 11-JUN-1979 | 07:00 | 1.0 | | | 6.40 | | |
| 09-JUL-1979 | 07:00 | 1.0 | | | 6.40 | | |
| 13-AUG-1979 | 06:30 | 1.0 | | | 6.60 | 6.50 | |
| 10-SEP-1979 | 08:30 | 1.0 | | | 6.40 | 3.00 | |
| 10-DEC-1979 | 07:00 | 1.0 | | | 6.40 | 10.00 | |
| 14-JAN-1980 | 07:30 | 1.0 | | | 6.60 | 5.50 | |
| 11-FEB-1980 | 07:00 | 1.0 | | | 6.40 | 4.50 | |
| 10-MAR-1980 | 07:00 | 1.0 | | | 6.40 | 4.50 | |
| 14-APR-1980 | 07:00 | 1.0 | | | 6.60 | 12.30 | |
| 12-MAY-1980 | 07:30 | 1.0 | | | 6.40 | 7.50 | |
| 09-JUN-1980 | 07:00 | 1.0 | | | 6.40 | 12.00 | |
| 11-AUG-1980 | 08:00 | 1.0 | | | 6.60 | 7.50 | |
| 15-SEP-1980 | 08:00 | 1.0 | | | 6.40 | | |
| 13-OCT-1980 | 08:00 | 1.0 | | | 7.00 | 3.80 | |
| 17-NOV-1980 | 08:00 | 1.0 | | | 6.40 | 4.00 | |
| 08-DEC-1980 | 08:00 | 1.0 | | | 6.60 | 7.50 | |
| 12-JAN-1981 | 08:00 | 1.0 | | | 6.80 | 7.80 | 24.0 |
| 09-FEB-1981 | 08:00 | 1.0 | | | 6.80 | 7.50 | |
| 09-MAR-1981 | 08:00 | 1.0 | | | 6.60 | 8.00 | 12.9 |
| 14-APR-1981 | 10:30 | 1.0 | < | 0.10000 | 6.40 | 4.50 | 5.8 |
| 11-MAY-1981 | 08:00 | 1.0 | | | 6.60 | | 6.4 |
| 08-JUN-1981 | 08:00 | 1.0 | | | 6.40 | 12.00 | 3.3 |
| 13-JUL-1981 | 08:00 | 1.0 | | | 6.00 | 10.50 | 6.1 |
| 10-AUG-1981 | 08:00 | 1.0 | | | 6.60 | 8.00 | 7.5 |
| 14-SEP-1981 | 08:00 | 1.0 | | | 6.80 | 8.00 | 5.9 |
| 12-OCT-1981 | 08:00 | 1.0 | | | 6.60 | 6.50 | 13.6 |
| 16-NOV-1981 | 08:00 | 1.0 | | | 6.60 | | |
| 14-DEC-1981 | 08:00 | 1.0 | | | 6.60 | 9.30 | 7.8 |
| 11-JAN-1982 | 08:00 | 1.0 | | | 6.80 | 7.00 | 5.1 |
| 09-FEB-1982 | 08:00 | 1.0 | | | 6.40 | 8.60 | 9.9 |
| 08-MAR-1982 | 08:00 | 1.0 | | | 5.50 | 7.00 | 8.2 |
| 12-APR-1982 | 08:00 | 1.0 | | | 6.80 | 13.00 | |
| 10-MAY-1982 | 08:00 | 1.0 | | | 6.80 | | |
| 14-JUN-1982 | 08:00 | 1.0 | | | 6.60 | | |
| 12-JUL-1982 | 08:00 | 1.0 | | | 6.40 | | |
| 09-AUG-1982 | 08:00 | 1.0 | | 0.10000 | 6.60 | 13.80 | 2.9 |
| 13-SEP-1982 | 08:00 | 1.0 | | | 6.40 | | 11.9 |
| 11-OCT-1982 | 08:00 | 1.0 | | | 6.60 | 10.80 | 5.0 |
| 15-NOV-1982 | 08:00 | 1.0 | | | 6.80 | 13.00 | 23.5 |
| 13-DEC-1982 | 08:00 | 1.0 | | | 6.60 | 14.00 | 5.0 |
| 10-JAN-1983 | 08:00 | 1.0 | | | 5.50 | 12.40 | 5.1 |
| 07-FEB-1983 | 08:00 | 1.0 | | | 7.90 | 9.00 | 6.3 |
| 14-MAR-1983 | 08:00 | 1.0 | | | 6.47 | | |
| 11-APR-1983 | 08:00 | 1.0 | | | 7.84 | 8.80 | 4.6 |
| 10-MAY-1983 | 08:00 | 1.0 | | | 6.76 | 11.20 | 3.6 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL ug/L | | PH, FIELD su | T.O.C. mg/L | SO4, TOTAL mg/L |
|---|---|---|---|---|---|---|---|
| 13-JUN-1983 | 08:00 | 1.0 | | 0.90000 | 6.48 | 13.00 | |
| 11-JUL-1983 | 08:00 | 1.0 | | 1.10000 | 6.72 | 11.70 | 3.7 |
| 08-AUG-1983 | 08:00 | 1.0 | | | 7.40 | 11.60 | |
| 12-SEP-1983 | 07:00 | 1.0 | | | 7.44 | 8.10 | |
| 10-OCT-1983 | 08:00 | 1.0 | | 0.30000 | 7.54 | 6.00 | 6.7 |
| 14-NOV-1983 | 08:00 | 1.0 | < | 0.20000 | 7.26 | 5.20 | 7.9 |
| 12-DEC-1983 | 08:00 | 1.0 | | | 7.12 | 11.10 | |
| 09-JAN-1984 | 08:00 | 1.0 | < | 0.20000 | 7.50 | 7.30 | 13.5 |
| 13-FEB-1984 | 08:02 | 1.0 | < | 0.20000 | 7.80 | 13.00 | |
| 12-MAR-1984 | 08:00 | 1.0 | | | 7.41 | 12.40 | |
| 09-APR-1984 | 08:00 | 1.0 | < | 0.20000 | 7.23 | 14.10 | 24.6 |
| 14-MAY-1984 | 08:00 | 1.0 | | 0.40000 | 9.33 | 13.50 | |
| 11-JUN-1984 | 08:00 | 1.0 | < | 0.20000 | 6.80 | 13.00 | 4.9 |
| 09-JUL-1984 | 08:00 | 1.0 | | 0.20000 | 6.50 | 15.80 | 12.1 |
| 13-AUG-1984 | 08:00 | 1.0 | | 0.60000 | 5.85 | 11.50 | |
| 10-SEP-1984 | 08:00 | 1.0 | | 0.90000 | 7.78 | 12.40 | 8.2 |
| 08-OCT-1984 | 08:00 | 1.0 | | 1.10000 | 6.85 | 8.50 | |
| 13-NOV-1984 | 08:00 | 1.0 | < | 0.20000 | 7.60 | | 3.9 |
| 10-DEC-1984 | 08:00 | 1.0 | | 0.30000 | 9.62 | | 5.4 |
| 14-JAN-1985 | 08:00 | 1.0 | | 0.50000 | 8.20 | 12.60 | 3.5 |
| 11-FEB-1985 | 08:00 | 1.0 | < | 0.20000 | 9.45 | 10.30 | 6.0 |
| 11-MAR-1985 | 08:00 | 1.0 | | 0.20000 | 8.00 | 12.30 | 4.2 |
| 09-APR-1985 | 09:10 | 1.0 | < | 0.20000 | 6.90 | 13.90 | 4.1 |
| 13-MAY-1985 | 08:00 | 1.0 | < | 0.20000 | 8.50 | 13.80 | 3.4 |
| 10-JUN-1985 | 08:00 | 1.0 | | 0.50000 | 6.80 | 11.70 | 5.9 |
| 08-JUL-1985 | 08:00 | 1.0 | | 1.30000 | 7.00 | 8.70 | 3.5 |
| 12-AUG-1985 | 08:00 | 1.0 | | | 7.76 | 9.60 | 7.2 |
| 09-SEP-1985 | 08:00 | 1.0 | < | 0.20000 | 7.57 | 9.70 | 7.0 |
| 14-OCT-1985 | 08:00 | 1.0 | | 0.60000 | 7.20 | 8.70 | 5.8 |
| 18-NOV-1985 | 08:00 | 1.0 | < | 0.20000 | 7.21 | 11.80 | 12.0 |
| 09-DEC-1985 | 08:00 | 1.0 | < | 0.20000 | 8.00 | 12.50 | 14.4 |
| 13-JAN-1986 | 09:05 | 1.0 | < | 0.20000 | 6.30 | 5.80 | 8.8 |
| 17-FEB-1986 | 08:20 | 1.0 | < | 0.20000 | 4.50 | 11.20 | 8.6 |
| 17-MAR-1986 | 09:00 | 1.0 | | 0.50000 | 6.10 | 9.10 | 6.6 |
| 14-APR-1986 | 08:15 | 1.0 | | 0.60000 | 6.10 | 10.20 | 8.0 |
| 12-MAY-1986 | 08:25 | 1.0 | | | 5.90 | 13.20 | 3.6 |
| 09-JUN-1986 | 08:10 | 1.0 | | 0.20000 | 7.30 | 11.70 | 7.7 |
| 14-JUL-1986 | 08:35 | 1.0 | | | 5.80 | 16.80 | 3.1 |
| 11-AUG-1986 | 08:45 | 1.0 | | 1.20000 | 5.90 | 12.20 | 18.5 |
| 08-SEP-1986 | 08:45 | 1.0 | < | 0.20000 | 6.10 | 7.40 | 8.3 |
| 13-OCT-1986 | 10:25 | 1.0 | < | 0.20000 | 6.90 | 7.30 | 7.0 |
| 17-NOV-1986 | 09:30 | 1.0 | | | 4.50 | 10.40 | 8.5 |
| 08-DEC-1986 | 10:10 | 1.0 | < | 0.20000 | 6.00 | 9.50 | 8.0 |
| 12-JAN-1987 | 10:15 | 1.0 | < | 0.20000 | 6.00 | 7.00 | 7.1 |
| 16-FEB-1987 | 09:25 | 1.0 | < | 0.20000 | 5.92 | 8.80 | 5.6 |
| 09-MAR-1987 | 09:50 | 1.0 | | | 7.60 | 8.60 | 5.9 |
| 13-APR-1987 | 09:15 | 1.0 | < | 0.20000 | 5.83 | 7.70 | 6.0 |
| 11-MAY-1987 | 09:30 | 1.0 | | | 6.07 | 8.67 | 4.6 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | ug/L | su | mg/L | mg/L |
| 09-JUN-1987 | 08:15 | 1.0 | < | 0.20000 | 6.08 | 12.40 | 10.6 |
| 13-JUL-1987 | 08:10 | 1.0 | | | 6.04 | 8.50 | 7.4 |
| 11-AUG-1987 | 08:25 | 1.0 | < | 0.20000 | 6.94 | 7.90 | 3.7 |
| 14-SEP-1987 | 11:00 | 1.0 | | | 6.10 | 7.90 | 3.2 |
| 12-OCT-1987 | 09:15 | 1.0 | < | 0.20000 | 5.93 | 7.10 | 3.1 |
| 17-NOV-1987 | 07:20 | 1.0 | | | 6.90 | 5.40 | 13.3 |
| 14-DEC-1987 | 08:40 | 1.0 | < | 0.20000 | 6.20 | 12.00 | 11.2 |
| 11-JAN-1988 | 10:45 | 1.0 | | | 5.40 | 8.10 | 6.5 |
| 08-FEB-1988 | 09:20 | 1.0 | < | 0.20000 | 5.91 | 6.90 | 7.5 |
| 14-MAR-1988 | 09:00 | 1.0 | | | 5.40 | 10.50 | 5.9 |
| 11-APR-1988 | 09:10 | 1.0 | < | 0.20000 | 6.06 | 13.30 | 4.6 |
| 09-MAY-1988 | 09:00 | 1.0 | | | 5.70 | 10.30 | 4.0 |
| 14-JUN-1988 | 07:40 | 1.0 | < | 0.20000 | 6.30 | 10.50 | 3.7 |
| 11-JUL-1988 | 09:00 | 1.0 | | | 6.40 | 10.00 | 3.0 |
| 08-AUG-1988 | 09:10 | 1.0 | | | 6.61 | 9.00 | 3.1 |
| 12-SEP-1988 | 08:50 | 1.0 | | | 6.20 | 7.90 | 3.6 |
| 10-OCT-1988 | 09:15 | 1.0 | < | 0.20000 | 6.26 | 6.60 | 2.8 |
| 15-NOV-1988 | 09:05 | 1.0 | | | 6.10 | 6.70 | 4.3 |
| 12-DEC-1988 | 09:10 | 1.0 | < | 0.20000 | 5.72 | 14.00 | 7.7 |
| 09-JAN-1989 | 10:40 | 1.0 | | | 6.23 | 9.90 | 6.7 |
| 13-FEB-1989 | 10:25 | 1.0 | < | 0.20000 | 6.16 | 11.10 | 4.5 |
| 13-MAR-1989 | 11:00 | 1.0 | | | 6.32 | 8.80 | 6.2 |
| 10-APR-1989 | 10:45 | 1.0 | < | 0.20000 | 6.50 | 12.70 | 3.5 |
| 08-MAY-1989 | 10:15 | 1.0 | | | 6.15 | 12.30 | 6.3 |
| 12-JUN-1989 | 10:20 | 1.0 | < | 0.20000 | 6.46 | 11.40 | 4.9 |
| 11-JUL-1989 | 10:30 | 1.0 | | | 6.57 | 13.90 | 2.6 |
| 14-AUG-1989 | 09:30 | 1.0 | < | 0.20000 | 5.94 | 10.20 | 2.9 |
| 11-SEP-1989 | 11:00 | 1.0 | | | 6.31 | 10.00 | 2.6 |
| 09-OCT-1989 | 10:35 | 1.0 | < | 0.02000 | 6.59 | 8.50 | 3.8 |
| 13-NOV-1989 | 11:40 | 1.0 | | | 6.55 | 7.90 | 4.2 |
| 11-DEC-1989 | 09:25 | 1.0 | < | 0.20000 | 6.47 | 9.90 | 9.3 |
| 07-JAN-2002 | 01:00 | | | 0.00369 | 13.12 | 18.40 | 9.7 |
| 05-FEB-2002 | 11:45 | | | | 7.30 | 9.10 | 5.8 |
| 05-MAR-2002 | 08:50 | | | | 6.80 | 10.90 | 5.0 |
| 02-APR-2002 | 11:15 | | | 0.00668 | 6.49 | 13.90 | 3.5 |
| 02-APR-2002 | 11:25 | | | | 6.48 | 14.10 | 3.8 |
| 07-MAY-2002 | 08:45 | | | | 6.30 | 13.50 | 3.2 |
| 04-JUN-2002 | 08:10 | | | | 6.25 | 12.20 | 3.8 |
| 16-JUL-2002 | 08:30 | | | 0.00241 | 13.12 | 22.40 | 8.7 |
| 06-AUG-2002 | 08:30 | 1.0 | | | 6.31 | 7.70 | 6.3 |
| 10-SEP-2002 | 08:40 | 1.0 | | | 6.08 | 6.90 | 5.5 |
| 08-OCT-2002 | 08:40 | 1.0 | | 0.00037 | 12.10 | 11.30 | 10.7 |
| 06-NOV-2002 | 08:30 | 1.0 | | | 6.22 | 8.10 | 8.5 |
| 03-DEC-2002 | 08:25 | 1.0 | | | 6.10 | 9.60 | 8.9 |
| 01-OCT-2003 | 12:45 | 1.0 | | | | 8.70 | 3.1 |
| 08-DEC-2003 | 06:35 | 1.0 | | | | 9.20 | 6.3 |
| 29-JAN-2007 | 12:10 | 1 | | | 6.15 | | 6.5 |
| 26-FEB-2007 | | | | | | | 7.2 |

Table C.1. Bayou Dorcheat west of Minden, Louisiana, Site Id Number 61

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | ug/L | su | mg/L | mg/L |
| 19-MAR-2007 | 12:30 | 1 | | | 6.35 | | 10.3 |
| 09-APR-2007 | 12:15 | 1 | | | 6.27 | | 4 |
| 30-APR-2007 | 10:25 | 1 | | | 6.27 | | 4.9 |
| 21-MAY-2007 | | | | | | | 4.1 |
| 11-JUN-2007 | 12:00 | 1 | | | 6.46 | | 4 |
| 09-JUL-2007 | 12:45 | 1 | | | 5.94 | | |
| 30-JUL-2007 | 10:56 | 1 | | | 6.22 | | |

Table C.2. Bayou Dorcheat west of Sibley, Louisiana, Site Id Number 274

| Collection Date | Collection Time | Sample Depth (meters) | HG, TOTAL | | PH, FIELD | T.O.C. | SO4, TOTAL |
|---|---|---|---|---|---|---|---|
| | | | | ug/L | su | mg/L | mg/L |
| 12-FEB-1990 | 01:30 | 1.0 | < | 0.20000 | 6.00 | 10.10 | 4.6 |
| 09-APR-1990 | 11:10 | 1.0 | < | 0.20000 | 6.81 | 7.70 | 3.9 |
| 11-JUN-1990 | 11:20 | 1.0 | < | 0.20000 | 7.72 | 10.90 | 2.7 |
| 13-AUG-1990 | 11:00 | 1.0 | < | 0.20000 | 7.50 | 8.00 | 4.5 |
| 15-OCT-1990 | 11:30 | 1.0 | < | 0.20000 | 8.25 | 6.80 | 8.9 |
| 10-DEC-1990 | 12:15 | 1.0 | < | 0.20000 | 6.68 | 8.20 | 11.8 |
| 04-FEB-1991 | 12:45 | 1.0 | < | 0.20000 | 6.40 | 7.10 | 7.2 |
| 15-APR-1991 | 12:30 | 1.0 | < | 0.20000 | 6.02 | 7.60 | 3.6 |
| 10-JUN-1991 | 12:10 | 1.0 | < | 0.20000 | 6.40 | 12.90 | 25.0 |
| 12-AUG-1991 | 11:25 | 1.0 | < | 0.20000 | 7.24 | 7.80 | 5.1 |
| 15-OCT-1991 | 12:25 | 1.0 | < | 0.20000 | 6.89 | 7.20 | 8.3 |
| 09-DEC-1991 | 12:25 | 1.0 | < | 0.20000 | 5.42 | 10.20 | 6.6 |
| 11-FEB-1992 | 10:30 | 1.0 | < | 0.20000 | 6.17 | 7.40 | 6.2 |
| 07-APR-1992 | 11:40 | 1.0 | < | 0.20000 | 6.43 | 7.60 | 5.1 |
| 16-JUN-1992 | 09:30 | 1.0 | < | 0.20000 | 6.88 | 10.20 | 4.3 |
| 11-AUG-1992 | 10:30 | 1.0 | < | 0.20000 | 7.26 | 8.50 | 8.7 |
| 12-OCT-1992 | 11:45 | 1.0 | < | 0.20000 | 8.08 | 11.90 | 5.5 |
| 15-DEC-1992 | 11:25 | 1.0 | < | 0.20000 | 7.32 | 7.70 | 13.0 |
| 08-FEB-1993 | 12:30 | 1.0 | < | 0.20000 | 6.86 | 8.90 | 7.2 |
| 12-APR-1993 | 11:50 | 1.0 | | 0.20000 | 6.33 | 10.00 | 4.3 |
| 15-JUN-1993 | 11:25 | 1.1 | < | 0.20000 | 7.62 | 9.50 | 5.8 |
| 10-AUG-1993 | 10:20 | 1.0 | < | 0.05000 | 6.97 | 10.30 | 7.3 |
| 12-OCT-1993 | 10:55 | 1.0 | < | 0.05000 | 7.11 | 8.10 | 9.8 |
| 13-DEC-1993 | 10:58 | 1.0 | | 0.12000 | 6.98 | 9.70 | 10.6 |
| 07-FEB-1994 | 12:10 | 1.0 | < | 0.10000 | 6.46 | 11.70 | 6.9 |
| 11-APR-1994 | 10:45 | 1.1 | < | 0.05000 | 6.36 | 11.90 | 4.6 |
| 14-JUN-1994 | 09:58 | 1.1 | < | 0.05000 | 7.05 | 12.00 | 3.9 |
| 09-AUG-1994 | 10:25 | 1.0 | < | 0.05000 | 7.45 | 28.40 | 7.2 |
| 10-OCT-1994 | 10:25 | 1.0 | < | 0.05000 | 7.58 | 7.30 | 8.2 |
| 12-DEC-1994 | 11:30 | 1.0 | < | 0.05000 | 7.03 | 12.00 | 6.3 |
| 13-FEB-1995 | 10:25 | 1.0 | | 0.07000 | 7.42 | 9.90 | 6.1 |
| 03-APR-1995 | 11:05 | 1.2 | < | 0.05000 | 7.58 | 10.30 | 4.5 |
| 13-JUN-1995 | 10:56 | 1.4 | < | 0.05000 | 7.17 | 9.80 | 5.8 |
| 14-AUG-1995 | 10:30 | 1.0 | < | 0.05000 | 7.85 | 7.20 | 13.1 |
| 10-OCT-1995 | 11:34 | 1.0 | < | 0.05000 | 7.29 | 7.50 | 9.0 |
| 12-DEC-1995 | 11:16 | 1.1 | < | 0.05000 | 7.77 | 5.60 | 14.0 |
| 12-FEB-1996 | 10:56 | 1.0 | < | 0.05000 | 8.02 | 8.30 | 27.3 |
| 09-APR-1996 | 12:13 | 1.0 | < | 0.05000 | 7.87 | 14.00 | 16.5 |
| 11-JUN-1996 | 11:38 | 1.0 | < | 0.05000 | 7.71 | 11.90 | 6.9 |
| 12-AUG-1996 | 11:38 | 1.0 | < | 0.05000 | 7.74 | 15.50 | 3.7 |
| 14-OCT-1996 | 11:24 | 1.0 | < | 0.05000 | 8.33 | 10.60 | 7.8 |
| 10-DEC-1996 | 10:36 | 1.0 | < | 0.05000 | 8.04 | 17.30 | 7.7 |
| 17-FEB-1997 | 11:58 | 1.0 | < | 0.05000 | 8.10 | 11.20 | 5.2 |
| 14-APR-1997 | 11:36 | 1.0 | < | 0.05000 | 7.51 | 10.30 | 3.3 |
| 10-JUN-1997 | 11:08 | 1.0 | < | 0.05000 | 7.61 | 12.90 | 4.7 |
| 11-AUG-1997 | 11:36 | 1.0 | < | 0.05000 | 7.80 | 8.00 | 5.1 |
| 13-OCT-1997 | 02:06 | 1.0 | | | 7.65 | 6.30 | 7.8 |
| 08-DEC-1997 | 11:42 | 1.0 | | | 7.11 | 9.30 | 15.4 |
| 09-FEB-1998 | 11:42 | 1.0 | | | 8.01 | 7.30 | 7.3 |
| 13-APR-1998 | 12:34 | 1.0 | | | 7.80 | 11.60 | 4.7 |
| | | | | | | | |

# APPENDIX D

## Fish Tissue Mercury Data

Appendix D. Fish Tissue Mercury Measurements from Subsegment 100501.

| SITE | SUBSEGMENT NUMBER | SITE NAME | COLLECTION DATE | MERCURY IN TISSUE | | NUMBER OF FISH | AVERAGE FISH WEIGHT | AVERAGE FISH LENGTH | FISH SPECIES NAME |
|---|---|---|---|---|---|---|---|---|---|
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.69 | ppm | 1 | 645 | 32 | BLACK CRAPPIE |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.47 | ppm | 2 | 270 | 24.9 | BLACK CRAPPIE |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.58 | ppm | 1 | 2950 | 64.3 | BOWFIN |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.57 | ppm | 1 | 2950 | 64.3 | BOWFIN |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.81 | ppm | 2 | 1660 | 53.9 | BOWFIN |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.5 | ppm | 2 | 1242.5 | 50.5 | BOWFIN |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.17 | ppm | 1 | 6080 | 64.5 | FRESHWATER DRUM |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.02 | ppm | 2 | 3005 | 53.7 | FRESHWATER DRUM |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.78 | ppm | 4 | 287.5 | 27.6 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.21 | ppm | 1 | 1260 | 44.4 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.12 | ppm | 2 | 985 | 40.4 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 1.24 | ppm | 2 | 1560 | 46 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 0.99 | ppm | 1 | 1040 | 42.5 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 1.15 | ppm | 1 | 785 | 37.5 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 0.75 | ppm | 4 | 252.5 | 27.2 | LARGEMOUTH BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.1 | ppm | 2 | 615 | 35.2 | SPOTTED BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 1.14 | ppm | 1 | 905 | 38.5 | SPOTTED BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 1.86 | ppm | 1 | 670 | 37.8 | SPOTTED BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 2 | ppm | 1 | 670 | 37.8 | SPOTTED BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 12/8/2003 | 0.66 | ppm | 4 | 288.8 | 27.8 | SPOTTED BASS |
| 0061 | LA100501_00 | Bayou Dorcheat west of Minden, Louisiana | 10/1/2003 | 0.34 | ppm | 1 | 600 | 35.1 | WHITE BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.28 | ppm | 2 | 507.5 | 31.8 | AMERICAN EEL |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.55 | ppm | 2 | 167.5 | 22 | BLACK CRAPPIE |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.88 | ppm | 3 | 318.3 | 27.7 | BLACK CRAPPIE |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.84 | ppm | 3 | 318.3 | 27.7 | BLACK CRAPPIE |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.34 | ppm | 2 | 410 | 28.9 | BLACK CRAPPIE |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 1.65 | ppm | 1 | 2830 | 66 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 1.02 | ppm | 3 | 2276.7 | 60.1 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.81 | ppm | 3 | 2276.7 | 60.1 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.61 | ppm | 1 | 2025 | 57.5 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.43 | ppm | 2 | 1477.5 | 50.5 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.56 | ppm | 1 | 1115 | 45.6 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.69 | ppm | 3 | 2645 | 62.4 | BOWFIN |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.81 | ppm | 2 | 2107.5 | 56.4 | BOWFIN |

Appendix D. Fish Tissue Mercury Measurements from Subsegment 100501.

| SITE | SUBSEGMENT NUMBER | SITE NAME | COLLECTION DATE | MERCURY IN TISSUE | | NUMBER OF FISH | AVERAGE FISH WEIGHT | AVERAGE FISH LENGTH | FISH SPECIES NAME |
|---|---|---|---|---|---|---|---|---|---|
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.48 | ppm | 1 | 1205 | 57 | CHANNEL CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.5 | ppm | 1 | 1205 | 57 | CHANNEL CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 2.1 | ppm | 1 | 5115 | 74.8 | FLATHEAD CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.21 | ppm | 1 | 9795 | 87.6 | FLATHEAD CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.49 | ppm | 2 | 2737.5 | 58.1 | FLATHEAD CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.7 | ppm | 1 | 1975 | 55.2 | FLATHEAD CATFISH |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.43 | ppm | 2 | 1045 | 40 | FRESHWATER DRUM |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.91 | ppm | 1 | 2575 | 51.6 | FRESHWATER DRUM |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.73 | ppm | 2 | 2117.5 | 48.3 | FRESHWATER DRUM |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.79 | ppm | 2 | 1730 | 45.9 | FRESHWATER DRUM |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.68 | ppm | 4 | 432.5 | 30.7 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.79 | ppm | 2 | 565 | 33.7 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 1.01 | ppm | 2 | 1112.5 | 40.1 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 1.49 | ppm | 2 | 1107.5 | 42.1 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.03 | ppm | 2 | 430 | 29.9 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.96 | ppm | 3 | 585 | 33.9 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.16 | ppm | 2 | 1717.5 | 44.2 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 1.1 | ppm | 3 | 1053.3 | 40.5 | LARGEMOUTH BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.74 | ppm | 1 | 905 | 38.2 | SPOTTED BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 7/19/2005 | 0.97 | ppm | 2 | 557.5 | 32.7 | SPOTTED BASS |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.36 | ppm | 2 | 320 | 28.6 | WHITE CRAPPIE |
| 2302 | LA100501_00 | Bayou Dorcheat near Sarepta, Louisiana | 5/24/2004 | 0.55 | ppm | 2 | 495 | 32.1 | WHITE CRAPPIE |

# APPENDIX E

## Local Mercury Air Emission point source from 2002 National Emissions Inventory

Table E.2 Local mercury air emission point sources for Red River basin subsegment 100501

| FIPS Code | Parish/County | State | SCC Code | SCC Description | | | Pollutant Code | Source Code | Emissions Ton/yr | Hg(II) Speciation Factor* Particulate divalent % | Hg(II) Speciation Factor* Gaseous divalent % | Hg(II) Emissions Ton/yr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05103 | Ouachita | Arkansas | 10100401 | Electric Generation | Residual Oil | Grade 6 Oil: Normal Firing | 7439976 | 767/CAMD | 0.0001707 | 20 | 30 | 8.535E-05 |
| 05139 | Union | Arkansas | 10200907 | Industrial | Wood/Bark Waste | Wood Cogeneration | 7439976 | S | 0.0011 | 20 | 30 | 0.00055 |
| 05139 | Union | Arkansas | 30700898 | Pulp and Paper and Wood Products | Sawmill Operations | Other Not Classified | 7439976 | S | 0.00009 | 20 | 30 | 0.000045 |
| 22067 | Morehouse | Louisiana | 10200204 | Industrial | Bituminous/Subbituminous Coal | Spreader Stoker | 7439976 | S | 0.0005 | 20 | 30 | 0.00025 |
| 22067 | Morehouse | Louisiana | 30700104 | Pulp and Paper and Wood Products | Sulfate (Kraft) Pulping | Recovery Furnace/Direct Contact Evaporator | 7439976 | S | 0.005 | 20 | 30 | 0.0025 |
| 22069 | Natchitoches | Louisiana | 10200902 | Industrial | Wood/Bark Waste | Wood/Bark-fired Boiler | 7439976 | S | 0.0005 | 20 | 30 | 0.00025 |
| 22073 | Ouachita | Louisiana | 10200504 | Industrial | Distillate Oil | Grade 4 Oil | 7439976 | S | 0.001 | 20 | 30 | 0.0005 |
| 22127 | Winn | Louisiana | 10200902 | Industrial | Wood/Bark Waste | Wood/Bark-fired Boiler | 7439976 | S | 0.0015 | 20 | 30 | 0.00075 |
| 48037 | Bowie | Texas | 10200205 | Industrial | Bituminous/Subbituminous Coal | Overfeed Stoker | 7439976 | A-B | 0.000657 | 20 | 30 | 0.0003285 |
| 48037 | Bowie | Texas | 10200501 | Industrial | Distillate Oil | Grades 1 and 2 Oil | 7439976 | A-B | 6.49E-06 | 20 | 30 | 3.25E-06 |
| 48183 | Gregg | Texas | 10100501 | Electric Generation | Distillate Oil | Grades 1 and 2 Oil | 7439976 | 767/CAMD | 8.82E-07 | 20 | 30 | 4.41E-07 |
| 48183 | Gregg | Texas | 30300908 | Primary Metal Production | Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT) | Electric Arc Furnace: Carbon Steel (Stack) | 7439976 | P | 0.0202008 | 10 | 10 | 0.0040402 |
| 48203 | Harrison | Texas | 39999999 | Miscellaneous Manufacturing Industries | Miscellaneous Industrial Processes | | 7439976 | T | 0.046 | 20 | 30 | 0.023 |
| 48315 | Marion | Texas | 10100501 | Electric Generation | Distillate Oil | Grades 1 and 2 Oil | 7439976 | 767/CAMD | 1.59E-05 | 20 | 30 | 7.94E-06 |
| 48343 | Morris | Texas | 30300908 | Primary Metal Production | Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT) | Electric Arc Furnace: Carbon Steel (Stack) | 7439976 | P | 0.043171 | 10 | 10 | 0.0086342 |
| 48401 | Rusk | Texas | 10100501 | Electric Generation | Distillate Oil | Grades 1 and 2 Oil | 7439976 | 767/CAMD | 0.0010461 | 20 | 30 | 0.000523 |

* from "Emissions Inventory and Emissions Processing for the Clean Air Mercury Rule (CAMR)", EPA, 2005.

(light blue) = based on SCC Code

(yellow) = based on MACT Code most similar to description

Total = 0.0414678

Airshed Area m2 = 7.10E+10

Areal local Hg(II) load ug/m2/yr = 0.50

# APPENDIX F

## Sediment Mercury Data

| SITE | SITE_NAME | SUBSEGMENT | COLLECTION DATE | PARAMETER | RESULT | UNITS |
|---|---|---|---|---|---|---|
| 0061 | Bayou Dorcheat west of Minden, Louisiana | LA100501_00 | 10/1/2003 | HG | 0.00586 | MG/KG |
| 0061 | Bayou Dorcheat west of Minden, Louisiana | LA100501_00 | 12/8/2003 | HG | 0.01 | MG/KG |
| 2302 | Bayou Dorcheat near Sarepta, Louisiana | LA100501_00 | 5/24/2004 | HG | 0.2 | MG/KG |
| 0061 | Bayou Dorcheat west of Minden, Louisiana | LA100501_00 | 10/1/2003 | METHYL-HG | 0.11 | UG/KG |
| 0061 | Bayou Dorcheat west of Minden, Louisiana | LA100501_00 | 12/8/2003 | METHYL-HG | 0.1 | UG/KG |
| 2302 | Bayou Dorcheat near Sarepta, Louisiana | LA100501_00 | 5/24/2004 | METHYL-HG | 2.17 | UG/KG |
| Average | | | | HG | 0.071953 | MG/KG |