

Bayou Grosse Tete Watershed TMDL
Subsegment 120104
Originated: October 11, 2006
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BAYOU GROSSE TETE WATERSHED TMDL FOR
BIOCHEMICAL OXYGEN-DEMANDING SUBSTANCES AND NUTRIENTS,
INCLUDING BAYOU PORTAGE AND BAYOU FORDOCHE

Subsegment 120104
and former Subsegments 120101 and 120112

SURVEYED September 24-26, 2001

TMDL REPORT

By:

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EXECUTIVE SUMMARY

This report presents the results of a watershed based, calibrated modeling analysis of Bayou Grosse Tete, which includes Bayou Portage (formerly Subsegment 120101) and Bayou Fordoche (formerly Subsegment 120101). The modeling was conducted to establish a TMDL for biochemical oxygen-demanding pollutants for this watershed, which is located in south-central Louisiana and is part of the Terrebonne Basin. The area of the subsegment is sparsely populated and land use is dominated by agriculture and wetland forest.

The model for Bayou Grosse Tete, Water Quality Subsegment 120104, begins at the point where the False River Overflow Canal flows into the bayou and extends to the confluence of Bayou Grosse Tete with the Intracoastal Waterway southeast of the town of Grosse Tete, LA. A portion of the headwaters flows eastward over the Torbert weir and thence into Bayou Cholpe. This portion is not included in the model because it never rejoins Bayou Grosse Tete. The watershed is 620.74 square kilometers (239.7 square miles) in area and includes the following tributaries: Bayou Blue, Bayou George, Bayou Portage (formerly Subsegment 120101), Bayou Black, Bayou Fordoche (formerly Subsegment 120112), Grand Bayou, Catfish Canal, and several unnamed tributaries. Thirteen permitted facilities were addressed in the TMDL effort. Seven of these discharge directly into Bayou Grosse Tete and were included in the model. The remaining dischargers were either too small or too far away to have an impact and are accounted for as nonpoint loading through the calibration process. They fall under one of several state or regional policies that govern permit limitations.

Input data for the calibration model was developed from data collected during the September, 2001 intensive survey of Bayou Grosse Tete; data collected by LDEQ and USGS at monitoring stations in the watershed; the LDEQ Reference Stream Study; permits and permit applications for each of the point source dischargers; USGS drainage area and low flow publications; and data garnered from several previous LDEQ studies on non-point source loadings. A satisfactory calibration was achieved for the main stem. For the projection models, data was taken from the current municipal discharge permits, current applications and ambient temperature records. The Louisiana Total Maximum Daily Load Technical Procedures, 05/26/2005, have been followed in this study.

Modeling was limited to low flow scenarios for the calibration and the projections since the constituent of concern was dissolved oxygen and the available data was limited to low flow conditions. The model used was LAQUAL, a modified version of QUAL-TX, which has been adapted to address specific needs of Louisiana waters.

Bayou Grosse Tete, Subsegment 120104, appeared on the 2002 and 2004 303(d) lists. It was found to be “not supporting” its designated uses of primary contact recreation and fish and wildlife propagation. It was “fully supporting” its designated use of secondary contact recreation. The subsegment was subsequently scheduled for TMDL development with other listed waters in the Terrebonne Basin. The suspected cause of impairment was organic enrichment/low DO. This TMDL addresses the organic enrichment/low DO impairment.

This TMDL establishes load limitations for oxygen-demanding substances and goals for reduction of those pollutants. LDEQ’s position, as supported by the declaratory ruling issued by Secretary Givens in response to the lawsuit regarding water quality criteria for nutrients (*Sierra Club v. Givens*, 710 So.2d 249 (La. App. 1st Cir. 1997), writ denied, 705 So.2d 1106 (La. 1998)), is that when oxygen-demanding substances are controlled and limited in order to ensure that the dissolved oxygen criterion is supported, nutrients are also controlled and limited. The implementation of this TMDL

through wastewater discharge permits and implementation of best management practices to control and reduce runoff of soil and oxygen-demanding pollutants from nonpoint sources in the watershed will also control and reduce the nutrient loading from those sources.

The results of projection modeling for Bayou Grosse Tete show that the water quality standard for dissolved oxygen of 5.0 mg/L can be maintained during the summer critical season with a 95% reduction in man-made pollution. This results in a minimum DO of 4.81 mg/L at RK 39.228 to RK 39.392. The winter projection model with a 95% reduction of man-made pollution shows a minimum DO of 7.19 mg/L at RK 47.310 to RK 47.560. The No Load Scenario for summer without reduction in natural background pollution yields a minimum DO of 5.18 mg/L.

Table 1. Total Maximum Daily Load (Sum of UBOD and SOD) for Bayou Grosse Tete

| ALLOCATION | SUMMER | | WINTER | |
|---|-------------------------|------------------------|-------------------------|------------------------|
| | % Reduction Required | (MAY-OCT) (lbs/day) | % Reduction Required | (NOV-APR) (lbs/day) |
| Point Source WLA | 0 | 57 | 0 | 57 |
| Point Source Reserve MOS = 20% | | 15 | | 15 |
| Natural Nonpoint Source LA | 0 | 7,270 | 0 | 5,627 |
| Manmade Nonpoint Source LA | 95 | 666 | 95 | 507 |
| Manmade Nonpoint Source Reserve MOS Summer = 20% Winter = 20% | | 165 | | 126 |
| TMDL | | 8,173 | | 6,332 |

***Note 1: UBOD as stated in this allocation is Ultimate BOD.
 UBOD to BOD₅ ratio = 2.3 for all treatment levels
 Permit allocations are generally based on BOD₅***

Achieving a 95% reduction of all man-made loading within a watershed is not a feasible goal. A number of projects (including weirs, diversions and dredging) have irretrievably altered the hydrology of the Bayou Grosse Tete system. The LDEQ suggests that criteria be modified to suit these changes to the watershed.

LDEQ will work with other agencies such as local Soil Conservation Districts to implement agricultural best management practices in the watershed through the 319 programs. LDEQ will also continue to monitor the waters to determine whether standards are being attained.

In accordance with Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act, the LDEQ has established a comprehensive program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) and the 303 (d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ is continuing to implement a watershed approach to surface water quality monitoring. In 2004 a four year sampling cycle replaced the previous five year cycle. Approximately one quarter of the states watersheds will be sampled in each year so that all of the states watersheds will be sampled within the four year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

Table 2. Point Source TMDL Summary for Subsegment 120104, Bayou Grosse Tete

| FACILITY | FILE No. | Out-fall No. | CURRENT EXPECTED FLOW | CURRENT MONTHLY AVERAGE CONCENTRATION LIMITS | | TMDL FLOW | MOS FLOW | TMDL MONTHLY AVERAGE CONCENTRATION LIMITS | | TMDL MONTHLY AVERAGE MASS LIMITS | | MODELING COMMENTS |
|--|-----------|--------------|-----------------------|--|-----------------------------|-----------|----------|---|-----------------------------|----------------------------------|---------------------------------|-------------------------|
| | | | GPD | BOD5/ CBOD5, mg/L | NH ₃ -N, mg/L | GPD | GPD | BOD5/ CBOD5, mg/L | NH ₃ -N, mg/L | CBOD5, lbs./day | NH ₃ -N, lbs./day | |
| Louisiana Laborer's T&A Fund | LAG540442 | 001 | 1900 | 30 | | 2375 | 475 | 30 | | 0.476 | | |
| Joe's "Dryfus Store" Restaurant | LAG540995 | 001 | 7500 | 30 | | 9375 | 1875 | 30 | | 1.877 | | |
| Valverda Elementary | WG020653 | 001 | 12,040 | 30 | | 15,050 | 3010 | 30 | | 3.014 | | |
| Town of Maringouin STP | LA0086771 | 001 | 150,000 | 10 | | 187,500 | 37,500 | 10 | | 12.518 | | |
| North Iberville Elementary and High School | LAG540386 | 001 | 15,575 | 30 | | 19,468.75 | 3893.75 | 30 | | 3.899 | | |
| Bayou Truck Stop | LAG541027 | 001 | 12,300 | 30 | | 15,375 | 3075 | 30 | | 3.079 | | |
| David's Catering | LAG531142 | 001 | 1050 | 45 | | 1312.5 | 262.5 | 45 | | 0.394 | | |
| Village of Grosse Tete STP | LAG560105 | 001 | 30,000 | 20 | | | | | | | | No impact – Not modeled |
| Delta Place Subdivision STP | LAG570185 | 001 | 70,000 | 10 | | | | | | | | Too small/too far away |
| Pointe Coupee Sewer District #4 | LA0092665 | 001 | 70,000 | 10 | | | | | | | | Too small/too far away |
| Village of Morganza STP | LA0020028 | 001 | 125,000 | 10 | | | | | | | | Too small/too far away |
| Pointe Coupee Central High School | LAG540580 | 001 | 25,000 | 30 | | | | | | | | Too small/too far away |
| LaBarre Elementary | LAG530425 | 001 | 5,000 | 45 | | | | | | | | Too small/too far away |

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1. Introduction

Bayou Grosse Tete appeared on the 2002 and 2004 303(d) lists. Bayou Grosse Tete, Subsegment 120104, was found to be “not supporting” its designated uses of primary contact recreation and fish and wildlife propagation. It was “fully supporting” its designated use of secondary contact recreation. The subsegment was subsequently scheduled for TMDL development with other listed waters in the Terrebonne Basin. The suspected cause of impairment was organic enrichment/low DO. This TMDL addresses the organic enrichment/low DO impairment.

A calibrated water quality model was developed for the watershed, which includes Bayou Portage (formerly Subsegment 120101) and Bayou Fardoche (formerly Subsegment 120101). During the Bayou Grosse Tete survey, there was no measureable flow from either Bayou Portage or Bayou Fardoche. It was determined that these two waterbodies were more accurately described as tributaries to Bayou Grosse Tete instead of significant waterbodies in their own right. Therefore, the drainage areas of Bayou Portage and Bayou Fardoche have been incorporated into subsegment 120104, Bayou Grosse Tete.

Summer and winter projections of Bayou Grosse Tete were modeled to quantify the point source and non-point source waste load reductions necessary in order for the bayou to comply with its established water quality standards and criteria. This report presents the results of those analyses.

2. Study Area Description

2.1 General Information

The Terrebonne Basin covers an area extending approximately 120 miles from the Mississippi River on the north to the Gulf of Mexico on the south. It varies in width from 18 miles to 70 miles. This basin is bounded on the west by the Atchafalaya River Basin and on the east by the Mississippi River and Bayou LaFourche. The topography of the entire basin is lowland, and all the land is subject to flooding except the natural levees along major waterways. The coastal portion of the basin is prone to tidal flooding and consists of marshes ranging from fresh to saline. (LDEQ, 1994)

Louisiana water quality subsegment 120104, Bayou Grosse Tete, is in the northern part of the Terrebonne Basin. The subsegment has a drainage area of 620.74 square kilometers (239.7 square miles). It is bounded on the north by the Mississippi River and False River, on the east by the Bayou Cholpe and Bayou Choctaw drainage areas, on the west by the East Atchafalaya Basin Protection Levee and the Bayou Maringouin drainage area and on the south by the Intracoastal Waterway and the Upper Grand River drainage area. Bayou Grosse Tete begins at the False River Overflow Canal and flows westward for just under 5 kilometers to the confluence with Bayou Portage. It then turns southwest for 3 kilometers to the mouth of Bayou Fardoche. From this point, Bayou Grosse Tete continues in a southeast direction for approximately 45 kilometers before flowing into the Intracoastal Waterway.

A portion of the headwaters flows eastward and crosses the Torbert weir. This flow proceeds across the subsegment boundary and joins with Bayou Cholpe. Because this portion of the flow does not rejoin the Bayou Grosse Tete system, it has not been included as part of this model.

Table 3. Land Uses in Subsegment 120104, Bayou Grosse Tete

| LAND USE | SQUARE KILOMETERS | PERCENT |
|--------------------------------|-------------------|-------------|
| Agriculture/Cropland/Grassland | 330.92 | 53.31 |
| Wetland Forest Deciduous | 244.67 | 39.42 |
| Water | 24.87 | 4.01 |
| Vegetated Urban | 7.60 | 1.22 |
| Wetland S/S Mixed | 6.96 | 1.12 |
| Upland Forest Evergreen | 1.86 | 0.30 |
| Upland Forest Deciduous | 1.28 | 0.21 |
| Wetland S/S Deciduous | 0.92 | 0.15 |
| Upland S/S Mixed | 0.60 | 0.10 |
| Upland Forest Mixed | 0.44 | 0.07 |
| Fresh Marsh | 0.31 | 0.05 |
| Non-Vegetated Urban | 0.19 | 0.03 |
| Upland S/S Deciduous | 0.06 | 0.01 |
| Upland S/S Evergreen | 0.05 | 0.01 |
| Wetland Barren | 0.01 | 0.00 |
| Total | 620.74 | 100% |

Figure 1. Vector Diagram for Bayou Grosse Tete

Bayou Grosse Tete Model Layout Subsegment 120104

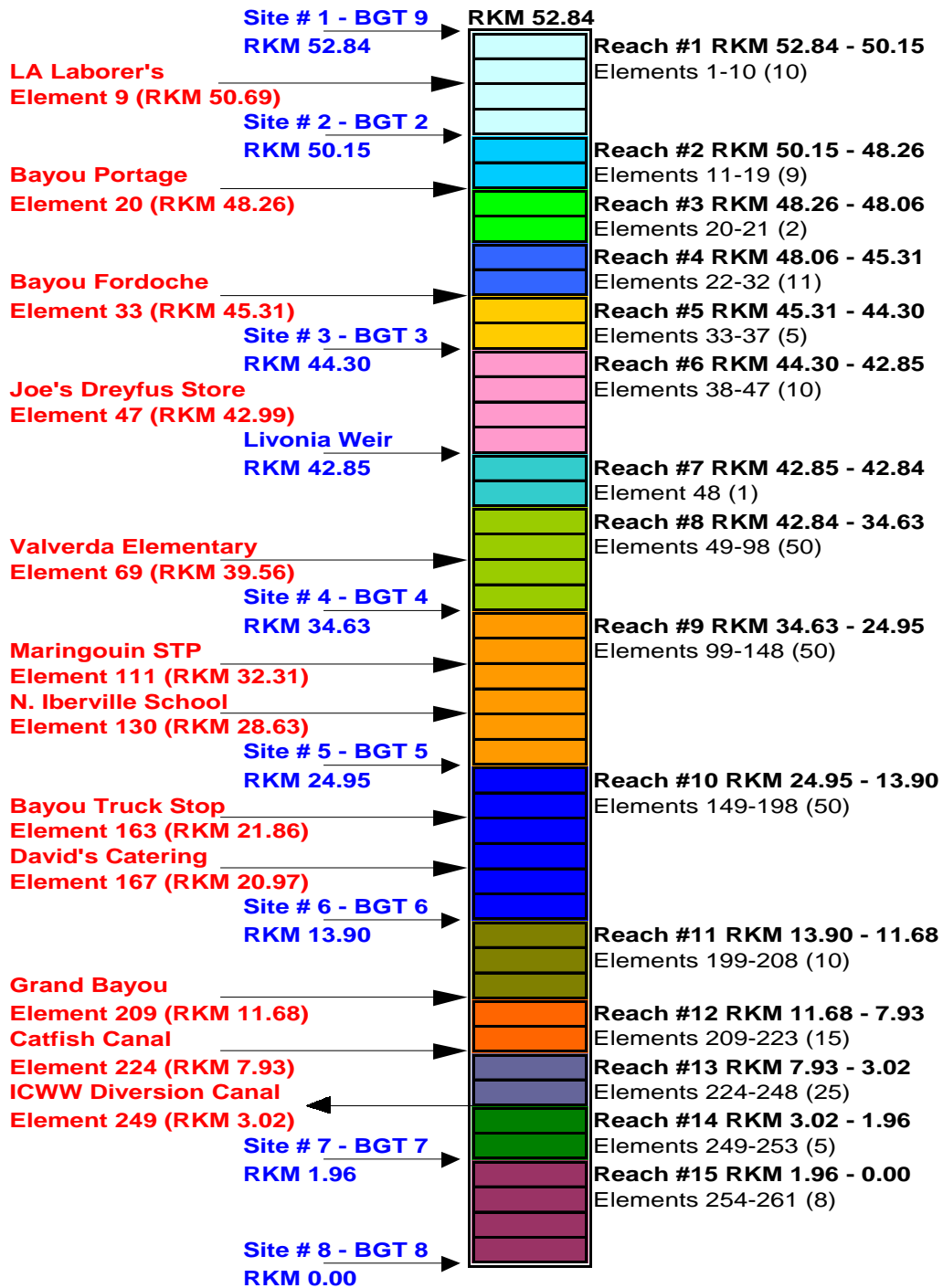


Figure 2. Map of Northern Bayou Grosse Tete Study Area

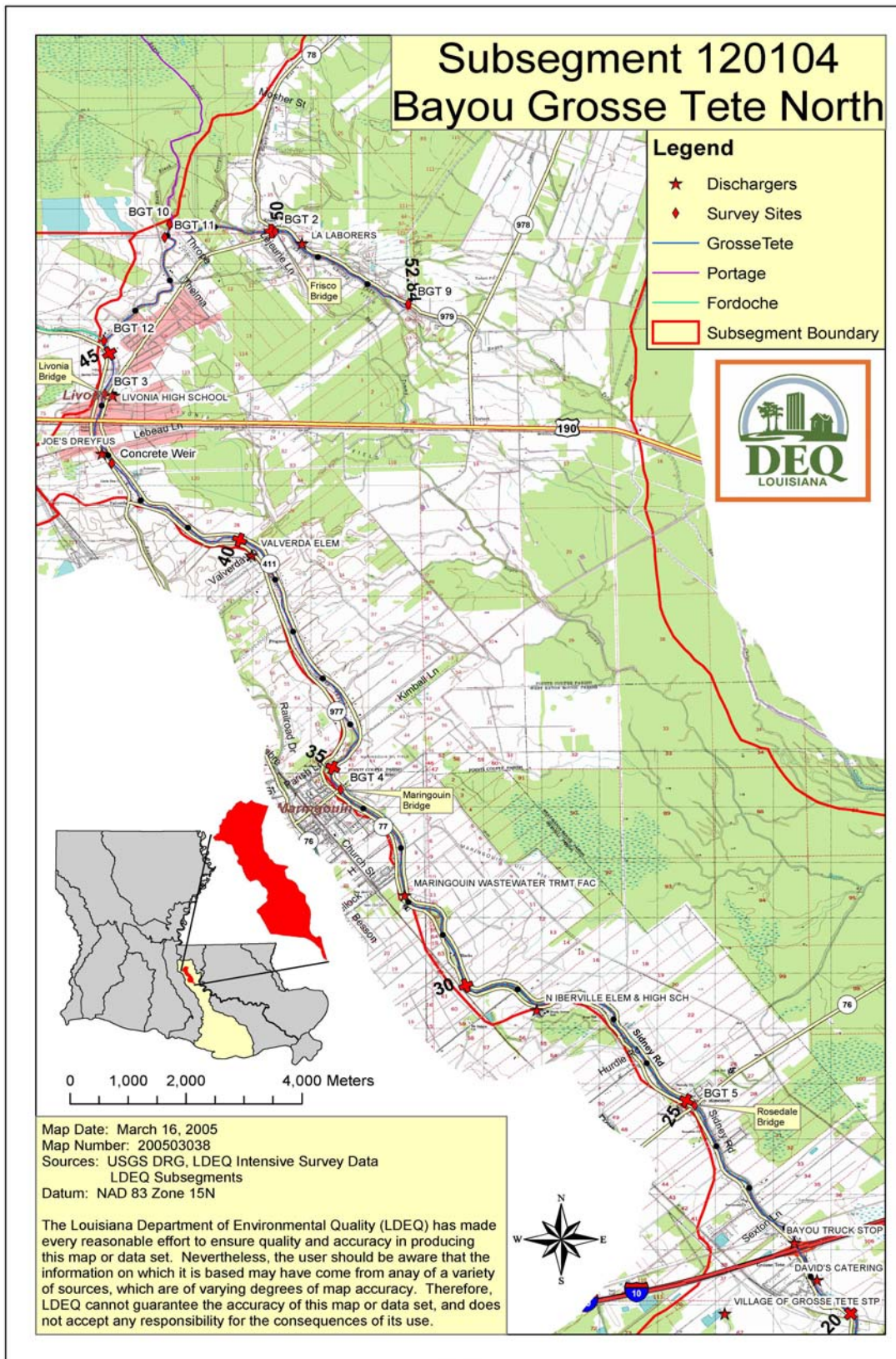
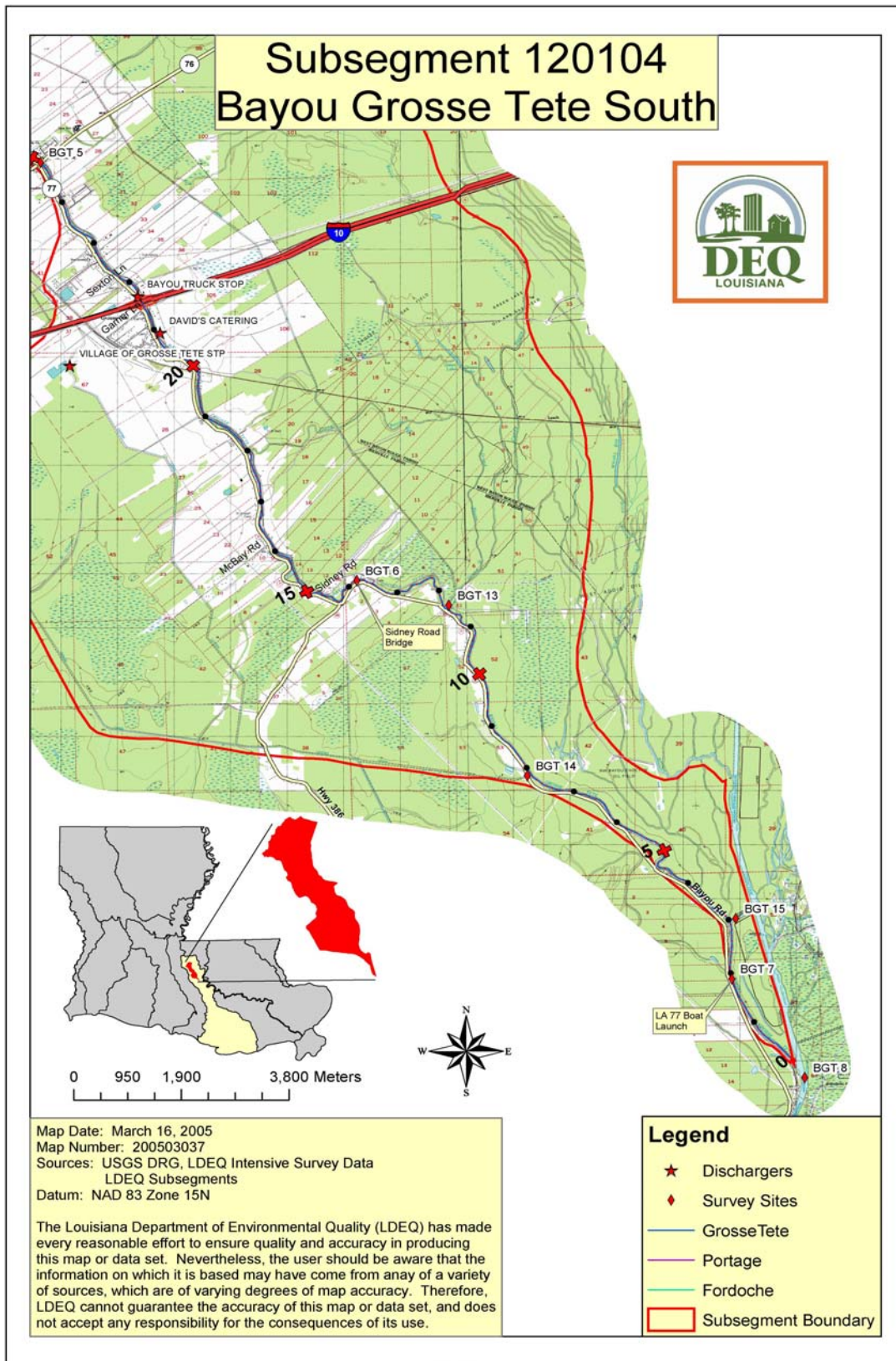


Figure 3. Map of Southern Bayou Grosse Tete Study Area



2.2 Water Quality Standards

The Water Quality criteria and designated uses for the Bayou Grosse Tete watershed are shown in Table 4.

Table 4. Water Quality Numerical Criteria and Designated Uses for Bayou Grosse Tete

| Subsegment | 120104 |
|--------------------|-------------------|
| Stream Description | Bayou Grosse Tete |
| Designated Uses | A, B, C |
| Criteria: | |
| C1 | 25 |
| SO ₄ | 25 |
| DO | 5.0 |
| pH | 6.0-8.5 |
| BAC | 1—Note 1 |
| °C | 32 |
| TDS | 200 |

USES: A – primary contact recreation; B - secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

Note 1 – 200 colonies/100mL maximum log mean and no more than 25% of samples exceeding 400 colonies/100mL for the period May through October; 1,000 colonies/100mL maximum log mean and no more than 25% of samples exceeding 2,000 colonies/100mL for the period November through April.

2.3 Wastewater Discharges

A review of the inventory for Bayou Grosse Tete showed a total of 14 permitted facilities. One of these facilities, Livonia High School, discharges into Bayou Tommy and then out of the subsegment to Bayou Choctaw. The other facilities were evaluated based on the volume and type of discharge, location relative to the listed waterbody, and best professional judgement. Delta Place Subdivision STP, Pointe Coupee Sewer District #4, Village of Morganza STP, Pointe Coupee Central High School and LaBarre Elementary all discharge into Bayou Portage and are assumed to have no impact on Bayou Grosse Tete due to the distance traveled. The Village of Grosse Tete STP was judged to have no impact because it discharges into the headwaters of Catfish Canal and travels approximately thirteen and a half kilometers before reaching Bayou Grosse Tete. These dischargers are accounted for as nonpoint loading through the process of calibration. They fall within one of several state or regional policies that govern permit limitations. The remaining facilities discharge directly into Bayou Grosse Tete and were included in the model. Current permit information was reviewed for all dischargers. A list of facilities is shown below in Table 5.

Table 5. Discharger Inventory for Subsegment 120104, Bayou Grosse Tete

| FACILITY | FILE No. | Out-fall No. | OUTFALL DESCRIPTION | FACILITY TYPE | RECEIVING WATER | EXPECTED FLOW GPD | MONTHLY AVERAGE CONCENTRATION LIMITS | | MONTHLY AVERAGE MASS LIMITS | | MODELING COMMENTS |
|--|-----------|--------------|---------------------|----------------------------|---------------------------------|-------------------|--------------------------------------|--------------------------|-----------------------------|------------------------------|--|
| | | | | | | | BOD5/CBOD5, mg/L | NH ₃ -N, mg/L | BOD, lbs./day | NH ₃ -N, lbs./day | |
| Louisiana Laborer's T&A Fund | LAG540442 | 001 | Sanitary sewage | Training facility | Bayou Grosse Tete | 1900 | 30 | | | | 1900 gpd flow rate listed in Application |
| Joe's "Dreyfus Store" Restaurant | LAG540995 | 001 | Sanitary sewage | Restaurant | Bayou Grosse Tete | 7500 | 30 | | | | Application lists design capacity of 7500 gpd |
| Valverde Elementary | WG020653 | 001 | Sanitary sewage | Public school | Bayou Grosse Tete | 12,040 | 30 | | | | Expected flow calculated from number of students and employees at school |
| Town of Maringouin STP | LA0086771 | 001 | Sanitary sewage | Municipal sewage treatment | Bayou Grosse Tete | 150,000 | 10 | | | | App. lists design capacity of 150,000 gpd |
| North Iberville Elementary and High School | LAG540386 | 001 | Sanitary sewage | Public school | Unnamed ditch-Bayou Grosse Tete | 15,575 | 30 | | | | Expected flow calculated from number of students and employees at school |
| Bayou Truck Stop | LAG541027 | 001 | Sanitary sewage | Truck stop and restaurant | Unnamed ditch-Bayou Grosse Tete | 12,300 | 30 | | | | Application lists design flow of 12,300 gpd |
| David's Catering | LAG531142 | 001 | Sanitary sewage | Restaurant | Unnamed ditch-Bayou Grosse Tete | 1050 | 45 | | | | Application lists design flow of 1050 gpd |
| Village of Grosse Tete STP | LAG560105 | 001 | Sanitary sewage | Municipal sewage treatment | Catfish Canal-Bayou Grosse Tete | 30,000 | 20 | | | | No impact – Not modeled |
| Delta Place Subdivision STP | LAG570185 | 001 | Sanitary sewage | Municipal sewage treatment | Unnamed ditch-Portage Canal #1 | 70,000 | 10 | | | | Too small/too far away |

Bayou Grosse Tete Watershed TMDL
 Subsegment 120104
 Originated: October 11, 2006
 Revised: July 03, 2007

| | | | | | | | | | | | |
|-----------------------------------|-----------|-----|-----------------|----------------------------|---|---------|----|--|--|--|------------------------|
| Pointe Coupee Sewer District #4 | LA0092665 | 001 | Sanitary sewage | Municipal sewage treatment | Unnamed ditch-Buckhorn Bayou-Portage Canal #1 | 70,000 | 10 | | | | Too small/too far away |
| Village of Morganza STP | LA0020028 | 001 | Sanitary sewage | Municipal sewage treatment | Unnamed ditch-Portage Canal #2 | 125,000 | 10 | | | | Too small/too far away |
| Pointe Coupee Central High School | LAG540580 | 001 | Sanitary sewage | Public school | Unnamed ditch-Portage Canal #2 | 25,000 | 30 | | | | Too small/too far away |
| LaBarre Elementary | LAG530425 | 001 | Sanitary sewage | Public school | Portage Canal #2 | 5,000 | 45 | | | | Too small/too far away |

2.4 Water Quality Conditions/Assessment

Subsegment 120104, Bayou Grosse Tete, is not supporting its designated uses of primary contact recreation and fish and wildlife propagation. It is fully supporting its designated use of secondary contact recreation. The impairment is believed to be caused by organic enrichment/low DO. Bayou Grosse Tete appears on the 2002 and 2004 303(d) lists and was scheduled for TMDL development with other listed waterbodies in the Terrebonne Basin.

2.5 Prior Studies

There have been no prior TMDL studies on the Bayou Grosse Tete system.

3. Documentation Calibration Model

3.1 Program Description

“Simulation models are used extensively in water quality planning and pollution control. Models are applied to answer a variety of questions, support watershed planning and analysis and develop total maximum daily loads (TMDLs). . . . Receiving water models simulate the movement and transformation of pollutants through lakes, streams, rivers, estuaries, or near shore ocean areas. . . . Receiving water models are used to examine the interactions between loadings and response, evaluate loading capacities (LCs), and test various loading scenarios. . . . A fundamental concept for the analysis of receiving waterbody response to point and nonpoint source inputs is the principle of mass balance (or continuity). Receiving water models typically develop a mass balance for one or more constituents, taking into account three factors: transport through the system, reactions within the system, and inputs into the system.” (EPA841-b-97-006, pp. 1-30)

The model used for this TMDL was LA-QUAL, a steady-state one-dimensional water quality model. LA-QUAL has the mechanisms for incorporating dams and weirs in the analysis and was particularly suitable for use in modeling the Bayou Portage, Bayou Fordoche and Bayou Grosse Tete systems. LA-QUAL history dates back to the QUAL-I model developed by the Texas Water Development Board with Frank D. Masch & Associates in 1970 and 1971. William A. White wrote the original code.

In June, 1972, the United States Environmental Protection Agency awarded Water Resources Engineers, Inc. (now Camp Dresser & McKee) a contract to modify QUAL-I for application to the Chattahoochee-Flint River, the Upper Mississippi River, the Iowa-Cedar River, and the Santee River. The modified version of QUAL-I was known as QUAL-II.

Over the next three years, several versions of the model evolved in response to specific client needs. In March, 1976, the Southeast Michigan Council of Governments (SEMCOG) contracted with Water Resources Engineers, Inc. to make further modifications and to combine the best features of the existing versions of QUAL-II into a single model. That became known as the QUAL-II/ SEMCOG version.

Between 1978 and 1984, Bruce L. Wiland with the Texas Department of Water Resources modified QUAL-II for application to the Houston Ship Channel estuarine system. Numerous modifications were made to enable modeling this very large and complex system including the addition of tidal dispersion, lower boundary conditions, nitrification inhibition, sensitivity analysis capability,

branching tributaries, and various input/output changes. This model became known as QUAL-TX and was subsequently applied to streams throughout the State of Texas.

In 1999, the Louisiana Department of Environmental Quality and Wiland Consulting, Inc. developed LA-QUAL based on QUAL-TX Version 3.4. The program was converted from a DOS-based program to a Windows-based program with a graphical interface and enhanced graphic output. Other program modifications specific to the needs of Louisiana and the Louisiana DEQ were also made. LA-QUAL is a user-oriented model and is intended to provide the basis for evaluating total maximum daily loads in the State of Louisiana.

The development of a TMDL for dissolved oxygen generally occurs in 3 stages. Stage 1 encompasses the data collection activities. These activities may include gathering such information as stream cross-sections, stream flow, stream water chemistry, stream temperature and dissolved oxygen at various locations on the stream, location of the stream centerline and the boundaries of the watershed which drains into the stream, and other physical and chemical factors which are associated with the stream. Additional data gathering activities include gathering all available information on each facility which discharges pollutants into the stream, gathering all available stream water quality chemistry and flow data from other agencies and groups, gathering population statistics for the watershed to assist in developing projections of future loadings to the water body, land use and crop rotation data where available, and any other information which may have some bearing on the quality of the waters within the watershed. During Stage 1, any data available from reference or least impacted streams which can be used to gauge the relative health of the watershed is also collected.

Stage 2 involves organizing all of this data into one or more useable forms from which the input data required by the model can be obtained or derived. Water quality samples, field measurements, and historical data must be analyzed and statistically evaluated in order to determine a set of conditions which have actually been measured in the watershed. The findings are then input to the model. Best professional judgment is used to determine initial estimates for parameters which were not or could not be measured in the field. These estimated variables are adjusted in sequential runs of the model until the model reproduces the field conditions which were measured. In other words, the model produces a value of dissolved oxygen, temperature, or other parameter which matches the measured value within an acceptable margin of error at the locations along the stream where the measurements were actually made. When this happens, the model is said to be calibrated to the actual stream conditions. At this point, the model should confirm that there is an impairment and give some indications of the causes of the impairment. If a second set of measurements is available for slightly different conditions, the calibrated model is run with these conditions to see if the calibration holds for both sets of data. When this happens, the model is said to be verified.

Stage 3 covers the projection modeling which results in the TMDL. The critical conditions of flow and temperature are determined for the waterbody and the maximum pollutant discharge conditions from the point sources are determined. These conditions are then substituted into the model along with any related condition changes which are required to perform worst case scenario predictions. At this point, the loadings from the point and nonpoint sources (increased by an acceptable margin of safety) are run at various levels and distributions until the model output shows that dissolved oxygen criteria are achieved. It is critical that a balanced distribution of the point and nonpoint source loads be made in order to predict any success in future achievement of water quality standards. At the end of Stage 3, a TMDL is produced which shows the point source permit limits and the amount of reduction in man-made nonpoint source pollution which must be achieved to attain water quality

standards. The man-made portion of the NPS pollution is estimated from the difference between the calibration loads and the loads observed on reference or least impacted streams.

3.2 Input Data Documentation

Data collected during an intensive survey from September 24-26, 2001 was used to establish the input for the Bayou Grosse Tete model calibration. This data is presented in Appendix F. The flow in each reach, headwater, and unmodeled tributary was determined based on the survey discharge measurements, the flow balance at selected sampling stations, the drainage area associated with each flow, and a determination of appropriate incremental nonpoint source flow rates in terms of cms/mile. Best professional judgment was used to determine where similar streams concepts could be used. Flow determinations are presented in Appendix F2.

Field and laboratory water quality data from the Bayou Grosse Tete intensive survey were entered in a spreadsheet for analysis. The Louisiana GSBOD program was applied to the BOD data in a separate spreadsheet and values were computed and compiled for ultimate BOD, BOD decay rate and BOD Lag.

This data was the primary source for the model input data for initial conditions; decay rates; incremental temperature, DO, and BOD; headwater temperature and DO; and wasteload data. Two other sources of data also figured prominently in developing the input data set: reference stream data and previous determinations of nonpoint source loadings for several heavily impacted streams. As shown in Figure 4, the DO during the time of the survey was not meeting standards in Bayou Grosse Tete.

3.2.1 Model Schematics and Maps

A vector diagram of the modeled area is presented in Figure 1. The vector diagram shows the locations of survey stations, the reach/element design, and the locations of the tributaries contributing flow but not modeled. ARCVIEW maps of the stream and subsegment showing river kilometers, survey stations, drainage area boundaries and other points of interest are presented in Figures 2 and 3. An overview map of the entire watershed is presented in Appendix K.

3.2.2 Model Options, Data Type 2

For the Bayou Grosse Tete calibration process, four constituents were modeled. These were chlorides, sulfates, dissolved oxygen, and biochemical oxygen demand. Chlorophyll A and temperature were not modeled but were input into the initial conditions. This allowed the effects of temperature and chlorophyll A to reflect in the model without running a thermal or full nutrient model.

3.2.3 Program Constants, Data Type 3

Some changes were made to the default program constants defined in data type 3. The maximum iteration limit was increased from 100 to 1000 iterations to allow for convergence of oxygen dependant rates. KL minimum, the minimum reaeration rate, was changed from a default of 0.6 m/day to 0.7 m/day. The change is to reflect the conversion of 2.3 ft/day to m/day as recommended in the LTP.

Inhibition control value was changed from the default of option 4 to option 3. This sets all decay rates except for sediment oxygen demand (SOD) to be inhibited based on dissolved oxygen levels. This change is a result of recent discussion within the modeling group and consultation with outside modelers on whether SOD should be inhibited by low dissolved oxygen levels.

The hydraulic calculation method was set to option 2 or “widths and depths.” This was done because the low slopes in these waterbodies cause a substantial amount of water to be present in some reaches during critical flow.

Effective BOD Due to Algae was set to a value of 0.15. LDEQ practice for waterbodies with high algal influence is to set Algae Oxygen Production to zero and calibrate to DO values of 1 mg/L above the minimum measured values. This is done to reflect conditions at which there is no net contribution to the DO concentration due to algal photosynthesis or respiration.

3.2.4 Temperature Correction of Kinetics, Data Type 4

The temperature values computed are used to correct the rate coefficients in the source/sink terms for the other water quality variables. These coefficients are input at 20 °C and are then corrected to temperature using the following equation:

$$X_T = X_{20} * \text{Theta}^{(T-20)}$$

Where:

X_T = the value of the coefficient at the local temperature T in degrees Celsius

X_{20} = the value of the coefficient at the standard temperature at 20 degrees Celsius

Theta = an empirical constant for each reaction coefficient

In the absence of specified values for data type 4, the model uses default values. A complete listing of these values can be found in the LA-QUAL for Windows User’s Manual (LDEQ, 2003).

3.2.5 Reach Identification Data, Data Type 8

The reach and element breakdown was determined using physical data from the survey, aerial photography and USGS quad maps. The calibration for the Bayou Grosse Tete system consisted of one headwater, one weir, four wasteloads from unmodeled tributaries, one distributary, no point source wasteloads, and fifteen reaches consisting of two hundred sixty-one elements. The listed permitted facilities were not included in the calibration because it was determined during the survey that none were flowing. The projection models for Bayou Grosse Tete are slightly different, containing seven point source wasteloads.

3.2.6 Advective Hydraulic Coefficients, Data Type 9

Widths and depths were entered as constants due to the low slopes within the modeled subsegments. Information came from cross-section measurements at survey sites. For reaches between survey sites, interpolation was used to estimate width and depth values. Hydraulic determinations are presented in Appendix F2.

3.2.7 Initial Conditions, Data Type 11

The initial conditions are used to reduce the number of iterations required by the model and to set values for constituents not directly modeled. Values needed for the Bayou Grosse Tete model were DO, temperature and chlorophyll A by reach. The input values came from the survey station located closest to the reach.

3.2.8 Reaeration Rates, Sediment Oxygen Demand and BOD Coefficients, Data Type 12

The Louisiana reaeration equation was chosen for the majority of reaches in the Bayou Grosse Tete model. Reaches nine to thirteen, which covers the area from the town of Maringouin to the Intracoastal Waterway diversion channel, have a depth that is greater than the suggested range for the Louisiana equation. For these reaches, the Owens-Edwards-Gibbs equation was used.

The SOD values were achieved through calibration of the model. SOD values for Bayou Grosse Tete start at a low to moderate value in the headwaters area and climb to high values throughout the rest of the upper reaches. As the stream gets deeper, the SOD falls to a value of roughly 2 g/m²/day until reaching the ICWW diversion. Beyond this point, depth decreases drastically and SOD values rise. The SOD value for each reach is shown in Appendix B3.

The decay rates used for Bayou Grosse Tete were based on the bottle rates from the September, 2001 survey. The measured rates for CBOD1, CBOD2 and NBOD were compiled into a weighted average total decay rate. The decay and settling rates used for each reach are shown in Appendix B3.

3.2.9 Incremental Conditions, Data Types 16, 17, and 18

Incremental conditions were used in the calibration to represent nonpoint source loads associated with flows. These flows represent a combination of surface runoff, small tributaries that were not surveyed, and local drainage. Incremental outflow and inflow was also used in the Bayou Grosse Tete model to account for suspected bank flow under and around the weir at reach seven. The data for each reach are presented in Appendix B3.

3.2.10 Nonpoint Sources, Data Type 19

Nonpoint source loads which are not associated with a flow are input into this part of the model. These can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, CBOD and NBOD loads. Over the years LDEQ has collected data on heavily impacted streams in Louisiana. These data were reviewed and summarized by Smythe and Waldon. LDEQ also determined these types of loading as part of the Reference Stream work and these loads have also been used to determine some of the input data. In general the total NPS load exceeds the reference stream load. The manmade portion of the NPS loading is the difference between the calibration load and the reference stream load where the calibration load is higher. The data are presented in Appendix B3.

3.2.11 Headwaters, Data Types 20, 21, and 22

Values for the headwaters of Bayou Grosse Tete came from site BGT9 during the September, 2001 survey. Sulfate concentration was adjusted from the survey data due to the fact that concentrations both upstream (BGT1A and BGT1B) and downstream (BGT2) from the False River Overflow Canal were significantly lower than indicated at site BGT9. The BOD value entered for the headwaters is the combined total of CBOD1, CBOD2 and NBOD from site BGT9. The data are presented in Appendix B3.

3.2.12 Wasteloads, Data Types 24, 25, and 26

A discharger inventory listed eight permitted facilities flowing into the Bayou Grosse Tete system. The Village of Grosse Tete STP discharges to the headwaters of Catfish Canal and was assumed to be fully recovered before reaching Bayou Grosse Tete. The Town of Maringouin STP was not completed at the time of the survey and it was determined that none of the other facilities were currently discharging, so no point source wasteloads were included in the calibration model. The Bayou Grosse Tete calibration model had four tributaries and one distributary. There were no measurable flows for Bayou Portage and Bayou Fordoche during the September, 2001 survey, so flows were determined by modeler judgment based on dischargers and wetland/swamp areas within the Bayou Portage drainage system, and calibration to downstream flow measurements. All other input data came from sites located at each tributary. The Intracoastal Waterway diversion functions as a distributary of the Bayou Grosse Tete system. The majority of flow travels through this diversion to reach the ICWW. The data are presented in Appendix B3.

3.2.13 Boundary Conditions, Data Type 27

The lower boundary conditions were assumed to be equivalent to the measurements taken at survey station BGT8 for the Bayou Grosse Tete model.

3.2.14 Dam Data, Data Type 28

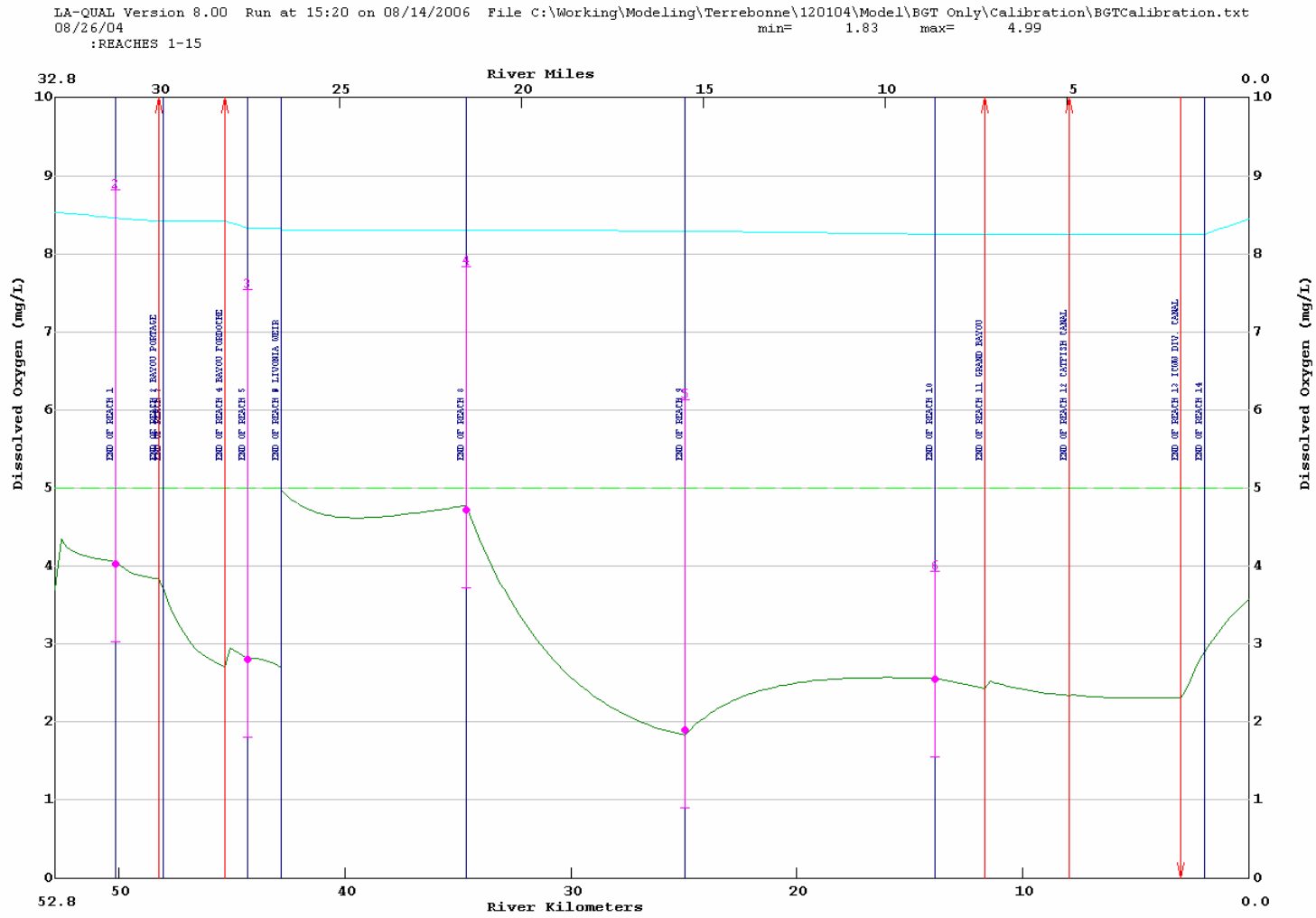
A weir is located on Bayou Grosse Tete south of the town of Livonia, LA. This weir makes up reach number seven and the input data was gathered from the physical properties of the weir and field observation.

3.3 Model Discussion and Results

Input and output from the calibration model are presented in Appendix B1. The overlay plotting option was used to determine if calibration had been achieved. A plot of the dissolved oxygen concentration versus river kilometer is presented in Figure 4.

Bayou Grosse Tete had a good calibration to flow, effective BOD, DO, and chlorophyll A. An acceptable calibration was achieved for chlorides and sulfates. Output from the calibration model shows that Bayou Grosse Tete was not meeting the DO standard of 5.0 mg/L at any point in the modeled reaches.

Figure 4. Calibration Model Dissolved Oxygen versus River Kilometer, Bayou Grosse Tete



4. Water Quality Projections

Since the calibrated models indicated that the DO criterion was not being met through the majority of the waterbody, “No Load” summer scenarios were performed in addition to the traditional summer and winter projections.

4.1 Critical Conditions, Seasonality and Margin of Safety

The Clean Water Act requires the consideration of seasonal variation of conditions affecting the constituent of concern, and the inclusion of a margin of safety (MOS) in the development of a TMDL. For the TMDL covering Bayou Grosse Tete, an analysis of LDEQ ambient data has been employed to determine critical seasonal conditions and an appropriate margin of safety.

Critical conditions for dissolved oxygen were determined for Bayou Grosse Tete using water quality data from the bayou on the LDEQ Ambient Monitoring Network. The 90th percentile temperature for each season and the corresponding 90% of saturation DO was determined for the bayou. Ambient temperature data, critical temperature and DO saturation determinations are shown in Appendix E3. Graphical and regression analysis techniques have been used by LDEQ historically to evaluate the temperature and dissolved oxygen data from the Ambient Monitoring Network and run-off determinations from the Louisiana Office of Climatology water budget. Since nonpoint loading is conveyed by run-off, this was a reasonable correlation to use. Temperature is strongly inversely proportional to dissolved oxygen and moderately inversely proportional to run-off. Dissolved oxygen and run-off are also moderately directly proportional. The analysis concluded that the critical conditions for stream dissolved oxygen concentrations were those of negligible nonpoint run-off and low stream flow combined with high stream temperature.

When the rainfall run-off (and non-point loading) and stream flow are high, turbulence is higher due to the higher flow and the temperature is lowered by the run-off. In addition, run-off coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. Reaeration rates and DO saturation are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and dissolved oxygen but not necessarily periods of high BOD decay.

This phenomenon is interpreted in TMDL modeling by assuming that nonpoint loading associated with flows into the stream are responsible for the benthic blanket which accumulates on the stream bottom and that the accumulated benthic blanket of the stream, expressed as SOD and/or resuspended BOD in the calibration model, has reached steady state or normal conditions over the long term and that short term additions to the blanket are off set by short term losses. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow. The manmade portion of the NPS loading is the difference between the calibration load and the reference stream load where the calibration load is higher. The only mechanism for changing this normal benthic blanket condition is to implement best management practices and reduce the amount of nonpoint source loading entering the stream and feeding the benthic blanket.

Critical season conditions were simulated in the dissolved oxygen TMDL projection modeling by using the default flows from the Louisiana Technical Procedures Manual, and the 90th percentile temperature for the modeled waterbody. Incremental flow was assumed to be zero; model loading was from perennial tributaries, sediment oxygen demand, and resuspension of sediments.

In reality, the highest temperatures occur in July-August, the lowest stream flows occur in October-November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The summer projection model is established as if all these conditions happened at the same time. The winter projection model accounts for the seasonal differences in flows and BMP efficiencies. Other conservative assumptions regarding rates and loadings are also made during the modeling process. In addition to the conservative measures, an explicit MOS of 20% was used for all loads to account for future growth, safety, model uncertainty and data inadequacies.

4.2 Input Data Documentation

The flow in each headwater and unmodeled tributary was set at 0.1 cfs = 0.00283 cms for summer critical conditions in accordance with the LTP. The flow in each headwater and unmodeled tributary was set at 1.0 cfs = 0.0283 cms for winter critical conditions in accordance with the LTP.

4.2.1 Model Options, Data Type 2

Two constituents were modeled during the projection process. These were dissolved oxygen and biochemical oxygen demand.

4.2.2 Program Constants, Data Type 3

The Algae Oxygen Production constant was set back to the default value for the Bayou Grosse Tete projection models.

4.2.3 Temperature Correction of Kinetics, Data Type 4

The temperature correction factors specified in the LTP are entered in the model.

4.2.4 Reach Identification Data, Data Type 8

The reach-element design from the calibration was used in the projection modeling.

4.2.5 Advective Hydraulic Coefficients, Data Type 9

The stream width and depth values from the calibration were used in the projection modeling.

4.2.6 Initial Conditions, Data Type 11

The initial conditions were set to the 90th percentile critical season temperature in accordance with the LTP. The dissolved oxygen values for the initial conditions were set to 90% of the DO saturation value for the given temperature. Chlorophyll A concentrations were set at 10 micrograms per liter in the Bayou Grosse Tete projections to represent an estimate of algae presence when stream conditions are closer to meeting criteria.

4.2.7 Reaeration Rates and BOD Decay and Settling Rates, Data Type 12

The reaeration rate equations, BOD decay and settling rates, and the fractions converting settled BOD to SOD were not changed from the calibration.

4.2.8 Incremental Conditions, Data Types 16, 17, and 18

The incremental conditions were used in the calibration to represent nonpoint source loads associated with flows. For the projection runs, the incremental flows were set to zero to emulate the critical conditions for dissolved oxygen.

4.2.9 Sediment Oxygen Demand, Nonpoint Sources, Headwaters, Wasteloads, Data Type 12, 19, 20, 21, 22, 24, 25, and 26

The NPS values were calculated for each projection scenario using a load equivalent spreadsheet. An analysis was made of the calibration NPS and SOD loads in terms of total loading in units of gm-O₂/m²/day and compared to the reference stream loads in the same terms (which accounted for the width differences between the reference and the modeled streams). Calibration values were used where they were smaller than the reference stream values. The same spreadsheet also calculated load reductions for the headwaters and wasteloads. The values and sources of the input data and the load analyses are presented in Appendix D for each of the projection runs.

LDEQ has collected and measured the CBOD and NBOD oxygen demand loading components for a number of years. These loads have been found in all streams including the non-impacted reference streams. It is LDEQ's opinion that much of this loading is attributable to run-off loads which are flushed into the stream during run-off events, and subsequently settle to the bottom in our slow moving streams. These benthic loads decay and breakdown during the year, becoming easily resuspended into the water column during the low flow/high temperature season. This season has historically been identified as the critical dissolved oxygen season.

LDEQ simulates part of the non-point source oxygen demand loading as resuspended benthic load and SOD. The calibrated non-point loads, UCBOD, UNBOD and SOD, are summed to produce the total calibrated benthic load. The total calibrated benthic load is then reduced by the total background benthic load (determined from LDEQ's reference stream research) to determine the total manmade benthic loading. The manmade portion is then reduced incrementally on a percentage basis to determine the necessary percentage reduction of manmade loading required to meet the water body's dissolved oxygen criteria. These reductions are applied uniformly to all reaches sharing similar hydrology and land uses.

Following the same protocol as the point source discharges, the total reduced manmade benthic load is adjusted for the margin of safety by dividing the value by one minus the margin of safety. This adjusted load is added back to the total background benthic value to obtain the total projection model benthic load. This total projection benthic load is then broken out into its components of SOD, resuspended CBOD and resuspended NBOD by multiplying the total projection benthic load by the ratio of each calibrated component to the total calibrated benthic load.

LDEQ has found variations in the breakdown of the individual CBOD and NBOD components. While the total BOD is reliable, the carbonaceous and nitrogenous component allocation is subject to the type of test method. In the past, LDEQ used a method which suppressed the nitrogenous component to obtain the carbonaceous component value, which was then subtracted from the total measured BOD to determine the nitrogenous value. The suppressant in this method was only reliable

for twenty days thus leading to the assumption that the majority of the carbonaceous loading was depleted within that period of time. The test results supported this assumption. A new method was found in Standard Methods for testing long term BODs and was implemented in 2000. This new method was necessary because the nitrogen suppressant started failing around day seven and the manufacturer of the suppressant will only guarantee its potency for a five day period. LDEQ felt a five day test would not adequately depict the water quality of streams.

This method is a sixty day test which measures the incremental total BOD of the sample while at the same time measuring the increase in nitrite/nitrate in the sample. This increase in nitrite/nitrate allows LDEQ to calculate the incremental nitrogenous portion by multiplying the increase by 4.57 to determine the NBOD daily readings. These NBOD daily readings are then subtracted from the daily reading for total BOD to determine the CBOD daily values. A curve fit algorithm is then applied to the daily component readings to obtain the estimated ultimate values of each component as well as the decay rate and lag times of the first order equations.

LDEQ has implemented the new test method over the last several survey seasons. The results obtained using the new method showed that a portion of the CBOD first order equation does begin to level off prior to the twentieth day, however a secondary CBOD component begins to use dissolved oxygen sometime between day ten and day twenty-five. This secondary CBOD component was not being assessed as CBOD using the previous method but was being included in the NBOD load. Thus the CBOD and NBOD component loading used in the reference stream studies is not consistent with the results using the new proposed 60 day method and the individual values should not be used to determine background values for samples processed using the new test methods. However, the sum of CBOD and NBOD should be about the same for both new and old test methods. For this reason LDEQ decided to use the sum of reference stream benthic loads as background values.

4.2.10 Boundary Conditions, Data Type 27

The lower boundary conditions were set at the 90th percentile critical season temperature, the dissolved oxygen criteria, and the measured stream UBOD loads for all projections and scenarios. Chlorophyll A values were set to 10 micrograms per liter to represent an estimate of algae presence when stream conditions are closer to meeting criteria.

4.2.11 Dam Data, Data Type 28

The physical parameters of the weir south of Livonia did not change for the projections, and the values were not changed from the calibration model.

4.3 Model Discussion and Results

The projection model input and output data sets are presented in Appendix D.

4.3.1 No Load Scenario

Under this scenario, the SOD, NPS, headwater and wasteload values were reduced to reference stream values except where the calibration value was less than the reference stream value. Several reduction runs were made after the original No Load run revealed that 100% removal of man-made nonpoint sources would result in a minimum DO of 5.20 mg/L in Bayou Grosse Tete. A graph of

DO concentration versus river kilometer for the No Load summertime projection is shown in Figure 5.

4.3.2 Summer Projection

A summer critical season projection was run against the current DO standard of 5.0 mg/L for Bayou Grosse Tete. To meet standards in Bayou Grosse Tete required a 95% reduction to man-made loading. This yields a model output minimum DO of 4.81 mg/L. A graph of the dissolved oxygen concentration versus river kilometer for the summer projection is presented in Figure 6.

4.3.3 Winter Projection

A projection for the winter critical season was also run against the DO standard of 5.0 mg/L for Bayou Grosse Tete. Applying a 95% reduction to man-made loading in the winter season results in a minimum DO of 7.19 mg/L. A graph of the dissolved oxygen concentration versus river kilometer for the winter projection is presented in Figure 7.

Figure 5. Bayou Grosse Tete No Load scenario with 100% Removal of Man-Made NPS Loads

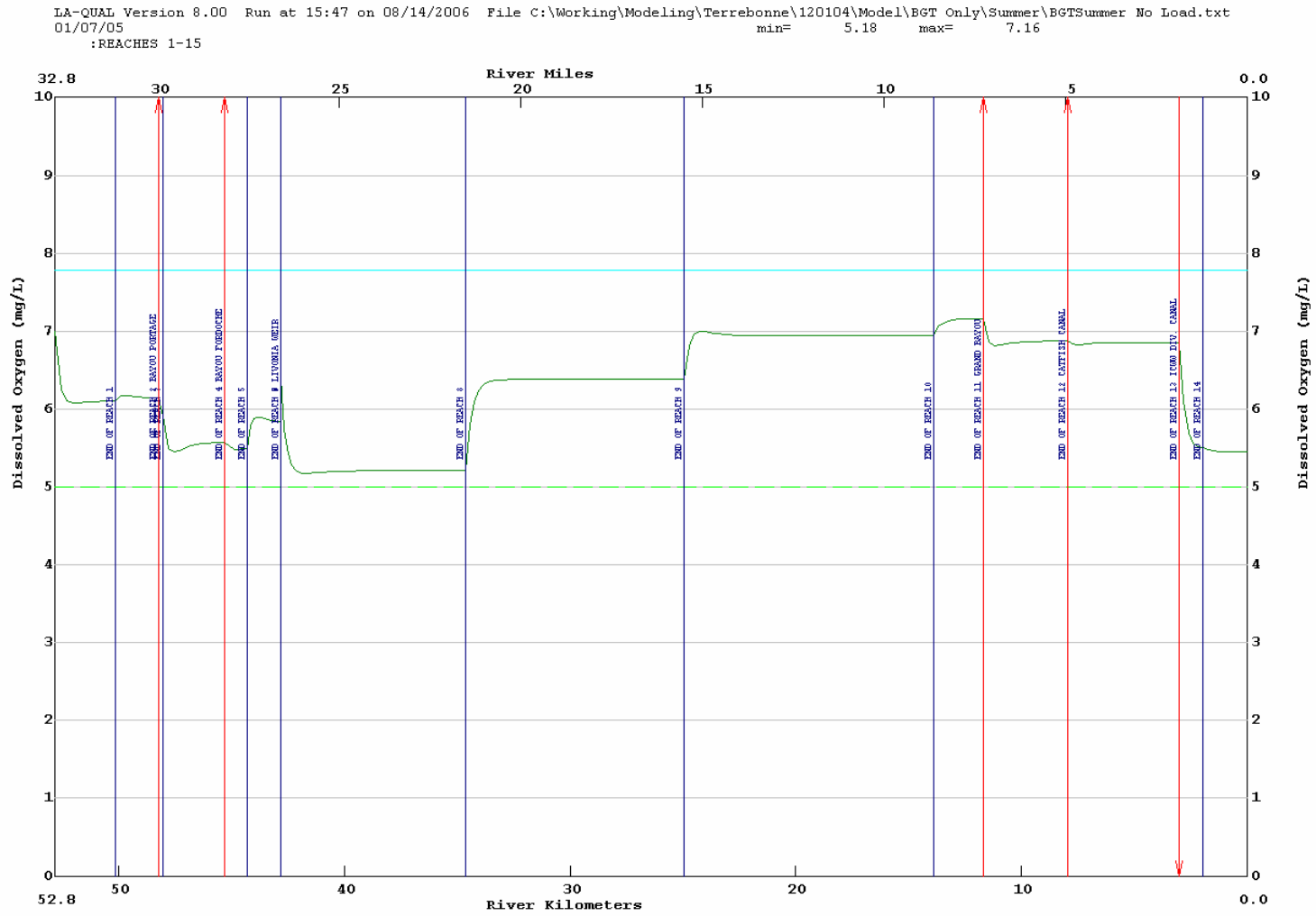


Figure 6. Bayou Grosse Tete Summer Projection at 95% Removal of Man-Made Loads

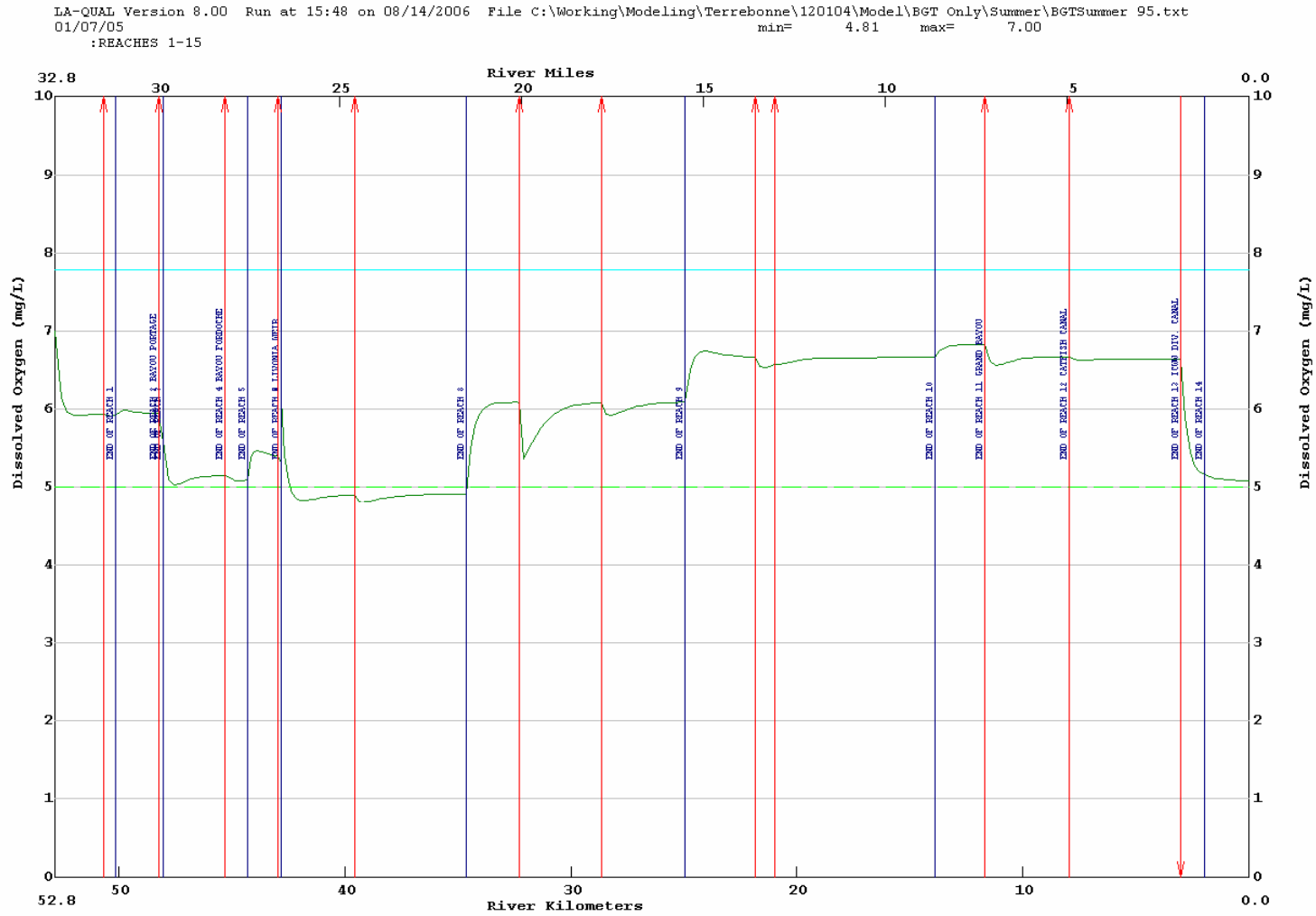
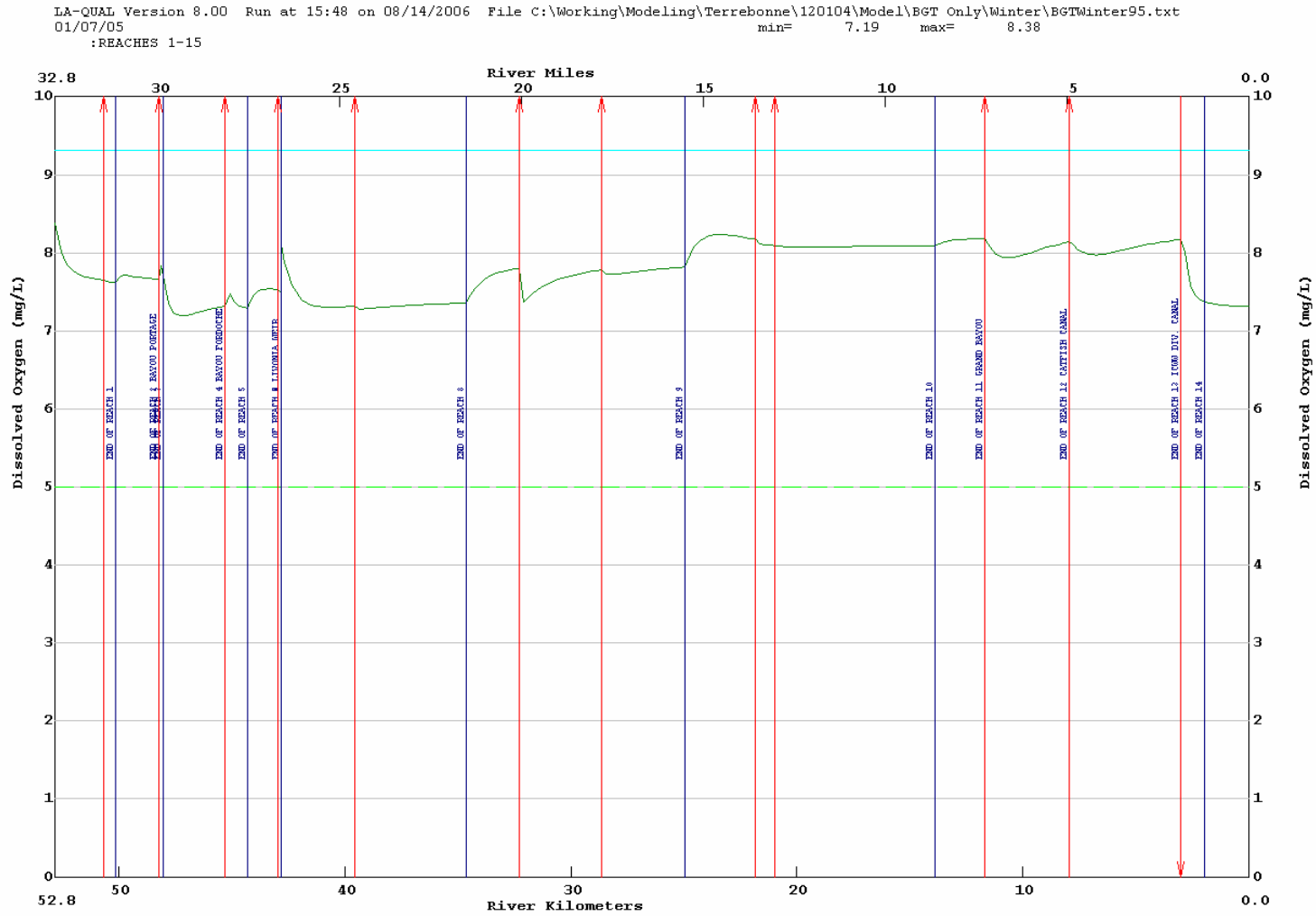


Figure 7. Bayou Grosse Tete Winter Projection at 95% Removal of Man-Made Loads



4.4 Calculated TMDL, WLAs and LAs

4.4.1 Outline of TMDL Calculations

An outline of the TMDL calculations is provided to assist in understanding the calculations in the Appendices. Slight variances may occur based on individual cases.

4.4.1.1 The natural background benthic loading was estimated from reference stream resuspension (nonpoint CBOD and NBOD), and SOD load data.

4.4.1.2 The calibration man-made benthic loading was determined as follows:

- Calibration resuspension and SOD loads were summed for each reach as $\text{gm O}_2/\text{m}^2\text{-day}$ to get the calibration benthic loading.
- The natural background benthic loading was subtracted from the calibration benthic loading to obtain the man-made calibration benthic loading.

4.4.1.3 Projection benthic loads are determined by trial and error during the modeling process using a uniform percent reduction for resuspension and SOD. Point sources are reduced as necessary to subsequently more stringent levels of treatment consistent with the size of the treatment facility as much as possible. Point source design flows are increased to obtain an explicit MOS of 20%. Headwater and tributary concentrations of BOD and DO range from reference stream levels to calibration levels based on the character of the headwater. Where headwaters and tributaries exhibit man-made pollutant loads in excess of reference stream values, the loadings are reduced by the same uniform percent reduction as the benthic loads.

- The projection benthic loading at 20 °C is calculated as the sum of the projection resuspension and SOD components expressed as $\text{gm O}_2/\text{m}^2\text{-day}$.
- The natural background benthic load is subtracted from the projection benthic load to obtain the man-made projection benthic load for each reach.
- The percent reduction of man-made loads for each reach is determined from the difference between the projected man-made non-point load and the man-made non-point load found during calibration.
- The projection loads are also computed in units of lb/d and kg/d for each kind.

4.4.1.4 The total stream loading capacity at critical water temperature is calculated as the sum of:

- Headwater and tributary BOD loading in lb/d and kg/d.
- The natural and man-made projection benthic loading for all reaches of the stream is converted to the loading at critical temperature and summed in lb/d and kg/d.
- Point source BOD loading in lb/d and kg/d.

- The margin of safety in lb/d and kg/d.

4.4.2 Bayou Grosse Tete TMDL, Subsegment 120104

The TMDLs for the biochemical oxygen demanding constituents (BOD and SOD), have been calculated for the summer and winter critical seasons. The TMDLs for the Bayou Grosse Tete watershed were set equal to the total stream loading capacity. They are presented in Appendix A. A summary of the loads is presented in Table 6.

Table 6. Total Maximum Daily Load (Sum of UBOD and SOD) for Bayou Grosse Tete

| ALLOCATION | SUMMER | | WINTER | |
|--|----------------------|------------------------|----------------------|------------------------|
| | % Reduction Required | (MAY-OCT) (lbs/day) | % Reduction Required | (NOV-APR) (lbs/day) |
| Point Source WLA | 0 | 57 | 0 | 57 |
| Point Source Reserve MOS = 20% | | 15 | | 15 |
| Natural Nonpoint Source LA | 0 | 7,270 | 0 | 5,627 |
| Manmade Nonpoint Source LA | 95 | 666 | 95 | 507 |
| Manmade Nonpoint Source Reserve MOS Summer = 20% Winter = 20% | | 165 | | 126 |
| TMDL | | 8,173 | | 6,332 |

***Note1: UBOD as stated in this allocation is Ultimate BOD.
 UBOD to BOD₅ ratio = 2.3 for all treatment levels
 Permit allocations are generally based on BOD₅***

Table 7. Point Source TMDL Summary for Bayou Grosse Tete, Subsegment 120104

| FACILITY | FILE No. | Out-fall No. | CURRENT EXPECTED FLOW | CURRENT MONTHLY AVERAGE CONCENTRATION LIMITS | | TMDL FLOW | MOS FLOW | TMDL MONTHLY AVERAGE CONCENTRATION LIMITS | | TMDL MONTHLY AVERAGE MASS LIMITS | | MODELING COMMENTS |
|--|-----------|--------------|-----------------------|--|-----------------------------|-----------|----------|---|-----------------------------|----------------------------------|---------------------------------|-------------------------|
| | | | GPD | BOD5/ CBOD5, mg/L | NH ₃ -N, mg/L | GPD | GPD | BOD5/ CBOD5, mg/L | NH ₃ -N, mg/L | CBOD5, lbs./day | NH ₃ -N, lbs./day | |
| Louisiana Laborer's T&A Fund | LAG540442 | 001 | 1900 | 30 | | 2375 | 475 | 30 | | 0.476 | | |
| Joe's "Dryfus Store" Restaurant | LAG540995 | 001 | 7500 | 30 | | 9375 | 1875 | 30 | | 1.877 | | |
| Valverde Elementary | WG020653 | 001 | 12,040 | 30 | | 15,050 | 3010 | 30 | | 3.014 | | |
| Town of Maringouin STP | LA0086771 | 001 | 150,000 | 10 | | 187,500 | 37,500 | 10 | | 12.518 | | |
| North Iberville Elementary and High School | LAG540386 | 001 | 15,575 | 30 | | 19,468.75 | 3893.75 | 30 | | 3.899 | | |
| Bayou Truck Stop | LAG541027 | 001 | 12,300 | 30 | | 15,375 | 3075 | 30 | | 3.079 | | |
| David's Catering | LAG531142 | 001 | 1050 | 45 | | 1312.5 | 262.5 | 45 | | 0.394 | | |
| Village of Grosse Tete STP | LAG560105 | 001 | 30,000 | 20 | | | | | | | | No impact – Not modeled |
| Delta Place Subdivision STP | LAG570185 | 001 | 70,000 | 10 | | | | | | | | Too small/too far away |
| Pointe Coupee Sewer District #4 | LA0092665 | 001 | 70,000 | 10 | | | | | | | | Too small/too far away |
| Village of Morganza STP | LA0020028 | 001 | 125,000 | 10 | | | | | | | | Too small/too far away |
| Pointe Coupee Central High School | LAG540580 | 001 | 25,000 | 30 | | | | | | | | Too small/too far away |
| LaBarre Elementary | LAG530425 | 001 | 5,000 | 45 | | | | | | | | Too small/too far away |

5. Sensitivity Analysis

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The LAQUAL model allows multiple parameters to be varied with a single run. The model adjusts each parameter up or down by the percentage given in the input set. The rest of the parameters listed in the sensitivity section are held at their original projection value. Thus the sensitivity of each parameter is reviewed separately. A sensitivity analysis was performed on the calibration and summer projection model runs of Bayou Grosse Tete. The sensitivity of the model's minimum DO projections to these parameters is presented in Appendix I. Parameters were varied by +/- 30%, except temperature, which was adjusted +/- 2 degrees Centigrade.

Table 8 shows that Bayou Grosse Tete is most sensitive to stream reaeration, benthic demand, initial temperature and non-point source BOD. The other parameters creating significant variations in the minimum DO values are BOD decay rate, wasteload flow, BOD settling rate, stream Baseflow, incremental inflow, stream depth, wasteload BOD and incremental BOD. The model is slightly to not sensitive to the remaining parameters.

Table 8. Summary of Calibration Model Sensitivity Analysis for Bayou Grosse Tete

| Parameter | Positive Changes in Parameter | | | Negative Changes in parameter | | |
|-----------------------|-------------------------------|-------------------|-----------------------|-------------------------------|-------------------|-----------------------|
| | % change | Minimum DO (mg/L) | Percentage Difference | % change | Minimum DO (mg/L) | Percentage Difference |
| Stream Reaeration | 30 | 3.17 | 73.0 | -30 | 0.81 | -55.9 |
| Benthic Demand | 30 | 1.25 | -32.0 | -30 | 2.95 | 60.9 |
| Initial Temperature | 2 | 1.48 | -19.3 | -2 | 2.46 | 34.6 |
| Non-Point Source BOD | 30 | 1.56 | -14.9 | -30 | 2.36 | 28.7 |
| BOD Decay Rate | 30 | 1.66 | -9.2 | -30 | 2.28 | 24.5 |
| Wasteload Flow | 30 | 1.99 | 8.8 | -30 | 1.77 | -3.3 |
| BOD Settling Rate | 30 | 1.96 | 7.4 | -30 | 1.72 | -6.0 |
| Stream Baseflow | 30 | 1.96 | 6.6 | -30 | 1.77 | -3.5 |
| Incremental Inflow | 30 | 1.95 | 6.5 | -30 | 1.77 | -3.5 |
| Stream Depth | 30 | 1.72 | -6.0 | -30 | 2.19 | 19.6 |
| Wasteload BOD | 30 | 1.73 | -5.3 | -30 | 1.97 | 7.6 |
| Incremental BOD | 30 | 1.79 | -2.1 | -30 | 1.88 | 2.8 |
| Incremental DO | 30 | 1.83 | 0.2 | -30 | 1.83 | -0.2 |
| Headwater Flow | 30 | 1.83 | 0.0 | -30 | 1.83 | 0.0 |
| Headwater Temperature | 2 | 1.83 | 0.0 | -2 | 1.83 | 0.0 |
| Headwater DO | 30 | 1.83 | 0.0 | -30 | 1.83 | 0.0 |
| Headwater BOD | 30 | 1.83 | 0.0 | -30 | 1.83 | 0.0 |
| Wasteload Temperature | 2 | 1.83 | 0.0 | -2 | 1.83 | 0.0 |
| Wasteload DO | 30 | 1.83 | 0.0 | -30 | 1.83 | 0.0 |

6. Conclusions

The TMDL for Bayou Grosse Tete requires a watershed wide 95% decrease in manmade nonpoint source loads in order to meet the DO criteria in the summer. The existing point sources have no impact on the main stem of Bayou Grosse Tete and require no changes to their permitted discharges.

It is not feasible that a 95% reduction of all man-made loading can be achieved. The Bayou Grosse Tete system has been irretrievably altered by weirs, diversions and dredging projects. LDEQ suggests that criteria be modified to suit these changes to the watershed.

The modeling which has been conducted for this TMDL is very conservative and based on limited information. Future studies may show that this TMDL is smaller than that which can actually be accommodated by the watershed.

LDEQ has developed this TMDL to be consistent with the state antidegradation policy (LAC 33:IX.1109.A).

LDEQ will work with other agencies such as local Soil Conservation Districts to implement agricultural best management practices in the watershed through the 319 programs. LDEQ will also continue to monitor the waters to determine whether standards are being attained.

In accordance with Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act, the LDEQ has established a comprehensive program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term database for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ is continuing to implement a watershed approach to surface water quality monitoring. In 2004 a four year sampling cycle replaces the previous five year cycle. Approximately one quarter of the states watersheds will be sampled each year so that all of the states watersheds will be sampled within the four year cycle. This will allow LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list.

7. References

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8. Appendices