LAKE FAUSSE POINTE AND DAUTERIVE LAKE WATERSHED TMDL FOR DISSOLVED OXYGEN AND NUTRIENTS INCLUDING WLAS FOR THREE POINT SOURCE DISCHARGES

SUBSEGMENT 060702

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EXECUTIVE SUMMARY

This report presents the results of a watershed based, calibrated modeling analysis of Lake Fausse Pointe and Dauterive Lake. The modeling was conducted to establish a dissolved oxygen and nutrient TMDL for the Lake Fausse Pointe and Dauterive Lake watershed. The model extends from the inlet of Dauterive Lake (Borrow Pit Canal and Bayou du Portage) to the Charenton Drainage and Navigation Canal at the southern end of Lake Fausse Pointe. Lake Fausse Pointe and Dauterive Lake are located in southern Louisiana. The watershed is 247 square miles in area (USGS, 1971). Lake Fausse Pointe and Dauterive Lake are in the Vermilion-Teche River Basin and includes Water Quality Subsegment 060702. The area is sparsely populated outside the municipalities, and land use is dominated by agriculture and wetlands.

Input data for the calibration model was developed from the LDEQ Reference Stream Study; data collected during the August and September 1999 intensive surveys; data collected by LDEQ at an ambient monitoring station in the watershed; DMRs; USGS drainage area and low flow publications; previous modeling studies conducted by LDEQ in the area; and data garnered from several previous LDEQ studies on non-point source loadings. A satisfactory calibration was achieved for the lake system. In those cases where the calibration was not as accurate (primarily due to extremely limited data), the difference was in the conservative direction. For the projection models, data was taken from the current point source discharge permits and ambient temperature records. The Louisiana Total Maximum Daily Load Technical Procedures, 1999, have been followed in this study.

Modeling was limited to low flow scenarios for both 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 the USEPA WASP model. WASP was selected since it offers the ability to model flow splits and has been used successfully in TMDLs in the past.

Lake Fausse Pointe and Dauterive Lake, Subsegment 060702, were on the 1996 and 1998 303(d) list of impaired water bodies requiring the development of TMDLs. The subsegment was ranked priority one on the 1998 list. The suspected causes of impairment for the 1998 list were organic enrichment/low DO and nutrients (phosphorus and nitrogen). This TMDL addresses the organic enrichment/low DO impairment and nutrients.

The results of the summer projection model show that the water quality standard for dissolved oxygen for Lake Fausse Pointe and Dauterive Lake (WQ Subsegment 060702) of 5.0 mg/L can be maintained during the summer critical season. The results of the summer projection model show that a DO of 5.0 mg/L can be maintained with the imposition of a 30% reduction from all manmade nonpoint sources of BOD and SOD. The minimum predicted DO for summer was 5.2 mg/L in the western portion of the southern basin of Lake Fausse Pointe

The results of the winter projection model show that the water quality criteria for dissolved oxygen for Lake Fausse Pointe and Dauterive Lake of 5.0 mg/L can be maintained during the

winter critical season without reduction in either point source or NPS loading. The minimum predicted DO for winter was 6.2 mg/L in the western portion of the southern basin of Lake Fausse Pointe. Projection runs for both seasons include a 20% margin of safety.

The nutrient TMDL was performed by comparing model results to historical ratios of inorganic nitrogen (NH_3, NO_3+NO_2) to ortho phosphorus (PO_4). The historical data were for Louisiana lakes that were sampled during 1974 as part of EPA's National Eutrophication Survey. Model results show that the nonpoint source loads of phosphorus must be reduced by 50% to meet historical ratios.

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 has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-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. The sampling schedule for the first five-year cycle is shown below.

1998 - Mermentau and Vermilion-Teche Basins
1999 - Calcasieu and Ouachita River Basins
2000 - Barataria and Terrebonne Basins
2001 - Lake Pontchartrain Basin and Pearl River Basin
2002 - Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.) Mermentau and Vermilion-Teche Basins will be sampled again in 2003.

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ACKNOWLEDGMENTS

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The Louisiana Office of State Climatology in Baton Rouge provided meteorological data (daily precipitation and daily wind speeds) as well as monthly water budgets. The US Geological Survey in Baton Rouge provided stage data for Bayou Teche at Adeline Bridge.

Data analyses and preparation of the survey report were performed by several FTN personnel including Pat Downey, Philip Massirer, Gerry Conley, Mark Uguccioni, Cassandra Prewett, Christina Laurin, Sharon Baker, and others.

The water quality modeling and TMDL calculations and preparation of this report were done by Mark Uguccioni with guidance from Philip Massirer.

1.0 INTRODUCTION

The 1996 and 1998 303(d) lists cited Lake Fausse Pointe and Dauterive Lake, Subsegment 060702, as being impaired due to organic enrichment/low dissolved oxygen (DO) and nutrients and required the development of Total Maximum Daily Loads (TMDLs) for DO and nutrients. The subsegment was ranked priority one on the 1998 list. A calibrated water quality model was developed and projections were modeled to quantify the point source and non-point source load reductions which would be necessary in order for Lake Fausse Pointe and Dauterive Lake to comply with the established water quality standards and criteria. This report presents the results of that analysis.

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Lake Fausse Pointe and Dauterive Lake are located in southern Louisiana in the Vermilion-Teche basin (subsegment 060702) about 25-30 miles southeast of Lafayette (Figure A.1 in Appendix A). The two lakes are connected and function somewhat as a single lake. Both lakes are natural lakes (as opposed to a reservoir created by a dam across a stream). The land surrounding the lakes is flat with little relief. The natural drainage pattern is to the east toward the Atchafalaya River. However, the lakes are separated from the Atchafalaya Basin by the West Atchafalaya Basin Protection Levee (Figure A.2 in Appendix A).

The watershed for these lakes consists of the area northwest of the lakes that is between Bayou Teche and the West Atchafalaya Basin Protection Levee. Runoff from this watershed enters the lakes through Bayou du Portage and the Borrow Pit Canal along the west side of the levee. Water from areas outside of this watershed can drain into these lakes depending on the operation of various control structures.

Other tributaries and canals entering Lake Fausse Pointe include Loreauville Canal, Tete Bayou, and Cotton Canal. All of these enter Lake Fausse Pointe along the west and south sides. Tete Bayou and Cotton Canal both have point source discharges upstream of Lake Fausse Pointe. Loreauville Canal is a connection between Lake Fausse Pointe and Bayou Teche and has a set of locks approximately 1.4 miles west of Lake Fausse Pointe. These locks are operated by the Teche Vermilion Freshwater District. According to Mr. Ralph Castille (318-566-8927), the locks are opened only during flooding on Bayou Teche (to allow floodwater to drain into Lake Fausse Pointe) and for occasional boat traffic. Normally, the locks remain closed and the difference between water levels on the Bayou Teche side and the Lake Fausse Pointe side is only a few tenths of a foot.

The primary outlet for these lakes is the Charenton Drainage and Navigation Canal at the southeast corner of Lake Fausse Pointe. Although this canal is the outlet, water in this canal often flows into the lakes during periods of high tide in the Gulf of Mexico. The outlet of Lake Fausse

Pointe is approximately 16 miles upstream from the Gulf of Mexico (West Cote Blanche Bay). These lakes also may experience effects from wind tides as well as lunar tides. As discovered during the September survey, the upstream (i.e., northward) flows during high tides can extend several miles upstream of sampling stations BPC-1 and BdP-1.

The land use in the watershed is summarized in Table 2.1.

Table 2.1. Land Uses in Segment 0607 (LDEQ, 1993).

LAND USE TYPE	% OF TOTAL AREA
Urban	2.8
Extractive	1.1
Agricultural	46.7
Forest Land	1.0
Water	14.0
Wetland	34.0
Barren Land	0.4
TOTAL	100.0

2.2 Water Quality Standards

The water quality criteria and designated uses for the Lake Fausse Pointe and Dauterive Lake watershed are shown in Table 2.2.

Table 2.2 Water Quality Numerical Criteria and Designated Uses (LDEQ, 1999a).

Subsegment	060702
Stream Description	Lake Fausse Pointe and Dauterive Lake
Designated Uses	ABC
Criteria:	
Chloride	80 mg/L
Sulfate	50 mg/L
DO	5 mg/L
pH	6.0 – 8.5
Temperature	32EC
TDS	350 mg/L

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.

2.3 Wastewater Discharges

The LDEQ Permit Tracking System and the Discharger Inventory were reviewed. The only permitted point source discharge that goes directly into either Lake Fausse Pointe or Dauterive Lake is the wastewater treatment plant (WWTP) for Lake Fausse Pointe State Park. The location of this discharge is shown on Figure A.2 (sampling point labeled “FPSP”). Other discharges that enter the lake indirectly are the City of New Iberia WWTP and St. Mary Sugar Cooperative (Jeanerette facility). The St. Mary Sugar Cooperative operates on a seasonal basis and typically discharges only during the spring and early summer.

There are other discharges in the upper end of the basin (i.e., towards Interstate 10) that eventually drain into Lake Fausse Pointe, but those discharges are considered too far away and/or too small to directly impact Lake Fausse Pointe.

2.4 Water Quality Conditions/Assessment

Primary and secondary contact recreation uses are being fully supported, but propagation of fish and wildlife is only partially being supported (LDEQ, 1998). Nutrients and organic enrichment / low DO are the suspected causes of impairment. The numeric water quality standard that is of primary importance for propagation of fish and wildlife is the year-round DO standard of 5.0 mg/L (LDEQ, 1999a).

2.5 Prior Studies

Previous water quality data collected for Lake Fausse Pointe and Dauterive Lake include the following:

1. Bi-monthly data collected by LDEQ for “Lake Fausse Pointe east of New Iberia” (station 313) for 1991-present
2. Data collected by LDEQ for “Lake Dauterive northeast of Loreauville” (station 594) on 3 dates during 1997-98 as part of a mercury assessment study.

Other water quality data for tributaries to Lake Fausse Pointe and Dauterive Lake include the following:

1. Data collected by LDEQ for Bayou du Portage (station 676) on 10 dates during June-November 1998
2. Data collected by LDEQ for Tete Bayou (station 675) on 11 dates during June-December 1998
3. Data collected by LDEQ at multiple locations along Tete Bayou during an intensive survey on August 16-20, 1993 (LDEQ, 1995)
4. Data collected by Louisiana Department of Natural Resources (LDNR) at multiple locations along Tete Bayou during an intensive survey on August 16-17, 1983.

A reconnaissance survey of Lake Fausse Pointe and Dauterive Lake was performed by FTN Associates and subcontractors and the LDEQ project manager on July 7-8, 1999. During the reconnaissance survey, limited quantities of field data were collected, including some in situ and depth measurements. The in situ measurements indicated high algal productivity (i.e., supersaturated DO values) in the surface of the lakes, but the dissolved oxygen values 1-2 m below the surface were often much lower. Intensive field surveys were performed August 24-25, 1999 and September 23, 1999. Data collected from these surveys were used in this modeling study.

No previous intensive survey data or modeling studies are known to exist for Lake Fausse Pointe or Dauterive Lake. A wasteload modeling study of Tete Bayou was performed by Limno Tech, Inc. to examine the impact of wastewater discharges from the City of New Iberia into Tete Bayou (Limno Tech, 1984). This study showed that DO levels in Tete Bayou should recover upstream of Lake Fausse Pointe. However, the Limno Tech wasteload allocation report was not accepted by EPA (LDEQ, 1995). In the 1993 LDEQ survey of Tete Bayou, DO concentrations were measured only as far downstream as river mile 5.0, at which point the measured DO ranged from 1.4 mg/L (9:35 am) to 6.3 mg/L (5:00 pm).

No stream gages with daily flows have been identified for either Lake Fausse Pointe or Dauterive Lake or any of their tributaries.

3.0 DOCUMENTATION OF CALIBRATION MODEL

3.1 Model Description and Input Data Documentation

3.1.1 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 nearshore 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." (EPA 841-B-97-006, pp. 1-30)

The model used for this TMDL was the WASP model (EPA, 1993). This model was used because it could simulate the flow split between the west branch of Lake Fausse Pointe and Bird Island Chute. This model has also been used successfully for TMDL studies in the past.

"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, flow, water chemistry, water temperature and dissolved oxygen and various locations on the water body, location of the centerline and the boundaries of the watershed which drains into the water body, and other physical and chemical factors which are associated with the water body. Additional data gathering activities include gathering all available information on each facility which discharges pollutants in to the water body, gathering all available 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 that 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 that have actually been measured in the watershed. The findings are then input to the model. Best professional judgement 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 that were measured. In other words, the model produces a value of the dissolved oxygen, temperature, or other parameter that 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 water body 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 that 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." (LDEQ, 1999b)

The model was calibrated to the 1999 survey measurements. Water quality parameters and coefficients were established based on available data and best professional judgement. The calibration model output was then compared to the 1999 survey measurements of water quality and the calibration was determined to be successful.

3.1.2 Model Setup

The modeling was performed with the WASP model (EPA, 1993). The parameters modeled using WASP were DO, $CBOD_U$, chlorophyll a, inorganic phosphorus (ortho phosphorus), ammonia nitrogen, nitrate+nitrite nitrogen, and organic nitrogen. Except for organic nitrogen and $CBOD_U$, these parameters were all directly measured from samples collected during the August 24-25, 1999. Organic nitrogen was calculated as TKN minus ammonia nitrogen. For the samples where the laboratory reported ammonia nitrogen values that were greater than the TKN values (LFP-1 and LFP-9), the organic nitrogen was considered to be unknown. Water quality data from the surveys are summarized in Appendix B.

Because the samples from the August survey were inadvertently analyzed for BOD_5 instead of $CBOD_U$, values for $CBOD_U$ were estimated based on the BOD_5 values for August and the ratio of $CBOD_U$ to BOD_5 from the September survey. The average ratio of $CBOD_U$ to BOD_5 from the September survey was 0.94 (see Appendix B). Each of the BOD_5 measurements from the August survey was multiplied by this ratio to obtain estimates of $CBOD_U$ for the calibration period (August 24-25).

Although WASP is a dynamic model, steady state simulations were considered appropriate for this system based on the objectives of the project and the amount of data that are available. Steady state simulations were made by running the WASP model for 2000 days with no temporal changes in boundary conditions or model parameters. Output from the last time step of each simulation was taken as the model results for steady state conditions. Output from each simulation was reviewed to make sure that the model had actually reached steady state. Most of the simulations reached steady state much sooner than 2000 days.

3.1.3 Geometry

The lake was divided into seven segments as shown in Figure 3.1 in Appendix C. Each segment roughly corresponds to one or more of the sampling stations used in the field survey. Segment volumes were calculated by multiplying the surface areas (determined by digitizing maps) with the average depths (based on measurements from the surveys). The model inputs for segment geometry (Data Group C in WASP) are shown in Appendix D.

3.1.4 Flow Rates

The flows measured during the August field survey showed that the system was tidally influenced because the measured flows were all in the upstream direction (away from the Gulf). Because the model was set up for steady state conditions, the flow rates specified in the model were estimates of net flows averaged over one or more tidal cycles. Using average flows in the model is more appropriate than using instantaneous flows measured during the survey because the theoretical hydraulic residence time of the lake (volume divided by flow) is on the order of months rather than days.

There are no USGS gages with daily flow data on any of the tributaries to Lake Fausse Pointe and Dauterive Lake. Therefore, the inflow to the lake system was estimated using monthly water budgets provided by the Louisiana Office of State Climatology. Water budgets for 1999 were obtained for 4 precipitation stations: New Iberia, St. Martinville, Breaux Bridge, and Grand Coteau. Printouts of the water budgets and a map showing the station locations (Figure 3.2) are included in Appendix E. These 4 stations were the closest stations to the watershed that had precipitation data for 1999. There were no other stations within the watershed with precipitation data for 1999.

Each of these water budgets provided an estimate of monthly runoff in inches. A weighted average runoff value for the whole watershed was computed using the Thiessen method (USDA, 1972; Chow et al, 1988). The watershed area considered to be represented by each station is shown on Figure 3.2 in Appendix E. The average runoff depth for the whole watershed was calculated as the weighted average of the August 1999 runoff values from the 4 stations. The weighting factor for this average was simply the fraction of the watershed represented by each station. The average runoff for the whole watershed was 0.45 inches. Based on the size of the watershed draining into the lakes, this corresponded to a flow rate of 2.69 m^3/s. The calculations for the average runoff depth and corresponding flow rate are shown in Appendix E.

The inflow from Tete Bayou was specified in the model input as 0.081 m^3/s, which was the monthly average flow rate from the City of New Iberia WWTP for August 1999 as reported in their Discharge Monitoring Report (DMR). The inflow from Cotton Canal was assumed to be zero because there was no discharge out of the canal during the intensive surveys and the St. Mary's Sugar Cooperative would not be expected to discharge during late summer (as discussed in Section 2.3). The flow in Loreauville Canal was set to zero in the model input because the lock was closed during the August survey (confirmed by phone during the survey). All of the inflow and outflow rates specified in the model (Data Group D) are summarized in Appendix D.

3.1.5 Longitudinal Dispersion

Data from the surveys indicated that longitudinal dispersion has a noticeable affect on water quality in the Lake Fausse Pointe / Dauterive Lake system. Near the downstream end of the system, the observed values of chloride and conductivity were increasing in the downstream direction, which is a typical effect of tidal dispersion. Near the upstream end of the system, the longitudinal trend of chloride and conductivity values was the opposite (increasing in the upstream direction). A review of the observed data showed that the conductivity values in the middle of the system were similar to the values measured throughout the system during the reconnaissance on July 7-8 (about 250 µmhos/cm). Based on the chloride and conductivity data and the residence time of the lake (several months), it was assumed that the gradients of conductivity and chloride at the upper end of the system were due largely to changing inflow concentrations rather than longitudinal dispersion. Although longitudinal dispersion was specified in the WASP model for the entire system, simulating dispersion was considered more important for the downstream end of the system than for the upstream end.

A hydraulic calibration was performed based on chloride and conductivity measurements from the August survey. Because WASP does not have state variables for conservative tracers, the organic nitrogen and organic phosphorus state variables were used. The conservative nature of conductivity and chloride were maintained by setting all of the kinetic rates to zero for organic nitrogen and organic phosphorus and simulating only those two state variables. The objective of the hydraulic calibration was to adjust the dispersion so that the model would reproduce the observed patterns of chloride and conductivity.

In order to simulate a dispersive system, boundary concentrations were specified for both the upstream and downstream boundaries. For the downstream boundary, the observed values of conductivity and chloride at CDNC-1 were specified in the model. For the upstream boundary, the observed values from the August survey could not be used for a steady state simulation because they appeared to be higher than inflow concentrations that occurred earlier when most of the water in the lakes actually entered the lakes. With a steady state simulation, it is not mathematically possible to predict chloride or conductivity values in the middle of the system that are lower than both the upstream and downstream boundaries. Because the focus of the hydraulic calibration was the lower end of the system, the upstream boundary was based on the average of the observed values in the middle of the system (LFP-4, LFP-5, LFP-6, and LFP-7).

The other model inputs required to simulate dispersion are the characteristic mixing lengths, cross sectional areas between segments, and the dispersion coefficients. The values used for these inputs (in Data Group B of WASP) are shown in Appendix D. The dispersion coefficient was held constant at 50 m^2/sec, which was selected as a typical value for tidal dispersion in the constant density portions of estuaries (Fischer et al, 1979; Martin and McCutcheon, 1999).

Calibration of dispersion in the model was accomplished by adjusting the cross sectional areas between segments because WASP does not allow the user to specify spatial variation of the dispersion coefficient. The input values specified for cross sectional area in Data Group B (the dispersion inputs) do not affect any other part of the model (e.g., segment volumes, hydraulic residence time, velocity, depth, etc.). Results of the hydraulic calibration are shown on Figures 3.3 and 3.4 in Appendix F.

After the hydraulic calibration was completed, the dispersion inputs in Data Group B were left unchanged, but the boundary conditions and kinetic rates were reset so that the organic nitrogen state variable could be used for the water quality calibration.

3.1.6 Boundary Concentrations and Point Source Discharges

Boundary concentrations specified in the model input (Data Group E) are shown in Appendix D. The upstream boundary was set equal to the average of the measured concentrations at stations BdP-1 and BPC-1. The downstream boundary was set equal to the concentrations measured at CDNC-1. The boundary representing Tete Bayou (entering segment 4) was set equal to the measured concentrations at TetB-1. The boundary representing Cotton Canal (entering segment 6) was set equal to the measured concentrations at LFP-8 (no field data were collected in

Cotton Canal). The boundary concentration for Cotton Canal did not have any effect on the calibration simulation because there was no inflow from Cotton Canal during the calibration period.

No point sources were discharging directly into the lake during the August 24-25, 1999 field survey; therefore, no point sources were simulated for the calibration. The discharge from the City of New Iberia WWTP was accounted for by the boundary concentration and flow at station TetB-1.

3.1.7 Nonpoint Source Loads

Nonpoint source loads of $CBOD_U$, organic nitrogen, ammonia nitrogen, and phosphorus were simulated using mass loads that are not associated with a flow (Data Group F in the WASP input). Generally, loads were initially added proportionally to the surface area or volume of the segment and then adjusted during calibration to improve the match between predicted and observed values. Dissolved oxygen loads were used to account for the algal productivity measured from the field study. The loads used in each segment and the DO load calculations are shown in Appendix D.

3.1.8 Temperature and Kinetic Rates

The temperature used for all segments in the model was 33.39ºC. This was an average of the lake station measurements (DL-1, LFP-1, LFP-4, LFP-5, LFP-6, LFP-7, LFP-8 and LFP-9) taken on August 24, 1999.

Temperatures and kinetic rate parameters specified in the model (Data Groups G, H, and I) are listed in Appendix D. These values were either measured (such as BOD bottle decay rate) or chosen based on the Louisiana TMDL Technical Procedures Manual or other literature sources (e.g., Bowie et. al., 1985).

3.1.9 Initial Concentrations

Initial concentrations of the parameters simulated are shown in Appendix D (Data Group J in WASP). The initial concentrations were the values measured on August 24 during the intensive survey. LFP-2 was not used for Segment 2 because it was sampled one day after the rest of the stations had been sampled. Station LFP-3 was not used for Segment 3 because it was too far into the Loreauville Canal to be representative of a lake station. The initial concentrations are initial starting points for the model but they do not affect the final model results because the system is simulated as steady state.

3.2 Calibration Results and Discussion

Graphs of predicted and observed values for the water quality calibration are presented in Appendix G. The inherent variability of the observed data were depicted on these graphs by showing error bars that represent the standard deviation of the measured values. A tabular listing of the calibration model output is included in Appendix H.

3.2.1 $CBOD_U$

The predicted $CBOD_U$ values were within 0.5 mg/L of the observed values (Figure 3.5 in Appendix G). The calibration was achieved by adding $CBOD_U$ to each of the segments (except segment 1) through NPS loads. No $CBOD_U$ load was added to segment 1 because the predicted concentration was already higher than the observed concentration without a NPS load. The sources of $CBOD_U$ in the WASP model include transport from adjacent segments or boundaries (i.e., inflow or dispersion), NPS loads, and algal mortality. Because of the contribution to $CBOD_U$ from algae, the model can predict concentrations of $CBOD_U$ on the order of several mg/L with no external loading (i.e., no NPS loads and no inflow of $CBOD_U$).

3.2.2 Nitrogen Cycle

The components of the nitrogen cycle were calibrated together because the parameters interact. Calibration results for organic nitrogen, ammonia nitrogen, and nitrate+nitrite nitrogen are shown on Figures 3.6, 3.7, and 3.8, respectively in Appendix G. Except for one segment, the predicted values of organic nitrogen and ammonia nitrogen were within 0.07 mg/L of the observed values.

The organic nitrogen was calibrated by adding NPS loads to segments 5 and 6. NPS loads of organic nitrogen were not needed in the other segments because the predicted concentrations were already higher than the observed concentrations without NPS loads. The sources of organic nitrogen in the WASP model include transport from adjacent segments or boundaries (i.e., inflow or dispersion), NPS loads, and algal respiration and mortality.

The ammonia nitrogen was calibrated by adding NPS loads to each of the segments except segments 1 and 4. NPS loads were not needed in segments 1 and 4. In the WASP model, algal respiration and mortality contribute to ammonia as well as organic nitrogen.

Nitrate+nitrite nitrogen was not calibrated because the observed data in the lakes were all reported by the laboratory as below the detection limit of 0.05 mg/L. The predicted concentrations are higher than 0.05 mg/L. The overprediction of nitrate+nitrite is not uncommon in DO/eutrophication models because these models usually do not have any sink of nitrate+nitrite (except for a small amount that is taken up by algae) and the result is that the models predict a buildup of nitrate+nitrite that exceeds the observed concentrations.

3.2.3 Phosphorus/Algae Cycle

The components of the phosphorus/algae cycle were calibrated together because the parameters interact. Calibration results for ortho phosphorus and algae (as chlorophyll *a*) are shown in Figures 3.9 and 3.10 in Appendix G.

Ortho phosphorus was calibrated by adding NPS loads to each segment. Phosphorus loads were needed for all 7 segments. The predicted values were within 0.025 mg/L of the observed values.

Chlorophyll *a* concentrations were calibrated by adjusting various kinetic parameters as indicated in Appendix D (Data Groups G, H, and I). Except for segments 2 and 7, the predicted values were within 1.6 µg/L of the observed values. The chlorophyll *a* concentration was overpredicted for segment 2 and underpredicted for segment 7. This was considered the best possible calibration due to:

1. the limited amount of data (i.e., only one snapshot of data was collected, making it difficult to accurately characterize algae concentrations for calibrating a steady state model),

2. the interactions of the nutrient and algae variables (e.g., changing one parameter to improve the chlorophyll calibration will affect the calibration of the nutrients), and

3. WASP's restrictions on spatial variation of certain kinetic parameters (parameters such as algal growth rates and respiration rates can be changed for each reach in models such as QUAL-TX but WASP does not allow spatial variation of these parameters).

3.2.4 DO

DO was the last parameter calibrated because it is affected by all of the other parameters. Calibration results are shown on Figures 3.11 and 3.12 in Appendix G. These graphs also show the estimated minimum and maximum DO concentrations for each station (based on the continuous DO measurements at LFP-9 on August 25-26).

Calibration of DO was achieved by adjusting the SOD for segments 3 and 6 and adding mass loads of DO to represent algal productivity that was being underpredicted by the model. The WASP model does include a DO contribution from photosynthesis by algae in the water column. However, the model was significantly underpredicting DO values in the lake, even with SOD values set to 0.5 g/m^2/day. SOD values below 0.5 g/m^2/day were not considered reasonable for shallow, productive lakes such as Fausse Pointe and Dauterive. Therefore, the actual DO production by algae was assumed to be higher than what was being calculated in the model. In order to account for additional DO contribution, the formula of DiToro (1975) found in Thomann and Mueller (1987) was used. The formula is written as:

Productivity (mg/L/day) = 2.0 * (max. diurnal DO conc. – min. diurnal DO conc.)

Continuous monitoring data from August 25-26, 1999 at LFP-9 were used for the maximum (8.20 mg/L) and minimum (5.86 mg/L) diurnal DO concentrations. These data yielded a productivity of 1.85 mg/L/day. This productivity was added to the model as a NPS load at each segment by multiplying it by the segment volume.

Although the model significantly underpredicted the higher DO values, this was considered the best possible calibration. It is difficult for steady state DO/eutrophication models to accurately predict DO values that are above saturation (as is the case here). Because the objective of this modeling is to make projections about meeting water quality standards (i.e., maintaining a minimum DO in the lakes), it was considered more important to match the lower DO values than the high, supersaturated DO values. Because the match between predicted and observed values was good for the lower DO values, the model calibration was considered acceptable.

4.0 WATER QUALITY PROJECTIONS

Since the calibrated model indicated that the DO criterion was not being met in some sections of Lake Fausse Pointe and Dauterive Lake, three summer loading scenarios were performed in addition to the traditional summer and winter projections. These additional scenarios were:

a. No Load Scenario - No point source loads and no nonpoint source loads above reference stream background
b. No Discharge Scenario - No point source loads with the calibrated nonpoint source loads
c. No NPS Scenario - Current permitted dischargers with no NPS loads above reference stream background

4.1 Critical Conditions

4.1.1 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 Lake Fausse Pointe and Dauterive Lake TMDL, an analysis of LDEQ long-term ambient data has been employed to determine critical seasonal conditions and an appropriate margin of safety has been used.

Critical conditions for dissolved oxygen were determined for Lake Fausse Pointe and Dauterive Lake using long term water quality data from the station on the LDEQ Ambient Monitoring Network. The critical conditions for dissolved oxygen concentrations were those of negligible nonpoint run-off and low stream flow combined with high temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the temperature is lowered by the runoff. In addition, runoff 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. DO saturation rates 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 was interpreted in TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the lake, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the lakes 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.

Critical summer conditions were simulated in the Lake Fausse Pointe and Dauterive Lake dissolved oxygen TMDL projection modeling by using an estimated 7Q10 flow of 0.1 cfs for all headwaters as stated in the LTP and temperature of 30ºC for the summer season. Incremental flow was assumed to be zero; model loading was from point sources, and sediment oxygen demand. Critical winter conditions were simulated by using an estimated 7Q10 flow of 1.0 cfs as stated in the LTP and temperature of 20ºC. Again, incremental flow was assumed to be zero; model loading was from point sources, and sediment oxygen demand. In addition, all point sources were assumed to be discharging at 125% of maximum capacity to provide a 20% margin of safety.

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

4.1.2 Flows and Dispersion and Sources

Headwater inflows for the summer period were set to 0.1 cfs. For the winter period, the headwater inflows were set 1.0 cfs. Flows for Tete Bayou and Cotton Canal for both summer and winter no non point source projections were set to 125% of the design flow of the New Iberia POTW (3.1 MGD) and the St. Mary Sugar Co-op (1.8 MGD), respectively. This was done in order to explicitly incorporate a 20% margin of safety in the effluent loads. For the no load and no discharge scenarios flow in Tete Bayou and Cotton Canal was set to 0.1 cfs (summer) or 1.0 cfs (winter).

Critical temperature for the summer was set to 30ºC following guidance in the LTP. For the winter, the critical temperature was to 20ºC.

Examination of historical precipitation records show that 1999 was in the lower 10^{th} percentile at both the Jeanerette and New Iberia monitoring stations. Therefore, depths were not adjusted in the projection simulations as 1999 was a dry year and water levels were assumed to reflect that fact, (see Appendix I for precipitation records).

Table 4.1. Treatment plant flow information

Treatment Plant	**Current or Expected Flow (MGD)**	**Modeled Flow (MGD)**	**Modeled Flow (m^3/s)**
Lake Fausse Pointe State Park WWTP	0.01	0.0125	5.48E-4
City of New Iberia WWTP (via Tete Bayou)	2.5	3.125	1.37E-1
St. Mary's Sugar Co-op (via Cotton Canal)	1.4	1.75	7.7E-2

4.1.3 Water Quality Input Data and Their Sources.

The dissolved oxygen values for the initial conditions were set to the August measured value. The dissolved oxygen boundary conditions were set to the 90% saturation value for 30ºC for the summer simulation period (DO value of 6.80 mg/L) and 20ºC for the winter period (DO value of 8.19 mg/L).

The reaeration rate equations, CBOD decay rates, nitrification rates, and mineralization rates were not changed from the calibration.

August 24th measured values were used as initial and boundary conditions for all other simulated parameters (e.g. CBOD, organic nitrogen, etc.). DO loads, which accounted for the observed productivity from the field study, were excluded from the simulation. Instead, only the model-calculated productivity was included in the simulations. This approach is more conservative and adds to the implicit margin of safety.

4.1.3.1 Sediment Oxygen Demand

The reference SOD value assumed to be 0.5 g/m^2-day. This is lower than Louisiana reference stream values, however, Fausse Pointe is a lake system. Best professional judgement was used to determine the value of 0.5 g/m^2-day, which is in the range given in the literature (Bowie et.al, 1985 pg. 190). Loads above 0.5 g/m^2-day for segments 3 and 6 were assumed due to man-made non point source loads. The value and sources for SOD for each projection run are presented in Appendix K.

4.1.3.2 Nonpoint Sources

Except for the “No Load Scenario” (no point source loads with the reference stream nonpoint source loads) and the “No NPS Scenario” (point source loads with the reference stream nonpoint source loads), the NPS values were based on the calibrated values. The values and sources of the nonpoint input and the load analyses are presented in Appendix K for each of the projection runs.

4.1.3.3 Wasteloads

Except for the “No Discharge Scenario” (no point source loads with the calibrated nonpoint source loads) and the “No Load Scenario” (no point source loads and no nonpoint source loads above reference stream background), the wasteloads entered in the projection models for the treatment plants were taken as 125% of the design flow of the current permit. The values and sources of the data are presented in Appendix K.

4.2 Model Discussion and Results

The projection model input and output data sets are presented in Appendix L. The summer projection is presented as a complete printout. The three scenarios are presented as the dissolved oxygen graphs only.

4.2.1 No Load Scenario

Under this scenario, there were no treatment plant discharges and the SOD was set to 0.5 g/m^2-day. The NPS loads were also reduced to reference stream values. Results are shown in Figures 4.1 and 4.2 for the summer and winter seasons respectively in Appendix M.

4.2.2 No Discharge Scenario

Under this scenario, the treatment plant discharges were eliminated and the SOD value was set at the calibration value. The NPS load used was also set at the calibration value. Results are shown in Figures 4.3 and 4.4 for the summer and winter seasons respectively in Appendix M. As shown in the output graphs, the west arm and western portion of the southern basin of Lake Fausse Pointe (Segments 3 and 6) do not meet the existing dissolved oxygen criteria in the summer period.

4.2.3 No NPS Scenario

Under this scenario, the treatment plant discharges were set at 125% of the design flow of current permit values and the SOD was set to 0.5 g/m^2-day. The NPS load was also reduced to reference stream values. Results are shown in Figures 4.5 and 4.6 for the summer and winter seasons respectively in Appendix M. As shown in the output graphs, all segments of the lake system met the DO standard. The plots show that the impact of the treatment plants on the system is much less than the impact of the nonpoint sources. This is reasonable since the treatment plants do not directly discharge into the lake except for the very small contribution of the State Park.

4.2.4 Summer Projection

To meet a DO criterion of 5.0 mg/L throughout the entire watershed requires the imposition of a 30% reduction from all manmade nonpoint sources of BOD (including SOD). This reduction would result in a minimum DO of 5.2 mg/L. The predicted DO for each segment is shown in the following Table 4.2. A graph of the dissolved oxygen concentration versus lake segment for the summer projection is presented in Figure 4.7.

Current point source discharge limits can be maintained as follows:

Facility	**Current Flow (MGD)**	**Current Limits (mg/L)**	**Proposed Limits (mg/L)**
Lake Fausse Pointe State Park	0.01	30 BOD/30 TSS	Same as current
City of New Iberia	2.5	10 BOD/15 TSS	Same as current
St. Mary's Sugar Coop	1.4	15 BOD/50 TSS	Same as current

Table 4.2 Summer projection dissolved oxygen for each segment.

Segment Number	DO Criteria mg/L	Predicted DO mg/L	Segment Location
1	5	6.4	Dauterive Lake
2	5	6.0	Northern portion of Lake Fausse Pointe
3	5	5.2	West arm of Lake Fausse Pointe
4	5	6.4	Bird Island Chute
5	5	6.7	East basin of Lake Fausse Pointe
6	5	5.5	Southern basin – western half
7	5	6.3	Southern basin – eastern half

4.2.5 Winter Projection

The results of the model show that the water quality criterion for dissolved oxygen for Lake Fausse Pointe and Dauterive Lake of 5.0 mg/L can be maintained during the winter critical season without a reduction in point source or nonpoint source loading. The minimum dissolved oxygen is 6.2 mg/L and occurs in the west arm of Lake Fausse Pointe (segment 3). The predicted DO for each segment is shown in the following Table 4.3. A graph of the dissolved oxygen concentration versus lake segment for the winter projection is presented in Figure 4.8.

Current point source discharge limits can be maintained as follows:

Facility	Current Flow (MGD)	Current Limits (mg/L)	Proposed Limits (mg/L)
Lake Fausse Pointe State Park	0.01	30 BOD/30 TSS	Same as current
City of New Iberia	2.5	10 BOD/15 TSS	Same as current
St. Mary's Sugar Coop	1.4	15 BOD/50 TSS	Same as current

Table 4.3 Winter projection dissolved oxygen for each segment.

Segment Number	DO Criteria mg/L	Predicted DO mg/L	Segment Location
1	5	7.6	Dauterive Lake
2	5	7.1	Northern portion of Lake Fausse Pointe
3	5	6.2	West arm of Lake Fausse Pointe
4	5	7.5	Bird Island Chute
5	5	8.1	East basin of Lake Fausse Pointe
6	5	6.8	Southern basin – western half
7	5	7.5	Southern basin – eastern half

4.3 Calculated TMDL, WLAs and LAs

TMDLs for the oxygen demanding constituents (CBOD, NH_3N, and SOD) have been calculated for the summer and winter projection run. These are shown in Table 4.4. A detailed TMDL breakdown is shown in Appendix N.

Table 4.4 Total Maximum Daily Load (Sum of CBOD, NH_3N, and SOD).

Source	Summer		Winter	
	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)
Fausse Pointe State Park WWTP	6.9	15.1	6.9	15.1
City of New Iberia WWTP	1,477.0	3,256.2	1,477.0	3,256.2
St. Mary Sugar Coop	99.4	219.1	99.4	219.1
Total Point Source allocations (WLA)	1,583.2	3,490.4	1,583.2	3,490.4
Point Source MOS	395.8	872.6	395.8	872.6
Natural Nonpoint Source LA	59,438.3	131,038.9	31,892.2	70,310.4
Natural Nonpoint Source MOS	0.0	0.0	0.0	0.0
Manmade Nonpoint Source LA	195,756.4	431,569.0	195,808.8	431,684.6
Manmade Nonpoint Source MOS	48,939.1	107,892.3	48,952.2	107,921.2
TMDL	306,112.7	674,863.2	278,632.3	614,279.1

4.4 Nutrient TMDL

In addition to the DO TMDL, LDEQ also required a nutrient TMDL. Currently there is no concentration based nutrient standard in the State, however, the ratio of nitrogen to phosphorus must be maintained. For TMDL purposes, the ratio of inorganic nitrogen (NH_3, NO_3+NO_2) to ortho phosphorus was analyzed. These parameters were chosen as they had previously been measured in various Louisiana lakes during 1974 as part of EPA's National Eutrophication Survey, and because these parameters are biologically available and are components of commercially available fertilizers which are a manmade nonpoint source. The historical range of inorganic nitrogen to ortho phosphorus for the five least impacted lakes in the study was 8:1 to 10:1 (see Appendix O for data and calculations). The calculated ratios for all runs are shown in Table 4.5.

In order to maintain the nutrient ratio within the historical range, the phosphorus nonpoint source loading was decreased by 50%. This was done on both the winter and summer projection runs. Therefore, in order to achieve an inorganic nitrogen to orthophosphorus ratio of between 8:1 and 10:1, the nonpoint source loading of phosphorus must be reduced by 50%.

The TMDL is given in Table 4.6. Note that a zero load for inorganic nitrogen and orthophosphorus were assumed for the St. Mary Sugar Co-op.

TABLE 4.5: Inorganic Nitrogen to Ortho Phosphorus Ratios

Segment	Summer								Winter							
	No Load		No Point Source Load		No NonPoint Source Load		Projection		No Load		No Point Source Load		No NonPoint Source Load		Projection	
	Inorg. N	Ortho P	Inorg. N	Ortho P	Inorg. N	Ortho P	Inorg. N	Ortho P	Inorg. N	Ortho P	Inorg. N	Ortho P	Inorg. N	Ortho P		
1	0.42	0.29	0.51	0.30	1.82	0.29	1.47	0.12	0.44	0.35	0.32	0.36	1.84	0.36	1.90 0.20	
2	0.50	0.38	0.63	0.39	2.49	0.38	1.99	0.16	0.52	0.46	0.26	0.48	2.51	0.47	2.61 0.26	
3	0.60	0.57	0.83	0.59	3.04	0.55	2.48	0.25	0.62	0.67	0.20	0.71	3.04	0.69	3.23 0.39	
4	0.62	0.62	0.75	0.62	3.33	0.62	2.60	0.27	0.63	0.71	0.28	0.72	3.32	0.73	3.42 0.38	
5	0.89	1.36	1.02	1.36	6.37	1.38	4.75	0.63	0.89	1.47	0.08	1.49	6.28	1.52	6.38 0.78	
6	1.15	8.30	1.08	6.21	20.54	9.48	11.37	3.49	1.08	7.21	0.02	5.98	17.96	8.24	15.07 3.43	
7	0.71	0.60	0.71	0.60	2.97	0.71	2.29	0.37	0.71	0.61	0.13	0.62	2.98	0.73	2.99 0.38	
In. N: Ortho-P Average	1.0		1.1		5.0		8.8		0.9		0.3		4.3		8.2	

Note: Inorganic nitrogen is the sum of NH3 and NO3+NO2

Table 4.6: Nutrient TMDL

Source	Summer				Winter			
	Inorganic Nitrogen		Ortho Phosphorus		Inorganic Nitrogen		Ortho Phosphorus	
	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)	(kg/day)	(lbs/day)
Fausse Point State Park WWTP	0.7	1.6	0.2	0.4	0.7	1.6	0.2	0.4
City of New Iberia WWTP	177.4	391.2	44.4	97.8	177.4	391.2	44.4	97.8
St. Mary Sugar Coop	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Point Source allocations (WLA)	178.2	392.8	44.5	98.2	178.2	392.8	44.5	98.2
Point Source MOS	133.6	294.6	178.6	393.6	133.6	294.6	33.4	73.6
Natural Nonpoint Source LA	57.7	127.2	573.2	1263.7	57.7	127.2	573.2	1263.7
Natural Nonpoint Source MOS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manmade Nonpoint Source LA	4560.0	10053.1	0.0	0.0	5700.0	12566.4	0.0	0.0
Manmade Nonpoint Source MOS	456.0	1005.3	0.0	0.0	456.0	1005.3	0.0	0.0
TMDL	5385.5	11872.9	796.3	1755.5	6525.5	14386.2	651.1	1435.5

5.0 SENSITIVITY ANALYSES

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 sensitivity analysis was performed in accordance with accepted practice by adjusting one parameter at a time while the rest of the parameters listed in the sensitivity section are held at their original projection value (Take and Uguccioni, 1997). Thus, the sensitivity of each parameter is reviewed separately. A sensitivity analysis was performed on the summer projection. The sensitivity of the model's minimum DO projections to these parameters is presented in Table 5.1 in Appendix P. Parameters were varied by ∀30%, except temperature, which was adjusted ∀2 degrees Centigrade.

As shown in the summary table in Appendix P, reaeration is the parameter to which DO is most sensitive. The other parameters creating major variations in the minimum DO values are depth and benthal SOD.

6.0 CONCLUSIONS

The DO TMDL requires a watershed wide 30% decrease in manmade nonpoint source BOD loads and SOD in the summer season. No load reduction is necessary in the winter season for the system to meet standards. Both seasons include a 20% MOS.

Table 6.1. Minimum Dissolved Oxygen for Lake Fausse Pointe and Dauterive Lake for Projections

PERMIT NO.	FACILITY	CURRENT FLOW (MGD)	CURRENT LIMITS (mg/L)	MODELE D FLOW (MGD)	SUMMER PROJECTION LIMITS (mg/L)	WINTER PROJECTION LIMITS (mg/L)
LAG540415	Lake Fausse Pointe State Park	0.01	30 BOD/ 30 TSS	0.0125	Same	Same
LA0065251	City of New Iberia	2.5	10 BOD/ 15 TSS	3.125	Same	Same
LA0005410	St. Mary Sugar Cooperative	1.4	15 BOD/ 50 TSS	1.75	Same	Same
	Minimum DO in Lake Fausse Pointe and Dauterive Lake				5.2	6.2

Also, the nutrient TMDL performed showed that in order to meet historical inorganic nitrogen to orthophosphorus ratios of 8:1 to 10:1 from the National Eutrophication Survey, the nonpoint source loads of phosphorus must be decreased by 50%.

The modeling, which has been conducted for this TMDL, is very conservative and based on limited information. The inherently conservative nature of the model has been increased due to assumptions made during modeling.

LDEQ will work with other agencies such as local Soil Conservation Districts to implement agricultural best management practices in the watershed through the section 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 has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-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. The sampling schedule for the first five-year cycle is shown below.

1998 – Mermentau and Vermilion-Teche Basins
1999 - Calcasieu and Ouachita River Basins
2000 - Barataria and Terrebonne Basins
2001 - Lake Pontchartrain Basin and Pearl River Basin
2002 - Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously) Mermentau and Vermilion-Teche Basins will be sampled again in 2003.

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8.0 APPENDICES

See attached Appendices A through P.