

1999 REVIEW AND ASSESSMENT OF
THE 1987
VERMILION RIVER WATERSHED TMDL
FOR DISSOLVED OXYGEN

SUBSEGMENTS 060801 AND 060802

SURVEYED AUGUST, 1982 AND
AUGUST, 1985

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TABLE OF CONTENTS

1.	Introduction	1
2.	General Information	1
3.	Water Quality Standards	2
4.	1987 Total Maximum Daily Load	3
5.	1998 Water Quality Conditions/Assessment	5
6.	1999 Review	6
7.	Conclusions and Recommendations	7
8.	References	8

ATTACHMENTS

- A. Subsegment Boundary Map
- B. Louisiana GAP Land Use Map
- C. 1992 and 1998 Satellite Imagery
- D. 1987 Vector Diagram
- E. USGS Station Information
- F. DEQ Station DO Graphs
- G. DEQ Station at LA 3073 Data Graphs
- H. Summer Loadings Spreadsheet
- I. Winter Loadings Spreadsheet
- J. Study Area Maps

1. Introduction

The 1996 and 1998 303(d) lists cited the Vermilion River, Subsegments 060801 and 060802, as being impaired due to organic enrichment/low DO. The subsegments were ranked priority 7 and 9 respectively on the 1996 list and "high" on the 1998 list. A Total Maximum Daily Load (TMDL) for dissolved oxygen (DO) for these subsegments was prepared by LDEQ and approved by EPA in 1987. The TMDL quantified both point and nonpoint sources of pollution, established waste load allocations (WLA) for point sources, established the load allocation (LA) for nonpoint sources at existing quantities, addressed seasonal variations and included a margin of safety. The WLAs for point sources have been consistently implemented via the NPDES permit program since the 1987 TMDL was approved. A map showing the boundaries of the two subsegments is attached.

Since this area of the state has been adversely impacted by several droughts, economic slumps in oil/mineral prices, and the resulting reductions in exploration and service activities over the past 10 to 15 years, conditions in the watershed in 1999 have not changed significantly from the conditions observed in 1987. The 1987 model followed a conservative development procedure only slightly different from the current Louisiana technical procedures for developing TMDLs. An extensive review has been conducted to determine if the results and recommendations of the 1987 TMDL are still valid. This paper summarizes the results of that review.

2. General Information

Water quality segment 0608 is part of the Vermilion River Basin. The Basin covers 652 square miles and lies in south-central Louisiana. The upper end of the basin lies in the central part of the state near Alexandria, and the basin extends southward to the Gulf of Mexico. The basin is bordered on the north and northeast by a low escarpment and the lower end of the Red River Basin. The Atchafalaya River Basin is to the east, and the Mermentau River Basin is to the west. The land use in the watershed from the 1990 Nonpoint Source Pollution Assessment Report is summarized in Table 1. The land use map used in 1990 was created by Annotated Soil Maps and digitized by LSU students.

Table 1. Land Uses in Segment 0608 in 1990

LAND USE TYPE	NUMBER OF ACRES	% OF TOTAL AREA
Urban	38,559	9.7
Extractive	1,783	0.4
Agricultural	310,281	77.7
Forest Land	30,268	7.6
Water	2,816	0.7
Wetland	14,832	3.7
Barren Land	728	0.2
Other	106	0.0
TOTAL AREA	399,373	100

Land use from the 1992 imagery has much better resolution and is probably more representative of actual conditions than the 1990 mapping. The categories used in 1992 are also slightly different from those used in 1990. Land uses from the 1992 imagery are summarized in Table 2.

Table 2. Land Uses in Segment 0608 in 1992

LAND USE TYPE	NUMBER OF ACRES	% OF TOTAL AREA
Urban	57,748.5	15.5
Extractive		
Agricultural	226,635.4	60.8
Forest Land	13,165.3	3.5
Water	17,580.8	4.7
Wetland	54,202.0	14.6
Barren Land	385.3	0.1
Rangeland	2,800.6	0.8
TOTAL AREA	372,517.9	100.0

A map showing the 1992 land uses is attached. Since later satellite imagery has not been processed into land use categories yet, the basic images for 1992 and 1998 are also attached. Land use is still dominated by agriculture followed by urban as it was when the 1987 model was developed.

3. Water Quality Standards

The Water Quality criteria and designated uses for subsegments in the Vermilion River watershed are shown in Table 3.

Table 3. Water Quality Numerical Criteria and Designated Uses

Subsegment	060801	060802
Stream Description	Vermilion River – Headwaters at Bayou Fusilier – Bourbeux junction to New Flanders (Ambassador Caffery) Bridge, Hwy. 3073	Vermilion River - New Flanders (Ambassador Caffery) Bridge, Hwy. 3073, to Intracoastal Waterway
Designated Uses	A B C F	A B C F
Criteria:		
Cl, mg/l	230	230
SO ₄ , mg/l	35	35
DO, mg/l	5	5 : JAN – APR 3.5 : MAY- DEC
PH, su	6.0 – 8.5	6.0 – 8.5
BAC	1	1
Temperature, Degrees C	32	32
TDS, mg/l	350	350

USES: A – primary contact recreation, BAC=1; B – secondary contact recreation, BAC=2; C – propagation of fish and wildlife; D – drinking water supply, BAC=3; E – oyster propagation, BAC=4; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

These standards are supported by the 1987 TMDL. The model was run using 4 different temperature scenarios, 30, 28, 23 and 20 degrees C. The recommendations were based on the 30 and 20 degree results which are more conservative than the 90th percentile temperature for the defined seasons. These scenarios were not statistically tied to the seasons cited by the model as December - March and April - November. This difference does not impact the results of the model

in this case, however, the implementation of the WLAs for point sources have been made using the seasons of December - March and April - November rather than the seasons shown in Table 3. This can be easily corrected in the permits as they come up for renewal and would not involve treatment upgrades or other significant impacts on the facilities.

4. 1987 Total Maximum Daily Load

In 1987, a calibrated water quality model for the entire watershed covered by Subsegments 060801 and 060802 was developed and projections were modeled to quantify the point source and non-point source waste loads and the load reductions which would be necessary in order for the Vermilion River to comply with its established water quality standards and criteria.

The model used for this TMDL was QUAL-TX, "a steady-state one-dimensional water quality model that has been developed by the Water Quality Standards and Evaluation Section of the Texas Water Commission. It is a modified version of QUAL-II. The original QUAL-II model was developed by Water Resources Engineers (now Camp Dresser & McKee) for the United States Environmental Protection Agency. Since that time, many modifications have been made to QUAL-II by many people. QUAL-TX is a user oriented model incorporating many of those modifications and is intended to provide the basis for evaluating waste load allocations in the State of Texas." (QUAL-TX User's Manual, rev. 1990).

The model was developed from intensive survey data gathered in August, 1982 and August, 1985. The survey conditions were near low flow, high temperature critical conditions. All available data from DEQs ambient monitoring network and the USGS monitoring network were also considered in the development of this model. The model was calibrated to the 1985 intensive survey data. A limited verification was achieved using the 1982 data. The verification was limited due to the changing hydrologic conditions which occurred during the 1982 survey.

The model extends from the headwaters near the Towns of Sunset and Arnaudville to the confluence of the Vermilion River with the Intracoastal Waterway and includes the following tributaries: Bayou Bourbeux, Bayou Belleview, Bayou Fusilier, Bayou Carencro, Coulee Bend North, Coulee Bend South, Ruth Canal, Bayou Tortue, Coulee Des Poches, Coulee Mine, Anselm Coulee, Coulee Ile Des Cannes, Coulee Kenny, Coulee Gaileque, Youngs Canal, Bancker Canal, Little Bayou and several unnamed tributaries. Dischargers to the tributaries "were necessarily considered in this modeling effort, but may have their major impact on the receiving tributary, rather than on the River. The tributary data used in calibration was inadequate to consider the tributary projections to be calibrated." (WLA, p. 3) The study area is sparsely populated outside its municipalities and land use is dominated by agriculture. A total of ninety sewage treatment facilities (89 dischargers and 1 unknown source), were included in the 1987 modeling effort. A vector diagram of the 1987 model is attached.

The 1987 study focused on the main channel below Lafayette due to historical water quality problems. "The structure and flows within the Vermilion River system have been significantly altered from their natural conditions. At low flow, the major flow in the Vermilion River enters through two major tributaries, Bayou Fusilier, and the Ruth Canal. Flow in these tributaries originates in Bayou Teche, and, at low flow, is largely the result of diversion from the Atchafalaya River. This diversion was developed for the primary purpose of maintaining and improving water quality in the Vermilion River and Bayou Teche by restoring flow, at low flow, to levels which are similar to those which were present prior to the Federal construction of the West Atchafalaya Basin

Floodway Project (US Army Corps of Engineers, 1986). Operations of the diversion pumps and structures is under the authority of the Teche-Vermilion fresh Water District." Additional "flood control, channel improvement, and navigation projects have also significantly changed the hydrological characteristics of the river. . . . Thus, man-induced water quality influences at low flows include point sources of pollutants, agricultural and urban runoff, and channel modifications, as well as the level of diversion flow." (Waste Load Allocation for the Vermilion River, Volume 1, pp. 5-6)

The TMDL which resulted from the 1987 model and study is presented in Table 4. TMDLs for the oxygen demanding constituents ultimate biochemical oxygen demand, organic nitrogen, ammonia, and nitrite-nitrate (UBOD, ORG-N, NH₃N, and NO₃-N), have been calculated for the summer and winter projection runs.

Table 4. 1987 Total Maximum Daily Load (Sum of UBOD, ORG-N, NH₃N, and NO₃-N)

SOURCE	SUMMER (30° C) (lbs/day)	WINTER (20° C) (lbs/day)
Point Source WLA	6,202.2	10,366.2
Point Source Reserve MOS	1,550.6	2,591.6
Headwater Source LA	20,106.3	20,106.3
Nonpoint Source LA	2,405.0	2,405.0
Incremental Nonpoint Source LA	8,042.6	8,042.6
TMDL	38,306.7	43,511.7
Point Source WLA + MOS as %TMDL	20.2	29.8

The 1987 model was extremely conservative in several areas which severely impact Louisiana waters. First, the minimum reaeration equation was used on many streams where we would now use the Louisiana Reaeration Equation to more accurately simulate conditions. Also, the only difference between the summer and winter projections is the temperature difference. Headwater flows were not increased to simulate winter conditions more appropriately. Under current procedures, we would more realistically increase the headwater flow during the winter. Also, the default temperatures of 30°C for summer and 20°C for winter are probably much more conservative than the 90th percentile temperature for each season computed from actual data. The default temperatures are more representative of seasons defined by May - October and November - April and recent study has shown that the default temperatures are conservative for those months.

The minimum DO for the summer season was projected to be 3.5 on the main channel at river mile 1.1. The minimum DO for the winter season was projected to be 5.2 on the main channel at river mile 0.0.

The Vermilion River TMDL has been the basis for issuing NPDES permits in the watershed since 1987. Facilities with discharge flowrates of greater than 25,000 gpd have been permitted at 10 mg/l CBOD₅/5 mg/l NH₃N/5 mg/l DO for April-November and at 20 mg/l CBOD₅/10 mg/l NH₃N/5 mg/l DO for December-March. Facilities discharging 25,000 gpd or less have been permitted at secondary limits year round. The City of Abbeville received mass limits under the 1987 TMDL. Since then Abbeville has upgraded and increased the capacity of its treatment system. They were allowed to use half of the margin of safety originally associated with their system. Their current permit limits were therefore set at 7 mg/l CBOD₅/3 mg/l NH₃N/5 mg/l DO for April-November and

at 14 mg/l CBOD₅/7 mg/l NH₃N/5 mg/l DO for December-March which changes their allocation to 90% instead of 80% of the original 1987 TMDL. The City of Lafayette Plants are permitted at 10 mg/l CBOD₅/5 mg/l NH₃N/5 mg/l DO for July-September, 10 mg/l CBOD₅/10 mg/l NH₃N/5 mg/l DO for April-July and October-November and at 20 mg/l CBOD₅/10 mg/l NH₃N/5 mg/l DO for December-March as established in an update approved by EPA on 02/03/88. As stated earlier, the permits can be corrected to seasons of January – April and May – December as they come up for renewal.

The allocations made to the point sources in the 1987 model were quantified in terms of CBOD₅ and NH₃N. A summary of the allocations is shown in Table 5.

Table 5. Summary of Point Source Allocations

LOAD TYPE	SUMMER		WINTER	
	CBOD ₅ , lb/day	NH ₃ N, lb/day	CBOD ₅ , lb/day	NH ₃ N, lb/day
Point Sources WLAs	2220.3	1113.5	4312.6	2154.1
Margin of Safety	555.1	278.7	1078.1	538.5
TOTAL	2775.4	1392.2	5390.7	2692.6

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 QUAL-TX 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 calibrations model. Parameters were varied by +/- 10% and +/- 30%, except temperature, which was varied by +/- 2 and +/-4 degrees Centigrade. As is typical of Louisiana waters, dissolved oxygen concentration was found to be most sensitive to temperature, reaeration, depth and background SOD in that order.

5. 1998 Water Quality Conditions/Assessment

Subsegment 060801, Vermilion River from the headwaters at Bayou Fusilier - Bourbeux junction to New Flanders (Ambassador Caffery) Bridge, Hwy. 3073, was assessed as threatened according to the 1998 305(b) Water Quality assessment for Louisiana. Suspected pollutants were Phosphorus, Nitrogen, Organic Enrichment/Low DO, Pathogens, Cadmium, and Lead from minor industrial point sources, minor municipal point sources, package plants (small flows), irrigated and nonirrigated crop production, and unknown sources. Subsegment 060802, Vermilion River from the New Flanders (Ambassador Caffery) Bridge, Hwy. 3073, to Intracoastal Waterway, was partially supporting its designated uses according to the 1998 305(b) Water Quality assessment for Louisiana. Suspected pollutants were Phosphorus, Nitrogen, Organic Enrichment/Low DO, Pathogens and Lead from minor industrial point sources, major and minor municipal point sources, package plants (small flows), irrigated and nonirrigated crop production, and unknown sources. Both subsegments were also on the 1996 303(d) list for habitat alterations, nutrients, organic enrichment/low DO, pathogen indicators, suspended solids, and turbidity. The subsegments were ranked "high" on the 1998 list and at priority 7 and 9 respectively on the 1996 list. A TMDL is in force for the two subsegments and is being implemented through the NPDES permitting program.

The USGS maintains five active stations on the Vermilion River. Current conditions of stage and rainfall can be obtained for each of these sites. Three of the stations were established in 1996 and therefore the historical stage record is not yet available: 07396600, Bayou Vermilion near Carencro, LA, Hwy 726; 07386850, Vermilion River near Lafayette, LA, Hwy 94; and, 07386940, Vermilion River at Hwy 733 near Lafayette, LA. Station 07386880 is on the Vermilion River at Surrey Street at Lafayette, LA and has intermittent historical discharge measurements from December 15, 1967 to September 30, 1996. The record is poor, but shows tidal influences at all stages. Station 07386980, Vermilion River at Perry, LA, is a long term record station with nearly continuous data from November 15, 1984 to September 30, 1997. The discharge is also affected by tides at the station for all stages. Copies of location maps, station descriptions, and graphs of any available data for each station are attached.

LDEQ has data from 4 ambient water quality network stations on the Vermilion River. A long term monthly water quality sampling station is located at Perry and coordinates with the USGS station in Perry. The period of record is from June 1, 1958 through August 10, 1999. This station continues to be sampled on a monthly basis under DEQ's new monitoring strategy as the trend station for the Vermilion River. The data shows an overall trend toward higher dissolved oxygen concentrations at this location. Another long term station was located at the Hwy 94 bridge from March 7, 1978 to May 11, 1998 and was sampled on a bi-monthly basis. Data at that station also show a trend toward higher dissolved oxygen concentrations. The Hwy 94 station is no longer sampled under the new monitoring strategy which began in July, 1998. The new ambient monitoring strategy focuses on each Basin intensely for a limited period of time over a five year cycle. The LDEQ station at Hwy 3073 has been sampled sporadically: 01/01/63 - 12/31/68, 03/07/78 - 12/11/90, and 06/24/98 - 12/15/98. In the 60's the dissolved oxygen trend was toward lower values. In the later periods, the trend has been toward higher dissolved oxygen concentrations. In the latest sampling effort, bi-weekly for six months in 1998, the trend is toward higher dissolved oxygen concentrations in spite of the one anomalous reading on 9/22/98. The anomaly could be seen in field conductivity, DO, Sulfate, Chlorides, TKN, and NO₂+NO₃. Graphs of the DO data for each station are attached. Graphs of the anomalies at the LA3073 station are also attached.

Although there are still water quality violations for dissolved oxygen in subsegments 060801 and 060802, there is a distinct but slow trend toward improving water quality at all of the DEQ sampling sites. This trend is most likely due to the implementation of the WLAs for the point sources. Since the point sources are not the major of source of pollutants in the watershed, the trend suggests that more improvement will be made when a reduction is achieved in the nonpoint source pollution load.

6. 1999 Review

The discharger inventory for the Vermilion River watershed was reviewed and the dischargers were evaluated based on the volume of their discharge, their location with respect to the listed waterbody, any water quality data which demonstrated their impact or lack of impact, whether or not the NPS contribution included any small facilities, and best professional judgement. There are 139 dischargers which are considered to have any ability to impact the Vermilion River. It is possible that some of these may have been evaluated for the 1987 model and judged to have no impact. For this review, a conservative approach is being used toward the dischargers. Many of these plants discharge to tributaries and/or subtributaries to the River and probably have no impact on the main channel. However, if they discharge to a tributary system which was part of the original 1987 model, they have been included in the 1999 evaluation in order to preserve a conservative analysis.

The NPDES permit for each facility was reviewed and flow and loading data were retrieved and placed in a spreadsheet to facilitate analysis. The loadings for both summer and winter seasons were evaluated. A summary of the total loads and how they compare to the 1987 TMDL is presented in Table 6. A copy of the spreadsheet used to compute and compare loadings for 1987 and 1999 for each season is attached. Maps of the study area showing the locations of the dischargers are also attached.

Table 6. Summary of Point Source NPDES Permitted Loads

	SUMMER		WINTER	
	CBOD ₅ , lb/day	NH ₃ N, lb/day	CBOD ₅ , lb/day	NH ₃ N, lb/day
Point Sources	2671.9	1325.1	5095.0	2547.5
% of 1987 Point Source WLA + MOS	96.3	95.2	94.5	94.6

From this evaluation, the percent change to the total TMDL is much less than 10% and given the conservative nature of the review, the remaining MOS for the point sources should exceed 10%.

It should be noted that of the 6 industrial dischargers included in the 1987 model, all have changed significantly:

1. Cargill Salt - No longer discharges oxygen demanding substances in main outfall; sanitary flow is separate and less than 5000 gpd
2. Bruce Foods - Discharges into the portion of Bayou Tortue that flows into Bayou Teche (not the Vermilion River)
3. B. F. Trappey - Facility Closed
4. Dixie Canning - No oxygen demanding wastes found
5. Riviana Foods - Permit Voided (either closed or discharging to a municipal WWTP)
6. Seacoast Products - Still discharging at about the same loading as for the 1987 Model

Most of the municipalities have upgraded their treatment facilities. The Lafayette Municipal plants have lower design capacities than was projected in the 1987 model. Overall, the point source contributions in terms of both flow and loading have not significantly changed from the 1987 model.

7. Conclusions and Recommendations

The 1987 Vermilion River model continues to adequately simulate conditions in the watershed. The TMDL which resulted from that model has been implemented with regard to point sources of pollution. The water quality monitoring data collected by LDEQ shows an overall trend toward improving water quality in spite of the occasional violation of the dissolved oxygen criteria.

The modeling which was conducted for the 1987 TMDL was very conservative and based on policies and procedures more stringent in many ways from current modeling policies and procedures. Key among those differences was the use of default temperatures to model for each season and the use of the default minimum reaeration equation on streams where the Louisiana Equation would now be considered more appropriate.

The NPDES Permits for the individual point sources in the watershed should continue to be issued on the basis of flowrates:

FLOWRATE

PERMIT LIMITS

greater than 25,000 gpd

10 mg/l CBOD₅/5 mg/l NH₃N/5 mg/l DO: May-Dec
20 mg/l CBOD₅/10 mg/l NH₃N/5 mg/l DO: Jan - Apr

25,000 gpd or less

secondary limits year round

As existing permits come up for renewal, the season definitions should be changed to correspond with the standards.

The nonpoint source pollution should have been reduced by at least 20 % in the 1987 model to provide a greater margin of safety. In view of the recent modeling of other south Louisiana watersheds, a 50 % reduction in man-made nonpoint source pollution is recommended for the watershed. This should accelerate the progress toward full support of designated uses in the watershed.

Finally, the Teche-Vermilion Freshwater Diversion still imparts the major impact on the water quality in the watershed. Progress toward full water quality support could be accelerated if the diversion could be increased.

8. References

Louisiana Department of Environmental Quality. Environmental Regulatory Code, Part IX. Water Quality Regulations. Baton Rouge, LA: 1999.

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