FINAL

TMDL for Total Suspended Solids for the Grand Bayou and Little Grand Bayou, Subsegment 120206 in the Terrebonne Basin, Louisiana

Prepared for:

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EXECUTIVE SUMMARY

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody can assimilate without exceeding its water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

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

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

The study area for this TMDL is the Terrebonne Basin, which is in southeastern Louisiana. The Terrebonne Basin covers an area extending approximately 120 miles west of the Mississippi River at Baton Rouge in the north to the Gulf of Mexico in the south. It varies in width from 18 miles to 70 miles. The 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 1993).

The northern portion of the Terrebonne Basin is dominated by agricultural land and wetlands. The majority of the agricultural land is in sugarcane production. In subsegment 120206, the southwestern portion of the watershed is dominated by wetlands, while the northern and eastern portions are dominated by agriculture.

The Louisiana Department of Environmental Quality (LDEQ) listed subsegment 120206 in the Terrebonne Basin on Louisiana's 2004 section 303(d) list for impairment due to total suspended solids (TSS). The suspected source of the impairment is not known. The impaired designated uses for this subsegment are primary contact recreation, secondary contact recreation, and fish and wildlife propagation.

State water quality standards provide only narrative water quality criteria for TSS: "[t]here shall be no substances present in concentrations sufficient to produce distinctly visible solids or scum, nor shall there be any formation of long-term bottom deposits of slimes or sludge banks attributable to waste discharges from municipal, industrial, or other sources including agricultural practices, mining, dredging, and the exploration for and production of oil and natural gas."

The TMDL numerical endpoint was determined through a regression analysis between TSS and turbidity for the two monitoring locations in the subsegment. The resulting surrogate endpoints were 61.7 and 65.0 mg/L for each monitoring location.

The TMDL was calculated using a load reduction approach. Using this approach, the percent reduction for an LDEQ monitoring station was calculated on the basis of observed levels of constituents. The minimum percent reduction was calculated so that the monitoring data would meet criteria at that station. The percent reduction was applied to the entire subsegment. Because two monitoring stations were present in subsegment 120206, the larger percent reduction was used to ensure that both monitoring stations will meet criteria.

Because of the lack of flow data in subsegment, the monthly water yield (runoff in millimeters) was used to obtain TMDL loadings. The water yield was used to determine runoff intensities that were multiplied by each subsegment area and the average reduced constituent levels to obtain the TMDL loading.

In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis for establishing water quality-based controls. WLAs were given to permitted point source dischargers. The LA includes background loadings as well as human-induced nonpoint sources. An implicit MOS was included in this TMDL. An FG component of 10 percent was also included in this TMDL. A summary of the TMDL for is presented in Table ES-1. A percent reduction of 93 percent is needed to meet the proposed TSS endpoint. WLAs are presented in Table ES-2. Although the derived TSS TMDLs are based on best professional judgment using current data and regression analyses, meeting WLAs might not be necessary if alternative remediation and future monitoring prove that TSS is being corrected without reducing WLAs.

Table ES-1. Summary of TSS TMDL, MOS, FG, WLA, and LA for subsegment 120206

Subsegment	Station	Pollutant	Percent reduction	Total allowable loading	MOS	FG (10%)	∑ WLA	∑ LA
				tons/day				
120206	82	TSS	92.7	5.95	Implicit	0.59	5.05	0.30

Hurricane Katrina made landfall on Monday, August 29, 2005, as a Category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80 percent of New Orleans and large areas of coastal Louisiana. Much of the area that was flooded during Hurricane Katrina was flooded again by the storm surge from Hurricane Rita. Both Hurricanes Katrina and Rita have caused a significant amount of change in sedimentation and water quality in southern Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will be rebuilt, while others will be relocated. The hurricanes expedited the loss of coastal land and modified the hydrology of some of the coastal waterbodies. Several federal and state agencies including EPA and LDEQ are engaged in collecting environmental data and assessing the recovery of the Gulf of Mexico waters.

The proposed TMDLs in this report were developed on the basis of pre-hurricane water quality conditions. Some point sources in this TMDL have been updated with post-hurricane information, where available. Therefore, post-hurricane water quality conditions and other factors could delay the implementation of these proposed TMDLs, render some proposed TMDLs obsolete, or could require modifications of the TMDLs. While hurricane effects might be valid for some TMDLs, any deviation from the TMDLs should be justified using site-specific data or information.

Table ES-2. Summary of WLAs for point sources in subsegment 120206

NPDES permit number	Outfall	Facility name	Flow (gpd)	TSS (mg/L)	TSS (lb/d)
LA0000485	001	Lula Westfield LLC—Westfield Raw Sugar Factory	10,000,000	50	4,172.703
LA0001295	002	Cora Texas Manufacturing Co.	7,100,000	50	2,962.619
LA0007382	001/002	Lula Westfield LLC—Lula Raw Sugar Factory	3,637,845	50	1,517.965
LA0049310	001	Dow Chemical Co.—Grand Bayou Operations	1,300,000	45	488.206
LA0049310	002	Dow Chemical Co.—Grand Bayou Operations	1,700,000	50	709.360
LA0049310	003	Dow Chemical Co.—Grand Bayou Operations	130,000	50	54.245
LA0049310	004	Dow Chemical Co.—Grand Bayou Operations	270,000	45	101.397
LA0049310	101	Dow Chemical Co.—Grand Bayou Operations	100	45	na[a]
LA0049310	104	Dow Chemical Co.—Grand Bayou Operations	240	45	na[a]
LA0049310	106	Dow Chemical Co.—Grand Bayou Operations	variable	50	na[a]
LA0049310	204	Dow Chemical Co.—Grand Bayou Operations	80	45	na[a]
LA0107212	003	Texas Eastern Transmission Corp—White Castle Compressor Station	10	45	0.004
LA0119491	001	K/D/S Promix LLC, Fractionation Plant	150,789	45	56.628
LAG110053	001/001A	Leblanc Brothers Redi Mix—Paincourtville Facility	144	50	0.060
LAG480530	001	Southern Natural Gas Co.—White Castle Compressor Station	500	45	0.188
LAG531143	001	St. Elizabeth School	4,050	45	1.521
LAG531262	001	Gulf South Pipeline Co. LP—Rodrigue Compressor Station	2,500	45	0.939
LAG531692	001	Acadian Gas Storage Facility	60	30	0.015
LAG540036	001	Bayou Corne Sewer Co. Inc.—Sportman's Paradise Subdivision	15,200	30	3.806
LAG540157	001	World-Wide Environmental Solutions LLC—Lucky Hit Shopping Center	8,900	30	2.228
LAG540548	001	Assumption Community Hospital	7,600	30	1.903
LAG540954	001	Assumption Parish Police Jury—Belle Rose Lane Sewerage District	14,300	30	3.580
LAG541081		Super Stop Enterprises—Gator Super Stop Truck Stop	7,760	30	1.943
LAG541191	001	No Problem Raceway Park	23,860	30	5.974
LAG541277	001	Grant Loop Community Sewer System	17,200	30	4.306
LAG541415	001	Assumption Parish Recreation District #2 Veterans Park	6,000	20	1.001
LAG560026	001A	World-Wide Environmental Solutions LLC—Bayou Tranquille Subdivision	45,000	45	16.899
LAG670075	001	Triad Nitrogen LLC	na[b]	90	na[b]

[a] These are internal outfalls. WLAs are included in the corresponding external outfalls. (Outfall 101 goes to outfall 001. Outfalls 104 and 204 go to outfall 004. Outfall 106 goes to outfalls 001, 002, 003, and 004.)
[b] This facility has a permit that took effect in 2004. No flow information is available in the permit and as of September 2007, this facility has not discharged effluent.

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APPENDIX

TABLES

FIGURES

1 INTRODUCTION

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

The Louisiana Department of Environmental Quality (LDEQ) listed subsegment 120206 in the Terrebonne Basin on Louisiana's 2004 section 303(d) list for impairment due to total suspended solids (TSS). The suspected source of the impairment is not known. The impaired designated uses for this subsegment are primary contact recreation, secondary contact recreation, and fish and wildlife propagation.

2 BACKGROUND INFORMATION

2.1 General Description

The subsegment addressed in this TMDL report is in the Terrebonne Basin, which is in southeastern Louisiana in portions of U.S. Geological Survey (USGS) hydrologic unit code (HUC) 08090302. Figure 2-1 shows the location of the listed subsegment. The Terrebonne Basin covers an area extending approximately 120 miles west of the Mississippi River at Baton Rouge in the north to the Gulf of Mexico in the south. It varies in width from 18 miles to 70 miles. The 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 1993). Table 2-1 lists the parishes in which the subsegment 120206 is located and the drainage area of the subsegment.

Table 2-1. Parish and drainage area for each listed subsegment in the Terrebonne Basin

Subsegment number	Subsegment name	Parish	Drainage area (acres)
120206	Grand Bayou and Little Grand Bayou	Iberville, Ascension, Assumption	9,329.6

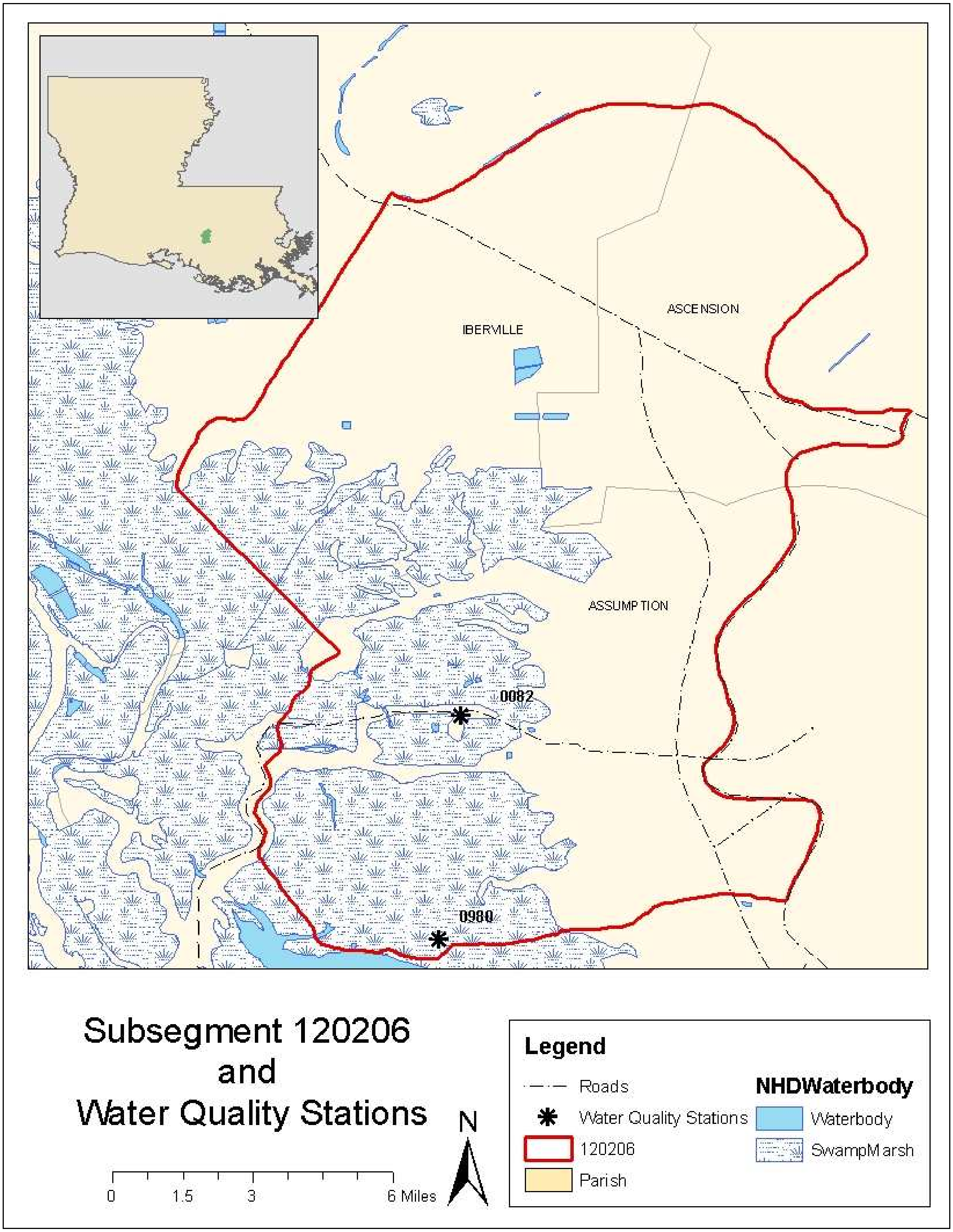

Figure 2-1. Location of the subsegment 120206.

2.2 Land Use

Land use data were obtained from the USGS 2001 National Land Cover Data (NLCD). The subsegment is dominated by agricultural land (pasture/hay and row crops) and wetlands. Table 2-2 lists the percentage of each land use by subsegment, and Figure 2-2 shows its land use coverage.

Table 2-2. Percent land use in subsegment 120206

Barren	Forest	Grassland/ herbaceous	Pasture/hay	Row crops	Urban	Water	Wetlands	Total
0.0	0.1	0.0	2.5	47.4	4.7	0.9	44.4	100.0

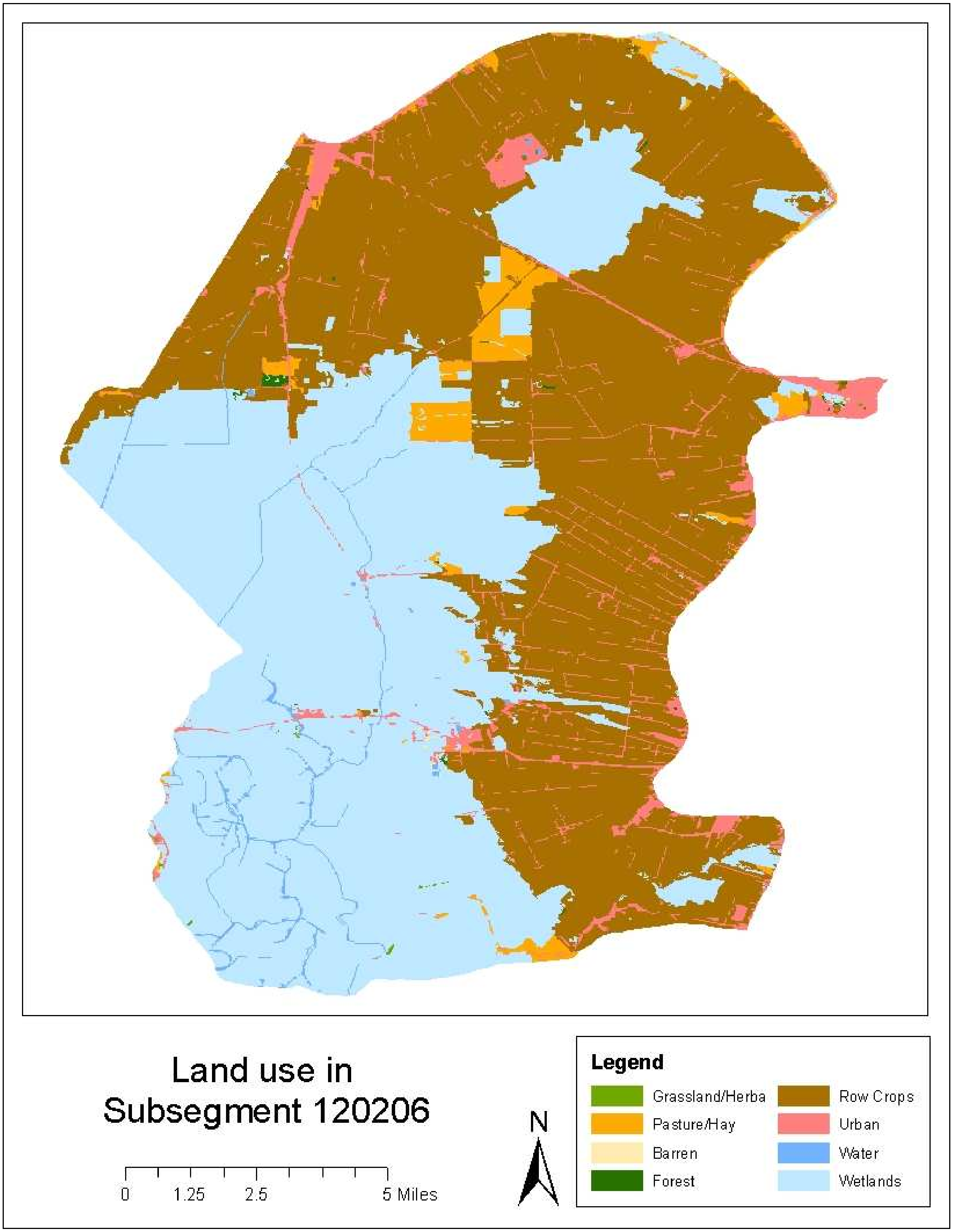

Figure 2-2. Land use in subsegment 120206.

2.3 Soils

General soils data for the United States are provided as part of the Natural Resources Conservation Service's (NRCS's) State Soil Geographic (STATSGO) database. Soils data from this database and a geographic information system (GIS) coverage from NRCS were used to characterize soils in the Terrebonne Basin subsegments.

One of the soil characteristics provided in the STATSGO database is the K-factor. The K-factor is a component of the Universal Soil Loss Equation, or USLE (Wischmeier and Smith 1978). The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion, and values can range from 0 to 1.00. In practice, maximum factor values generally do not exceed 0.67. Large K-factor values reflect greater inherent soil erodibility. The distribution of K-factor values in the surface soil layers of the Terrebonne Basin subsegments is shown in Table 2-3 and Figure 2-3. The figure indicates that, on average, the soils in the basin have K-factors that range from 0.0497 to 0.388. The areas without K-factor values are open water. The upper portion of the subsegment has higher K-factors, suggesting that these soils are more likely to erode than those in the southeastern portion. Erosion is also influenced by a number of other factors, including rainfall and runoff, land slope, vegetation cover, and land management practices.

The hydrologic soil group classification is another commonly used soil characteristic provided in the STATSGO database. The hydrologic soil group is a means for grouping soils by similar infiltration and runoff characteristics. Clay soils that are poorly drained tend to have the lowest infiltration rates, whereas sandy soils that are well drained have the highest infiltration rates. NRCS has defined four hydrologic groups for soils (Table 2-4). The STATSGO data were summarized using the major hydrologic group in the soil surface layers (Figure 2-3). Subsegment 120206 consists of the C and D hydrologic soil groups. The C and D soils in these watersheds are indicative of the predominance of wet, poorly drained soils in the Terrebonne Basin.

Table 2-3. Soil properties

Subsegment	K-factor range	Surface texture	Hydrologic soil group
120206	0.0497–0.3878	fine sandy loam, silt loam, loamy fine sand, clay, muck, variable, mucky peat, silty clay loam, very fine sandy loam	C, D

Table 2-4. Hydrologic soil groups

Hydrologic soil group	Description
A	Soils with high infiltration rates. Usually deep, well-drained sands or gravels. Little runoff.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well-drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates, high clay content, and poor drainage. High amounts of runoff.

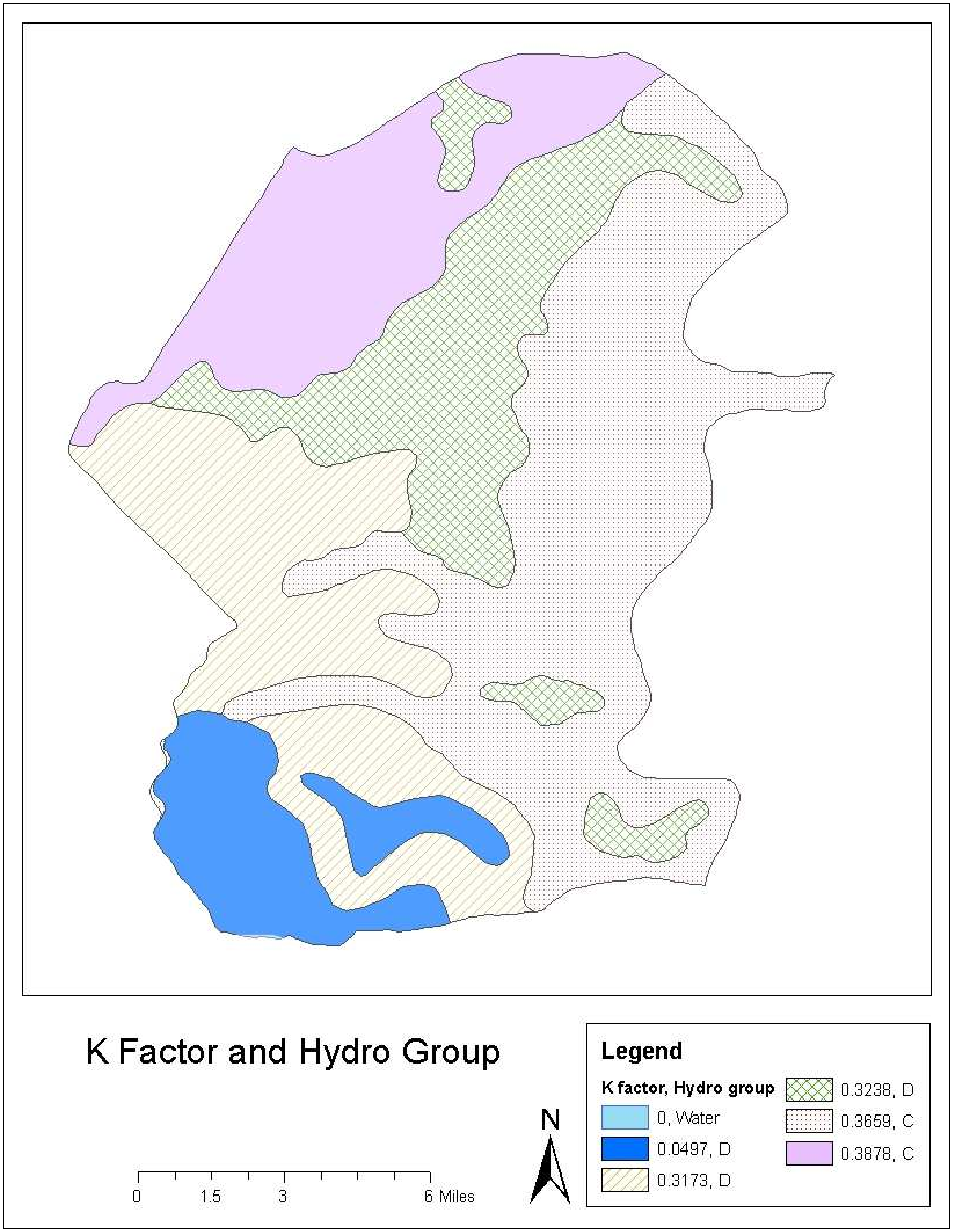

Figure 2-3. Hydrologic soil group and soil K-factor values in subsegment 120206.

2.4 Flow Characteristics

There are three active USGS flow-monitoring gages in the Terrebonne Basin. However, these gages recorded several zero and negative flow values because of the tidal influences. As a result, they cannot be used for TMDL development because average flow could not be determined.

2.5 Designated Uses and Water Quality Criteria

Louisiana's 2004 section 303(d) list indicates that subsegment 120206 has a designate uses of primary contact recreation, secondary contact recreation, and fish and wildlife propagation (LDEQ 2005a).

Primary contact recreation involves any recreational or other water contact use involving full-body exposure with water and considerable probability of the ingestion of water. Examples are swimming and water skiing, whereas, secondary contact recreation involves activities such as fishing, wading, or boating where water contact is accidental or incidental and there is a minimal chance of ingesting appreciable amounts of water.

The designated use of fish and wildlife propagation includes the use of water for aquatic habitat, food, resting, reproduction, cover, or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment. The fish and wildlife propagation use also includes maintaining water quality at a level that prevents damage to native wildlife and aquatic species associated with the aquatic environment and contamination of aquatic life consumed by humans.

This subsegment is included on Louisiana's 2004 section 303(d) list for TSS impairments. State water quality standards (2005b) provide only narrative water quality criteria for TSS: "[t]here shall be no substances present in concentrations sufficient to produce distinctly visible solids or scum, nor shall there be any formation of long-term bottom deposits of slimes or sludge banks attributable to waste discharges from municipal, industrial, or other sources including agricultural practices, mining, dredging, and the exploration for and production of oil and natural gas."

Antidegradation Policy

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

2.6 Point Sources

During the TMDL development process, information on point source dischargers in the impaired subsegments was obtained from LDEQ internal databases. Data were pulled from these databases and analyzed for TSS limit and facility flow. Table 2-5 presents the identified facilities. For facilities that were not identified, this TMDL contains a Future Growth (FG) component that can be used for any point sources not identified or are in the planning state.

Phase I and II stormwater systems are another possible point source contributor in the Terrebonne Basin. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby waterbodies. Most stormwater discharges are considered point sources and require coverage by a National Pollutant Discharge Elimination System (NPDES) permit. No municipal separate storm sewer system (MS4) municipalities were identified in subsegment 120206.

Table 2-5. NPDES permitted facilities in subsegment 120206 with TSS limits

NPDES permit number	Outfall	Facility name	Location	Receiving water	Flow (gpd)	TSS (mg/L)
LA0000485	001	Lula Westfield LLC—Westfield Raw Sugar Factory	451 Hwy 1005; Paincourtville	Armelise Canal	10,000,000 (average)	50 (daily max.)
LA0001295	002	Cora Texas Manufacturing Co.	32505 Hwy 1; White Castle	Bayou Sigur	7,100,000 (average) 7,900,000 (design)	50 (daily max.)
LA0007382	001/002	Lula Westfield LLC—Lula Raw Sugar Factory	351 Hwy 999; Belle Rose	Lulu Canal - Lake Verret	3,637,845 (average) 6,200,000 (design)	50 (daily max.)
LA0049310	001	Dow Chemical Co.—Grand Bayou Operations	875 Hwy 70; Belle Rose	drainage - Bayou Oliver - Grand Bayou	1,300,000 (design)	Monitor only
	002				1,700,000 (design)	Monitor only
	003				130,000 (design)	Monitor only
	004				270,000 (design)	Monitor only
	101				100 (design)	45 (daily max.)
	104				240 (design)	45 (daily max.)
	106				variable	50 (daily max.)
	204				80 (design)	45 (daily max.)
LA0107212	003	Texas Eastern Transmission Corp—White Castle Compressor Station	55095 Grand Rd; White Castle	drainage - Grand Bayou - Palquenmine Bayou	10 (design)	45 (weekly ave.)
LA0119491	001	K/D/S Promix LLC, Fractionation Plant	6225 Hwy 996; Belle Rose	Grand Bayou	150,789 (design)	45 (weekly ave.)
LAG110053	003	Leblanc Brothers Redi-Mix - Paincourtville Facility	6185 Hwy 1, Paincourtville	Magnolia Canal	144 (average)	50 (daily max.)
LAG480530	001	Southern Natural Gas Co.—White Castle Compressor Station	33480 Hwy 405; White Castle	drainage - Rocky Canal - Bayou Sigur - Grand Bayou	500 (average) 5,000 (permit max.)	45 (weekly ave.)

Table 2-5. (continued)

NPDES permit number	Outfall	Facility name	Location	Receiving water	Flow (gpd)	TSS (mg/L)
LAG531143	001	St Elizabeth School	6051 Convent St; Paincourtville	Whitmel Canal to Lake Verret	4,050 (design) 5,000 (permit max.)	45 (weekly ave.)
LAG531262	001	Gulf South Pipeline Co. LP—Rodrigue Compressor Station	Hwy 996; Paincourtville	ditch - Bayou Des Oliver - Grand Bayou	2,500 (permit max.)	45 (weekly ave.)
LAG531692	001	Acadian Gas Storage Facility	6326 Hwy 996; Belle Rose	ditch - Bayou Des Oliver - Grand Bayou	60 (average) 2,500 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG540036	001	Bayou Corne Sewer Co. Inc. —Sportman's Paradise Subdivision	1491 Hwy 70 S; Bayou Corne	Bayou Corne	15,200 (design)	30 (monthly ave) 45 (weekly ave.)
LAG540157	001	World-Wide Environmental Solutions LLC—Lucky Hit Shopping Center	2 miles north of Plattenville	ditch-Catfish Canal-Bayou Gross Tete	8,900 (average) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG540548	001	Assumption Community Hospital	135 Hwy 402; Napoleonville	Glennwood Creek	2,160 (average) 7,600 (design) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG540954	001	Assumption Parish Police Jury—Belle Rose Lane Sewerage District	Belle Rose Ln; Belle Rose	Grand Bayou	14,300 (design) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG541081		Super Stop Enterprises—Gator Super Stop Truck Stop	1230 Hwy 70; Belle Rose	Grand Bayou	7,760 (design) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG541191	001	No Problem Raceway Park	6470 Hwy 996; Belle Rose	Grand Bayou	23,860 (design) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG541277	001	Grant Loop Community Sewer System	Grant Rd & Grant Loop; Paincourtville	drainage - Whitmel Canal - Lake Verret	17,200 (design) 25,000 (permit max.)	30 (monthly ave) 45 (weekly ave.)
LAG541415	001	Assumption Parish Recreation District #2 "Veterans Park"	2862 LA Hwy 70; Pierre Part	ditch - Bayou Pierre Part - Pierre Bay	6,000 (average) 25,000 (permit max.)	20 (weekly ave.) 30 (daily max.)
LAG560026	001A	World-Wide Environmental Solutions LLC— Bayou Tranquille Subdivision	off Hwy 70; Belle River	swamp to Lake Verrett	45,000 (average) 50,000 (permit max.)	20 (monthly ave.) 30 (weekly ave.)
LAG670075	001	Triad Nitrogen LLC	3 miles NE of Donaldsonville and SW of Hwy 1	Rocky Canal	variable	90 (daily max.)

2.7 Nonpoint Sources

The source of TSS in this subsegment is unknown. The subsegment is dominated by agricultural land uses (47.4 percent and 2.5 percent row crops and pasture/hay, respectively). These land uses are a possible source of TSS to the subsegment.

3 CHARACTERIZATION OF EXISTING WATER QUALITY

Water quality data were obtained from LDEQ. There are two water quality stations with relevant data. Figure 2-1 shows the locations of the water quality stations subsegment.

3.1 Comparison of Observed Data to Criteria

Subsegment 120206 has two water quality stations. Tables 3-1 through 3-3 present a summary of the observations at stations 0082 and 0980 including the number of observations; the minimum, maximum, and median observations; the number of exceedances of the criterion; and the percentage of observations exceeding the criterion.

Table 3-1. Water quality stations in subsegment 120206

Station ID	Station name	Period of record	Number of observations
0082	Grand Bayou at Grand Bayou, Louisiana	03/06/78–05/11/98	177
0980	Grand Bayou, Louisiana	01/11/00–08/02/05	22

Table 3-2. Statistics for water quality stations in subsegment 120206

Station ID	Minimum TSS (mg/L)	Mean TSS (mg/L)	Median TSS (mg/L)	Maximum TSS (mg/L)
0082	8.0	115.4	73.0	840.0
0980	4.0	26.4	15.0	226.0

Table 3-3. Water quality results compared to water quality endpoint

Station ID	Number of observations	Number of observations above endpoint	Percentage observations above endpoint
0082	177	116	65.5
0980	22	1	4.5

Note:
Station 0082 has a water quality endpoint of 61.7 mg/L and station 0980 has a water quality endpoint of 65.0 mg/L. (See section 4.1.)

The maximum TSS observation is 840 mg/L at station 0980 (from 11/17/87). Station 0082 had 116 exceedances. There is one exceedance of the TSS criterion at station 0980, resulting in an exceedance of 4 percent.

3.2 Trends and Patterns in Observed Data

Water quality monitoring data was analyzed for trends and patterns. Figures 3-1 and 3-2 present the sampling results at station 0082 for TSS plotted over time and by month, respectively. No distinct trends of patterns were observed; however, July monitoring results appeared greater on average than other months and monitoring results in February were more variable than other months. Because of the limited number of samples at station 0082, no distinct trends or patterns are seen in the water quality data results to make significant comparisons. Figure 3-3 presents the sampling results for station 0980 for TSS plotted over time.

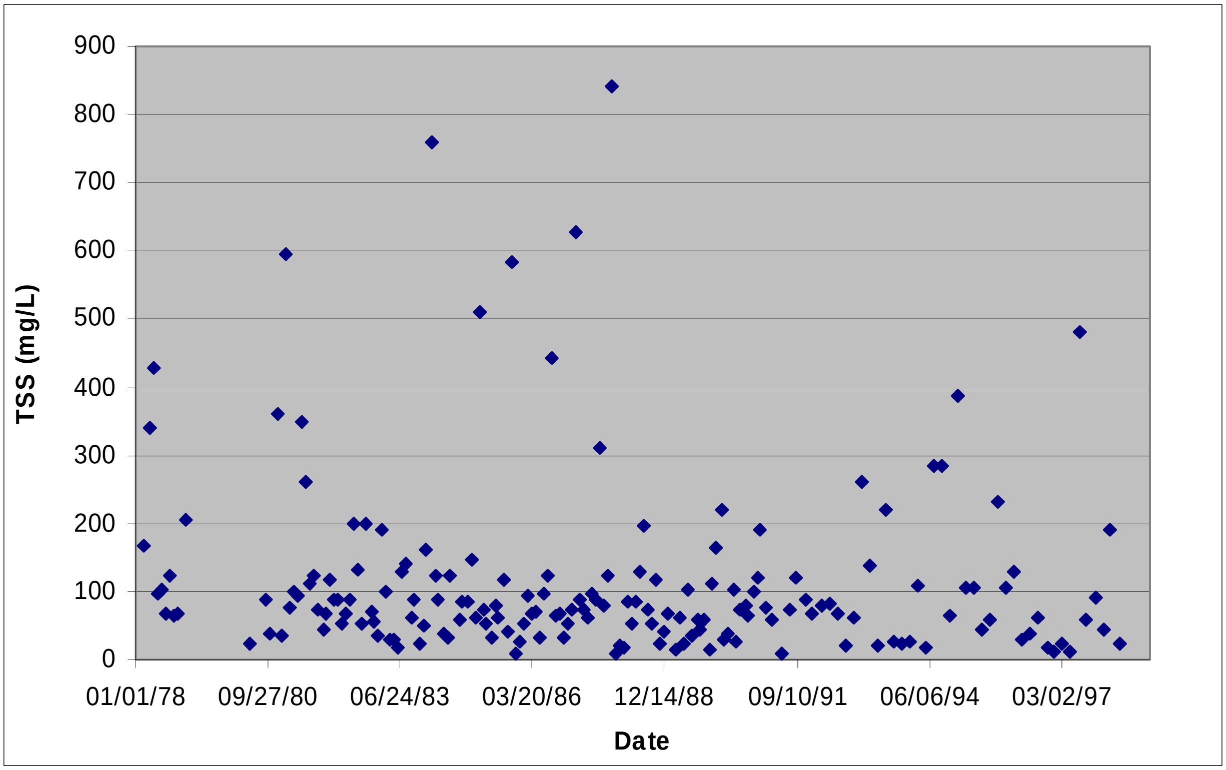

Figure 3-1. TSS concentrations at station 0082 plotted over time

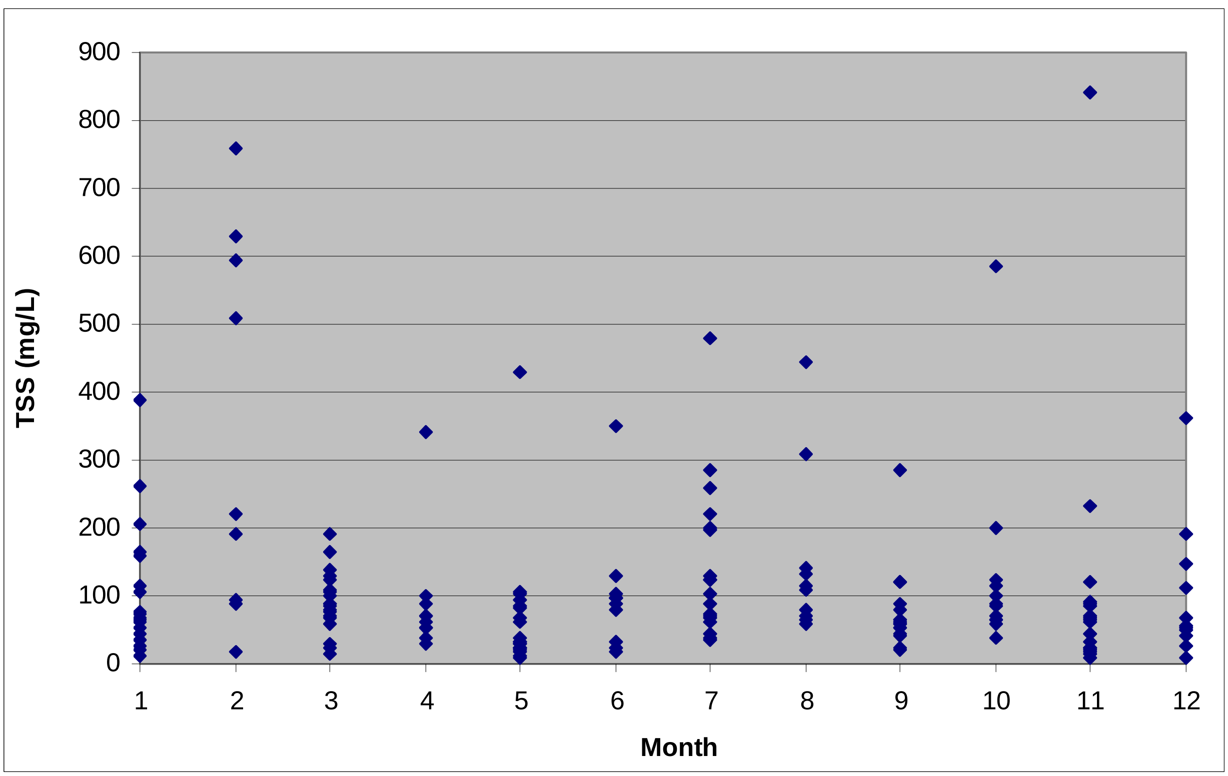

Figure 3-2. TSS concentrations at station 0082 plotted by month

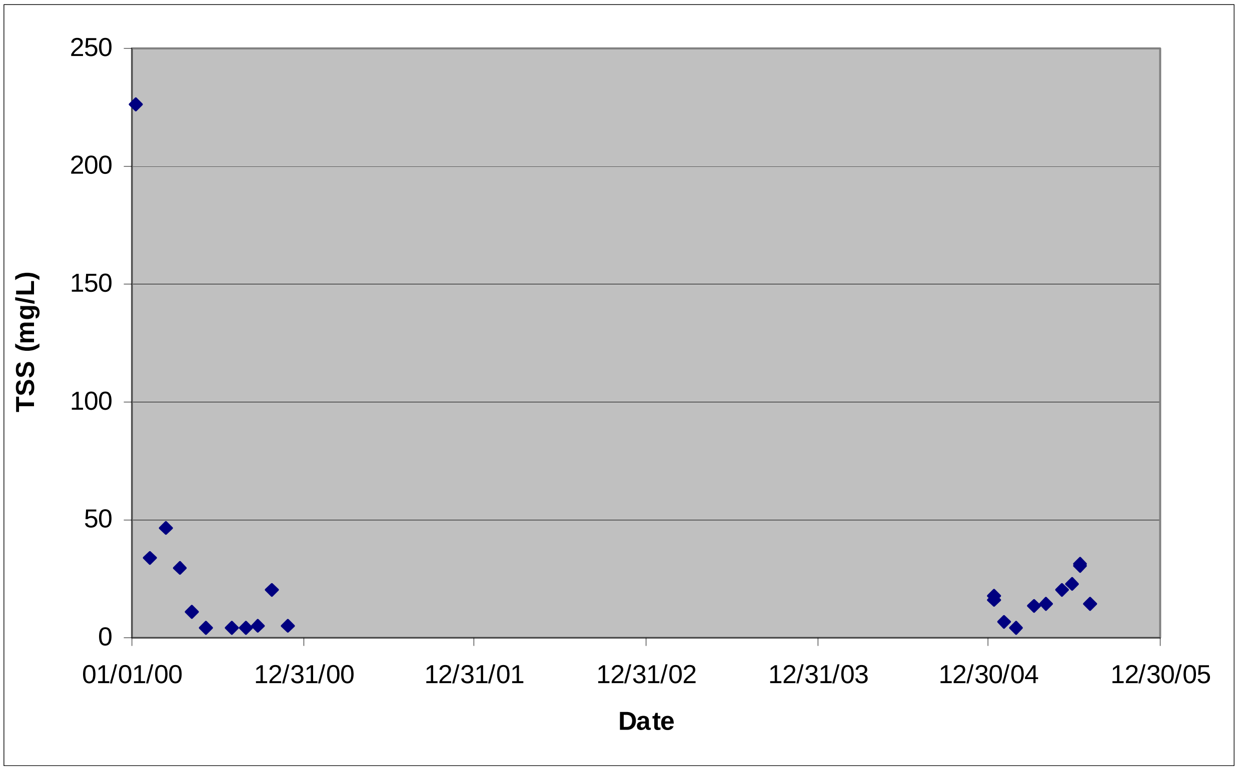

Figure 3-3. TSS concentrations at station 0980 plotted over time

4 TMDL DEVELOPMENT

A TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis for establishing water quality-based controls. TMDLs are expressed on a mass loading basis (e.g., kilograms per day).

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

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

4.1 TMDL Analytical Approach

The TMDL for subsegment 120206 was calculated using a load reduction approach. Using this approach, the percent reduction for each LDEQ monitoring station was calculated on the basis of observed pollutant concentrations. The minimum percent reduction was calculated so that the monitoring data would meet water quality standards at that station. The percent reduction was applied to the entire subsegment. Because two monitoring stations were present in the subsegment, the larger percent reduction was used to ensure that both monitoring stations meet criteria. The new reduced average load was used to determine the TMDL loading. TMDL calculations are included in Appendix A, along with the original water quality data.

Because of the lack of flow data in subsegment 120206, the monthly water yield (runoff in millimeters) was used to obtain TMDL loadings. The monthly water yield for the South-central and Southeast Climate Divisions were obtained from the Louisiana Office of State Climatology. The monthly water yield was divided by the number of days in the month to obtain runoff intensity. Data from 1980 to the present were averaged to obtain yearly averages. These averages were assigned to each subsegment according to their location. Because the subsegment was part of more than one division, the percent area of the subsegment was estimated for each of the divisions, and the yield for that subsegment was calculated from these percents and the water yields of the divisions. Subsegment 120206 is 25 percent in the South-central and 75 percent in the Southeast Divisions. So the average monthly water yield for each division was multiplied by 50 percent and added together to get the average water yield for that subsegment. Because the water yield did not include water input from point sources, the point source flows are added to the water yield. Table 4-1 presents the average monthly water yields.

Because only narrative criteria are available for TSS, it was necessary to calculate a numeric endpoint for TSS to develop the TMDL using the turbidity endpoint. Turbidity can be affected by different suspended particles such as clay, silt, and microorganisms, many of which are the

Table 4-1. Average water yields for climate divisions

Climate division	Yearly average monthly water yield (millimeters)
South-central	2.378
Southeast	2.402
Estimated water yield for subsegment 120206	2.384

same substances that form TSS. Turbidity can also be affected by algae and water color; however, for these TMDLs, TSS is assumed to be the dominant source of turbidity.

The TSS endpoint was calculated on the basis of the relationship between turbidity and TSS using a regression analysis. The TSS versus turbidity plots are presented in Figure 4-1. The resulting equations (Table 4-2) from the regression analysis were used to calculate the TSS endpoint using the turbidity criteria for the bayous (50 NTU) as the dependant variable, turbidity, on the Y-axis. The equations were solved for the independent variable, *X*, to determine the TSS value associated with a turbidity value of 50 NTU. The R^2 values demonstrate that there is a correlation between turbidity and TSS, albeit not a strong one for station 0980, and that TSS can be used as a surrogate.

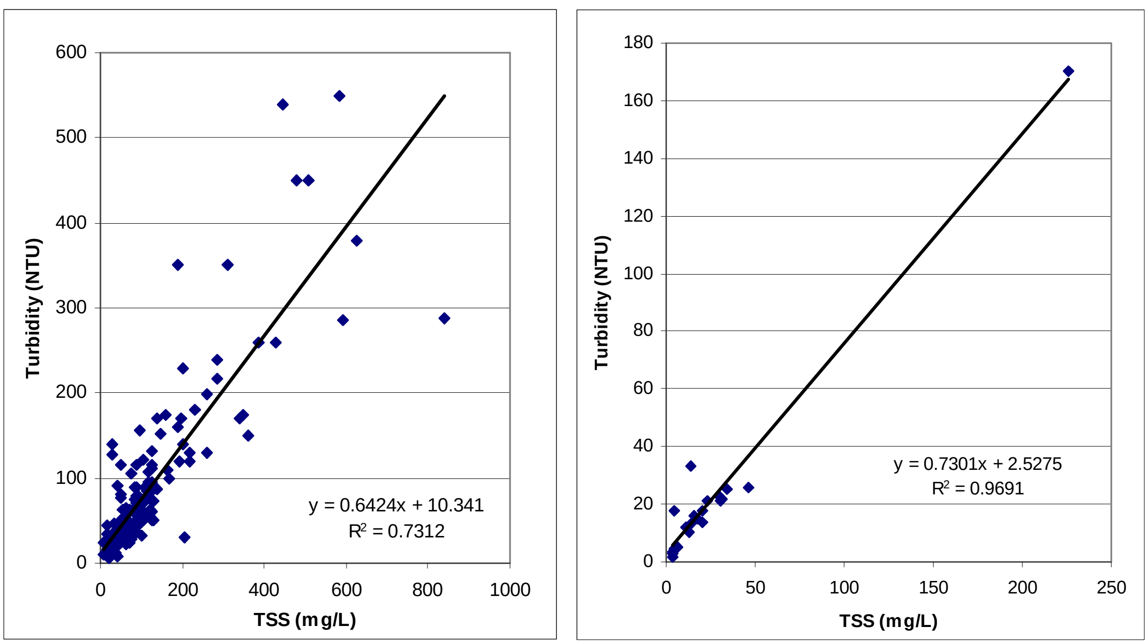

Figure 4-1. Turbidity versus TSS plots for station 0082 (left) and station 0980 (right)

Table 4-2. Surrogate turbidity, TSS, and sediment criteria for the Terrebonne Basin

Station number	Station name	Regression equation	R^2 value	Turbidity endpoint (NTU)	Calculated TSS endpoint (mg/L)
0082	Grand Bayou at Grand Bayou, Louisiana	$y = 0.6424x + 13.341$	0.7312	50	61.7
0980	Grand Bayou, Louisiana	$y = 0.7301x + 2.5275$	0.9691	50	65.0

For TMDL calculations (Appendix A), the calculated TSS endpoint was compared to existing TSS data. Results from these calculations are used in this report and as the loads assigned to the watersheds. An alternative method of determining the TMDL and percent reduction is to use TSS concentrations that are calculated the same way the endpoint is. TMDLs and percent reductions were calculated this way and provided similar, often identical loads and percent reductions. These calculations are also included in Appendix A for comparison.

4.2 TMDL, WLA, and LA

The reduced average concentration and the average water yield were multiplied by the estimated subsegment area, which was assumed to represent the drainage area for the subsegment. Table 4-3 presents a summary of the TMDLs and allocations for the subsegments included in this report.

Table 4-3. Summary of TSS TMDL, MOS, FG, WLA, and LA for subsegment 120206

Subsegment	Station	Pollutant	Percent reduction	Total allowable loading	MOS	FG (10%)	∑ WLA	∑ LA
				tons/day				
120206	82	TSS	92.7	5.95	Implicit	0.59	5.05	0.30

Both section 303(d) of the Clean Water Act and the regulations at 40 CFR 130.7 require that TMDLs include an MOS to account for uncertainty in available data or in the actual effect that controls will have on the loading reductions and receiving water quality. The MOS may be expressed explicitly as unallocated assimilative capacity or implicitly using conservative assumptions in establishing the TMDL. For a more detailed discussion of the MOS, see Section 4.4. In addition to the MOS, an FG component was added for an additional MOS to account specifically for FG in the TMDL area (see Section 4.5).

Hurricane Katrina made landfall on Monday, August 29, 2005, as a Category 4 hurricane. The storm brought heavy winds and rain to southeast Louisiana, breaching several levees and flooding up to 80 percent of New Orleans and large areas of coastal Louisiana. Much of the area that was flooded during Hurricane Katrina was flooded again by the storm surge from Hurricane Rita. Both hurricanes caused a significant amount of change in sedimentation and water quality in southern Louisiana. Many wastewater treatment facilities were temporarily or permanently damaged. Some wastewater treatment facilities will be rebuilt, while others will be relocated. The hurricanes expedited the loss of coastal land and modified the hydrology of some of the coastal waterbodies. Several federal and state agencies including EPA and LDEQ are engaged in collecting environmental data and assessing the recovery of the Gulf of Mexico waters.

The proposed TMDLs in this report were developed on the basis of pre-hurricane water quality conditions. Some point sources in this TMDL have been updated with post-hurricane information, where available. Therefore, post-hurricane water quality conditions and other factors could delay the implementation of these proposed TMDLs, render some proposed TMDLs obsolete, or could require modifications of the TMDLs. While hurricane effects might be valid for some TMDLs, any deviation from the TMDLs should be justified using site-specific data or information.

Wasteload Allocation

The WLA portion of the TMDL equation is the total loading of a pollutant that is assigned to point sources. WLAs are based on the current permit limits and discharge flow levels and are presented in Table 4-4. The permitted or average (expected or observed) flows were used to calculate the WLAs. Although the derived TSS TMDLs are based on best professional judgment using current data and regression analyses, meeting WLAs might not be necessary if alternative remediation and future monitoring prove that TSS is being corrected without reducing WLAs.

Table 4-4. Summary of WLAs for point sources in subsegment 120206

NPDES permit number	Outfall	Facility name	Flow (gpd)	TSS (mg/L)	TSS (lb/d)
LA0000485	001	Lula Westfield LLC—Westfield Raw Sugar Factory	10,000,000	50	4,172.703
LA0001295	002	Cora Texas Manufacturing Co.	7,100,000	50	2,962.619
LA0007382	001/002	Lula Westfield LLC—Lula Raw Sugar Factory	3,637,845	50	1,517.965
LA0049310	001	Dow Chemical Co.—Grand Bayou Operations	1,300,000	45	488.206
LA0049310	002	Dow Chemical Co.—Grand Bayou Operations	1,700,000	50	709.360
LA0049310	003	Dow Chemical Co.—Grand Bayou Operations	130,000	50	54.245
LA0049310	004	Dow Chemical Co.—Grand Bayou Operations	270,000	45	101.397
LA0049310	101	Dow Chemical Co.—Grand Bayou Operations	100	45	na[a]
LA0049310	104	Dow Chemical Co.—Grand Bayou Operations	240	45	na[a]
LA0049310	106	Dow Chemical Co.—Grand Bayou Operations	variable	50	na[a]
LA0049310	204	Dow Chemical Co.—Grand Bayou Operations	80	45	na[a]
LA0107212	003	Texas Eastern Transmission Corp—White Castle Compressor Station	10	45	0.004
LA0119491	001	K/D/S Promix LLC, Fractionation Plant	150,789	45	56.628
LAG110053	001/001A	Leblanc Brothers Redi Mix—Paincourtville Facility	144	50	0.060
LAG480530	001	Southern Natural Gas Co.—White Castle Compressor Station	500	45	0.188
LAG531143	001	St. Elizabeth School	4,050	45	1.521
LAG531262	001	Gulf South Pipeline Co. LP—Rodrigue Compressor Station	2,500	45	0.939
LAG531692	001	Acadian Gas Storage Facility	60	30	0.015
LAG540036	001	Bayou Corne Sewer Co. Inc.—Sportman's Paradise Subdivision	15,200	30	3.806
LAG540157	001	World-Wide Environmental Solutions LLC—Lucky Hit Shopping Center	8,900	30	2.228
LAG540548	001	Assumption Community Hospital	7,600	30	1.903
LAG540954	001	Assumption Parish Police Jury—Belle Rose Lane Sewerage District	14,300	30	3.580
LAG541081		Super Stop Enterprises—Gator Super Stop Truck Stop	7,760	30	1.943
LAG541191	001	No Problem Raceway Park	23,860	30	5.974
LAG541277	001	Grant Loop Community Sewer System	17,200	30	4.306
LAG541415	001	Assumption Parish Recreation District #2 Veterans Park	6,000	20	1.001
LAG560026	001A	World-Wide Environmental Solutions LLC—Bayou Tranquille Subdivision	45,000	45	16.899
LAG670075	001	Triad Nitrogen LLC	na[b]	90	na[b]

[a] These are internal outfalls. WLAs are included in the corresponding external outfalls. (Outfall 101 goes to outfall 001. Outfalls 104 and 204 go to outfall 004. Outfall 106 goes to outfalls 001, 002, 003, and 004.)

[b] This facility has a permit that took effect in 2004. No flow information is available in the permit and as of September 2007, this facility has not discharged effluent.

Any future facility permitted to discharge should meet end-of-pipe limits so that the discharge does not cause or contribute TSS in the stream. Permit limit designations are made by LDEQ during the permitting process on a case-by-case basis. For facilities that were not identified, this TMDL contains an FG component that can be used for any point sources not identified or that are in the planning state. EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. No MS4s were identified in subsegment 120206.

Load Allocation

The LA is the portion of the TMDL assigned to natural background conditions as well as nonpoint sources such as septic tank leakage, wildlife, and agricultural practices. For this TMDL, the LA was calculated by subtracting the WLA and FG from the total TMDL. LAs were not allocated to separate nonpoint sources because there was a lack of available source characterization data. LAs are presented in Table 4-3.

4.3 Seasonality and Critical Conditions

The federal regulations at 40 CFR 130.7 require that TMDLs include seasonal variations and take into account critical conditions for streamflow, loading, and water quality parameters. The sampling results for TSS were plotted over time and reviewed for any seasonal patterns (see Section 3.2). The water quality criteria for TSS are applied all year, and the TMDLs were developed over a several-year period, therefore, accounting for seasonal variations.

4.4 Margin of Safety

The MOS is the portion of the pollutant loading reserved to account for any uncertainty in the data. There are two ways to incorporate the MOS (USEPA 1991). One way is to implicitly incorporate it by using conservative model assumptions to develop allocations. The other way is to explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, an implicit MOS was incorporated by using conservative assumptions. The primary conservative assumption was calculating the turbidity TMDLs assuming that TSS is a conservative parameter and does not settle out of the water column. In addition, when samples were below the detection limit, the sampling results were assumed to equal the detection limit.

4.5 Future Growth

While the MOS is an allocation for scientific uncertainly, FG is an allocation for growth. Ten percent of the load was allocated for FG in the area that is covered by the TMDL. This includes future urban development, point sources, MS4 areas, agricultural areas, and other typical nonpoint source contributing areas. The FG could also be used for unaccounted or unknown sources not included in the TMDL.

5 FUTURE WATERSHED ACTIVITIES

5.1 TMDL Implementation Strategies

LDEQ will work with other agencies to address LAs through the LDEQ Nonpoint Source Management Program. Louisiana's *Nonpoint Source Management Plan* (LDEQ 2000) states that TMDLs are being developed through a close relationship between LDEQ and EPA Region 6. It further states that "[m]anagement strategies outlined within this document (both statewide and watershed) will be implemented in each of the watersheds where water quality problems have been attributed to nonpoint sources of pollution." On page ii, Objective 3 of the watershed management strategies is to, "utilize pollutant load reductions of the TMDL to develop nonpoint source pollution reduction strategies for each of the watersheds...that have water quality problems identified."

The plan broadly discusses programs including agriculture, forestry, home sewerage systems, hydromodification, urban runoff, construction, and resource extraction. Provided with each BMP is an evaluation of the effectiveness of that BMP, given as a high, medium, or low ranking. Additional evaluations should be conducted to determine the most likely source of impairment in this watershed and to identify localized hot spots to be targeted for effective BMP implementation. These and other BMPs may be implemented at a scale adequate to achieve the load reductions established in the TMDL.

LDEQ will implement WLAs through LPDES permit procedures.

5.2 Water Quality Monitoring Activities

LDEQ uses funds provided under section 106 of the Clean Water Act and under the authority of the Louisiana Environmental Quality Act to run a program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations using appropriate sampling methods and procedures to ensure the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, develop a long-term database for water quality trend analysis, and monitor the effectiveness of pollution controls. The state uses the data obtained through the surface water monitoring program to develop its biennial section 305(b) report (Water Quality Inventory) and the section 303(d) list of impaired waters.

LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled on a 4-year cycle. LDEQ samples long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain throughout the 4-year cycle. They sample monthly to yield approximately 12 samples per site during each year the site is monitored. Sampling sites are located where they are considered representative of the waterbody. Under the current monitoring schedule, approximately one-half of the state's waters are newly assessed for section 305(b) and section 303(d) listing purposes for each biennial cycle, with sampling occurring statewide each year. The 4-year cycle follows an initial 5-year rotation that covered all basins in the state according to the TMDL priorities. Monitoring 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, the state may add or remove waterbodies from the section 303(d) list of impaired waterbodies.

6 PUBLIC PARTICIPATION

Federal regulations require EPA to notify the public and seek comment concerning TMDLs it prepares. This TMDL was developed under contract to EPA, and EPA held a public review period seeking comments, information, and data from the public and any other interested party. The notice for the public review period was published in the *Federal Register* on October 25, 2007, and the review period closed on November 26, 2007. No comments and additional information were submitted during this public comment.

EPA will submit the final TMDL to LDEQ for implementation and incorporation into LDEQ's current water quality management plan.

7 REFERENCES

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Appendix A
TMDL Calculations for Subsegment 120206

Table A-1. TSS concentrations before and after reductions for station 0082

Station	Date	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	3/6/78	166	12.2	16.47	1.21
82	4/12/78	340	25.0	33.73	2.48
82	5/10/78	428	31.5	42.47	3.12
82	6/14/78	98	7.2	9.72	0.71
82	7/12/78	102	7.5	10.12	0.74
82	8/16/78	66	4.9	6.55	0.48
82	9/13/78	122	9.0	12.10	0.89
82	10/11/78	64	4.7	6.35	0.47
82	11/15/78	68	5.0	6.75	0.50
82	1/10/79	206	15.1	20.44	1.50
82	5/14/80	24	1.8	2.38	0.18
82	9/16/80	88	6.5	8.73	0.64
82	10/15/80	38	2.8	3.77	0.28
82	12/10/80	362	26.6	35.92	2.64
82	1/13/81	36	2.6	3.57	0.26
82	10-Feb-81	594	43.7	58.94	4.33
82	10-Mar-81	76	5.6	7.54	0.55
82	13-Apr-81	100	7.3	9.92	0.73
82	11-May-81	94	6.9	9.33	0.69
82	09-Jun-81	350	25.7	34.73	2.55
82	14-JuA-81	260	19.1	25.80	1.90
82	10-Aug-81	110	8.1	10.91	0.80
82	15-Sep-81	122	9.0	12.10	0.89
82	13-Oct-81	72	5.3	7.14	0.53
82	16-Nov-81	44	3.2	4.37	0.32
82	14-Dec-81	68	5.0	6.75	0.50
82	13-Jan-82	116	8.5	11.51	0.85
82	08-Feb-82	88	6.5	8.73	0.64
82	08-Mar-82	88	6.5	8.73	0.64
82	12-Apr-82	52	3.8	5.16	0.38
82	10-May-82	68	5.0	6.75	0.50
82	14-Jun-82	88	6.5	8.73	0.64
82	12-JuA-82	200	14.7	19.84	1.46
82	09-Aug-82	132	9.7	13.10	0.96
82	13-Sep-82	52	3.8	5.16	0.38
82	11-Oct-82	200	14.7	19.84	1.46
82	16-Nov-82	70	5.1	6.95	0.51
82	13-Dec-82	56	4.1	5.56	0.41
82	10-Jan-83	34	2.5	3.37	0.25
82	07-Feb-83	190	14.0	18.85	1.39
82	14-Mar-83	100	7.3	9.92	0.73
82	11-Apr-83	30	2.2	2.98	0.22
82	09-May-83	28	2.1	2.78	0.20
82	13-Jun-83	18	1.3	1.79	0.13
82	11-JuA-83	128	9.4	12.70	0.93
82	08-Aug-83	140	10.3	13.89	1.02

Table A-1. (continued)

Station	Date	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	12-Sep-83	62	4.6	6.15	0.45
82	10-Oct-83	88	6.5	8.73	0.64
82	14-Nov-83	24	1.8	2.38	0.18
82	12-Dec-83	50	3.7	4.96	0.36
82	09-Jan-84	160	11.8	15.87	1.17
82	13-Feb-84	760	55.9	75.41	5.54
82	13-Mar-84	124	9.1	12.30	0.90
82	09-Apr-84	88	6.5	8.73	0.64
82	14-May-84	38	2.8	3.77	0.28
82	11-Jun-84	32	2.4	3.17	0.23
82	09-JuA-84	124	9.1	12.30	0.90
82	10-Sep-84	58	4.3	5.75	0.42
82	08-Oct-84	84	6.2	8.33	0.61
82	13-Nov-84	84	6.2	8.33	0.61
82	10-Dec-84	146	10.7	14.49	1.06
82	14-Jan-85	62	4.6	6.15	0.45
82	11-Feb-85	510	37.5	50.60	3.72
82	11-Mar-85	72	5.3	7.14	0.53
82	08-Apr-85	54	4.0	5.36	0.39
82	13-May-85	33	2.4	3.27	0.24
82	10-Jun-85	78	5.7	7.74	0.57
82	08-JuA-85	62	4.6	6.15	0.45
82	12-Aug-85	116	8.5	11.51	0.85
82	09-Sep-85	40	2.9	3.97	0.29
82	14-Oct-85	584	42.9	57.94	4.26
82	18-Nov-85	10	0.7	0.99	0.07
82	09-Dec-85	26	1.9	2.58	0.19
82	13-Jan-86	52	3.8	5.16	0.38
82	17-Feb-86	94	6.9	9.33	0.69
82	17-Mar-86	68	5.0	6.75	0.50
82	14-Apr-86	70	5.1	6.95	0.51
82	12-May-86	32	2.4	3.17	0.23
82	09-Jun-86	96	7.1	9.52	0.70
82	14-JuA-86	124	9.1	12.30	0.90
82	11-Aug-86	444	32.6	44.05	3.24
82	08-Sep-86	64	4.7	6.35	0.47
82	13-Oct-86	66	4.9	6.55	0.48
82	17-Nov-86	32	2.4	3.17	0.23
82	08-Dec-86	52	3.8	5.16	0.38
82	12-Jan-87	74	5.4	7.34	0.54
82	16-Feb-87	628	46.2	62.31	4.58
82	09-Mar-87	88	6.5	8.73	0.64
82	13-Apr-87	72	5.3	7.14	0.53
82	11-May-87	62	4.6	6.15	0.45
82	08-Jun-87	98	7.2	9.72	0.71
82	13-JuA-87	88	6.5	8.73	0.64
82	10-Aug-87	310	22.8	30.76	2.26

Table A-1. (continued)

Station	Date	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	14-Sep-87	78	5.7	7.74	0.57
82	10/13/87	124	9.1	12.30	0.90
82	11/17/87	840	61.7	83.34	6.13
82	12/14/87	8	0.6	0.79	0.06
82	1/11/88	20	1.5	1.98	0.15
82	2/8/88	18	1.3	1.79	0.13
82	3/14/88	84	6.2	8.33	0.61
82	4/12/88	52	3.8	5.16	0.38
82	5/10/88	84	6.2	8.33	0.61
82	6/14/88	130	9.6	12.90	0.95
82	7/12/88	196	14.4	19.45	1.43
82	8/8/88	72	5.3	7.14	0.53
82	9/12/88	52	3.8	5.16	0.38
82	10/10/88	116	8.5	11.51	0.85
82	11/14/88	22	1.6	2.18	0.16
82	12/12/88	40	2.9	3.97	0.29
82	1/9/89	68	5.0	6.75	0.50
82	3/14/89	16	1.2	1.59	0.12
82	4/11/89	62	4.6	6.15	0.45
82	5/9/89	24	1.8	2.38	0.18
82	6/13/89	104	7.6	10.32	0.76
82	7/10/89	34	2.5	3.37	0.25
82	8/14/89	60	4.4	5.95	0.44
82	9/11/89	44	3.2	4.37	0.32
82	10/9/89	60	4.4	5.95	0.44
82	11/13/89	16	1.2	1.59	0.12
82	12/11/89	112	8.2	11.11	0.82
82	1/8/90	164	12.1	16.27	1.20
82	2/12/90	220	16.2	21.83	1.60
82	3/12/90	28	2.1	2.78	0.20
82	4/9/90	38	2.8	3.77	0.28
82	5/14/90	102	7.5	10.12	0.74
82	6/11/90	25	1.8	2.48	0.18
82	7/9/90	73	5.4	7.24	0.53
82	8/13/90	80	5.9	7.94	0.58
82	9/10/90	64	4.7	6.35	0.47
82	10/15/90	100	7.3	9.92	0.73
82	11/13/90	120	8.8	11.91	0.88
82	12/10/90	192	14.1	19.05	1.40
82	1/14/91	76	5.6	7.54	0.55
82	3/11/91	60	4.4	5.95	0.44
82	5/13/91	8	0.6	0.79	0.06
82	7/15/91	72	5.3	7.14	0.53
82	9/9/91	120	8.8	11.91	0.88
82	11/18/91	88	6.5	8.73	0.64
82	1/6/92	66	4.9	6.55	0.48
82	3/9/92	78	5.7	7.74	0.57
82	5/11/92	82	6.0	8.14	0.60

Table A-1. (continued)

Station	Date	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	7/13/92	68	5.0	6.75	0.50
82	9/14/92	20	1.5	1.98	0.15
82	11/16/92	62	4.6	6.15	0.45
82	1/11/93	262	19.3	26.00	1.91
82	3/8/93	138	10.1	13.69	1.01
82	5/10/93	20	1.5	1.98	0.15
82	7/12/93	220	16.2	21.83	1.60
82	9/13/93	25	1.8	2.48	0.18
82	11/15/93	23	1.7	2.28	0.17
82	1/10/94	26	1.9	2.58	0.19
82	3/14/94	108	7.9	10.72	0.79
82	5/9/94	18	1.3	1.79	0.13
82	7/11/94	284	20.9	28.18	2.07
82	9/12/94	284	20.9	28.18	2.07
82	11/14/94	64	4.7	6.35	0.47
82	1/9/95	388	28.5	38.50	2.83
82	3/13/95	106	7.8	10.52	0.77
82	5/8/95	106	7.8	10.52	0.77
82	7/10/95	43	3.2	4.27	0.31
82	9/11/95	60	4.4	5.95	0.44
82	11/13/95	232	17.1	23.02	1.69
82	1/8/96	105	7.7	10.42	0.77
82	3/11/96	128	9.4	12.70	0.93
82	5/13/96	28	2.1	2.78	0.20
82	7/8/96	39	2.9	3.87	0.28
82	9/9/96	62	4.6	6.15	0.45
82	11/18/96	19	1.4	1.89	0.14
82	1/6/97	13	1.0	1.29	0.09
82	3/10/97	23	1.7	2.28	0.17
82	5/12/97	12	0.9	1.19	0.09
82	7/14/97	480	35.3	47.62	3.50
82	9/8/97	58	4.3	5.74	0.42
82	11/17/97	90	6.6	8.93	0.66
82	1/12/98	44	3.2	4.37	0.32
82	3/9/98	190	14.0	18.85	1.39
82	5/11/98	23	1.7	2.28	0.17

A-2. TSS TMDL summary for station 0082

Average water budget (mm/day)		2.384
Subsegment area (acres)		9,329.6
Turbidity criteria (NTU)		50.0
TSS target (mg/L)		61.7
TSS target as loading (ton/d)		11.2
Wasteload allocation (ton/d)		5.05
Point source flow (MGD)		24.44
Percent reduction		92.7
	Before reduction	After reduction
Average concentration (mg/L)	122.8	9.0
Average loading (ton/d)	17.24	5.95

Table A-3. TSS concentrations before and after reductions for station 0980

Station	Date	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
980	1/11/00	226.0	65.0	22.42	6.45
980	2/8/00	34.0	9.8	3.37	0.97
980	3/14/00	46.7	13.4	4.63	1.33
980	4/11/00	29.3	8.4	2.91	0.84
980	5/9/00	11.0	3.2	1.09	0.31
980	6/7/00	4.0	1.2	0.40	0.11
980	8/2/00	4.0	1.2	0.40	0.11
980	8/30/00	4.0	1.2	0.40	0.11
980	9/27/00	5.0	1.4	0.50	0.14
980	10/25/00	20.5	5.9	2.03	0.59
980	11/29/00	4.7	1.4	0.47	0.13
980	1/11/05	16.0	4.6	1.59	0.46
980	1/11/05	18.0	5.2	1.79	0.51
980	2/1/05	6.5	1.9	0.64	0.19
980	3/1/05	4.0	1.2	0.40	0.11
980	4/5/05	13.3	3.8	1.32	0.38
980	5/3/05	14.0	4.0	1.39	0.40
980	6/7/05	20.0	5.8	1.98	0.57
980	6/28/05	23.3	6.7	2.31	0.67
980	7/12/05	31.3	9.0	3.11	0.89
980	7/12/05	30.7	8.8	3.05	0.88
980	8/2/05	14.0	4.0	1.39	0.40

Table A-4. TSS TMDL summary for station 0980

Average water budget (mm/day)		2.384
Subsegment area (acres)		9,329.6
Turbidity criteria (NTU)		50.0
TSS target (mg/L)		65.0
TSS target as loading (ton/d)		11.5
Wasteload allocation (ton/d)		5.05
Point source flow (MGD)		24.44
Percent reduction		71.2
	Before reduction	After reduction
Average concentration (mg/L)	26.4	7.6
Average loading (ton/d)	7.67	5.81

Table A-5. Alternate TSS concentrations before and after reductions for station 0082

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	3/6/78	100	139.6	10.3	13.85	1.02
82	4/12/78	170	248.5	18.3	24.66	1.82
82	5/10/78	260	388.6	28.6	38.56	2.84
82	6/14/78	65	85.1	6.3	8.44	0.62
82	7/12/78	53	66.4	4.9	6.59	0.49
82	8/16/78	58	74.2	5.5	7.36	0.54
82	9/13/78	83	113.1	8.3	11.22	0.83
82	10/11/78	47	57.1	4.2	5.66	0.42
82	11/15/78	36	39.9	2.9	3.96	0.29
82	1/10/79	30	30.6	2.3	3.04	0.22
82	2/13/79	70	92.9	6.8	9.21	0.68
82	3/14/79	35	38.4	2.8	3.81	0.28
82	4/18/79	20	15.0	1.1	1.49	0.11
82	6/13/79	36	39.9	2.9	3.96	0.29
82	7/11/79	32	33.7	2.5	3.35	0.25
82	12-Sep-79	35	38.4	2.8	3.81	0.28
82	10-Oct-79	48	58.6	4.3	5.82	0.43
82	07-Nov-79	45	54.0	4.0	5.35	0.39
82	12-Dec-79	33	35.3	2.6	3.50	0.26
82	16-Jan-80	120	170.7	12.6	16.94	1.25
82	13-Feb-80	73	97.5	7.2	9.68	0.71
82	12-Mar-80	64	83.5	6.1	8.29	0.61
82	16-Apr-80	35	38.4	2.8	3.81	0.28
82	14-May-80	21	16.6	1.2	1.65	0.12
82	16-Sep-80	48	58.6	4.3	5.82	0.43
82	15-Oct-80	28	27.5	2.0	2.73	0.20
82	19-Nov-80	34	36.8	2.7	3.65	0.27
82	10-Dec-80	150	217.4	16.0	21.57	1.59
82	13-Jan-81	23	19.7	1.5	1.96	0.14

Table A-5. (continued)

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	10-Feb-81	285	427.6	31.5	42.42	3.12
82	10-Mar-81	29	29.0	2.1	2.88	0.21
82	13-Apr-81	33	35.3	2.6	3.50	0.26
82	11-May-81	62	80.4	5.9	7.98	0.59
82	09-Jun-81	175	256.3	18.9	25.43	1.87
82	14-JuA-81	130	186.3	13.7	18.48	1.36
82	10-Aug-81	54	68.0	5.0	6.74	0.50
82	15-Sep-81	55	69.5	5.1	6.90	0.51
82	13-Oct-81	25	22.8	1.7	2.26	0.17
82	16-Nov-81	40	46.2	3.4	4.58	0.34
82	14-Dec-81	36	39.9	2.9	3.96	0.29
82	13-Jan-82	96	133.3	9.8	13.23	0.97
82	08-Feb-82	70	92.9	6.8	9.21	0.68
82	08-Mar-82	50	61.7	4.5	6.13	0.45
82	12-Apr-82	26	24.4	1.8	2.42	0.18
82	10-May-82	38	43.1	3.2	4.27	0.31
82	14-Jun-82	37	41.5	3.1	4.12	0.30
82	12-JuA-82	230	341.9	25.2	33.93	2.50
82	09-Aug-82	73	97.5	7.2	9.68	0.71
82	13-Sep-82	31	32.2	2.4	3.19	0.23
82	11-Oct-82	140	201.8	14.9	20.03	1.47
82	16-Nov-82	36	39.9	2.9	3.96	0.29
82	13-Dec-82	52	64.8	4.8	6.43	0.47
82	10-Jan-83	47	57.1	4.2	5.66	0.42
82	07-Feb-83	160	233.0	17.2	23.11	1.70
82	14-Mar-83	53	66.4	4.9	6.59	0.49
82	11-Apr-83	140	201.8	14.9	20.03	1.47
82	09-May-83	19	13.5	1.0	1.34	0.10
82	13-Jun-83	16	8.8	0.6	0.87	0.06
82	11-JuA-83	115	162.9	12.0	16.16	1.19
82	08-Aug-83	170	248.5	18.3	24.66	1.82
82	12-Sep-83	64	83.5	6.1	8.29	0.61
82	10-Oct-83	115	162.9	12.0	16.16	1.19
82	14-Nov-83	31	32.2	2.4	3.19	0.23
82	12-Dec-83	115	162.9	12.0	16.16	1.19
82	09-Jan-84	175	256.3	18.9	25.43	1.87
82	13-Mar-84	112	158.2	11.7	15.70	1.16
82	09-Apr-84	90	124.0	9.1	12.30	0.91
82	14-May-84	39	44.6	3.3	4.43	0.33
82	11-Jun-84	21	16.6	1.2	1.65	0.12
82	09-JuA-84	132	189.4	13.9	18.79	1.38
82	10-Sep-84	47	57.1	4.2	5.66	0.42
82	08-Oct-84	90	124.0	9.1	12.30	0.91
82	13-Nov-84	64	83.5	6.1	8.29	0.61
82	10-Dec-84	152	220.5	16.2	21.88	1.61
82	14-Jan-85	64	83.5	6.1	8.29	0.61
82	11-Feb-85	450	684.4	50.4	67.91	5.00

Table A-5. (continued)

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	11-Mar-85	62	80.4	5.9	7.98	0.59
82	08-Apr-85	62	80.4	5.9	7.98	0.59
82	13-May-85	31	32.2	2.4	3.19	0.23
82	10-Jun-85	60	77.3	5.7	7.67	0.56
82	08-JuA-85	53	66.4	4.9	6.59	0.49
82	12-Aug-85	107	150.5	11.1	14.93	1.10
82	09-Sep-85	92	127.1	9.4	12.61	0.93
82	14-Oct-85	549	838.5	61.7	83.20	6.13
82	18-Nov-85	11	1.0	0.1	0.10	0.01
82	09-Dec-85	29	29.0	2.1	2.88	0.21
82	13-Jan-86	50	61.7	4.5	6.13	0.45
82	17-Feb-86	80	108.4	8.0	10.76	0.79
82	17-Mar-86	32	33.7	2.5	3.35	0.25
82	14-Apr-86	29	29.0	2.1	2.88	0.21
82	12-May-86	33	35.3	2.6	3.50	0.26
82	09-Jun-86	156	226.7	16.7	22.50	1.66
82	14-JuA-86	96	133.3	9.8	13.23	0.97
82	8/11/86	540	824.5	60.7	81.81	6.02
82	9/8/86	41	47.7	3.5	4.74	0.35
82	10/13/86	40	46.2	3.4	4.58	0.34
82	11/17/86	29	29.0	2.1	2.88	0.21
82	12/8/86	82	111.5	8.2	11.07	0.81
82	1/12/87	45	54.0	4.0	5.35	0.39
82	2/16/87	380	575.4	42.4	57.09	4.20
82	3/9/87	42	49.3	3.6	4.89	0.36
82	4/13/87	33	35.3	2.6	3.50	0.26
82	5/11/87	42	49.3	3.6	4.89	0.36
82	6/8/87	60	77.3	5.7	7.67	0.56
82	7/13/87	66	86.6	6.4	8.60	0.63
82	8/10/87	351	530.3	39.0	52.61	3.87
82	9/14/87	43	50.8	3.7	5.04	0.37
82	10/13/87	60	77.3	5.7	7.67	0.56
82	11/17/87	288	432.2	31.8	42.88	3.16
82	12/14/87	11	1.0	0.1	0.10	0.01
82	1/11/88	22	18.1	1.3	1.80	0.13
82	2/8/88	45	54.0	4.0	5.35	0.39
82	3/14/88	76	102.2	7.5	10.14	0.75
82	4/12/88	78	105.3	7.8	10.45	0.77
82	5/10/88	38	43.1	3.2	4.27	0.31
82	6/14/88	50	61.7	4.5	6.13	0.45
82	7/12/88	170	248.5	18.3	24.66	1.82
82	8/8/88	39	44.6	3.3	4.43	0.33
82	9/12/88	34	36.8	2.7	3.65	0.27
82	10/10/88	58	74.2	5.5	7.36	0.54
82	11/14/88	14	5.7	0.4	0.57	0.04
82	12/12/88	21	15.8	1.2	1.57	0.12
82	1/9/89	35	38.4	2.8	3.81	0.28

Table A-5. (continued)

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	3/14/89	15	7.3	0.5	0.72	0.05
82	4/11/89	22	18.1	1.3	1.80	0.13
82	5/9/89	22	18.1	1.3	1.80	0.13
82	6/13/89	122	173.8	12.8	17.25	1.27
82	7/10/89	31	32.2	2.4	3.19	0.23
82	8/14/89	32	33.7	2.5	3.35	0.25
82	9/11/89	24	21.3	1.6	2.11	0.16
82	10/9/89	52	64.8	4.8	6.43	0.47
82	11/13/89	35	38.4	2.8	3.81	0.28
82	12/11/89	85	116.2	8.6	11.53	0.85
82	1/8/90	110	155.1	11.4	15.39	1.13
82	2/12/90	120	170.7	12.6	16.94	1.25
82	3/12/90	128	183.2	13.5	18.17	1.34
82	4/9/90	29	29.0	2.1	2.88	0.21
82	5/14/90	60	77.3	5.7	7.67	0.56
82	6/11/90	16	8.8	0.6	0.87	0.06
82	7/9/90	36	39.9	2.9	3.96	0.29
82	8/13/90	41	47.7	3.5	4.74	0.35
82	9/10/90	31	32.2	2.4	3.19	0.23
82	10/15/90	50	61.0	4.5	6.05	0.45
82	11/13/90	62	80.4	5.9	7.98	0.59
82	12/10/90	120	170.7	12.6	16.94	1.25
82	1/14/91	105	147.4	10.8	14.62	1.08
82	3/11/91	37	41.5	3.1	4.12	0.30
82	5/13/91	24	21.3	1.6	2.11	0.16
82	7/15/91	24	21.3	1.6	2.11	0.16
82	9/9/91	75	100.7	7.4	9.99	0.74
82	11/18/91	47	57.1	4.2	5.66	0.42
82	1/6/92	31	32.2	2.4	3.19	0.23
82	3/9/92	40	46.2	3.4	4.58	0.34
82	5/11/92	46	55.5	4.1	5.51	0.41
82	7/13/92	32	33.7	2.5	3.35	0.25
82	9/14/92	12	2.6	0.2	0.26	0.02
82	11/16/92	50	61.0	4.5	6.05	0.45
82	1/11/93	198	292.1	21.5	28.98	2.13
82	3/8/93	88	120.9	8.9	11.99	0.88
82	5/10/93	10	0.0	0.0	0.00	0.00
82	7/12/93	130	186.3	13.7	18.48	1.36
82	9/13/93	13	4.1	0.3	0.41	0.03
82	11/15/93	16	8.8	0.6	0.87	0.06
82	1/10/94	17	10.4	0.8	1.03	0.08
82	3/14/94	90	124.0	9.1	12.30	0.91
82	5/9/94	10	0.0	0.0	0.00	0.00
82	7/11/94	216	320.1	23.6	31.76	2.34
82	9/12/94	240	357.5	26.3	35.47	2.61
82	11/14/94	30	30.6	2.3	3.04	0.22
82	1/9/95	260	388.6	28.6	38.56	2.84

Table A-5. (continued)

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
82	3/13/95	75	100.7	7.4	9.99	0.74
82	5/8/95	50	61.7	4.5	6.13	0.45
82	7/10/95	9	0.0	0.0	0.00	0.00
82	9/11/95	32	33.7	2.5	3.35	0.25
82	11/13/95	180	264.1	19.4	26.20	1.93
82	1/8/96	70	92.9	6.8	9.21	0.68
82	3/11/96	50	61.7	4.5	6.13	0.45
82	5/13/96	22	18.1	1.3	1.80	0.13
82	7/8/96	12	2.6	0.2	0.26	0.02
82	9/9/96	28	27.5	2.0	2.73	0.20
82	11/18/96	6	0.0	0.0	0.00	0.00
82	1/6/97	12	2.6	0.2	0.26	0.02
82	3/10/97	6	0.0	0.0	0.00	0.00
82	5/12/97	10	0.0	0.0	0.00	0.00
82	7/14/97	450	684.4	50.4	67.91	5.00
82	9/8/97	55	69.5	5.1	6.90	0.51
82	11/17/97	80	108.4	8.0	10.76	0.79
82	1/12/98	34	36.8	2.7	3.65	0.27
82	3/9/98	350	528.7	38.9	52.46	3.86
82	5/11/98	16	8.8	0.6	0.87	0.06

Table A-6. Alternate TSS TMDL summary for station 0082

Average water budget (mm/day)		2.384
Subsegment area (acres)		9,329.6
Turbidity criteria (NTU)		50.0
TSS target (mg/L)		61.7
TSS target as loading (ton/d)		11.2
Wasteload allocation (ton/d)		5.05
Point source flow (MGD)		24.44
Percent reduction		92.6
	Before reduction	After reduction
Average concentration (mg/L)	117.4	8.6
Average loading (ton/d)	16.71	5.91

Table A-7. Alternate TSS concentrations before and after reductions for station 0980

Station	Date	Turbidity before reduction (NTU)	TSS concentration before reduction (mg/L)	TSS concentration after reduction (mg/L)	TSS loading before reduction (ton/d)	TSS loading after reduction (ton/d)
980	1/11/00	170.0	229.4	65.0	22.76	6.45
980	2/8/00	25.0	30.8	8.7	3.05	0.87
980	3/14/00	26.0	32.1	9.1	3.19	0.90
980	4/11/00	23.0	28.0	7.9	2.78	0.79
980	5/9/00	12.0	13.0	3.7	1.29	0.36
980	6/7/00	3.6	1.5	0.4	0.15	0.04
980	8/2/00	3.1	0.8	0.2	0.08	0.02
980	8/30/00	3.4	1.2	0.3	0.12	0.03
980	9/27/00	4.5	2.7	0.8	0.27	0.08
980	10/25/00	18.0	21.2	6.0	2.10	0.60
980	11/29/00	18.0	21.2	6.0	2.10	0.60
980	1/11/05	16.0	18.5	5.2	1.83	0.52
980	1/11/05	18.0	21.2	6.0	2.10	0.60
980	2/1/05	6.5	5.4	1.5	0.54	0.15
980	3/1/05	4.0	2.0	0.6	0.20	0.06
980	4/5/05	13.3	14.8	4.2	1.46	0.41
980	5/3/05	14.0	15.7	4.5	1.56	0.44
980	6/7/05	20.0	23.9	6.8	2.37	0.67
980	6/28/05	23.3	28.5	8.1	2.82	0.80
980	7/12/05	31.3	39.4	11.2	3.91	1.11
980	7/12/05	30.7	38.6	10.9	3.83	1.09
980	8/2/05	14.0	15.7	4.5	1.56	0.44

Table A-8. Alternate TSS TMDL summary for station 0980

Average water budget (mm/day)		2.384
Subsegment area (acres)		9,329.6
Turbidity criteria (NTU)		50.0
TSS target (mg/L)		65.0
TSS target as loading (ton/d)		11.5
Wasteload allocation (ton/d)		5.05
Point source flow (MGD)		24.44
Percent reduction		71.7
	Before reduction	After reduction
Average concentration (mg/L)	27.5	7.8
Average loading (ton/d)	7.78	5.83