FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHWEST DISTRICT • APALACHICOLA BASIN

Final TMDL Report

Dissolved Oxygen and Nutrient TMDLs for Little Gully Creek (WBID 1039)

Douglas Gilbert

November 2, 2009

Acknowledgments

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Editorial assistance provided by: Jan Mandrup-Poulsen and Linda Lord

For additional information on the watershed management approach and impaired waters in the Apalachicola Basin, contact:

Bonita Gorham, Environmental Consultant,
Bureau of Watershed Restoration
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
Email: bonita.gorham@dep.state.fl.us
Phone: (850) 245–8513
Fax: (850) 245–8434

Access to all data used in the development of this report can be obtained by contacting:

Douglas Gilbert
Florida Department of Environmental Protection
Bureau of Watershed Restoration
Watershed Evaluation and TMDL Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
Email: douglas.gilbert@dep.state.fl.us
Phone: (850) 245–8450
Fax: (850) 245–8536

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TMDL Program

http://www.dep.state.fl.us/water/tmdl/index.htm

Identification of Impaired Surface Waters Rule

http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

STORET Program

http://www.dep.state.fl.us/water/storet/index.htm

2008 305(b) Report

http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/water/wqssp/classes.htm

Basin Status Report for the Apalachicola Basin
http://www.dep.state.fl.us/water/basin411/apalach/status.htm

Water Quality Assessment Report for the Apalachicola River Basin
http://www.dep.state.fl.us/water/basin411/apalach/assessment.htm

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

http://www.epa.gov/region4/water/tmdl/florida/

National STORET Program

http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Loads (TMDLs) for dissolved oxygen (DO) and nutrients for Little Gully Creek in the Apalachicola Basin. The creek was verified as impaired for DO and nutrients (by chlorophyll *a* [chl*a*]) and therefore was included on the Verified List of impaired waters for the Apalachicola Basin that was adopted by Secretarial Order on May 19, 2009. These TMDLs establish the allowable nutrient loadings to Little Gully Creek that would restore this waterbody so that it meets the applicable water quality criteria for DO and nutrients.

1.2 Identification of Waterbody

Little Gully Creek is located along the western edge of the central portion of Liberty County (**Figure 1.1**) about 9 kilometers south of Bristol and just to the east of the Apalachicola River. The creek flows to the south, where it joins with Big Gully Creek and Mary Branch to form Equaloxic Creek, which is joined by the Florida River just before flowing into the Apalachicola River. **Figure 1.2** depicts the watershed boundaries for Little Gully Creek, which drains an area of approximately 15.9 square miles (10,163 acres). Additional information about the hydrology and geology of the Basin are available in the Basin Status Report for the Apalachicola Basin (Florida Department of Environmental Protection [Department], 2002).

For assessment purposes, the Department has divided the Apalachicola Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Little Gully Creek is WBID 1039 (**Figure 1.2**).

1.3 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Laws of Florida).

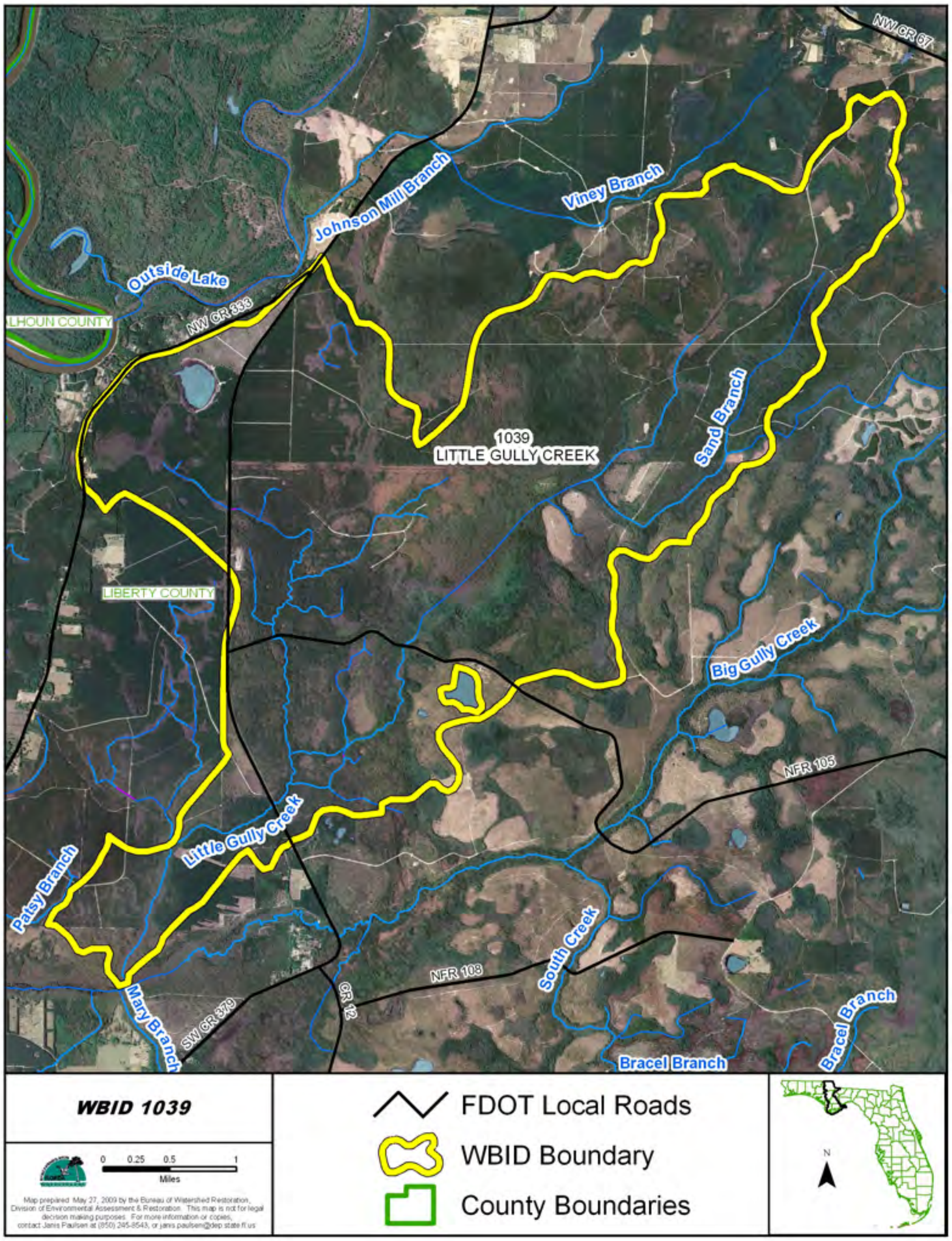
A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. They provide important water quality restoration goals that will guide restoration activities.

This TMDL report will be followed by the development and implementation of a restoration plan, designed to reduce the amount of nutrients and increase the DO levels that caused the verified impairment of Little Gully Creek. These activities will depend heavily on the active participation of the Northwest Florida Water Management District (NWFWMD), Liberty County, local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for the impaired waterbody.

Figure 1.1. Location of the Little Gully Creek Watershed (WBID 1039) in the Apalachicola Basin and Major Hydrologic and Geopolitical Features in the Area

Figure 1.2. Location of the Little Gully Creek Watershed (WBID 1039) in Liberty County and Major Hydrologic Features in the Area

Note: Florida Department of Transportation (FDOT) local roads are for illustration purposes only and are not meant to depict roadways for which FDOT is responsible.



Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]); the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 14 waterbody segments (WBIDs) in the Apalachicola Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Little Gully Creek and verified the impairments during the second cycle of the TMDL Program (**Table 2.1**). **Table 2.2** summarizes the DO and nutrient data collected during the verified period (January 1, 2000, through June 30, 2007). The projected year for the 1998 303(d)–listed DO TMDL for the creek was 2008, but the Settlement Agreement between EPA and Earthjustice, which drives the TMDL development schedule for waters on the 1998 303(d) list, allows an additional nine months to complete the TMDLs. As such, these TMDLs must be adopted and submitted to the EPA by September 30, 2009.

Little Gully Creek was verified as impaired based on DO because, using the IWR methodology, more than 10 percent of the values exceeded the Class III freshwater criterion of 5.0 milligrams per liter (mg/L) in the verified period (13 out of 16 samples). The waterbody was verified as impaired for nutrients due to elevated annual average chl*a* in 2007 (greater than 20 micrograms per liter [μg/L] as an annual average). The data used in this report are based on the IWR Run35 database.

The verified impairments were based on data collected by the NWFWMD, the Department, and the Department's Northwest District, at stations in WBID 1039 (**Figure 2.1** and **Table 2.2**). **Figures 2.4** through **2.8** display the data collected during the complete period of record, including the verified period (January 1, 2000, through June 30, 2007) for Little Gully Creek. Stations are plotted on each graph (see the legend) in an upstream to downstream order.

Table 2.1. Verified Impairments for Little Gully Creek (WBID 1039)

[1] IIIF = Class III fresh water

WBID	Waterbody Segment	Waterbody Type	Waterbody Class[1]	1998 303(d) Parameters of Concern	Parameter Causing Impairment
1039	Little Gully Creek	Stream	IIIF	DO	Nutrients
1039	Little Gully Creek	Stream	IIIF	Nutrients	Chl*a*

Table 2.2. Summary of Data for Little Gully Creek (WBID 1039) During the Verified Period (January 1, 2000–December 31, 2007)

N/A = Not applicable
* BOD_5 = Five-day biological oxygen demand
** CChla = Chlorophyll *a* corrected

WBID	Para-meter	Total Number of Samples	IWR-Required Number of Exceedances	Number of Observed Exceedances	Number of Observed Non-exceedances	Number of Seasons Data Were Collected	Mean	Median	Minimum	Maximum
1039	DO (mg/L)	16	5	13	3	4	3.76	2.60	0.74	9.90
1039	TN (mg/L)	13	N/A	N/A	N/A	4	0.71	0.77	0.16	1.82
1039	TP (mg/L)	13	N/A	N/A	N/A	4	0.057	0.047	0.012	0.130
1039	BOD_5* (mg/L)	12	N/A	N/A	N/A	4	2.91	3.15	0.20	12.00
1039	CChla** (µg/L)	14	1 annual average	1	0	4	28.2	8.1	1.0	290.0

Table 2.3 lists the water quality stations for Little Gully Creek. Data from stations associated with Camel Lake were not considered, as Camel Lake (WBID 1039A) has no outflow channel connecting it to Little Gully Creek. In all subsequent tables and graphs, the remaining stations are "nicknamed" to save space, as follows:

- *Station 21FLGW 27458 (Sand Creek) at the upper end of the watershed is titled GW;*
- *Station 21FLNPS301648108500483 located at the upper end of Little Gully Creek is titled PN0483; and*
- *Station 21FLNWFD301542085004801 is titled NWD and is co-located with Station 21FLPNS301541908500465, titled PN0465.*

Figure 2.1. Location of Water Quality Monitoring Locations in Little Gully Creek (WBID 1039)

Note: FDOT local roads are for illustration purposes only and are not meant to depict roadways for which FDOT is responsible.

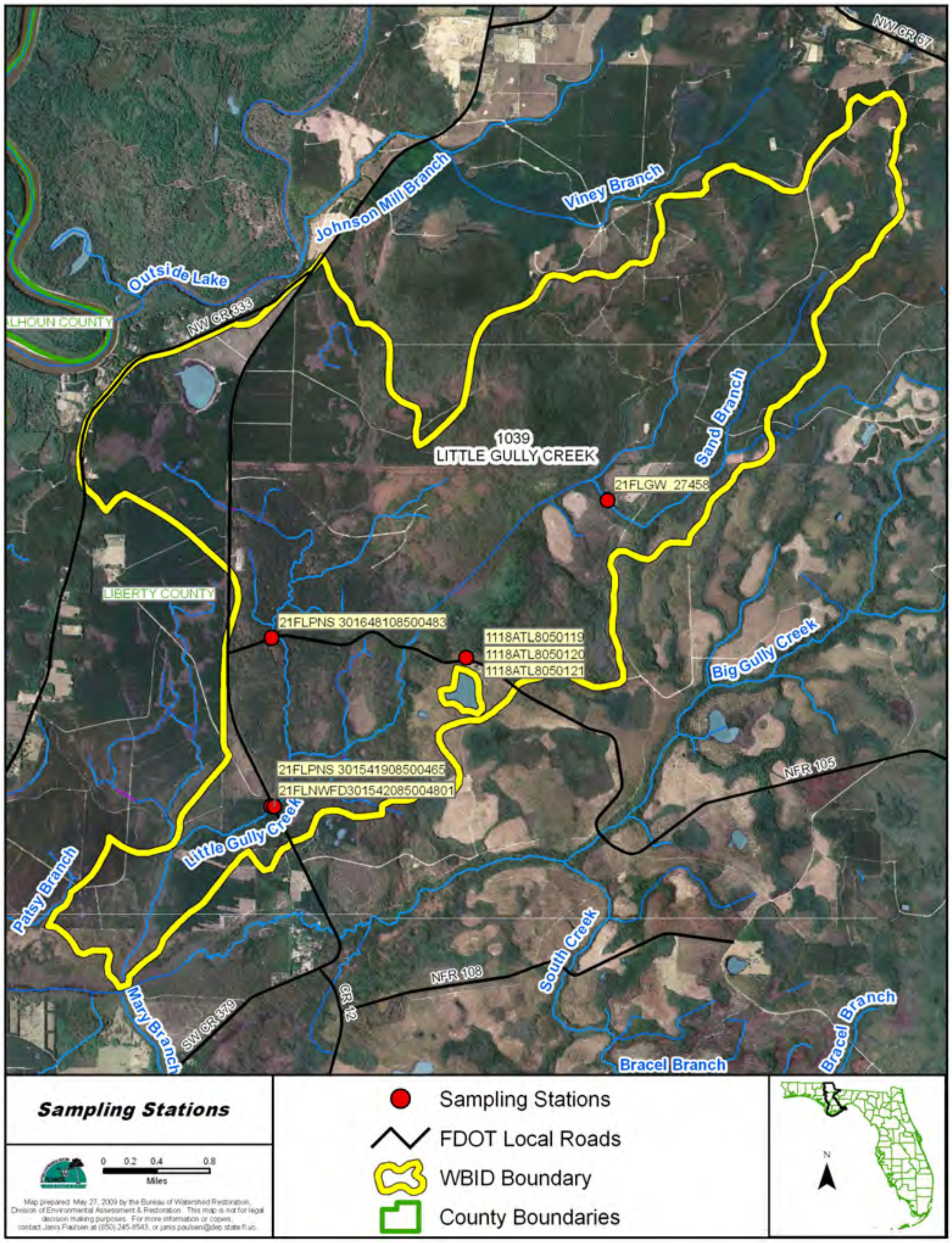


Table 2.3. Water Quality Stations for Little Gully Creek (WBID 1039)

Station	Name
1118ATL8050119	Camel Lake, Apalachicola District
1118ATL8050120	Camel Lake Rec Area Swimming Beach
1118ATL8050121	Camel Lake Rec Area Swimming Beach
21FLGW 27458	NW2-SS-2081 Sand Branch
21FLNWFD301542085004801	Little Gulley Cr. @ C.R. 12
21FLPNS 301541908500465	Little Gulley Creek @ CR 12
21FLPNS 301648108500483	Little Gulley Creek @ FR 105

Table 2.4 and **Figure 2.2** depict the annual rainfall at Bristol. These data show that 2007, the year that Little Gully Creek became impaired, had less than 50 percent of the rainfall of 2003, was the driest year during the period from 2002 to 2008, and came at the end of several years of declining rainfall.

Table 2.4. Annual Rainfall (in Inches) at Bristol, 2002–08

Year	Rainfall (inches)
2002	76.8
2003	93.4
2004	68.8
2005	75.7
2006	46.0
2007	40.6
2008	72.7

Figure 2.2. Annual Rainfall (in Inches) at Bristol, 2002–08

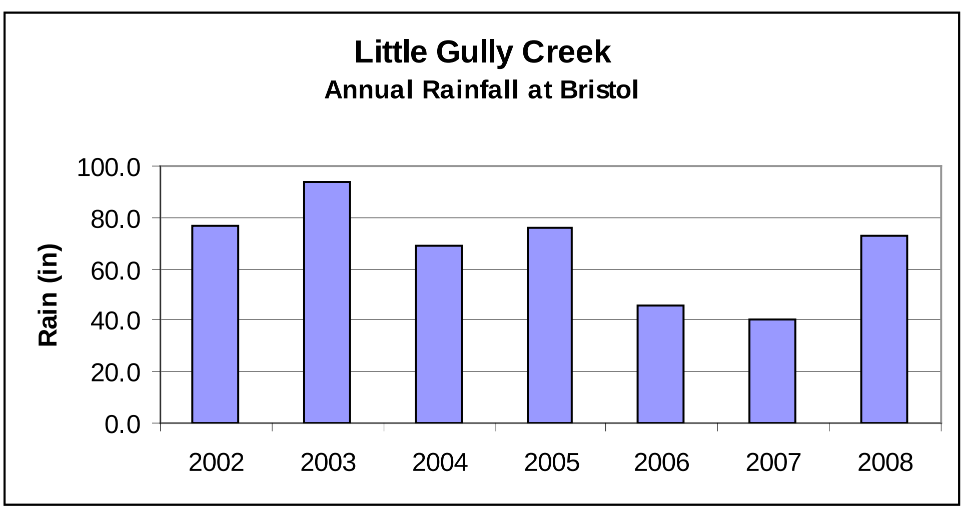


Table 2.5 and **Figure 2.3** depict the monthly average rainfall at Bristol. These data show that 2007, the year that Little Gully Creek became impaired, had similar monthly rainfall for the winter (December through February), but substantially less monthly rainfall than during the overall period from 2000 to 2008 for the rest of the year.

Table 2.5. Monthly Average Rainfall (in Inches) at Bristol During the Verified Period and 2007

Month	Verified Period Average Rainfall (inches)	2007 Average Rainfall (inches)
Jan	4.0	5.3
Feb	6.5	5.7
Mar	5.3	1.0
Apr	4.6	2.1
May	3.4	0.1
Jun	6.8	3.4
Jul	8.8	4.8
Aug	10.6	4.9
Sep	5.3	4.2
Oct	4.3	4.8
Nov	4.6	0.8
Dec	3.5	3.4

Figure 2.3. Monthly Average Rainfall (in Inches) at Bristol During the Verified Period and 2007

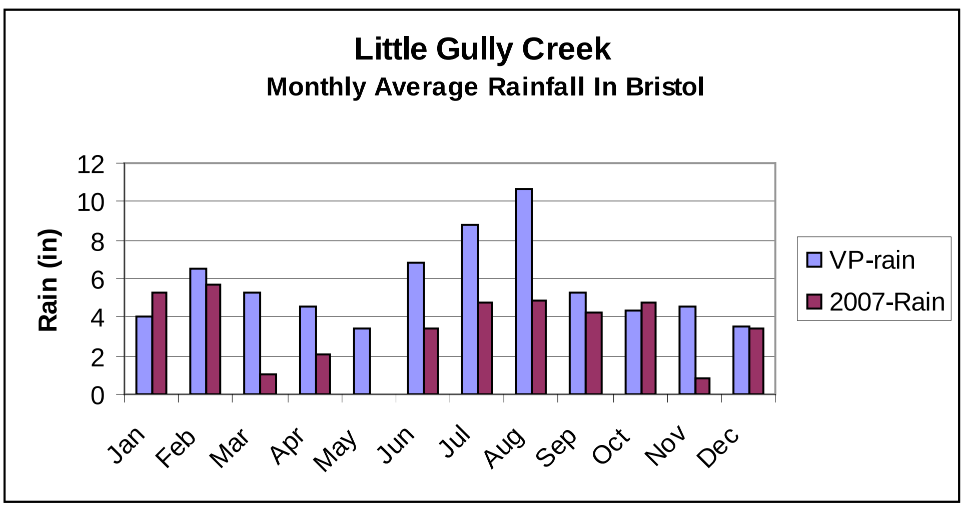


Figure 2.4 shows that the majority of the time, DO is less than 5.0 mg/L. There are insufficient DO data at the upstream stations to determine spatial trends. However, the limited paired data show the downstream station PN0465 and the upstream station PN0483 have nearly identical concentrations.

Figure 2.4. DO Measurements for Little Gully Creek (WBID 1039), January 1993–March 2008

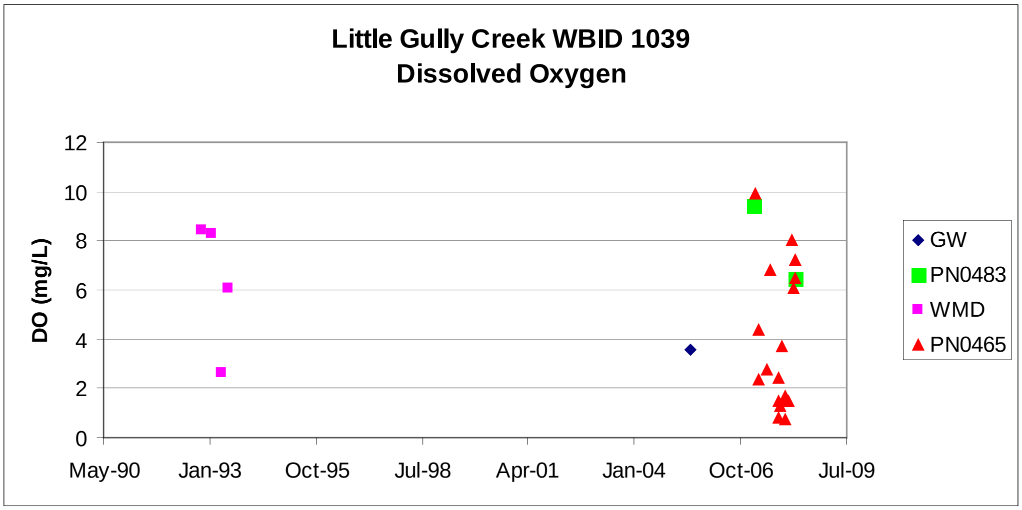


Figure 2.5 shows that while CChl*a* is often very low, at times it can increase up to 290 µg/L. There are insufficient CChl*a* data at the upstream stations to determine spatial trends. However, the limited paired data show the downstream station PN0465 and the upstream station PN0483 have similar concentrations.

Figure 2.5. CChl*a* Measurements for Little Gully Creek (WBID 1039), June 2005–March 2008

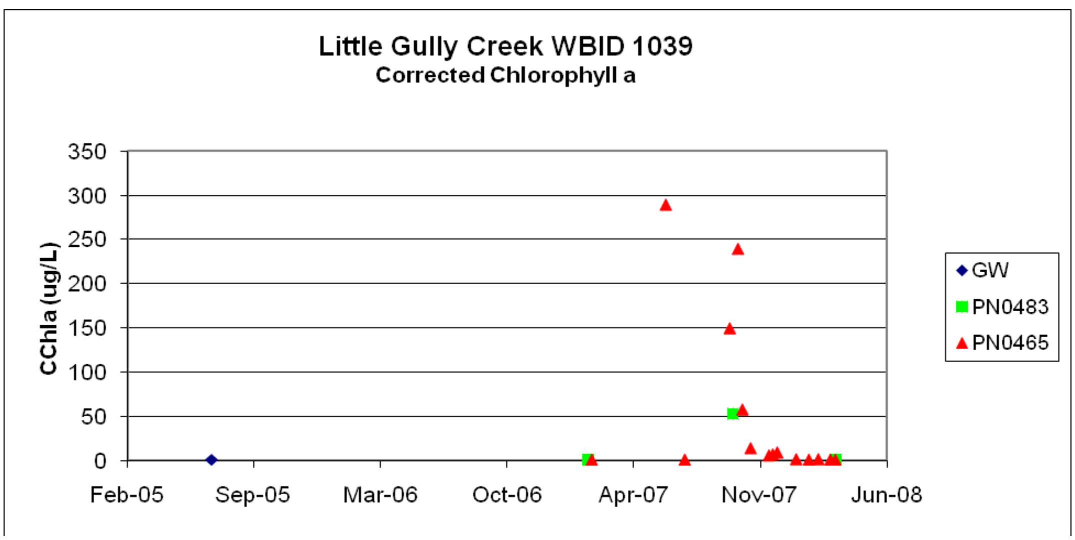


Figure 2.6 shows that while BOD_5 is often less than 2.0 mg/L, at times it can increase up to 12.0 mg/L. There are insufficient BOD_5 data at the upstream stations to determine spatial trends. However, the limited paired data show the downstream station PN0465 and the upstream station PN0483 have similar concentrations.

Figure 2.6. BOD_5 Measurements for Little Gully Creek (WBID 1039), February 2007–March 2008

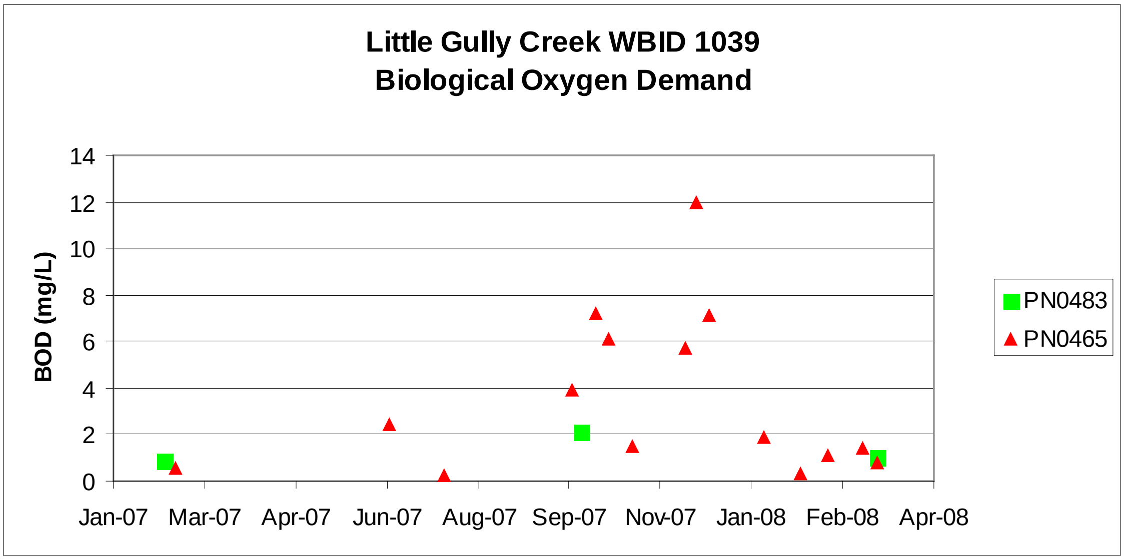


Figure 2.7 shows that total nitrogen (TN) ranges from less than 0.2 to 1.82 mg/L. There are insufficient TN data at the upstream stations to determine spatial trends. However, the limited paired data show the downstream station PN0465 and the upstream station PN0483 have similar concentrations.

Figure 2.7. TN Measurements for Little Gully Creek (WBID 1039), January 1993–March 2008

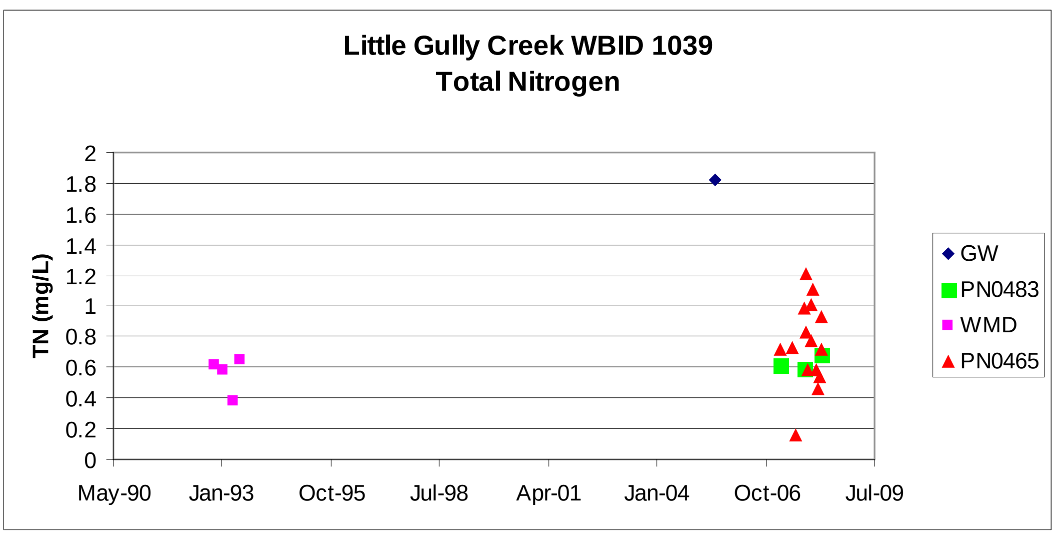


Figure 2.8 shows that total phosphorus (TP) ranges from less than 0.02 to 0.130 mg/L. There are insufficient TP data at the upstream stations to determine spatial trends. However, the limited paired data show the downstream station PN0465 and the upstream station PN0483 have similar concentrations.

Figure 2.8. TP Measurements for Little Gully Creek (WBID 1039), January 1993–March 2008

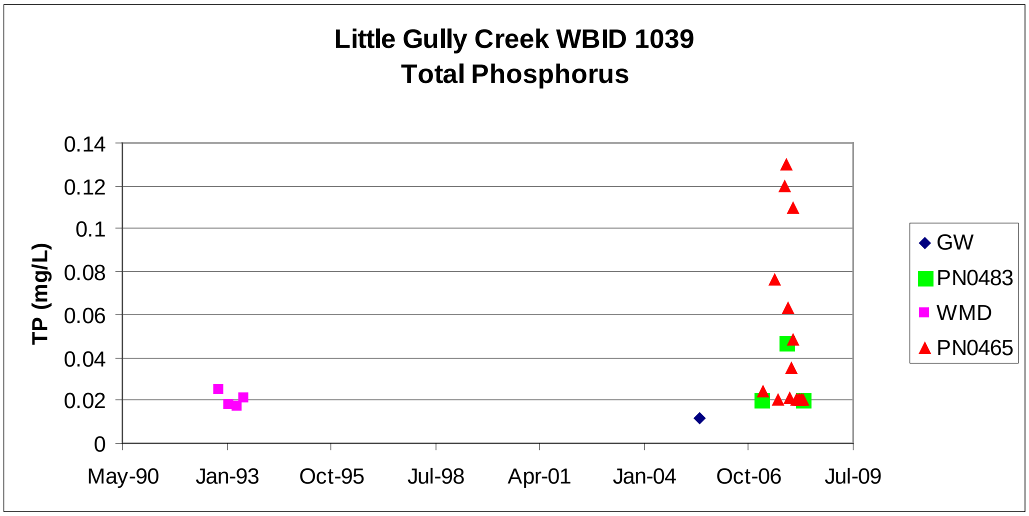
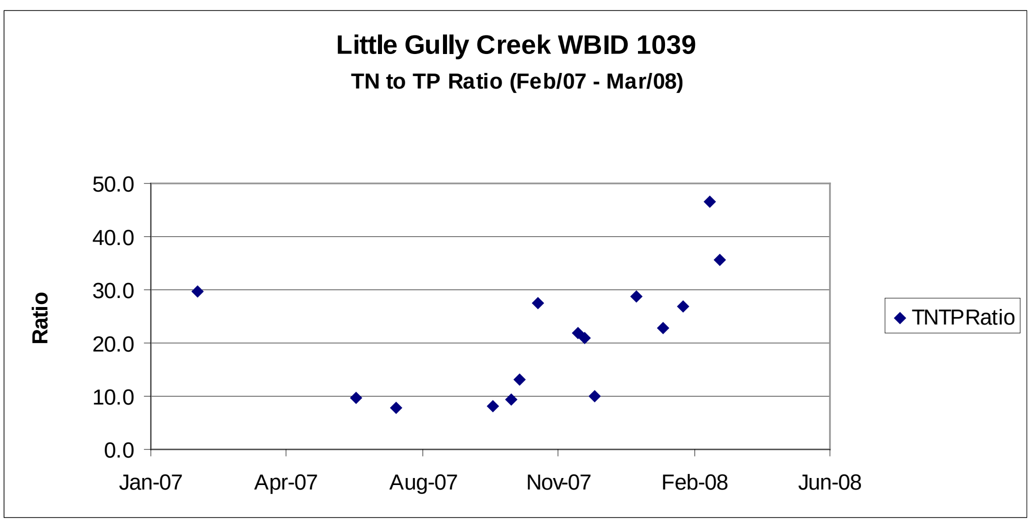


Figure 2.9 shows that the limiting nutrients, based on the ratio of TN to TP, vary. The creek ranges from nitrogen limited (ratio less than 10) during late spring and summer, to co-limited (ratio between 10 and 30) during the fall and early winter, to phosphorus limited (ratio greater than 30) during late winter. There are insufficient data at the upstream stations to determine spatial trends.

Figure 2.9. TN to TP Ratio, January 2007–March 2008



Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDLs

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

Little Gully Creek is a Class III fresh waterbody, with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. The criteria applicable to these TMDLs are the Class III criteria for DO and nutrients.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Definitions

Chlorophyll *a*

Chlorophyll, a green pigment found in plants, is an essential component in the process of converting light energy (sunlight) into chemical energy through the process of photosynthesis. In photosynthesis, the energy absorbed by chlorophyll transforms carbon dioxide and water into carbohydrates and oxygen. The chemical energy stored by photosynthesis in carbohydrates drives biochemical reactions in nearly all living organisms. Thus, chlorophyll is at the center of the photosynthetic oxidation-reduction reaction between carbon dioxide and water.

There are several types of chlorophyll; however, the predominant form is chlorophyll *a,* or chl*a*. The measurement of chl*a* in a water sample is a useful indicator of phytoplankton biomass, especially when used in conjunction with an analysis of algal growth potential and species abundance. The greater the abundance of chl*a*, typically the greater the abundance of algae. Algae are the primary producers in the aquatic food web, and thus are very important in characterizing the productivity of aquatic systems.

Total Nitrogen as N

TN is the combined measurement of nitrate (NO3), nitrite (NO2), ammonia, and organic nitrogen found in water. Nitrogen compounds function as important nutrients for many aquatic organisms and are essential to the chemical processes that take place between land, air, and water. The most readily bioavailable forms of nitrogen are ammonia and nitrate. These compounds, in conjunction with other nutrients, serve as an important base for primary productivity.

The major sources of excessive amounts of nitrogen in surface water are the effluent from municipal treatment plants and runoff from urban and agricultural sites. When nutrient concentrations consistently exceed natural levels, the resulting nutrient imbalance can cause undesirable changes in a waterbody's biological community and drive an aquatic system into an accelerated rate of eutrophication. Usually, the eutrophication process is observed as a change in the structure of the algal community and includes severe algal blooms that may cover large areas for extended periods. Large algal blooms are generally followed by depletion in DO concentrations as a result of algal decomposition.

Total Phosphorus as P

Phosphorus is one of the primary nutrients that regulates algal and macrophyte growth in natural waters, particularly in fresh water. Phosphate, the form in which almost all phosphorus is found in the water column, can enter the aquatic environment in a number of ways. Natural processes transport phosphate to water through atmospheric deposition, ground water percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities also contribute to phosphate loading through direct discharge and natural transport mechanisms. The very high levels of phosphorus in some Florida streams and estuaries are usually caused by phosphate mining and fertilizer processing activities.

High phosphorus concentrations are frequently responsible for accelerating the process of eutrophication, or accelerated aging, of a waterbody. Once phosphorus and other important nutrients enter the ecosystem, they are extremely difficult to remove. They become tied up in biomass or deposited in sediments. Nutrients, particularly phosphates, deposited in sediments generally are redistributed to the water column. This type of cycling compounds the difficulty of halting the eutrophication process.

3.2.2 Dissolved Oxygen Criterion

Florida's DO criterion for Class III fresh waterbodies states that DO shall not be less than 5.0 mg/L. Normal daily and seasonal fluctuations above these levels shall be maintained. However, DO concentrations in ambient waters are influenced by many factors, including the following:

- *DO solubility, which is controlled by temperature and salinity;*
- *DO enrichment processes influenced by reaeration, which is controlled by flow velocity;*
- *The photosynthesis of phytoplankton, periphyton, and other aquatic plants;*
- *DO consumption from the decomposition of organic materials in the water column and sediment, and the oxidation of some reductants such as ammonia and metals; and*
- *Respiration by aquatic organisms.*

Little Gully Creek was verified as impaired for DO based on 13 of the 16 measured values being below the Class III freshwater criterion.

3.2.3 Nutrient Criterion

Florida's nutrient criterion is narrative only—nutrient concentrations of a body of water shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Accordingly, a nutrient-related target was needed to represent levels at which an imbalance in flora or fauna is expected to occur.

While the IWR provides a threshold for nutrient impairment for streams based on annual average CChl*a* levels, these thresholds are not standards and need not be used as the nutrient-related water quality target for TMDLs. In fact, in recognition that the IWR thresholds were developed using statewide average conditions, the IWR (Section 62-303.450, F.A.C.) specifically allows the use of alternative, site-specific thresholds that more accurately reflect conditions beyond which an imbalance in flora or fauna occurs in the waterbody. The IWR used the threshold concentration of 20.0 μg/L CChl*a* for assessing Little Gully Creek for nutrient impairment. The stream exceeded this threshold in 2007, during the verified period, and was determined to be impaired for nutrients.

3.2.4 Nutrient Target Development

Numerous regression analyses were conducted on the data to examine the correlations between nutrients, color, and BOD_5 with CChl*a* and DO. As a result of this investigation, it was determined that the majority of the impacts from BOD_5 on DO are a result of natural conditions and not entirely linked to anthropogenic sources.

After the initial data investigation, an empirical equation was developed from the stream data to establish the nutrient and DO TMDLs for Little Gully Creek. **Equation 5.1 (**see **Section 5.1.1)**, relating DO to the quarterly mean concentrations of TN and TP, was solved to find the concentration of TN and TP that would result in a DO greater than 5.0 mg/L. During this process, the current annual average ratio of TN to TP was maintained while establishing the reductions in nutrients. Percent reductions for nutrients were established based on the relationship between the annual average concentrations that resulted in the impairments and the nutrient concentrations from the equation that predicted a DO greater than 5.0 mg/L.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the impaired waterbody and the amount of pollutant loadings contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term "point sources" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources encompassed certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) ***and*** stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Nutrients and BOD_5 in the Little Gully Creek Watershed

4.2.1 Point Sources

There are no NPDES-permitted facilities discharging directly or indirectly into Little Gully Creek.

Municipal Separate Storm Sewer System Permittees

According to the Department's geographic information system (GIS) information, there are no NPDES municipal separate storm sewer system (MS4) permits that cover the Little Gully Creek watershed.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water (EPA, 1994).

Land Uses

The spatial distribution and acreage of different land use categories were identified using the NWFWMDs 2004 land use coverage (scale 1:40,000) contained in the Department's GIS library. Land use categories in the watershed were aggregated using the Level 3 codes and tabulated in **Table 4.1.** **Figure 4.1** shows the acreage of the principal land uses at the Level 1 land use scale.

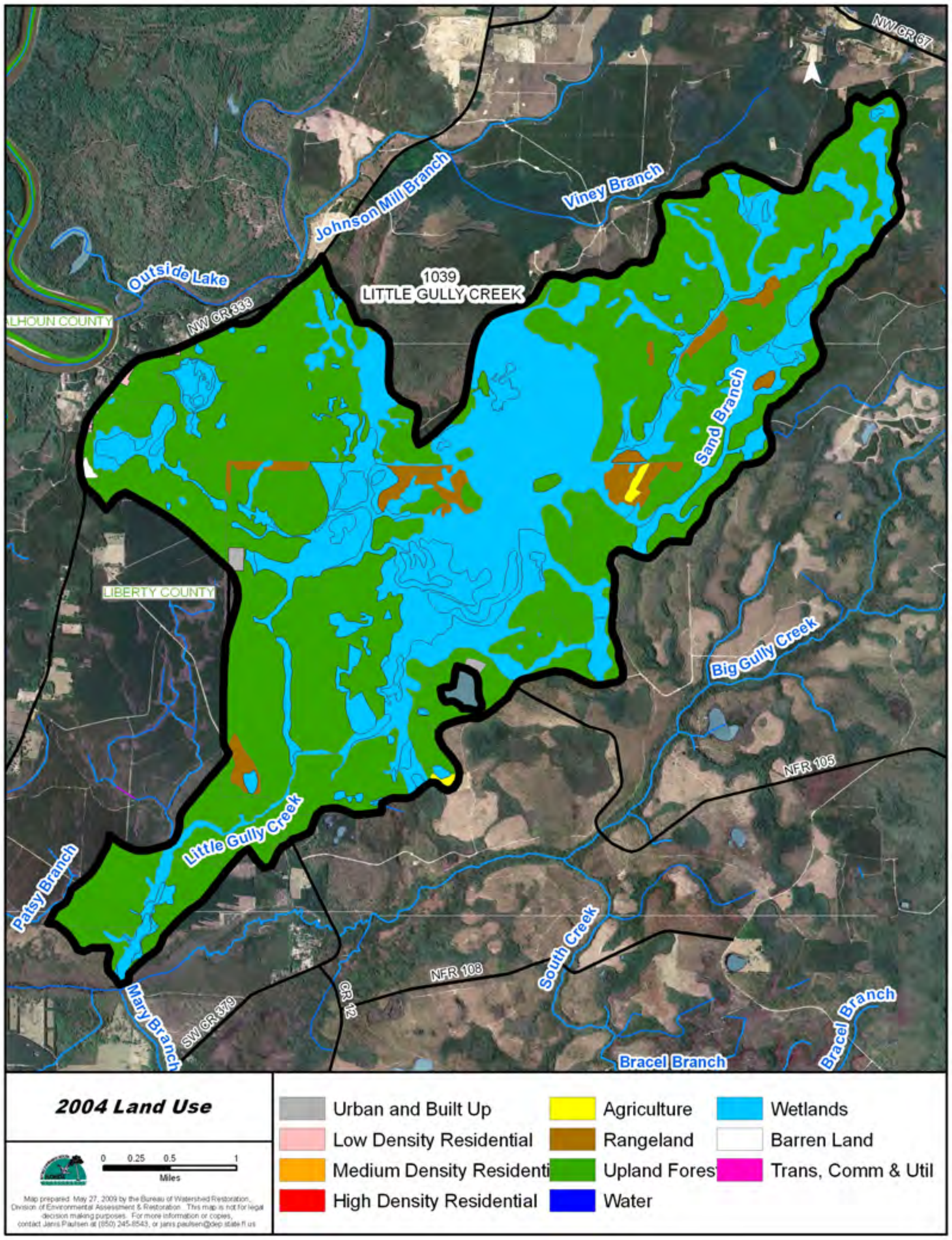
As shown in **Table 4.1,** the Little Gully Creek watershed drains about 10,167 acres of land. The primary land uses are coniferous plantations (38.4 percent), followed by mixed wetland forest (22 percent), and upland coniferous forest (18 percent). Residential and other land uses with high imperviousness and that generate elevated nutrient loadings are ***less than 0.2 percent*** of the watershed.

Table 4.1. Classification of Land Use Categories for the Little Gully Creek Watershed (WBID 1039) in 2004

- = Empty cell/no data

Land Use	Land Use Code	Acres	%
Low-Density Residential (less than 2 dwelling units per acre)	1100	12.8	0.1%
Institutional	1700	12.8	0.1%
Parks	1800	7.6	0.1%
Improved Pasture	2100	23.1	0.2%
Rangeland	3100	46.8	0.5%
Mixed Rangeland	3300	67.8	0.7%
Coniferous Plantations	4400	3,901.4	38.4%
Forest Regeneration Areas	4430	368.9	3.6%
Rural Land in Transition	7400	7.6	0.1%
Open Land	1900	2.8	0.0%
Shrub and Brush	3200	145.2	1.4%
Upland Hardwood Forests	4200	4.5	0.0%
Upland Coniferous Forests	4100	1,808.1	17.8%
Hardwood Conifer Mix	4300	100.1	1.0%
Hydric Pine Flatwoods	6200	605.2	6.0%
Wetland Forest Mix	6300	2,248.9	22.1%
Mixed Scrub Wetland	6400	622.7	6.1%
Swamps/Wetlands	6100	179.6	1.8%
Lakes	5200	1.4	0.0%
Total:	**-**	**10,167.3**	**100.0%**

Figure 4.1. Principal Land Uses in the Little Gully Creek Watershed (WBID 1039) in 2004



Septic Tanks

Septic tanks are another potentially important source of nutrients in some watersheds. In areas with a relatively high ground water table, the drain field can be flooded during the rainy season and can pollute surface water through storm runoff.

It is not anticipated that septic tanks are a significant contributor in this watershed, given that less than 0.3 percent of the watershed has the potential for septic tanks (residential, parks, and institutional). It should be noted that any loadings from the Camel Lake Recreational Area go to Camel Lake. The topographic maps indicate that Camel Lake does not have a defined outflow channel.

Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) can also be a potential source of fecal bacteria pollution. Human sewage can be introduced into surface waters even when storm and sanitary sewers are separated. Leaks and overflows are common in many older sanitary sewers where capacity is exceeded, high rates of infiltration and inflow occur (i.e., outside water gets into pipes, reducing capacity), frequent blockages occur, or sewers are simply falling apart due to poor joints or pipe materials. Power failures at pumping stations are also a common cause of SSOs. The greatest risk of an SSO occurs during storm events; however, few comprehensive data are available to quantify SSO frequency and bacteria loads in most watersheds. There is no evidence of sanitary sewers in the Little Gully Creek watershed.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The DO and nutrient TMDL calculation was developed using a combination of an empirical equation and percent reduction based on the annual average concentrations from the year of impairment (2007).

5.1.1 Data Used in the Determination of the TMDLs

The data used for this TMDL report were provided by the NWFWMD and the Department's Northwest District. **Figure 2.1** shows the locations of the water quality sites where data were collected. **Figures 2.4** through **2.9** display the data used in this analysis. **Table 5.1** contains the paired quarterly mean data used to develop **Equation 5.1** relating TN and TP to DO. **Table 5.2** contains the complete set of paired raw data used to investigate the various relationships in the data, correlating BOD_5, TN, and TP to DO and CChl*a*. **Appendix B** contains the complete set of raw data for CChl*a*, BOD_5, TN, TP, and color.

5.1.2 TMDL Development Process for Little Gully Creek

The following information includes summary statistics for the regression equations investigated. The R^2 is a statistical measure of the fraction of the variance in the dependent variable that can be explained by the variance of the independent variables. For example, if the R^2 in an equation is 45, this indicates that the equation accounts for over 45 percent of the variance in the data.

Another important factor to be used in assessing the coefficients of a regression is the P-value. The P-value comes from comparing the t statistic (the coefficient divided by its standard error) of the independent variables to the t distribution. This indicates the precision with which the regression coefficient is measured. If the coefficient is large compared with its standard error, then it is probably different from zero. P-values less than 0.05 indicate that the slope of the regression line is significantly different from zero.

Figure 5.1 shows that BOD_5 and DO are correlated with BOD_5, explaining over 50 percent of the variance in DO. This relationship has an R^2 of 0.51 and a P-value for BOD_5 of 0.0026, indicating that higher BOD_5 concentrations are related to low DO.

Table 5.1. Quarterly Average Data Used to Develop Equation 5.1 for Little Gully Creek (WBID 1039)

Quarter	DO (mg/L)	BOD_5 (mg/L)	CChl*a* (µg/L)	TN (mg/L)	TP (mg/L)
Q1 (Jan-Mar)	7.03	0.71	1.00	0.66	0.022
Q2 (Apr-Jun)	2.58	2.40	1.00	0.73	0.076
Q3 (Jul-Sep)	3.80	2.05	75.50	0.57	0.070
Q4 (Oct-Dec)	1.65	6.49	35.08	0.88	0.060
Annual Average:	**3.76**	**2.91**	**28.15**	**0.71**	**0.057**

Table 5.2. Paired Raw Data for Little Gully Creek (WBID 1039)

Date	DO (mg/L)	BOD_5 (mg/L)	CChl*a* (µg/L)	TN (mg/L)	TP (mg/L)	TN/TP Ratio
2/21/2007	9.9	0.53	1.0	0.71	0.024	29.6
6/18/2007	2.79	2.40	290.0	0.73	0.076	9.5
7/18/2007	6.8	0.20	1.0	0.16	0.020	7.8
9/27/2007	0.8	3.90	150.0	0.99	0.120	8.2
10/10/2007	1.49	7.20	240.0	1.21	0.130	9.3
10/17/2007	1.3	6.10	58.0	0.83	0.063	13.1
10/30/2007	3.7	1.50	14.0	0.58	0.021	27.4
11/28/2007	1.5	5.70	5.9	0.77	0.035	21.9
12/4/2007	1.71	12.00	7.0	1.01	0.048	21.0
12/11/2007	0.74	7.10	9.2	1.11	0.110	10.1
1/10/2008	1.49	1.90	1.5	0.58	0.020	28.8
1/30/2008	8	0.28	1.0	0.46	0.020	22.9
2/14/2008	6.1	1.10	1.6	0.54	0.020	26.9
3/4/2008	7.2	1.40	1.0	0.93	0.020	46.5
3/12/2008	7.2	0.77	1.0	0.71	0.020	35.6

Figure 5.1. Relationship of DO to BOD_5

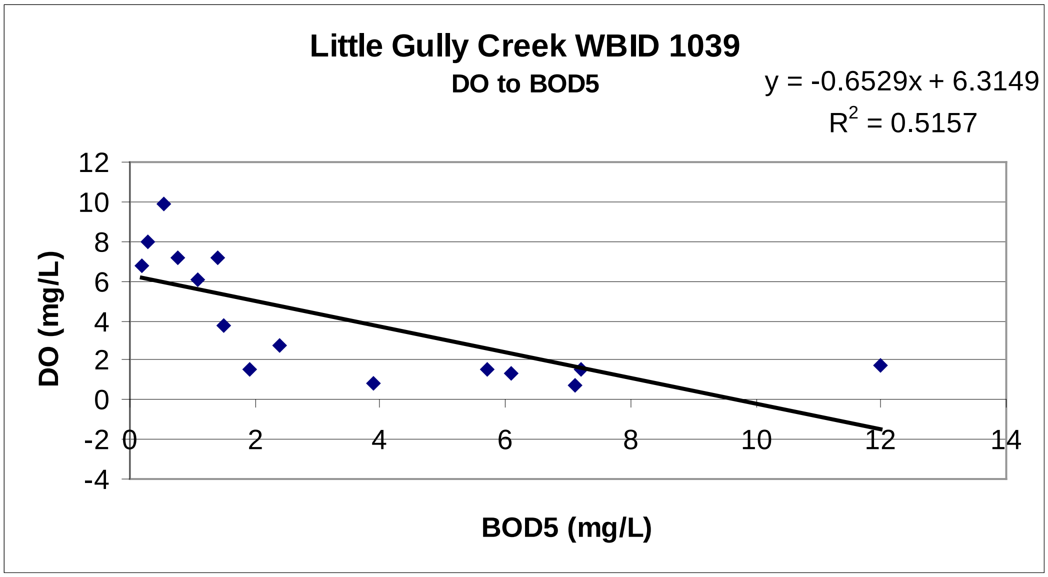


Figure 5.2 shows that DO and TN are correlated with TN, explaining over 29 percent of the variance in DO. This relationship has an R^2 of 0.29 and a P-value for TN of 0.038, indicating that higher TN concentrations are related to low DO.

Figure 5.2. Relationship of DO to TN

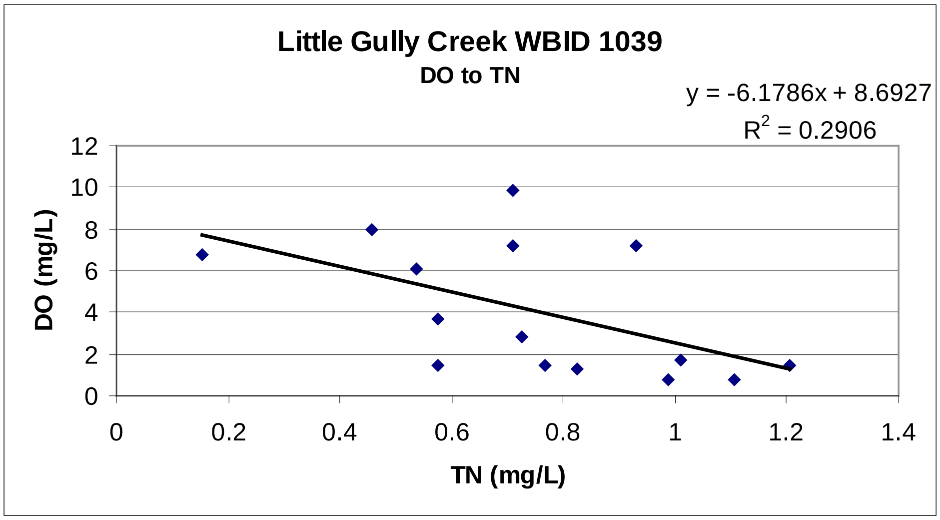
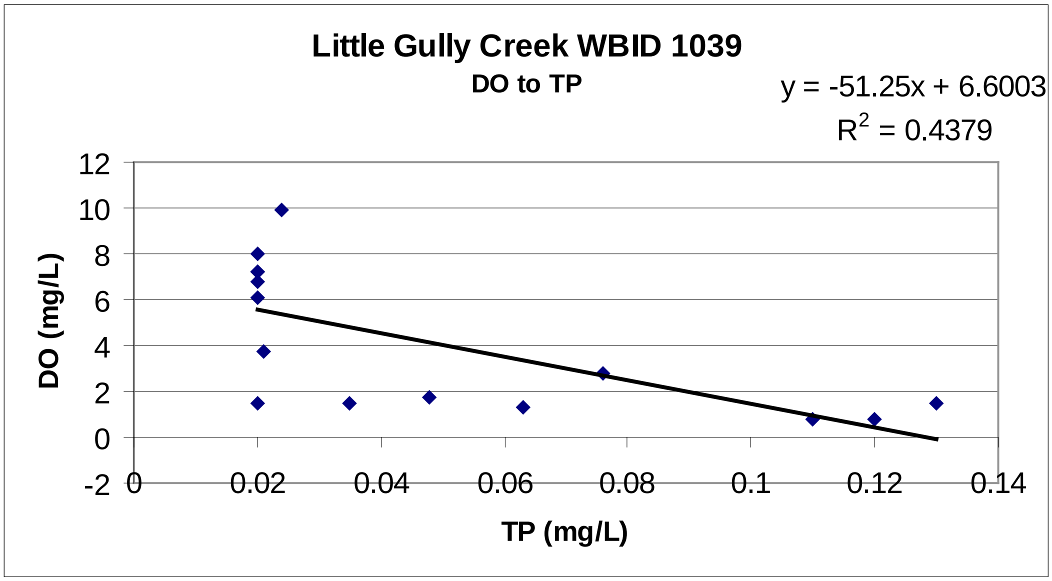


Figure 5.3 shows that DO and TP are correlated with TP, explaining over 43 percent of the variance in DO. This relationship has an R^2 of 0.43 and a P-value for TP of 0.007, indicating that higher TP concentrations are related to low DO.

Based on the relationships of these constituents to DO, **Equation 5.1** was developed from the quarterly mean values in **Table 5.1** for DO, TN, and TP and used to develop the nutrient TMDL.

Figure 5.3. Relationship of DO to TP



Given an R^2 of 0.035 and a P-value for BOD_5 of 0.5, **Figure 5.4** demonstrates the lack of a strong relationship between CChl*a* and BOD_5. This could indicate that the BOD_5 is not primarily a result of the breakdown of algal cells.

Given an R2 of 0.086 and a P-value for color of 0.289, **Figure 5.5** depicts a similar pattern of CChl*a* to DO as to BOD_5 and demonstrates the lack of a strong relationship between CChl*a* and color. This could indicate that changes in color alone are not correlated with changes in CChl*a* and, given the strong relationship between DO and BOD_5 and nutrients, that these factors could be primarily responsible for the low DO.

Figure 5.4. Relationship of CChl*a* to BOD_5

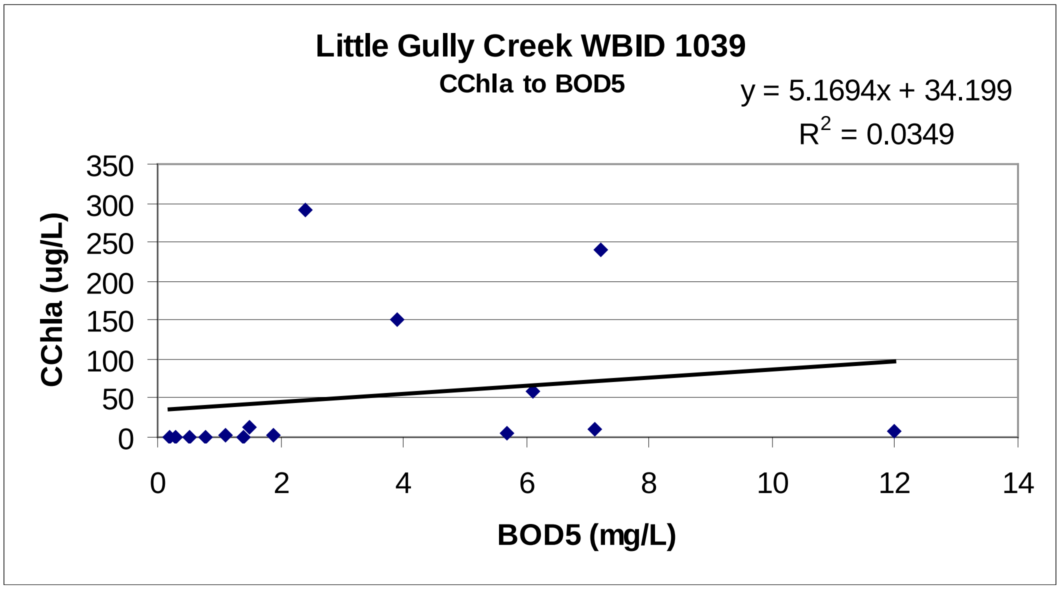
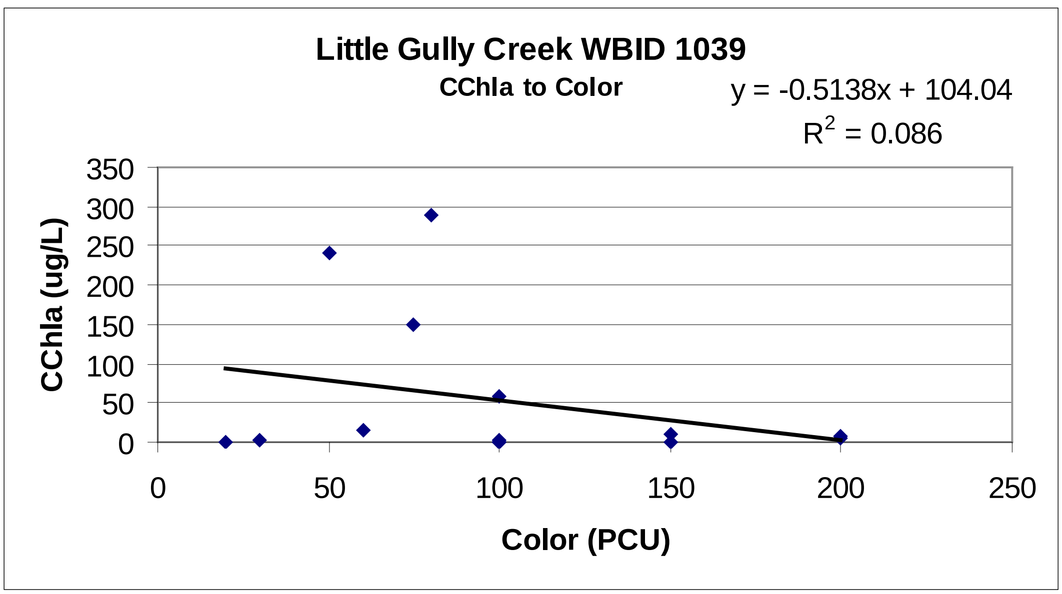
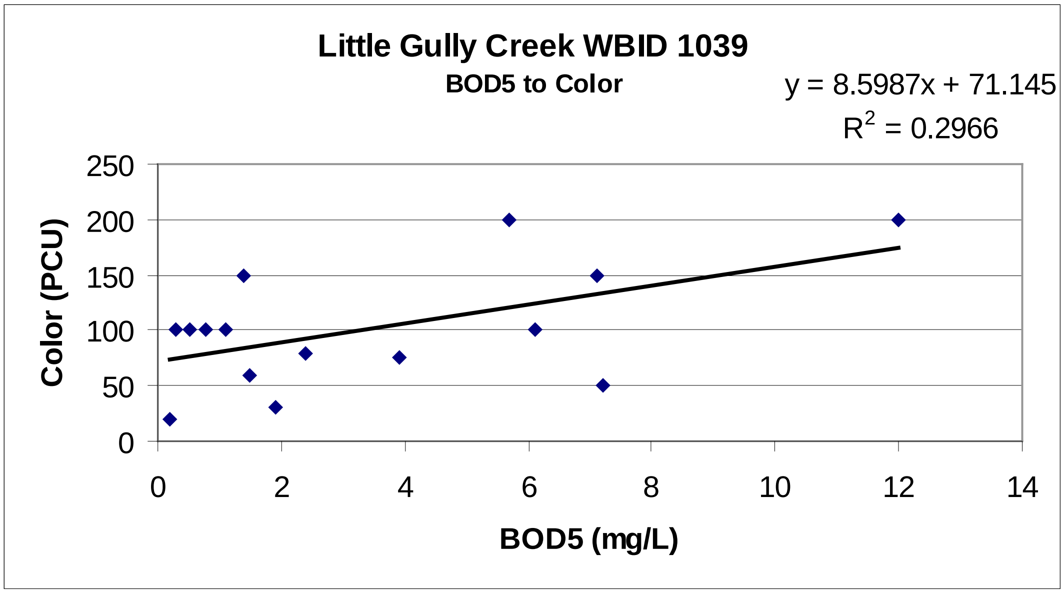


Figure 5.5. Relationship of CChl*a* to Color



Given an R^2 of 0.297 and a P-value for BOD_5 of 0.036, **Figure 5.6** demonstrates the strong relationship between color and BOD_5. This, in combination with the other information, could indicate that the BOD_5 is primarily a result of the breakdown of organic matter other than algal cells.

Figure 5.6. Relationship of Color to BOD_5



After reviewing all information, it appears that a large portion of the low DO is controlled by BOD_5 and that the majority of this demand is from the breakdown of naturally occurring vegetation in the watershed (the watershed is about 97 percent forested, of which about 34 percent is forested wetlands). This leads to the conclusion that a specific reduction to BOD_5 is not warranted and that after controlling the anthropogenic contribution from nutrients, any remaining DO below the criterion is not the result of a pollutant, but rather primarily a natural condition that would occur without the presence of human activities.

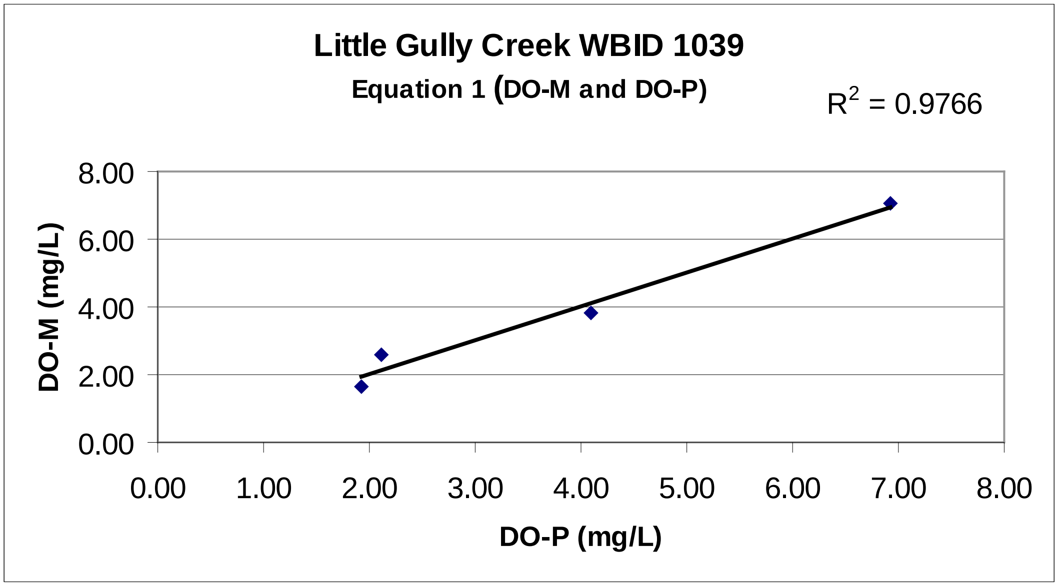
Equation 5.1 relates DO to the quarterly mean concentrations of TN and TP, in order to calculate the concentration of TN and TP resulting in a DO greater than 5.0 mg/L:

$$DO= ((-9.50776*TN)+(-76.4646*TP)+(14.874)) \qquad \textbf{(Equation 5.1)}$$

The R^2 for **Equation 5.1** is 0.97, and the P-values are 0.179 for TN and 0.122 for TP.

Figure 5.7 depicts the relationship between the calculated quarterly averages and the predicted values.

Figure 5.7. Relationship of Measured DO to Predicted DO



Equation 5.1 predicts an annual average DO of 3.77 mg/L, compared with the measured annual average of 3.76 mg/L (0.1 percent error) with the annual average concentrations for TN (0.71 mg/L) and TP (0.057 mg/L) (**Table 5.3**). Given the ability of **Equation 5.1** to predict annual average conditions with less than a 1 percent error, even with high P-values, the equation was used to develop the nutrient TMDL.

Table 5.3. Measured DO, Predicted DO, Percent Error, and Data Used to Develop Equation 5.1 for Little Gully Creek (WBID 1039)

Quarter	DO-Measured (mg/L)	DO-Predicted (mg/L)	% Error	TN (mg/L)	TP (mg/L)
Q1	7.03	6.92	-1.6%	0.66	0.022
Q2	2.58	2.12	-17.8%	0.73	0.076
Q3	3.80	4.10	7.9%	0.57	0.070
Q4	1.65	1.92	16.3%	0.88	0.060
Annual Average	**3.76**	**3.77**	**0.1%**	**0.71**	**0.057**

Percent reductions were calculated using the annual average TN and TP concentrations for 2007 (the only year in the verified period with enough data to calculate annual averages in accordance with the IWR methodology) as the worst-case values, and the results from the equation of 0.63 mg/L of TN and 0.0506 mg/L of TP as the targets.

TN Percent Reduction =
((0.71 – 0.63)/0.71)*100)
= 11.27 percent.

TP Percent Reduction =
((0.057 – 0.0506)/0.057)*100)
= 11.23 percent.

As part of the margin of safety (MOS), both percent reductions were rounded to 11.3 percent, and the TP concentration was rounded to 0.051 mg/L (**Table 5.4**).

Table 5.4. Percent Reduction in TN and TP Necessary To Meet the Water Quality Standard for DO and Nutrients in Little Gully Creek (WBID 1039)

Parameter (Unit)	TMDL	Verified Period Maximum Annual Average	% Reduction
TN (mg/L)	0.63	0.71	11.3%
TP (mg/L)	0.051	0.057	11.3%

5.1.3 Critical Conditions/Seasonality

The critical conditions for nutrient and BOD_5 loadings in a given watershed depend on the existence of point sources, land use patterns, and rainfall in the watershed. Typically, the critical condition for nonpoint sources is an extended dry period, followed by a rainfall runoff event. During wet weather periods, pollutants that have built up on the land surface under dry weather conditions are washed off by rainfall, resulting in wet weather loadings. However, significant nonpoint source contributions could also occur under dry weather conditions without any major surface runoff event. This usually happens when nonpoint sources contaminate the surficial aquifer, and pollutants are brought into the receiving waters through baseflow. Animals with direct access to the receiving water could also contribute to the exceedances during dry weather conditions. The critical condition for point source loading typically occurs during periods of low stream flow, when dilution is minimized. As previously noted, there are no point source discharges in the watershed.

5.1.4 Spatial Patterns

While data are very limited, in examining **Figures 2.4** through **2.9**, some conclusions can be postulated, as follows:

- *It appears that for DO, there are no exceedances in the upper portion of Little Gully Creek (PN0483); the single data point in Sand Branch is an exceedance, with the downstream stations (WMD and PN0465) having the majority of the exceedances.*

- *The upstream stations (GW and PN0483) have significantly lower CChla than the downstream stations (WMD and PN0465).*

- *BOD_5 appears to be higher at the downstream location.*

- *The maximum TN concentration (1.82 mg/L) occurred at the Sand Branch location in the upper part of the watershed. The stations along Little Gully Creek had higher average TN at the downstream stations.*

- *For TP, concentrations appear to increase in a downstream direction.*

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (wasteload allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\textbf{TMDL} = \sum \textbf{WLAs} + \sum \textbf{LAs} + \textbf{MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as “percent reduction” because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDLs for Little Gully Creek are expressed in terms of a percent reduction and represent the maximum TN and TP loads the stream can assimilate while meeting the DO and nutrient criteria (**Table 6.1**).

Table 6.1. TMDL Components for Nutrients in Little Gully Creek (WBID 1039)

N/A – Not applicable

WBID	Parameter	TMDL (% reduction)	WLA for Wastewater	WLA for NPDES Stormwater (% reduction)	LA (% reduction)	MOS
1039	TN	11.3%	N/A	11.3%	11.3%	Implicit
1039	TP	11.3%	N/A	11.3%	11.3%	Implicit

6.2 Load Allocation

TN and TP reductions of 11.3 percent for Little Gully Creek are needed from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

Currently, no NPDES-permitted wastewater facilities are identified in the Little Gully Creek watershed.

6.3.2 NPDES Stormwater Discharges

While there are currently no MS4-permitted entities in the Little Gully Creek watershed, limits will be established for any future permittees. The WLA for stormwater discharges with an MS4 permit is an 11.3 percent reduction in TN and TP for WBID 1039. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of these TMDLs by establishing the reductions based on the maximum annual average concentrations during the verified period.

6.5 Evaluating Effects of the TMDL on DO

Little Gully Creek is expected to attain water quality standards for DO and nutrients following the implementation of the TMDLs, because these will require a reduction of 11.3 percent in TN and TP loadings. The nutrient reductions will also lower CChla and to that degree lower the algal component of the BOD_5.

These reductions will improve overall water quality in the watershed, including DO levels. They will have a positive effect on reducing diurnal fluctuations in DO and will improve DO levels in the creek by removing anthropogenic sources of nutrients. These reductions in algal biomass will reduce DO fluctuations and the BOD that results from the breakdown of the algal cells in the water by a relative amount. As total BOD is composed of both a carbonaceous fraction and a nitrogenous fraction, additional reductions in BOD will occur as a result of reducing the amount of TN entering the system by an average of 11.3 percent.

6.6 Evaluating the Effects of the TMDLs on BOD

The elevated BOD_5 measured in Little Gully Creek is contributing to the low DO. These values (as high as 12.0 mg/L) were not found to be related to CChl*a* or to a significant degree, nutrients. It is the Department's finding that the elevated BOD_5 is mostly caused by the senescence of natural vegetation in the extensive forested and other wetland areas in the watershed. That portion of the BOD_5 attributed to the anthropogenic input of nutrients and the degradation of the resulting CChl*a* biomass should be eliminated after the TMDLs are implemented, and the stream will attain water quality standards for nutrients and DO.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 TMDL Implementation

Following the adoption of these TMDLs by rule, the Department will determine the best course of action regarding its implementation. Depending on the pollutant(s) causing the waterbody impairment and the significance of the waterbody, the Department will select the best course of action leading to the development of a plan to restore the waterbody. Often this will be accomplished cooperatively with stakeholders by creating a Basin Management Action Plan, referred to as the BMAP. BMAPs are the primary mechanism through which TMDLs are implemented in Florida (see Subsection 403.067[7], F.S.). A single BMAP may provide the conceptual plan for the restoration of one or many impaired waterbodies.

If the Department determines that a BMAP is needed to support the implementation of this TMDL, a BMAP will be developed through a transparent, stakeholder-driven process intended to result in a plan that is cost-effective, technically feasible, and meets the restoration needs of the applicable waterbodies. Once adopted by order of the Department Secretary, BMAPs are enforceable through wastewater and municipal stormwater permits for point sources and through BMP implementation for nonpoint sources. Among other components, BMAPs typically include the following:

- *Water quality goals (based directly on the TMDL);*
- *Refined source identification;*
- *Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible);*
- *A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach;*
- *A description of further research, data collection, or source identification needed in order to achieve the TMDL;*
- *Timetables for implementation;*
- *Implementation funding mechanisms;*
- *An evaluation of future increases in pollutant loading due to population growth;*
- *Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures; and*
- *Stakeholder statements of commitment (typically a local government resolution).*

BMAPs are updated through annual meetings and may be officially revised every five years. Completed BMAPs in the state have improved communication and cooperation among local stakeholders and state agencies; improved internal communication within local governments; applied high-quality science and local information in managing water resources; clarified the obligations of wastewater point source, MS4, and non-MS4 stakeholders in TMDL implementation; enhanced transparency in the Department's decision making; and built strong relationships between the Department and local stakeholders that have benefited other program areas.

7.2 Other TMDL Implementation Tools

However, in some basins, and for some parameters, particularly those with fecal coliform impairments, the development of a BMAP using the process described above will not be the most efficient way to restore a waterbody, such that it meets its designated uses. This is because fecal coliform impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Addressing these problems requires good old-fashioned detective work that is best done by those in the area.

A multitude of assessment tools is available to assist local governments and interested stakeholders in this detective work. The tools range from the simple (such as Walk the WBIDs and GIS mapping) to the complex (such as bacteria source tracking). Department staff will provide technical assistance, guidance, and oversight of local efforts to identify and minimize fecal coliform sources of pollution. Based on work in the Lower St Johns River tributaries and the Hillsborough Basin, the Department and local stakeholders have developed a logical process and tools to serve as a foundation for this detective work. In the near future, the Department will be releasing these tools to assist local stakeholders with the development of local implementation plans to address fecal coliform impairments. In such cases, the Department will rely on these local initiatives as a more cost-effective and simplified approach to identify the actions needed to put in place a road map for restoration activities, while still meeting the requirements of Subsection 403.067(7), F.S.

References

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Rule 62-40, F.A.C. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

Rule 62-40 also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific standard industrial classification (SIC) codes, construction sites disturbing 5 or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as MS4s. However, because the master drainage systems of most local governments in Florida are interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the 15 counties meeting the population criteria. The Department received authorization to implement the NPDES stormwater program in 2000.

An important difference between the federal NPDES and the state's stormwater/environmental resource permitting programs is that the NPDES Program covers both new and existing discharges, while the state's program focus on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 1,000 people. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Raw Data for CChla, BOD_5, DO, TN, TP, and Color

CChla:

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units
21FLGW 27458	2005	6	30	1655	0.20	32209	6/30/2005	1	µg/L
21FLPNS 301648108500483	2007	2	15	1310	0.15	32209	2/15/2007	1	µg/L
21FLPNS 301541908500465	2007	2	21	1345	0.15	32209	2/21/2007	1	µg/L
21FLPNS 301541908500465	2007	6	18	1645	0.10	32209	6/18/2007	290	µg/L
21FLPNS 301541908500465	2007	7	18	1230	0.15	32209	7/18/2007	1	µg/L
21FLPNS 301541908500465	2007	9	27	1200	0.15	32209	9/27/2007	150	µg/L
21FLPNS 301648108500483	2007	10	2	1125	0.10	32209	10/2/2007	53	µg/L
21FLPNS 301541908500465	2007	10	10	1405	0.15	32209	10/10/2007	240	µg/L
21FLPNS 301541908500465	2007	10	17	1105	0.15	32209	10/17/2007	58	µg/L
21FLPNS 301541908500465	2007	10	30	1120	0.15	32209	10/30/2007	14	µg/L
21FLPNS 301541908500465	2007	11	28	1130	0.15	32209	11/28/2007	5.9	µg/L
21FLPNS 301541908500465	2007	12	4	1205	0.15	32209	12/4/2007	7	µg/L
21FLPNS 301541908500465	2007	12	11	1155	0.15	32209	12/11/2007	9.2	µg/L
21FLPNS 301541908500465	2008	1	10	1140	0.15	32209	1/10/2008	1.5	µg/L
21FLPNS 301541908500465	2008	1	30	1415	0.15	32209	1/30/2008	1	µg/L
21FLPNS 301541908500465	2008	2	14	1245	0.10	32209	2/14/2008	1.6	µg/L
21FLPNS 301541908500465	2008	3	4	1045	0.15	32209	3/4/2008	1	µg/L
21FLPNS 301541908500465	2008	3	12	1205	0.15	32209	3/12/2008	1	µg/L
21FLPNS 301648108500483	2008	3	12	1130	0.15	32209	3/12/2008	1	µg/L

BOD_5:

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units
21FLPNS 301541908500465	2007	2	21	1345	0.15	310	2/21/2007	0.53	mg/L
21FLPNS 301541908500465	2007	6	18	1645	0.10	310	6/18/2007	2.4	mg/L
21FLPNS 301541908500465	2007	7	18	1230	0.15	310	7/18/2007	0.2	mg/L
21FLPNS 301541908500465	2007	9	27	1200	0.15	310	9/27/2007	3.9	mg/L
21FLPNS 301541908500465	2007	10	10	1405	0.15	310	10/10/2007	7.2	mg/L
21FLPNS 301541908500465	2007	10	17	1105	0.15	310	10/17/2007	6.1	mg/L
21FLPNS 301541908500465	2007	10	30	1120	0.15	310	10/30/2007	1.5	mg/L
21FLPNS 301541908500465	2007	11	28	1130	0.15	310	11/28/2007	5.7	mg/L
21FLPNS 301541908500465	2007	12	4	1205	0.15	310	12/4/2007	12	mg/L
21FLPNS 301541908500465	2007	12	11	1155	0.15	310	12/11/2007	7.1	mg/L
21FLPNS 301541908500465	2008	1	10	1140	0.15	310	1/10/2008	1.9	mg/L
21FLPNS 301541908500465	2008	1	30	1415	0.15	310	1/30/2008	0.28	mg/L
21FLPNS 301541908500465	2008	2	14	1245	0.10	310	2/14/2008	1.1	mg/L
21FLPNS 301541908500465	2008	3	4	1045	0.15	310	3/4/2008	1.4	mg/L
21FLPNS 301541908500465	2008	3	12	1205	0.15	310	3/12/2008	0.77	mg/L
21FLPNS 301648108500483	2007	2	15	1310	0.15	310	2/15/2007	0.89	mg/L
21FLPNS 301648108500483	2007	10	2	1125	0.10	310	10/2/2007	2.1	mg/L
21FLPNS 301648108500483	2008	3	12	1130	0.15	310	3/12/2008	0.98	mg/L

DO:

- = Empty cell/no data

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units
21FLNWFD301542085004801	1992	11	17	1245	-	299	11/17/1992	8.4	mg/L
21FLNWFD301542085004801	1993	2	16	1030	-	299	2/16/1993	8.3	mg/L
21FLNWFD301542085004801	1993	5	17	1030	-	299	5/17/1993	2.6	mg/L
21FLNWFD301542085004801	1993	7	19	1400	-	299	7/19/1993	6.1	mg/L
21FLGW 27458	2005	6	30	1650	0.30	299	6/30/2005	3.66	mg/L
21FLGW 27458	2005	6	30	1655	0.20	299	6/30/2005	3.43	mg/L
21FLPNS 301648108500483	2007	2	15	1310	0.15	299	2/15/2007	9.42	mg/L
21FLPNS 301541908500465	2007	2	21	1345	0.15	299	2/21/2007	9.9	mg/L
21FLPNS 301541908500465	2007	3	28	1245	0.15	299	3/28/2007	4.39	mg/L
21FLPNS 301541908500465	2007	4	3	1021	0.15	299	4/3/2007	2.36	mg/L
21FLPNS 301541908500465	2007	6	18	1645	0.15	299	6/18/2007	2.79	mg/L
21FLPNS 301541908500465	2007	7	18	1230	0.15	299	7/18/2007	6.8	mg/L
21FLPNS 301541908500465	2007	9	27	1200	0.10	299	9/27/2007	0.8	mg/L
21FLPNS 301541908500465	2007	10	2	1125	0.15	299	10/2/2007	2.4	mg/L
21FLPNS 301541908500465	2007	10	10	1405	0.15	299	10/10/2007	1.49	mg/L
21FLPNS 301541908500465	2007	10	17	1105	0.15	299	10/17/2007	1.3	mg/L
21FLPNS 301541908500465	2007	10	30	1120	0.15	299	10/30/2007	3.7	mg/L
21FLPNS 301541908500465	2007	11	28	1130	0.15	299	11/28/2007	1.5	mg/L
21FLPNS 301541908500465	2007	12	4	1205	0.15	299	12/4/2007	1.71	mg/L
21FLPNS 301541908500465	2007	12	11	1155	0.15	299	12/11/2007	0.74	mg/L
21FLPNS 301541908500465	2008	1	10	1140	0.15	299	1/10/2008	1.49	mg/L
21FLPNS 301541908500465	2008	1	30	1415	0.15	299	1/30/2008	8	mg/L
21FLPNS 301541908500465	2008	2	14	1245	0.15	299	2/14/2008	6.1	mg/L
21FLPNS 301541908500465	2008	3	4	1045	0.15	299	3/4/2008	7.2	mg/L
21FLPNS 301541908500465	2008	3	12	1205	0.15	299	3/12/2008	7.2	mg/L
21FLPNS 301648108500483	2008	3	12	1130	0.15	299	3/12/2008	6.5	mg/L

TN:

- = Empty cell/no data

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units
21FLGW 27458	2005	6	30	1655	0.20	600	6/30/2005	1.82	mg/L
21FLNWFD301542085004801	1992	11	17	1230	-	600	11/17/1992	0.61	mg/L
21FLNWFD301542085004801	1993	2	16	1015	-	600	2/16/1993	0.58	mg/L
21FLNWFD301542085004801	1993	5	17	1015	-	600	5/17/1993	0.38	mg/L
21FLNWFD301542085004801	1993	7	19	1345	-	600	7/19/1993	0.65	mg/L
21FLPNS 301541908500465	2007	2	21	1345	0.15	600	2/21/2007	0.71	mg/L
21FLPNS 301541908500465	2007	6	18	1645	0.10	600	6/18/2007	0.725	mg/L
21FLPNS 301541908500465	2007	7	18	1230	0.15	600	7/18/2007	0.155	mg/L
21FLPNS 301541908500465	2007	9	27	1200	0.15	600	9/27/2007	0.987	mg/L
21FLPNS 301541908500465	2007	10	10	1405	0.15	600	10/10/2007	1.205	mg/L
21FLPNS 301541908500465	2007	10	17	1105	0.15	600	10/17/2007	0.825	mg/L
21FLPNS 301541908500465	2007	10	30	1120	0.15	600	10/30/2007	0.576	mg/L
21FLPNS 301541908500465	2007	11	28	1130	0.15	600	11/28/2007	0.767	mg/L
21FLPNS 301541908500465	2007	12	4	1205	0.15	600	12/4/2007	1.009	mg/L
21FLPNS 301541908500465	2007	12	11	1155	0.15	600	12/11/2007	1.107	mg/L
21FLPNS 301541908500465	2008	1	10	1140	0.15	600	1/10/2008	0.576	mg/L
21FLPNS 301541908500465	2008	1	30	1415	0.15	600	1/30/2008	0.457	mg/L
21FLPNS 301541908500465	2008	2	14	1245	0.10	600	2/14/2008	0.537	mg/L
21FLPNS 301541908500465	2008	3	4	1045	0.15	600	3/4/2008	0.929	mg/L
21FLPNS 301541908500465	2008	3	12	1205	0.15	600	3/12/2008	0.711	mg/L
21FLPNS 301648108500483	2007	2	15	1310	0.15	600	2/15/2007	0.613	mg/L
21FLPNS 301648108500483	2007	10	2	1125	0.10	600	10/2/2007	0.594	mg/L
21FLPNS 301648108500483	2008	3	12	1130	0.15	600	3/12/2008	0.681	mg/L

TP:

- = Empty cell/no data

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units
21FLGW 27458	2005	6	30	1655	0.20	665	6/30/2005	0.012	mg/L
21FLNWFD301542085004801	1992	11	17	1230	-	665	11/17/1992	0.025	mg/L
21FLNWFD301542085004801	1993	2	16	1015	-	665	2/16/1993	0.018	mg/L
21FLNWFD301542085004801	1993	5	17	1015	-	665	5/17/1993	0.017	mg/L
21FLNWFD301542085004801	1993	7	19	1345	-	665	7/19/1993	0.021	mg/L
21FLPNS 301541908500465	2007	2	21	1345	0.15	665	2/21/2007	0.024	mg/L
21FLPNS 301541908500465	2007	6	18	1645	0.10	665	6/18/2007	0.076	mg/L
21FLPNS 301541908500465	2007	7	18	1230	0.15	665	7/18/2007	0.02	mg/L
21FLPNS 301541908500465	2007	9	27	1200	0.15	665	9/27/2007	0.12	mg/L
21FLPNS 301541908500465	2007	10	10	1405	0.15	665	10/10/2007	0.13	mg/L
21FLPNS 301541908500465	2007	10	17	1105	0.15	665	10/17/2007	0.063	mg/L
21FLPNS 301541908500465	2007	10	30	1120	0.15	665	10/30/2007	0.021	mg/L
21FLPNS 301541908500465	2007	11	28	1130	0.15	665	11/28/2007	0.035	mg/L
21FLPNS 301541908500465	2007	12	4	1205	0.15	665	12/4/2007	0.048	mg/L
21FLPNS 301541908500465	2007	12	11	1155	0.15	665	12/11/2007	0.11	mg/L
21FLPNS 301541908500465	2008	1	10	1140	0.15	665	1/10/2008	0.02	mg/L
21FLPNS 301541908500465	2008	1	30	1415	0.15	665	1/30/2008	0.02	mg/L
21FLPNS 301541908500465	2008	2	14	1245	0.10	665	2/14/2008	0.02	mg/L
21FLPNS 301541908500465	2008	3	4	1045	0.15	665	3/4/2008	0.02	mg/L
21FLPNS 301541908500465	2008	3	12	1205	0.15	665	3/12/2008	0.02	mg/L
21FLPNS 301648108500483	2007	2	15	1310	0.15	665	2/15/2007	0.02	mg/L
21FLPNS 301648108500483	2007	10	2	1125	0.10	665	10/2/2007	0.047	mg/L
21FLPNS 301648108500483	2008	3	12	1130	0.15	665	3/12/2008	0.02	mg/L

Color:

- = Empty cell/no data
[1] PCU = Platinum cobalt unit

Station	Year	Month	Day	Time	Depth (ft)	Parameter	Date	Result	Units[1]
21FLGW 27458	2005	6	30	1655	0.20	80	6/30/2005	300	PCU
21FLNWFD301542085004801	1992	11	17	1230	-	80	11/17/1992	200	PCU
21FLNWFD301542085004801	1993	2	16	1045	-	80	2/16/1993	200	PCU
21FLNWFD301542085004801	1993	5	17	1015	-	80	5/17/1993	120	PCU
21FLNWFD301542085004801	1993	7	19	1345	-	80	7/19/1993	120	PCU
21FLPNS 301541908500465	2007	2	21	1345	0.15	80	2/21/2007	100	PCU
21FLPNS 301541908500465	2007	6	18	1645	0.10	80	6/18/2007	80	PCU
21FLPNS 301541908500465	2007	7	18	1230	0.15	80	7/18/2007	20	PCU
21FLPNS 301541908500465	2007	9	27	1200	0.15	80	9/27/2007	75	PCU
21FLPNS 301541908500465	2007	10	10	1405	0.15	80	10/10/2007	50	PCU
21FLPNS 301541908500465	2007	10	17	1105	0.15	80	10/17/2007	100	PCU
21FLPNS 301541908500465	2007	10	30	1120	0.15	80	10/30/2007	60	PCU
21FLPNS 301541908500465	2007	11	28	1130	0.15	80	11/28/2007	200	PCU
21FLPNS 301541908500465	2007	12	4	1205	0.15	80	12/4/2007	200	PCU
21FLPNS 301541908500465	2007	12	11	1155	0.15	80	12/11/2007	150	PCU
21FLPNS 301541908500465	2008	1	10	1140	0.15	80	1/10/2008	30	PCU
21FLPNS 301541908500465	2008	1	30	1415	0.15	80	1/30/2008	100	PCU
21FLPNS 301541908500465	2008	2	14	1245	0.10	80	2/14/2008	100	PCU
21FLPNS 301541908500465	2008	3	4	1045	0.15	80	3/4/2008	150	PCU
21FLPNS 301541908500465	2008	3	12	1205	0.15	80	3/12/2008	100	PCU
21FLPNS 301648108500483	2007	2	15	1310	0.15	80	2/15/2007	200	PCU
21FLPNS 301648108500483	2007	10	2	1125	0.10	80	10/2/2007	80	PCU
21FLPNS 301648108500483	2008	3	12	1130	0.15	80	3/12/2008	100	PCU

Appendix C: Public Comments and Department Responses

No public comments requiring responses were received.

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400