FINAL

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTH DISTRICT • EVERGLADES WEST COAST BASIN

TMDL Report

Dissolved Oxygen TMDLs for Hendry Creek (WBIDs 3258B and 3258B1)

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The most important part of this TMDL - the target concentration of total nitrogen, and the supporting evidence that reducing the total nitrogen concentration will improve the DO concentration in Hendry Creek, were provided by Dr. Nathan Bailey. Special thanks also go to Dr. Wayne Magley, who provided valuable support in conducting statistical analyses.

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Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management

Total Maximum Daily Load (TMDL) Program

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

Identification of Impaired Surface Waters Rule

https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-303

STORET Program

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

2006 305(b) Report

http://www.dep.state.fl.us/water/tmdl/docs/2006_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

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

Basin Status Reports

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

Water Quality Assessment Reports

http://www.dep.state.fl.us/water/tmdl/stat_rep.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 the pollutant causing the low dissolved oxygen (DO) concentration in two waterbody segments (freshwater and marine) of Hendry Creek in the Everglades West Coast Basin. These segments were verified as impaired for low DO based on the observation that DO values for 31 out of 59 samples in the freshwater segment and 34 out of 39 samples in the marine segment collected during the verified period (January 1, 2000, through June 30, 2007) were lower than the state water quality criteria for Class III freshwater and marine systems, respectively. Total nitrogen (TN) was considered the causative pollutant. The creek was therefore included on the Verified List of impaired waters for the Everglades West Coast Basin that was adopted by Secretarial Order in June 2008. The TMDLs establish the allowable loading of TN to Hendry Creek that would restore both waterbody segments so that they meet their applicable water quality criteria for DO.

1.2 Identification of Waterbody

Hendry Creek is located in the southwest part of Lee County in southwest Florida, approximately 3 miles south of the city of Ft. Myers and approximately 3 miles southeast of the city of Cape Coral (**Figure 1.1**). For assessment purposes, Hendry Creek is divided into a predominantly freshwater segment and a predominantly marine segment. State Road (S.R.) 45 runs between the two segments. Hendry Creek flows south for approximately 6 miles into north Estero Bay and drains a watershed of about 15.35 square miles (mi^2). Most development is in the north end of the watershed, and wetlands and water dominate the southern portion.

For assessment purposes, the Florida Department of Environmental Protection (Department) has divided the Everglades West Coast Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. This TMDL addresses **WBID 3258B**, **Hendry Creek**, **Freshwater**, and **WBID 3258B1**, **Hendry Creek Marine**, for low DO (**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 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, and provide important water quality restoration goals that will guide restoration activities.

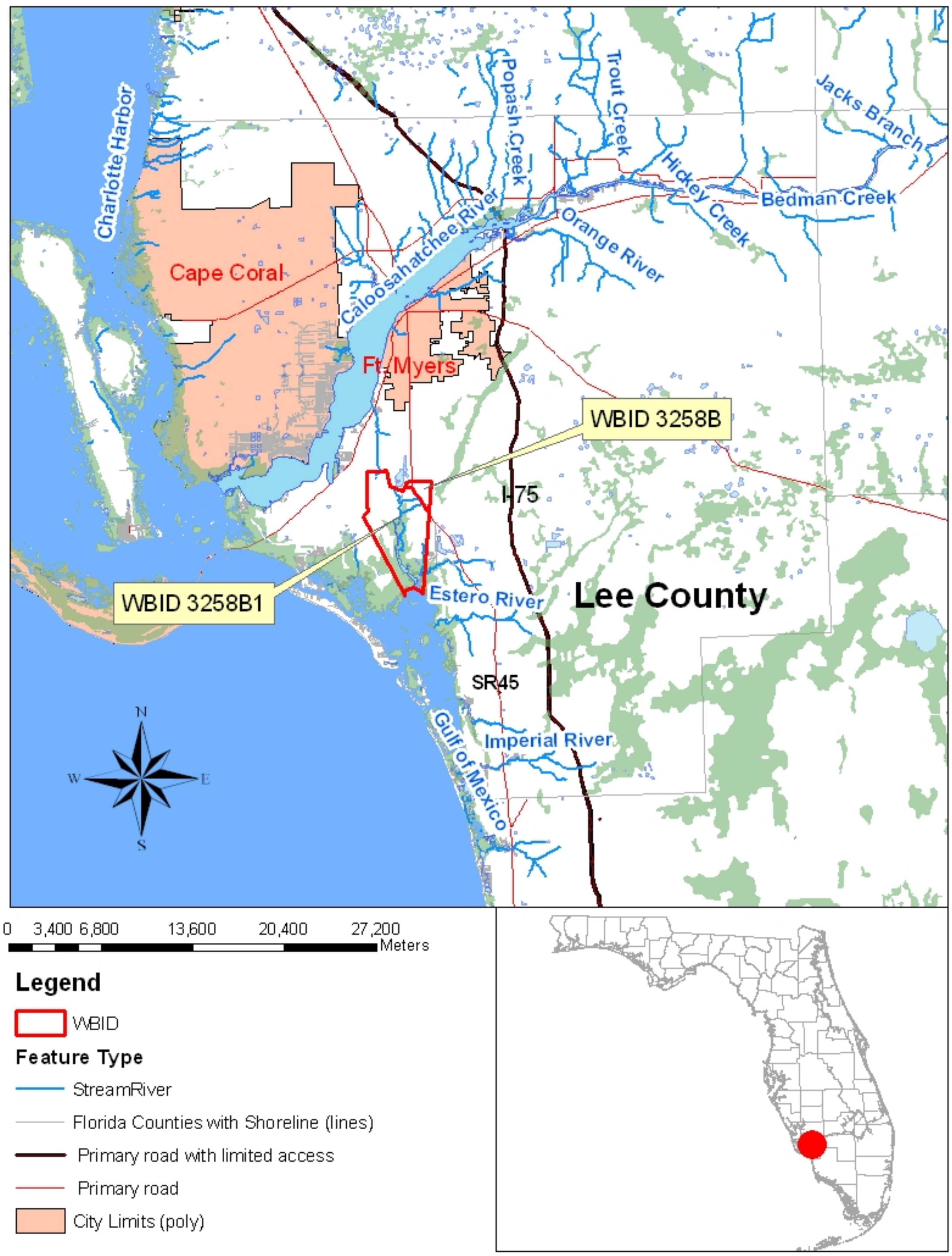

Figure 1.1. Location of Hendry Creek (WBID 3258B and WBID 3258B1) in Lee County

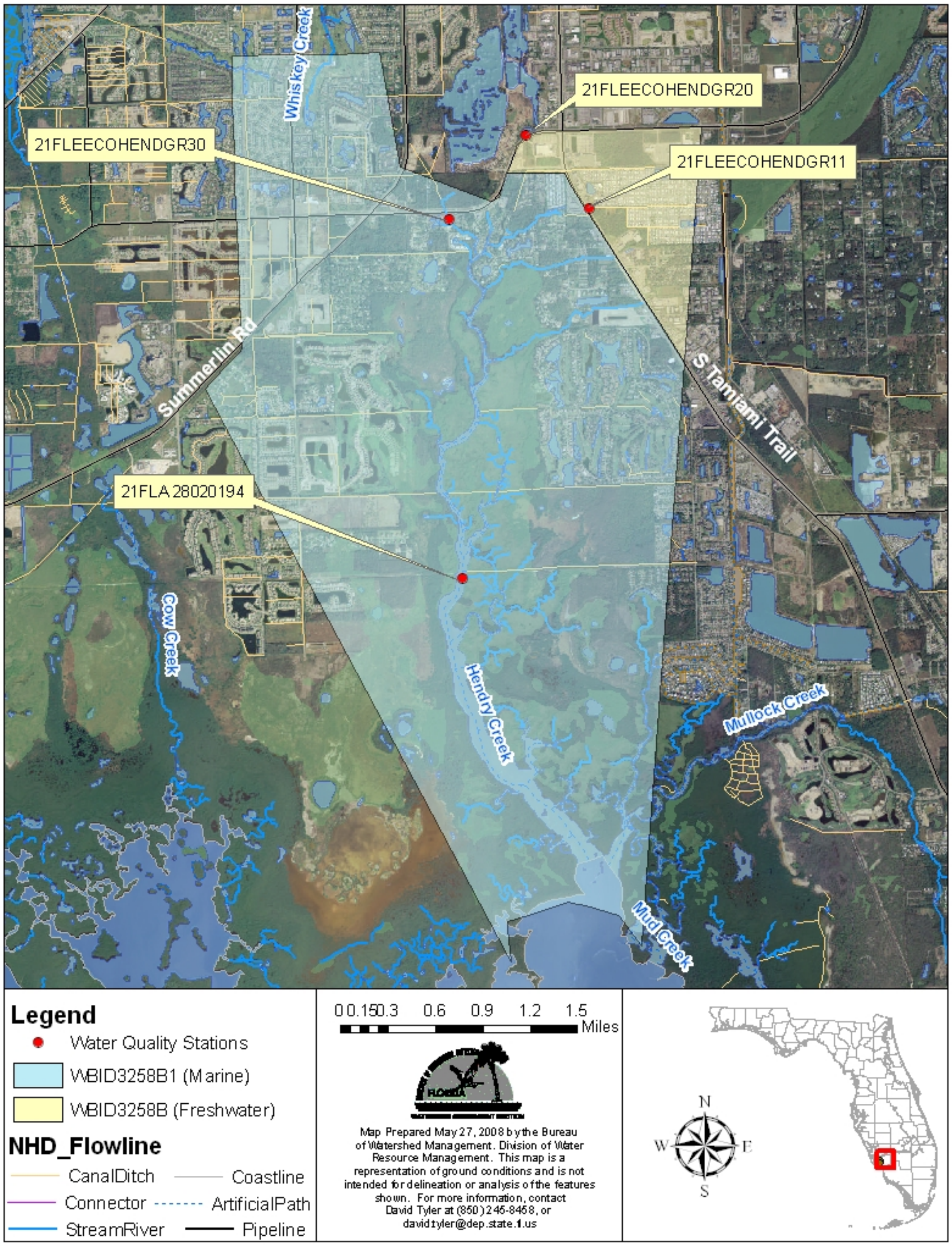

Figure 1.2. Location of Hendry Creek, WBIDs 3258B and WBID 3258B1, and Associated Water Quality Stations

This TMDL report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of TN that caused the verified impairment for low DO in Hendry Creek. These activities will depend heavily on the active participation of the Lee County Division of Natural Resources, South Florida Water Management District (SFWMD), Charlotte Harbor National Estuary Program, 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 impaired waterbodies.

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 13 waterbodies in the Everglades West Coast 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 has used the IWR to assess water quality impairments in the Hendry Creek watershed and has verified the impairments listed in **Table 2.1**. Hendry Creek was placed on the Verified List for DO in the first basin assessment cycle (based on data collected between January 1, 1995 and June 30, 2002). During the second basin cycle, the creek was also verified as impaired for low DO based on the observation that the DO concentrations in 31 out of 59 samples in WBID 3258B and in 34 out of 39 samples in WBID 3258B1 measured during the verified period (January 1, 2000, through June 30, 2007), were lower than the state's DO criteria for Class III freshwater and marine water, respectively.

TN was considered the causative pollutant for the low DO in both WBIDs because the median value of 67 TN measurements for WBID 3258B1 in the verified period exceeded the 0.59 mg/L screening level for reference estuaries, and the median value of 30 TN measurements for WBID 3258B in the verified period exceeded the 0.70 mg/L screening level for freshwater streams. The marine portion of the creek was also verified as impaired for fecal coliform bacteria and elevated mercury concentration in fish tissues. This TMDL analysis establishes the allowable loads of TN to improve DO concentrations in both segments of the creek. **Table 2.2** summarizes the DO observations for the verified period for Hendry Creek. **Figure 1.2** displays the locations of the water quality stations used in this assessment.

As shown in **Table 2.1**, the projected year for TMDL development was 2007, but the Settlement Agreement between the 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, the TMDLs must be adopted and submitted to the EPA, Region 4, no later than September 30, 2008.

Table 2.1. Verified Parameters for Hendry Creek, WBIDs 3258B and 3258B1

Waterbody Segment	Parameters of Concern	Priority for TMDL Development	Projected Year for TMDL Development
WBID 3258B (Freshwater)	DO (TN)	Medium	2007
WBID 3258B1 (Marine)	DO (TN)	Medium	2007
WBID 3258B1 (Marine)	Fecal coliform	Medium	2007
WBID 3258B1 (Marine)	Mercury (in fish tissue)	High	2012

Note: The parameters listed in **Table 2.1** provide a complete picture of the impairment in the creek, but this TMDL only addresses the DO impairment.

Table 2.2. Summary of DO Monitoring Data in the Verified Period for Hendry Creek, WBIDs 3258B and 3258B1

Parameter	Summary of Observations	
	WBID 3258B	WBID 3258B1
Total number of samples	59	39
IWR required number of violations for the Verified List	10	7
Number of observed violations	31	34
Number of observed nonviolations	28	5
Number of seasons during which samples were collected	4	4
Highest observation (mg/L)	13.0	6.9
Lowest observation (mg/L)	1.1	0.5
Median observation (mg/L)	4.9	2.6
Mean observation (mg/L)	5.0	2.7
Screening value for BOD (mg/L)	2.0	2.1
Screening value for TN (mg/L)	1.6	1.0
Screening value for TP (mg/L)	0.22	0.19
Median value for BOD observations (mg/L)	1.5	1.3
Median value for TN observations (mg/L)	0.775	0.886
Median value for TP observations (mg/L)	0.03	0.054
Possible causative pollutant by IWR	TN	TN
FINAL ASSESSMENT	**Impaired**	**Impaired**

Mg/L – Milligrams per liter; BOD – Biological oxygen demand; TP – Total phosphorus.

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criterion Applicable to the TMDL

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)**

Both segments of Hendry Creek (WBIDs 3258B and 3258B1) are Class III waterbodies, with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criteria applicable to the impairment addressed by this TMDL report are freshwater and marine DO.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Dissolved Oxygen

Florida's Surface Water Quality Standard (Rule 62-302, F.A.C.) states that, for Class III freshwater waterbodies, the DO concentration

> *Shall not be less than 5.0 (mg/L). Normal daily and seasonal fluctuations above these levels shall be maintained.*

The standard also states that for Class III marine water, the DO concentration

> *Shall not average less than 5.0 in a 24-hour period and shall never be less than 4.0. Normal daily and seasonal fluctuations above these levels shall be maintained.*

DO concentrations in ambient waters can be 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, water depth, and wind;

- The photosynthesis of phytoplankton, periphyton, and other aquatic plants;
- DO consumption from the decomposition of organic materials in the water column and sediment, and from the oxidation of some reductants, such as ammonia and metals;
- Respiration by aquatic organisms in both the water column and sediments; and
- Contributions of water that are naturally low in DO from wetlands and ground water input.

Due to the limited amount of data available for this analysis, the Department examined the overall effects of nitrogen, phosphorus, and BOD on the DO concentration in Hendry Creek using statistical analyses, assuming that the existing regimes of temperature, flow velocity, and salinity remain the same. These analyses revealed a statistically significant correlation between DO and TN concentrations, suggesting that if the TN concentration in the two waterbody segments is reduced, the part of the observed low DO concentrations caused by pollutants coming from anthropogenic activities will be improved.

3.2.2 Calculating Reference Concentrations for Potential Low DO Causative Pollutants

For most of Florida, the threshold value (used as a guideline) for potential causative pollutants for low DO is determined at the statewide 70th percentile concentration. Because the hydrology of the Everglades West Coast Basin is unique, the statewide threshold is less useful as a guideline; thus another approach was used to develop target concentrations. In this TMDL analysis, thresholds for causative pollutants were developed through the calculation of a region-based reference concentration (EPA, 2000).

The Department used two methods for calculating the TN, TP, and BOD reference concentrations for the Hendry Creek marine and freshwater segments. The method used for the marine segment is based on a reference approach, where the calculated TN, TP, and BOD median values of a reference waterbody are used as the target concentration. The reference waterbody used for this TMDL is WBID 3258A (Estero Bay Wetland, Class IIIM Estuary).[1] The Estero Bay Wetland has similar hydrologic features to Hendry Creek and the anthropogenic influence is minimal, making it a good reference waterbody for developing a target concentration representing “natural conditions.” **Table 3.1** shows the land use statistics for the Estero Bay Wetland, WBID 3258A.

In the Estero Bay Wetland, the reference concentrations established for TN, TP, and BOD using this approach are 0.60, 0.05, and 1.30 mg/L, respectively. Similarly, in the marine segment of Hendry Creek, the existing TN, TP, and BOD concentrations are 0.89, 0.05, and 1.30 mg/L, respectively. Again, only the TN concentration exceeded the corresponding reference concentration target. As TN is the only pollutant exceeding the reference concentrations in both the freshwater and marine segments of Hendry Creek, this TMDL only addresses the total allowable TN load. The target TN concentration established for the marine segment of the creek is 0.60 mg/L. The Department believes this TN reference target will address the anthropogenic portion of low DO caused by pollutant loading in Hendry Creek.

[1] Class IIIM – Class III marine.

The method used for the freshwater segment is the 75th percentile of the medians from reference freshwater WBIDs in the Southwest Coast Planning Unit. Sample statistics were completed for TN data for freshwater stations with land use characteristics that demonstrated relatively low impacts from urban development. These stations are located in WBIDs that are representative of "natural condition" waterbodies. The reference concentration targets are 0.74 mg/L for TN, 0.04 mg/L for TP, and 1.85 mg/L for BOD (**Table 3.2**). **Table 3.3** lists the stations used to develop the targets. **Table 3.4** shows land use statistics for the freshwater WBIDs used to develop the TN reference concentration.

Table 3.1. Summary of Land Use Statistics for Marine Reference WBID

Land Use Code and Description	Acres	% Total
WBID 3258A		
6000: Wetland	6,285.1	47.82%
5000: Water	4,854.8	36.94%
1000: Urban and Built up	1,493.2	11.36%
4000: Upland Forests	291.7	2.22%
3000: Rangeland	136.3	1.04%
8000: Transportation, Communication, & Utilities	77.8	0.59%
7000: Barren Land	3.9	0.03%
Total	**13,142.69**	**100.00%**

Table 3.2. Class 3F Region-based Reference Concentration Thresholds for Causative Pollutants Located within Everglades West Coast Basin

75th Percentile Reference Value			
Waterbody Class	TN (mg/L)	TP (mg/L)	BOD (mg/L)
3F	0.74	0.04	1.85

Note: 3F stands for a Class III freshwater.

Table 3.3. Summary of Freshwater Stations in the Southwest Coast Planning Unit Used To Develop the TN Reference Target

WBID	Station Number	Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Median (mg/L)
3278G	21FLSFWMBC12	59	0.005	1.260	0.240
3278G	21FLSFWMBC18	60	0.005	5.320	0.610
3278G	21FLSFWMBC19	59	0.005	4.230	0.810
3278G	21FLSFWMBC21	59	0.005	4.520	0.800
3278G	21FLSFWMCHKMATE	15	0.005	2.000	0.830
3278H	21FLFTM 28030070FTM	5	0.588	0.839	0.695
3278H	21FLSFWMFAKA858	56	0.008	1.240	0.750
3278I	21FLSFWMBC10	57	0.010	1.300	0.370
3278I	21FLSFWMBC20	59	0.005	5.030	0.650
3278I	21FLSFWMBC7	58	0.010	1.360	0.435
3278I	21FLSFWMBC8	60	0.005	1.470	0.365
3278I	21FLSFWMBC9	57	0.010	1.540	0.500
3278I	21FLSFWMFAKA	58	0.010	2.700	0.380
3278V	21FLSFWMBC22	57	0.010	1.800	0.640
				75th Percentile of Medians =	**0.74**

Table 3.4. Summary of Land Use Statistics for Freshwater Reference WBIDS Used To Develop the TN Target

Land Use Code and Description	Acres	% Total
WBID 3278I		
6000: Wetland	56,313.0	94.72%
4000: Upland Forests	1,151.6	1.94%
3000: Rangeland	1,117.3	1.88%
5000: Water	628.4	1.06%
1000: Urban and Built up	97.3	0.16%
8000: Transportation, Communication, & Utilities	93.9	0.16%
2000: Agriculture	50.1	0.08%
Total	**59,451.70**	**100.00%**
WBID 3278V		
6000: Wetland	35,737.3	66.19%
2000: Agriculture	7,532.9	13.95%
4000: Upland Forests	4,939.7	9.15%
3000: Rangeland	3,199.6	5.93%
1000: Urban and Built up	1,588.4	2.94%
8000: Transportation, Communication, & Utilities	478.6	0.89%
5000: Water	355.6	0.66%
7000: Barren Land	159.4	0.30%
Total	**53,991.5**	**100.00%**
WBID 3278G		
6000: Wetland	92,282.2	97.65%
4000: Upland Forests	1,091.4	1.15%
5000: Water	335.2	0.35%
2000: Agriculture	239.7	0.25%
3000: Rangeland	213.5	0.23%
8000: Transportation, Communication, & Utilities	198.7	0.21%
1000: Urban and Built up	114.8	0.12%
7000: Barren Land	24.6	0.03%
Total	**94,500.0**	**100.00%**
WBID 3278H		
6000: Wetland	12,569.1	45.79%
3000: Rangeland	7,770.7	28.31%
4000: Upland Forests	4,381.2	15.96%
1000: Urban and Built up	1,473.3	5.37%
2000: Agriculture	860.5	3.13%
5000: Water	243.0	0.89%
8000: Transportation, Communication, & Utilities	100.3	0.37%
7000: Barren Land	51.6	0.19%
Total	**27,449.6**	**100.00%**

Supporting evidence that reducing TN concentrations will improve DO concentrations in receiving waters was obtained from a region wide analysis of the relationship between TN and DO concentrations. Instead of using only the data from Hendry Creek, the Department used TN and DO data from multiple WBIDs and stations in the Southwest Coast Planning Unit to establish the relationship between TN and DO. Using data from multiple WBIDs and multiple stations increases the range of TN and DO concentrations, making the statistical analysis more robust.

To improve the statistical relevance of the analysis, the Department also focused on WBIDs and stations with 20 or more data points, ensuring that the data used were representative of the nutrient and DO environments being evaluated. In addition, to explore the possible difference between the functional dynamics of TN and DO in both freshwater and marine environments, the Department analyzed the TN–DO relationship in freshwater and marine waterbodies (and related stations) separately. **Figures 3.1** and **3.2** show the established relationships in freshwater and marine segments, respectively. The R^2 is 0.44, which is not unusual when considering the other variables (not included in this linear equation) that typically affect DO concentrations.

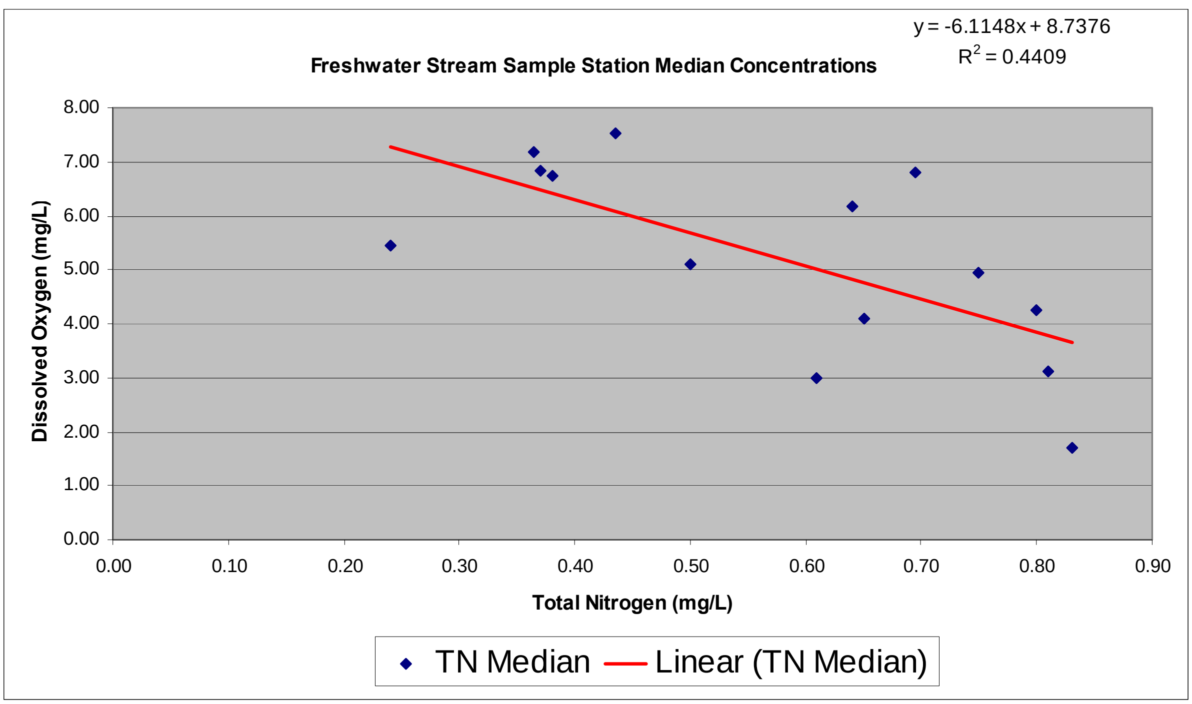

Figure 3.1. Correlation of DO Medians vs. TN Medians for Southwest Coast Planning Unit Freshwater Stations

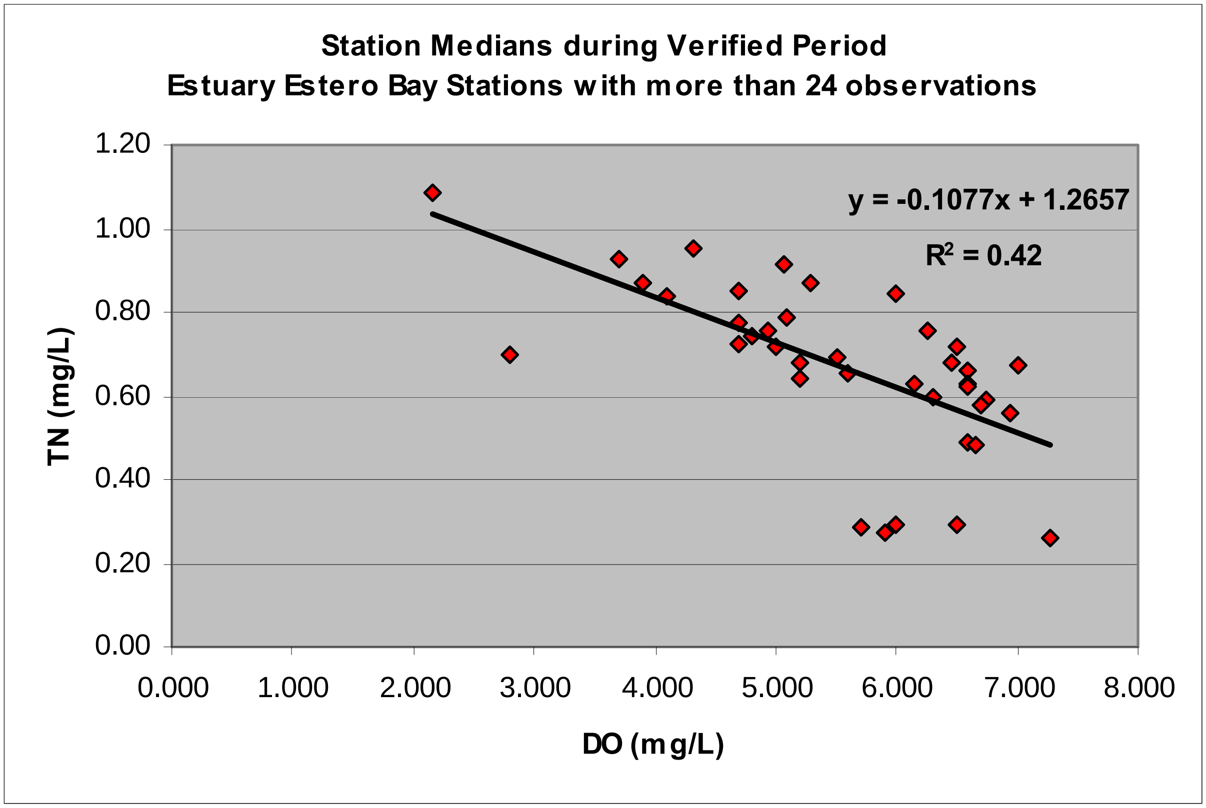

Figure 3.2. Correlation of TN Medians vs. DO Medians for Estero Bay Estuary Stations

It is no surprise that, although these relationships are statistically significant ($p < 0.05$), the correlation coefficients are relatively low, especially for the freshwater environments. As discussed in previous sections, the DO concentration in a receiving waterbody can be influenced by many factors other than nutrients. Therefore, the correlation between DO and TN established in this TMDL analysis is not used for quantitative purposes to establish the nitrogen targets. Instead, it is used qualitatively to show the general negative correlation between DO and TN concentrations in receiving waters in the Estero Bay area. This suggests that by reducing the TN concentration in waters in the Estero Bay area, including Hendry Creek, DO concentrations in these waters will be improved.

In summary, as the existing TP and BOD concentration medians in Hendry Creek did not exceed the reference targets established for waters in the Estero Bay Wetland, this analysis only establishes TN targets to address the low DO concentrations in Hendry Creek. The TN target established for the marine segment is based on the mean of the Estero Bay Wetland reference waterbody, or 0.60 mg/L, while the target for the freshwater segment is based on the 75^{th} percentile of the reference waterbodies, or 0.74 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 the pollutant of concern in the target watershed and the amount of pollutant loading 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 included 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” is 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 Expression and Allocation of the TMDL)**. However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES 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 Pollutants in the Hendry Creek Watershed

4.2.1 Point Sources

4.2.1.1 Wastewater Point Sources

There are no NPDES permitted wastewater facilities that discharge to Hendry Creek. A domestic wastewater facility (Permit No. FL0039829 Fiesta Village Domestic Wastewater Facility) is located less than one-half mile north of the Hendry Creek watershed; this facility discharges to the Caloosahatchee River and not to Hendry Creek.

4.2.1.2 Municipal Separate Storm Sewer System Permittees

The Hendry Creek watershed is covered by the Lee County Phase I municipal separate storm sewer system (MS4) permit (FLS000035).

4.2.2 Nonpoint Sources

As there are no major point source dischargers located in the drainage basin of Hendry Creek, it is reasonable to believe that, within the drainage basin of Hendry Creek, the majority of the TN loadings to the Hendry Creek comes from nonpoint sources, including surface runoff, ground water input, and nutrient sediment release.

4.2.2.1 Land Uses

Surface runoff could be a very important source of pollutants in the watershed. The amount of surface runoff and pollutant concentrations in surface runoff could be significantly influenced by land uses in the watershed. These land uses were classified based on the Level 1 Florida Land Use, Cover, and Forms Classification System (FLUCCS) using the SFWMD's 2004–05 land use Geographic Information System (GIS) coverage (**Table 4.1**). **Figure 4.1** shows the spatial distribution of land use types across the watershed area discharging to the two waterbody segments analyzed in this report. The entire Hendry Creek watershed, instead of the WBID area shown in **Figure 1.1**, was used in developing the tables and figures in this section, in order to capture the overall watershed contribution of potential sources into Hendry Creek.

Table 4.1. Summary of Level 1 Land Use Statistics for the Hendry Creek Watershed's Drainage Area

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Build-Up	1927	19.6
1100	Low-Density Residential	797	8.1
1200	Medium-Density Residential	844	8.6
1300	High-Density Residential	1070	10.9
2000	Agriculture	98	1.0
3000/4000	Upland Forests/Rangeland	923	9.4
5000	Water	904	9.2
6000	Wetlands	2970	30.2
7000	Barren Land	13	0.1
8000	Transportation, Communication, & Utilities	279	2.8
	TOTAL	**9825**	**100**

As shown in **Table 4.1,** the Hendry Creek watershed drains about 9,825 acres of land. The dominant land use category is urban land (urban and built-up; low-, medium-, and high-density residential; and transportation, communication, and utilities), which accounts for about 51 percent of the total watershed area. Of the 4,917 acres of urban land, residential areas occupy about 2,711 acres, or about 28 percent of the total watershed area. Natural land use areas, which include water/wetlands, upland forest, and barren land, occupy about 4810 acres, accounting for about 48 percent of the total watershed area.

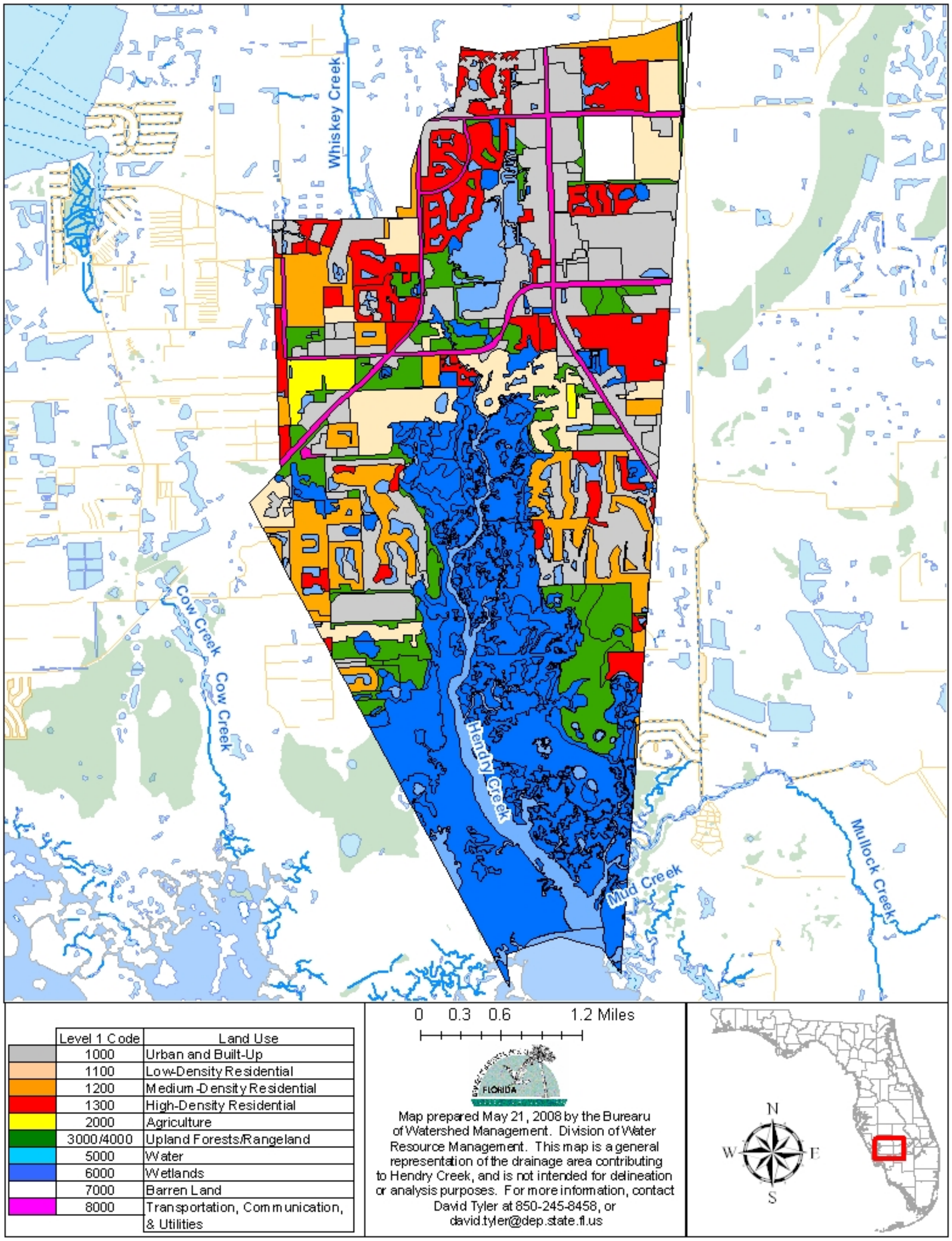

Figure 4.1. Principal Land use Types in the Hendry Creek Watershed's Drainage Area

The TN loading (pounds per year [lbs/yr]) from surface runoff was estimated by multiplying the acreage from each land use by the literature published per-acre TN loading rates (Harper, 1994) for each land use class (**Table 4.2**).

Table 4.2. Surface Runoff TN Loading According to Land Use Classification

Level 1 Code	Land Use	Acreage	TN loading rates (lbs/acre/yr)	TN (lbs/yr)	%
1000	Urban and Built-Up	1927	5.18	22003	27.08
1100	Low-Density Residential	797	2.88	5060	6.23
1200	Medium-Density Residential	844	4.68	8712	10.72
1300	High-Density Residential	1070	8.51	20081	24.72
2000	Agriculture	98	3.62	779	0.96
3000/4000	Upland Forests/Rangeland	923	1.07	2177	2.68
5000	Water	904	3.23	6436	7.92
6000	Wetlands	2970	1.81	11849	14.59
7000	Barren Land	13	1.07	30	0.04
8000	Transportation, Communication, & Utilities	279	6.69	4117	5.07
	Total	**9824**		**81243**	**100**

4.2.2.2 Population

According to the U.S. Census Bureau, the population density in and around the Hendry Creek watershed in the year 2000 was at or less than people per mi^2 (10 persons/mi^2 is the minimum used by the Census Bureau). The Bureau reports that, in Lee County, which includes (but is not exclusive to) Hendry Creek, the total population for 2000 was 440,888, with 245,405 housing units. For all of Lee County, the Bureau reported a housing density of 305.4 houses per square mile, ranking Lee County among some of the highest housing densities in Florida (U. S. Census Bureau Web site, 2007). This ranking is also supported by land use data, which show that 28 percent of the land use in the Hendry Creek watershed is dedicated to residences and 20 percent is urban/build-up. There are roughly 17,600 people located in the Hendry Creek watershed based on Census track/ lock GIS coverages. Using Lee County's average household size of 2.31, this equates to 7,619 households within the Hendry Creek watershed.

4.2.2.3 Septic Tanks

Based on the 2000 Census figure of 245,405 housing units and the Florida Department of Health (FDOH) estimate of 127,081 permitted septic tanks in Lee County, approximately 52 percent of the households in the county are using septic tanks. FDOH reports that as of fiscal year 2006–07, there were 127,081 permitted septic tanks in Lee County (FDOH Website, 2006b). From fiscal years 1991–2007 (missing 1992–93), 4,914 permits for repairs were issued, for an average of approximately 328 repairs annually (FDOH Website, 2006c) countywide.

Based on 2007 FDOH onsite sewage GIS coverage (available: http://www.doh.state.fl.us/environment/programs/EhGis/EhGisDownload.htm), about 266 housing units (*N*) were identified as being on septic tanks in the Hendry Creek watershed (**Figure 4.2**). The discharge rate from each septic tank (*Q*) was calculated by multiplying the average household size by the per capita wastewater production rate per day. Based on the information published by the U.S. Census Bureau, the average household size for Lee County is about 2.31 people/household. The same household size was assumed for the Hendry Creek watershed. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (EPA, 2001).

No measured septic tank failure rate data were available for the watershed at the time this TMDL analysis was conducted. Therefore the failure rate was derived from the number of septic tank installation and repair permits for the county published by FDOH (available: http://www.doh.state.fl.us/environment/OSTDS/statistics/ostdsstatistics.htm). The number of septic tanks in the county was calculated assuming that none of the installed septic tanks will be removed after being installed (**Table 4.3**). The reported number of septic tank repair permits was also obtained from the FDOH Website (**Table 4.3**).

Based on this information, a discovery rate of failed septic tanks for each year between 2000 and 2006 was calculated and listed in **Table 4.3**. Using the table, the average annual septic tank failure discovery rate for Lee County is about 0.24 percent. Assuming that failed septic tanks are not discovered for about 5 years, the estimated annual septic tank failure rate is about 5 times the discovery rate, or 1.18 percent.

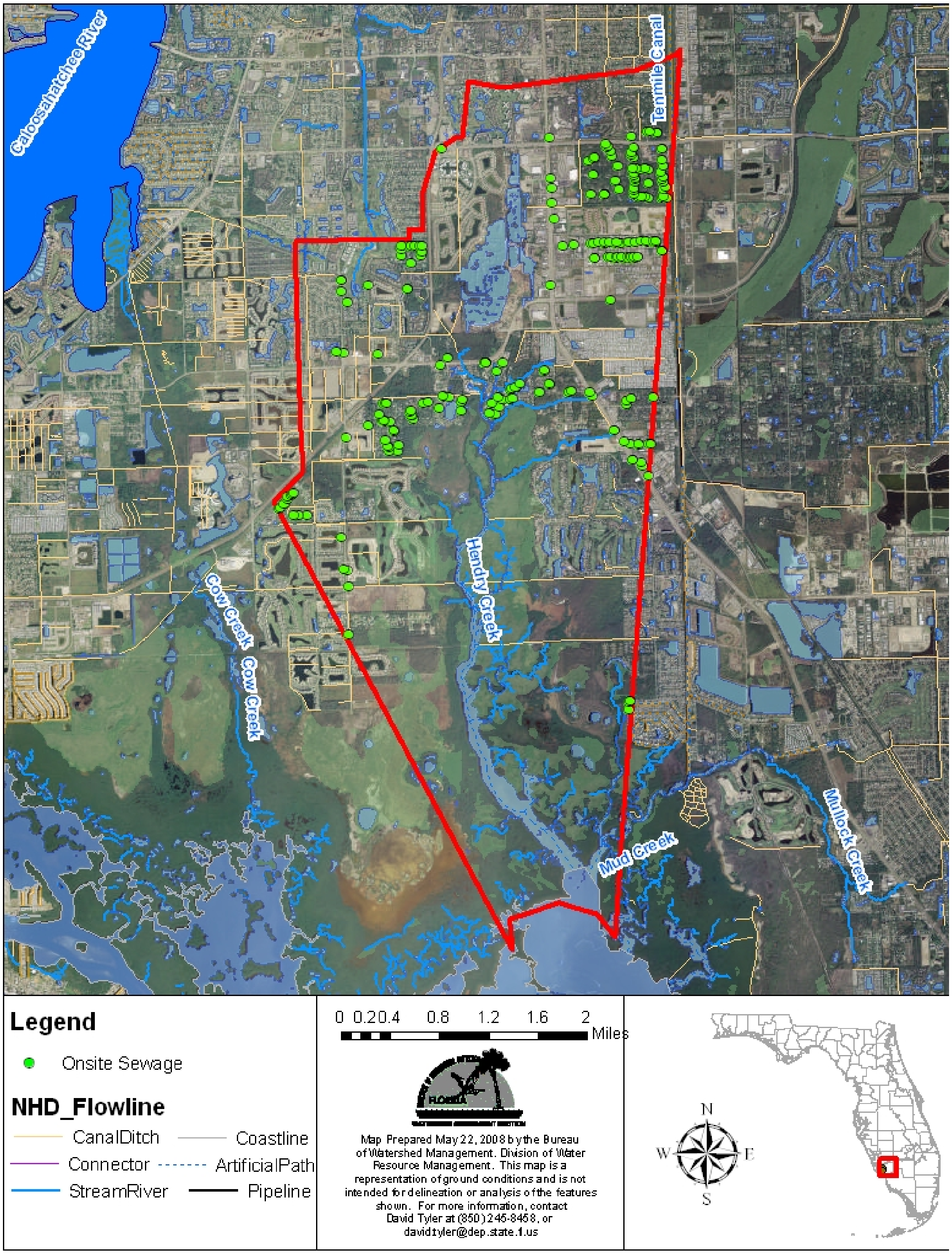

Figure 4.2. Distribution of Onsite Sewage Systems (Septic Tanks) in the Hendry Creek Watershed

Table 4.3. Estimated Septic Tank Numbers and Septic Failure Rates for Lee County, 2000–06

Year	2000	2001	2002	2003	2004	2005	2006	Average
New installation (septic tanks)	2,220	2,254	3,149	4,180	5,883	9,672	12,588	5,707
Accumulated installation	89,355	91,609	94,758	98,938	104,821	114,493	127,081	103,008
Repair permit (septic tanks)	319	368	253	219	122	110	243	233
Failure discovery rate (%)	0.36	0.40	0.27	0.22	0.12	0.10	0.19	0.24
Failure rate (%)*	1.79	2.01	1.33	1.11	0.58	0.48	0.96	1.18

Approximately 3.5 percent of the households in the Hendry Creek watershed use septic tanks. Using an estimate of 70 gallons/day/person (EPA, 1999) and a drainfield total nitrogen (TN) concentration of 36 mg/L (FDOH, 2006a) potential annual ground water loads of TN were calculated. As in the case of earlier estimates, this is a screening level calculation, and soil types, the age of the system, vegetation, proximity to receiving water, and other factors will influence the degree of attenuation of this load (**Table 4.4**).

Table 4.4. Estimated TN Annual Loading from Septic Tanks in the Hendry Creek Watershed

Estimated No. Households on Septic	Estimated No. Persons Per Household[1]	Gallons/ Person/ Day[2]	TN in Drainfield (mg/L)	Estimated Annual TN Load (lbs/yr)
266	2.31	70	36	56

1 U.S Census Bureau; see **Table 4.3** for more information on this estimate.
2 EPA, 1999.

At the time this TMDL was developed, no data were available to the Department on nutrient loading from ground water and on sediment nutrient release. Therefore, this analysis does not include loads from these sources. Comparing the TN loading from the watershed and failed septic tanks, the contribution from failed septic tanks appears to be relatively small.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Overall Approach

5.1.1 Data Used in the Determination of the TMDL

This analysis used data from two water quality monitoring stations for WBID 3258B (21FLEECOHENDGR11 and 21FLEECOHENDGR20) and two stations for WBID 3258B1 (21FLEECOHENDGR30 [upstream] and 21FLFTM 28020194 [downstream]) during the verified period. **Figure 1.2** shows the locations of these stations.

The DO measurements in the verified period were taken from January 2000 to May 2007 for Station 21FLEECOHENDGR11, from January 2000 to May 2007 at Station 21FLEECOHENDGR20, from October 2004 to March 2007 at Station 21FLEECOHENDGR30, and in May and June 2007 at Station 21FLFTM 28020194. **Table 5.1** contains summary information on each of the stations. **Table 5.2** provides a statistical summary of DO observations at each station. DO exceedance rates range from 63 to 91 percent.

Figures 5.1 through **5.3** show the temporal variation of DO and TN at Stations 21FLEECOHENDGR11, 21FLEECOHENDGR20, and 21FLEECOHENDGR30. DO concentrations were lower in WBID 3258B1 than in WBID 3258B, in part due to higher salinity, which decreases the solubility of DO in water. Mean DO concentrations in all three stations were lower than 5.0 mg/L. In WBID 2358B1, DO at the downstream station was higher than at the upstream station (**Table 5.2**), most likely due to reaeration from water flow. The highest TN concentrations occurred at Station 21FLEECOHENDGR11 (receiving water from a residential area), while the lowest occurred at Station 21FLEECOHENDGR20 (receiving water from Lakes Park). TN concentrations did not show a distinct seasonal pattern. However, this conclusion is not certain because many other factors can affect DO concentrations in the water.

Seasonally, DO concentrations in the first quarter (January, February, and March) were higher than in the third quarter (July, August, and September) in the two WBIDs (**Figures 5.1** through **5.3**). High DO concentrations appear more often in low-temperature conditions, such as those in the first quarter. In cold seasons, low temperature increases the solubility of DO in the water, and therefore high DO concentrations are usually observed. Temperatures are usually higher in the third quarter than in the first quarter. Higher temperature lowers DO solubility, contributing to the low DO concentrations in Hendry Creek.

As TMDLs primarily address impairments caused by pollutants, this report focuses on the effect of TN on DO concentrations in Hendry Creek. It should be noted that, while physical factors could have an important influence on DO concentration, TN could also play a significant role because it can directly and indirectly influence the oxygen consumption rate in the water. In cold months, low organismal metabolic rates—especially the low oxygen consumption rate of bacteria in a heterotrophic ecosystem such as Hendry Creek—could be a major factor in causing the relatively high DO concentrations. In contrast, when the temperature increases, higher TN concentrations would support a higher oxygen consumption rate by bacteria and result in low DO if the consumption rate were not compensated for by the reaeration rate.

Table 5.1. Sampling Station Summary for the Hendry Creek Watershed, WBIDS 3258B and 3258B1

WBID	Station	STORET ID	Years with Data	N
3258B	Hendry Creek- US 41	21FLEECOHENDGR11	2000-07	164
	Hendry Creek - Gladiolus East	21FLEECOHENDGR20	2000-07	161
3258B1	Hendry Creek - Gladiolus West	21FLEECOHENDGR30	2000-07	93
	Hendry Creek at Power Lines	21FLFTM 28020194	2007	9

Table 5.2. Statistical Summary of Historical DO Data for Hendry Creek, WBIDs 3258B and 3258B1

WBID	Station	N	Minimum	Maximum	Median	Mean	Exceedance	% Exceedance
3258B	21FLEECOHENDGR11	164	0.05	10.85	4.54	4.62	103	62.80%
	21FLEECOHENDGR20	161	0.27	13	4.35	4.49	102	63.40%
3258B1	21FLEECOHENDGR30	93	0.5	6.9	1.93	2.2	85	91.40%
	21FLFTM 28020194	9	3.07	4.97	3.55	3.93	6	66.67%

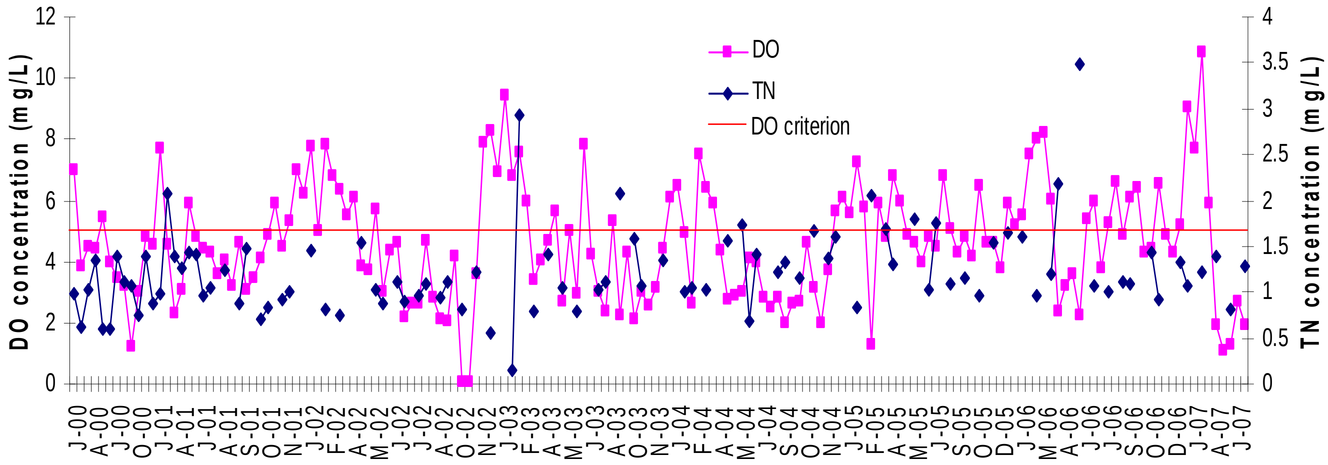

Figure 5.1. Temporal Variation of DO and TN at Station 21FLEECOHENDGR11

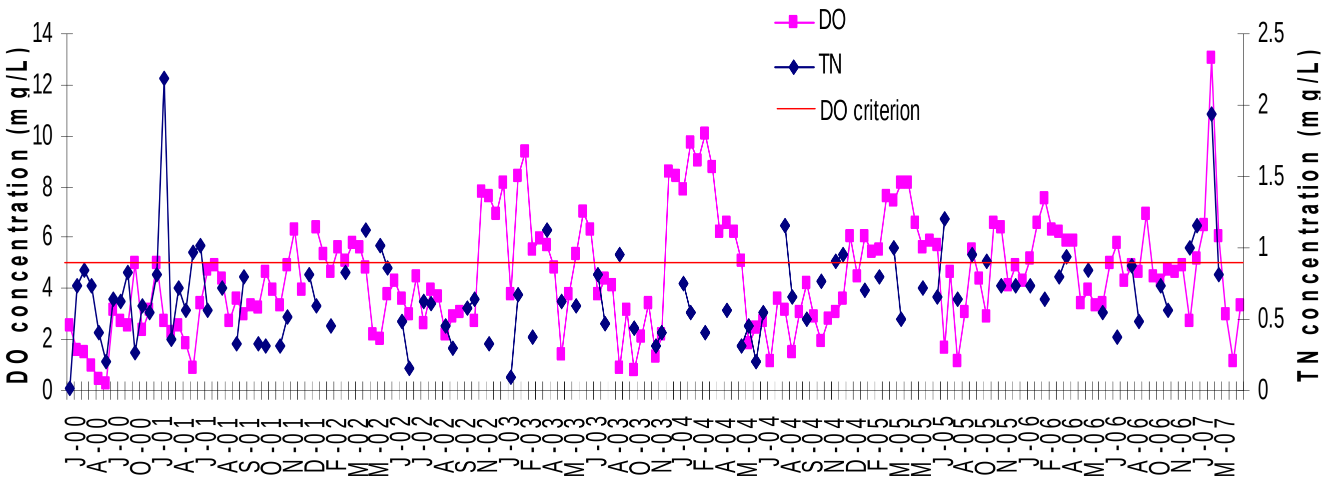

Figure 5.2. Temporal Variation of DO and TN at Station 21FLEECOHENDGR20

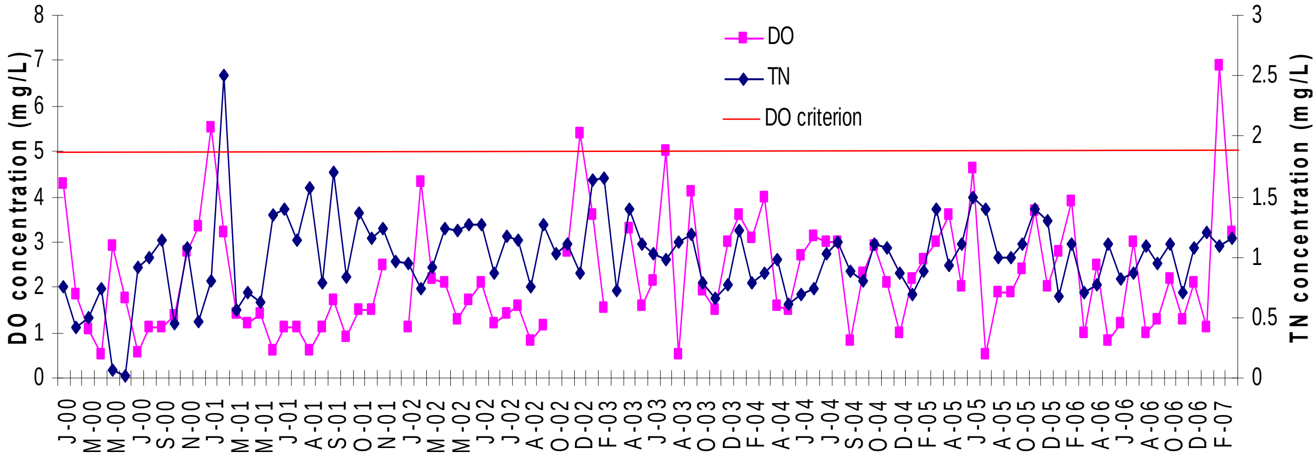

Figure 5.3. Temporal Variation of DO and TN at Station 21FLEECOHENDGR30

5.1.2 TMDL Development Process

As discussed in Chapter 3, the Department established the TN target concentration for the marine segment as the median concentration of the Estero Bay Wetland (WBID 3258A), and the 75^{th} percentile of all freshwater reference WBIDs for the freshwater segment of Hendry Creek. For each individual observation of TN greater than 0.74 mg/L for WBID 3258B and 0.60 mg/L for WBID 3258B1, an individual required reduction was calculated using the following:

$$\frac{[(\text{Observed value}) - (\text{Reference Target})] \times 100}{(\text{Observed value})}$$

After the individual results were calculated, the medians of the individual values were calculated: these were a 32 percent reduction for WBID 3258B and a 44 percent reduction for WBID 3258B1 (**Appendix B**). **Table 5.3** summarizes the TN median percent reduction for each WBID. A 32 percent reduction in TN loading should protect DO concentrations in the freshwater segment of Hendry Creek as well as in the downstream, marine segment. Therefore, instead of using separate required percent reductions for freshwater and marine environments, the Department proposes that a 44 percent TN load reduction be applied to the entire Hendry Creek watershed, including the freshwater segment. This approach adds to the margin of safety (MOS).

Table 5.3. Summary of TN Median Percent Reductions for Each WBID in the Hendry Creek Watershed

WBID	TN Median (mg/L)	TN Target (mg/L)	TN Median % Reduction
3258B	1.04	0.74	32
3258B1	1.08	0.60	44

5.1.3 Critical Conditions/Seasonality

Low DO occurred all seasons and all months **(Figures 5.1** through **5.3)**. Although it tended to occur more frequently in warm months, low DO was found in cold months at significant rates. Consequently, the percent reductions were calculated throughout the year and covered all months and seasons.

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 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 1) 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 2) 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 the 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**. TMDLs for Hendry Creek are expressed in terms of a percent reduction in TN, to protect the DO concentration **(Table 6.1).** The daily percent reduction requirement is the same as the percent reduction requirement established in this TMDL.

Table 6.1. TMDL Components for Hendry Creek, WBIDs 3258B and 3258B1

WBID	Parameter	TMDL (mg/L)	WLA		LA (% Reduction)[2]	MOS
			Wastewater (mg/L)[1]	NPDES Stormwater (% Reduction)[2]		
3258B	TN	0.74	N/A	44%	44%	Implicit
3258B1	TN	0.60	N/A	44%	44%	Implicit

[1]N/A = Not applicable
[2]As the TMDL represents a percent reduction; it also complies with EPA requirements to express the TMDL on a daily basis.

6.2 Load Allocation

As discussed in **Section 5.1.2**, although a 32 percent reduction in TN is required to protect the freshwater segment (**Table 5.3**), to protect the downstream marine segment a 44 percent TN reduction is required in the watershed's entire discharge to Hendry Creek. Therefore, a TN reduction of 44 percent is required from nonpoint sources for both the freshwater and marine segments of Hendry Creek (**Table 6.1**). 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

There are currently no permitted NPDES discharges in the Hendry Creek watershed; however, any future discharge permits issued in the watershed will also be required to meet the state's Class III criterion for DO and contain appropriate discharge limitations on TN that will comply with the TMDL as well as existing state requirements for discharges to Outstanding Florida Waters.

6.3.2 NPDES Stormwater Discharges

Lee County (FLS000035) has a Phase I MS4 permit that includes portions of the Hendry Creek watershed and is responsible for a 44 percent reduction in current anthropogenic TN loading. 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 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. An MOS was included by using the mean of the TN median concentrations from waters not impaired for low DO or chlorophyll *a*, instead of using the highest TN median concentration of unimpaired waters. In addition, though the freshwater segment requires only a 32 percent reduction, to protect the downstream marine segment, the Department proposes a 44 percent TN reduction for the entire Hendry Creek watershed that also adds to the MOS.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Enhanced TMDL Assessment

The Department realizes the uncertainty associated with this approach and is planning to develop hydrology, hydrodynamic, and water quality models to address overall water quality in the Estero Bay system. A DO simulation for Hendry Creek will also be part of this detailed modeling effort. The conclusion reached in this TMDL will be refined if necessary, based on the results of future modeling activities.

7.2 Basin Management Action Plan

Following the adoption of these TMDLs by rule, the next step in the TMDL process is to develop an implementation plan for the TMDLs, referred to as the Basin Management Action Plan (BMAP). This document will be developed over the next two years in cooperation with local stakeholders, who will attempt to reach a consensus on detailed allocations and on how load reductions will be accomplished. The BMAP will include, among other things:

- Appropriate load reduction allocations among the affected parties;
- 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;
- Confirmed and potential funding mechanisms;
- Any applicable signed agreement(s);
- Local ordinances defining actions to be taken or prohibited;
- Any applicable local water quality standards, permits, or load limitation agreements;
- Milestones for implementation and water quality improvement; and
- Implementation tracking, water quality monitoring, and follow-up measures.

An assessment of progress toward the BMAP milestones will be conducted every five years, and revisions to the plan will be made as appropriate, in cooperation with basin stakeholders.

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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 state's water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

Rule 62-40, F.A.C., also requires the water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a 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. No PLRG had been developed for Newnans Lake when this report was published.

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 municipal separate storm sewer systems (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 Program 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 focuses 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 re-opener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Observed Data for Calculating TN Percent Reductions for Hendry Creek, WBIDs 3258B and 3258B1

Table B.1. Observed Data for WBID 3258B, 2000–07

Sample Date	Station	Observed TN Value (mg/L)	Target Concentration (mg/L)	% Reduction
1/13/2000	21FLEECOHENDGR11	0.98	0.74	24.49
3/21/2000	21FLEECOHENDGR11	1.02	0.74	27.45
3/21/2000	21FLEECOHENDGR20	0.85	0.74	12.94
4/20/2000	21FLEECOHENDGR11	1.35	0.74	45.19
7/27/2000	21FLEECOHENDGR11	1.4	0.74	47.14
8/22/2000	21FLEECOHENDGR11	1.11	0.74	33.33
9/7/2000	21FLEECOHENDGR11	1.06	0.74	30.19
9/7/2000	21FLEECOHENDGR20	0.83	0.74	10.84
11/7/2000	21FLEECOHENDGR11	1.38	0.74	46.38
12/19/2000	21FLEECOHENDGR11	0.88	0.74	15.91
1/10/2001	21FLEECOHENDGR11	0.985	0.74	24.87
1/10/2001	21FLEECOHENDGR20	0.82	0.74	9.76
2/8/2001	21FLEECOHENDGR11	2.065	0.74	64.16
2/8/2001	21FLEECOHENDGR20	2.18	0.74	66.06
3/15/2001	21FLEECOHENDGR11	1.39	0.74	46.76
4/12/2001	21FLEECOHENDGR11	1.26	0.74	41.27
5/8/2001	21FLEECOHENDGR11	1.44	0.74	48.61
6/7/2001	21FLEECOHENDGR11	1.41	0.74	47.52
6/7/2001	21FLEECOHENDGR20	0.97	0.74	23.71
7/12/2001	21FLEECOHENDGR11	0.965	0.74	23.32
7/12/2001	21FLEECOHENDGR20	1.02	0.74	27.45
7/19/2001	21FLEECOHENDGR11	1.045	0.74	29.19
8/1/2001	21FLEECOHENDGR11	1.245	0.74	40.56
8/21/2001	21FLEECOHENDGR11	0.88	0.74	15.91
9/13/2001	21FLEECOHENDGR11	1.48	0.74	50.00
9/13/2001	21FLEECOHENDGR20	0.79	0.74	6.33
10/3/2001	21FLEECOHENDGR11	0.835	0.74	11.38
10/24/2001	21FLEECOHENDGR11	0.93	0.74	20.43
11/1/2001	21FLEECOHENDGR11	1.005	0.74	26.37
12/20/2001	21FLEECOHENDGR11	1.09	0.74	32.11
12/20/2001	21FLEECOHENDGR20	0.81	0.74	8.64
1/10/2002	21FLEECOHENDGR11	1.465	0.74	49.49
2/6/2002	21FLEECOHENDGR11	0.805	0.74	8.07
3/7/2002	21FLEECOHENDGR20	0.83	0.74	10.84

4/18/2002	21FLEECOHENDGR11	1.53	0.74	51.63
4/18/2002	21FLEECOHENDGR20	1.12	0.74	33.93
5/22/2002	21FLEECOHENDGR11	1.03	0.74	28.16
5/22/2002	21FLEECOHENDGR20	1.01	0.74	26.73
6/11/2002	21FLEECOHENDGR11	0.87	0.74	14.94
6/11/2002	21FLEECOHENDGR20	0.86	0.74	13.95
6/26/2002	21FLEECOHENDGR11	1.105	0.74	33.03
7/10/2002	21FLEECOHENDGR11	0.905	0.74	18.23
7/24/2002	21FLEECOHENDGR11	0.955	0.74	22.51
8/8/2002	21FLEECOHENDGR11	1.09	0.74	32.11
8/28/2002	21FLEECOHENDGR11	0.945	0.74	21.69
9/19/2002	21FLEECOHENDGR11	1.11	0.74	33.33
10/9/2002	21FLEECOHENDGR11	0.82	0.74	9.76
11/13/2002	21FLEECOHENDGR11	1.22	0.74	39.34
2/13/2003	21FLEECOHENDGR11	2.925	0.74	74.70
3/11/2003	21FLEECOHENDGR11	0.8	0.74	7.50
4/17/2003	21FLEECOHENDGR11	1.42	0.74	47.89
4/17/2003	21FLEECOHENDGR20	1.12	0.74	33.93
5/14/2003	21FLEECOHENDGR11	1.04	0.74	28.85
6/5/2003	21FLEECOHENDGR11	0.8	0.74	7.50
7/29/2003	21FLEECOHENDGR11	1.03	0.74	28.16
7/29/2003	21FLEECOHENDGR20	0.81	0.74	8.64
8/5/2003	21FLEECOHENDGR11	1.105	0.74	33.03
9/10/2003	21FLEECOHENDGR11	2.08	0.74	64.42
9/10/2003	21FLEECOHENDGR20	0.95	0.74	22.11
10/22/2003	21FLEECOHENDGR11	1.59	0.74	53.46
11/24/2003	21FLEECOHENDGR11	1.06	0.74	30.19
12/9/2003	21FLEECOHENDGR11	1.34	0.74	44.78
1/28/2004	21FLEECOHENDGR11	1.005	0.74	26.37
2/24/2004	21FLEECOHENDGR11	1.05	0.74	29.52
3/1/2004	21FLEECOHENDGR11	1.035	0.74	28.50
4/26/2004	21FLEECOHENDGR11	1.555	0.74	52.41
5/26/2004	21FLEECOHENDGR11	1.74	0.74	57.47
7/18/2004	21FLEECOHENDGR11	1.405	0.74	47.33
8/29/2004	21FLEECOHENDGR11	1.225	0.74	39.59
8/29/2004	21FLEECOHENDGR20	1.15	0.74	35.65
9/2/2004	21FLEECOHENDGR11	1.33	0.74	44.36
9/13/2004	21FLEECOHENDGR11	1.145	0.74	35.37
10/7/2004	21FLEECOHENDGR11	1.67	0.74	55.69
11/23/2004	21FLEECOHENDGR11	1.375	0.74	46.18
11/23/2004	21FLEECOHENDGR20	0.91	0.74	18.68
12/1/2004	21FLEECOHENDGR11	1.595	0.74	53.61
12/1/2004	21FLEECOHENDGR20	0.947	0.74	21.86

1/31/2005	21FLEECOHENDGR11	0.84	0.74	11.90
2/23/2005	21FLEECOHENDGR11	2.05	0.74	63.90
2/23/2005	21FLEECOHENDGR20	0.79	0.74	6.33
3/19/2005	21FLEECOHENDGR11	1.7	0.74	56.47
3/19/2005	21FLEECOHENDGR20	1	0.74	26.00
4/7/2005	21FLEECOHENDGR11	1.3	0.74	43.08
5/31/2005	21FLEECOHENDGR11	1.8	0.74	58.89
6/16/2005	21FLEECOHENDGR11	1.03	0.74	28.16
7/8/2005	21FLEECOHENDGR11	1.75	0.74	57.71
7/8/2005	21FLEECOHENDGR20	1.2	0.74	38.33
8/17/2005	21FLEECOHENDGR11	1.1	0.74	32.73
9/29/2005	21FLEECOHENDGR11	1.15	0.74	35.65
9/29/2005	21FLEECOHENDGR20	0.96	0.74	22.92
10/18/2005	21FLEECOHENDGR11	0.955	0.74	22.51
10/18/2005	21FLEECOHENDGR20	0.9	0.74	17.78
11/7/2005	21FLEECOHENDGR11	1.55	0.74	52.26
12/8/2005	21FLEECOHENDGR11	1.65	0.74	55.15
1/31/2006	21FLEECOHENDGR11	1.6	0.74	53.75
2/20/2006	21FLEECOHENDGR11	0.97	0.74	23.71
3/14/2006	21FLEECOHENDGR11	1.2	0.74	38.33
3/14/2006	21FLEECOHENDGR20	0.8	0.74	7.50
4/4/2006	21FLEECOHENDGR11	2.185	0.74	66.13
4/4/2006	21FLEECOHENDGR20	0.93	0.74	20.43
5/25/2006	21FLEECOHENDGR11	3.495	0.74	78.83
5/25/2006	21FLEECOHENDGR20	0.84	0.74	11.90
6/29/2006	21FLEECOHENDGR11	1.065	0.74	30.52
7/26/2006	21FLEECOHENDGR11	1.01	0.74	26.73
8/21/2006	21FLEECOHENDGR11	1.115	0.74	33.63
8/21/2006	21FLEECOHENDGR20	0.88	0.74	15.91
9/5/2006	21FLEECOHENDGR11	1.085	0.74	31.80
10/25/2006	21FLEECOHENDGR11	1.44	0.74	48.61
11/13/2006	21FLEECOHENDGR11	0.91	0.74	18.68
12/22/2006	21FLEECOHENDGR11	1.32	0.74	43.94
12/22/2006	21FLEECOHENDGR20	1	0.74	26.00
1/3/2007	21FLEECOHENDGR11	1.06	0.74	30.19
1/3/2007	21FLEECOHENDGR20	1.16	0.74	36.21
2/8/2007	21FLEECOHENDGR11	1.21	0.74	38.84
2/8/2007	21FLEECOHENDGR20	1.93	0.74	61.66
3/7/2007	21FLEECOHENDGR20	0.81	0.74	8.64
4/26/2007	21FLEECOHENDGR11	1.39	0.74	46.76
5/15/2007	21FLEECOHENDGR11	0.82	0.74	9.76
6/26/2007	21FLEECOHENDGR11	1.28	0.74	42.19
			TN Median	**32**

Table B.2. Observed Data for WBID 3258B1, 2000–07

Sample Date	Station	Observed TN Value (mg/L)	Target Concentration (mg/L)	% Reduction
1/13/2000	21FLEECOHENDGR30	0.75	0.60	20.00
4/20/2000	21FLEECOHENDGR30	0.74	0.60	18.92
7/27/2000	21FLEECOHENDGR30	0.91	0.60	34.07
8/22/2000	21FLEECOHENDGR30	1.00	0.60	40.00
9/7/2000	21FLEECOHENDGR30	1.14	0.60	47.37
11/7/2000	21FLEECOHENDGR30	1.08	0.60	44.44
1/10/2001	21FLEECOHENDGR30	0.80	0.60	25.00
2/8/2001	21FLEECOHENDGR30	2.51	0.60	76.10
4/12/2001	21FLEECOHENDGR30	0.71	0.60	15.49
5/8/2001	21FLEECOHENDGR30	0.63	0.60	4.76
6/7/2001	21FLEECOHENDGR30	1.34	0.60	55.22
7/12/2001	21FLEECOHENDGR30	1.40	0.60	57.14
7/19/2001	21FLEECOHENDGR30	1.14	0.60	47.37
8/1/2001	21FLEECOHENDGR30	1.58	0.60	62.03
8/21/2001	21FLEECOHENDGR30	0.79	0.60	24.05
9/13/2001	21FLEECOHENDGR30	1.70	0.60	64.71
9/25/2001	21FLEECOHENDGR30	0.84	0.60	28.57
10/3/2001	21FLEECOHENDGR30	1.36	0.60	55.88
10/24/2001	21FLEECOHENDGR30	1.16	0.60	48.28
11/1/2001	21FLEECOHENDGR30	1.23	0.60	51.22
12/20/2001	21FLEECOHENDGR30	0.96	0.60	37.50
1/10/2002	21FLEECOHENDGR30	0.94	0.60	36.17
2/6/2002	21FLEECOHENDGR30	0.74	0.60	18.92
3/7/2002	21FLEECOHENDGR30	0.91	0.60	34.07
4/18/2002	21FLEECOHENDGR30	1.24	0.60	51.61
5/22/2002	21FLEECOHENDGR30	1.22	0.60	50.82
6/11/2002	21FLEECOHENDGR30	1.27	0.60	52.76
6/26/2002	21FLEECOHENDGR30	1.26	0.60	52.38
7/10/2002	21FLEECOHENDGR30	0.86	0.60	30.23
7/24/2002	21FLEECOHENDGR30	1.17	0.60	48.72
8/8/2002	21FLEECOHENDGR30	1.14	0.60	47.37
8/28/2002	21FLEECOHENDGR30	0.76	0.60	21.05
9/19/2002	21FLEECOHENDGR30	1.27	0.60	52.76
10/9/2002	21FLEECOHENDGR30	1.03	0.60	41.75
11/13/2002	21FLEECOHENDGR30	1.10	0.60	45.45

12/17/2002	21FLEECOHENDGR30	0.86	0.60	30.23
1/14/2003	21FLEECOHENDGR30	1.64	0.60	63.41
2/13/2003	21FLEECOHENDGR30	1.66	0.60	63.86
3/11/2003	21FLEECOHENDGR30	0.72	0.60	16.67
4/17/2003	21FLEECOHENDGR30	1.39	0.60	56.83
5/14/2003	21FLEECOHENDGR30	1.11	0.60	45.95
6/5/2003	21FLEECOHENDGR30	1.02	0.60	41.18
7/29/2003	21FLEECOHENDGR30	0.98	0.60	38.59
8/5/2003	21FLEECOHENDGR30	1.12	0.60	46.43
9/10/2003	21FLEECOHENDGR30	1.18	0.60	49.15
10/22/2003	21FLEECOHENDGR30	0.78	0.60	23.08
11/24/2003	21FLEECOHENDGR30	0.65	0.60	7.69
12/9/2003	21FLEECOHENDGR30	0.77	0.60	22.08
1/28/2004	21FLEECOHENDGR30	1.22	0.60	50.82
2/24/2004	21FLEECOHENDGR30	0.79	0.60	24.05
3/1/2004	21FLEECOHENDGR30	0.86	0.60	30.23
4/26/2004	21FLEECOHENDGR30	0.98	0.60	38.78
5/26/2004	21FLEECOHENDGR30	0.61	0.60	1.64
6/3/2004	21FLEECOHENDGR30	0.69	0.60	13.04
7/14/2004	21FLEECOHENDGR30	0.73	0.60	17.81
7/18/2004	21FLEECOHENDGR30	1.02	0.60	41.18
8/29/2004	21FLEECOHENDGR30	1.13	0.60	46.90
9/2/2004	21FLEECOHENDGR30	0.89	0.60	32.58
9/13/2004	21FLEECOHENDGR30	0.81	0.60	25.93
10/7/2004	21FLEECOHENDGR30	1.11	0.60	45.95
11/23/2004	21FLEECOHENDGR30	1.08	0.60	44.44
12/1/2004	21FLEECOHENDGR30	0.87	0.60	30.64
1/31/2005	21FLEECOHENDGR30	0.69	0.60	13.04
2/23/2005	21FLEECOHENDGR30	0.88	0.60	31.82
3/19/2005	21FLEECOHENDGR30	1.40	0.60	57.14
4/7/2005	21FLEECOHENDGR30	0.93	0.60	35.48
5/31/2005	21FLEECOHENDGR30	1.10	0.60	45.45
6/16/2005	21FLEECOHENDGR30	1.50	0.60	60.00
7/8/2005	21FLEECOHENDGR30	1.40	0.60	57.14
8/17/2005	21FLEECOHENDGR30	1.00	0.60	40.00
9/29/2005	21FLEECOHENDGR30	1.00	0.60	40.00
10/18/2005	21FLEECOHENDGR30	1.10	0.60	45.45
11/7/2005	21FLEECOHENDGR30	1.40	0.60	57.14
12/8/2005	21FLEECOHENDGR30	1.30	0.60	53.85
1/31/2006	21FLEECOHENDGR30	0.67	0.60	10.45
2/20/2006	21FLEECOHENDGR30	1.10	0.60	45.45
3/14/2006	21FLEECOHENDGR30	0.70	0.60	14.29
4/4/2006	21FLEECOHENDGR30	0.77	0.60	22.08

5/25/2006	21FLEECOHENDGR30	1.10	0.60	45.45
6/29/2006	21FLEECOHENDGR30	0.82	0.60	26.83
7/26/2006	21FLEECOHENDGR30	0.87	0.60	31.03
8/21/2006	21FLEECOHENDGR30	1.09	0.60	44.95
9/5/2006	21FLEECOHENDGR30	0.95	0.60	36.84
10/25/2006	21FLEECOHENDGR30	1.10	0.60	45.45
11/13/2006	21FLEECOHENDGR30	0.71	0.60	15.49
12/22/2006	21FLEECOHENDGR30	1.07	0.60	43.93
1/3/2007	21FLEECOHENDGR30	1.20	0.60	50.00
2/8/2007	21FLEECOHENDGR30	1.09	0.60	44.95
3/7/2007	21FLEECOHENDGR30	1.15	0.60	47.83
5/2/2007	21FLFTM 28020194	0.85	0.60	28.99
5/9/2007	21FLFTM 28020194	1.21	0.60	50.33
5/16/2007	21FLFTM 28020194	1.44	0.60	58.25
5/23/2007	21FLFTM 28020194	1.21	0.60	50.54
5/30/2007	21FLFTM 28020194	1.11	0.60	45.85
6/6/2007	21FLFTM 28020194	1.72	0.60	65.01
6/13/2007	21FLFTM 28020194	1.23	0.60	51.18
6/20/2007	21FLFTM 28020194	1.41	0.60	57.39
			Median	**44**

Appendix C: Public Comments and FDEP Responses

Appendix C.1: Kevin Carter / SFWMD

The below comments were received by email from Mr. Kevin Carter of the South Florida Water Management District (SFWMD) on July 18, 2008

Comment 1.: Our major comments focus on the setting of the total nitrogen (TN) threshold of 0.74 mg/l in order for the water body to meet the state of Florida's (Florida Administrative Code 62-302 http://www.dep.state.fl.us/legal/Rules/shared/62-302/302-Table.pdf) dissolved oxygen (DO) water quality criteria of 5.0 mg/l (note the TN value of 0.74 mg/l was stated at Public Workshop on 07/11/2008 and differs very slightly from what is written in the DRAFT TMDL report which is 0.76 mg/l).

FDEP Response: All of the dissolved oxygen TMDL reports for freshwater will be revised to state the correct TN threshold of 0.74 mg/L, which was used in the TMDL presentation.

Comment 2: We would like the FDEP to consider the following District observations based on our brief data investigation of the DRAFT TMDL report's "Appendix B. Water Quality Measurements Used in the Verified Period Assessment."

• Overall, this table has 171 observations of TN and DO measurements taken concurrently in the Imperial River between January 2000 to March 2007.
• Of those 171 observations, the TN concentrations were less than the 0.74 mg/l threshold proposed by the DRAFT TMDL report 47 times (27.5%).
• Of those 47 observations where TN concentrations were less than 0.74 mg/l, dissolved oxygen concentrations failed the state of Florida's 5.0 mg/l DO criteria 41 times (87.2%).

Based solely on the historical ambient data, the occurrence of TN values less than 0.74 mg/l does not regularly ensure DO values will achieve water quality criteria compliance. Some variability is to be expected with instream DO concentrations because of the many diverse reasons for low DO values (e.g., groundwater inputs). However, the relatively high percentage of failures (87.2%) should be considered carefully as the FDEP moves forward with its TMDL process for this WBID. In addition, the FDEP should review the other DO TMDLs within this round for the EWC (Hendry Creek WBIDs 3258B and 3258B1; Gordon River WBID 3278K) to determine if a similar TN and DO dynamic exists across the watershed.

FDEP Response: The Department agrees there are other significant factors affecting the dissolved oxygen concentration within the Imperial River, such as groundwater inputs, atmospheric deposition, and hydrologic modifications. The TMDL report focused on the total nitrogen threshold since it had the best relationship with DO and it exceeded the reference concentrations, which was not the case for total phosphorus and BOD. Thus, reducing total nitrogen to a median value of 0.74 mg/L (using the 75th percentile of the medians from freshwater WBIDs in the Southwest Coast Planning Unit) was used as the reference concentration target. Applying this target to reduce total nitrogen, the Department believes the anthropogenic affects would be captured, which would result in dissolved oxygen improvement. As was noted in your comments, the Everglades West Coast has uniquely high number of waterbodies with naturally low dissolved oxygen. This was the reason for utilizing waterbodies in the Everglades West Coast as reference conditions. An observation of the relatively lower TN in these reference waterbodies, as well as the correlation between DO and TN in the entire region, indicate that a decrease in the TN can result an increase in the dissolved oxygen. The FDEP does not predict a final dissolved oxygen concentration after the anthropogenic activities have been modified to reduce total nitrogen.
The FDEP agrees with your comment that more work remains to be done to understand the local hydrology and positively affect change through a collaborative effort between local stakeholders and FDEP, which can occur during the Basin Management Action Plan (BMAP) development phase of the TMDL process.

Appendix C.2: Lee county Division of Natural Resources

The below comments were received by email from the Lee County Division of Natural Resources on July 17, 2008

Comment 1:
[There should be a] detailed review of the adequacy of the present database to support more detailed modeling, or to support determination of reference nutrient values with identification of data gaps. We need to know for future modeling efforts what data is lacking so that we can determine if and what additional data collection can be done.

FDEP Response: The department will also seek ways to work closer with local stakeholders to identify data gaps and develop water quality monitoring plans to develop as complete possible data set for the development of future TMDLs. For TMDLs that have been developed, During the implementation or Basin Management Action Plan (BMAP) phase, the Department will work with all interested stakeholders to identify data gaps for supplemental data collection to assist in the identification of effective management activities.

Comment 2:
Conducting a detailed peer review that assesses the following issues:

- Additional consideration must be given to the idea of "natural condition" for DO and the influence of SOD and system hydrology in the overall DO conditions. We do not have SOD data in this area as well as the affects of groundwater due to man-made alterations in the basin are as yet unknown.
- We recommend an evaluation of the present DO TMDLs against the precedent that has been established in recent delistings based upon determination of low "natural" DO levels.
- Variability in the baseline or reference levels of TN will have a significant impact upon the percent reduction in the system.

FDEP Response: The Department agrees that gaining an understanding of the affects of SOD and groundwater inputs and man-made alterations will help assess and restore this waterbody, so that water quality meets the established water quality standards.

The Department has proposed for Delisting several waterbodies that have low dissolved oxygen and no causative pollutant has been found, providing supporting evidence the low DO is due to natural conditions. The impact of land use change and urban development in the Hendry Creek watershed provide evidence to support that the low DO in Hendry Creek is predominantly due to anthropogenic affects.

The TMDL document will be revised to include reference WBIDs and stations from WBIDs that have low urban impacts and the TN reference concentration value will be changed accordingly.

Comment 3:
The County recognizes the approximate nature of these initial TMDLs and believes they have value for planning purposes.

FDEP Response: The Department will include the finalized TMDLs developed for the Everglades West Coast basin in the next phase of the TMDL process known as the Basin Management Action Plan (BMAP) development.

Comment 4:

Seasonal data needs to be collected for those TMDLs that currently consider only concentrations.

FDEP Response: The data used to develop the TMDLs were typically collected during each month of the calendar year, covering each season. This also includes variability occurring during the wet / dry seaons.

Comment 5:

The draft TMDLs are not sufficient for developing allocations.

FDEP Response: The Department will utilize the TMDLs developed for the Everglades West Coast basin as a starting point for the next phase of the TMDL process known as the Basin Management Action Plan (BMAP) development. Detailed allocations, as well as more refined TMDL calculations should be pursued and can be completed during the BMAP development phase.

Comment 6:

Detailed modeling must be completed, using viable seasonal water quality and stream flow data, to establish actual pollutant loadings (not concentrations) to serve as the basis of any credible determination of required annual pollutant load reductions, or subsequent allocation of reductions to the stakeholders.

FDEP Response: The Department will pursue flow monitoring and include any reliable accurate flow data, as it becomes available, to develop pollutant load and water quality models.

Comment 7:

The recent draft TMDLs prepared by FDEP provide very limited source assessments and will need detailed evaluation and assessment of pollutant sources prior to the development of accurate allocation of pollutant loads.

FDEP Response: The Department will include the finalized TMDLs developed for the Everglades West Coast basin in the next phase of the TMDL process known as the Basin Management Action Plan (BMAP) development. Detailed allocations, sources assessment, as well as more refined TMDL calculations can be completed during the BMAP.

Comment 8:

Detailed examination of the potential seasonal impact of septic tanks/OSTDSs and their annual pollutant load contribution is required which should include:

- Accurate quantification of the number of septic systems within the watershed (e.g. FDEP did not obtain Lee County's manhole data to determine where central sewer exists versus septic tanks.);
- Identification of the location of the existing systems. (e.g. There was no mention of package plant locations in the TMDL report.); and
- Estimation of the percentage of the septic tank population that have failed. The assumption that a permit for repair represents failure and that all repairs are permitted is a narrow assumption with the potential for more failures than are accounted for.

FDEP Response: The Department would appreciate any additional information to better reflect accurate septic tank coverages, sewer service areas, and package plant coverages within the Hendry Creek watershed. The information listed above can be incorporated into the TMDL document for this basin. The assumption that repaired septic tanks is an accurate representation of potentially failing septic tanks has been used in several Department fecal coliform TMDLs and is used only as information in the TMDL document.

Comment 9:

Evaluation of cross-border levels of contribution where WBIDs are shared between Lee County and adjacent counties so that these loads can be attributed to the proper stakeholders.

FDEP Response: The Department will include the finalized TMDLs developed for the Everglades West Coast basin in the next phase of the TMDL process known as the Basin Management Action Plan (BMAP) development. Detailed allocations, sources assessment, as well as more refined TMDL calculations can be completed during the BMAP.

Appendix C.3: Ms. Karen Bickford/Lee county Division of Natural Resources

The below comments were received by email from Ms. Karen Bickford of the Lee County Division of Natural Resources on July 17, 2008

Comment 1:

Detailed review of the available data used in the listing process in order to identify gaps, errors and other dataset technical problems. (Lee County has additional data available for Hendry Creek that may not have been previously used in the assessment; stations HENDGR11A, HENDGR40 and HENDGR41.)

FDEP Response: The Department will incorporate the additional stations and data into the assessment of Hendry Creek, provided that the data collected are within the verified period (January 1, 2000 – June 30, 2008). The data should be uploaded to the Florida STORET database and will subsequently used in the IWR analysis.

Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Watershed Management
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