Final

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • TAMPA BAY TRIBUTARIES BASIN

TMDL Report

Fecal and Total Coliform TMDL for Blackwater Creek WBID 1482

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September 15, 2004

Acknowledgments

This study could not have been accomplished without significant contributions from staff in the Florida Department of Environmental Protection's Watershed Assessment Section. David F. Tyler provided the basin delineations and land use aggregations, and carried out much of the data gathering. Molly Davis with Region 4, U.S. Environmental Protection Agency, provided all of the technical analysis. The Department also recognizes the substantial support and assistance of the Southwest Florida Water Management District staff, particularly their contributions towards understanding the issues, history, and processes at work in the Blackwater Creek watershed.

Editorial assistance provided by Daryll Joyner, Jan Mandrup-Poulsen, and Linda Lord.

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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/water/tmdl/docs/AmendedIWR.pdf

STORET Program

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

2002 305(b) Report

http://www.dep.state.fl.us/water/docs/2002_305b.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/legal/rules/shared/62-302t.pdf

Basin Status Report for the Tampa Bay Tributaries Basin

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

Water Quality Assessment Report for the Tampa Bay Tributaries Basin

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Allocation Technical Advisory Committee (ATAC) Report

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U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

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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 fecal and total coliform bacteria for Blackwater Creek, which is located in the Hillsborough River Basin, within the larger Tampa Bay Tributaries Basin. The stream was verified as impaired for fecal and total coliform bacteria, and was included on the Verified List of impaired waters for the Tampa Bay Tributaries Basin that was adopted by Secretarial Order in May 2004. The TMDL establishes the allowable loadings to Blackwater Creek that would restore the waterbody so that it meets its applicable water quality criteria for fecal and total coliform bacteria.

1.2 Identification of Waterbody

Blackwater Creek is located in Hillsborough and Polk Counties, with its 113-square-mile drainage area reaching into northeastern Hillsborough and northwestern Polk Counties **(Figure 1.1).** The creek is 13.6 miles long and flows to the west before joining the Hillsborough River to the south of Zephyrhills, Florida. Major population centers in the watershed include Plant City, a city of 29,915 people approximately 5 miles south of the creek, and Lakeland, a city of 405,382 people approximately 4 miles southeast of the creek. Blackwater Creek is a third-order, dark water river, and, along its length, it exhibits characteristics associated with riverine aquatic environments. Major tributaries to Blackwater Creek include East Canal, which drains a portion of Plant City, and Itchepackesassa Creek, which drains a portion of Lakeland. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Tampa Bay Tributaries Basin (Florida Department of Environmental Protection, June 2002).

For assessment purposes, the Department divided the Hillsborough River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Blackwater Creek is WBID 1482 **(Figure 1.2).**

1.3 Background

This report was developed as part of the Florida Department of Environmental Protection's (Department) 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).

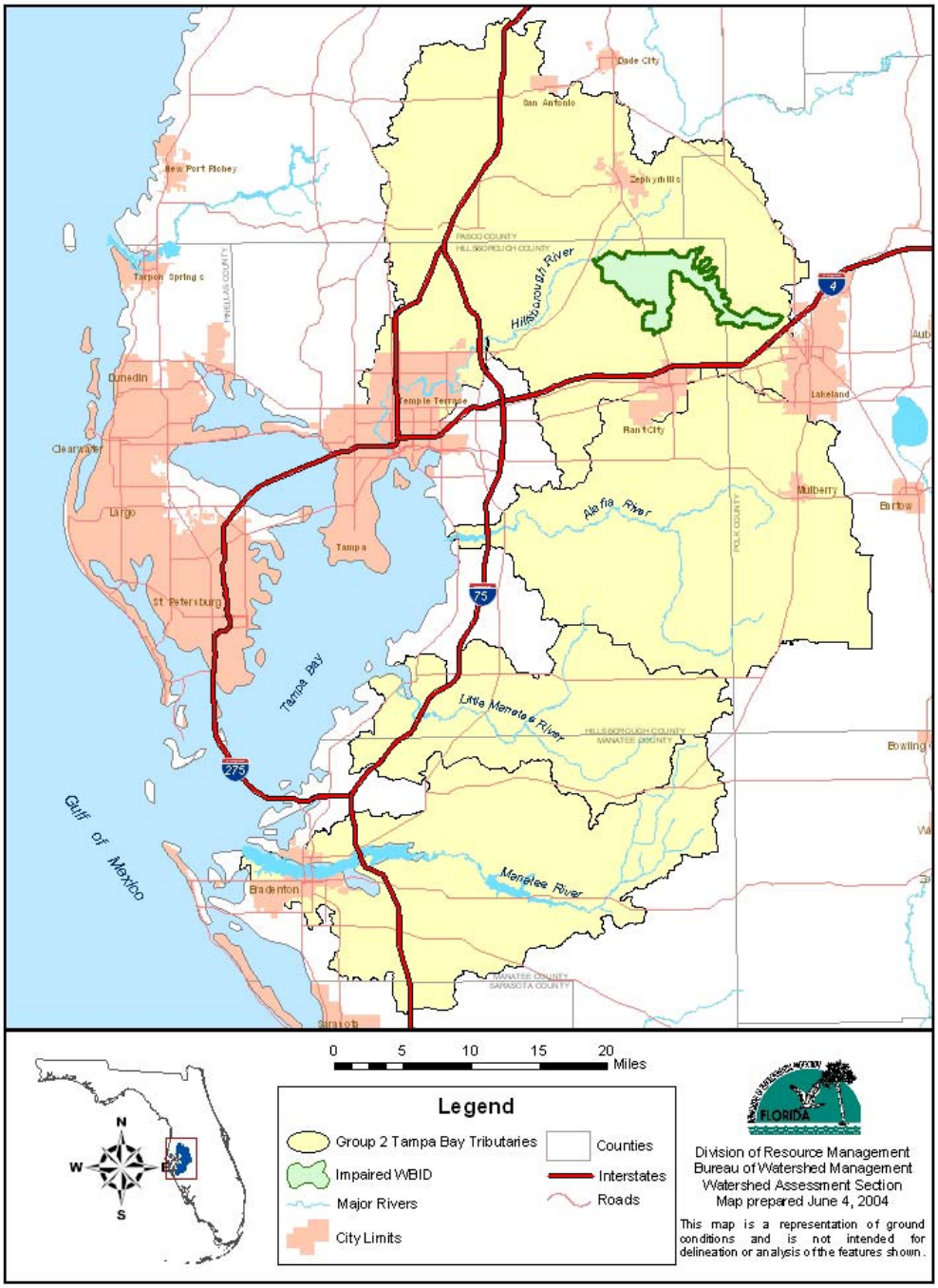

Figure 1.1. Location of the Blackwater Creek Watershed, WBID 1482, and Major Geopolitical Features in the Tampa Bay Tributaries Basin

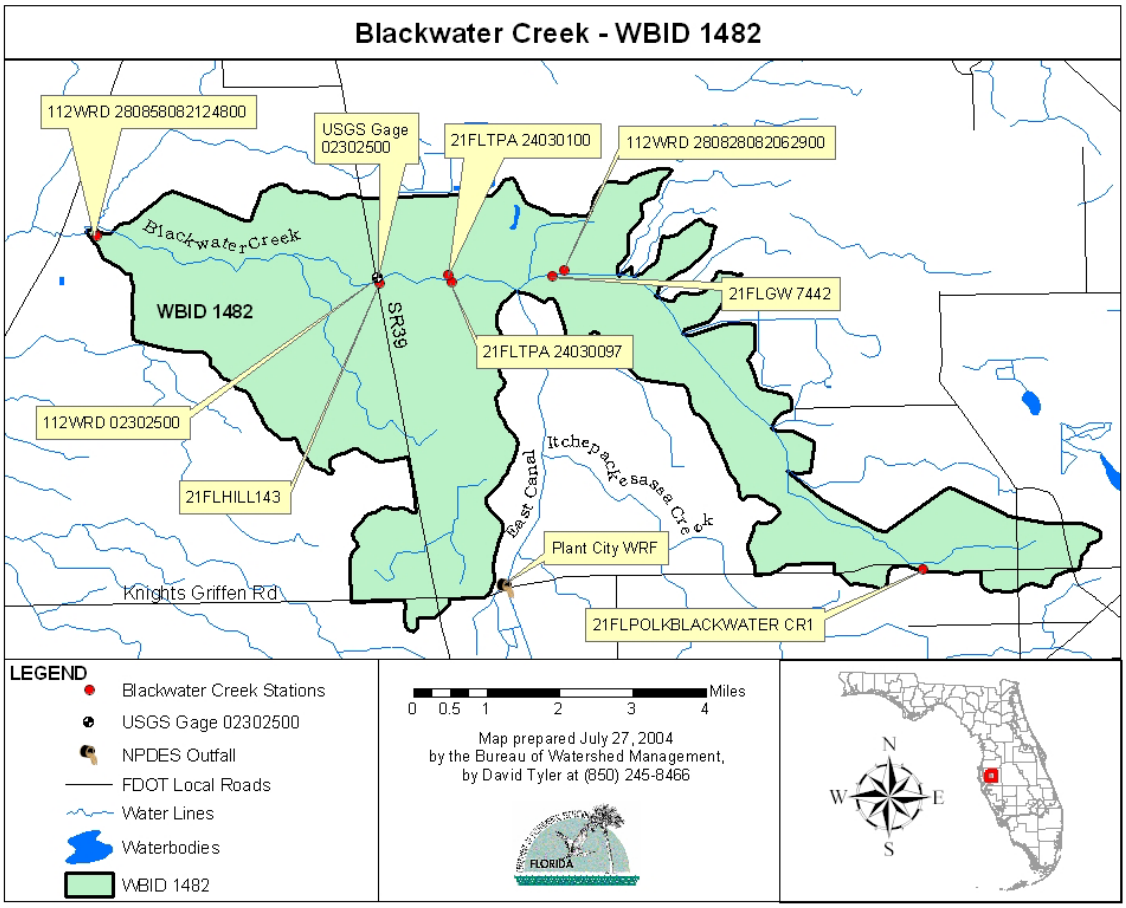

Figure 1.2. Blackwater Creek Watershed, WBID 1482, and Monitoring Locations

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. TMDLs provide important water quality restoration goals that will guide restoration activities.

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of fecal and total coliform bacteria that caused the verified impairment of Blackwater Creek. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), 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 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) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant identified as causing the impairment of the 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 43 waterbodies in the Tampa Bay Tributaries 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 Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Blackwater Creek and verified the impairments for fecal and total coliforms **(Table 2.1). Table 2.2** summarizes the data collected during the verification period (January 1996 to June 2003). The stream was verified as impaired for fecal coliforms and total coliforms because more than 10 percent of the values exceeded the Class III freshwater criteria of 400 counts per 100 milliliters (mL) for fecal coliforms and 2,400 counts per 100 mL for total coliforms.

The verified impairments were based on data collected mainly by the Hillsborough County Environmental Protection Commission (HCEPC), which maintains a routine sampling site (sampled monthly) at what is commonly referred to as Site 143 (STORET ID: 21FLHILL24030003/21FLHILL143). Other sampling site data used in the TMDL analysis came from the following stations: STORET ID: 112WRD 02302500, 112WRD 280828082062900, 21FLGW 7442, 21FLPOLKBLACKWATER CR 1, 21FLTPA 24030100, 21FLTPA 24030097, and 21FLTPA 24030100. **Figure 1.2** shows the locations of the sampling sites. **Figures 2.1** and **2.2** display the fecal coliform and total coliform data, respectively, collected from 1996 through 2002.

Table 2.1. Verified Impaired Segments in the Blackwater Creek Watershed, WBID 1482

Parameters Causing Impairment	Priority for TMDL Development	Projected Year for TMDL Development
Fecal Coliform, Total Coliform	High	2003

*These TMDLs were scheduled to be completed by December 31, 2003, based on a Consent Decree between the EPA and EarthJustice, but the Consent Decree allows a 9-month extension for completing the TMDLs.

Table 2.2. Summary of Fecal and Total Coliform Data for Blackwater Creek, WBID 1482, January 1996 to June 2003

Parameter Causing Impairment	Total Number of Samples	30-Day Geometric Mean	Percent Fecal Coliform Samples > 400 counts/100mL	Percent Total Coliform Samples > 2,400 counts/100mL	Minimum Concentration (counts/100mL)	Maximum Concentration (counts/100mL)
Fecal Coliform	118	N/A	17.8	N/A	1	7,900
Total Coliform	109	N/A	N/A	22.9	10	23,000

N/A – Not Applicable.

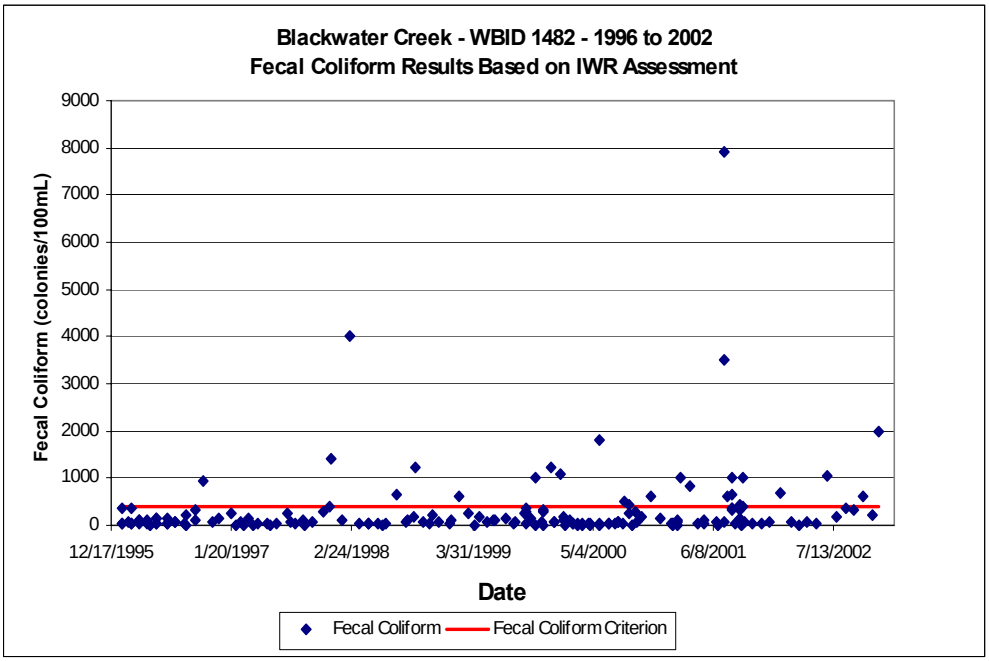

Figure 2.1. Fecal Coliform Measurements for Blackwater Creek, WBID 1482 (1996 to 2002)

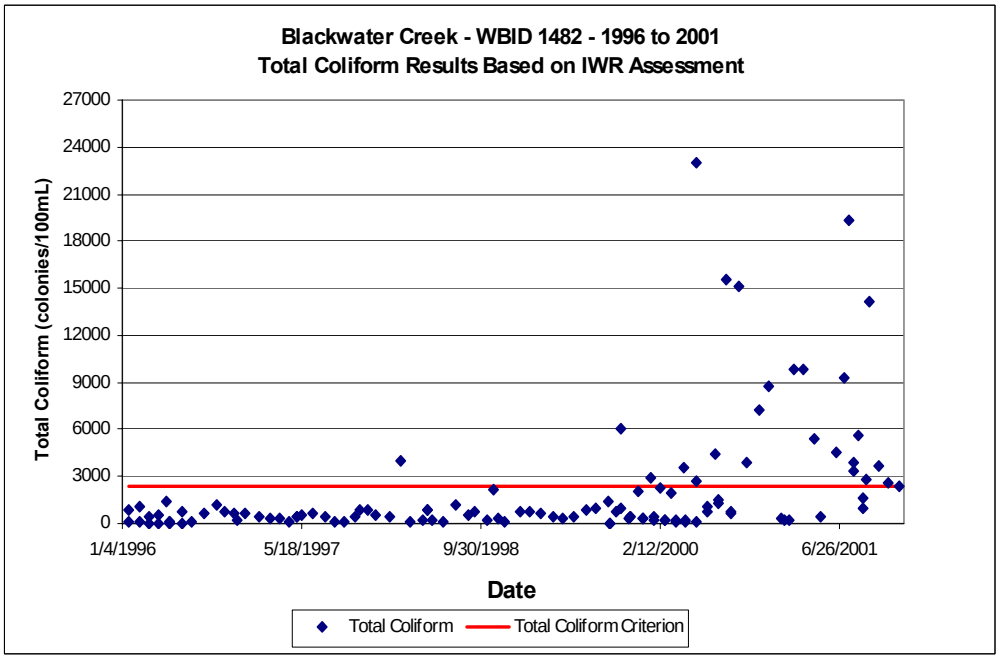

Figure 2.2. Total Coliform Measurements for Blackwater Creek, WBID 1482 (1996 to 2001)

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria 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)**

Blackwater Creek is a Class III waterbody, with a designated use of recreation, propagation, and 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 are the Class III criteria for fecal and total coliform.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Coliform Bacteria Criteria

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria and total coliform bacteria concentrations. The water quality criteria for protection of Class III waters, as established by Chapter 62-302, F.A.C., states the following:

> ***Fecal Coliform Bacteria:***
> *The most probable number (MPN) or membrane filter (MF) counts per 100 mL of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*
>
> ***Total Coliform Bacteria:***
> *The MPN per 100 mL shall be less than or equal to 1,000 as a monthly average nor exceed 1,000 in more than 20 percent of the samples examined during any month; and less than or equal to 2,400 at any time.*

For both parameters, the criteria state that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. During the

development of load curves for the impaired stream (as described in subsequent chapters), there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for either fecal coliform or total coliform bacteria. Therefore, the criteria selected for the development of the TMDLs were 400 counts/100mL for fecal coliforms and 2,400 counts/100mL for total coliforms.

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 causing impairment in the 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 5 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 Fecal and Total Coliform Bacteria in the Blackwater Creek Watershed

4.2.1 Point Sources

There is one permitted domestic wastewater treatment facility that discharges fecal and total coliform loads indirectly into Blackwater Creek. The Plant City Water Reclamation Facility (NPDES No. FL0026557) is an advanced wastewater reclamation facility with a permitted capacity of 2.68 million gallons per day (mgd). The facility outfall discharges to East Canal at Knights Griffen Road (Latitude 28 04' 42'', Longitude 82 07' 19'') approximately 4 miles upstream of Blackwater Creek **(Figure 1.2)**.

Municipal Separate Storm Sewer System Permittees

The majority of the Blackwater Creek watershed is located in the northeast portion of Hillsborough County, while the southeast portion of the watershed is located in the northwest portion of Polk County. Hillsborough County falls under Phase I MS4 Permit Number FLS000006, and Polk County falls under Phase I MS4 Permit Number FLS000015.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS 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 our underground sources of drinking water (U.S. Environmental Protection Agency, 1994). Potential nonpoint sources of coliforms include loadings from surface runoff, wildlife, livestock, pets, leaking sewer lines, and leaking septic tanks.

Wildlife

Wildlife deposit coliform bacteria with their feces onto land surfaces, where they can be transported during storm events to nearby streams. Some wildlife (such as otters, beavers, raccoons, and birds) deposit their feces directly into the water. The bacterial load from naturally occurring wildlife is assumed to be background. In addition, any strategy employed to control this source would probably have a negligible impact on attaining water quality standards.

Agricultural Animals

Agricultural animals are the source of several types of coliform loading to streams. Agricultural activities, including runoff from pastureland and cattle in streams, can affect water quality. Livestock data from the 1997 *Agricultural Census Report* for Polk and Hillsborough County are listed in **Table 4.1** (U.S. Department of Agriculture, 1997).

Urban Development

Coliform loading from urban areas is attributable to multiple sources, including stormwater runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD 1999 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the watershed were aggregated using the simplified Level 1 codes **(Table 4.2). Figure 4.1** shows the acreage of the principal land uses in the watershed. Land use comprises approximately 43.5 percent agriculture, 25.2 percent water and wetlands, and 10 percent urban and residential.

Table 4.1. Livestock Distribution for Polk and Hillsborough Counties

Livestock Distribution	Polk County (number of livestock)	Hillsborough County (number of livestock)
Cattle/Calves	49,759	62,328
Milk cows	2,116	4,463
Hogs/Pigs	1,482	3,567
Poultry layers >13 weeks	(D)	1,409,342
Poultry broilers	(D)	(D)
Sheep/Lambs	203	285
Horses	1,505	2,754

(D) – Data withheld to avoid disclosing data for individual farms.
Source: U.S. Department of Agriculture. 1997. *Agricultural Census Report*.

Table 4.2. Classification of Land Use Categories in the Blackwater Creek Watershed, WBID 1482

Code	Land Use	Acreage
1000	Urban open	473
1100	Low-density residential	1,220
1200	Medium-density residential	259
1300	High-density residential	81
2000	Agriculture	8,588
3000/7000	Rangeland	1,795
8000	Transportation, communication, and utilities	151
4000	Forest/rural open	2,152
5000/6000	Water/wetland	4,976

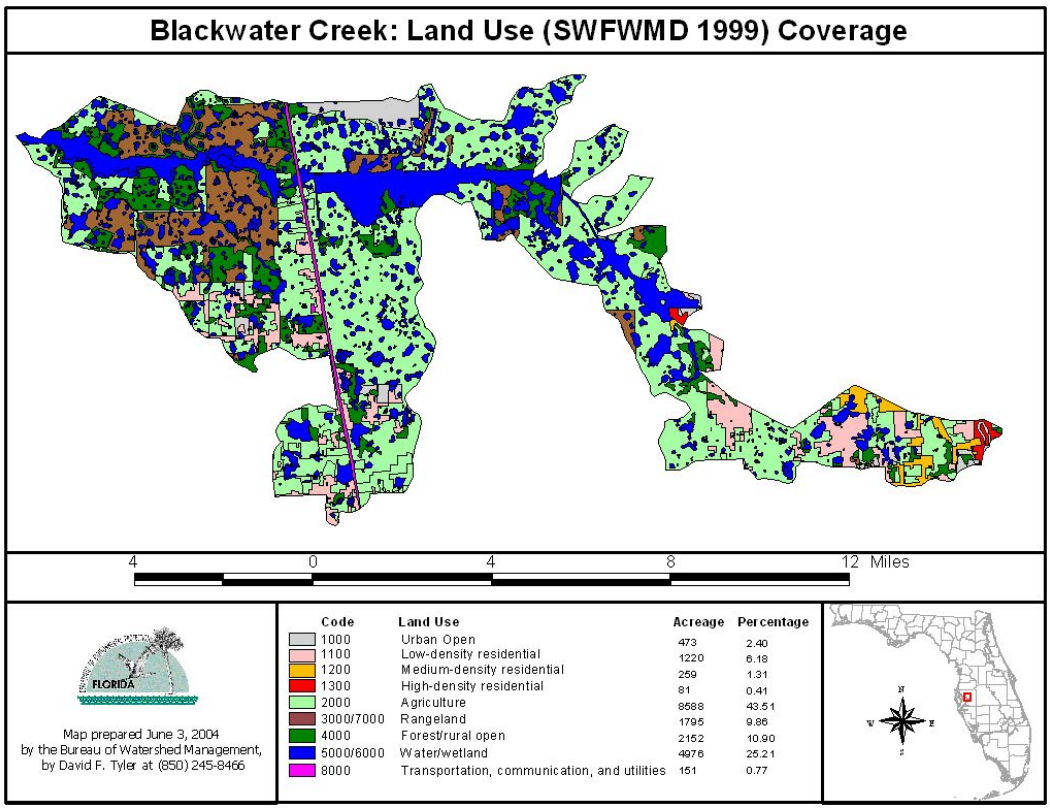

Figure 4.1. Principal Land Uses in the Blackwater Creek Watershed, WBID 1482, in 1999

Population

According to the U.S Census Bureau, the population density in and around Blackwater Creek, WBID 1482, in the year 2000 was at or less than 950.6 people per square mile **(Table 4.3).** The Bureau reports that the total population in 2000 for Hillsborough County, which includes (but is not exclusive to) WBID 1482, was 998,948, with 425,962 housing units. For all of Hillsborough County, the Bureau reported a housing density of 405.3 houses per square mile. This means that Hillsborough County has one of the highest housing densities in Florida (U.S. Census Bureau Web site, 2004).

Table 4.3. Population Density in Hillsborough County, Florida

Persons per Square Mile	Total Population	Houses per Square Mile	Housing Units
950.6	998,948	405.3	425,962

Source: U.S. Census Bureau Web site, 2004.

Septic Tanks

Data for septic tanks are based on the 1970 census results, with year-by-year additions based on new septic tank construction. The data do not reflect septic tanks that have been removed. Hillsborough County has a cumulative registry of 100,483 septic tanks. With 425,962 households in the county, this means that approximately 76 percent of the residences in the county are connected to wastewater treatment plants, with the rest (24 percent) utilizing septic tanks. Polk County has registered 110,200 septic tanks. With 226,376 households, this means that approximately 51 percent of the residences in the county are connected to wastewater treatment plants, with the rest (49 percent) utilizing septic tanks (Florida Department of Health Web site, 2004).

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Method Used To Determine Loading Capacity

The methodology used for this TMDL is the "load duration curve" approach. Also known as the "Kansas Approach" because it was developed by the state of Kansas, this method has been well documented in the literature, with improved modifications used by EPA Region 4.

5.2 Data Used in the Determination of the Loading Capacity

Fecal and total coliform bacteria concentrations and flow measurements were used to estimate both the allowable coliform loads and existing coliform loads. The primary data collector of water quality data is the HCEPC, which maintains a routine sampling site at what is commonly referred to as Site 143 (STORET ID: 21FLHILL24030003/21FLHILL143). The site has been sampled monthly from 1991 through 2003. Other sites used in the TMDL analysis include STORET ID: 112WRD 02302500, 112WRD 280828082062900, 112WRD 280858082124800, 21FLGW 7442, 21FLPOLKBLACKWATER CR 1, 21FLTPA 24030100, 21FLTPA 24030097, and 21FLTPA 24030100. **Figure 1.2** shows the locations of these sites, while **Table 2.2** provides a brief statistical overview of the observed data at the sites. **Figures 2.1** and **2.2**, respectively, display the data for fecal coliforms and total coliforms used in this analysis.

Flow measurements for this report were obtained from a U.S. Geological Survey (USGS) gaging station located on Blackwater Creek (USGS 02302500, Blackwater Creek near Knights, Florida, Latitude: 28°08'25", Longitude: 82°09'00") (**Figure 1.2)**.

5.3 TMDL Development Process

The range of flows from the USGS flow gage was divided into "flow zones." The concept of zones is adopted from Dr. Bruce Cleland (Cleland, August 15, 2002). The purpose of the zones is to demarcate hydrologic conditions between drought and peak flood into flow ranges such as low, dry, average, moist, and high.

Expressing the flows in terms of frequency of recurrence (duration) allows a linkage of exceedances of the criterion to specific flow intervals and durations. For example, if all of the exceedances occurred during low-flow conditions, point sources of the pollutant should be suspected. Conversely, if all the exceedances came during higher flow periods, then nonpoint sources of pollution should be suspected. Following Dr. Cleland's approach (Cleland, September 2003), the Department selected the following flow zones: "High" (0 – 10), "Moist" (11 – 40), "Mid-Range" (41 – 60), "Dry" (61 – 90), and "Low" (91 – 100). **Figure 5.1** shows the flow duration curve for USGS Gage 02302500.

Using the flows from the flow duration curve, load duration curves for fecal coliform bacteria **(Figure 5.2)** and total coliform bacteria **(Figure 5.3)** were calculated using the following equation:

(1) (observed flow) x (conversion factor) x (state criteria) = ([parameter quantity]/day or daily load)

The above equation yields the load duration curve or allowable load curve, shown as the fecal coliform and total coliform target lines in **Figures 5.2** and **5.3**. Using Equation 1 (above), tables of fecal coliform loads (**Table 5.1)** and total coliform loads **(Table 5.2)** were calculated, substituting the observed coliform exceedances for the state criteria value. Fecal and total coliform observations were then plotted, and it was noted where the samples were in relation to the allowable load curve (above or below the curve). Those above the curve **(Figure 5.2** and **5.3)** are noted as exceedances to the state criterion and are indicated by a purple square.

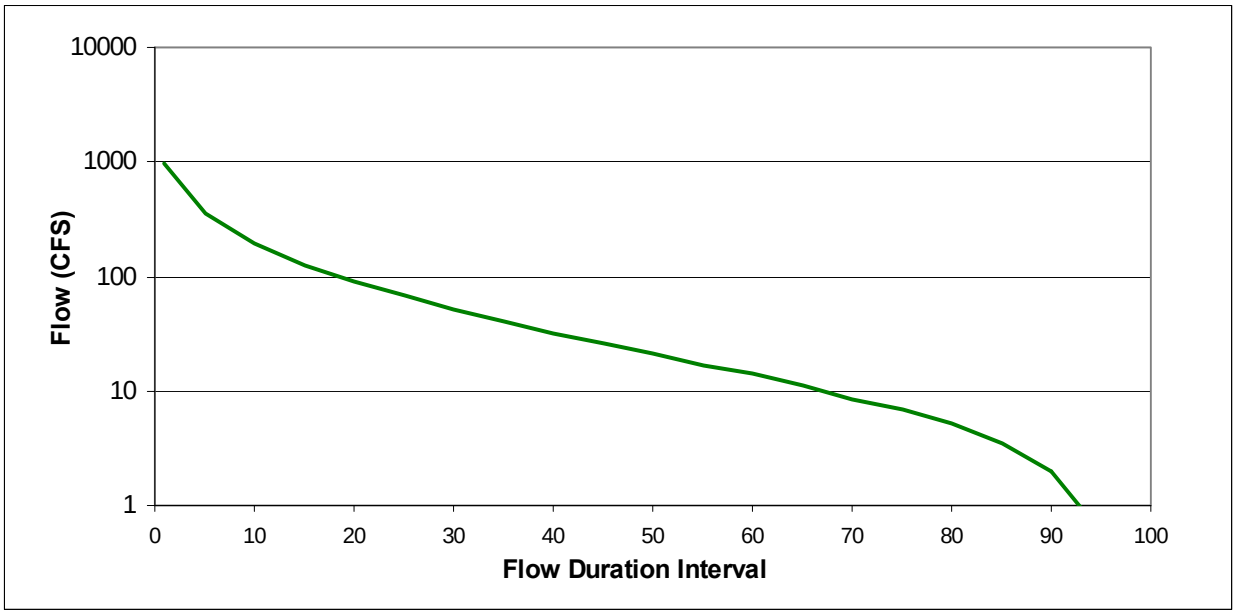

Figure 5.1. Flow Duration Curve for USGS Gage 02302500 (1991 – 2002)

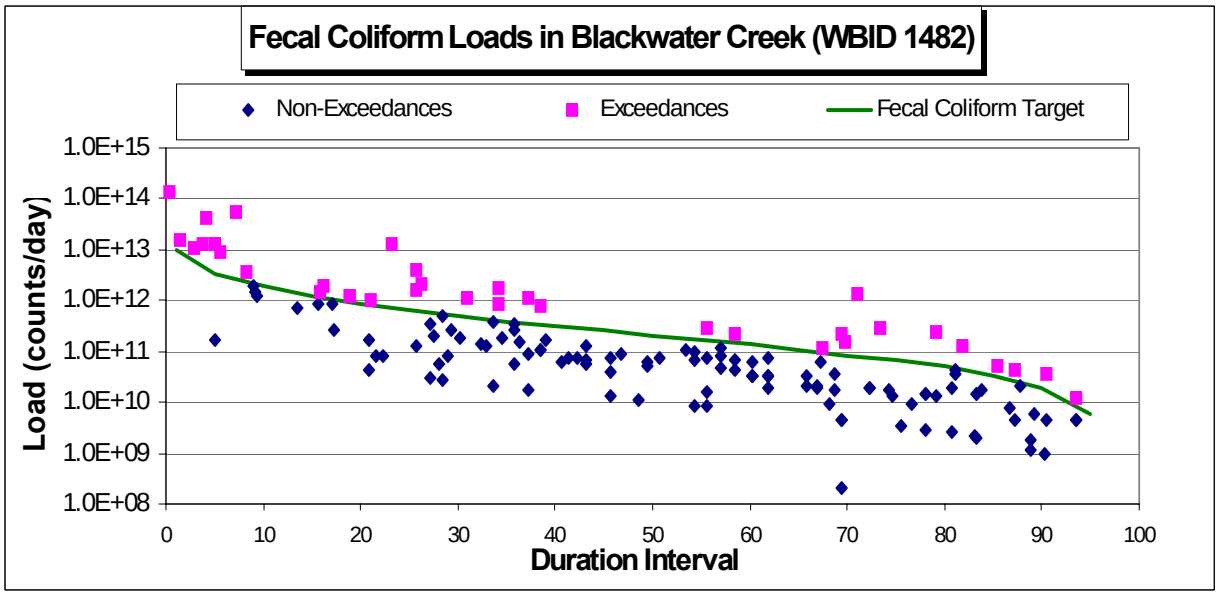

Figure 5.2. Load Duration Curve for Fecal Coliform in Blackwater Creek, WBID 1482

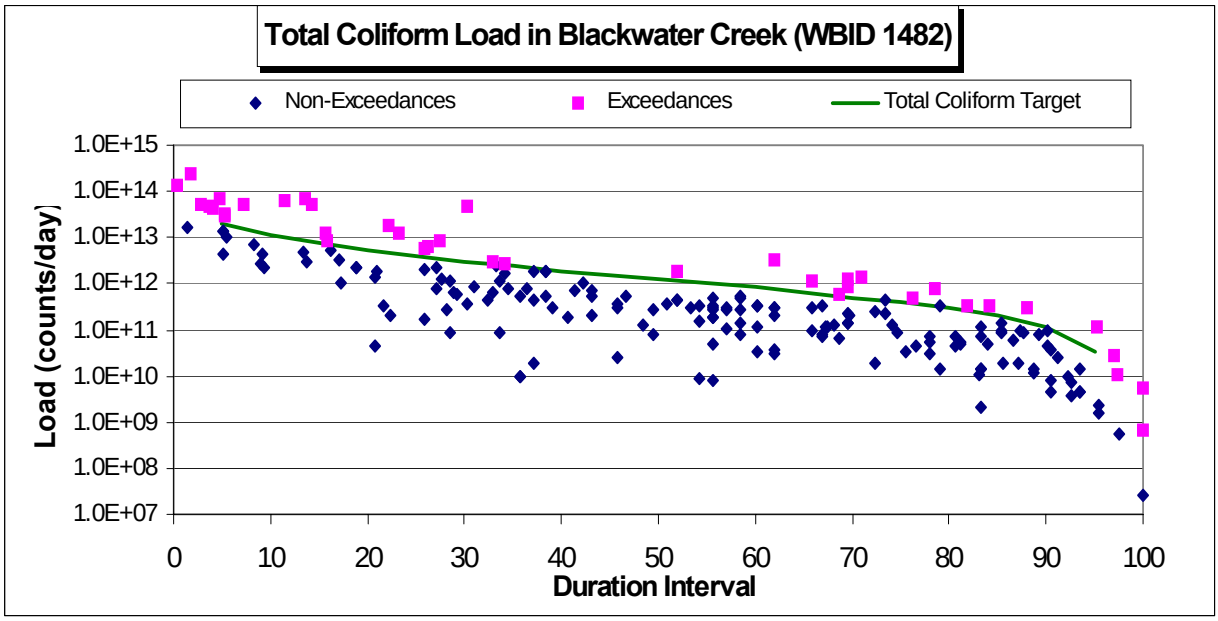

Figure 5.3. Load Duration Curve for Total Coliform in Blackwater Creek, WBID 1482

Table 5.1. Observed Fecal Coliform Data for Calculating Exceedances to the State Criterion for Blackwater Creek, WBID 1482

Station	Sample Date	Sample Time	Flow (cubic feet per second [cfs])	Flow Rank	Flow Rank (percent)	Fecal Coliform (counts/100mL)	Fecal Coliform Load (counts/day)	Remark Codes*
21FLHILL24030003	3/26/1991	1345	9.7	67.5%	67.5	500	1.19E+11	
21FLHILL24030003	6/25/1991	1420	87	21.0%	21	500	1.06E+12	
21FLHILL24030003	5/26/1992	1210	0.95	93.5%	93.5	500	1.16E+10	
21FLHILL24030003	1/19/1993	1415	119	15.9%	15.9	500	1.46E+12	
21FLHILL24030003	8/22/1995	1445	98	18.9%	18.9	520	1.25E+12	
21FLHILL24030003	8/22/1995	1445	98	18.9%	18.9	520	1.25E+12	
21FLHILL24030003	1/28/1992	1310	2.9	87.3%	87.3	600	4.26E+10	
21FLHILL143	2/16/1999	1430	15	58.4%	58.4	600	2.20E+11	
21FLHILL24030003	12/14/1993	1425	3.5	85.4%	85.4	620	5.31E+10	
21FLHILL24030003	7/21/1998	1435	229	8.3%	8.3	640	3.59E+12	
21FLHILL24030003	8/27/1991	1430	116	16.2%	16.2	700	1.99E+12	
21FLHILL24030003	9/24/1991	1310	8.7	69.8%	69.8	700	1.49E+11	
21FLHILL24030003	12/10/1991	1415	17	55.6%	55.6	700	2.91E+11	
21FLHILL24030003	9/27/1994	1445	834	1.4%	1.4	760	1.55E+13	
21FLHILL24030003	4/21/1992	1235	42	34.1%	34.1	800	8.22E+11	
21FLHILL24030003	6/23/1992	1325	1.9	90.5%	90.5	800	3.72E+10	J
21FLHILL24030003	6/27/1995	1508	553	2.9%	2.9	800	1.08E+13	
21FLHILL24030003	1/25/1994	1420	35	38.4%	38.4	900	7.71E+11	
21FLHILL24030003	10/15/1996	1425	50	31.0%	31	940	1.15E+12	
21FLHILL24030003	2/25/1992	1305	66	25.8%	25.8	1,000	1.61E+12	
21FLTPA 24030097	10/25/1999	1140	8.8	69.5%	69.5	1,000	2.15E+11	
21FLHILL143	1/18/2000	1448	4.7	81.9%	81.9	1,080	1.24E+11	
21FLHILL24030003	8/23/1994	1448	467	3.7%	3.7	1,140	1.30E+13	
21FLHILL24030003	6/21/1994	1505	330	5.5%	5.5	1,160	9.37E+12	
21FLHILL143	12/14/1999	1307	37	37.2%	37.2	1,240	1.12E+12	
21FLHILL24030003	2/21/1995	1500	64	26.3%	26.3	1,320	2.07E+12	
21FLHILL24030003	9/14/1993	1410	355	5.1%	5.1	1,520	1.32E+13	
21FLHILL24030003	9/14/1993	1410	355	5.1%	5.1	1,520	1.32E+13	
21FLHILL24030003	1/22/1991	1340	7.3	73.4%	73.4	1,600	2.86E+11	
21FLHILL24030003	4/21/1992	1345	42	34.1%	34.1	1,700	1.75E+12	
21FLHILL24030003	10/27/1992	1420	5.6	79.1%	79.1	1,700	2.33E+11	
21FLHILL24030003	2/25/1992	1410	66	25.8%	25.8	2,400	3.88E+12	
21FLHILL24030003	7/25/1995	1450	432	4.1%	4.1	4,000	4.23E+13	L
21FLHILL24030003	2/17/1998	1500	1370	0.4%	0.4	4,000	1.34E+14	L
21FLHILL24030003	5/21/1991	1345	76	23.2%	23.2	6,700	1.25E+13	J
21FLHILL24030003	4/23/1991	1325	8.1	71.0%	71	7,100	1.41E+12	
21FLHILL24030003	7/30/1991	1325	258	7.2%	7.2	8,600	5.43E+13	J

Table 5.2. Observed Total Coliform Data for Calculating Exceedances to the State Criterion for Blackwater Creek, WBID 1482

Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (percent)	Total Coliform (counts/100mL)	Total Coliform Load (counts/day)	Remark Codes*
21FLHILL143	11/13/2001	1456	9.1	68.7%	68.7	2,600	5.79E+11	
21FLHILL24030003	4/21/1992	1235	42	34.1%	34.1	2,700	2.77E+12	
21FLTPA 24030100	5/23/2000	1015	0.01	100.0%	100	2,700	6.61E+08	
21FLHILL24030003	1/19/1993	1415	119	15.9%	15.9	2,800	8.15E+12	
112WRD 02302500	9/12/2001	1245	45	32.9%	32.9	2,800	3.08E+12	
21FLHILL143	1/18/2000	1448	4.7	81.9%	81.9	2,920	3.36E+11	
21FLPOLKBLACKWATER CR1	6/14/1994	1155	6.5	76.3%	76.3	3,000	4.77E+11	
112WRD 280828082062900	8/8/2001	1215	347	5.2%	5.2	3,400	2.89E+13	
21FLHILL24030003	2/25/1992	1410	66	25.8%	25.8	3,600	5.81E+12	
21FLHILL143	4/18/2000	1415	3.9	84.2%	84.2	3,600	3.44E+11	
21FLHILL143	10/16/2001	1435	20	52.0%	52	3,700	1.81E+12	
21FLHILL143	10/10/2000	1500	8.8	69.5%	69.5	3,900	8.40E+11	
112WRD 02302500	8/8/2001	900	347	5.2%	5.2	3,900	3.31E+13	
21FLHILL24030003	8/23/1994	1448	467	3.7%	3.7	4,000	4.57E+13	L
21FLHILL24030003	2/21/1995	1500	64	26.3%	26.3	4,000	6.26E+12	L
21FLHILL24030003	6/27/1995	1508	553	2.9%	2.9	4,000	5.41E+13	
21FLHILL24030003	7/25/1995	1450	432	4.1%	4.1	4,000	4.23E+13	L
21FLHILL24030003	2/17/1998	1500	1370	0.4%	0.4	4,000	1.34E+14	L
21FLHILL24030003	9/22/1992	1355	121	15.6%	15.6	4,200	1.24E+13	
21FLHILL143	7/18/2000	1530	11	65.8%	65.8	4,400	1.18E+12	
21FLHILL143	6/19/2001	1530	2.7	88.0%	88	4,500	2.97E+11	
21FLHILL143	4/17/2001	1514	5.9	78.5%	78.5	5,400	7.79E+11	
21FLHILL143	8/21/2001	1445	60	27.4%	27.4	5,600	8.22E+12	
21FLTPA 24030097	10/25/1999	1140	8.8	69.5%	69.5	6,000	1.29E+12	
21FLHILL24030003	5/21/1991	1345	76	23.2%	23.2	6,700	1.25E+13	J
21FLHILL24030003	4/23/1991	1325	8.1	71.0%	71	7,100	1.41E+12	L
21FLHILL143	11/14/2000	1430	0.06	97.4%	97.4	7,200	1.06E+10	
21FLPOLKBLACKWATER CR1	10/4/1994	1220	369	4.8%	4.8	7,400	6.68E+13	
21FLHILL24030003	7/30/1991	1325	258	7.2%	7.2	8,600	5.43E+13	J
21FLHILL143	12/12/2000	1420	0.53	95.3%	95.3	8,700	1.13E+11	
112WRD 02302500	7/11/2001	855	81	22.1%	22.1	9,300	1.84E+13	
21FLHILL143	2/20/2001	1411	0.11	97.0%	97	9,800	2.64E+10	
21FLHILL143	3/20/2001	1346	13	61.9%	61.9	9,800	3.12E+12	
21FLHILL143	9/18/2001	1454	711	1.8%	1.8	14,200	2.47E+14	
21FLHILL143	9/19/2000	1540	168	11.5%	11.5	15,100	6.21E+13	
21FLHILL143	8/15/2000	1545	134	14.2%	14.2	15,500	5.08E+13	
21FLHILL143	7/24/2001	1434	141	13.6%	13.6	19,300	6.66E+13	
21FLGW 7442	5/23/2000	1130	0.01	100.0%	100	23,000	5.63E+09	
21FLPOLKBLACKWATER CR1	11/7/1995	1135	52	30.2%	30.2	35,500	4.52E+13	

Note: Flow and concentration data were limited to the Group 2 verification period, January 1996 through December 2003. Flow data were from USGS Gage 02302500, located in WBID 1482.
*Remark Codes: *J – Estimated Value.*
L – Actual Value is known to be greater than value given.

As noted previously, values on the load duration curve can generally be grouped by hydrologic conditions to identify the most likely potential sources. Exceedances falling into the 10th through 40th percentile flows are typically associated with moist conditions when stormwater loads are the most likely source, and exceedances falling into the 60th through 90th percentiles are typically associated with dry conditions when point sources are likely the dominant source. As shown in **Figures 5.2** and **5.3**, the fecal and total coliform exceedances in Blackwater Creek were spread throughout the flow record, with many of the exceedances at the extremes of the flow record.

Table 5.3 depicts the allowable coliform bacteria load for peak flow, low flow, and 5-percentile increments in flow. **Table 5.3** was created by taking the Nth percentile flow (flow rank in the table) from the measured flow data and multiplying each percentile flow by the fecal coliform criterion of 400 counts/100mL and the total coliform criterion of 2,400 counts/100mL and converting into bacteria counts/day. This conversion was accomplished by multiplying the criterion by [(28317/100)*60*60*24]. The factor 28317/100 converts counts/100mL into counts per cubic foot.

Table 5.3. Coliform Target Loads for Flow

Flow Rank	Flow Rank (percent)	Cfs	Allowable Loads		
			Fecal Coliform Load (counts/day)	Total Coliform Load (counts/day)	Flow Conditions
0.019%		2,580.0	2.52E+13	1.51E+14	Peak
0.100%		1,916.6	1.88E+13	1.13E+14	
0.274%		1,466.6	1.44E+13	8.61E+13	1-day
1%	1	969.9	9.49E+12	5.70E+13	
5%	5	355.4	3.48E+12	2.09E+13	
10%	10	193.8	1.90E+12	1.14E+13	
15%	15	125.0	1.22E+12	7.34E+12	
20%	20	91.0	8.91E+11	5.34E+12	
25%	25	68.0	6.65E+11	3.99E+12	
30%	30	52.0	5.09E+11	3.05E+12	
35%	35	40.0	3.91E+11	2.35E+12	
40%	40	32.0	3.13E+11	1.88E+12	
45%	45	26.0	2.54E+11	1.53E+12	
50%	50	21.0	2.06E+11	1.23E+12	
55%	55	17.0	1.66E+11	9.98E+11	
60%	60	14.0	1.37E+11	8.22E+11	
65%	65	11.0	1.08E+11	6.46E+11	
70%	70	8.5	8.32E+10	4.99E+11	
75%	75	6.9	6.75E+10	4.05E+11	

Flow Rank	Flow Rank (percent)	Cfs	Allowable Loads		
			Fecal Coliform Load (counts/day)	Total Coliform Load (counts/day)	Flow Conditions
80%	80	5.3	5.19E+10	3.11E+11	
85%	85	3.5	3.43E+10	2.06E+11	
90%	90	2.0	1.96E+10	1.17E+11	
95%	95	0.6	5.68E+09	3.41E+10	
99%	99	0.01	9.79E+07	5.87E+08	
100%	100	0.01	9.79E+07	5.87E+08	Low

Finally, the percent reduction in loading needed for compliance with the state criterion was calculated. For purposes of this TMDL, critical periods occurred for both "Dry (60 – 90)" and the combination of the "High/Moist (0 – 40)" flow zones. The critical periods are the flow intervals where the majority of the criteria exceedances occurred, as shown in **Figures 5.2** and **5.3.** Therefore, separate TMDL components were calculated to reflect the critical flow zones (**Tables 5.4** and **5.5**). This calculation involved both the median of allowable loads, which previously were calculated using percentile increments of 5, 25, 50, 75, and 95 as the median of the zones, and the median of the measured exceedances computed for each critical zone. The needed reduction of daily load was completed using the formula:

$$(2) \qquad \frac{\text{(median exceedance) – (median allowable load)}}{\text{(median exceedance) X 100}}$$

Table 5.4. Fecal Coliform Percent Reductions Required for Different Flow Zones

	High (0 – 10)	Moist (10 – 40)	Mid-Range (40 – 60)	Dry (60 – 90)	Low (90 – 100)
TMDL (allowed load)	3.48E+12	6.65E+11	2.06E+11	6.75E+10	5.68E+09
Existing	1.32E+13	1.35E+12	2.56E+11	1.49E+11	2.44E+10
Percent Reduction	73.7	50.8	19.6	54.7	76.7

Table 5.5. Total Coliform Percent Reductions Required for Different Flow Zones

	High (0 – 10)	Moist (10 – 40)	Mid-Range (40 – 60)	Dry (60 – 90)	Low (90 – 100)
TMDL (allowed load)	2.09E+13	3.99E+12	1.23E+12	4.05E+11	3.41E+10
Existing	5.41E+13	1.24E+13	1.81E+12	7.79E +11	1.06E+10
Percent Reduction	61.4	67.9	31.9	48.0	

5.4 Critical Conditions/Seasonality

The critical conditions for coliform loadings in a given watershed depend on the existence of point sources and land use patterns 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, coliform bacteria that have built up on the land surface under dry weather conditions are washed off by rainfall, resulting in wet weather exceedances. 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 coliform bacteria are brought into the receiving waters through baseflow. Livestock 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.

For the Blackwater Creek watershed, the majority of coliform bacteria exceedances occurred during “High/Moist (0 – 40)” and “Dry (60 – 90)” flow conditions (**Figures 5.2** and **5.3**). It should be noted that standard Department practice has been to exclude data for extremely high flow (less than 10th percentile) and extremely low flow (higher than 90th percentile) conditions. However, the Department included these flow conditions in this TMDL because of the preponderance of exceedances under extreme high flow conditions.

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 (waste load 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:

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

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

$$\mathbf{TMDL \cong \sum WLAs_{wastewater} + \sum WLAs_{NPDES\ Stormwater} + \sum LAs + MOS}$$

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 coliform bacteria TMDLs for Blackwater Creek are expressed in terms of counts per day for the point source facility and overall TMDL, and as a percent reduction for MS4 areas and other nonpoint sources to meet the applicable coliform bacteria criteria **(Table 6.1).**

Table 6.1. TMDL Components for Blackwater Creek, WBID 1482

Parameter	Zone	TMDL (counts/day)	WLA		LA (percent reduction)	MOS
			Wastewater (counts/day)	NPDES Stormwater (percent)		
Fecal Coliform	High/Moist[1]	2.07E+12	8.72E+09[3]	71.6%	71.6%	Implicit
Fecal Coliform	Dry[2]	6.75E+10	8.72E+09[3]	58.1%	58.1%	Implicit
Total Coliform	High/Moist[1]	1.24E+13	NA	62.6%	62.6%	Implicit
Total Coliform	Dry[2]	4.05E+11	NA	48.0%	48.0%	Implicit

[1]High/Moist flow zone represents flows between 32 to 1,370 cfs.
[2]Dry flow zone represents flows between 2 to 14 cfs.
[3]The Plant City Water Reclamation Facility load is based on the permitted annual average flow of 2.68 MGD and the single value fecal coliform limit of 86 counts/100mL.

6.2 Load Allocation

Based on a load duration curve approach similar to that developed by the state of Kansas (Stiles, 2002), a fecal coliform reduction of 71.6 percent is needed from nonpoint sources during the "High/Moist" period, and a 58.1 percent reduction is needed during the "Dry" period. Also, a total coliform reduction of 62.6 percent is needed from nonpoint sources during the "High/Moist" period, and a 48.0 percent reduction is needed during the "Dry" period. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the SWFWMD that are not part of the NPDES Stormwater Program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

The City of Plant City Water Reclamation Facility has a wastewater outfall into East Canal, a tributary to Blackwater Creek, that includes a permit limit for fecal coliforms. A fecal coliform load of 8.72E+09 counts/day is allocated to this facility. This allowable load is based on the permitted annual average flow of 2.68 mgd and the facility's current single-sample fecal coliform limit of 86 counts/100mL.

6.3.2 NPDES Stormwater Discharges

Hillsborough County MS4 Permit Number FLS000006, and Polk County MS4 Permit Number FLS000015 must obtain a 71.6 percent reduction in current fecal coliform loading during the "High/Moist" period and a 58.1 percent reduction during the "Dry" period. Also, a total coliform reduction of 62.6 percent is needed during the "High/Moist" period, and a 48.0 percent reduction is needed during the "Dry" period. It should be noted that any MS4 permittee will only be responsible for reducing the 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 (Florida Department of Environmental Protection, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. An implicit MOS was provided by the conservative decisions associated with the analytical assumptions and the development of assimilative capacity, which only focuses on exceedances. A MOS was included in the TMDL by not allowing any exceedances of the state criteria, even though intermittent natural exceedances of the criteria would be expected and would be taken into account when determining impairment. Additionally, the implicit MOS is appropriate, as existing loads are based on instream coliform measurements. These measurements include decay processes occurring instream and do not represent the maximum load that can be applied to the land and transported to the stream during a rain event.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan (BMAP) for the Tampa Bay Tributaries Basin. This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

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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 Chapter 62-40, F.A.C.

The rule requires the state's water management districts (WMDs) 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 has been developed for Newnans Lake at the time this study was conducted.

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 stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five 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 has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the fifteen counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. 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 similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

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