

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

SOUTHWEST DISTRICT • TAMPA BAY BASIN

Final TMDL Report

**Fecal Coliform TMDLs for
Mullet Creek (WBID 1575A) and
Mullet Creek Tidal (WBID 1575)**

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Acknowledgments

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Websites

Florida Department of Environmental Protection, Bureau of Watershed Restoration

TMDL Program

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

Identification of Impaired Surface Waters Rule

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

STORET Program

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

2008 Integrated Report

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

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Tampa Bay Basin

<http://www.dep.state.fl.us/water/basin411/tampa/status.htm>

Basin Water Quality Assessment Report for the Tampa Bay Basin

<http://www.dep.state.fl.us/water/basin411/tampa/assessment.htm>

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

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

National STORET Program

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

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform bacteria for Mullet Creek and the tidal portion of Mullet Creek, in the Tampa Bay Basin. These waterbodies were verified as impaired for fecal coliform and therefore were included on the Verified List of impaired waters for the Tampa Bay Basin that was adopted by Secretarial Order on June 3, 2008. The TMDL establishes the allowable fecal coliform loadings to Mullet Creek Tidal and Mullet Creek that would restore these waterbodies so that they meet their applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

Mullet Creek is located in the central portion of Pinellas County, mainly in the city of Safety Harbor (**Figure 1.1**). About 1.3 miles in length, the creek flows primarily southeast (draining about 2.86 square miles), entering the west side of Mullet Creek Tidal (about 0.1 square miles long) and discharging into Tampa Bay. The Mullet Creek watershed is located in the central portion of the city of Safety Harbor (17,271 people) and the outskirts of the city of Clearwater (106,642 people) (U.S. Census Bureau Website, 2007). Additional information about the creek's hydrology and geology is available in the Basin Status Report for the Tampa Bay Basin (Florida Department of Environmental Protection [Department], 2001). For assessment purposes, the Department has divided the Tampa Bay Basin into water assessment polygons with a unique **waterbody identification** (WBID) number for each watershed or stream reach. Mullet Creek and Mullet Creek Tidal are WBIDs 1575A and 1575, respectively (**Figure 1.2**).

1.3 Background

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

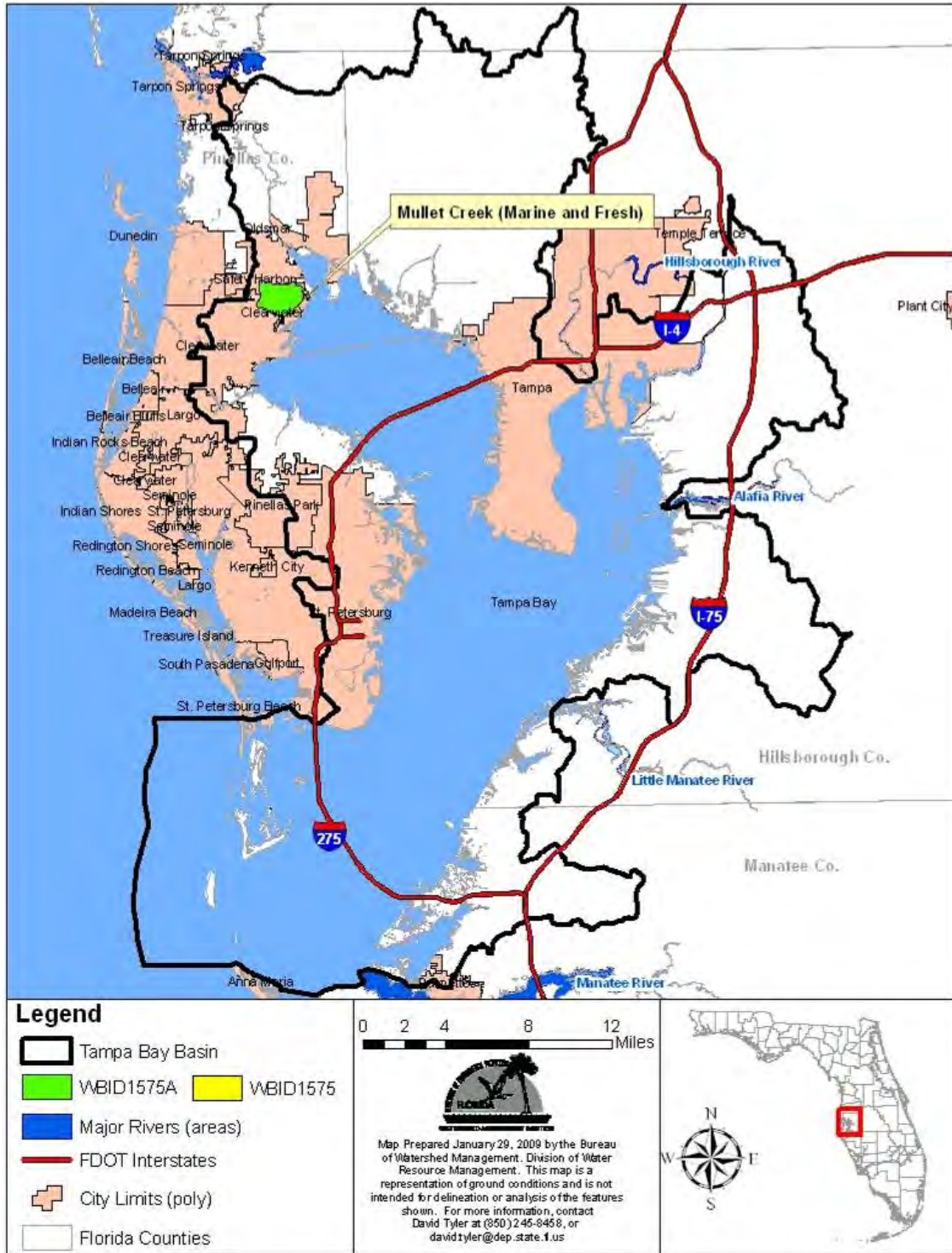


Figure 1.1. Location of the Mullet Creek and Mullet Creek Tidal Watersheds In the Tampa Bay Basin and Major Geopolitical Features In the Area

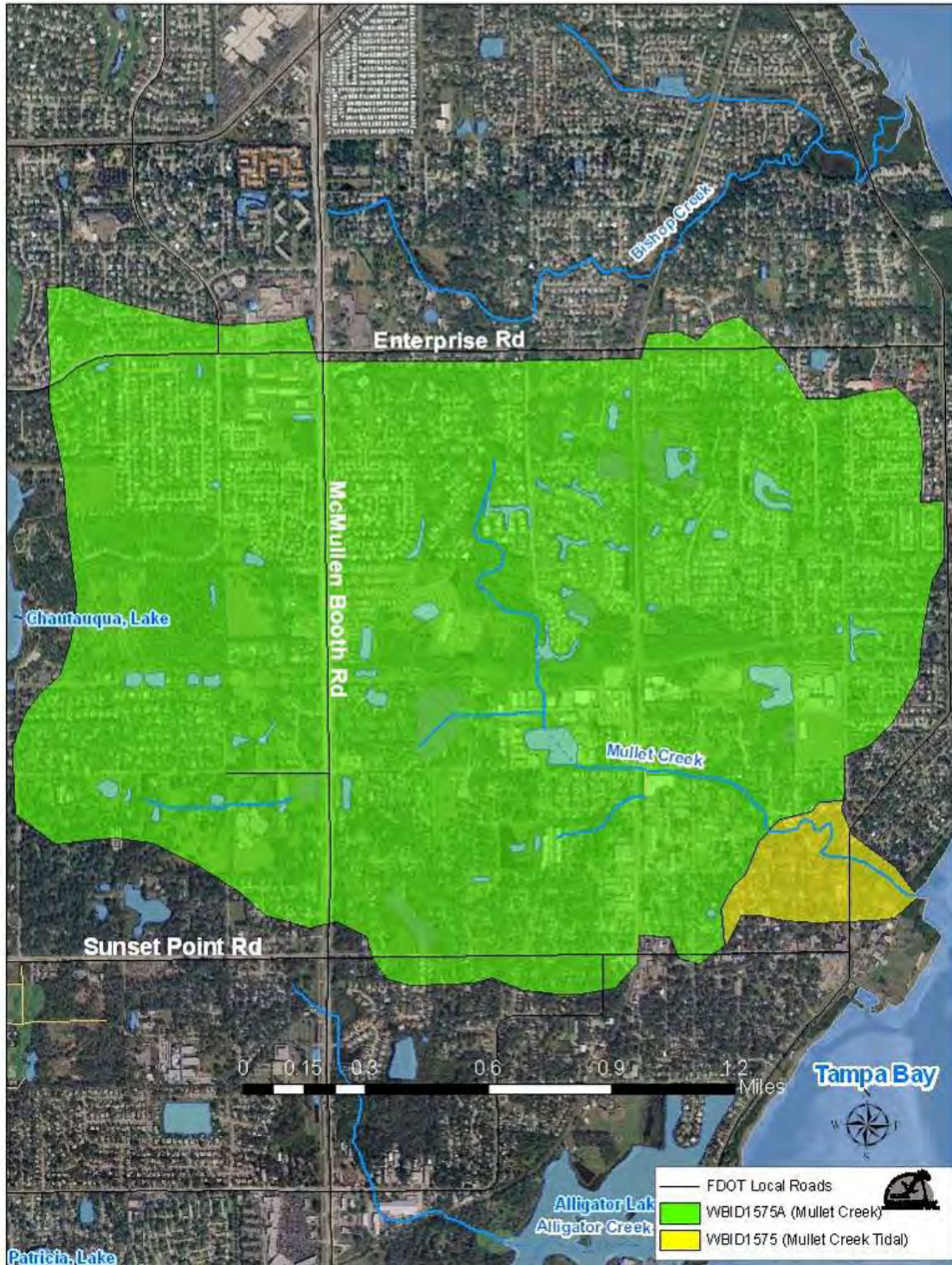


Figure 1.2. Location of the Mullet Creek and Mullet Creek Tidal Watersheds in the Cities of Safety Harbor and Clearwater

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

This TMDL Report may be followed by the development and implementation of a Basin Management Action Plan, or BMAP, designed to reduce the amount of fecal coliform that caused the verified impairment of Mullet Creek and Mullet Creek Tidal. These activities will depend heavily on the active participation of the Southwest Florida Water Management District (SWFWMD), Pinellas County's Department of Environmental Management (PDEM), 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) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing 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 47 waterbodies in the Tampa Bay Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Mullet Creek and Mullet Creek Tidal, and verified the impairments during the second cycle of the TMDL Program (**Table 2.1**). **Table 2.2** summarizes the fecal coliform data collected during the verified period (January 1, 2000, through June 30, 2007). The projected year for the 1998 303(d) listed fecal coliform bacteria TMDL for Mullet Creek Tidal (WBID 1575) was 2008, but the Settlement Agreement between EPA and Earthjustice, which drives the TMDL development schedule for waters on the 1998 303(d) list, allows an additional nine months to complete the TMDL. As such, this TMDL must be adopted and submitted to the EPA by September 30, 2009. Mullet Creek is hydrologically connected to Mullet Creek Tidal; therefore, the Department decided to address both fecal coliform impairments in the same TMDL report.

These waterbodies were verified as impaired based on fecal coliform because, using the IWR methodology, more than 10 percent of the values exceeded the Class III freshwater and Class III marine criterion of 400 counts per 100 milliliters (counts/100mL) for fecal coliform. In the verified period, 7 out of 19 samples in Mullet Creek and 7 out of 10 samples in Mullet Creek Tidal exceeded the criterion. The fecal coliform data used in this report are based on the IWR Run34 database.

The verified impairments were based on data collected by Pinellas County and the Department's Southwest District. **Figure 1.2** shows the WBIDs' locations. **Figures 2.1a** and **2.1b** display the fecal coliform data collected during the verified period (January 1, 2000–June 30, 2007) for Mullet Creek and Mullet Creek Tidal.

Table 2.1. Verified Impairments for Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575)

¹ WBID 1575 (Mullet Creek Tidal) was included on the 1998 303(d) list for fecal coliform, dissolved oxygen, and nutrients, with a TMDL priority of low and due date of 2008.

² Class III freshwater

³ Class III marine

⁴ N/A – Not applicable

WBID	Waterbody Segment	Waterbody Type	Waterbody Class	1998 303(d) Parameters of Concern	Parameter Causing Impairment
1575A	Mullet Creek	Stream	IIIF ²	N/A ⁴	Fecal Coliform
1575 ¹	Mullet Creek Tidal	Estuary	IIIM ³	Coliform	Fecal Coliform
				Dissolved Oxygen	Dissolved Oxygen
				N/A ⁴	Mercury (in Fish Tissue)
				Nutrients	Nutrients (Chlorophyll a)

Table 2.2. Summary of Fecal Coliform Data for Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575) During the Verified Period (January 1, 2000–June 30, 2007)

¹ Exceedances represent values above 400 counts/100mL.

² Coliform counts are #/100mL.

WBID	Total Number of Samples	IWR-Required Number of Exceedances for the Verified List ¹	Number of Observed Exceedances ¹	Number of Observed Nonexceedances ¹	Number of Seasons Data were Collected	Mean ²	Median ²	Min ²	Max ²
1575A	19	5	7	12	4	528	280	31	2,100
1575	10	5	7	3	4	1,237	555	220	5,800

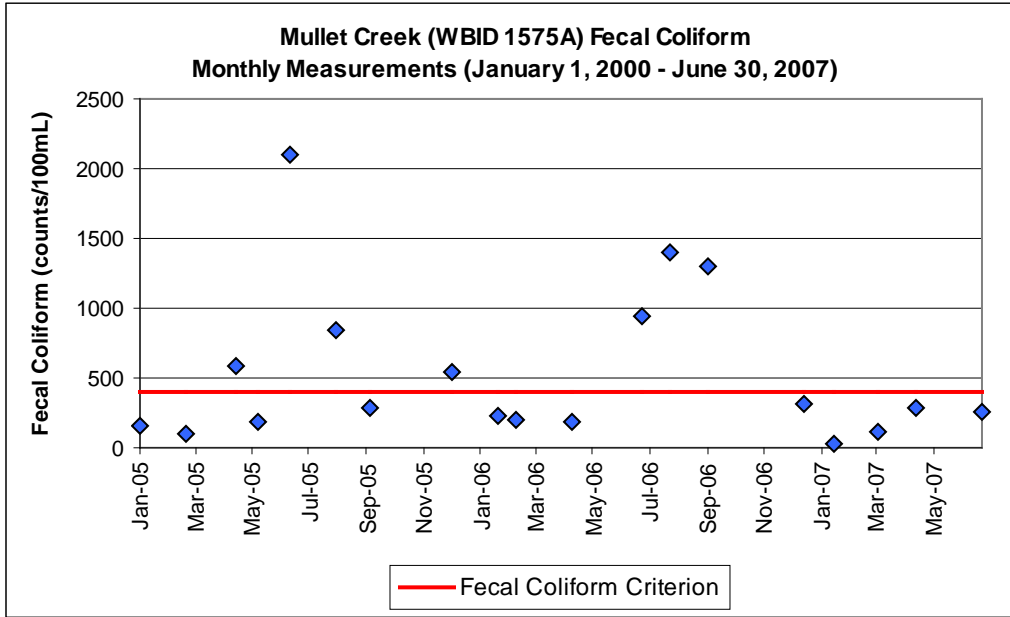


Figure 2.1a. Fecal Coliform Measurements for Mullet Creek (WBID 1575A) During the Verified Period (January 1, 2000–June 30, 2007)

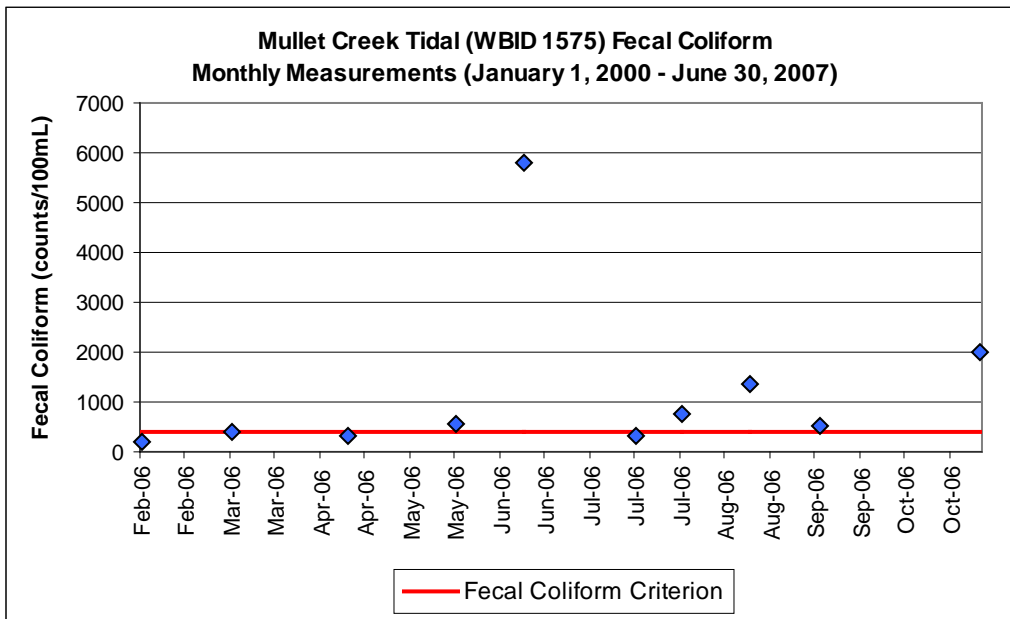


Figure 2.1b. Fecal Coliform Measurements for Mullet Creek Tidal (WBID 1575) During the Verified Period (January 1, 2000–June 30, 2007)

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)

Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575) 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 criterion applicable to these TMDLs is the Class III criterion for fecal coliform.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria concentration. The water quality criterion for the protection of Class III waters, as established by Rule 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.

The criterion states 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 the TMDLs (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 fecal coliform bacteria. Therefore, the criterion selected for the TMDLs was not to exceed 400 MPN/100mL in any sampling event for fecal coliform. The 10 percent exceedance allowed by the water quality criterion for fecal coliform bacteria was not used directly in estimating the target load, but was included in the TMDL margin of safety (as described in subsequent chapters).

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

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

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

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

4.2 Potential Sources of Fecal Coliform in the Mullet Creek and Mullet Creek Tidal Watersheds

4.2.1 Point Sources

There are no NPDES permitted facilities discharging directly or indirectly into Mullet Creek or Mullet Creek Tidal.

Municipal Separate Storm Sewer System Permittees

The stormwater collection systems owned and operated by Pinellas County and co-permittees (Florida Department of Transportation [FDOT] District 7, city of Safety Harbor, and city of Clearwater) are covered by a Phase I NPDES municipal separate storm sewer system (MS4) permit (FLS000005). There are no Phase II MS4 permits identified for Mullet Creek or Mullet Creek Tidal.

4.2.2 Land Uses and Nonpoint Sources

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint pollution is caused by rainfall moving over and through

the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water (EPA, 1994). Potential nonpoint sources of coliform include loadings from surface runoff, wildlife, livestock, pets, leaking sewer lines, and leaking septic tanks. **Table 4.5** provides estimated fecal coliform loadings from dogs, septic tanks, and sanitary sewer overflows (SSOs) for the Mullet Creek and Mullet Creek Tidal watersheds. The information provided for septic tanks and sewers in this report is for information purposes only, and is designed to give a rough estimate of the fecal coliform counts/day from septic tank leakage and SSOs.

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. Agriculture occupies less than 2 percent of the total land area of the Mullet Creek watershed.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the SWFWMD's 2006 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 and tabulated in **Tables 4.1** and **4.1b**. **Figure 4.2** shows the acreage of the principal land uses in each of the watersheds.

As shown in **Tables 4.1a** and **4.1b**, the Mullet Creek and Mullet Creek Tidal watersheds drain about 1,831 and 58 acres of land, respectively. The dominant land use category for both watersheds is urban land (urban and built-up; low-, medium-, and high-density residential; and transportation, communication, and utilities), which accounts for 87 and 96 percent, respectively, of each watershed's total area. Natural land uses for Mullet Creek and Mullet Creek Tidal, which include forest/rural open and water/wetlands, occupy about 12 and 4 percent of the total watershed area, respectively.

Table 4.1a. Classification of Land Use Categories for the Mullet Creek Watershed (WBID 1575A) in 2006

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	354	19.33%
1100	Low-Density Residential	211	11.52%
1200	Medium-Density Residential	183	9.99%
1300	High-Density Residential	787	42.98%
2000	Agriculture	25	1.37%
4000	Forest/Rural Open	103	5.63%
5000	Water	36	1.97%
6000	Wetlands	80	4.37%
8000	Transportation, Communication, and Utilities	52	2.84%
-	Total:	1,831	100.00%

Table 4.1b. Classification of Land Use Categories for the Mullet Creek Tidal Watershed (WBID 1575) in 2006

- = Empty cell

Level 1 Code	Land Use	Acreage	% Acreage
1000	Urban and Built-Up	6	10.34%
1300	High-Density Residential	48	82.76%
6000	Wetlands	2	3.45%
8000	Transportation, Communication, and Utilities	2	3.45%
-	Total:	58	100.00%

Urban Development

Pets (especially dogs) could be a significant source of coliform pollution through surface runoff in the Mullet Creek watershed. In addition to pets, other animal fecal coliform contributors commonly seen in urban areas include rats, pigeons, and sometimes raccoons.

Studies report that up to 95 percent of the fecal coliform found in urban stormwater can come from nonhuman origins (Alderiso et al., 1996; Trial et al., 1993). The most important nonhuman fecal coliform contributors appear to be dogs and cats. In a highly urbanized Baltimore catchment, Lim and Olivieri (1982) found that dog feces were the single greatest source for fecal coliform and fecal streptococcus bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliform in urban watersheds. Using bacteria source tracking techniques, Watson (2002) found that the amount of fecal coliform bacteria contributed by dogs in Stevenson Creek in Clearwater, Florida, was as important as that from septic tanks.

According to the American Pet Products Manufacturers Association (APPMA), about 4 out of 10 U.S. households include at least one dog. A single gram of dog feces contains about 23 million fecal coliform bacteria (Van der Wel, 1995). Unfortunately, statistics show that about 40 percent of American dog owners do not pick up their dogs' feces.

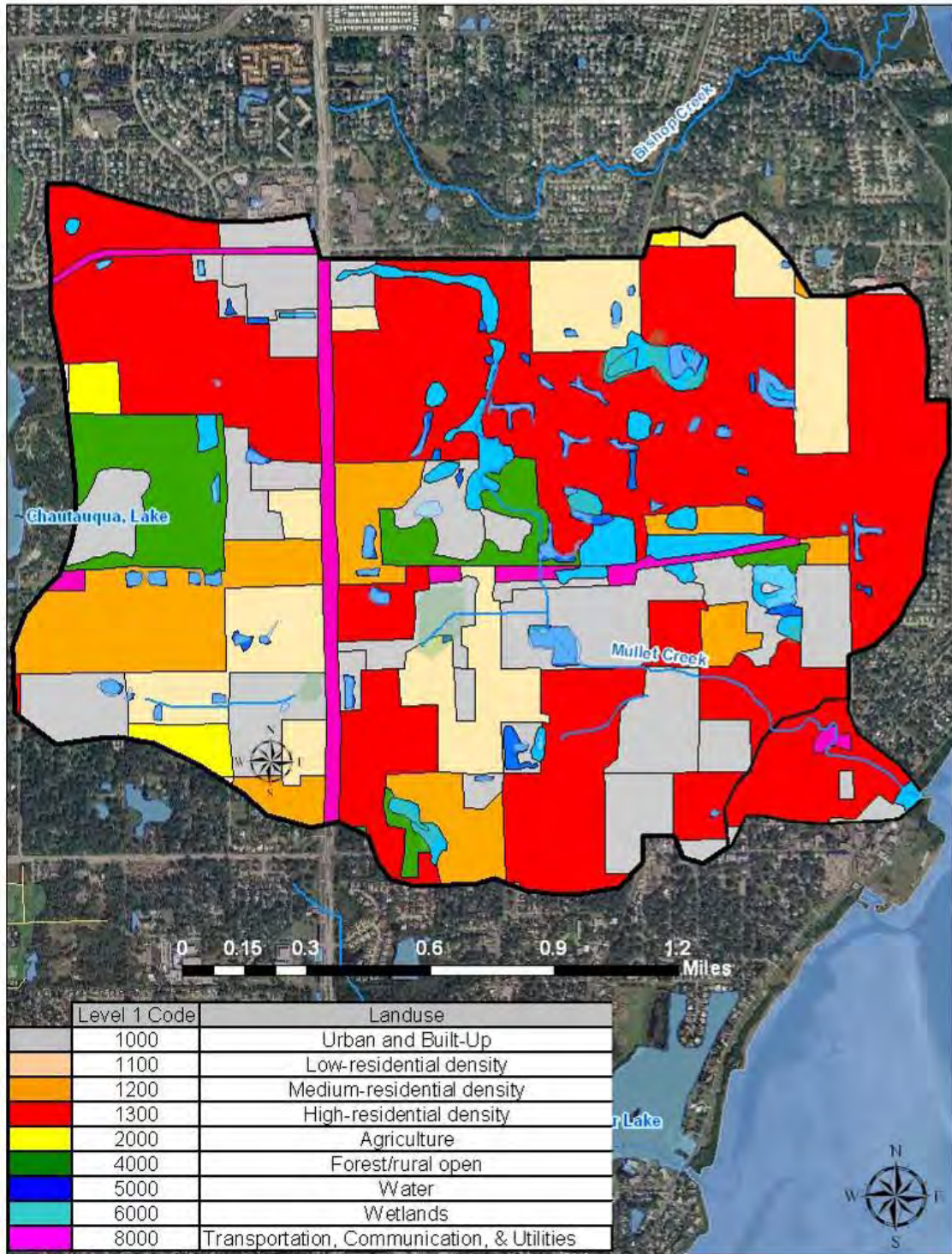


Figure 4.1. Principal Land Uses in the Mullet Creek and Mullet Creek Tidal Watersheds in 2006

Table 4.2 shows the fecal coliform concentrations of surface runoff measured in two urban areas (Bannerman et al., 1993; Steuer et al., 1997). While bacteria levels were widely different in the two studies, both indicated that residential lawns, driveways, and streets were the major source areas for bacteria.

Table 4.2. Concentrations (Geometric Mean Colonies per 100 mL) of Fecal Coliform from Urban Source Areas (Steuer et al., 1997; Bannerman et al., 1993)

Geographic Location	Marquette, Michigan	Madison, Wisconsin
Number of storms sampled	12	9
Commercial parking lot	4,200	1,758
High-traffic street	1,900	9,627
Medium-traffic street	2,400	56,554
Low-traffic street	280	92,061
Commercial rooftop	30	1,117
Residential rooftop	2,200	294
Residential driveway	1,900	34,294
Residential lawns	4,700	42,093
Basin outlet	10,200	175,106

The number of dogs in the Mullet Creek and Mullet Creek Tidal watersheds is not known. Therefore, this analysis used the statistics produced by APPMA to estimate the possible fecal coliform loads contributed by dogs. The human populations in the Mullet Creek and Mullet Creek Tidal watersheds calculated from the census track using Tiger Track 2000 data (the Department's GIS library) were approximately 6,426 and 98, respectively. According to the U.S. Census Bureau (2005–07: 3-year estimates), there were 2.19 people per household in Pinellas County. This results in an estimated 2,934 and 45 households in the Mullet Creek and Mullet Creek Tidal watersheds, respectively. Assuming that 40 percent of the households in this area have 1 dog, the total number of dogs in the Mullet Creek and Mullet Creek Tidal watersheds is about 1,174 and 18, respectively.

According to the waste production rate for dogs and the fecal coliform counts per gram of dog wastes listed in **Table 4.3**, and assuming that 40 percent of dog owners do not pick up dog feces, the total waste produced by dogs and left on the land surface of residential areas is 577,080 grams/day. The total fecal coliform produced by dogs for Mullet Creek and Mullet Creek Tidal is 4.65×10^{11} and 7.13×10^9 counts/day, respectively.

It should be noted that this load only represents the fecal coliform load created in the watershed and is not intended to be used to represent a part of the existing load that reaches the receiving waterbody. The fecal coliform load that eventually reaches the receiving waterbody could be significantly less than this value due to attenuation in overland transport.

Table 4.3. Dog Population Density, Wasteload, and Fecal Coliform Density

* Number from APPMA.

Source: Weiskel et al., 1996.

Type	Population density (an/household)	Wasteload (grams/an-day)	Fecal coliform density (fecal coliform/grams)
Dog	0.4*	450	2,200,000

Septic Tanks

Septic tanks are another potentially important source of coliform pollution in urban watersheds. When properly installed, most of the coliform from septic tanks should be removed within 50 meters of the drainage field (Minnesota Pollution Control Agency, 1999). However, in areas with a relatively high ground water table, the drainage field can be flooded during the rainy season, and coliform bacteria can pollute the surface water through storm runoff. Septic tanks may also cause coliform pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic tank system is built too close to the well (e.g., less than 75 feet), the septic tank discharge will be within the cone of influence of the well. As a result, septic tank effluent may go into the well and once the polluted water is used to irrigate lawns, coliform bacteria may reach the land surface and wash into surface waters during the rainy season.

A rough estimate of fecal coliform loads from failed septic tanks in each watershed can be made using **Equation 4.1**:

$$L = 37.85 * N * Q * C * F \quad \text{(Equation 4.1)}$$

Where,

L is the fecal coliform daily load (counts/day);

N is the total number of septic tanks in the watershed (septic tanks);

Q is the discharge rate for each septic tank;

C is the fecal coliform concentration for the septic tank discharge; and

F is the septic tank failure rate.

Based on 2007 Florida Department of Health (FDOH) onsite sewage GIS coverage (available: <http://www.doh.state.fl.us/environment/programs/EhGis/EhGisDownload.htm>), about 32 housing units (*N*) were identified as being on septic tanks in the Mullet Creek watershed, and no septic tanks were identified in the Mullet Creek Tidal 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 Pinellas County is about 2.19 people/household. The same population density was assumed for the Mullet Creek watershed. A commonly cited value for per capita wastewater production rate is 70 gallons/day/person (EPA, 2001). The commonly cited concentration (*C*) for septic tank discharge is 1×10^6 counts/100mL for fecal coliform (EPA, 2001).

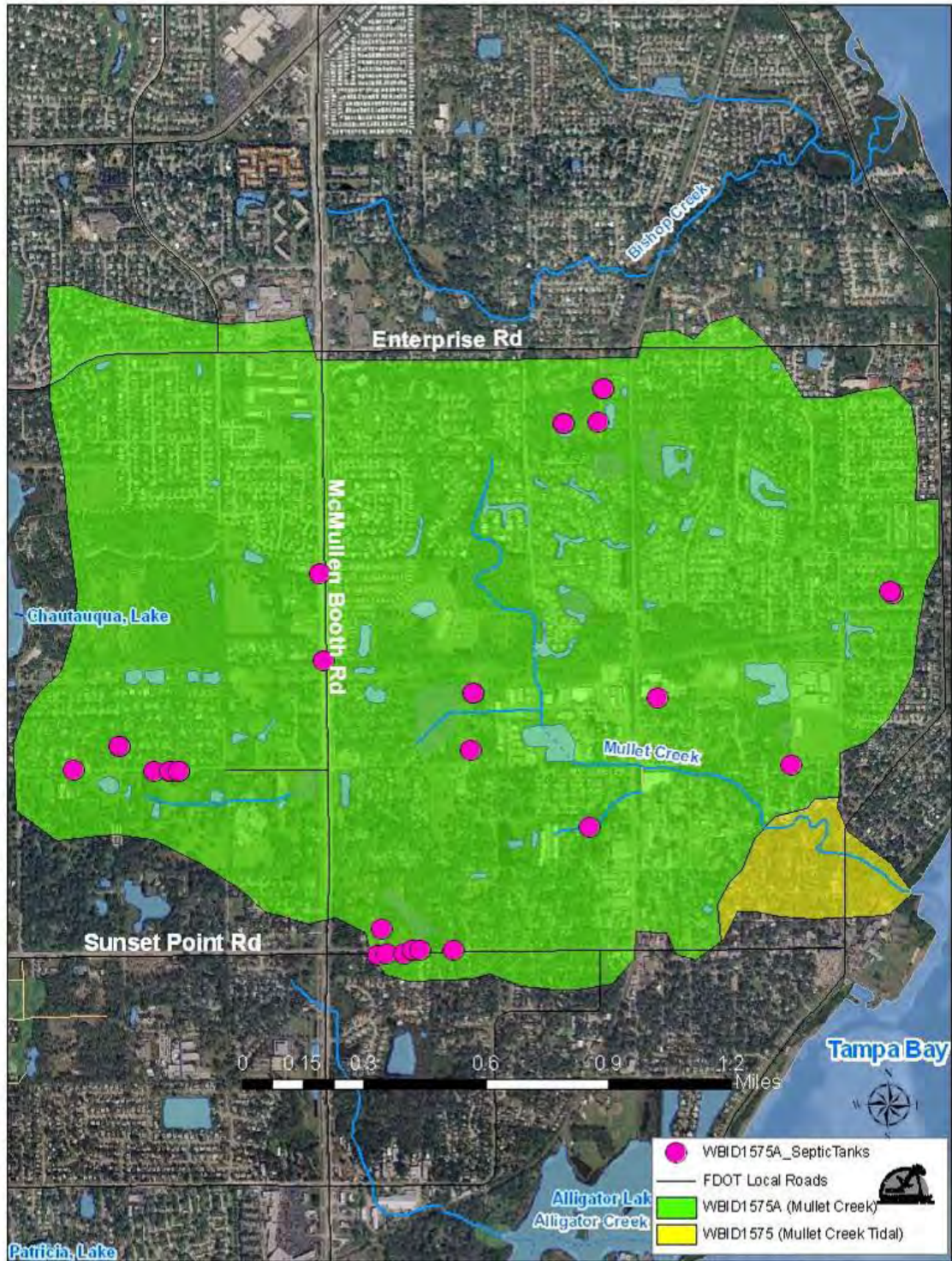


Figure 4.2. Distribution of Onsite Sewage Systems (Septic Tanks) in the Mullet Creek Watershed (WBID 1575A)

No measured septic tank failure rate data were available for the watershed when this TMDL analysis was conducted. Therefore, the failure rate was derived from the number of septic tank and septic tank repair permits for the county published by FDOH (<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. The reported number of septic tank repair permits was also obtained from the FDOH Website.

Based on this information, a discovery rate of failed septic tanks for each year between 2002 and 2007 was calculated and listed in **Table 4.4**. Using the table, the average annual septic tank failure discovery rate for Pinellas County is about 0.69 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 3.5 percent. Based on **Equation 4.1**, the estimated fecal coliform loading from failed septic tanks in the Mullet Creek watershed is approximately 6.50×10^9 counts/day.

Table 4.4. Estimated Septic Numbers and Septic Failure Rates for Pinellas County, 2002–07

- = Empty cell
* The failure rate is 5 times the failure discovery rate.

	2002	2003	2004	2005	2006	2007	Average
-							
New installation (septic tanks)	54	47	43	43	36	34	43
Accumulated installation (septic tanks)	23,578	23,632	23,679	23,722	23,765	23,801	23,696
Repair permit (septic tanks)	141	193	168	180	149	150	164
Failure discovery rate (%)	0.60%	0.82%	0.71%	0.76%	0.63%	0.63%	0.69%
Failure rate (%)*	3.0%	4.1%	3.5%	3.8%	3.1%	3.2%	3.5%

Sanitary Sewer Overflows

SSOs can also be a potential source of fecal bacteria pollution. Human sewage can be introduced into surface waters even when storm and sanitary sewers are separated. Leaks and overflows are common in many older sanitary sewers where capacity is exceeded, high rates of infiltration and inflow occur (i.e., outside water gets into pipes, reducing capacity), frequent blockages occur, or sewers are simply falling apart due to poor joints or pipe materials. Power failures at pumping stations are also a common cause of SSOs. The greatest risk of an SSO occurs during storm events; however, few comprehensive data are available to quantify SSO frequency and bacteria loads in most watersheds.

Fecal coliform loading from sewer line leakage can be calculated, based on the number of people in the watershed, typical per household generation rates, and the typical fecal coliform concentration in domestic sewage, assuming a leakage rate of 0.5 percent (Culver et al., 2002). Based on this assumption, a rough estimate of fecal coliform loads from leaks and SSOs in the Mullet Creek watershed can be made using **Equation 4.2**:

$$L = 37.85 * N * Q * C * F \quad \text{(Equation 4.2)}$$

Where,

- L is the fecal coliform daily load (counts/day);
- N is the number of households using sanitary sewer in the watershed;
- Q is the discharge rate for each household;
- C is the fecal coliform concentration for the domestic wastewater discharge; and
- F is the sewer line leakage rate.

The number of households (N) in the Mullet Creek and Mullet Creek Tidal watersheds that use the sewer line is 2,902 and 45 (total households minus septic tank households), respectively. The discharge rate through the sewer line from each household (Q) was calculated by multiplying the average household size (2.19 people) by the per capita wastewater production rate per day (70 gallons). The commonly cited concentration (C) for domestic wastewater is 1×10^6 counts/100mL for fecal coliform (EPA, 2001). Of the total number of households using the sewer line, 0.5 percent (F) was assumed as the sewer line leakage rate (Culver et al., 2002). Based on **Equation 4.2**, the estimated fecal coliform loading from sewer line leakage in the Mullet Creek and Mullet Creek Tidal watersheds is about 8.42×10^{10} and 1.31×10^9 counts/day, respectively.

Nonpoint Source Summary

Table 4.5 summarizes the loading estimates from various nonpoint sources. It is important to note that this is not a complete list and represents estimates of potential loadings. Proximity to each waterbody, rainfall frequency and magnitude, soil types, drainage features, and temperature are just a few of the factors that could influence and determine the actual loadings from these sources that reach Mullet Creek and Mullet Creek Tidal.

Table 4.5. Estimated Fecal Coliform Loadings from Dogs, Septic Tanks, and SSOs in the Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575) Watersheds

N/A = Not applicable

Waterbody	Dogs (counts/day)	Septic Tanks (counts/day)	SSOs (counts/day)
Mullet Creek	4.65×10^{11}	6.50×10^9	8.42×10^{10}
Mullet Creek Tidal	7.13×10^9	N/A	1.31×10^{11}

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The fecal coliform TMDL calculation was developed using the “percent reduction” approach. For this method, the percent reduction needed to meet the applicable criterion is calculated for each value above the criterion, and then a median percent reduction is calculated.

5.1.1 Data Used in the Determination of the TMDL

The data used for this TMDL report were provided by Pinellas County and the Department’s Southwest District from the following stations: Mullet Creek (Stations: 21FLPDEM13-02 and 21FLPDEM13-05) and Mullet Creek Tidal (Station: 21FLTPA 27593868241169) (**Tables 5.1a** and **5.1b**). **Figure 5.1** shows the locations of the water quality sites from which fecal coliform data were collected. **Figure 2.1** displays the data for fecal coliform used in this analysis.

5.1.1 TMDL Development Process for Mullet Creek and Mullet Creek Tidal

As described in **Section 5.1**, the percent reduction needed to meet the fecal coliform criterion was determined for each individual exceedance using **Equation 5.1**:

$$\frac{[\text{measured exceedance} - \text{criterion}] * 100}{\text{measured exceedance}} \quad (\text{Equation 5.1})$$

The fecal coliform TMDLs for Mullet Creek and Mullet Creek Tidal were calculated as the median of the percent reductions needed over the data range where exceedances occurred (see **Tables 5.2a** and **5.2b** for data). As noted in the next section, exceedances occurred throughout the data period for Mullet Creek and Mullet Creek Tidal, and the median percent reduction for this period was 57 and 49 percent, respectively.

Table 5.1a. Fecal Coliform Data for Mullet Creek (WBID 1575A)

Station	Date	Fecal Coliform (counts/100mL)
21FLPDEM13-02	1/6/2005	160
21FLPDEM13-02	2/23/2005	100
21FLPDEM13-02	4/18/2005	580
21FLPDEM13-02	5/12/2005	180
21FLPDEM13-02	6/16/2005	2,100
21FLPDEM13-02	8/4/2005	840
21FLPDEM13-02	9/8/2005	280
21FLPDEM13-02	12/5/2005	540
21FLPDEM13-02	1/25/2006	230
21FLPDEM13-02	2/13/2006	200
21FLPDEM13-02	4/13/2006	180
21FLPDEM13-02	6/28/2006	940
21FLPDEM13-02	7/27/2006	1,400
21FLPDEM13-02	9/6/2006	1,300
21FLPDEM13-02	12/18/2006	310
21FLPDEM13-05	1/18/2007	33
21FLPDEM13-05	3/8/2007	110
21FLPDEM13-05	4/16/2007	280
21FLPDEM13-05	6/26/2007	260

Table 5.1b. Fecal Coliform Data for Mullet Creek Tidal (WBID 1575)

Station	Date	Fecal Coliform (counts/100mL)
21FLTPA 27593868241169	2/13/2006	220
21FLTPA 27593868241169	3/13/2006	420
21FLTPA 27593868241169	4/18/2006	340
21FLTPA 27593868241169	5/22/2006	580
21FLTPA 27593868241169	6/12/2006	5,800
21FLTPA 27593868241169	7/17/2006	330
21FLTPA 27593868241169	7/31/2006	780
21FLTPA 27593868241169	8/21/2006	1,370
21FLTPA 27593868241169	9/12/2006	530
21FLTPA 27593868241169	11/1/2006	2,000

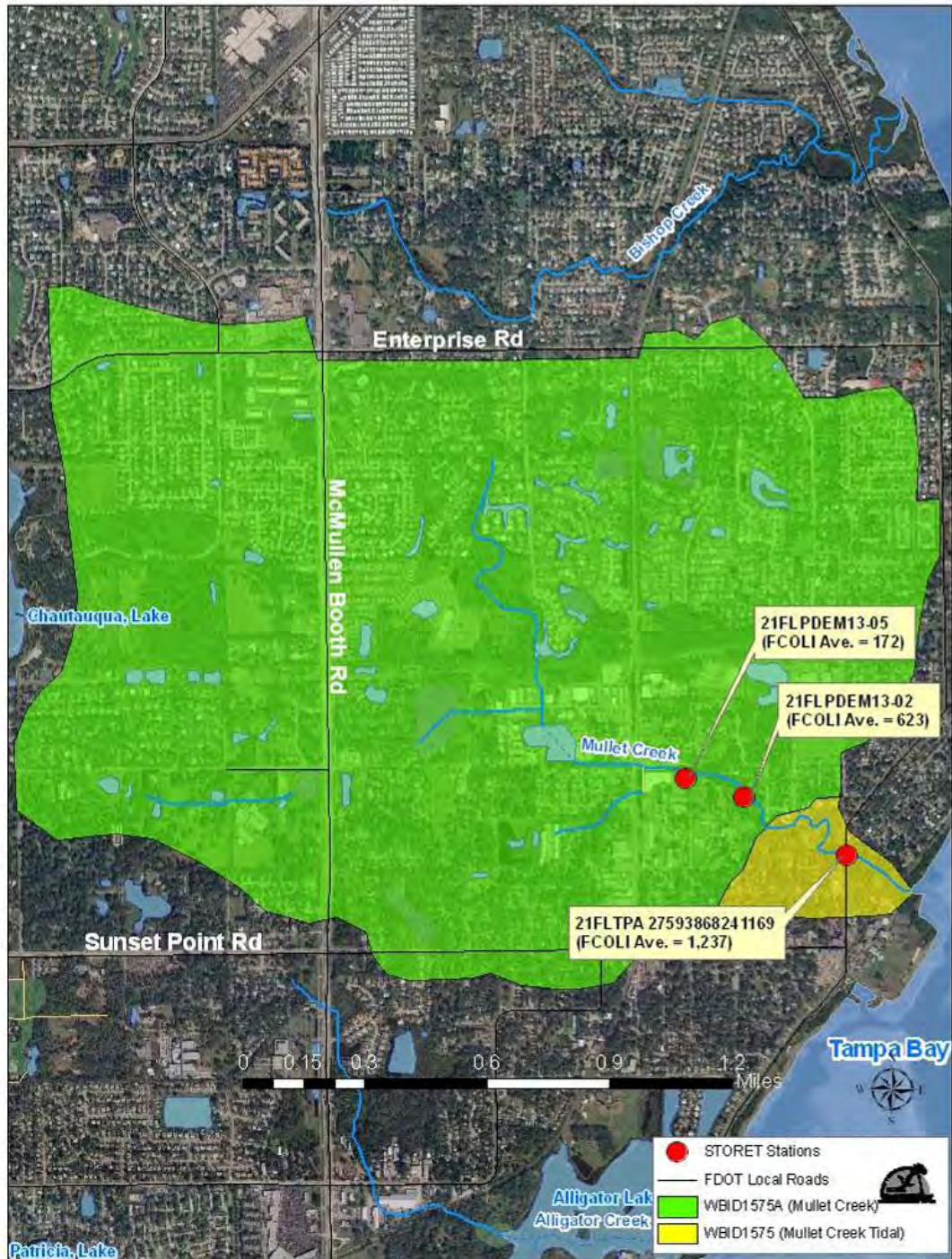


Figure 5.1. Locations of Water Quality Stations for Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575)

Table 5.2a. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Mullet Creek (WBID 1575A)

- = Empty cell

Station	Date	Fecal Coliform Exceedances (#/100mL)	Fecal Coliform Target (#/100mL)	% Reduction
21FLPDEM13-02	6/16/2005	2,100	400	81%
21FLPDEM13-02	7/27/2006	1,400	400	71%
21FLPDEM13-02	9/6/2006	1,300	400	69%
21FLPDEM13-02	6/28/2006	940	400	57%
21FLPDEM13-02	8/4/2005	840	400	52%
21FLPDEM13-02	4/18/2005	580	400	31%
21FLPDEM13-02	12/5/2005	540	400	26%
-	-	-	Median:	57%

Table 5.2b. Calculation of Percent Reduction in Fecal Coliform Necessary To Meet the Water Quality Standard of 400 Colonies/100mL in Mullet Creek Tidal (WBID 1575)

- = Empty cell

Station	Date	Fecal Coliform Exceedances (#/100mL)	Fecal Coliform Target (#/100mL)	% Reduction
21FLTPA 27593868241169	6/12/2006	5,800	400	93%
21FLTPA 27593868241169	11/1/2006	2,000	400	80%
21FLTPA 27593868241169	8/21/2006	1,370	400	71%
21FLTPA 27593868241169	7/31/2006	780	400	49%
21FLTPA 27593868241169	5/22/2006	580	400	31%
21FLTPA 27593868241169	9/12/2006	530	400	25%
21FLTPA 27593868241169	3/13/2006	420	400	5%
-	-	-	Median:	49%

5.1.2 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 Mullet Creek and Mullet Creek Tidal, the Department used rainfall data to compare with the measured fecal coliform data for each waterbody. Measurements were sorted by month and season (the calendar year was divided into quarters) to determine whether there was a temporal pattern of exceedances. Monthly rainfall data from St. Petersburg International Airport (KPIE) were also obtained and included in the analysis. **Tables 5.3a, 5.3b, 5.4a, and 5.4b** present summary statistics by month and season, respectively, for fecal coliform measurements for each watershed (*Winter*: January–March; *Spring*: April–June; *Summer*: July–September; *Fall*: October–December). The results show that fecal coliform values increased during the months with higher rainfall for Mullet Creek, suggesting surface runoff from increased rainfall. There was a limited dataset for Mullet Creek Tidal, making it difficult to derive any major seasonal trends for the fecal coliform data; however, fecal coliform exceedances did occur throughout all the seasons (see **Figures 5.2a and 5.2b**).

Table 5.3a. Summary Statistics of Fecal Coliform Data for Mullet Creek (WBID 1575A) by Month, 2000–07

- = Empty cell/no data

¹ Coliform counts are #/100mL.

² Exceedances represent values above 400 counts/100mL.

Month	Number of Cases	Minimum ¹	Maximum ¹	Median ¹	Mean ¹	Number of Exceedances ²	% Exceedances of Cases	Rainfall Mean (inches)
1	3	33	230	160	141	0	0.00	1.83
2	2	100	200	150	150	0	0.00%	3.68
3	1	110	110	110	110	0	0.00%	2.39
4	3	180	580	280	347	1	33.33%	2.25
5	1	180	180	180	180	0	0.00%	1.89
6	3	260	2,100	940	1,100	2	66.67%	9.77
7	1	1,400	1,400	1,400	1,400	1	100.00%	9.73
8	1	840	840	840	840	1	100.00%	8.87
9	2	280	1,300	790	790	1	50.00%	7.22
10	-	-	-	-	-	-	-	2.01
11	-	-	-	-	-	-	-	1.22
12	2	310	540	425	425	1	50.00%	3.44

Table 5.3b. Summary Statistics of Fecal Coliform Data for Mullet Creek (WBID 1575A) by Season, 2000–07

- = Empty cell/no data

¹ Coliform counts are #/100mL.

² Exceedances represent values above 400 counts/100mL.

Season	Number of Cases	Minimum ¹	Maximum ¹	Median ¹	Mean ¹	Number of Exceedances ²	% Exceedances of Cases	Total Rainfall Mean (inches)
1	6	33	230	150	134	0	0.00%	7.90
2	7	180	2,100	280	542	3	33.33%	13.91
3	4	280	1,400	840	1,010	3	83.33%	25.82
4	2	310	540	425	425	1	50.00%	6.67

Table 5.4a. Summary Statistics of Fecal Coliform Data for Mullet Creek Tidal (WBID 1575) by Month, 2000-07

- = Empty cell/no data

¹ Coliform counts are #/100mL.

² Exceedances represent values above 400 counts/100mL.

Month	Number of Cases	Mean ¹	Number of Exceedances ²	% Exceedances of Cases	Rainfall Mean (inches)
1	0	-	-	-	1.83
2	1	220	0	0.00%	3.68
3	1	420	1	100.00%	2.39
4	1	340	0	0.00%	2.25
5	1	580	1	100.00%	1.89
6	1	5,800	1	100.00%	9.77
7	2	555	1	50.00%	9.73
8	1	1370	1	100.00%	8.87
9	1	530	1	100.00%	7.22
10	-	-	-	-	2.01
11	1	2000	1	100.00%	1.22
12	-	-	-	-	3.44

Table 5.4b. Summary Statistics of Fecal Coliform Data for Mullet Creek Tidal (WBID 1575) by Season, 2000-07

- = Empty cell/no data

¹ Coliform counts are #/100mL.

² Exceedances represent values above 400 counts/100mL.

Season	Number of Cases	Mean ¹	Number of Exceedances ²	% Exceedances of Cases	Total Rainfall Mean (inches)
1	2	320	1	50.00%	7.90
2	3	2,240	2	66.67%	13.91
3	4	818	3	83.33%	25.82
4	1	2,000	1	100.00%	6.67

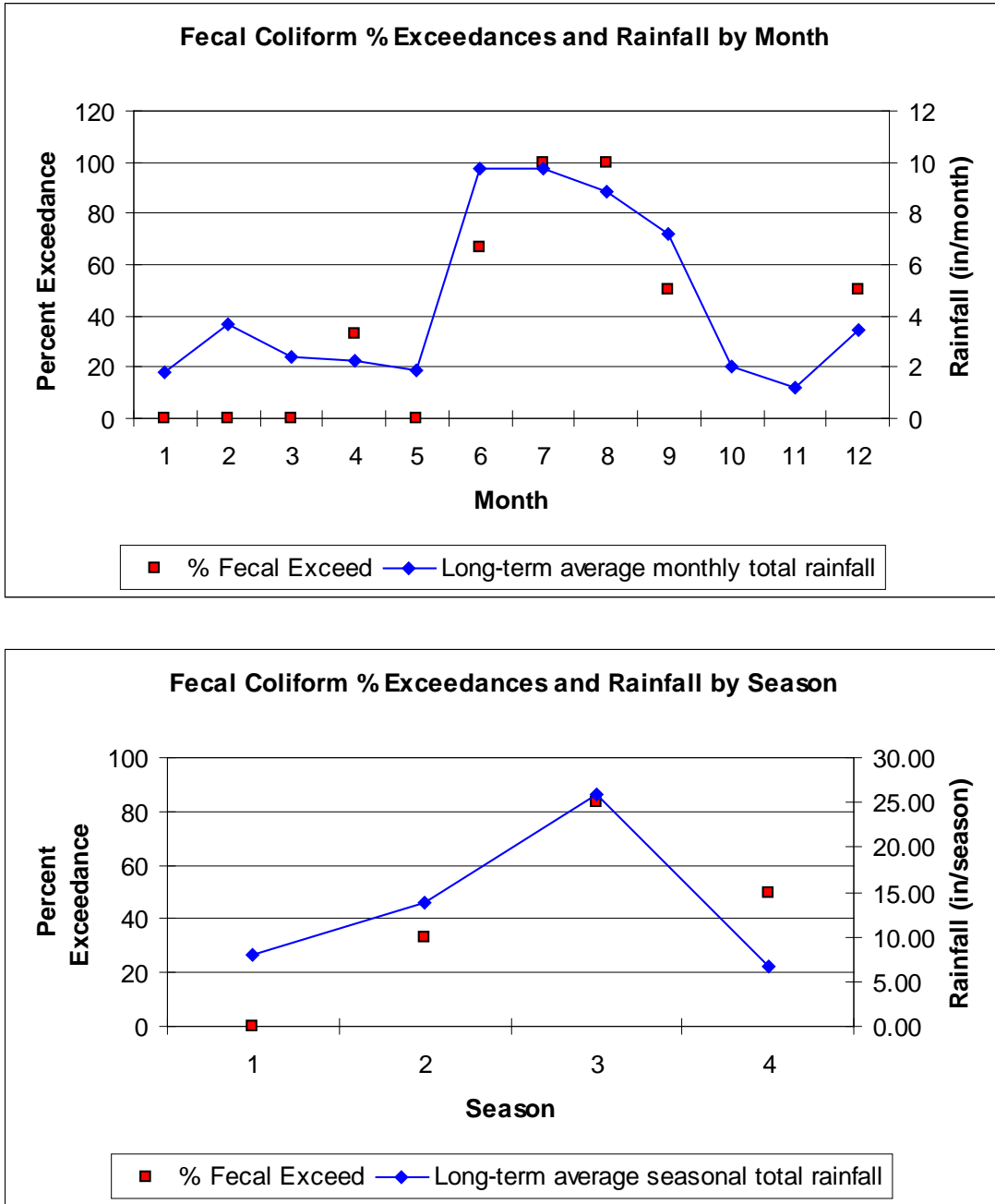
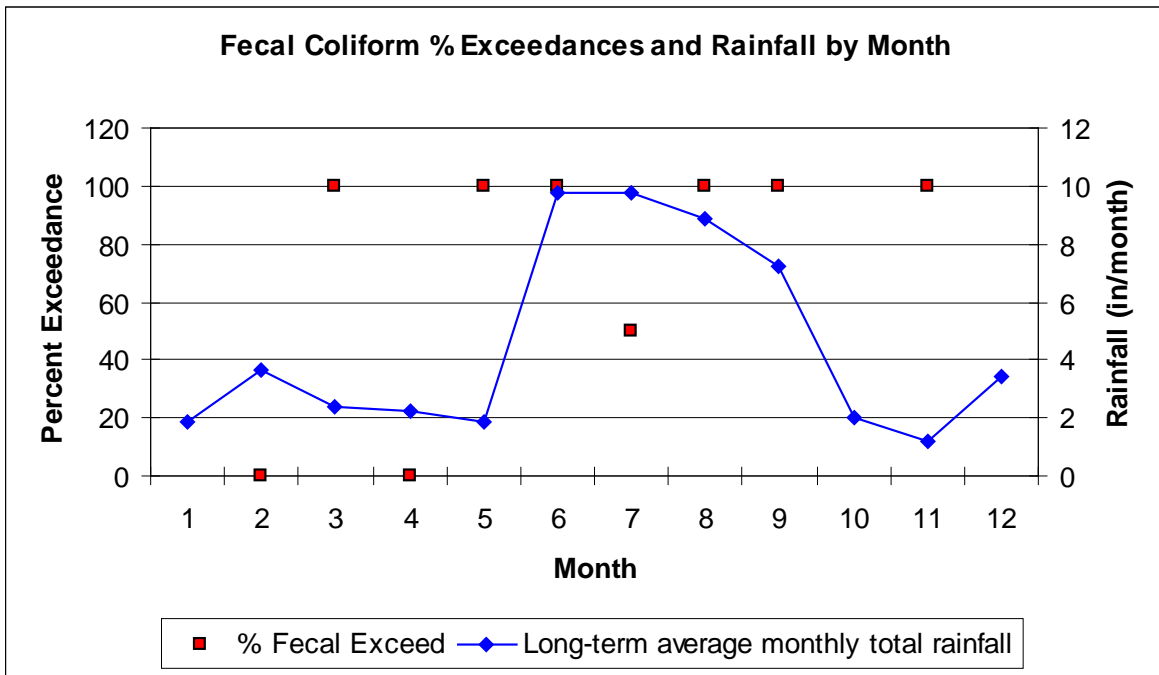


Figure 5.2a. Fecal Coliform Exceedances and Rainfall for Mullet Creek (WBID 1575A) by Month and Season, 2000-07



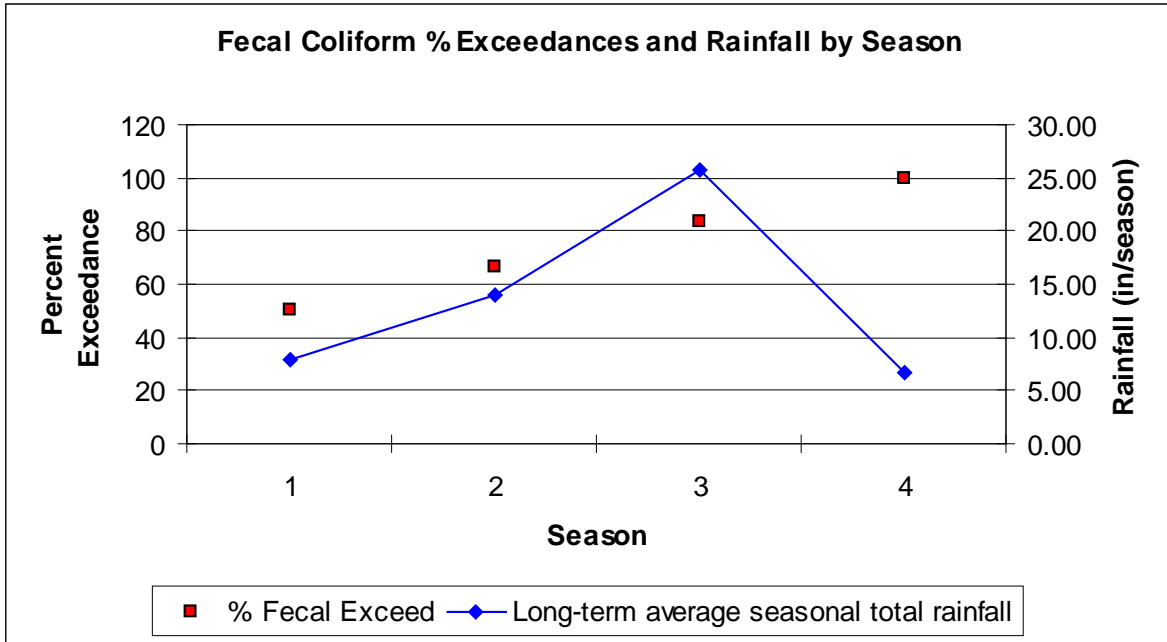


Figure 5.2b. Fecal Coliform Exceedances and Rainfall for Mullet Creek Tidal (WBID 1575), by Month and Season, 2000-07

5.1.3 Spatial Patterns

Because there is only one water quality station with fecal coliform data for Mullet Creek Tidal, the Department was not able to determine any spatial pattern.

There are two water quality stations (21FLPDEM13-02 and 21FLPDEM13-05) located in Mullet Creek for which the Department spatially analyzed the fecal coliform data (**Figure 5.1**). Station 21FLPDEM13-05 (located a quarter of a mile upstream of Station 21FLPDEM13-02) had no fecal coliform exceedances, while the downstream station, 21FLPDEM13-02, had 7 exceedances out of 15 samples. These water quality stations are located in the downstream portion of the Mullet Creek watershed; therefore, further sampling in the upstream and downstream portions of Mullet Creek (within the same period) would be needed to reach any final conclusions regarding spatial trends for the fecal coliform data. **Table 5.5** summarizes the fecal coliform data for each station.

Table 5.5. Station Summary Statistics of Fecal Coliform Data for Mullet Creek Tidal (WBID 1575) and Mullet Creek (WBID1575A)

¹ Coliform counts are #/100mL.

² Exceedances represent values above 400 counts/100mL.

WBID	Station	Average ¹	# Samples	# Exceedances ²	Minimum ₁	Maximum ₁
1575 A	21FLPDEM13-02	623	15	7	2,100	1,200
1575 A	21FLPDEM13-05	171	4	0	33	280
1575	21FLTPA 2821288240456	1,237	10	7	220	5,800

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[i]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDLs for Mullet Creek and Mullet Creek Tidal are expressed in terms of a percent reduction that represents the maximum daily fecal coliform loads these waterbodies can assimilate and maintain the fecal coliform criterion (**Table 6.1**).

Table 6.1. TMDL Components for Fecal Coliform in Mullet Creek (WBID 1575A) and Mullet Creek Tidal (WBID 1575)

N/A – Not applicable

WBID	Parameter	TMDL (counts/100mL)	Wasteload Allocation for Wastewater (counts/day)	Wasteload Allocation for NPDES Stormwater (% reduction)	LA (% reduction)	MOS
1575A	Fecal Coliform	400	N/A	57%	57%	Implicit
1575	Fecal Coliform	400	N/A	49%	49%	Implicit

6.2 Load Allocation

Fecal coliform reductions of 57 and 49 percent for Mullet Creek and Mullet Creek Tidal, respectively, are needed from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

No NPDES-permitted wastewater facilities were identified in Mullet Creek or Mullet Creek Tidal. The state already requires all NPDES point source dischargers to meet bacteria criteria at the end of the pipe. It is the Department's current practice not to allow mixing zones for bacteria. Any point sources that may discharge in these watersheds in the future will also be required to meet end-of-pipe standards for coliform bacteria.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges with an MS4 permit is a 57 and 49 percent reduction in current fecal coliform for Mullet Creek Tidal (WBID 1575A) and Mullet Creek (WBID 1575), respectively. It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this TMDL by meeting the water quality criterion of 400 colonies/100mL, while the actual criterion allows for a 10 percent exceedance over that level.

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, referred to as the BMAP. This document will be developed over the next year in cooperation with local stakeholders, who will attempt to reach 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 water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

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

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

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



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