FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

NORTHEAST DISTRICT • LOWER ST. JOHNS RIVER BASIN

TMDL Report

Fecal Coliform TMDL for Goodbys Creek (WBID 2326)

David Wainwright

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Acknowledgments

Editorial assistance provided by: Wayne Magley, Ph.D., Jan Mandrup-Poulsen, Daryll Joyner, and Linda Lord.

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

Jennifer Gihring
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Planning and Coordination Section
2600 Blair Stone Road, Mail Station 3565
Tallahassee, FL 32399-2400
jennifer.gihring@dep.state.fl.us
Phone: (850) 245-8418; Suncom: 205-8418
Fax: (850) 245-8434

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

David Wainwright
Florida Department of Environmental Protection
Bureau of Watershed Management
Watershed Assessment Section
2600 Blair Stone Road, Mail Station 3555
Tallahassee, FL 32399-2400
david.wainwright@dep.state.fl.us
Phone: (850) 245-8469; Suncom: 205-8469
Fax: (850) 245-8536

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Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management

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

2004 305(b) Report

http://www.dep.state.fl.us/water/docs/2004_Integrated_Report.pdf

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Lower St. Johns River Basin

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

Water Quality Assessment Report for the Lower St. Johns River Basin

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

Allocation Technical Advisory Committee (ATAC) Report

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

U.S. Environmental Protection Agency, 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 coliforms for the Goodbys Creek watershed in the North Mainstem Planning Unit of the Lower St. Johns River Basin. The creek was verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Lower St. Johns River Basin that was adopted by Secretarial Order in May 2004. The TMDL establishes the allowable loadings to Goodbys Creek that would restore the waterbody so that it meets its applicable water quality criteria for fecal coliform.

1.2 Identification of Waterbody

Goodbys Creek is located in Duval County, in northeast Florida (**Figures 1.1 and 1.2**). The creek is approximately 2.2 miles long and has an approximate 5.10 square-mile (mi^2) drainage area that flows directly into the St. Johns River. The Goodbys Creek watershed is located on the southern side of the City of Jacksonville and, as a result, is highly urbanized. Additional information about the creek's hydrology and geology are available in the Basin Status Report for the Lower St. Johns River Basin (Florida Department of Environmental Protection [FDEP], 2004).

For assessment purposes, the Department has divided the St. Johns River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Goodbys Creek lies within one WBID, 2326, as shown in **Figure 1.2**, which this TMDL addresses.

Goodbys Creek is part of the North Mainstem Planning Unit (PU). Planning units are groups of WBIDs, which are part of a larger basin unit, in this case the Lower St. Johns Basin. The North Mainstem Planning Unit consists of 49 WBIDs. **Figure 1.3** shows the location of these WBIDs, Goodbys Creek's location in the planning unit, as well as a list of other WBIDs in the PU.

Figure 1.1. Location of Goodbys Creek and Major Geopolitical Features in the St. Johns River Basin

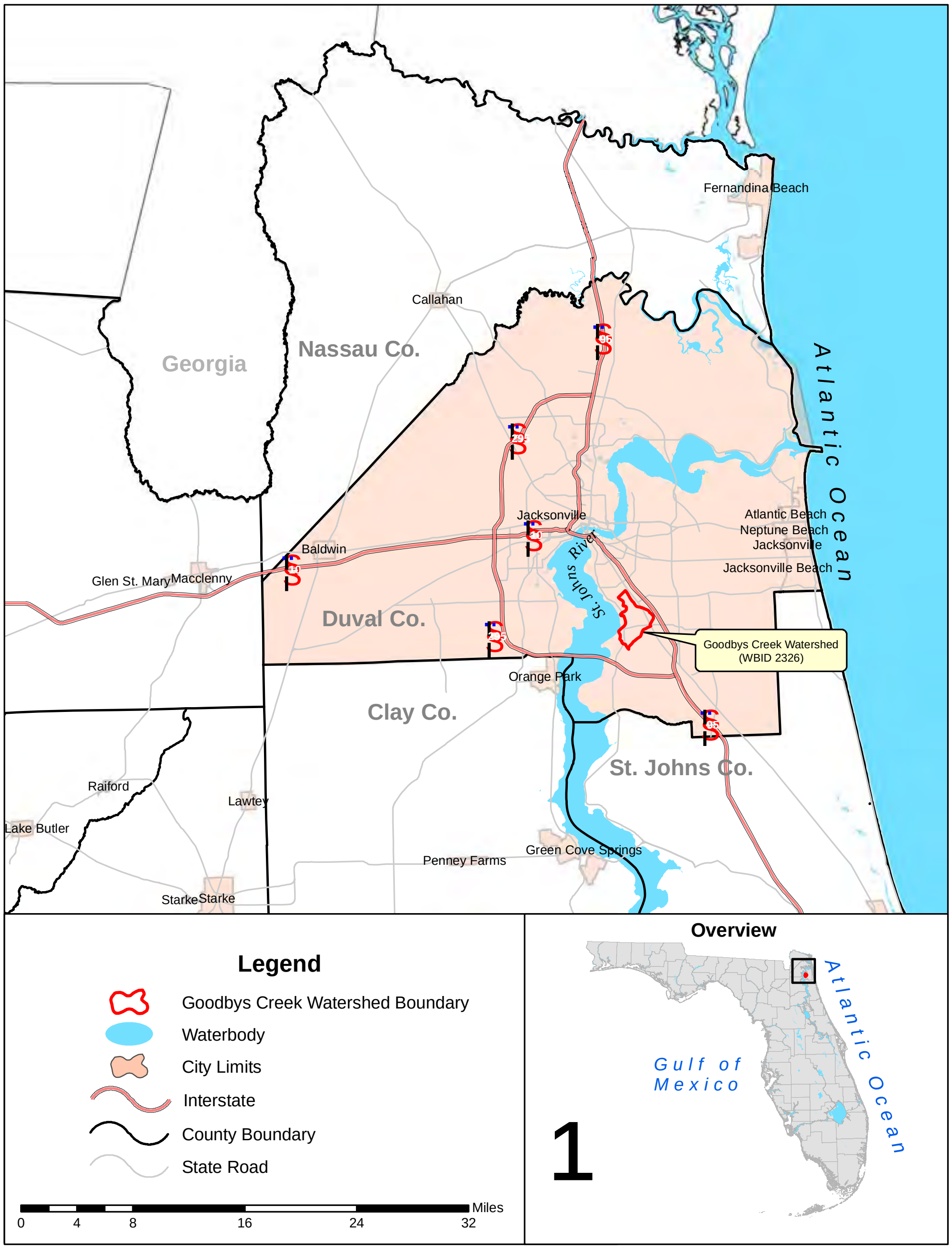


Figure 1.2. Overview of Goodbys Creek WBID

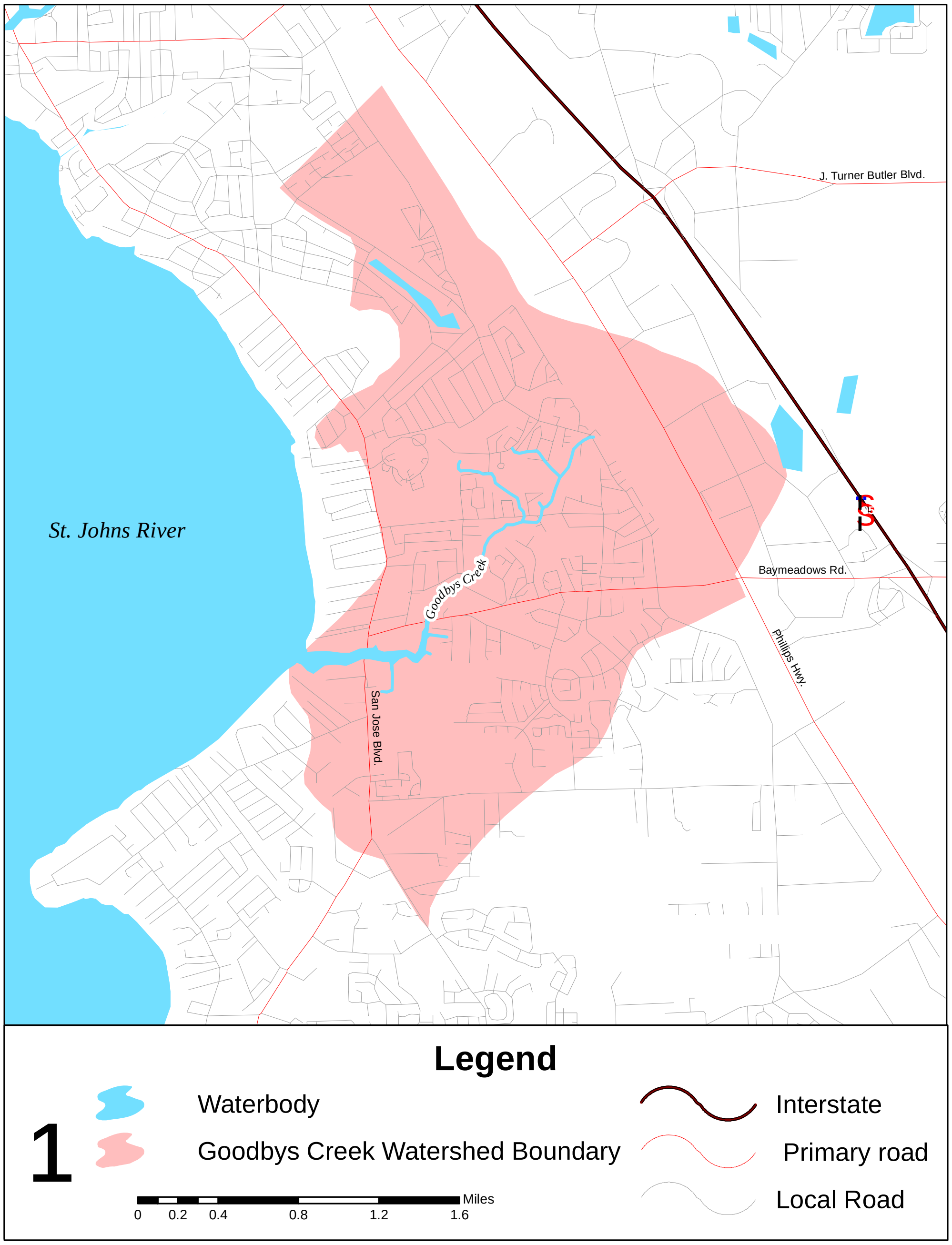
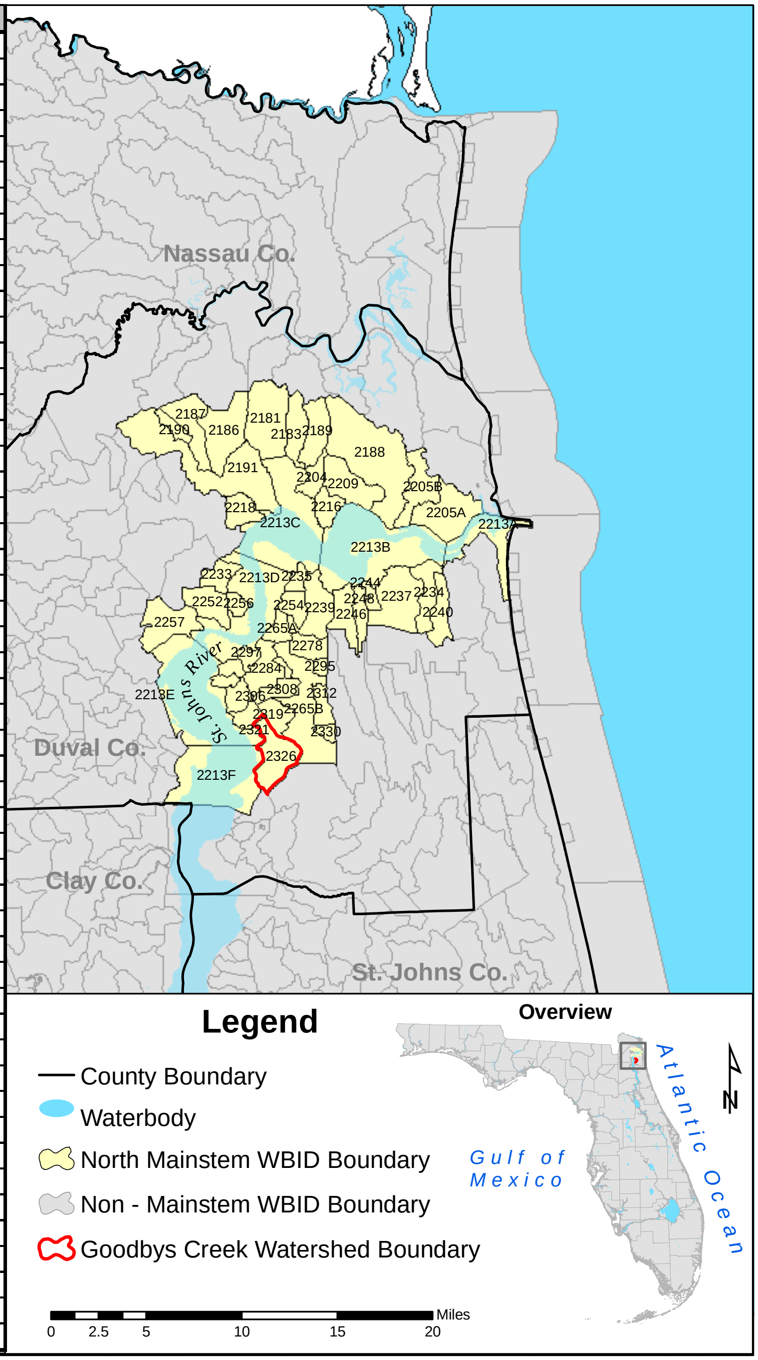


Figure 1.3. WBIDs in the North Mainstem Planning Unit

WBID	Waterbody Name
2181	Dunn Creek
2191	Broward River
2203	Trout River
2204	Terrapin Creek
2207	Blockhouse Creek
2210	West Branch
2213P	Ortega River
2220	Nine Mile Creek
2224	Ribault River
2227	Sherman Creek
2228	Moncrief Creek
2232	Sixmile Reach
2233	Long Branch
2235	New Castle Creek
2238	Little Sixmile Creek
2239	Strawberry Creek
2240	Greenfield Creek
2244	Cow Head Creek
2246	Jones Creek
2248	Gin House Creek
2249A	Ortega River
2249B	McGirts Creek
2252	Hogan Creek
2254	Red Bay Branch
2256	Deer Creek
2257	McCoy Creek
2262	Cedar River
2265B	Potsburg Creek
2266	Hopkins Creek
2270	Hogpen Creek
2278	Silversmith Creek
2280	Big Fishwier Creek
2282	Wills Branch
2284	Little Potsburg Creek
2287	Miller Creek
2297	Craig Creek
2299	Open Creek
2304	Miramar Creek
2306	New Rose Creek
2316	Williamson Creek
2321	Christopher Branch
2322	Butcher Pen Creek
2324	Fishing Creek
2326	Goodbys
2351	Julington Creek
2356	Big Davis Creek
2361	Deep Bottom Creek
2365	Durbin Creek
2370	Oldfield Creek
2381	Cormorant Branch
2385	Mandarin Drain



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 fifty-two river basins over a five-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA, Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. 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 coliforms that caused the verified impairment of Goodbys Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District, the City of Jacksonville, Jacksonville Electric Authority (JEA), local 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 EPA a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant source in each of these impaired 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.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 55 waterbodies and 277 parameters in the Lower St. Johns River Basin. However, the Florida Watershed Restoration Act (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 rule-making 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 Goodbys Creek and verified the creek is impaired for fecal coliform based on data in the Department's IWR database, **Tables 2.1** through **2.3** provide summary results for fecal coliforms for the verification period, which for Group 2 waters is January 1, 1996 – June 30, 2003, by month, season, and year, respectively.

There is a 59.18 percent overall exceedance rate for fecal coliforms in Goodbys Creek. Exceedances occur in all seasons and all months for which data exist (**Tables 2.1** and **2.2**). Summer has the highest percent exceedance rate (60.0 percent) and fall had the lowest (28.57 percent).

There are seven stations in the Goodbys Creek watershed with fecal coliform data. However, six of them have either one or two samples. The seventh station has 40 samples. Due to the small sample associated with most of the stations, it is difficult to analyze spatial trends. Sampling stations are discussed further in **Section 5.1**.

Table 2.1. Summary of Fecal Coliform Data by Month for Verified Period (January 1, 1996 – June 30, 2003)

Month	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedance	Mean Precipitation
January	4	70	3,000	1,650	1,593	2	50.00%	2.39
February	0	---	---	---	---	---	---	3.14
March	4	63	770	100	258	1	25.00%	3.95
April	6	160	720	190	322	2	33.33%	2.8
May	1	3,000	3,000	3,000	3,000	1	100.00%	1.61
June	0	---	---	---	---	---	---	7.40
July	3	190	3,000	300	1,163	1	33.33%	6.72
August	2	9,000	35,000	22,000	22,000	2	100.00%	6.72
September	0	---	---	---	---	---	---	9.94
October	5	130	16,000	250	3,370	1	20.00%	3.39
November	2	250	1,500	875	875	1	50.00%	1.81
December	0	---	---	---	---	---	---	3.12

Coliform counts are #/100 mL
Exceedances represent values above 400 counts/100 mL
Mean precipitation is the long term (1955 – 2004) mean for the stated month

Table 2.2. Summary of Fecal Coliform Data by Season for Verified Period (January 1, 1996 – June 30, 2003)

Season	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Mean Precipitation
Winter	8	63	3,000	210	925	3	37.50%	10.72
Spring	7	160	3,000	210	704	3	42.86%	12.41
Summer	5	190	35,000	3,000	9,498	3	60.00%	21.15
Fall	7	130	16,000	250	2,657	2	28.57%	8.34

Coliform counts are #/100 mL
Winter = January – March; spring = April – June; summer = July – September; fall = October - December
Exceedances represent values above 400 counts/100 mL
Mean precipitation is from Jacksonville International Airport (JIA) in inches, and is the long term mean (1955 – 2004) for all three months of the season

Table 2.3. Summary of Fecal Coliform Data by Year for Verified Period (January 1, 1996 – June 30, 2003)

Year	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Total Precipitation
1996	1	300	300	300	300	0	0.00%	60.63
1998	3	130	3,000	3,000	2,043	2	66.67%	56.72
1999	8	63	35,000	470	6,900	4	50.00%	42.44
2000	4	70	9,000	835	2,685	2	50.00%	39.77
2001	4	170	3,000	400	993	2	50.00%	49.14
2002	7	160	720	250	297	1	14.29%	54.72

Coliform counts are #/100 mL
Exceedances represent values above 400 counts/100 mL
Mean precipitation is from Jacksonville International Airport (JIA) in inches, and represents total precipitation for year shown
Precipitation is for Jacksonville International Airport (JIA) in inches, and represents the total precipitation for the year indicated.

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)**

Goodbys Creek is a Class III fresh 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 fecal coliforms.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

3.2.1 Fecal Coliform Criterion

Numeric criteria for bacterial quality are expressed in terms of fecal 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.*

The criteria state that monthly averages shall be expressed as geometric means based on a minimum of ten samples taken over a thirty-day period. However, there were insufficient data (less 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.

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 nutrients 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 Program (NPDES). These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" 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.

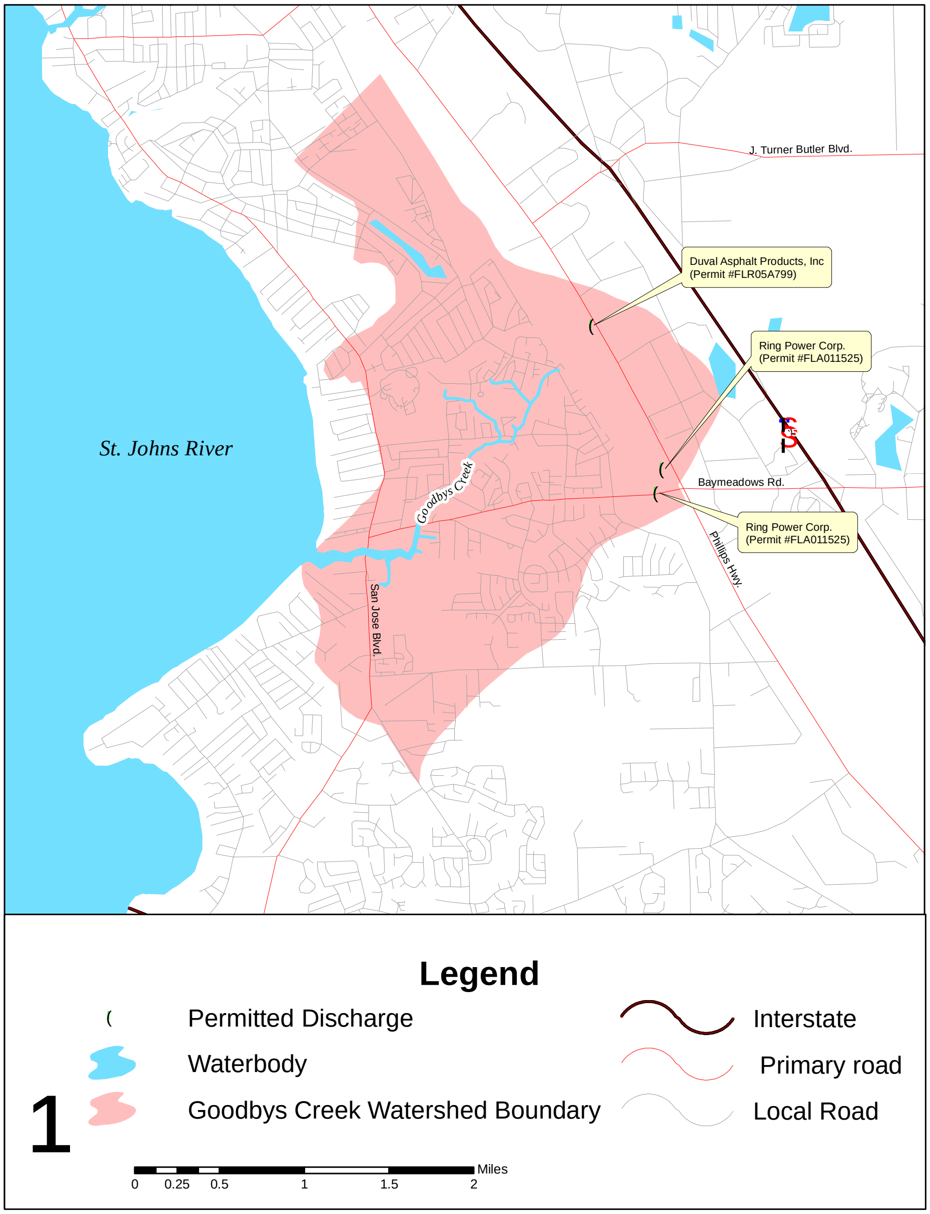
4.2 Potential Sources of Coliforms in Goodbys Creek Watershed

4.2.1 Point Sources

There are two permitted facilities in the Goodbys Creek watershed. Ring Power Corporation (permit #FLA011525) has several heavy construction equipment wash facilities on-site where wash water is collected and recycled. However, Ring Power Corporation is very unlikely to be a source of coliforms to Goodbys Creek because it is a 100 percent wash water recycle facility and is not permitted to discharge to surface waters.

The other facility is Duval Asphalt Products (permit #FLR05A799), dealing with paving mixtures and blocks, which is authorized to discharge under a general stormwater permit. Monitoring is not required, so possible effects on the creek can not be determined directly, but it is likely that the facility is having very little, if any, effect with respect to coliforms in the creek. **Figure 4.1** shows the location of these facilities within the watershed.

Figure 4.1. Location of Permitted Discharges in Goodbys Creek Watershed



Municipal Separate Storm Sewer System Permittees

The City of Jacksonville and the Florida Department of Transportation (FDOT) District 2 are co-permittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (permit FLS000012) that covers the Goodbys Creek watershed. Responsibility for the permit is shared among FDOT, and the Cities of Jacksonville, Neptune Beach, and Atlantic Beach.

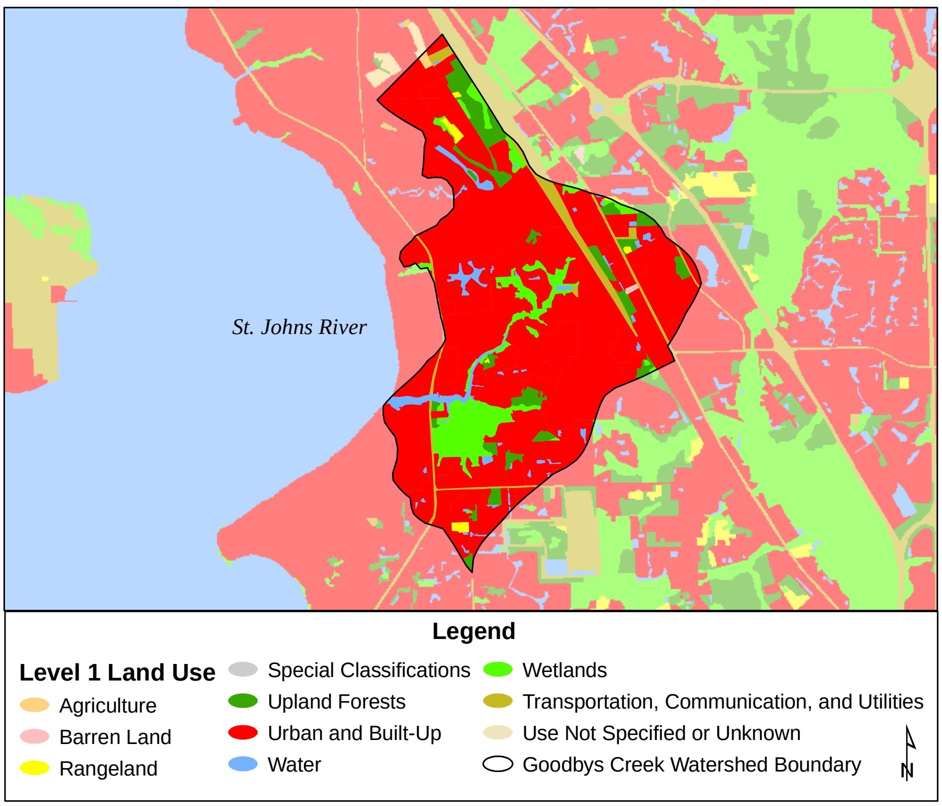
4.2.2 Land Uses and Nonpoint Sources

Additional coliform loadings to Goodbys Creek are generated from nonpoint sources in the basin. Potential nonpoint sources of coliforms include loadings from surface runoff, wildlife, pets, leaking or overflowing sewage lines, and leaking septic tanks.

Land Uses

The spatial distribution and acreage of different land use categories were identified using the 2000 land use coverage contained in the Department's Geographic Information System (GIS) library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 3 codes tabulated in **Table 4.1. Figure 4.2** shows the principle land uses in the watershed.

Figure 4.2. Principle Level 1 Land Uses in the Goodbys Creek Watershed



Being on the fringes of the City of Jacksonville, the Goodbys Creek watershed is a highly urbanized area. As shown in **Table 4.1**, the majority of the land is medium density residential (32.14 percent), followed by high density residential (25.00 percent) and commercial and services (10.68 percent). Natural land use types (pine flatwoods, streams, marshes, mixed wetland hardwoods, and wetland forested mixed, etc.) comprise 582.13 acres or only 17.85 percent of the land use in the watershed. Areas impacted by man comprise approximately 2,679.44 acres or 82.15 percent of the watershed.

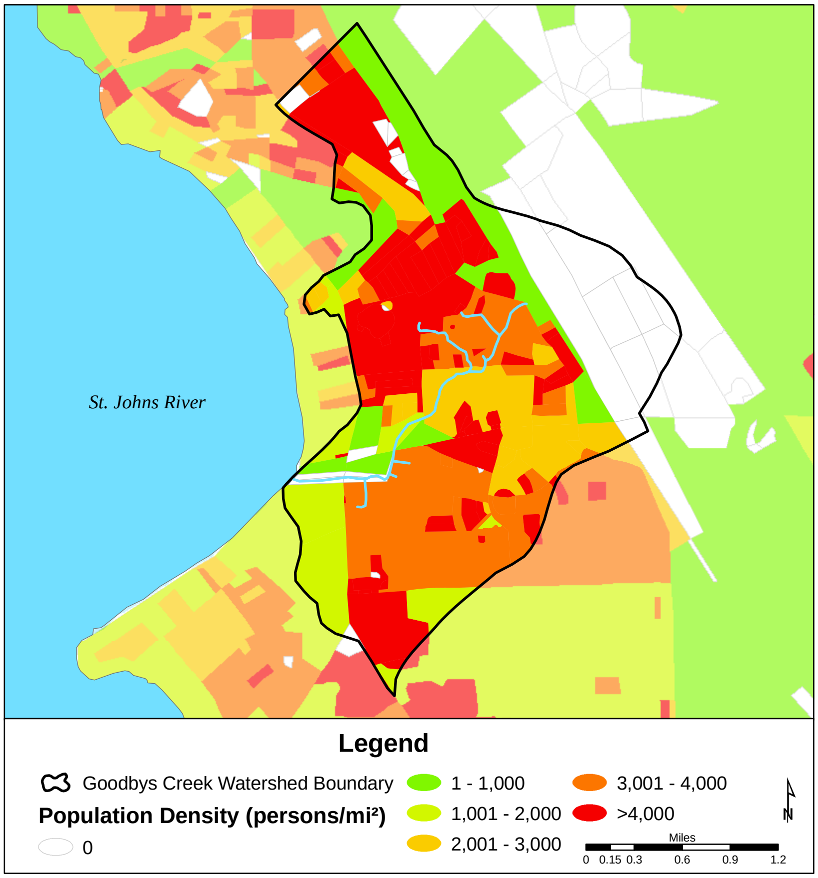
Table 4.1. Land Use Categories in the Goodbys Creek Watershed

Level 3 Land Use Code	Attribute	Acres	Percent of Watershed
1200	Residential, medium density - 2-5 dwelling units/acre	1,048.12	32.14%
1300	Residential, high density - 6 or more dwelling units/acre	815.56	25.00%
1400	Commercial and services	348.28	10.68%
6170	Mixed wetland hardwoods	185.00	5.67%
1550	Other light industrial	170.54	5.23%
4110	Pine flatwoods	121.21	3.72%
1700	Institutional	81.06	2.49%
5300	Reservoirs - pits, retention ponds, dams	63.12	1.94%
8120	Railroads	60.03	1.84%
8140	Roads and highways (divided 4-lanes with medians)	47.95	1.47%
4410	Coniferous pine	42.53	1.30%
6210	Cypress	41.31	1.27%
5100	Streams and waterways	35.74	1.10%
1100	Residential, low density - less than 2 dwelling units/acre	26.69	0.82%
1860	Community recreational facilities	20.82	0.64%
4430	Forest regeneration	18.67	0.57%
1800	Recreational	15.83	0.49%
3100	Herbaceous upland nonforested	15.79	0.48%
1820	Golf courses	15.15	0.46%
4340	Upland mixed coniferous/hardwood	12.75	0.39%
8340	Sewage treatment	10.75	0.33%
6300	Wetland forested mixed	10.15	0.31%
6460	Mixed scrub-shrub wetland	6.68	0.20%
1900	Open land	6.59	0.20%
6430	Wet prairies	6.35	0.19%
1840	Marinas & fish camps	6.32	0.19%
4200	Upland hardwood forests	6.19	0.19%
6250	Hydric pine flatwoods	5.36	0.16%
2140	Row crops	5.00	0.15%
8310	Electrical power facilities	4.63	0.14%
3200	Shrub and brushland	2.71	0.08%
7400	Disturbed land	2.70	0.08%
6410	Freshwater marshes	2.01	0.06%
	Total:	**3,261.60**	**100.00%**

Population

According to the U.S Census Bureau, census block population densities in WBID 2326 in the year 2000 ranged from 0 – 73,842 persons per square mile, with an average of 1,709 persons per square mile in the watershed **(Figure 4.3)**. Based on this density, the estimated population in the Goodbys Creek watershed would be 8,715. The Census Bureau reports that, for all of Duval County, the total population for 2000 was approximately 780,000, with 329,778 housing units and an average occupancy rate of 92.1 percent (303,747 units). For all of Duval County, the Bureau reported a housing density of 426 houses per square mile. This places Duval County seventh in housing densities and population in Florida (U.S. Census Bureau Web site, 2005).

Figure 4.3. Population Density in the Goodbys Creek Watershed



Septic Tanks

Using data supplied by the Department of Revenue and Department of Health (DoH), it is estimated that approximately 57 percent of residences within Duval County are connected to a wastewater treatment plant, with the rest utilizing septic tanks (Department of Revenue cadastral data, 2003, and DoH Website). The DoH reports that as of fiscal year 2003-2004, there were 88,834 permitted septic tanks in Duval County (DoH Website). From fiscal years 1994–2004, 4,954 permits for repairs were issued, or an average of approximately 450 repairs annually (DoH Website) countywide.

As noted previously, there are an estimated 1,709 persons/mi^2 in the WBID, or 8,175 persons in the watershed area. The average household in the Goodbys Creek watershed has 2.40 persons (see **Table 4.2**). According to the DoH, there is an annual average of 450 repairs (fiscal years 1994 – 2004) in Duval County. Based on this, there is an annual average of 3.4 failures in the Goodbys Creek watershed.

To focus on the Goodbys Creek watershed, the Department obtained septic tank repair permit data from JEA for their service area, which includes the Goodbys Creek watershed. The data include septic tank repair permit records issued from March 1990 – April 2004, areas serviced by a wastewater treatment facility (WWTF), and areas where high numbers of failing septic tanks are present. This information is presented in **Figure 4.4** in map form. The data show there were 89 permits for repairs issued during this time in the watershed, or an average of 6.4 repairs per year. This estimate is nearly double that based on the DoH countywide data.

Approximately 4.5 percent (147 acres) of the area within the watershed is considered to be in a high septic tank failure area by JEA. These are areas where a historically high number of septic tanks have failed and have the highest priority to be sewered and are known as septic tank phase out areas. Of the 89 permits issued in the watershed, 24 (27 percent) are within the septic tank phase out area.

Based on this data provided by JEA, which is more watershed specific than that of the countywide DoH data, there was an average of 6.4 permits issued annually in the watershed for septic tank repairs. If this estimate is rounded up to eight (to allow for those septic tanks where failures may not be known or have not been repaired), and using 70 gallons/day/person (U.S. Environmental Protection Agency [USEPA], 2001), a loading of 5.09 x 10^{10} counts/day is derived, or 1.86 x 10^{13} counts/year. These estimations are shown in **Table 4.3.**

Table 4.2. Estimation of Average Household Size in the Goodbys Creek Watershed Area

Household Size	Number of Households	Percentage of Total	Number of People
1-person household	997	27.48%	997
2-person household	1,301	35.85%	2,602
3-person household	593	16.35%	1,779
4-person household	456	12.57%	1,824
5-person household	197	5.43%	985
6-person household	60	1.64%	360
7-or-more-person household	24	0.67%	168
TOTAL:	**3,628**	**100.00%**	**8,715**
		AVERAGE HOUSEHOLD SIZE:	**2.40**

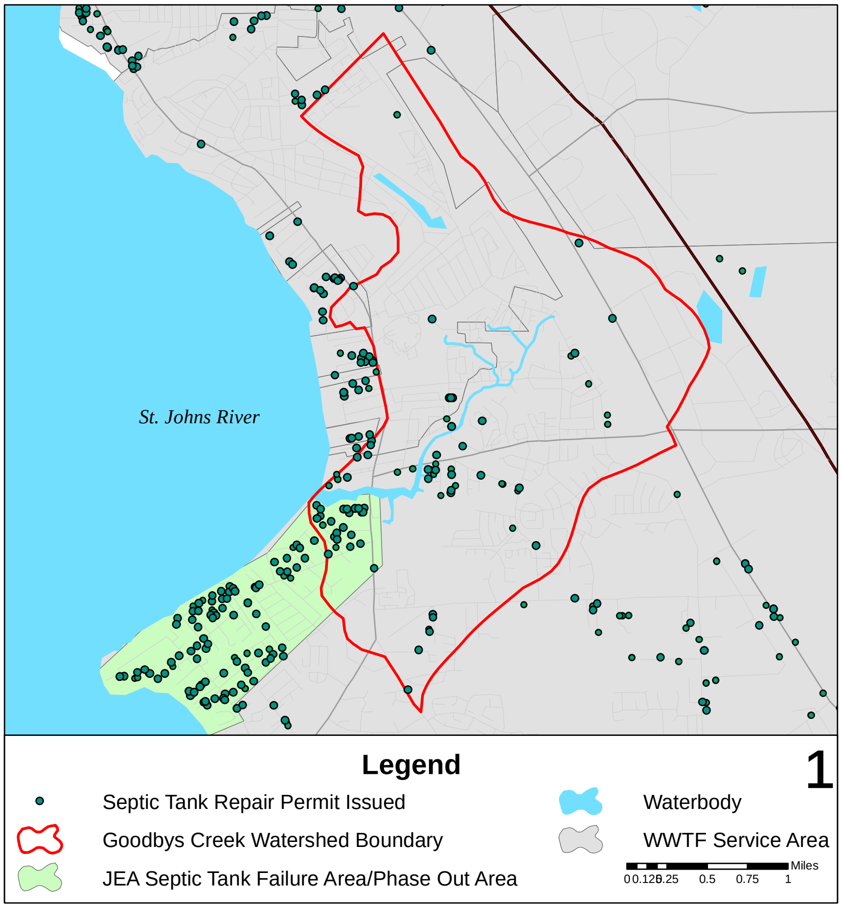
Data from U.S. Census Bureau web site, 2005, based on Duval County tracts which are present in the Goodbys Creek watershed

Table 4.3. Estimation of Fecal Coliform Loading from Failed Septic Tanks in the Goodbys Creek Watershed

Estimated Population Density	WBID Area (mi^2)	Estimated Population in Watershed	Estimated Number of Tank Failures[1]	Estimated Load From Failed Tank[2]	Gallons/ Person/ Day[2]	Estimated Number Persons Per Household[3]	Estimated Daily Load From Failing Tanks	Estimated Annual Load From Failing Tanks
1,709 persons/mi^2	5.10	8,715	8	1.00×10^4/mL	70	2.40	5.09×10^{10}	1.86×10^{13}

[1] Based on septic tank repair permits issued in the watershed from March 1990 – April 2004 (Fl. DoH and JEA information) – see text
[2] From EPA document "Protocol for Developing Pathogen TMDLs."
[3] From U.S Census Bureau, see Table 4.2 for more information on this estimate.

Figure 4.4. Septic Tank Repair Permits Issued March 1990 – April 2004 for Goodbys Creek Area



Agricultural Sources

According to Level 3 land use there are no agricultural areas in the Goodbys Creek watershed. As noted in **Section 4.2.2** the majority of the land use (82.15 percent) consists of residential, commercial and services, and other types impacted by humans.

Pets

Because the area is highly urbanized with a large number of people per square mile, it is very possible that pets, especially dogs, have an impact on the waterbody. The Department has been unable to obtain data on the number of dogs in the area; however, estimates can be made using literature based values of dog ownership rates (**Table 4.4)**. For example, using household-to-dog ratio estimates from the American Veterinary Medical Association (AVMA), and assuming that coliforms from10 percent of dogs reach the waterbody and are viable upon reaching it, the approximate loading would be 6.55×10^{11} counts/day, or 2.39×10^{14} counts/year. This is an estimate, as the actual loading from dogs is not known.

Table 4.4. Estimated Loading from Dogs in the Goodbys Creek Watershed

Pet	Estimated Number of Households	Estimated Household:Pet Ratio[1]	Estimated Total Dog Population in Watershed	Estimated Loading of Total	Estimated No. of Pets with Impact to Creek	Estimated (counts/pet/day[2])	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
Dogs	3,628	0.361	1,310	10%	131	5×10^9	6.55×10^{11}	2.39×10^{14}

[1]From the American Veterinary Medical Association website, which states the original source to be the "U.S Pet Ownership and Demographics Sourcebook," 2002.
[2]From EPA document, "Protocol for Developing Pathogen TMDLs," 2001.

Leaking or Overflowing Wastewater Collection Systems

As noted previously, it has been estimated that 57 percent of households in Duval County are connected to wastewater facilities. Assuming 3,628 homes in the watershed, with 2.40 people per home, and a 70 gallon per person per day discharge, and also assuming that the countywide average of 57 percent are connected to a WWTF applies to the Goodbys Creek watershed, a daily flow of approximately 1.66×10^5 L (0.438 MGD) is transported through the collection system. The EPA Protocol for Developing Pathogen TMDLs (EPA, 2001) suggests that a 5% leakage rate from collection systems is realistic. Based on this rate and EPA values for fecal coliforms in raw sewage, the potential loadings of fecal coliforms from leaking sewer lines is 4.15×10^{12} counts/day (1.51×10^{15} counts/year) (**Table 4.5**).

Table 4.5. Estimated Loading from the Wastewater Collection Systems

Coliform	Estimated Homes on Central Sewer	Estimated Daily Flow (L)	Daily Leakage (L)	Raw Sewage (counts/100ml)	Estimated (counts/day)	Estimated (counts/year)
Fecal	2,608	1.66×10^5	8.29×10^3	5×10^6	4.15×10^{12}	1.51×10^{15}

Table 4.6 summarizes the various estimates from various sources. It is important to note that this is not a complete list (wildlife, for example, is missing) and represents estimates of potential loadings. Proximity to the waterbody, rainfall frequency and magnitude, and temperature are just a few of the factors that could influence and determine the actual loadings from these sources that reach Goodbys Creek.

Table 4.6. Summary of Estimated Potential Coliform Loading From Various Sources in the Butcher Pen Creek Watershed

Source	Estimated Daily Load (counts/day)	Estimated Annual Load (counts/year)
Point Sources	N/A*	N/A*
Septic Tanks	5.09×10^{10}	1.86×10^{13}
Pets	6.55×10^{11}	2.39×10^{14}
Collection Systems	4.15×10^{12}	1.51×10^{15}

* There are currently no permitted facilities required to monitor for coliforms

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The methodology used for this TMDL was the "percent reduction" methodology. The Department generally prefers to use the load duration curve or "Kansas" method for coliform TMDLs, but this method could not be used because there are no stream gauging stations on Goodbys Creek. To determine the TMDL, the percent reduction that would be required for each of the exceedances to meet applicable criteria was determined, and the median value of all of these reductions for both fecal and total coliforms determined the overall required reduction, and therefore the TMDL.

5.1.1 Data Used in the Determination of the TMDL

There are seven sampling stations in Goodbys Creek that have historical coliform observations **(Figure 5.1)**; however, four of the stations have only been visited once, while another two have only been visited twice. The primary collector of historical data is the City of Jacksonville, which maintained a routine sampling site at Sanchez Road (STORET ID: SS319). Some data were also collected by the Department. The creek was sampled quarterly for the most part from 1991 – 2002 by the City of Jacksonville. **Table 5.1** shows data collection information for each of the stations, and **Figure 5.1** shows the location of the sample sites. **Figure 5.2** is a chart showing the observed historical data analysis, and **Appendix B** contains the historical fecal coliform observations from the sites. All exceedances in the IWR were used to calculate the TMDL.

Table 5.1. Sampling Station Summary for the Goodbys Creek Watershed

Station	STORET ID	Station Owner[1]	Years With Data	N
GOODBYS CR SR-13	21FLA 20030518	FDEP	1999; 2002	2
GOODBYS CREEK AT SAN CLERC ROAD	21FLA 20030538	FDEP	1999; 2002	2
GOODBYS CREEK AT SANCHEZ RD	21FLA 20030594	FDEP	1999	1
GOODBYS CREEK AT CAMP TOMMYHAWK	21FLA 20030599	FDEP	1999	1
GOODBY'S CREEK AT BAYMEADOWS ROAD	21FLJXWQSS29	COJ	1992	1
GOODBY'S CREEK AT SAN CLERC ROAD WEST BRANCH	21FLJXWQSS318	COJ	1992	1
GOODBYS CREEK AT SANCHEZ ROAD	21FLJXWQSS319	COJ	1991 - 1996; 1998 - 2002	40

[1]FDEP = Fl. Dept. of Env. Prot.; COJ = City of Jacksonville

Table 5.2. Statistical Table of Observed Historical Data for Goodbys Creek

Station	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedance
GOODBYS CR SR-13	2	63	720	392	392	1	50.00%
GOODBYS CREEK AT SAN CLERC ROAD	2	210	770	490	490	1	50.00%
GOODBYS CREEK AT SANCHEZ RD	1	80	80	80	80	0	0.00%
GOODBYS CREEK AT CAMP TOMMYHAWK	1	120	120	120	120	0	0.00%
GOODBY'S CREEK AT BAYMEADOWS ROAD	1	300	300	300	300	0	0.00%
GOODBY'S CREEK AT SAN CLERC ROAD WEST BRANCH	1	2,200	2,200	2,200	2,200	1	100.00%
GOODBYS CREEK AT SANCHEZ ROAD	40	30	35,000	1,500	4,799	26	65.00%

Coliform concentrations are counts/100 mL

Figure 5.1. Historical Sample Sites in Goodbys Creek Watershed

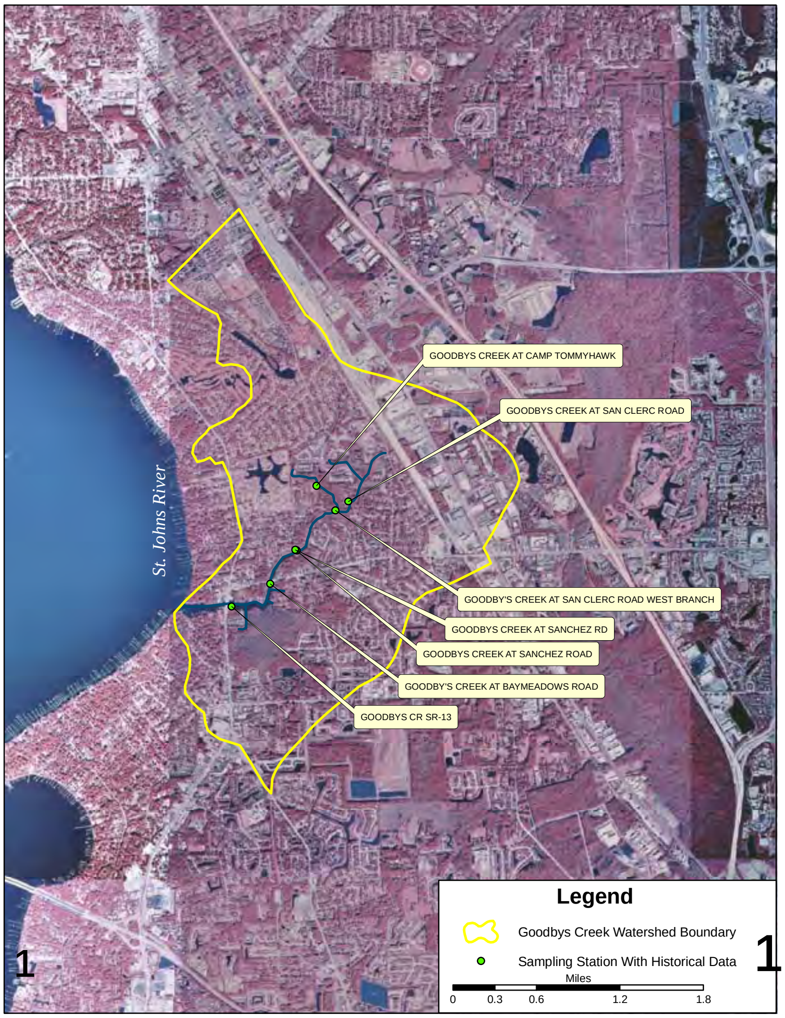
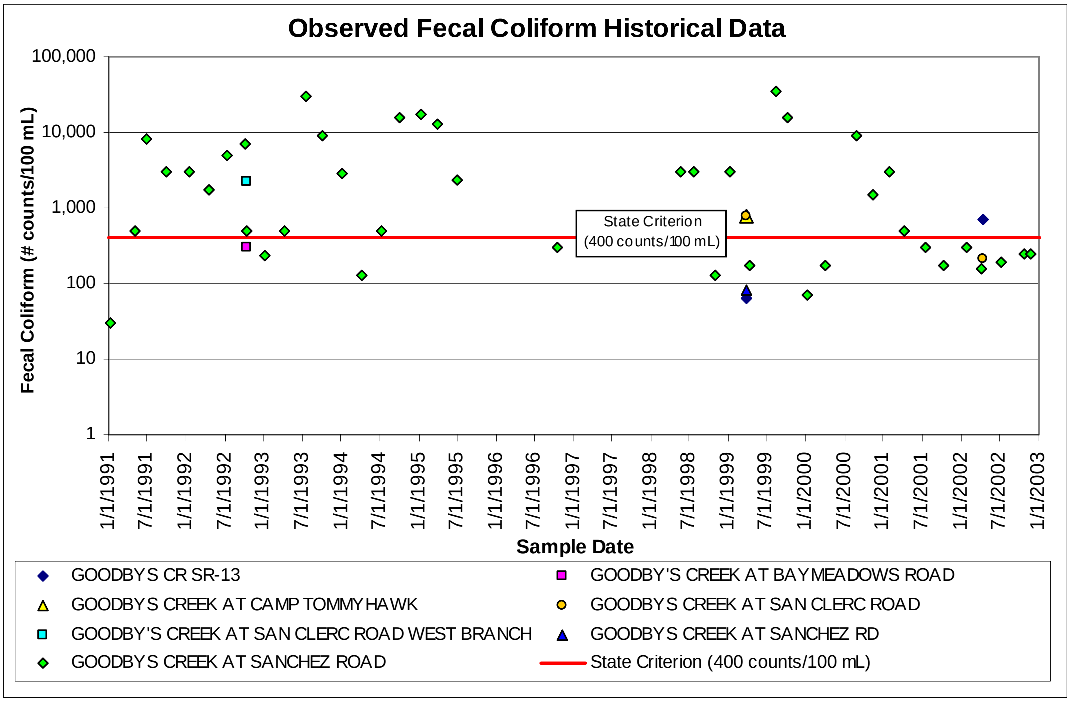


Figure 5.2. Historical Observations for Goodbys Creek



5.1.2 TMDL Development Process

Due to the lack of supporting information flow data, a simple calculation was performed to determine the needed reduction. Exceedances of the state criterion were compared to the criterion of 400 counts/100mL. For each individual exceedance, an individual required reduction was calculated using the following:

$$\frac{[(\text{observed value}) - (\text{state criterion})] \times 100}{(\text{observed value})}$$

After the individual results were calculated, the median of the individual values was calculated, which is 87 percent. This means that in order to meet the state criterion of 400 counts/100mL, an 87 percent reduction in current loading is necessary, and is therefore the TMDL for Goodbys Creek. **Table 5.3** shows annual summaries of data used in the calculation of the TMDL, and **Table 5.4** shows the individual reduction calculations for Goodbys Creek, which includes all exceedances.

Table 5.3. Annual Summary of Historical Observed Fecal Coliform Exceedances in Goodbys Creek

Year	N	Minimum	Maximum	Median	Mean
1991	3	500	8,000	3,000	3,833
1992	6	500	7,000	2,600	3,233
1993	3	500	30,000	9,000	13,167
1994	3	500	16,000	2,800	6,433
1995	3	2,400	17,000	13,000	10,800
1998	2	3,000	3,000	3,000	3,000
1999	4	770	35,000	9,500	13,693
2000	2	1,500	9,000	5,250	5,250
2001	2	500	3,000	1,750	1,750
2002	1	720	720	720	720

Coliform counts are #/100 mL and represent years for which data exists

Table 5.4. Calculation of Reductions for the Fecal Coliform TMDL for Goodbys Creek

Sample Date	Location	Observed Value (Exceedance)	Required Reduction
5/1/1991	GOODBYS CREEK AT SANCHEZ ROAD	500	20.00%
7/1/1991	GOODBYS CREEK AT SANCHEZ ROAD	8,000	95.00%
10/1/1991	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
1/13/1992	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
4/20/1992	GOODBYS CREEK AT SANCHEZ ROAD	1,700	76.47%
7/13/1992	GOODBYS CREEK AT SANCHEZ ROAD	5,000	92.00%
10/5/1992	GOODBYS CREEK AT SANCHEZ ROAD	7,000	94.29%
10/13/1992	GOODBY'S CREEK AT SAN CLERC ROAD WEST BRANCH	2,200	81.82%
10/13/1992	GOODBYS CREEK AT SANCHEZ ROAD	500	20.00%
4/6/1993	GOODBYS CREEK AT SANCHEZ ROAD	500	20.00%
7/15/1993	GOODBYS CREEK AT SANCHEZ ROAD	30,000	98.67%
10/4/1993	GOODBYS CREEK AT SANCHEZ ROAD	9,000	95.56%
1/4/1994	GOODBYS CREEK AT SANCHEZ ROAD	2,800	85.71%
7/11/1994	GOODBYS CREEK AT SANCHEZ ROAD	500	20.00%
10/3/1994	GOODBYS CREEK AT SANCHEZ ROAD	16,000	97.50%
1/10/1995	GOODBYS CREEK AT SANCHEZ ROAD	17,000	97.65%
4/3/1995	GOODBYS CREEK AT SANCHEZ ROAD	13,000	96.92%
7/3/1995	GOODBYS CREEK AT SANCHEZ ROAD	2,400	83.33%
5/19/1998	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
7/20/1998	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
1/11/1999	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
3/24/1999	GOODBYS CREEK AT SAN CLERC ROAD	770	48.05%
8/16/1999	GOODBYS CREEK AT SANCHEZ ROAD	35,000	98.86%
10/6/1999	GOODBYS CREEK AT SANCHEZ ROAD	16,000	97.50%
8/29/2000	GOODBYS CREEK AT SANCHEZ ROAD	9,000	95.56%
11/14/2000	GOODBYS CREEK AT SANCHEZ ROAD	1,500	73.33%
1/29/2001	GOODBYS CREEK AT SANCHEZ ROAD	3,000	86.67%
4/10/2001	GOODBYS CREEK AT SANCHEZ ROAD	500	20.00%
4/17/2002	GOODBYS CR SR-13	720	44.44%
	MEDIAN:	**3,000**	**86.67%**

5.1.3 Critical Conditions/Seasonality

Exceedances in Goodbys Creek cannot be associated with flows, as no flow data within the basin have been reported. Therefore, the effects of flow under various conditions cannot be determined or be considered as a critical condition.

Historical fecal coliform observations in Goodbys Creek are provided in **Appendix B**. Coliform data have been presented by month, season, and year to determine whether certain patterns are evident in the data set.

A non-parametric test (Kruskal-Wallis) was applied to the fecal coliform dataset to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, there are significant differences among months and seasons (**Appendices C,** and **D**). It is very difficult to evaluate possible patterns among months due to the small sample sizes. For example, the range in monthly observations for fecal coliforms varies from 0 to 20 in a given month, with eight months having less than six observations. Grouping observations by season increased sample sizes for statistical comparison and, as seen in **Table 2.2**, summer (July – September) has the highest exceedance rate (60.0 percent). Comparisons of station and seasons are presented in **Appendix E**. A likely factor that could contribute to these monthly or seasonal differences would be the pattern of rainfall.

Precipitation records for the Jacksonville International Airport (JIA) (**Appendix F** illustrates rainfall from 1990 – 2004) were used to determine rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (1D), the cumulative total for the day of and the previous two days (3D), the cumulative total for the day of and the previous six days (7D) were all paired with the respective coliform observation. A Spearman Correlation matrix was generated that summarized the simple correlation coefficients between the various rainfall regimes and coliform values (**Appendix G**). The simple correlations (r values in the Spearman Correlation table) between both fecal coliforms and the various rainfall totals were positive, suggesting that as rainfall (and possible runoff) increased, so did the number of coliforms.

Simple linear regressions were performed between coliform observations and rainfall totals to determine whether any of the relationships were significant at an α level of 0.05. Although the r^2 values were low, the correlations between fecal coliforms showed no significant difference (**Appendix H**). A table of historical monthly average rainfall (**Appendix I**) indicates that monthly rainfall totals increase in June and peak in September and by October return to levels observed in February and March. The highest amounts of precipitation historically fall in the summer months, which is when the highest percentage of exceedances is seen in Goodbys Creek. **Appendix J** includes a graph of annual rainfall over the 1955 – 2004 period versus the long-term average (52.27 inches) over this period.

Since no flow data was available, hydrologic conditions were analyzed using rainfall. A loading curve type chart, that would normally be applied to flow events, was created using precipitation data from JIA from 1990 – 2004 instead. The chart was divided in the same manner as if flow was being analyzed, where extreme precipitation events represent the upper percentiles (0-5th percentile), followed by large precipitation events (5th – 15th percentile), medium precipitation events (15th – 40th percentile), small precipitation events (40th – 60th percentile), and no recordable precipitation events

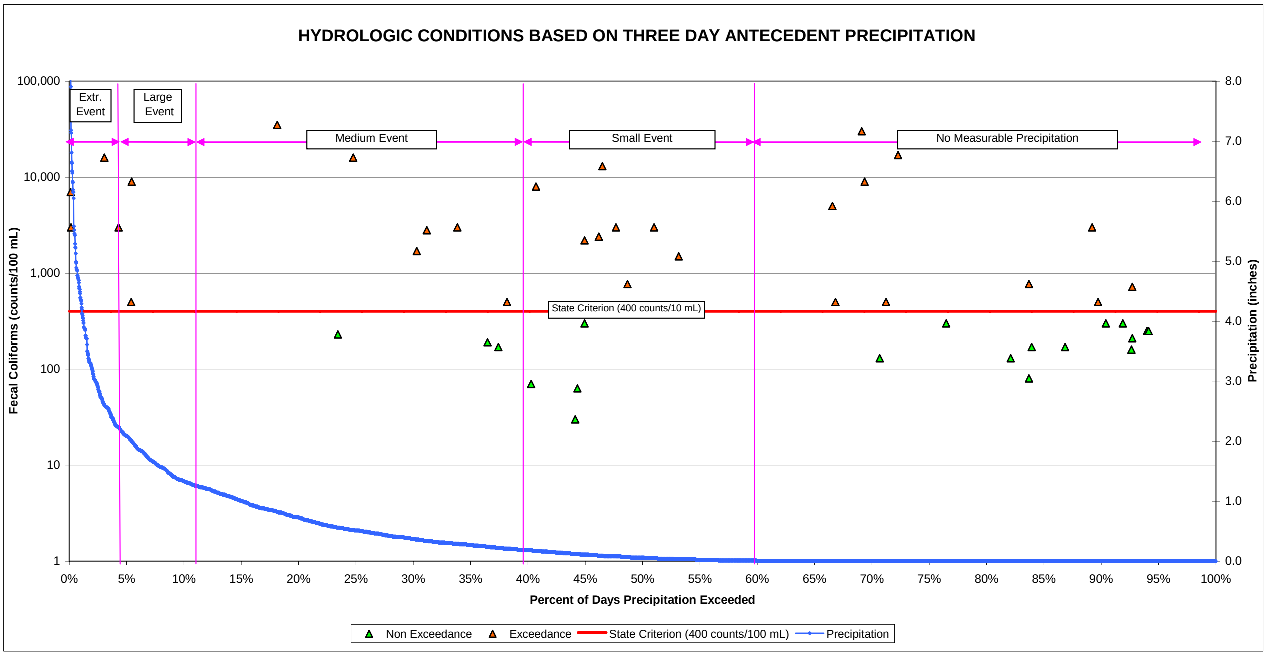
(60^{th} – 100^{th} percentile). Three day (day of and two days prior) precipitation accumulations were used in the analysis.

Data show that fecal coliform exceedances occurred over all hydrologic conditions; however, the least percentage of exceedances (45.45 percent) occurred when no measurable rainfall was reported. The greatest percentage of exceedances (100 percent) occurred after extreme and large precipitation events. If a large percentage of exceedances occur during no measurable precipitation days, it is suspected that point sources are contributing. Likewise, if a large percentage of exceedances are found to be occurring after large and extreme precipitation events, this may indicate that exceedances are more nonpoint source driven; perhaps from stormwater conveyance systems or various land uses. Although sample size is smaller within the extreme, large, and medium event ranges, the data suggest that nonpoint sources may be contributing heavily to exceedances, although there is most likely some influence from point sources as well. **Table 5.4** is a summary of data and hydrologic conditions. **Figure 5.3** shows the same data visually.

Table 5.5. Summary of Fecal Coliform Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Excedances	Percent Non-Exceedance
Extreme	>2.1"	4	4	100.00%	0	0.00%
Large	1.33" - 2.1"	2	2	100.00%	0	0.00%
Medium	0.18" - 1.33"	9	6	66.67%	3	33.33%
Small	0.01" - 0.18"	12	8	66.67%	4	33.33%
None/Not Measurable	<0.01"	22	10	45.45%	12	54.55%

Figure 5.3. Fecal Coliform Data by Hydrological Condition Based on Antecedent Precipitation



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:

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. TMDLs for Goodbys Creek are expressed in terms of counts per 100 mL and percent reduction, and represent the maximum daily fecal coliform load the creek can assimilate and maintain the fecal coliform criterion **(Table 6.1).**

Table 6.1. TMDL Components for Goodbys Creek

WBID	Parameter	TMDL (counts/100 mL)	WLA		LA (Percent Reduction)	MOS
			Wastewater (counts/day)	NPDES Stormwater		
2326	Fecal Coliform	400	N/A	87%	87%	Implicit

6.2 Load Allocation (LA)

A fecal coliform reduction of 87 percent is required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

As mentioned previously, there are two permitted facilities permits in the Goodbys Creek watershed. However, neither facility is expected to be a source of coliforms or have reasonable potential to exceed the coliform criteria. As such, no WLA has been assigned to either facility. As part of this TMDL, any future wastewater discharge permits issued within the Hogan Creek watershed will be required to meet state Class III criteria for fecal coliforms as well as the TMDL value, and therefore will not be allowed to exceed fecal coliform levels of 200 counts/100 mL as a monthly average or 400 counts/100 mL more than 10% of the time.

Deleted: basin

6.3.2 NPDES Stormwater Discharges

The WLA for the City of Jacksonville and FDOT's Municipal Separate Storm Sewer System (MS4) permit is an 87 percent reduction in current anthropogenic fecal coliform loading from the MS4. It should be noted that any MS4 permittee will only be responsible for reducing the loads associated with stormwater outfalls for which it owns or otherwise has responsible control, and is not responsible for reducing other nonpoint source loads within its jurisdiction.

6.4 Margin of Safety (MOS)

Consistent with the recommendations of the Allocation Technical Advisory Committee (FDEP, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. A MOS was included in the TMDL by not allowing any exceedances of the state criterion, even though intermittent natural exceedances of the criterion would be expected and would be taken into account when determining impairment. Additionally, the TMDL calculated was based on meeting the water quality criterion of 400 counts/100 mL without any exceedances, while the actual criterion allows for 10 percent exceedances over the criterion.

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 Goodbys Creek. 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:

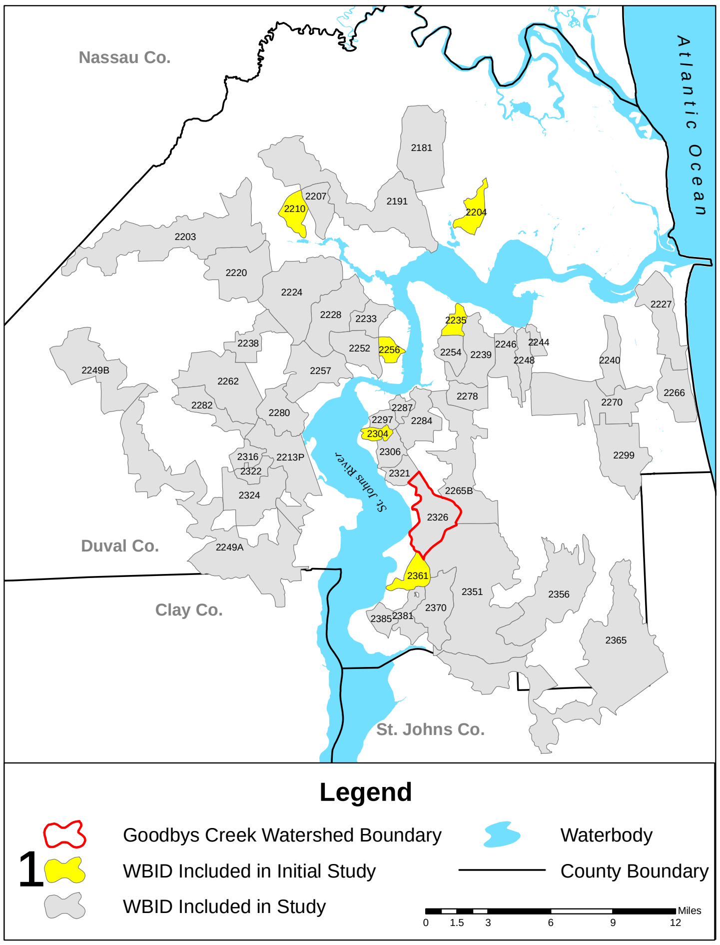
- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken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

The BMAP for Goodbys Creek will include the results of a project funded by JEA that will consider 51 drainage basins in the general area of the City of Jacksonville, which includes Goodbys Creek. The project, known as the Tributary Pollution Assessment Project (TPAP), is directed by a Tributary Assessment Team (TAT) consisting of representatives from JEA, the Department, City of Jacksonville, Duval County Health Department, Water and Sewer Expansion Authority, U.S. Army Corps of Engineers, St. Johns River Keepers, and PBS & J, who is the primary contractor for the project.

The goal of the TPAP is to devise a standard manual that can be used for tributary sanitary surveys in the Duval County area. The manual will be developed by studying 6 of the 51 watersheds deemed to be of the highest priority by JEA and the contractors, along with a control watershed. After the manual has been developed, it will be applied to the remaining 45 watersheds, and may then be expanded to other watersheds in the Duval County area. The manual will be used to help better determine the health of these watersheds and to determine potential sources of contamination, especially with respect to fecal coliforms. This will help JEA, who is the sewer utility provider in the area, concentrate repair efforts and to identify those areas where failing septic tanks may be playing a role in contamination. The drainage basins included in this initial study are shown in **Figure 7.1**, and include:

- Big Davis Creek (2356)
- Big Fishwier Creek (2280)
- Blockhouse Creek (2207)
- Broward River (2191)
- Butcher Pen Creek (2322)
- Cedar River (2262)
- Christopher Branch (2321)
- Cormorant Branch (2381)
- Cow Head Creek (2244)
- Craig Creek (2297)
- Deep Bottom Creek (2361)
- Deer Creek (2256)
- Dunn Creek (2181)
- Durbin Creek (2365)
- Fishing Creek (2324)
- Gin House Creek (2248)
- Goodbys Creek (2236)
- Greenfield Creek (2240)
- Hogan Creek (2252)
- Hogpen Creek (2270)
- Hopkins Creek (2266)
- Jones Creek (2246)
- Julington Creek (2351)
- Little Potsburg Creek (2284)
- Little Sixmile Creek (2238)
- Long Branch (2233)
- Mandarin Drain (2385)
- McCoy Creek (2257)
- McGirts Creek (2249B)
- Mill Creek (2287)
- Moncrief Creek (2228)
- New Castle Creek (2235)
- New Rose Creek (2306)
- Nine Mile Creek (2220)
- Oldfield Creek (2370)
- Open Creek (2299)
- Ortega River (2213P)
- Ortega River (2249A)

Figure 7.1. Map of WBIDs included in the TPAP study



The WBIDs included in this study have been categorized based on the primary land use (SJRWMD 2000 data) in the WBID – urban, suburban, or rural. Further efforts were made to identify potential sources of fecal coliform contamination based on land uses, JEA information, and survey data. The WBIDs were then prioritized based on this, as well as existing data. Six WBIDs of highest concern were selected for the initial study (3 urban, 2 suburban, and 1 rural). At the time this document was compiled, a control waterbody had yet to be selected.

Initial sampling for the study is set to begin on the six initial WBIDs on July 26, 2005 and end on February 1, 2006. The final deliverable (manual) will be submitted to JEA on June 1, 2006, and will be available for public review and comment on June 16, 2006. Four types of fecal indicators (fecal coliforms, *E. coli*., *Enterococci*, and coliphages) will be studied. *Enterococcus faecalis* will be studied in an attempt to further identify potential sources of sewage, and samples will be checked for human/ruminant primers. In addition, optical brighteners (using fluorometric techniques) will be included to bolster potential sewage sources input identification.

The executive summary submitted to the Department by JEA and PBS & J is attached as **Appendix K**. It is expected that the results of this study will be used to help guide identification of restoration projects during BMAP development. In addition to addressing failing septic tanks, BMAP plans may include some sort of public education in picking up after dogs. As **Table 4.5** shows, potential impacts from dogs and cats could be significant. If pet owners are educated on the potential impacts their pets are having on Goodbys Creek, and they are inclined to take action, this could potentially decrease a source load.

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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.

Appendix B: Historical Fecal Coliform Observations in Goodbys Creek

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
GOODBYS CREEK	2326	1/9/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	30	
GOODBYS CREEK	2326	1/9/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	30	
GOODBYS CREEK	2326	1/13/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/13/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/4/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	230	
GOODBYS CREEK	2326	1/4/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	230	
GOODBYS CREEK	2326	1/4/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	2,800	
GOODBYS CREEK	2326	1/4/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	2,800	
GOODBYS CREEK	2326	1/10/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	17,000	
GOODBYS CREEK	2326	1/10/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	17,000	
GOODBYS CREEK	2326	1/11/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/11/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/5/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	70	
GOODBYS CREEK	2326	1/5/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	70	
GOODBYS CREEK	2326	1/29/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/29/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	1/29/2002	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	300	
GOODBYS CREEK	2326	3/24/1999	21FLA 20030518	GOODBYS CR " SR-13	63	
GOODBYS CREEK	2326	3/24/1999	21FLA 20030538	GOODBYS CREEK AT SAN CLERC ROAD	770	
GOODBYS CREEK	2326	3/24/1999	21FLA 20030593	GOODBYS CREEK AT BAYMEADOWS RD	80	
GOODBYS CREEK	2326	3/24/1999	21FLA 20030594	GOODBYS CREEK AT SANCHEZ RD	80	
GOODBYS CREEK	2326	3/24/1999	21FLA 20030599	GOODBYS CREEK AT CAMP TOMMYHAWK	120	
GOODBYS CREEK	2326	4/20/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	1,700	
GOODBYS CREEK	2326	4/20/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	1,700	
GOODBYS CREEK	2326	4/6/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	4/6/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	4/4/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	130	
GOODBYS CREEK	2326	4/4/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	130	
GOODBYS CREEK	2326	4/3/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	13,000	
GOODBYS CREEK	2326	4/3/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	13,000	
GOODBYS CREEK	2326	4/13/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	4/13/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	4/4/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	4/4/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	4/10/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	4/10/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	4/8/2002	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	160	
GOODBYS CREEK	2326	4/17/2002	21FLA 20030518	GOODBYS CR " SR-13	720	
GOODBYS CREEK	2326	4/17/2002	21FLA 20030538	GOODBYS CREEK AT SAN CLERC ROAD	210	
GOODBYS CREEK	2326	5/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	5/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	5/19/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	5/19/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	7/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	8,000	
GOODBYS CREEK	2326	7/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	8,000	
GOODBYS CREEK	2326	7/13/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	5,000	
GOODBYS CREEK	2326	7/13/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	5,000	

WATERBODY	WBID	SAMPLE DATE	STATION	LOCATION	VALUE (#/100mL)	REMARK CODE
GOODBYS CREEK	2326	7/15/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	30,000	
GOODBYS CREEK	2326	7/15/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	30,000	
GOODBYS CREEK	2326	7/11/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	7/11/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	7/3/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	2,400	
GOODBYS CREEK	2326	7/3/1995	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	2,400	
GOODBYS CREEK	2326	7/20/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	7/20/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	7/17/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	300	
GOODBYS CREEK	2326	7/17/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	300	
GOODBYS CREEK	2326	7/8/2002	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	190	
GOODBYS CREEK	2326	8/16/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	35,000	
GOODBYS CREEK	2326	8/16/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	35,000	
GOODBYS CREEK	2326	8/29/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	9,000	
GOODBYS CREEK	2326	8/29/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	9,000	
GOODBYS CREEK	2326	10/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	10/1/1991	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	3,000	
GOODBYS CREEK	2326	10/5/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	7,000	
GOODBYS CREEK	2326	10/5/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	7,000	
GOODBYS CREEK	2326	10/13/1992	21FLJXWQSS29	GOODBY'S CREEK AT BAYMEADOWS ROAD	300	
GOODBYS CREEK	2326	10/13/1992	21FLJXWQSS318	GOODBY'S CREEK AT SAN CLERC ROAD WEST BRANCH	2,200	
GOODBYS CREEK	2326	10/13/1992	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	500	
GOODBYS CREEK	2326	10/4/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	9,000	
GOODBYS CREEK	2326	10/4/1993	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	9,000	
GOODBYS CREEK	2326	10/3/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	16,000	L
GOODBYS CREEK	2326	10/3/1994	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	16,000	L
GOODBYS CREEK	2326	10/15/1996	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	300	
GOODBYS CREEK	2326	10/15/1996	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	300	
GOODBYS CREEK	2326	10/27/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	130	
GOODBYS CREEK	2326	10/27/1998	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	130	
GOODBYS CREEK	2326	10/6/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	16,000	
GOODBYS CREEK	2326	10/6/1999	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	16,000	
GOODBYS CREEK	2326	10/10/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	10/10/2001	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	170	
GOODBYS CREEK	2326	10/28/2002	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	250	
GOODBYS CREEK	2326	11/14/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	1,000	
GOODBYS CREEK	2326	11/14/2000	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	2,000	
GOODBYS CREEK	2326	11/25/2002	21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD	250	

Shaded cells are values which exceed the state criterion of 400 counts/100 mL

Remark Codes: L – Off-scale high. Actual value not known, but known to be greater then value shown

NOTE: Some samples were seen as duplicates (i.e. same date and location) and were averaged, per the IWR, for TMDL determination. Appendix B includes all data contained in the IWR database. For this reason, some discrepancies may exist between Appendix B and tables contained in the text.

Appendix C: Kruskall – Wallis Analysis of Fecal Coliform Observations versus Season in Goodbys Creek

The following results are for:
WBID$ = 2326

Categorical values encountered during processing are:
SEASON2 (4 levels)
1, 2, 3, 4

Kruskal-Wallis One-Way Analysis of Variance for 85 cases
Dependent variable is VALUE
Grouping variable is SEASON2

Group	Count	Rank Sum
1	22	758.500
2	21	731.000
3	19	1104.000
4	23	1061.500

Kruskal-Wallis Test Statistic = 12.491
Probability is 0.006 assuming Chi-square distribution with 3 df

Appendix D: Kruskall – Wallis Analysis of Fecal Coliform Observations versus Month in Goodbys Creek

The following results are for:
WBID$ = 2326

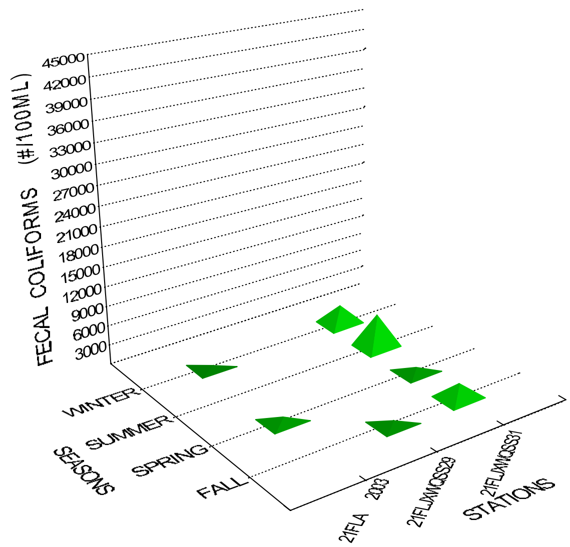
Categorical values encountered during processing are:
MONTH (8 levels)
1, 3, 4, 5, 7, 8, 10, 11

Kruskal-Wallis One-Way Analysis of Variance for 85 cases
Dependent variable is VALUE
Grouping variable is MONTH

Group	Count	Rank Sum
1	17	692.500
3	5	66.000
4	17	544.000
5	4	187.000
7	15	792.000
8	4	312.000
10	20	948.000
11	3	113.500

Kruskal-Wallis Test Statistic = 22.190
Probability is 0.002 assuming Chi-square distribution with 7 df

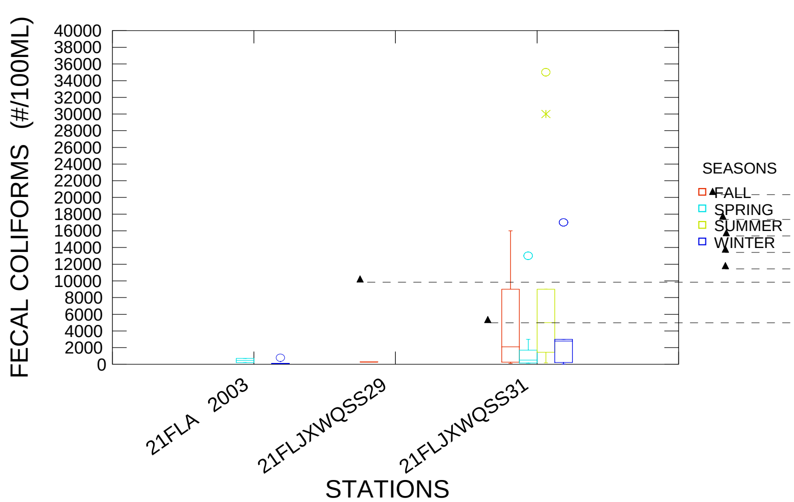
Appendix E: Fecal Coliform Observations versus Season and Station in Goodbys Creek



STORET ID	Station
21FLJXWQSS29	GOODBY'S CREEK AT BAYMEADOWS ROAD
21FLJXWQSS319	GOODBYS CREEK AT SANCHEZ ROAD
21FLA 20030518	GOODBYS CR SR-13
21FLA 20030538	GOODBYS CREEK AT SAN CLERC ROAD

* Not all stations had enough data to analyze

FECAL COLIFORMS BY SITE AND SEASON



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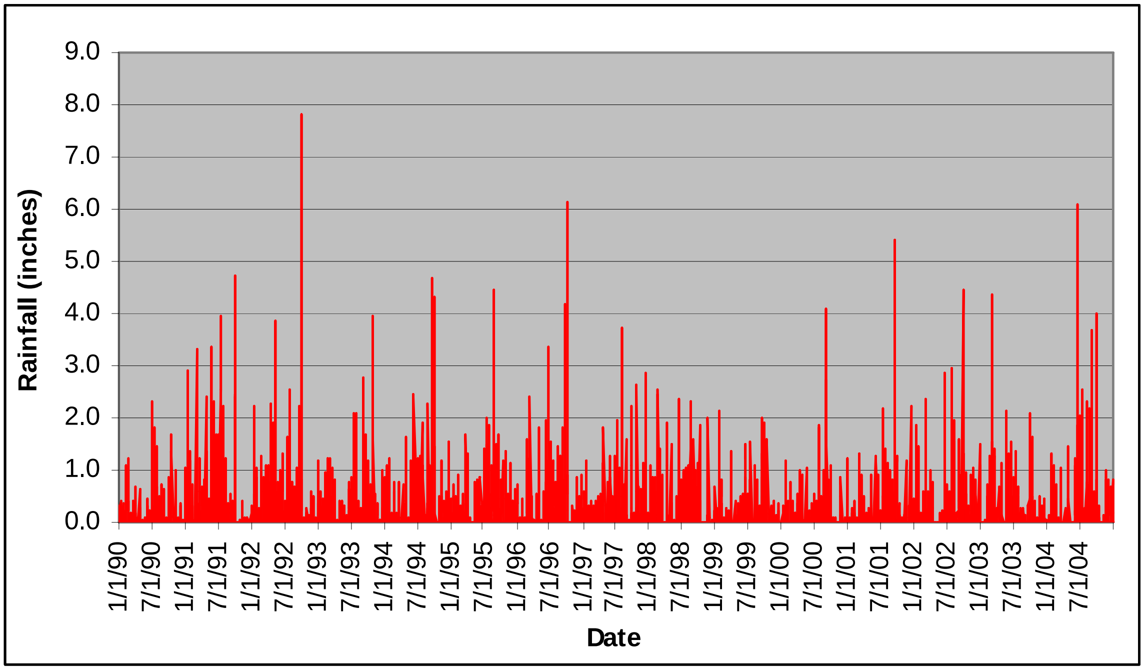
Appendix F: Chart of Rainfall for Jacksonville International Airport (JIA) from 1990 – 2004

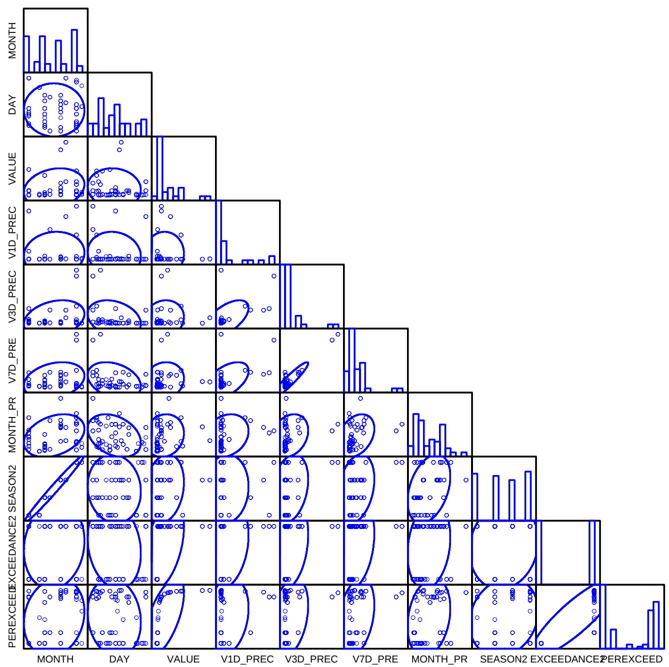


Appendix G: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliforms in Butcher Pen Creek

The following results are for:
WBID$ = 2326
Spearman correlation matrix

	MONTH	DAY	VALUE	V1D_PREC	V3D_PREC
MONTH	1.000				
DAY	-0.004	1.000			
VALUE	0.250	-0.133	1.000		
V1D_PREC	0.180	-0.195	0.171	1.000	
V3D_PREC	0.105	-0.410	0.337	0.664	1.000
V7D_PRE	0.067	-0.333	0.411	0.416	0.610
MONTH_PR	0.331	-0.325	0.280	0.220	0.368
SEASON2	0.985	-0.065	0.258	0.145	0.103
EXCEEDANCE2	0.127	-0.171	0.836	0.197	0.364
PEREXCEED	0.184	-0.160	0.976	0.156	0.357

	V7D_PRE	MONTH_PR	SEASON2	EXCEEDANCE2	PEREXCEED
V7D_PRE	1.000				
MONTH_PR	0.384	1.000			
SEASON2	0.096	0.384	1.000		
EXCEEDANCE2	0.355	0.191	0.121	1.000	
PEREXCEED	0.380	0.230	0.185	0.857	1.000



Appendix H: Analysis of Fecal Coliform Observations versus Precipitation in Goodbys Creek

FECAL COLIFORM DATA VERSUS DAY (1 day) OF SAMPLING PRECIPITATION

The following results are for:
WBID$ = 2326

Dep Var: VALUE N: 85 Multiple R: 0.026 Squared multiple R: 0.001

Adjusted squared multiple R: 0.000 Standard error of estimate: 7833.665

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4586.806	910.262	0.000	.	5.039	0.000
V1D_PREC	326.704	1391.915	0.026	1.000	0.235	0.815

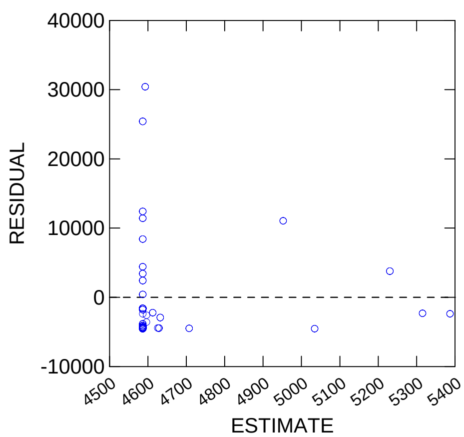
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	3380756.733	1	3380756.733	0.055	0.815
Residual	5.09340E+09	83	6.13663E+07		

*** WARNING ***
Case 2228 has large leverage (Leverage = 0.167)
Case 2229 has large leverage (Leverage = 0.167)
Case 2245 is an outlier (Studentized Residual = 3.478)
Case 2246 is an outlier (Studentized Residual = 3.478)
Case 2280 is an outlier (Studentized Residual = 4.299)
Case 2281 is an outlier (Studentized Residual = 4.299)

Durbin-Watson D Statistic 0.761
First Order Autocorrelation 0.616

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND TWO DAYS (3 day) PRIOR PRECIPITATION

The following results are for:
WBID$ = 2326

Dep Var: VALUE N: 85 Multiple R: 0.100 Squared multiple R: 0.010

Adjusted squared multiple R: 0.000 Standard error of estimate: 7796.633

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4352.112	910.894	0.000	.	4.778	0.000
V3D_PREC	464.353	504.868	0.100	1.000	0.920	0.360

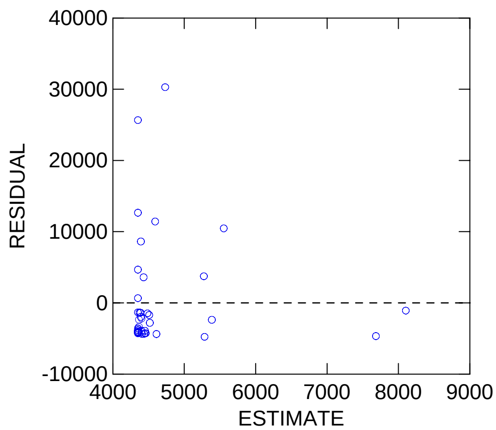
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	5.14227E+07	1	5.14227E+07	0.846	0.360
Residual	5.04536E+09	83	6.07875E+07		

*** WARNING ***
Case 2228 has large leverage (Leverage = 0.189)
Case 2229 has large leverage (Leverage = 0.189)
Case 2236 has large leverage (Leverage = 0.242)
Case 2237 has large leverage (Leverage = 0.242)
Case 2245 is an outlier (Studentized Residual = 3.534)
Case 2246 is an outlier (Studentized Residual = 3.534)
Case 2280 is an outlier (Studentized Residual = 4.296)
Case 2281 is an outlier (Studentized Residual = 4.296)

Durbin-Watson D Statistic 0.758
First Order Autocorrelation 0.617

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND SIX DAYS (7 day) PRIOR PRECIPITATION

The following results are for:
WBID$ = 2326

Dep Var: VALUE N: 85 Multiple R: 0.112 Squared multiple R: 0.013

Adjusted squared multiple R: 0.001 Standard error of estimate: 7786.520

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4121.395	994.721	0.000	.	4.143	0.000
V7D_PRE	521.676	505.771	0.112	1.000	1.031	0.305

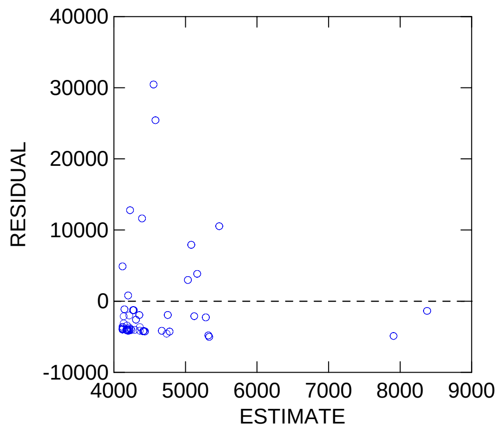
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	6.45032E+07	1	6.45032E+07	1.064	0.305
Residual	5.03228E+09	83	6.06299E+07		

*** WARNING ***
Case 2228 has large leverage (Leverage = 0.175)
Case 2229 has large leverage (Leverage = 0.175)
Case 2236 has large leverage (Leverage = 0.226)
Case 2237 has large leverage (Leverage = 0.226)
Case 2245 is an outlier (Studentized Residual = 3.500)
Case 2246 is an outlier (Studentized Residual = 3.500)
Case 2280 is an outlier (Studentized Residual = 4.335)
Case 2281 is an outlier (Studentized Residual = 4.335)

Durbin-Watson D Statistic 0.754
First Order Autocorrelation 0.620

Plot of residuals against predicted values

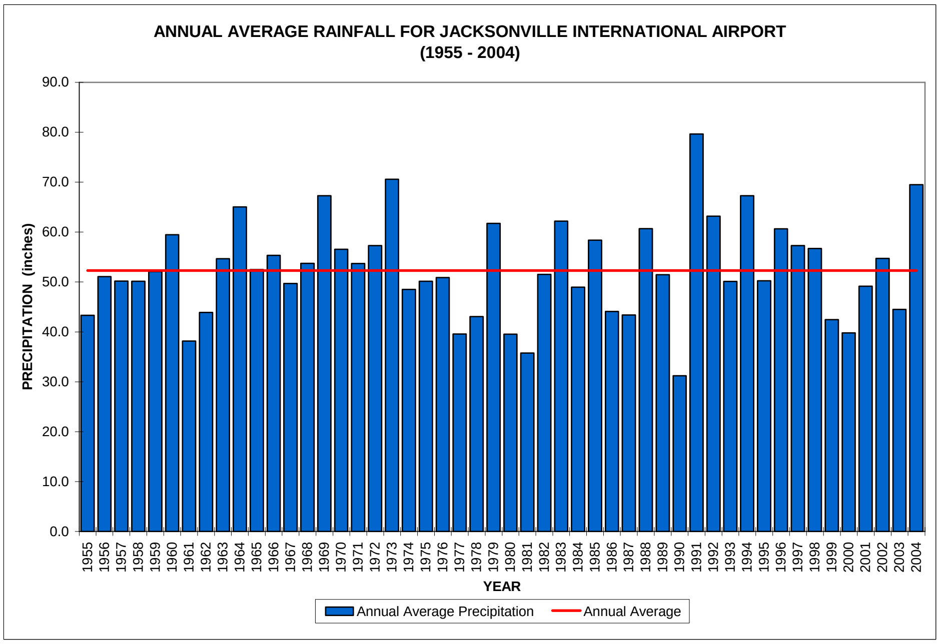


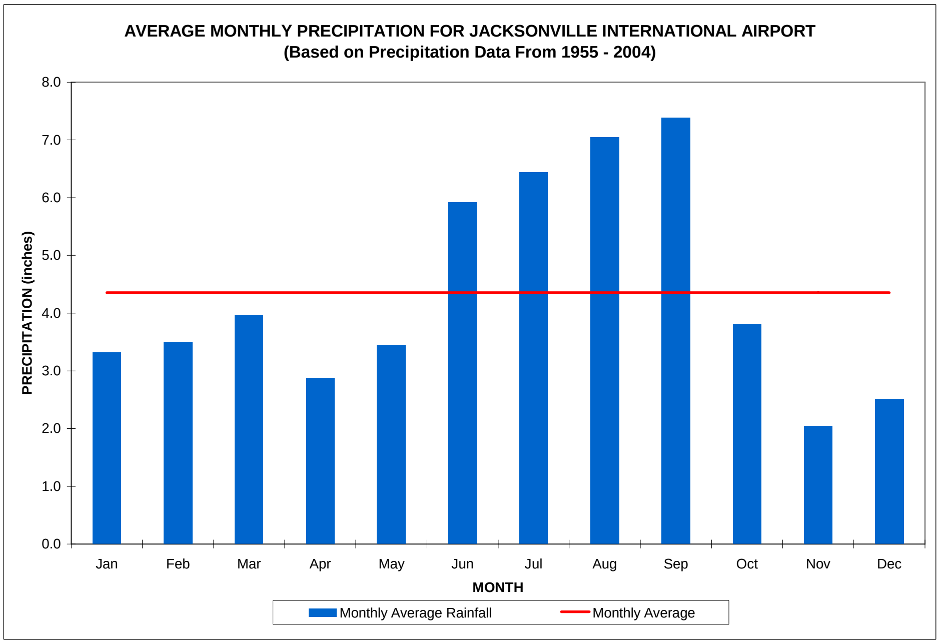
Appendix I: Monthly and Annual Precipitation 1955 – 2004 from JIA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.09	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.56	5.36	1.9	0.21	**43.33**
1956	2.91	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.44	0.38	0.04	**51.08**
1957	0.33	1.69	3.87	1.61	5.25	7.1	12.34	3.3	8.33	3.5	1.55	1.31	**50.18**
1958	3.39	3.74	3.38	8.24	3.79	3.96	4.37	4.67	4.75	5.07	2.02	2.76	**50.14**
1959	2.97	5.22	9.75	2.65	9.2	2.94	4.51	2.86	5.67	3.12	2.24	0.95	**52.08**
1960	2.07	5.17	6.94	3.54	1.18	4.7	16.21	6.5	8.57	2.95	0.11	1.51	**59.45**
1961	2.87	4.85	1.17	4.16	3.06	5.27	3.48	10.64	1.02	0.27	0.89	0.47	**38.15**
1962	2.16	0.52	3.1	2.36	1.12	8.22	6.31	10.07	4.37	1.13	2.08	2.46	**43.90**
1963	5.39	6.93	2.23	1.75	1.74	12.49	6.47	4.95	4.88	1.53	2.7	3.6	**54.66**
1964	7.29	6.55	1.76	4.65	4.8	4.67	6.12	5.63	10.31	5.09	3.33	4.83	**65.03**
1965	0.65	5.5	3.91	0.95	0.94	9.79	2.71	9.58	11.02	1.75	1.92	3.75	**52.47**
1966	4.56	5.97	0.71	2.25	10.43	7.74	11.09	3.88	5.94	1.38	0.21	1.14	**55.30**
1967	3.05	4.35	0.81	2	1.18	12.9	5.22	12.31	1.8	1.13	0.24	4.69	**49.68**
1968	0.82	3.05	1.2	0.99	2.17	12.25	6.84	16.24	2.68	5.09	1.3	1.09	**53.72**
1969	0.84	3.39	4.23	0.34	3.78	5.12	5.89	15.1	10.33	9.81	4.56	3.87	**67.26**
1970	4.18	8.85	9.98	1.77	1.84	2.65	7.6	10.96	3.2	3.95	0	1.57	**56.55**
1971	2.01	2.55	2.41	4.07	1.9	5.52	5.07	12.83	4.17	6.46	0.83	5.87	**53.69**
1972	5.77	3.48	4.43	2.98	8.26	6.75	3.15	9.76	2.6	4.46	4.22	1.43	**57.29**
1973	4.64	5.07	10.18	11.61	5.33	4.1	5.45	7.49	7.86	4.08	0.44	4.32	**70.57**
1974	0.28	1.28	3.47	1.53	4.14	5.53	9.83	11.23	8.13	0.34	1.03	1.73	**48.52**
1975	3.48	2.58	2.46	5.78	7	5.21	6.36	6.23	5.24	3.63	0.39	1.79	**50.15**
1976	2.29	1.05	3.41	0.63	10.02	4.26	5.41	6.37	8.56	1.63	2.43	4.81	**50.87**
1977	2.96	3.24	1.03	1.76	3.07	2.65	1.97	7.26	7.45	1.68	3.11	3.38	**39.56**
1978	4.64	4.17	2.83	2.24	9.18	2.62	6.67	2.39	4.4	1.26	0.8	1.84	**43.04**
1979	6.28	3.75	1	4.18	7.54	5.91	4.67	4.78	17.75	0.25	3.64	2.01	**61.76**
1980	2.61	1.06	6.83	3.91	3.02	4.59	5.29	3.97	3.03	2.69	2.32	0.21	**39.53**
1981	0.92	4.53	5.41	0.32	1.48	3.31	2.46	6.47	1.22	1.35	4.92	3.38	**35.77**
1982	3	1.67	4.26	3.6	3.55	8.06	3.81	6.93	9.32	3.37	1.93	2.02	**51.52**
1983	7.19	4.27	8.46	4.65	1.38	6.86	6.11	4.63	4.61	4.29	3.32	6.42	**62.19**
1984	2.13	4.67	5.77	3.14	1.46	4.76	6.01	3.78	12.28	1.53	3.3	0.13	**48.96**
1985	1.05	1.45	1.26	2.76	2.08	3.71	6.33	8.93	16.82	8.34	2.07	3.59	**58.39**
1986	4.19	4.72	5.44	0.93	2.13	2.53	3.27	9.6	1.99	1.8	2.85	4.65	**44.10**
1987	4.09	6.47	6.27	0.14	0.75	4.18	4.4	4.48	7.13	0.3	5.02	0.16	**43.39**
1988	6.36	6.08	2.65	3.44	1.35	3.71	4.5	8.48	16.36	2.35	4.27	1.13	**60.68**
1989	1.73	1.77	2.14	2.79	1.55	3.66	8.98	9.16	14.37	1.39	0.51	3.4	**51.45**
1990	1.84	4.07	1.59	1.34	0.18	1.59	6.53	3.81	2.6	4.54	1.17	1.94	**31.20**
1991	10.2	1.52	7.33	6.31	9.35	11.7	15.9	3.48	6.2	6.36	0.71	0.57	**79.63**
1992	5.79	2.64	4.09	5.33	5.97	7.04	3.32	10.76	7.33	8.34	1.92	0.65	**63.18**
1993	3.86	2.89	5.98	0.85	1.6	2.52	7.54	2.96	7.6	8.84	3.58	1.9	**50.12**
1994	6.58	0.92	2.14	1.51	3.15	13.96	8.26	3.29	9.79	10.23	3.49	3.94	**67.26**
1995	1.91	2.07	3.67	1.77	1.77	5.35	9.45	9.93	5.41	3.53	3.2	2.19	**50.25**
1996	1.11	1.11	6.83	2.85	0.72	11.41	4.2	7.83	8.49	11.46	1.39	3.23	**60.63**
1997	2.91	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.41	9.77	**57.27**
1998	3.49	11.12	2.64	4.71	0.96	2.95	7.29	10.09	7.65	3.01	2.39	0.42	**56.72**
1999	4.63	1.7	0.4	1.92	1.02	7.75	3.56	3.51	13	3.24	0.83	0.88	**42.44**
2000	2.77	1.17	1.79	2.6	1.15	2.43	5.69	7.38	11.64	0.23	1.55	1.37	**39.77**
2001	0.91	0.68	5.48	0.62	2.56	5.59	8.31	3.58	16.03	0.81	1.44	3.13	**49.14**
2002	4.48	0.82	4.38	2.41	0.47	6.24	7.8	8.14	9.31	2.58	2.68	5.41	**54.72**
2003	0.07	4.66	10.71	2.63	2.54	6.75	7.33	1.83	3.04	2.98	0.74	1.19	**44.47**
2004	1.64	4.47	1.36	2.02	1.24	17.15	8.6	9.85	16.31	1.32	2.85	2.66	**69.47**
AVG	**3.32**	**3.50**	**3.96**	**2.88**	**3.45**	**5.92**	**6.44**	**7.05**	**7.38**	**3.81**	**2.05**	**2.51**	**52.27**

Rainfall is in inches, and represents data from Jacksonville International Airport (JIA)

Appendix J: Annual and Monthly Average Precipitation at JIA





Appendix K: Executive Summary of Tributary Pollution Assessment Project (TPAP)

Tributary Pollution Assessment
Executive Summary

The Tributary Pollution Assessment Project involves developing and evaluating a methodology for conducting tributary pollution assessments for listed water bodies in the Duval County area, as referenced in the Reasonable Assurance (RA) Plan. Duval County has approximately 100 tributary Water Body IDs (WBIDs), i.e. small to large tributaries of the St. Johns River, identified by the State. The RA Plan provides reasonable assurance that the fecal coliform levels of the 51 top-ranked WBIDs will be reduced sufficiently to restore them to their designated use for recreation. The 51 WBIDs are grouped into four priority groups in the RA Plan.

PBS&J was contracted by JEA to develop a methodology for conducting tributary pollution assessments for sources of fecal coliform contamination in the listed tributaries. This methodology will be field-verified by conducting sanitary surveys of selected tributary water body segments, and revised based on lessons learned from this process. The final product of this endeavor will be a *Tributary Pollution Assessment Manual* that can be used as a blueprint for conducting sanitary surveys.

The Tributary Pollution Assessment Project is a continuation of the effort started under the RA Plan. The RA Plan participants have been brought together to form the Tributary Assessment Team (TAT). The TAT will serve as an advisory committee to the PBS&J Project Team throughout the development of the *Tributary Pollution Assessment Manual*. The TAT is composed of representatives from:

- JEA
- City of Jacksonville Environmental Quality Division
- City of Jacksonville Public Works Department
- Duval County Health Department
- Florida Department of Environmental Protection
- St. Johns Riverkeeper
- Water and Sewer Expansion Authority
- US Army Corps of Engineers

Other representatives (from these and additional entities) may be included in the TAT activities in varying roles, as relevant.

Our approach for developing and evaluating a methodology for conducting tributary pollution assessments is divided into six major phases including:

1) Pre-planning;
2) Planning;
3) Development of *Tributary Pollution Assessment Manual*;
4) Evaluation of Methodology/Manual by Conducting Sanitary Surveys;
5) Summary Report; and
6) Public Workshop.

The Pre-Planning phase (Phase I) entailed four main goals:

1) to obtain and review all documents included in the RA Plan;
2) to develop categories for tributary classification and categorize the 51 priority WBIDs;
3) to overlay each WBID onto land use, infrastructure, and historical sampling maps to begin assessing probable sources and migration pathways; and
4) to develop the *Draft Work Plan*.

The Planning phase (Phase II) begins with the organization and initial meeting of the Tributary Assessment Team (TAT) with the ultimate goal of finalizing the *Work Plan*.

The Development of the *Tributary Pollution Assessment Manual* phase (Phase III) primarily involves the formulation of the assessment methodology for each tributary category described in the Pre-Planning phase, the use of a decision tree to determine which assessment methodology corresponds to each of the highest-ranked WBIDs, and the establishment of a model monitoring plan for each tributary category. This phase will be completed upon submitting the *Manual* to the TAT for review.

The next phase, Evaluation of Methodology/Manual by Conducting Sanitary Surveys (Phase IV), entails field-verification of the methodology described in the *Draft Tributary Pollution Assessment Manual* for the highest ranked water bodies for each category (or as determined to ensure adequate geographical representation of the study area) and applying the results to recommend generic corrective actions and revise the methodology, if necessary. The outcome of this phase would be the *Tributary Pollution Assessment Manual.*

The final two phases, Summary Report (Phase V) and Public Workshop (Phase VI), would entail providing a summary of the results of the tributary pollution assessments, including a discussion of lessons learned and site-specific corrective actions, to JEA and presenting the results from the *Tributary Pollution Assessment Manual* to the public. The final phase would also include a written summary of public input received at the workshop.

For additional information, please contact: Don Deis, PBS&J Project Manager, at (904) 363-8442 or drdeis@pbsj.com.

Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Watershed Management
2600 Blair Stone Road, Mail Station 3565
Tallahassee, Florida 32399-2400
(850) 245-8561
www.dep.state.fl.us/water/