FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Final TMDL Report

Fecal Coliform TMDL for Deer Creek, WBID 2256

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http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf
STORET Program
http://www.dep.state.fl.us/water/storet/index.htm
2008 305(b) Report
http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf
Criteria for Surface Water Quality Classifications
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Basin Status Report for the Lower St. Johns Basin
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U.S. Environmental Protection Agency, National STORET Program

Region 4: Total Maximum Daily Loads in Florida
http://www.epa.gov/region4/water/tmdl/florida/
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Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal coliform for the Deer Creek watershed in the North Mainstem Planning Unit. The creek was verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Lower St. Johns Basin adopted by Secretarial Order in May 2004. Deer Creek is located in central Duval County, on the west side of the St. Johns River (**Figure 1.1**). This TMDL establishes the allowable loadings to Deer Creek that would restore the waterbody and allow it to meet its applicable water quality criterion for fecal coliform.

1.2 Identification of Waterbody

Deer Creek, located in Duval County in northeast Florida, has a drainage area of approximately 1.06 square miles (mi^2) that flows directly into the St. Johns River (**Figure 1.2**). The creek is approximately 0.85 miles long and is a second-order stream. The Deer Creek watershed is located within the city of Jacksonville proper 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 Basin (Florida Department of Environmental Protection [Department], 2004).

For assessment purposes, the Department has divided the Lower St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Deer Creek lies within WBID 2256 (**Figure 1.2**), which this TMDL addresses.

Deer Creek is part of the North Mainstem Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that 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 boundaries of these WBIDs, Deer Creek's location in the planning unit, and a list of the other WBIDs in the planning unit.

Figure 1.1. Location of Deer Creek, WBID 2256, and Major Geopolitical Features in the Lower St. Johns Basin

Figure 1.2. Overview of the Deer Creek Watershed, WBID 2256

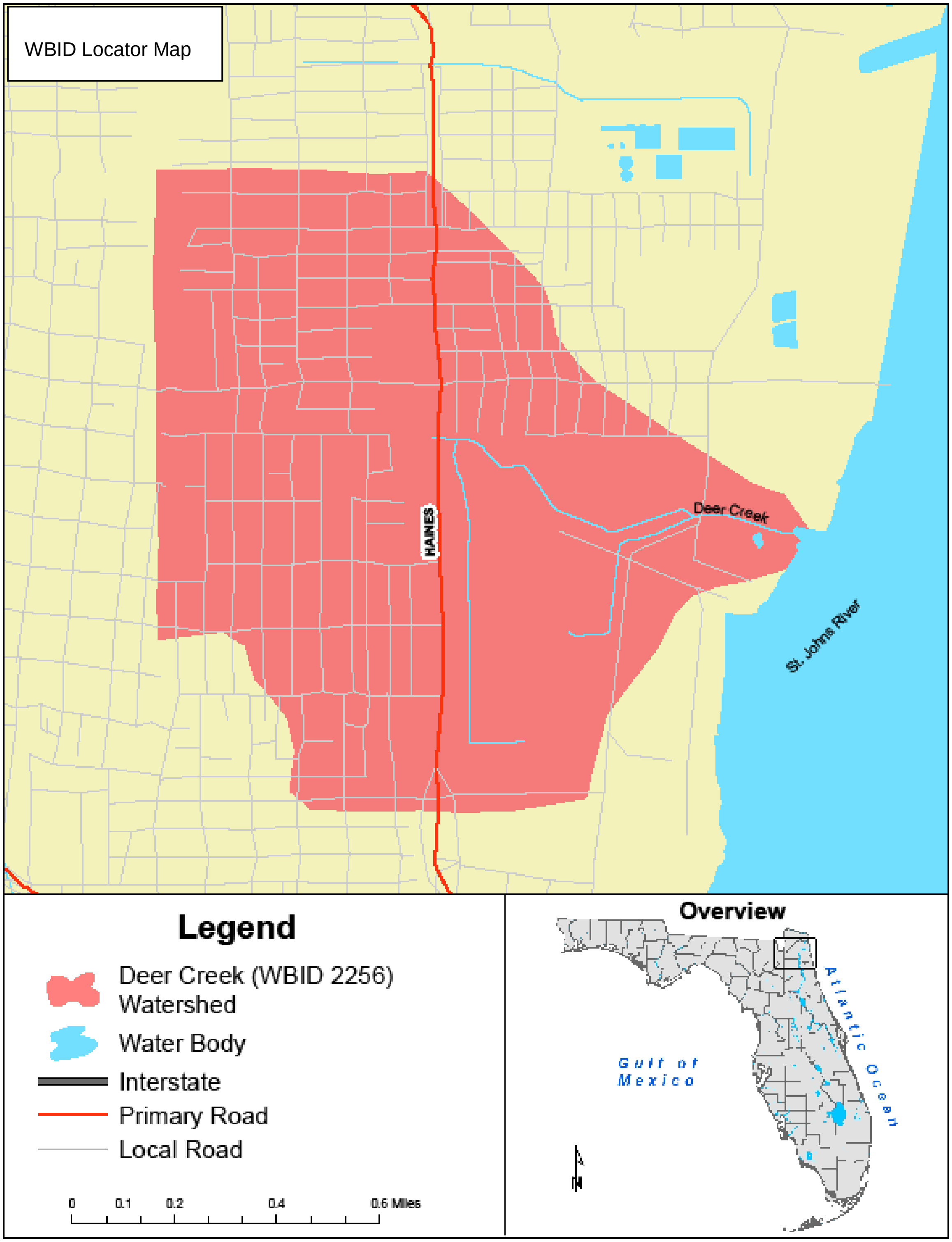
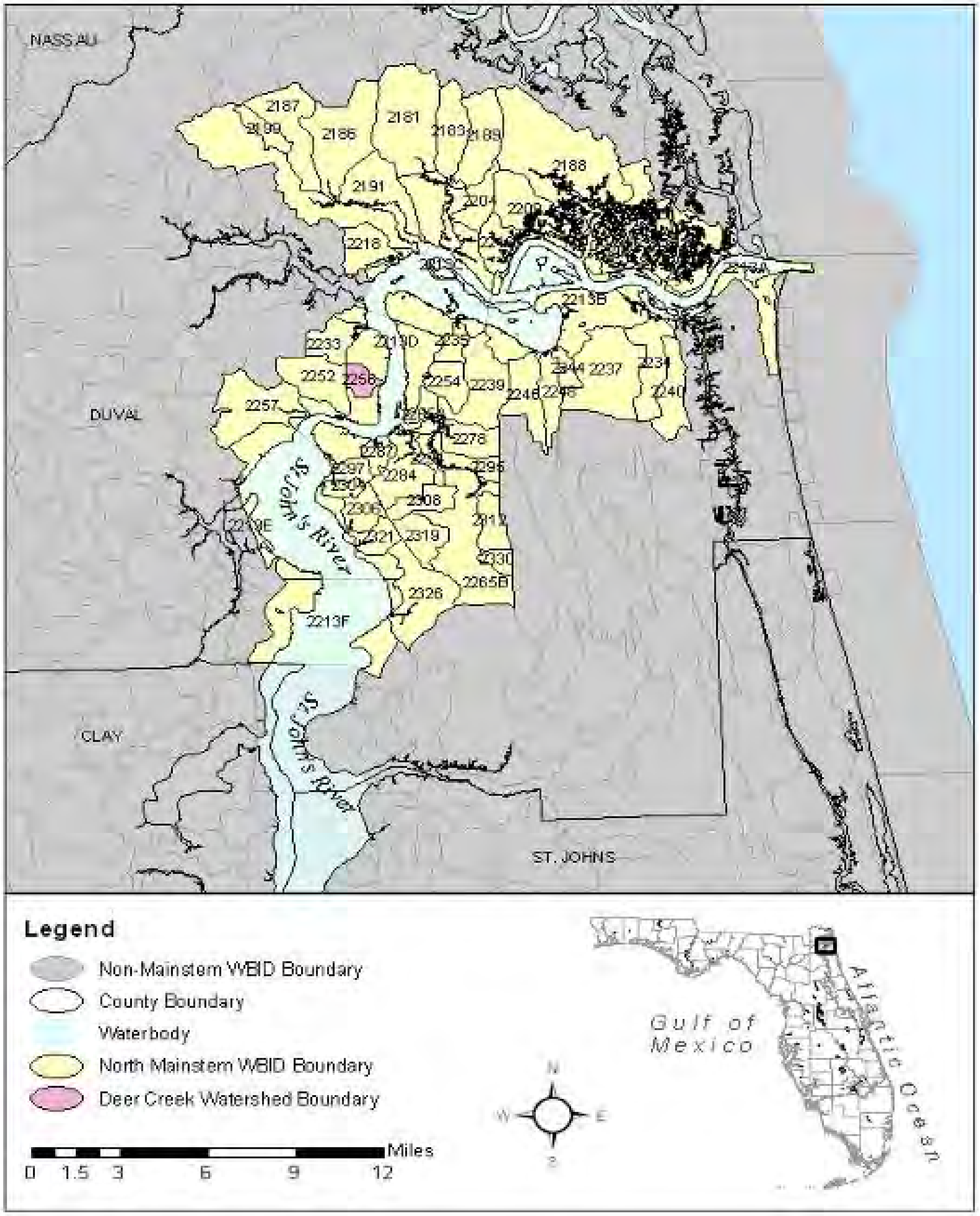


Figure 1.3. WBIDs in the North Mainstem Planning Unit

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
2249B	McGrits Creek
2249A	Ortega River
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	Goobys
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 Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program–related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA) (Chapter 99-223, Laws of Florida).

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

This TMDL report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of fecal coliform that caused the verified impairment of Deer Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), 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 U.S. Environmental Protection Agency (EPA) a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant 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.]). Florida's 1998 303(d) list included 55 waterbodies and 277 parameters in the Lower St. Johns Basin, and the state's 303(d) list is amended annually to include basin updates.

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 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; the rule was amended in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Deer Creek and has verified that 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 coliform data for the verification period (which for Group 2 waters is January 1, 1996, to June 30, 2003), by month, season, and year, respectively. There is an 82 percent overall exceedance rate for fecal coliform in Deer Creek during the verified period. There are a total of 50 samples, ranging from 80 to 200,000 counts per 100 milliliters (counts/100mL), with 41 samples exceeding the criterion for fecal coliform.

January, July, September, and October all demonstrated an exceedance rate of 100 percent. The lowest percentage of exceedances, 50 percent, was seen in June and December (**Table 2.1**). Summer had the highest exceedance rate (92.86 percent) and also the most rainfall. Fall had the lowest percentage of exceedances (72.73 percent), while spring followed closely with an exceedance rate of 73.33 percent. Both fall and spring also had the smallest amount of rainfall (**Table 2.2**). Over the years, exceedance rates have generally fallen. In 1996, 1998, and 1999, 100 percent exceedance rates were observed, while 2003 only had an exceedance rate of 20 percent (**Table 2.3**).

Historical data were collected at three sampling sites during the verified period (January 1, 1996, to June 30, 2003). The samples were taken mostly by the city of Jacksonville (Stations 21FLAJXWQDR1 and 21FLAJXWQDR2), but also by the Department (Station 21FLA20030728). **Section 5.1** discusses sampling stations further.

Table 2.1. Summary of Fecal Coliform Data by Month for the Verified Period (January 1, 1996–June 30, 2003), WBID 2256

Month	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation
January	5	1,100	160,000	1,300	33,460	5	100.00	2.55
February	-	-	-	-	-	-	-	2.82
March	5	340	11,000	830	3,294	4	80.00	4.26
April	5	100	90,000	800	21,080	4	80.00	2.79
May	8	170	90,000	6,901	17,604	6	75.00	1.61
June	2	300	2,200	1,250	1,250	1	50.00	6.18
July	3	17,000	200,000	50,000	89,000	3	100.00	6.36
August	5	300	16,000	9,000	7,080	4	80.00	6.97
September	6	1,300	11,000	3,150	4,483	6	100.00	10.01
October	5	3,000	50,000	8,000	7,600	5	100.00	3.74
November	-	-	-	-	-	-	-	1.81
December	6	80	10,700	3,635	4,213	3	50.00	3.46

- = No data available for February and November.

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Mean precipitation is for Jacksonville International Airport (JIA) in inches.

Table 2.2. Summary of Fecal Coliform Data by Season for the Verified Period (January 1, 1996–June 30, 2003), WBID 2256

Season	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation*
Winter	10	340	160,000	1,200	18,377	9	90.00	3.21
Spring	15	100	90,000	801	16,582	11	73.33	3.53
Summer	14	300	200,000	7,800	23,521	13	92.86	7.78
Fall	11	80	50,000	7,000	10,298	8	72.73	3.00

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Mean precipitation is for JIA in inches.

*Represents a monthly average for that season.

Table 2.3. Summary of Fecal Coliform Data by Year for the Verified Period (January 1, 1996–June 30, 2003), WBID 2256

Year	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation
1996	1	8,000	8,000	8,000	8,000	1	100.00	5.05
1997	-	-	-	-	-	-	-	4.77
1998	6	300	24,000	7,550	13,513	6	100.00	4.73
1999	8	140	16,000	7,550	13,513	8	100.00	3.54
2000	10	80	160,000	5,650	29,148	8	80.00	3.31
2001	9	300	13,000	7,100	6,711	8	88.89	4.1
2002	11	130	200,000	1,700	20,494	9	81.82	4.56
2003	5	100	830	230	334	1	20.00	3.71

- = No data for 1997.

Table represents years for which data exist.

Coliform counts are #/100mL.

Exceedances represent values above 400 counts/100mL.

Total precipitation is for JIA in inches.

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)**

Deer 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 criterion applicable to the impairment addressed by this TMDL is for fecal coliform.

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 criterion 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 criterion states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. There are 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 TMDL is not to exceed 400 in 10 percent of the samples.

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

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, 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).

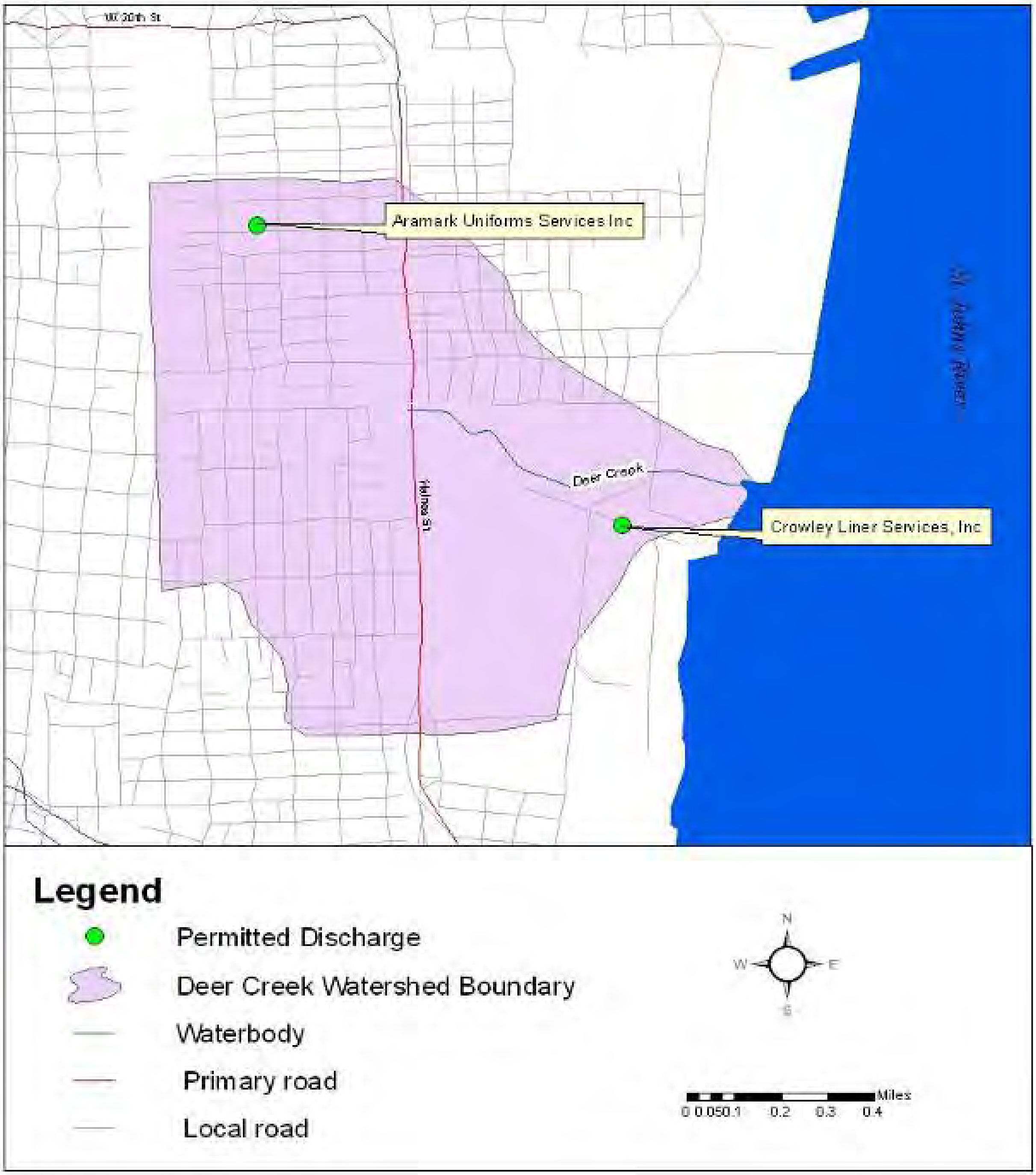
To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) **AND** stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a 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 Coliform in the Deer Creek Watershed

4.2.1 Point Sources

There are two permitted discharge facilities in the Deer Creek watershed. Aramark Uniform Services, Inc. (Permit #FL0178845) has been issued a permit for air stripping and filtration of contaminated ground water. This permit does not allow discharge into surface waters. The other facility, Crowley Liner Services, Inc. (Permit #FLA016872) cleans refrigerated containers and is a 100 percent recycle facility. No discharge is emitted to surface waters from this facility. Therefore, neither of these permitted facilities contributes coliform to the Deer Creek watershed. **Figure 4.1** shows the location of the facilities in the watershed.

Figure 4.1. Location of Permitted Discharge Facilities in the Deer Creek Watershed, WBID 2256



Municipal Separate Storm Sewer System Permittees

Phase 1 or Phase 2 MS4s. The entire city of Jacksonville, including the Deer Creek watershed, is covered by a Phase I NPDES municipal separate storm sewer system (MS4) permit (FLS000012) issued to the Florida Department of Transportation (FDOT) District 2. Responsibility for the permit is shared among FDOT and the cities of Jacksonville, Neptune Beach, and Atlantic Beach.

Figure 4.2 shows the stormwater infrastructure of the watershed. Outfalls represent points where a conveyance of stormwater discharges into a separate stormwater system through a channelized or natural waterway. Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or the low point of an area to provide for the collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008). In the Deer Creek watershed, there are 4 outfalls and 390 inlets.

4.2.2 Land Uses and Nonpoint Sources

Additional coliform loadings to Deer Creek are generated from nonpoint sources in the watershed. Potential nonpoint sources of coliform 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 2004 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 4.3** shows the principal land uses in the watershed.

Being within the city of Jacksonville proper, the Deer Creek watershed is highly urbanized and impacted. As **Table 4.1** shows, the majority of land use is high-density residential (33.38 percent), followed by other light industrial (14.53 percent) and commercial and services (13.28 percent). Natural land use types (mixed wetland hardwoods, open land, mixed scrub-shrub wetland, upland hardwood forests, saltwater marshes, streams and waterways, and wetland forested mixed) comprise 87.84 acres, or 12.97 percent of the land use in the watershed. Urban land use areas comprise approximately 590 acres, or 87 percent.

Population

According to the U.S. Census Bureau, census block population densities in the Deer Creek watershed in the year 2000 ranged from 0 to 177 people/acre (**Figure 4.4**), or 0 to 0.28 people/mi^2 (calculated). The population density of the waterbody is 2,184 people/mi^2 (calculated with U.S. Census Bureau information), or 1,397,760 people per acre. Based on this average, the estimated population in the Deer Creek watershed is 2,315 (**Table 4.2**). 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 Website, 2005). The estimated average housing density in Deer Creek is 818 houses/mi^2, based on population, which is higher than that of Duval County.

Table 4.1. Land Use Categories in the Deer Creek Watershed, WBID 2256

Level 3 Land Use Code	Attribute	Acres	% of Total
1200	Residential, medium density–2-5 dwelling units/acre	4.14	0.61%
1300	Residential, high density–6 or more dwelling units/acre	226.17	33.38%
1400	Commercial and services	89.96	13.28%
1550	Other light industrial	98.45	14.53%
1560	Other heavy industrial	0.95	0.14%
1700	Institutional	57.69	8.52%
1850	Parks and zoos	4.56	0.67%
1860	Community recreational facilities	6.21	0.92%
1900	Open land	16.38	2.42%
3300	Mixed upland nonforested	2.52	0.37%
4200	Upland hardwood forests	2.41	0.36%
5100	Streams and waterways	0.33	0.05%
6170	Mixed wetland hardwoods	51.41	7.59%
6300	Wetland forested mixed	0.11	0.02%
6420	Saltwater marshes	2.27	0.34%
6430	Wet prairies	3.04	0.45%
6460	Mixed scrub-shrub wetland	9.37	1.38%
8120	Railroads	26.37	3.89%
8140	Roads and highways (divided 4-lanes with medians)	16.80	2.48%
8150	Port facilities	58.32	8.61%
	TOTAL:	**677.46**	**100.00%**

Table 4.2. Estimated Average Household Size in the Deer Creek Watershed, WBID 2256

Household Size	Number of Households	% of Total	Number of People
1-person household	244	28.16	244
2-person household	229	26.41	458
3-person household	164	18.92	492
4-person household	109	12.62	438
5-person household	66	7.58	329
6-person household	28	3.25	169
7-or-more-person household	26	3.05	185
TOTAL:	**867**	**100.00**	**2,315**
		AVERAGE HOUSEHOLD SIZE:	**2.67**

*Individual values for number of people per household size are rounded to the nearest whole number, while total number of people remains based on unrounded values.

Figure 4.2. Stormwater Infrastructure in the Deer Creek Watershed, WBID 2256

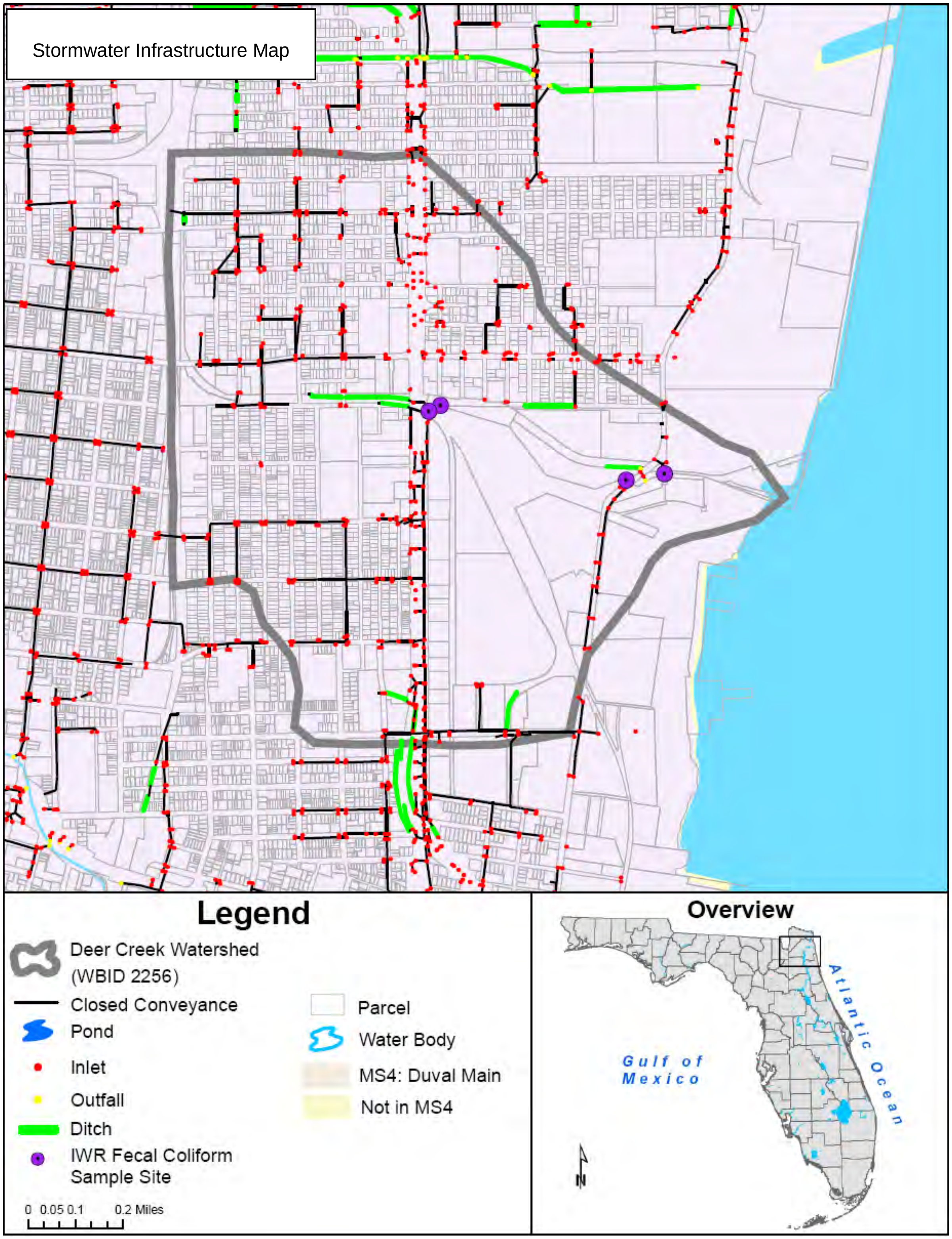
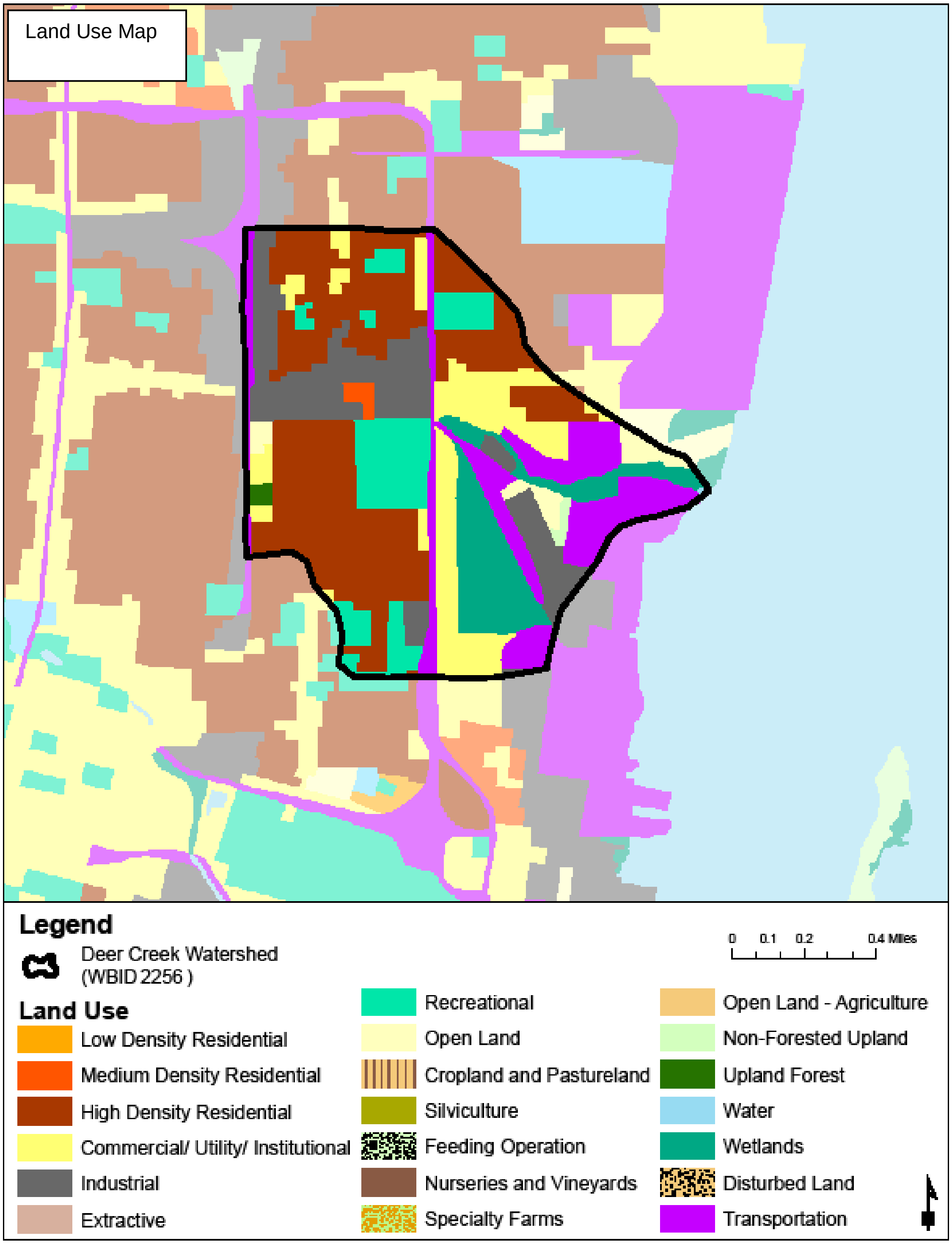
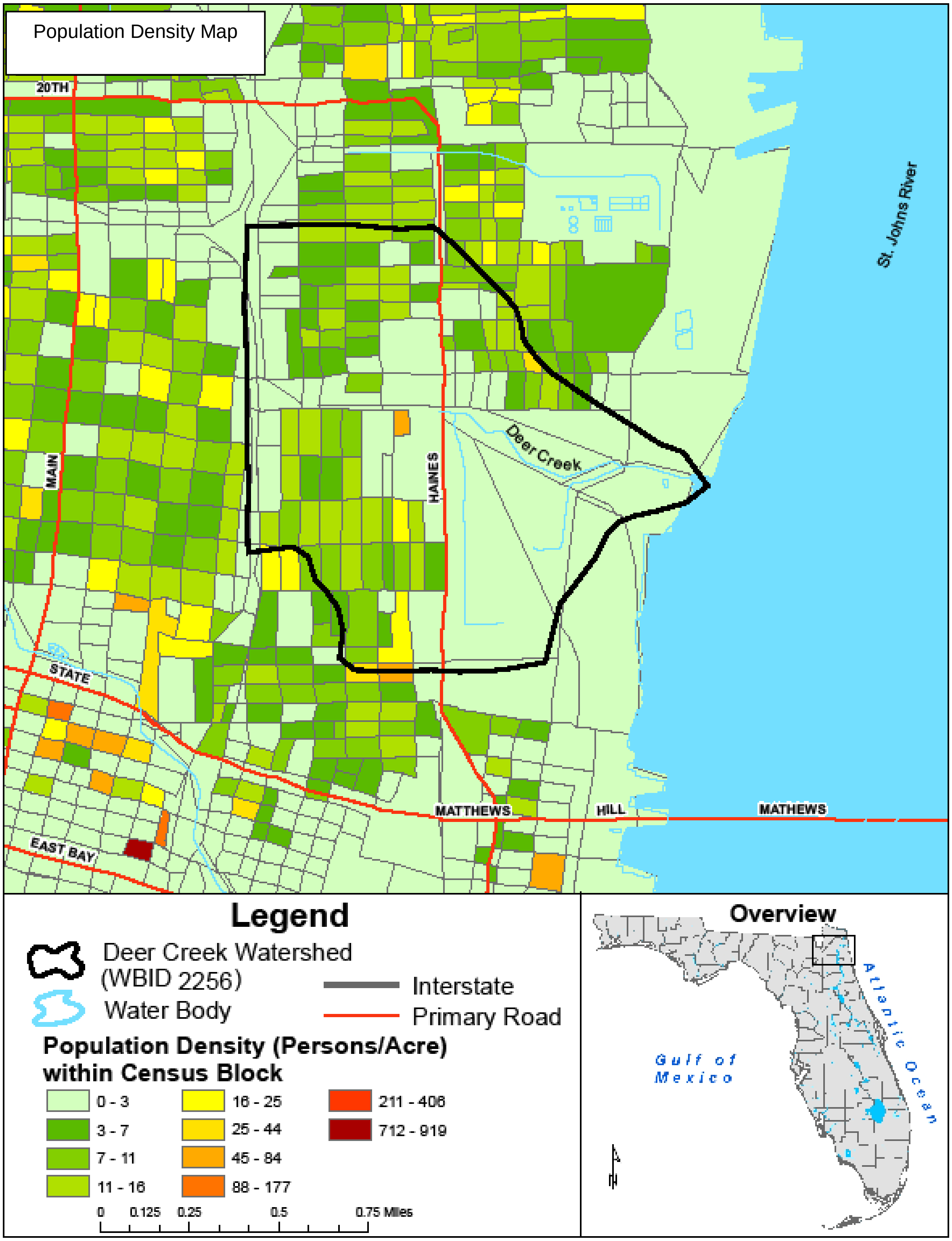


Figure 4.3. Principal Level 3 Land Uses in the Deer Creek Watershed, WBID 2256, in 2004



*Land use map developed by Post, Buckley, Schuh & Jernigan, Inc. (PBS&J).

Figure 4.4. Population Density in the Deer Creek Watershed, WBID 2256, in 2000



Septic Tanks

Approximately 78 percent of residences in Duval County are connected to a wastewater treatment plant, with the rest utilizing septic tanks (Florida Department of Revenue cadastral data, 2003; and Florida Department of Health [FDOH] Website, 2005b). The FDOH reports that as of fiscal year 2003–04, there were 88,834 permitted septic tanks in Duval County (FDOH Website, 2005b). For fiscal years 1994 to 2004, 4,954 repair permits were issued, and 369 repair permits were issued in fiscal year 2003–04 (FDOH Website, 2005c).

The Department obtained septic tank repair permit data from JEA and the FDOH for the JEA service area, which includes the Deer Creek watershed. The data include septic tank repair permits issued from March 1990 to April 2004, areas serviced by a WWTF, and areas where large numbers of failing septic tanks are present. **Figure 4.5** presents this information.

Based on these data, which are more watershed specific than the countywide FDOH data, there were 2 septic tank repair permits issued during this time. This equates to an average of 0.14 permits issued per year. If this estimate is rounded up to 1 (to allow for those septic tanks where failures may not be known or have not been repaired), and using an estimate of 70 gallons/day/person (EPA, 2001), a loading of 7.37×10^9 colonies/day is derived. **Table 4.3** shows this calculation.

The data provided by JEA also include areas serviced by a WWTF and areas where large numbers of failing septic tanks are present. None of the watershed is in a JEA septic tank phase-out area (an area with the highest priority to be sewered due to high septic tank failure rates), or an area where a historically high number of septic tanks have failed. **Figure 4.5** shows that there are no such areas in or near the watershed (they would be depicted in yellow). The entire watershed is serviced by the Buckman Street WWTF.

Table 4.3. Estimated Annual Fecal Coliform Loading from Failed Septic Tanks in the Deer Creek Watershed, WBID 2256

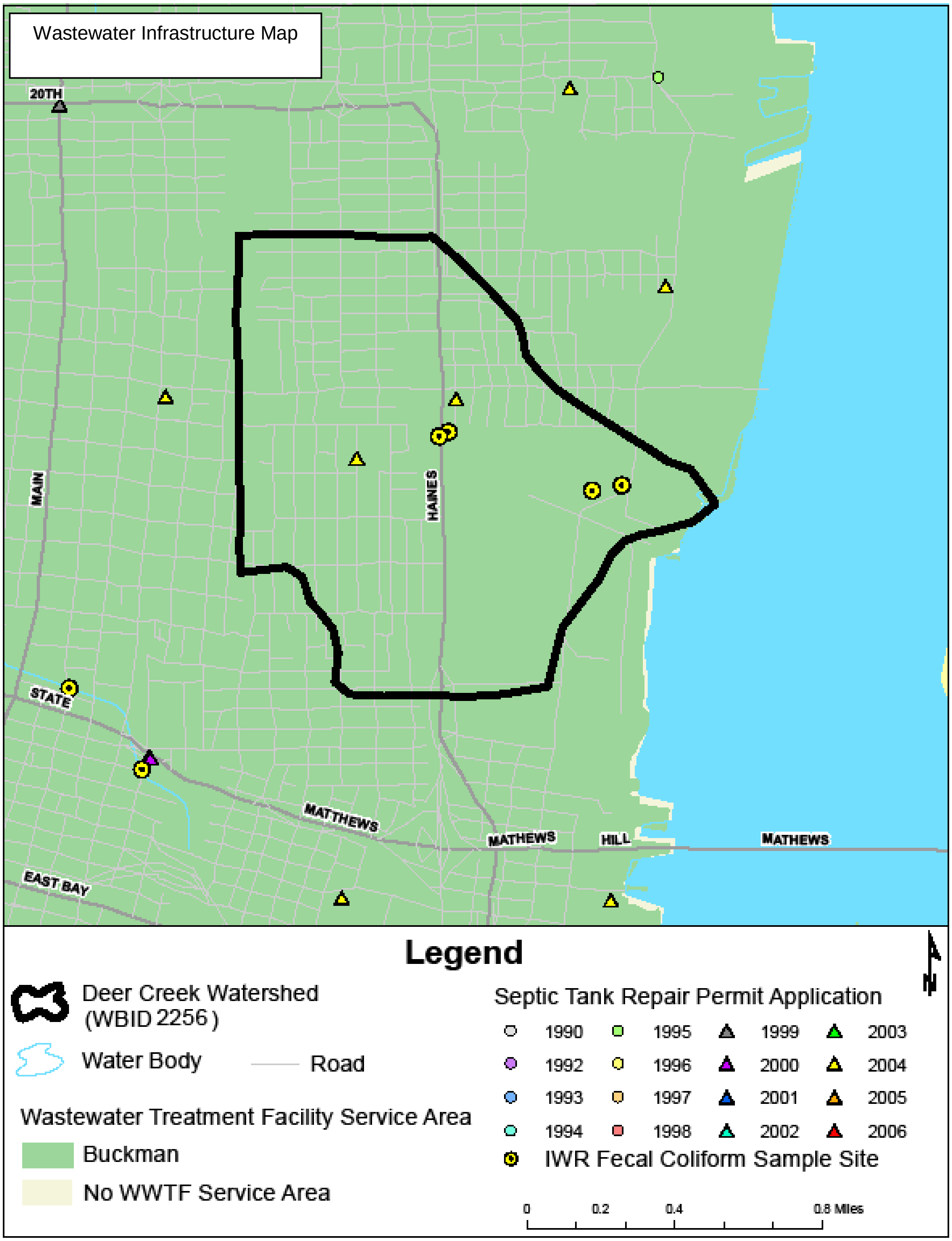
Estimated Population Density (people/mi^2)	WBID Area (mi^2)	Estimated Population in Watershed	Estimated Number of Tank Failures[1]	Estimated Load from Failed Tanks[2]	Gallons/ Person/ Day[2]	Estimated Number Persons per Household[3]	Estimated Load from Failing Tanks	Estimated Annual Load from Failing Tanks
2,184	1.06	2,315	1	1.00×10^4 /mL	70	2.78	7.37×10^9	2.69×10^{12}

[1] Based on septic tank repair permits issued in the watershed from March 1990 to April 2004 (FDOH and JEA information); see text.

[2] EPA, 2001.

[3] From U.S. Census Bureau; see **Table 4.2** for more information on this estimate.

Figure 4.5. Septic Tank Repair Permits Issued in the Deer Creek Watershed, WBID 2256, 1990–2006



4.3.1 Other Potential Sources

Agriculture

According to Level 3 land use data, there are no agricultural areas in the Deer Creek watershed. As noted in **Section 4.2.2,** the majority of land use (86.75 percent) consists of residential, other light industrial, commercial and services, and other types impacted by humans. It is doubtful that agriculture has any influence on the watershed.

Pets

As the watershed is highly urbanized, with a large number of people per square mile, pets, especially dogs, may be having an impact on the waterbody. The Department has been unable to obtain information 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) (2006), the approximate loading from dogs is 2.51×10^{12} organisms/day. This is an estimate, as the actual loading from dogs is not known; however; since the watershed is mostly downtown, the estimate may be high.

Table 4.4. Estimated Loading from Dogs in the Deer Creek Watershed, WBID 2256

Estimated Number of Households in WBID 2256	Estimated Dog: Household Ratio[1]	Estimated Number of Dogs in WBID 2256	Estimated Fecal Coliform (counts/dog/day[2])	Estimated Fecal Coliform (counts/day)	Estimated Fecal Coliform (counts/year)
867	0.58	503	5×10^{9}	2.51×10^{12}	9.18×10^{14}

[1] From the AVMA Website, which states the original source to be the *U.S. Pet Ownership and Demographics Sourcebook,* 2002.

[2] EPA, 2001.

Leaking or Overflowing Wastewater Collection Systems

As noted previously, about 78 percent of households in Duval County are connected to wastewater facilities. Assuming 867 homes in the watershed, with 2.67 people per home, and a 70-gallon-per-person-per-day discharge, and also assuming that the countywide average of 78 percent of households connected to a WWTF applies in the Deer Creek watershed, a daily flow of approximately 2.39×10^{4} liters (L) is transported through the collection system. The EPA (Davis, 2002) suggests that a 5 percent leakage rate from collection systems is a realistic estimate. Based on this and EPA values for fecal coliform in raw sewage, the potential loadings from leaking sewer lines are 1.20×10^{12} organisms/day (**Table 4.5**).

Table 4.5. Estimated Loading from Wastewater Collection Systems in the Deer Creek Watershed, WBID 2256

Estimated Number of Homes on Central Sewer in WBID 2256	Estimated Daily Flow (L)	Daily Leakage (L)	Raw Sewage Counts/ 100mL	Estimated Fecal Coliform (counts/day)	Estimated Fecal Coliform (counts/year)
676	4.78×10^{5}	2.39×10^{4}	5×10^{6}	1.20×10^{12}	4.37×10^{14}

4.3 Source Summary

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 (affects coliform viability) are just a few of the factors that could influence and determine the actual loadings from these sources that reach Deer Creek.

Due to the lack of flow data, no correlation between exceedances and flow can be made. However, there is an 82 percent overall exceedance rate, which occurs across all seasons and months for which data exist (**Tables 2.2** and **2.3**). Based on the exceedance rate, it is assumed that if a loading curve could be created, exceedances would be distributed across all flow regimes. It is possible that the chronic exceedances result from a combination of factors. For example, failing septic tanks (**Figure 4.5**) may contribute during low-flow conditions. Although the Deer Creek watershed is thought to be below the countywide average for annual septic tank failures, many other areas in the planning unit have high rates of failing septic tanks. During higher flows, influenced by rain events, runoff containing feces from pets and other wildlife may be contributing to exceedances.

Table 4.6. Summary of Estimated Potential Coliform Loading from Various Sources in the Deer Creek Watershed, WBID 2256

Source	Fecal Coliform (counts/day)	Fecal Coliform (counts/year)
Septic Tanks	7.37×10^{9}	2.69×10^{12}
Dogs	2.51×10^{12}	9.18×10^{14}
Collection Systems	1.20×10^{12}	4.37×10^{14}

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

There are no U.S. Geological Survey (USGS) stream gaging stations on Deer Creek; therefore the load duration curve method could not be applied. To determine the necessary reduction for this TMDL, the percent reduction that would be required for each of the exceedances was determined using all available data, and the percent reduction required to meet the state standard of 400 counts/100mL was determined. The median value of all of these reductions determined the overall required reduction, and therefore the TMDL.

5.1.1 Data Used in the Determination of the TMDL

The following four sampling stations in WBID 2256 have historical observations (**Figure 5.1**):

- *Deer Creek approximately 50 feet east of Haines Street (STORET ID: 21FLA 20030728);*
- *Deer Creek East of Haines Street downstream of South Branch (STORET ID: 21FLJXWQDR2);*
- *Deer Creek at Talleyrand Avenue (STORET ID: 21FLA 20030792); and*
- *Deer Creek at Talleyrand Avenue (21FLJXWQDR1).*

Haines Street and Talleyrand Avenue each have two stations monitored by different entities (the city of Jacksonville and the Department). The Department maintains a station 50 feet east of Haines Street (21FLA 20030728), while the city of Jacksonville station is east of Haines Street and downstream of South Branch (21FLJXWDR2). The two Talleyrand Avenue stations (21FLA 20030792 and 21FLJXWQDR1) are located where Talleyrand Avenue crosses Deer Creek. The stations maintained by the Department had the fewest samples; 14 samples were collected from 2000 to 2001 and 2006 to 2007 at the Haines Street location (21FLA 20030728), and 1 sample in 2006 and 2007 at the Talleyrand Avenue location (21FLA 20030792). The city of Jacksonville maintained routine (mostly quarterly) sampling from 1995 to 2007 (excluding 1997) at the Talleyrand Avenue station (21FLJXWQDR1) and from 1995 to 2007 (excluding 1996 and 1997) at the Haines Street station (21FLJXWQDR2).

Table 5.1 shows data collection information for each of the stations. **Table 5.2** contains statistical information on each station's fecal coliform data. **Figure 5.1** shows the location of the sample sites. **Figure 5.2** is a chart showing the observed historical data analysis summary, and **Appendix B** contains the historical fecal coliform observations from the sites.

Table 5.1. Sampling Station Summary for the Deer Creek Watershed, WBID 2256

Station	STORET ID	Monitoring Agency	Years With Data	N
Deer Creek Approx 50 Ft East of Haines Street	21FLA 20030728	Department (Northeast District)	2000–01, 2006–07	14
Deer Cr @ Talleyrand Ave	21FLA 20030792	Department (Northeast District)	2006–07	11
Deer Creek at Talleyrand Ave	21FLJXWQDR1	City of Jacksonville	1995–96, 1998–2007	41
Deer Creek E of Haines St D/S of S Branch	21FLJXWQDR2	City of Jacksonville	1995, 1998–2007	53

Table 5.2. Statistical Table of Observed Historical Data for Deer Creek, WBID 2256

Station	STORET ID	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedances
Deer Creek Approx 50 Ft East of Haines Street	21FLA 20030728	14	10	2,800	333	4,183	7	50.00
Deer Cr @ Talleyrand Ave	21FLA 20030792	11	83	4,000	627	936	8	72.73
Deer Creek at Talleyrand Ave	21FLJXWQDR1	41	0	160,000	1,300	29	29	70.73
Deer Creek E of Haines St D/S of S Branch	21FLJXWQDR2	53	20	200,000	1,400	38	38	71.70

Coliform concentrations are counts/100mL.

5.1.2 TMDL Development Process

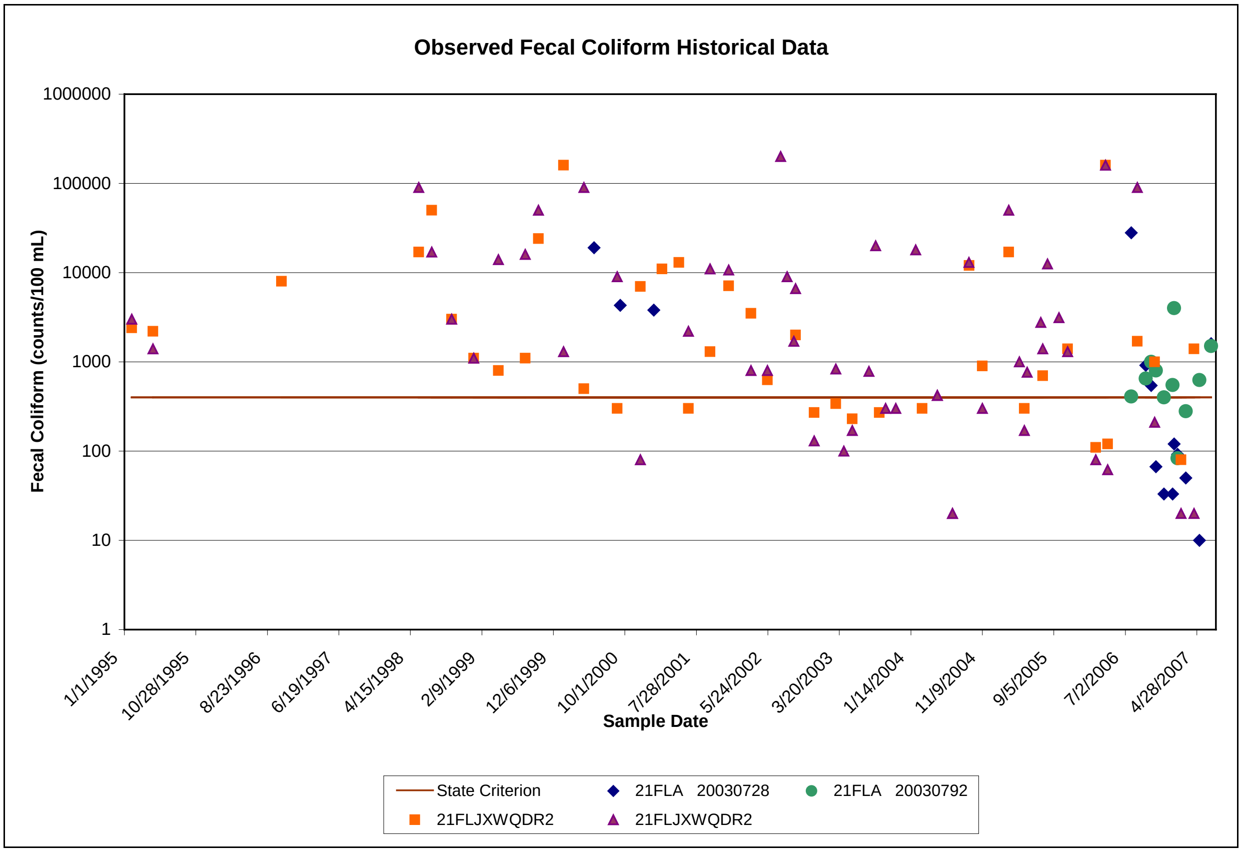
Due to the lack of supporting information, mainly flow data, a simple, straightforward calculation was performed to determine the needed reduction. Exceedances of the state criterion were compared with the criterion of 400 counts/100mL. For each individual exceedance, an individual required reduction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

$$\frac{\text{[(observed value) – (state criterion)] x 100}}{\text{(observed value)}}$$

After the individual results were calculated, the median of the individual values was calculated, which is 86 percent. This means that in order to meet the state criterion of 400 counts/100mL, an 86 percent reduction in current loading is necessary, and is therefore the TMDL for Deer Creek. **Table 5.3** shows the annual summaries of data used in the calculation of the TMDL, and **Table 5.4** shows the individual reduction calculations for Deer Creek, including all exceedances.

Figure 5.1. Historical Sample Sites in Deer Creek, WBID 2256

Figure 5.2. Historical Observations for Deer Creek, WBID 2256, 1995–2007



*One result value is 0 (occurred on 5/4/2004 at Station 21FLA20030792); in order to display the graph on a logarithmic scale, this result was excluded.

Table 5.3. Annual Summary of Historical Observed Fecal Coliform Data in Deer Creek, WBID 2256, Used in the TMDL

Year	N	Minimum	Maximum	Median	Mean
1995	0	1,400	2,400	2,300	2,250
1996	0	8,000	8,000	8,000	8,000
1997	-	-	-	-	-
1998	0	3,000	90,000	17,000	30,000
1999	0	800	50,000	7,550	13,513
2000	0	80	160,000	5,650	29,148
2001	0	300	13,000	7,100	6,711
2002	11	130	200,000	1,700	20,494
2003	6	100	20,000	300	2,332
2004	7	0	18,000	420	4,125
2005	8	170	50,000	1,400	7,109
2006	9	33	160,000	599	22,305
2007	9	10	4,000	106	654

Coliform counts are #/100mL and represent years for which data exist.
- = There are no data for 1997.

Table 5.4. Calculation of Reductions for the Fecal Coliform TMDL for Deer Creek, WBID 2256

Sample Date	Location	Observed Value (Exceedance) (#/100mL)	Required % Reduction
2/1/1995	Deer Creek at Talleyrand Ave	2,400	83.33
2/1/1995	Deer Creek E of Haines St D/S of S Branch	3,000	86.67
5/1/1995	Deer Creek at Talleyrand Ave	2,200	81.82
5/1/1995	Deer Creek E of Haines St D/S of S Branch	1,400	71.43
10/21/1996	Deer Creek at Talleyrand Ave	8,000	95.00
5/20/1998	Deer Creek at Talleyrand Ave	17,000	97.65
5/20/1998	Deer Creek E of Haines St D/S of S Branch	90,000	99.56
7/14/1998	Deer Creek at Talleyrand Ave	50,000	99.20
7/14/1998	Deer Creek E of Haines St D/S of S Branch	17,000	97.65
10/5/1998	Deer Creek at Talleyrand Ave	3,000	86.67
10/5/1998	Deer Creek E of Haines St D/S of S Branch	3,000	86.67
1/6/1999	Deer Creek at Talleyrand Ave	1,100	63.64
1/6/1999	Deer Creek E of Haines St D/S of S Branch	1,100	63.64
4/19/1999	Deer Creek at Talleyrand Ave	800	50.00
4/19/1999	Deer Creek E of Haines St D/S of S Branch	14,000	97.14
8/10/1999	Deer Creek at Talleyrand Ave	1,100	63.64
8/10/1999	Deer Creek E of Haines St D/S of S Branch	16,000	97.50
10/4/1999	Deer Creek at Talleyrand Ave	24,000	98.33
10/4/1999	Deer Creek E of Haines St D/S of S Branch	50,000	99.20
1/18/2000	Deer Creek at Talleyrand Ave	160,000	99.75
1/18/2000	Deer Creek E of Haines St D/S of S Branch	1,300	69.23
4/12/2000	Deer Creek at Talleyrand Ave	500	20.00
4/12/2000	Deer Creek E of Haines St D/S of S Branch	90,000	99.56
5/25/2000	Deer Creek Approx 50 Ft East of Haines Street	19,000	97.89
8/30/2000	Deer Creek E of Haines St D/S of S Branch	9,000	95.56
9/12/2000	Deer Creek Approx 50 Ft East of Haines Street	4,300	90.70
12/5/2000	Deer Creek at Talleyrand Ave	7,000	94.29
1/30/2001	Deer Creek Approx 50 Ft East of Haines Street	3,800	89.47
3/6/2001	Deer Creek at Talleyrand Ave	11,000	96.36
5/16/2001	Deer Creek at Talleyrand Ave	13,000	96.92
6/25/2001	Deer Creek E of Haines St D/S of S Branch	2,200	81.82
9/24/2001	Deer Creek at Talleyrand Ave	1,300	69.23
9/24/2001	Deer Creek E of Haines St D/S of S Branch	11,000	96.36
12/11/2001	Deer Creek at Talleyrand Ave	7,100	94.37
12/11/2001	Deer Creek E of Haines St D/S of S Branch	10,700	96.26
3/14/2002	Deer Creek at Talleyrand Ave	3,500	88.57
3/14/2002	Deer Creek E of Haines St D/S of S Branch	800	50.00
5/22/2002	Deer Creek at Talleyrand Ave	630	36.51
5/22/2002	Deer Creek E of Haines St D/S of S Branch	801	50.06
7/17/2002	Deer Creek E of Haines St D/S of S Branch	200,000	99.80
8/13/2002	Deer Creek E of Haines St D/S of S Branch	9,000	95.56
9/10/2002	Deer Creek E of Haines St D/S of S Branch	1,700	76.47
9/17/2002	Deer Creek at Talleyrand Ave	2,000	80.00
9/17/2002	Deer Creek E of Haines St D/S of S Branch	6,600	93.94

Sample Date	Location	Observed Value (Exceedance) (#/100mL)	Required % Reduction
3/5/2003	Deer Creek E of Haines St D/S of S Branch	830	51.81
7/22/2003	Deer Creek E of Haines St D/S of S Branch	780	48.72
8/19/2003	Deer Creek E of Haines St D/S of S Branch	20,000	98.00
2/3/2004	Deer Creek E of Haines St D/S of S Branch	18,000	97.78
5/4/2004	Deer Creek E of Haines St D/S of S Branch	420	4.76
5/4/2004	Deer Creek E of Haines St D/S of S Branch	420	4.76
9/14/2004	Deer Creek E of Haines St D/S of S Branch	13,000	96.92
9/15/2004	Deer Creek at Talleyrand Ave	12,000	96.67
11/9/2004	Deer Creek at Talleyrand Ave	900	55.56
2/28/2005	Deer Creek at Talleyrand Ave	17,000	97.65
2/28/2005	Deer Creek E of Haines St D/S of S Branch	50,000	99.20
4/13/2005	Deer Creek E of Haines St D/S of S Branch	1,000	60.00
5/16/2005	Deer Creek E of Haines St D/S of S Branch	765	47.71
7/12/2005	Deer Creek E of Haines St D/S of S Branch	2,765	85.53
7/20/2005	Deer Creek at Talleyrand Ave	700	42.86
7/20/2005	Deer Creek E of Haines St D/S of S Branch	1,400	71.43
8/9/2005	Deer Creek E of Haines St D/S of S Branch	12,500	96.80
9/27/2005	Deer Creek E of Haines St D/S of S Branch	3,120	87.18
11/2/2005	Deer Creek at Talleyrand Ave	1,400	71.43
11/2/2005	Deer Creek E of Haines St D/S of S Branch	1,300	69.23
4/10/2006	Deer Creek at Talleyrand Ave	160,000	99.75
4/10/2006	Deer Creek E of Haines St D/S of S Branch	160,000	99.75
7/27/2006	Deer Creek Approx 50 Ft East of Haines Street	28,000	98.57
7/27/2006	Deer Cr @ Talleyrand Ave	409	2.20
8/21/2006	Deer Creek at Talleyrand Ave	1,700	76.47
8/21/2006	Deer Creek E of Haines St D/S of S Branch	90,000	99.56
9/26/2006	Deer Creek Approx 50 Ft East of Haines Street	913	56.19
9/26/2006	Deer Cr @ Talleyrand Ave	652	38.65
10/18/2006	Deer Creek Approx 50 Ft East of Haines Street	545	26.61
10/18/2006	Deer Cr @ Talleyrand Ave	1,000	60.00
11/2/2006	Deer Creek at Talleyrand Ave	1,000	60.00
11/7/2006	Deer Cr @ Talleyrand Ave	800	50.00
12/11/2006	Deer Cr @ Talleyrand Ave	400	0.00
1/16/2007	Deer Cr @ Talleyrand Ave	550	27.27
1/23/2007	Deer Cr @ Talleyrand Ave	4,000	90.00
4/16/2007	Deer Creek at Talleyrand Ave	1,400	71.43
5/9/2007	Deer Cr @ Talleyrand Ave	627	36.20
6/27/2007	Deer Creek Approx 50 Ft East of Haines Street	1,600	75.00
6/27/2007	Deer Cr @ Talleyrand Ave	1,500	73.33
	MEDIAN:	**2,765**	**85.53**

5.1.3 Critical Conditions/Seasonality

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

A nonparametric test (Kruskal-Wallis) was applied to the fecal coliform dataset to determine whether there were significant differences among months or seasons. The analysis indicated that there were no significant differences between fecal coliform observations versus season (**Appendix C**) and versus month (**Appendix D**) at an alpha (α) level of 0.05. **Appendix E** contains a chart showing comparisons between each station and season.

Kruskal–Wallis tests were also used to analyze fecal coliform data and several rainfall regimes, including sampling day (1 day), sampling day and 2 days prior (3 day), sampling day and 6 days prior (7 day), and sampling day and 29 days prior (30 day). A Spearman correlation matrix was generated that summarized the simple correlation coefficients between the various rainfall and coliform values (**Appendix G**). The simple correlations (r values in the Spearman correlation table) between both fecal coliform and the various rainfall totals were all positive, suggesting that as rainfall (and possible runoff) increased, so did the number of coliform. 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. The r^2 values between fecal coliform and all of the various intervals were not significant (**Appendix H**).

Appendix F presents rainfall at JIA from 1990 to 2008. A table of historical monthly average rainfall (**Appendix I**) indicates that monthly rainfall totals increase in June, peak in September, and by October return to the levels observed in February and March. Data analysis by season (**Table 2.3**) indicates that the highest percentage of exceedances occurs in the summer months (July to September). **Appendix J** contains a graph of annual rainfall from 1955 to 2008 versus the long-term average (52.47 inches) over this period. The years 1996 to 1998 had above-average rainfall, while 1999 to 2001 were below average and 2002 was again above average.

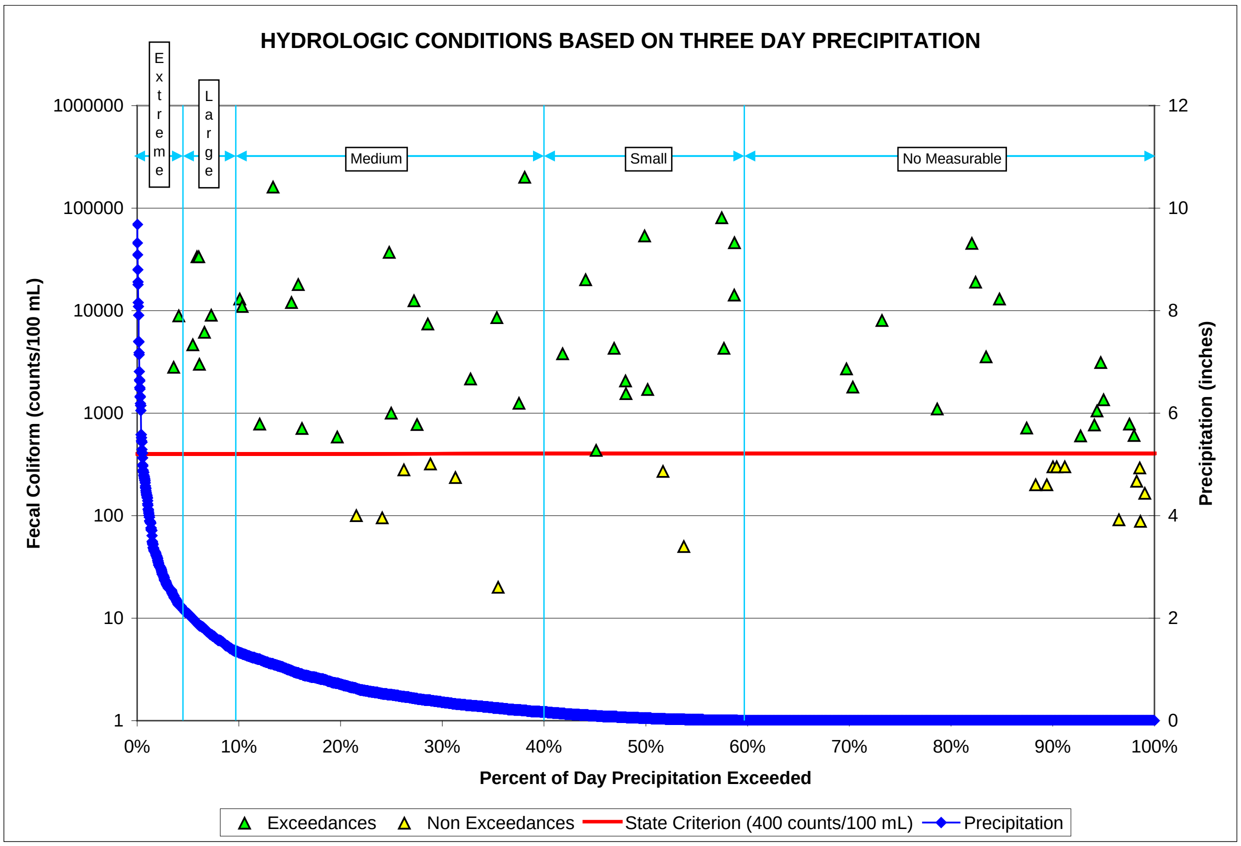
Hydrologic conditions were analyzed using rainfall, since no flow data were available. A loading curve type chart was created using precipitation data from JIA from 1990 to 2008. The same hydrologic conditions were applied to the precipitation curve as would be applied to a flow-based loading curve: extreme flows for the upper percentiles (0 to 5th percentiles), large flows (5th to 10th percentile), medium flows (10th to 40th percentile), small flows (40th to 60th percentile), and no flow (60th to 100th percentile). Three-day (the day of and 2 days prior) precipitation accumulations were used in the analysis.

Data show that exceedances occurred over all hydrologic conditions; however, the lowest percentage of exceedances (61.54 percent) occurred during no-rainfall conditions. The greatest percentage of exceedances occurred during extreme and large rainfall conditions (100 percent). Most of the samples (26) were collected under no-measurable-rainfall conditions, and the fewest samples (2) under extreme rainfall conditions. All values collected in the extreme and large rainfall ranges exceeded 400 counts/100mL. When measurable amounts of rainfall occurred, the percentage of exceedances was greater than when there was no measurable rainfall. **Table 5.5** summarizes data and hydrologic conditions. **Figure 5.3** shows the same data visually.

Table 5.5. Summary of Fecal Coliform Data by Hydrologic Condition

Precipitation Event	Event Range (inches)	Total Samples	Number of Exceedances	% Exceedances	Number of Nonexceedances	% Nonexceedances
Extreme	>2.1"	2	2	100.00	0	0.00
Large	1.33" - 2.1"	7	7	100.00	0	0.00
Medium	0.18" - 1.33"	21	16	76.19	6	28.57
Small	0.01" - 0.18"	14	12	85.71	2	14.29
None/ No Measurable	<0.01"	26	16	61.54	10	38.46

Figure 5.3. Fecal Coliform Data by Hydrologic Condition Based on Rainfall



Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. The TMDL for Deer Creek is expressed in terms of counts/100mL and represents 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 Deer Creek, WBID 2256

WBID	Parameter	TMDL (colonies/ 100mL)	WLA Wastewater (colonies/day)	WLA NPDES Stormwater	LA (% reduction)	MOS
2256	Fecal Coliform	400	N/A	86%	86%	Implicit

N/A = Not applicable

6.2 Load Allocation

The LA for nonpoint sources is a 86 percent reduction of instream fecal coliform concentrations. 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

6.3.1 NPDES Wastewater Discharges

There currently are no facilities permitted to discharge wastewater to surface waters in the Deer Creek watershed. Any future permits issued in the watershed will be required to meet the state Class III criterion for fecal coliform as well as the TMDL value, and therefore will not be allowed to exceed 200 counts/100mL as a monthly average, 400 counts/100mL in more than 10 percent of the samples, or 800 counts/100mL at any given time.

6.3.2 NPDES Stormwater Discharges

The city of Jacksonville, including the Deer Creek watershed, is covered by a Phase I MS4 permit (FL000012) that includes the cities of Jacksonville, Atlantic Beach, and Neptune Beach. Permit responsibility is shared among the cities of Jacksonville, Atlantic Beach, and Neptune Beach; and FDOT District 2.

The WLA for the MS4 permit (FL000012) is to address anthropogenic sources in the watershed to result in an 86 percent reduction of instream fecal coliform concentrations. It should be noted that any MS4 permittee is only responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

While the LA and WLA for fecal coliform are expressed as the percent reductions needed to attain the applicable Class III criterion, it is the combined reductions from both anthropogenic point and nonpoint sources that will result in the required reduction of instream fecal coliform concentrations. However, it is not the intent of these TMDLs to abate natural background conditions.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was assumed in the development of this TMDL by not allowing any exceedances of the state criterion, even though it allows for 10 percent exceedances over the fecal coliform criterion of 400 counts/100mL.

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, or BMAP, for the TMDL. The first BMAP for the tributaries to the Lower St. Johns River will address the 10 worst-case impairments in the 55 tributaries impaired for fecal coliform. Any future BMAPs will address additional subsets of the tributaries listed for fecal coliform.

In addition to addressing failing septic tanks, the BMAP may include some sort of public education program about pet waste cleanup. As **Table 4.4** shows, potential impacts from dogs in the watershed could be significant. If pet owners are educated on the potential impacts their pets are having on Deer Creek, and they are inclined to take action, this could potentially decrease a source load. When considering the significance of seven-day rainfall, this could be a potentially significant load to the stream.

Through the implementation of projects, activities, and additional source assessments in the BMAP, stakeholders expect the following outcomes:

- *Improved water quality trends in the tributaries of the Lower St. Johns River, which will also help improve water quality in the main stem of the river;*
- *Decreased loading of the target pollutant (fecal coliform);*
- *Enhanced public awareness of pollutant sources, pollutant impacts on water quality, and corresponding corrective actions;*
- *Enhanced understanding of basin hydrology, water quality, and pollutant sources; and*
- *The ability to evaluate management actions, estimate their benefits, and identify additional pollutant sources.*

7.1.1 Determination of Worst-Case WBIDs

The initial determination of the worst-case WBIDs uses a ranking method that establishes the severity of bacterial contamination based on the number of exceedances of fecal coliform colony counts—i.e., the number of total fecal coliform samples in a waterbody during the period of record to indicate how many samples are over 800, 5,000, and 10,000 colony counts. A combined rank is then created based on the number of exceedances in each category. The WBIDs are sorted from worst to best to provide a guideline for assessment priorities, with the worst-case waterbody ranked first. Future BMAPs will continue to address the worst-case waters first, using the ranking method.

7.1.2 Identification of Probable Sources

Tributary Pollutant Assessment Project

Initial sampling for the study on the six initial WBIDs of highest concern began July 26, 2005, and was completed on February 1, 2006. The final deliverable (the *Tributary Pollutant Assessment Project Manual*) was submitted to JEA on June 1, 2006, and became available for public review and comment on June 16, 2006. Four types of fecal indicators (fecal coliform, *E. coli*., *Enterococci*, and coliphages) were studied. *Enterococcus faecalis* was also studied in an attempt to further identify potential sources of sewage, and samples were checked for human/ruminant primers.

The executive summary submitted to the Department by JEA and PBS&J is attached as **Appendix K**. The results of the study will be used to help guide the identification of restoration projects during BMAP development.

Technical Reports

In an effort to address the known impairments in the Lower St. Johns tributaries, the Department contracted with Post, Buckley, Schuh & Jernigan (PBS&J) to develop technical reports that describe and interpret the water quality, spatial, and geographic data from the Department, Duval County Health Department, city of Jacksonville, and JEA. The reports analyze the available data to identify the most probable sources of fecal coliform, which fall into five main categories, as follows: (1) stormwater, (2) onsite sewage treatment and disposal systems (OSTDS), (3) sewer infrastructure, (4) nonpoint sources such as pet waste, and (5) natural background such as wildlife. These reports were peer reviewed by technical stakeholders in the basin, who also provided additional input based on their knowledge of the tributaries.

7.1.3 Issues To Be Addressed in Future Watershed Management Cycles

The BMAP process identified the following items that should be addressed in future watershed management cycles to ensure that future BMAPs use the most accurate information:

Source Identification*—Sources of fecal coliform impairment are particularly difficult to trace. For this reason, the BMAP includes source identification studies as management actions.*

Septic Tanks*—The Department is implementing a study, Evaluation of Septic Tank Influences on Nutrient Loading to the Lower St. Johns River Basin and Its Tributaries, to better understand the nutrient and bacteria loading from septic tanks via ground water by monitoring conditions at representative sites. The study seeks to answer questions on potential OSTDS impacts and the attenuation of nitrogen, phosphorus, and bacteria (fecal coliform) by soil, under the range of conditions that represent typical OSTDS sites near impaired surface waters. It will also document the nutrients and bacteria in the receiving Lower St. Johns tributaries at each site. The results will provide information about the relative contribution of fecal coliform from septic tanks located near the impaired tributaries.*

GIS Information—*During the BMAP process, the available GIS data, which provide a basis for some of the source analyses, have improved. As more information becomes available, the updated GIS database for the tributaries will be utilized to aid in source identification. This information will include determining the spatial locations for private wastewater systems and infrastructure, collecting jurisdictional or systemwide programs and activities on a WBID scale for future reporting and assessment, and systematically updating all GIS information databases used to compile the BMAP.*

7.1.4 BMAP Implementation

The BMAP requires that all stakeholders implement their projects to achieve reductions as soon as practicable. However, the full implementation of the BMAP will be a long-term process. While some of the projects and activities in the BMAP are recently completed or currently ongoing, several projects will require more time to design, secure funding, and construct. Although funding the projects could be an issue, funding limitations do not affect the requirement that every entity must implement the activities listed in the BMAP.

Since BMAP implementation is a long-term process, the TMDL targets established for the Lower St. Johns Basin will not be achieved in the next five years. It may take even longer for the tributaries to respond to reduced loadings and fully meet applicable water quality standards. Regular follow-up and continued coordination and communication among the stakeholders will be essential to ensure the implementation of management strategies and the assessment of their incremental effects. Any additional management actions required to achieve TMDLs, if necessary, will be developed as part of BMAP follow-up.

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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. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the state's water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations

Chapter 62-40, F.A.C., also requires the water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a 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.

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. 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 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 FDOT throughout the 15 counties meeting the population criteria. EPA authorized the Department to implement the NPDES Stormwater Program (except for tribal lands) in October 2000.

An important difference between the federal and the state's stormwater/environmental resource permitting programs is that the NPDES Program covers both new and existing discharges, while the state's program focuses on new discharges only. Additionally, Phase II of the NPDES Program, implemented in 2003, expands the need for these permits to construction sites between 1 and 5 acres, and to local governments with as few as 10,000 people. The 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, as are other point sources of pollution, such as domestic and industrial wastewater discharges. It should be noted that all MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Historical Fecal Coliform Observations in Deer Creek, WBID 2256

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Deer Creek	2256	2/1/1995	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	3,000	
Deer Creek	2256	2/1/1995	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,400	
Deer Creek	2256	5/1/1995	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,400	
Deer Creek	2256	5/1/1995	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,200	
Deer Creek	2256	10/21/1996	21FLJXWQDR1	Deer Creek at Talleyrand Ave	8,000	
Deer Creek	2256	5/20/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	17,000	
Deer Creek	2256	5/20/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	90,000	
Deer Creek	2256	7/14/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	50,000	
Deer Creek	2256	7/14/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	17,000	
Deer Creek	2256	10/5/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	3,000	
Deer Creek	2256	10/5/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	3,000	
Deer Creek	2256	1/6/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,100	
Deer Creek	2256	1/6/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,100	
Deer Creek	2256	4/19/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	800	
Deer Creek	2256	4/19/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	14,000	
Deer Creek	2256	8/10/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,100	
Deer Creek	2256	8/10/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	16,000	
Deer Creek	2256	10/4/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	24,000	
Deer Creek	2256	10/4/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	50,000	
Deer Creek	2256	1/18/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	160,000	L
Deer Creek	2256	1/18/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,300	
Deer Creek	2256	4/12/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	500	
Deer Creek	2256	4/12/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	90,000	
Deer Creek	2256	5/25/2000	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	19,000	
Deer Creek	2256	8/30/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	9,000	
Deer Creek	2256	8/30/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	9/12/2000	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	4,300	
Deer Creek	2256	12/5/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	7,000	
Deer Creek	2256	12/5/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	80	
Deer Creek	2256	1/30/2001	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	3,800	
Deer Creek	2256	3/6/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	11,000	
Deer Creek	2256	5/16/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	13,000	
Deer Creek	2256	6/25/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	2,200	
Deer Creek	2256	6/25/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	9/24/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	11,000	
Deer Creek	2256	9/24/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,300	
Deer Creek	2256	12/11/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	10,700	
Deer Creek	2256	12/11/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	7,100	
Deer Creek	2256	3/14/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	800	L
Deer Creek	2256	3/14/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	3,500	
Deer Creek	2256	5/22/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	630	
Deer Creek	2256	5/22/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	801	
Deer Creek	2256	7/17/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	200,000	
Deer Creek	2256	8/13/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	9,000	
Deer Creek	2256	9/10/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,700	

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Deer Creek	2256	9/17/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,000	
Deer Creek	2256	9/17/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	6,600	
Deer Creek	2256	12/4/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	270	
Deer Creek	2256	12/4/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	130	
Deer Creek	2256	3/5/2003	DR1	Deer Creek at Talleyrand Ave	340	
Deer Creek	2256	3/5/2003	DR2	Deer Creek E of Haines St D/S of S Branch	830	
Deer Creek	2256	4/8/2003	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	100	
Deer Creek	2256	5/13/2003	DR1	Deer Creek at Talleyrand Ave	230	
Deer Creek	2256	5/13/2003	DR2	Deer Creek E of Haines St D/S of S Branch	170	
Deer Creek	2256	7/22/2003	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	780	
Deer Creek	2256	8/19/2003	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	20,000	
Deer Creek	2256	9/4/2003	DR1	Deer Creek at Talleyrand Ave	270	
Deer Creek	2256	9/30/2003	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	300	
Deer Creek	2256	11/12/2003	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	300	
Deer Creek	2256	2/3/2004	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	18,000	
Deer Creek	2256	3/2/2004	DR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	5/4/2004	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	420	
Deer Creek	2256	5/4/2004	DR1	Deer Creek at Talleyrand Ave	0	
Deer Creek	2256	5/4/2004	DR2	Deer Creek E of Haines St D/S of S Branch	420	
Deer Creek	2256	7/7/2004	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	20	U
Deer Creek	2256	7/7/2004	DR2	Deer Creek E of Haines St D/S of S Branch	20	
Deer Creek	2256	9/14/2004	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	13,000	
Deer Creek	2256	9/15/2004	DR1	Deer Creek at Talleyrand Ave	12,000	
Deer Creek	2256	11/9/2004	DR1	Deer Creek at Talleyrand Ave	900	
Deer Creek	2256	11/9/2004	DR2	Deer Creek E of Haines St D/S of S Branch	300	
Deer Creek	2256	2/28/2005	DR1	Deer Creek at Talleyrand Ave	17,000	
Deer Creek	2256	2/28/2005	DR2	Deer Creek E of Haines St D/S of S Branch	50,000	
Deer Creek	2256	4/13/2005	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,000	
Deer Creek	2256	5/4/2005	DR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	5/4/2005	DR2	Deer Creek E of Haines St D/S of S Branch	170	
Deer Creek	2256	5/16/2005	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	765	
Deer Creek	2256	7/12/2005	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	2,765	
Deer Creek	2256	7/20/2005	DR1	Deer Creek at Talleyrand Ave	700	
Deer Creek	2256	7/20/2005	DR2	Deer Creek E of Haines St D/S of S Branch	1,400	
Deer Creek	2256	8/9/2005	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	12,500	
Deer Creek	2256	9/27/2005	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	3,120	Q
Deer Creek	2256	11/2/2005	DR1	Deer Creek at Talleyrand Ave	1,400	
Deer Creek	2256	11/2/2005	DR2	Deer Creek E of Haines St D/S of S Branch	1,300	
Deer Creek	2256	2/28/2006	DR1	Deer Creek at Talleyrand Ave	110	
Deer Creek	2256	2/28/2006	DR2	Deer Creek E of Haines St D/S of S Branch	80	
Deer Creek	2256	4/10/2006	DR1	Deer Creek at Talleyrand Ave	160,000	
Deer Creek	2256	4/10/2006	DR2	Deer Creek E of Haines St D/S of S Branch	160,000	
Deer Creek	2256	4/19/2006	DR1	Deer Creek at Talleyrand Ave	120	
Deer Creek	2256	4/19/2006	DR2	Deer Creek E of Haines St D/S of S Branch	62	
Deer Creek	2256	7/27/2006	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	28,000	
Deer Creek	2256	7/27/2006	21FLA 20030792	Deer Creek at Talleyrand Ave	409	A
Deer Creek	2256	8/21/2006	DR1	Deer Creek at Talleyrand Ave	1,700	
Deer Creek	2256	2/1/1995	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	3,000	

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Deer Creek	2256	2/1/1995	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,400	
Deer Creek	2256	5/1/1995	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,400	
Deer Creek	2256	5/1/1995	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,200	
Deer Creek	2256	10/21/1996	21FLJXWQDR1	Deer Creek at Talleyrand Ave	8,000	
Deer Creek	2256	5/20/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	17,000	
Deer Creek	2256	5/20/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	90,000	
Deer Creek	2256	7/14/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	50,000	
Deer Creek	2256	7/14/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	17,000	
Deer Creek	2256	10/5/1998	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	3,000	
Deer Creek	2256	10/5/1998	21FLJXWQDR1	Deer Creek at Talleyrand Ave	3,000	
Deer Creek	2256	1/6/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,100	
Deer Creek	2256	1/6/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,100	
Deer Creek	2256	4/19/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	800	
Deer Creek	2256	4/19/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	14,000	
Deer Creek	2256	8/10/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,100	
Deer Creek	2256	8/10/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	16,000	
Deer Creek	2256	10/4/1999	21FLJXWQDR1	Deer Creek at Talleyrand Ave	24,000	
Deer Creek	2256	10/4/1999	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	50,000	
Deer Creek	2256	1/18/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	160,000	L
Deer Creek	2256	1/18/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,300	
Deer Creek	2256	4/12/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	500	
Deer Creek	2256	4/12/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	90,000	
Deer Creek	2256	5/25/2000	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	19,000	
Deer Creek	2256	8/30/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	9,000	
Deer Creek	2256	8/30/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	9/12/2000	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	4,300	
Deer Creek	2256	12/5/2000	21FLJXWQDR1	Deer Creek at Talleyrand Ave	7,000	
Deer Creek	2256	12/5/2000	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	80	
Deer Creek	2256	1/30/2001	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	3,800	
Deer Creek	2256	3/6/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	11,000	
Deer Creek	2256	5/16/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	13,000	
Deer Creek	2256	6/25/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	2,200	
Deer Creek	2256	6/25/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	300	
Deer Creek	2256	9/24/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	11,000	
Deer Creek	2256	9/24/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	1,300	
Deer Creek	2256	12/11/2001	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	10,700	
Deer Creek	2256	12/11/2001	21FLJXWQDR1	Deer Creek at Talleyrand Ave	7,100	
Deer Creek	2256	3/14/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	800	L
Deer Creek	2256	3/14/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	3,500	
Deer Creek	2256	5/22/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	630	
Deer Creek	2256	5/22/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	801	
Deer Creek	2256	7/17/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	200,000	
Deer Creek	2256	8/13/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	9,000	
Deer Creek	2256	9/10/2002	21FLJXWQDR2	Deer Creek E of Haines St D/S of S Branch	1,700	
Deer Creek	2256	9/17/2002	21FLJXWQDR1	Deer Creek at Talleyrand Ave	2,000	

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Deer Creek	2256	8/21/2006	DR2	Deer Creek E of Haines St D/S of S Branch	90,000	
Deer Creek	2256	9/26/2006	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	913	A
Deer Creek	2256	9/26/2006	21FLA 20030792	Deer Creek at Talleyrand Ave	652	A
Deer Creek	2256	10/18/2006	21FLA 20030792	Deer Creek at Talleyrand Ave	1,000	A
Deer Creek	2256	10/18/2006	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	545	A
Deer Creek	2256	11/2/2006	DR1	Deer Creek at Talleyrand Ave	1,000	
Deer Creek	2256	11/2/2006	DR2	Deer Creek E of Haines St D/S of S Branch	210	
Deer Creek	2256	11/7/2006	21FLA 20030792	Deer Creek at Talleyrand Ave	800	A
Deer Creek	2256	11/7/2006	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	67	B
Deer Creek	2256	12/11/2006	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	33	B
Deer Creek	2256	12/11/2006	21FLA 20030792	Deer Creek at Talleyrand Ave	400	B
Deer Creek	2256	1/16/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	550	A
Deer Creek	2256	1/16/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	33	B
Deer Creek	2256	1/23/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	4,000	B
Deer Creek	2256	1/23/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	120	B
Deer Creek	2256	2/6/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	92	A
Deer Creek	2256	2/6/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	83	A
Deer Creek	2256	2/21/2007	DR1	Deer Creek at Talleyrand Ave	80	
Deer Creek	2256	2/21/2007	DR2	Deer Creek E of Haines St D/S of S Branch	20	
Deer Creek	2256	3/13/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	280	A
Deer Creek	2256	3/13/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	50	U
Deer Creek	2256	4/16/2007	DR1	Deer Creek at Talleyrand Ave	1,400	
Deer Creek	2256	4/16/2007	DR2	Deer Creek E of Haines St D/S of S Branch	20	
Deer Creek	2256	5/9/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	10	U
Deer Creek	2256	5/9/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	627	A
Deer Creek	2256	6/27/2007	21FLA 20030792	Deer Creek at Talleyrand Ave	1,500	B
Deer Creek	2256	6/27/2007	21FLA 20030728	Deer Creek Approx 50 Ft East of Haines Street	1,600	B

*Deleted blank result entries and dups.

City of Jacksonville data from PBS&J.

Values that exceed the state criterion of 400 counts/100mL.

Remark Code:

A – Average value.

B – Results based on colony counts outside the acceptable range.

L – Off-scale high. Actual value not known, but known to be greater than value shown.

Q – Held beyond holding time.

U – Not detected.

Appendix C: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Season in Deer Creek, WBID 2256

Categorical values encountered during processing are:
SEASON$ (4 levels)
fall, spring, summer, winter

Kruskal-Wallis One-Way Analysis of Variance for 119 cases
Dependent variable is FECALS
Grouping variable is SEASON$

Group	Count	Rank Sum
fall	24	1338.500
spring	34	1903.500
summer	33	2413.000
winter	28	1485.000

Kruskal-Wallis Test Statistic = 6.740
Probability is 0.081 assuming Chi-square distribution with 3 df

Appendix D: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Month in Deer Creek, WBID 2256

Categorical values encountered during processing are:
MONTH (12 levels)
1, 2, 3, 4, 5, 6, 7,
8, 9, 10, 11, 12

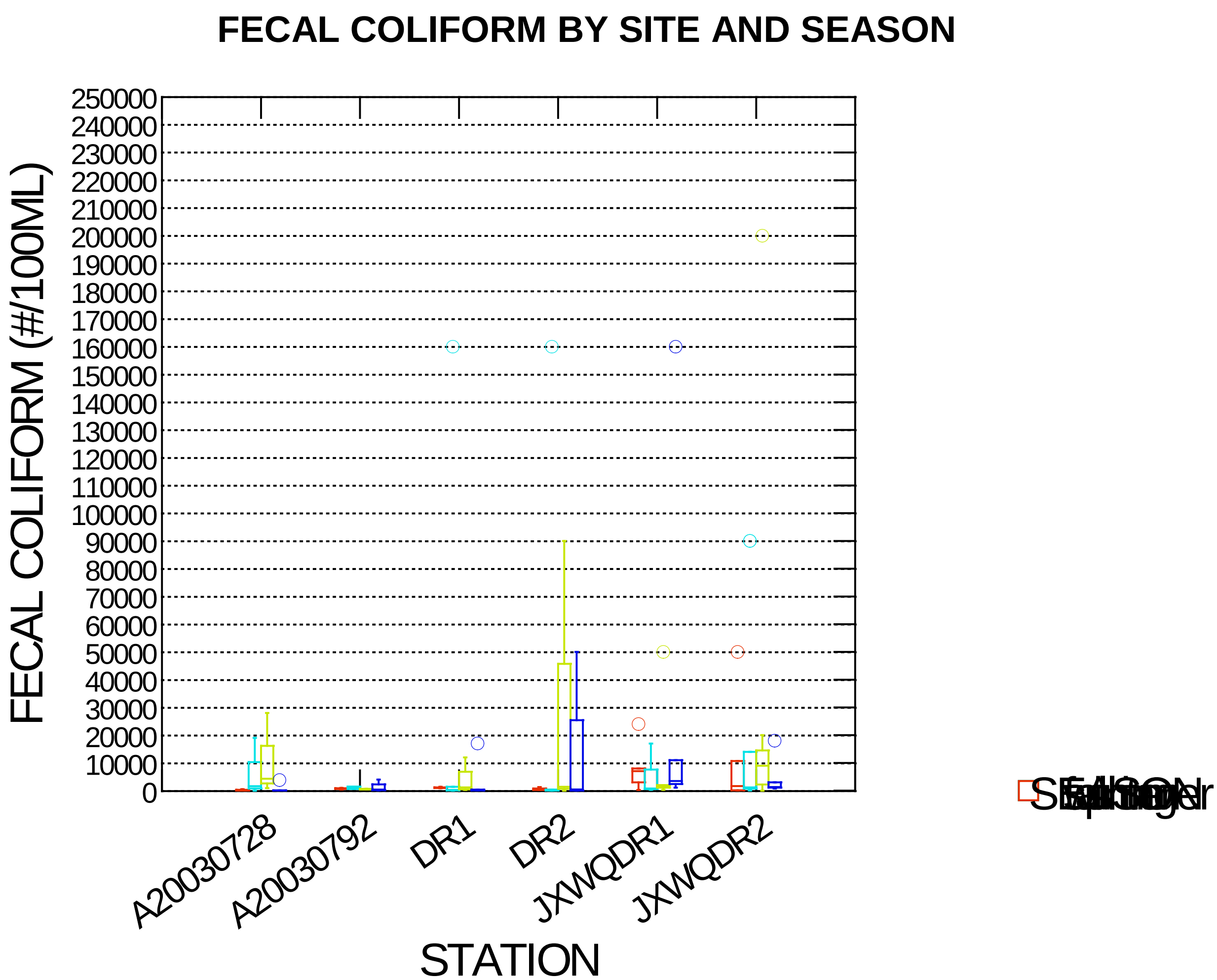
Kruskal-Wallis One-Way Analysis of Variance for 119 cases
Dependent variable is FECALS
Grouping variable is MONTH

Group	Count	Rank Sum
1	9	542.000
2	11	555.500
3	8	387.500
4	12	716.500
5	18	938.500
6	4	248.500
7	11	730.500
8	9	767.500
9	13	915.000
10	7	569.000
11	9	394.500
12	8	375.000

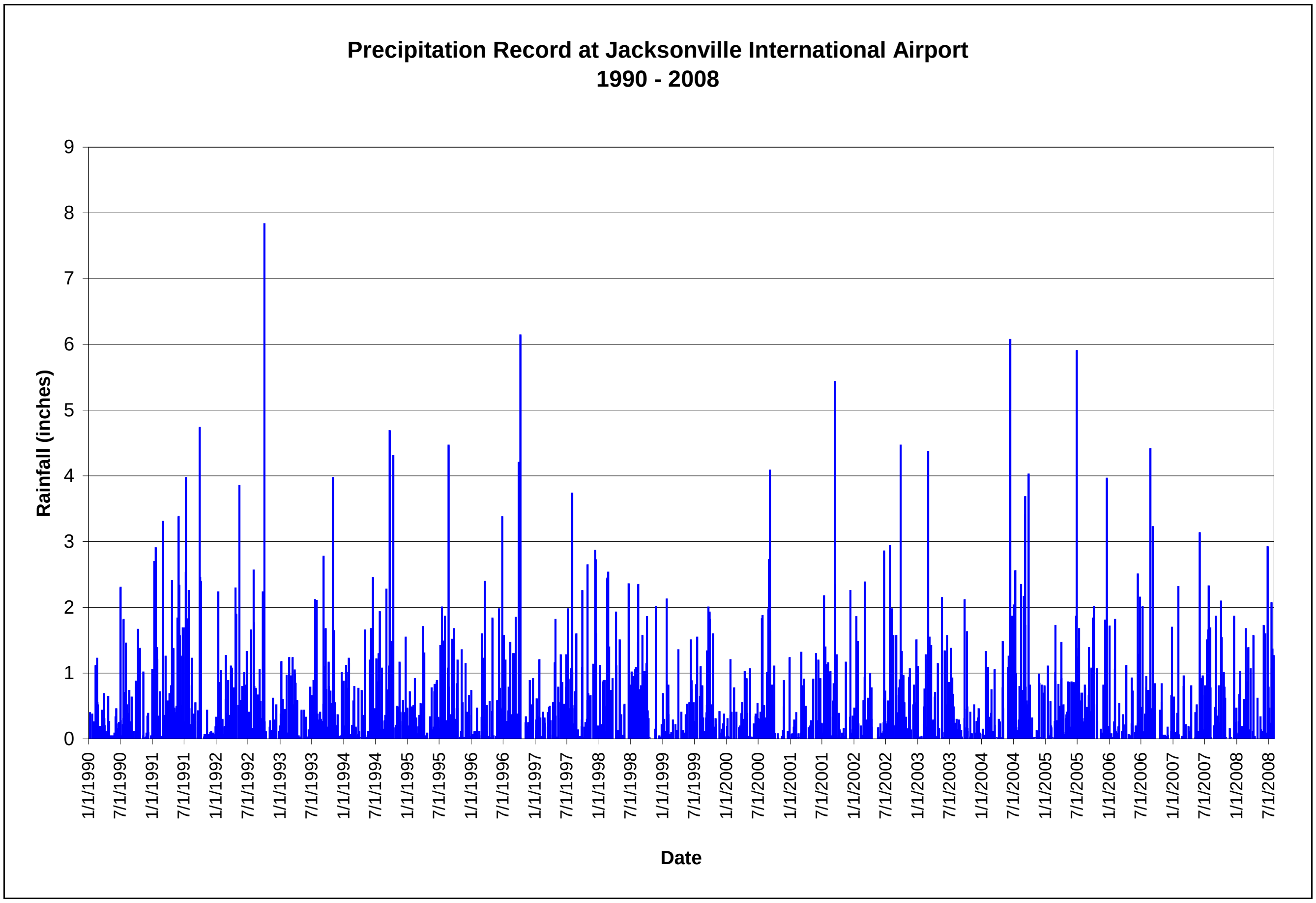
Kruskal-Wallis Test Statistic = 14.881
Probability is 0.188 assuming Chi-square distribution with 11 df

Appendix E: Fecal Coliform Observations versus Season and Station in Deer Creek, WBID 2256

Station	STORET ID
Deer Creek Approx 50 Ft East of Haines Street	21FLA 20030728
Deer Cr @ Talleyrand Ave	21FLA 20030792
Deer Creek at Talleyrand Ave	21FLJXWQDR1
Deer Creek E of Haines ST D/S of S Branch	21FLJXWQDR2



Appendix F: Chart of Rainfall for JIA, 1990–2008

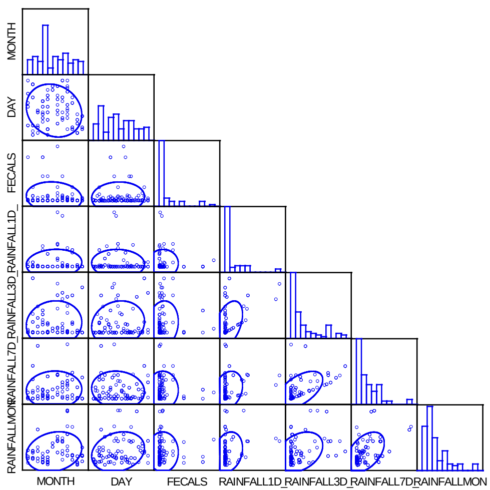


Appendix G: Spearman Correlation Matrix Analysis for Precipitation and Fecal Coliform in Deer Creek, WBID 2256

Spearman correlation matrix

	MONTH	DAY	FECALS	RAINFALL1D_	RAINFALL3D_
MONTH	1.000				
DAY	-0.156	1.000			
FECALS	0.080	0.138	1.000		
RAINFALL1D_	0.044	0.010	0.121	1.000	
RAINFALL3D_	-0.013	0.123	0.312	0.510	1.000
RAINFALL7D_	0.036	-0.007	0.215	0.333	0.679
RAINFALLMON	0.148	0.231	0.224	0.185	0.309

	RAINFALL7D_	RAINFALLMON
RAINFALL7D_	1.000	
RAINFALLMON	0.424	1.000



Number of observations: 119

Appendix H: Analysis of Fecal Coliform Observations versus Precipitation in Deer Creek, WBID 2256

FECAL COLIFORM DATA VERSUS DAY OF SAMPLING PRECIPITATION

2 case(s) deleted due to missing data.

Dep Var: FECALS N: 119 Multiple R: 0.024 Squared multiple R: 0.001

Adjusted squared multiple R: 0.000 Standard error of estimate: 33956.809

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	12314.940	3315.741	0.000	.	3.714	0.000
RAINFALL1D_	3058.232	12006.766	0.024	1.000	0.255	0.799

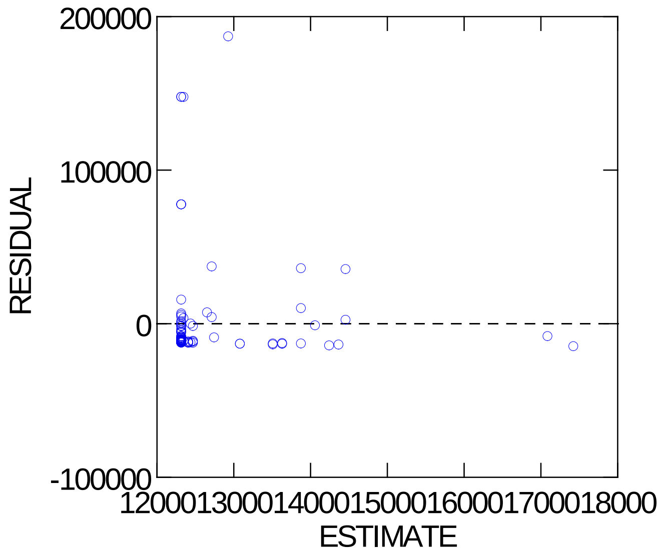
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7.48070E+07	1	7.48070E+07	0.065	0.799
Residual	1.34909E+11	117	1.15306E+09		

*** WARNING ***
Case 20 is an outlier (Studentized Residual = 4.755)
Case 43 is an outlier (Studentized Residual = 6.417)
Case 44 has large leverage (Leverage = 0.277)
Case 77 has large leverage (Leverage = 0.318)
Case 86 is an outlier (Studentized Residual = 4.757)
Case 87 is an outlier (Studentized Residual = 4.757)

Durbin-Watson D Statistic 1.580
First Order Autocorrelation 0.209

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 2 DAYS PRIOR PRECIPITATION

2 case(s) deleted due to missing data.

Dep Var: FECALS N: 119 Multiple R: 0.110 Squared multiple R: 0.012

Adjusted squared multiple R: 0.004 Standard error of estimate: 33761.423

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10283.449	3656.047	0.000	.	2.813	0.006
RAINFALL3D_	5378.875	4507.877	0.110	1.000	1.193	0.235

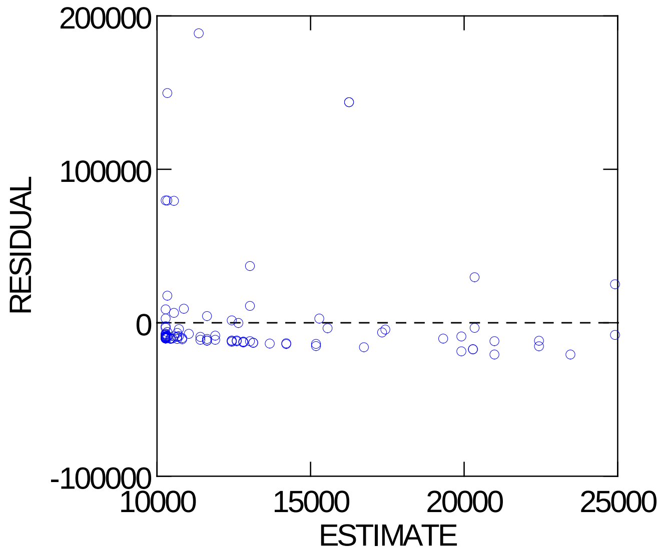
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.62286E+09	1	1.62286E+09	1.424	0.235
Residual	1.33361E+11	117	1.13983E+09		

*** WARNING ***
Case 20 is an outlier (Studentized Residual = 4.873)
Case 43 is an outlier (Studentized Residual = 6.539)
Case 86 is an outlier (Studentized Residual = 4.658)
Case 87 is an outlier (Studentized Residual = 4.658)

Durbin-Watson D Statistic 1.586
First Order Autocorrelation 0.206

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 6 DAYS PRIOR PRECIPITATION

2 case(s) deleted due to missing data.

Dep Var: FECALS N: 119 Multiple R: 0.013 Squared multiple R: 0.000

Adjusted squared multiple R: 0.000 Standard error of estimate: 33963.401

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	12948.747	3967.733	0.000	.	3.264	0.001
RAINFALL7D_	-318.259	2282.893	-0.013	1.000	-0.139	0.889

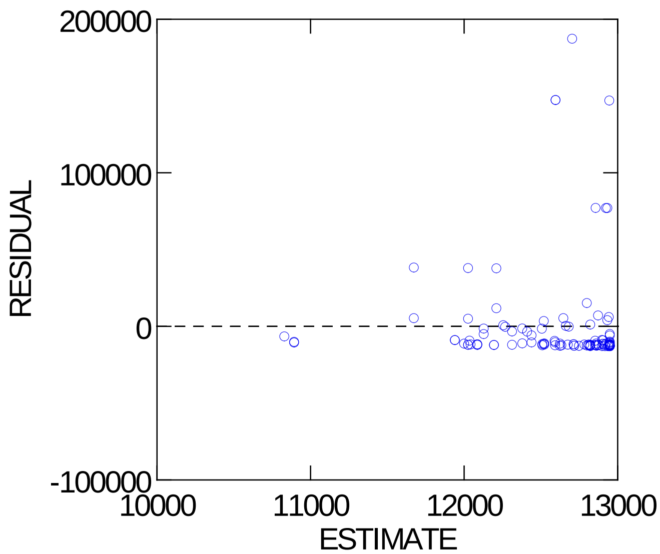
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2.24188E+07	1	2.24188E+07	0.019	0.889
Residual	1.34961E+11	117	1.15351E+09		

*** WARNING ***
Case 20 is an outlier (Studentized Residual = 4.743)
Case 27 has large leverage (Leverage = 0.149)
Case 43 is an outlier (Studentized Residual = 6.421)
Case 50 has large leverage (Leverage = 0.139)
Case 51 has large leverage (Leverage = 0.139)
Case 86 is an outlier (Studentized Residual = 4.742)
Case 87 is an outlier (Studentized Residual = 4.742)

Durbin-Watson D Statistic 1.565
First Order Autocorrelation 0.216

Plot of residuals against predicted values



FECAL COLIFORM DATA VERSUS DAY OF SAMPLING AND 29 DAYS PRIOR PRECIPITATION

2 case(s) deleted due to missing data.

Dep Var: FECALS N: 119 Multiple R: 0.007 Squared multiple R: 0.000

Adjusted squared multiple R: 0.000 Standard error of estimate: 33965.316

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	12901.724	4870.707	0.000	.	2.649	0.009
RAINFALLMON	-70.773	895.962	-0.007	1.000	-0.079	0.937

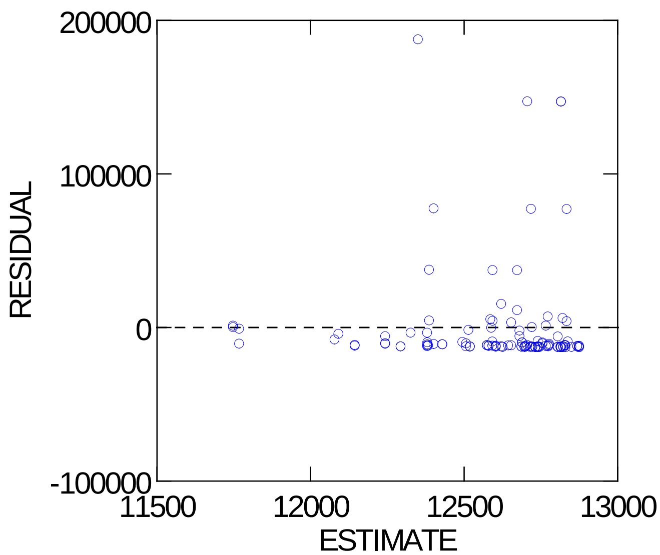
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7198283.276	1	7198283.276	0.006	0.937
Residual	1.34976E+11	117	1.15364E+09		

*** WARNING ***
Case 20 is an outlier (Studentized Residual = 4.741)
Case 43 is an outlier (Studentized Residual = 6.476)
Case 67 has large leverage (Leverage = 0.111)
Case 68 has large leverage (Leverage = 0.111)
Case 86 is an outlier (Studentized Residual = 4.750)
Case 87 is an outlier (Studentized Residual = 4.750)

Durbin-Watson D Statistic 1.566
First Order Autocorrelation 0.216

Plot of residuals against predicted values



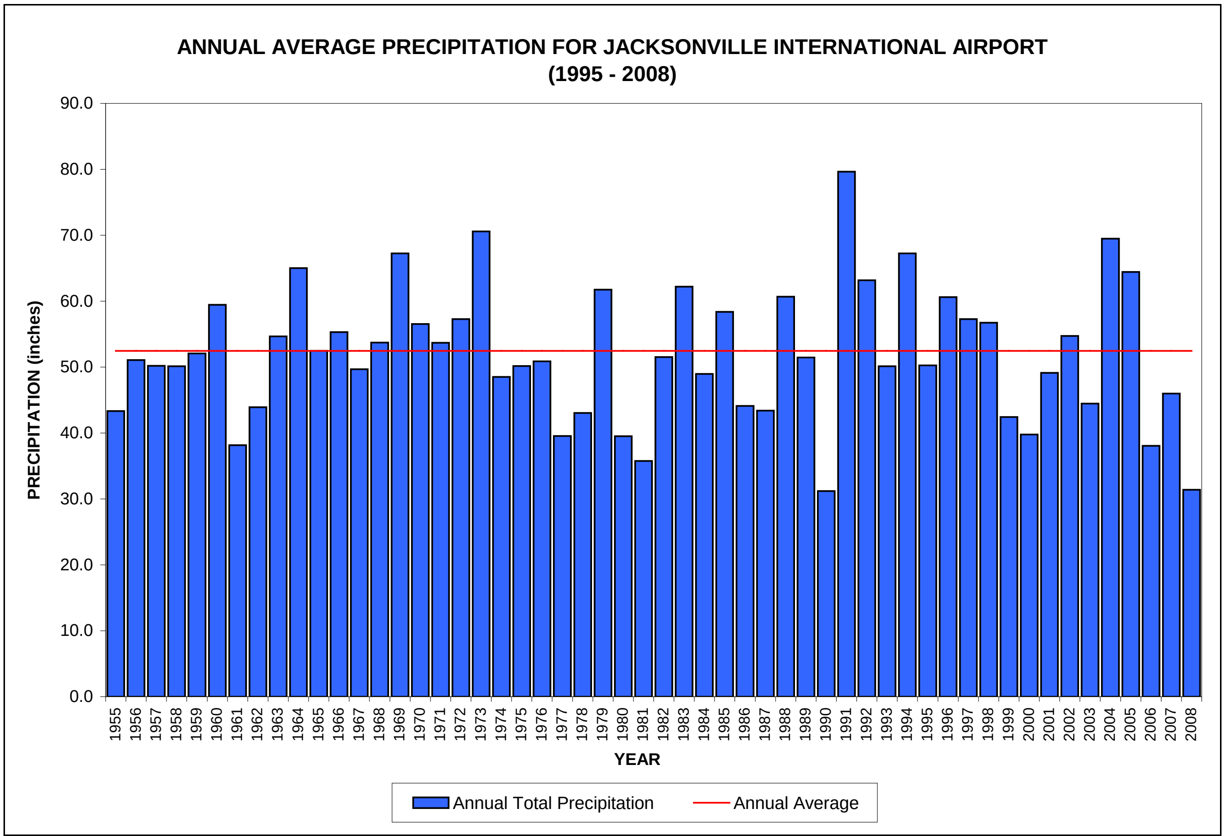
Appendix I: Monthly and Annual Precipitation at JIA, 1955–2008

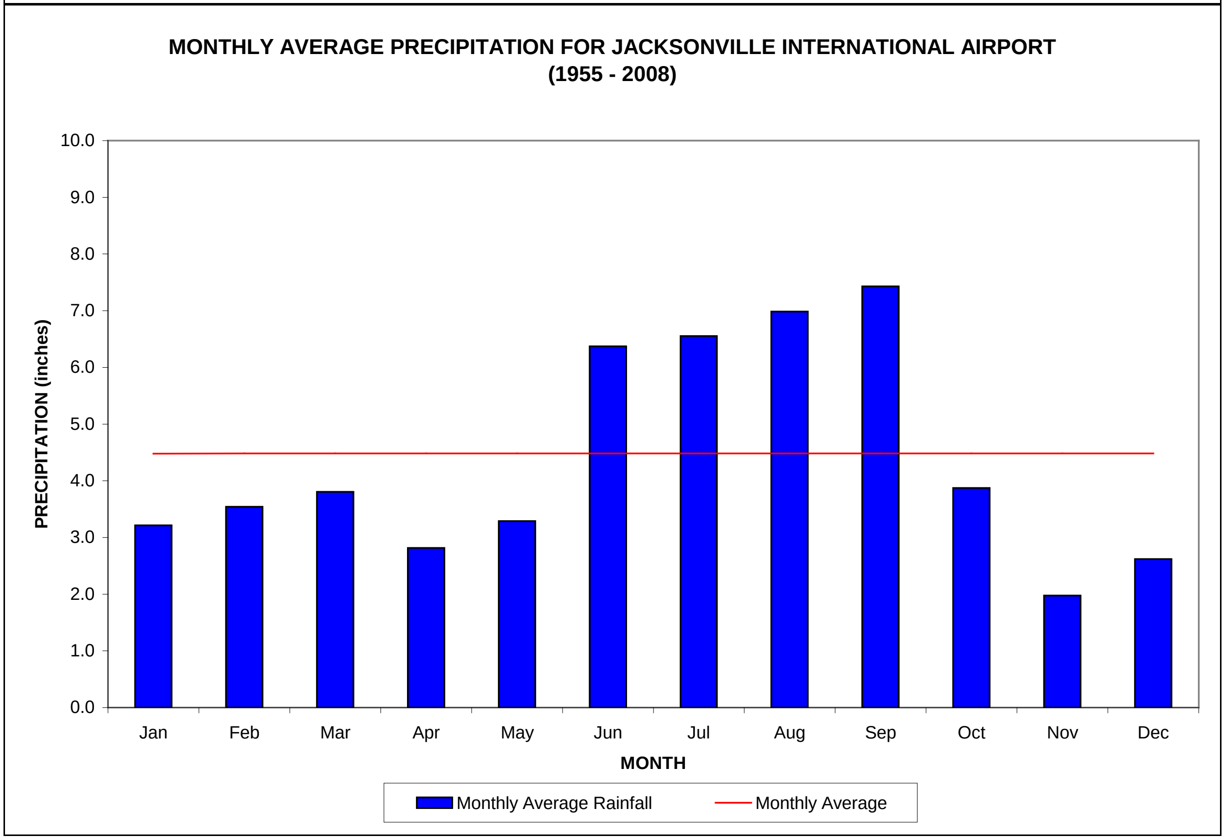
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1955	3.1	2.46	1.66	1.5	4.51	2.7	5.53	3.85	10.6	5.36	1.9	0.2	**43.33**
1956	2.9	2.94	0.81	2.33	3.98	7.87	8.25	5.24	2.89	13.4	0.4	0	**51.08**
1957	0.3	1.69	3.87	1.61	5.25	7.1	12.3	3.3	8.33	3.5	1.6	1.3	**50.18**
1958	3.4	3.74	3.38	8.24	3.79	3.96	4.37	4.67	4.75	5.07	2	2.8	**50.14**
1959	3	5.22	9.75	2.65	9.2	2.94	4.51	2.86	5.67	3.12	2.2	1	**52.08**
1960	2.1	5.17	6.94	3.54	1.18	4.7	16.2	6.5	8.57	2.95	0.1	1.5	**59.45**
1961	2.9	4.85	1.17	4.16	3.06	5.27	3.48	10.6	1.02	0.27	0.9	0.5	**38.15**
1962	2.2	0.52	3.1	2.36	1.12	8.22	6.31	10.1	4.37	1.13	2.1	2.5	**43.9**
1963	5.4	6.93	2.23	1.75	1.74	12.5	6.47	4.95	4.88	1.53	2.7	3.6	**54.66**
1964	7.3	6.55	1.76	4.65	4.8	4.67	6.12	5.63	10.3	5.09	3.3	4.8	**65.03**
1965	0.7	5.5	3.91	0.95	0.94	9.79	2.71	9.58	11	1.75	1.9	3.8	**52.47**
1966	4.6	5.97	0.71	2.25	10.4	7.74	11.1	3.88	5.94	1.38	0.2	1.1	**55.3**
1967	3.1	4.35	0.81	2	1.18	12.9	5.22	12.3	1.8	1.13	0.2	4.7	**49.68**
1968	0.8	3.05	1.2	0.99	2.17	12.3	6.84	16.2	2.68	5.09	1.3	1.1	**53.72**
1969	0.8	3.39	4.23	0.34	3.78	5.12	5.89	15.1	10.3	9.81	4.6	3.9	**67.26**
1970	4.2	8.85	9.98	1.77	1.84	2.65	7.6	11	3.2	3.95	0	1.6	**56.55**
1971	2	2.55	2.41	4.07	1.9	5.52	5.07	12.8	4.17	6.46	0.8	5.9	**53.69**
1972	5.8	3.48	4.43	2.98	8.26	6.75	3.15	9.76	2.6	4.46	4.2	1.4	**57.29**
1973	4.6	5.07	10.2	11.6	5.33	4.1	5.45	7.49	7.86	4.08	0.4	4.3	**70.57**
1974	0.3	1.28	3.47	1.53	4.14	5.53	9.83	11.2	8.13	0.34	1	1.7	**48.52**
1975	3.5	2.58	2.46	5.78	7	5.21	6.36	6.23	5.24	3.63	0.4	1.8	**50.15**
1976	2.3	1.05	3.41	0.63	10	4.26	5.41	6.37	8.56	1.63	2.4	4.8	**50.87**
1977	3	3.24	1.03	1.76	3.07	2.65	1.97	7.26	7.45	1.68	3.1	3.4	**39.56**
1978	4.6	4.17	2.83	2.24	9.18	2.62	6.67	2.39	4.4	1.26	0.8	1.8	**43.04**
1979	6.3	3.75	1	4.18	7.54	5.91	4.67	4.78	17.8	0.25	3.6	2	**61.76**
1980	2.6	1.06	6.83	3.91	3.02	4.59	5.29	3.97	3.03	2.69	2.3	0.2	**39.53**
1981	0.9	4.53	5.41	0.32	1.48	3.31	2.46	6.47	1.22	1.35	4.9	3.4	**35.77**
1982	3	1.67	4.26	3.6	3.55	8.06	3.81	6.93	9.32	3.37	1.9	2	**51.52**
1983	7.2	4.27	8.46	4.65	1.38	6.86	6.11	4.63	4.61	4.29	3.3	6.4	**62.19**
1984	2.1	4.67	5.77	3.14	1.46	4.76	6.01	3.78	12.3	1.53	3.3	0.1	**48.96**
1985	1.1	1.45	1.26	2.76	2.08	3.71	6.33	8.93	16.8	8.34	2.1	3.6	**58.39**
1986	4.2	4.72	5.44	0.93	2.13	2.53	3.27	9.6	1.99	1.8	2.9	4.7	**44.1**
1987	4.1	6.47	6.27	0.14	0.75	4.18	4.4	4.48	7.13	0.3	5	0.2	**43.39**
1988	6.4	6.08	2.65	3.44	1.35	3.71	4.5	8.48	16.4	2.35	4.3	1.1	**60.68**
1989	1.7	1.77	2.14	2.79	1.55	3.66	8.98	9.16	14.4	1.39	0.5	3.4	**51.45**
1990	1.8	4.07	1.59	1.34	0.18	1.59	6.53	3.81	2.6	4.54	1.2	1.9	**31.2**
1991	10	1.52	7.33	6.31	9.35	11.7	15.9	3.48	6.2	6.36	0.7	0.6	**79.63**
1992	5.8	2.64	4.09	5.33	5.97	7.04	3.32	10.8	7.33	8.34	1.9	0.7	**63.18**
1993	3.9	2.89	5.98	0.85	1.6	2.52	7.54	2.96	7.6	8.84	3.6	1.9	**50.12**
1994	6.6	0.92	2.14	1.51	3.15	14	8.26	3.29	9.79	10.2	3.5	3.9	**67.26**
1995	1.9	2.07	3.67	1.77	1.77	5.35	9.45	9.93	5.41	3.53	3.2	2.2	**50.25**
1996	1.1	1.11	6.83	2.85	0.72	11.4	4.2	7.83	8.49	11.5	1.4	3.2	**60.63**
1997	2.9	1.28	1.84	4.56	3.43	6.33	7.69	8.24	3.97	4.84	2.4	9.8	**57.27**
1998	3.5	11.1	2.64	4.71	0.96	2.95	7.29	10.1	7.65	3.01	2.4	0.4	**56.72**
1999	4.6	1.7	0.4	1.92	1.02	7.75	3.56	3.51	13	3.24	0.8	0.9	**42.44**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2000	2.8	1.17	1.79	2.6	1.15	2.43	5.69	7.38	11.6	0.23	1.6	1.4	**39.77**
2001	0.9	0.68	5.48	0.62	2.56	5.59	8.31	3.58	16	0.81	1.4	3.1	**49.14**
2002	4.5	0.82	4.38	2.41	0.47	6.24	7.8	8.14	9.31	2.58	2.7	5.4	**54.72**
2003	0.1	4.66	10.7	2.63	2.54	6.75	7.33	1.83	3.04	2.98	0.7	1.2	**44.47**
2004	1.6	4.47	1.36	2.02	1.24	17.2	8.6	9.85	16.3	1.32	2.9	2.7	**69.47**
2005	1.9	3.56	3.67	4.53	3.51	14.8	7.37	4.43	5.76	6.49	1.1	7.4	**64.44**
2006	2.30	3.91	0.68	1.22	2.01	7.25	3.97	7.08	4.55	1.81	0.39	2.90	**38.07**
2007	2.29	2.40	2.22	1.02	1.12	6.68	9.48	3.57	5.44	8.85	0.17	2.74	**45.98**
2008	2.63	5.22	3.50	2.34	0.66	8.21	8.83						**31.39**
AVG	**3.21**	**3.54**	**3.81**	**2.82**	**3.29**	**6.37**	**6.55**	**6.99**	**7.43**	**3.87**	**1.98**	**2.62**	**52.47**

Rainfall is in inches, and represents data from JIA.

Appendix J: Annual and Monthly Average Precipitation at JIA





Appendix K: Executive Summary of Tributary Pollution Assessment Project

Note: *This appendix contains the executive summary of the Tributary Pollution Assessment Project (TPAP) submitted to the Department by JEA and PBS&J. The six phases detailed in the methodology development and evaluation section have already been completed as of the date of this TMDL. In place of the public workshop mentioned in the section describing Phase 6, the* Tributary Pollution Assessment Manual *was presented to the Jacksonville Waterways Commission on February 1, 2007.*

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.

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