FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

NORTHEAST DISTRICT • UPPER EAST COAST BASIN

Final TMDL Report

Fecal Coliform TMDL for Spruce Creek, WBID 2674

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Websites

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

2006 305(b) Report

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

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Upper East Coast Basin

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

Water Quality Assessment Report for the Upper East Coast Basin

http://www.dep.state.fl.us/water/basin411/uppereast/status.htm

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 coliform for Spruce Creek in the Halifax River Planning Unit of the Upper East Coast Basin. The creek was verified as impaired for fecal coliform, and was included on the Verified List of impaired waters for the Upper East Coast Basin that was adopted by Secretarial Order in December 2007. This TMDL establishes the allowable loadings to Spruce Creek that would restore the waterbody so that it meets its applicable water quality criteria for fecal coliform.

1.2 Identification of Waterbody

Spruce Creek is located in Volusia County, in east-central Florida, near New Smyrna Beach. It forms in wetlands west of New Smyrna Beach and flows north, then turns east and discharges to the Atlantic Intracoastal Waterway (**Figures 1.1** and **1.2**). Spruce Creek is approximately 20.1 miles long and is a second-order stream that is tidally influenced in its lower reaches. Additional information about the creek's hydrology and geology are available in the Basin Status Report for the Upper East Coast Basin (Florida Department of Environmental Protection [Department], 2005).

Spruce Creek and certain tributaries were designated as Outstanding Florida Waters (OFWs) in 1991. Volusia County initiated a study in May 1994 to evaluate the impact of stormwater on overall water quantity and water quality in the designated OFW areas of Spruce Creek and Rose Bay ((Volusia County, 1996). Under OFW provisions, there is a requirement for 50 percent greater treatment for direct discharge of stormwater to an OFW. Volusia County is currently working on an update to the master plan.

For assessment purposes, the Department has divided the Upper East Coast Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Spruce Creek consists of two segments, WBIDs 2674 and 2674A, as shown in **Figure 1.1.** The combined drainage area of WBIDs 2674 (17.67 square miles) and 2674A (13.10 square miles) is 30.77 square miles.

This TMDL addresses the fecal coliform impairment in WBID 2674. WBID 2674 was included on the 1998 303(d) list as impaired for coliform. The Upper East Coast Basin Verified List adopted in December 2007 also identified WBID 2674A as impaired for fecal coliform and set a TMDL date of 2017. Presumably, reductions of fecal coliform in the upper WBID (2674) of Spruce Creek will also result in improvements to the lower WBID (2674A), which will be reassessed in the next assessment cycle for this basin.

Spruce Creek is part of the Halifax River Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Upper East Coast Basin. The Halifax River Planning Unit consists of 53 WBIDs. **Figure 1.3** shows the location of these WBIDs, Spruce Creek's location in the planning unit, and a list of the other WBIDs in the planning unit.

Figure 1.1. Location of Spruce Creek and Major Geopolitical Features in the Upper East Coast Basin

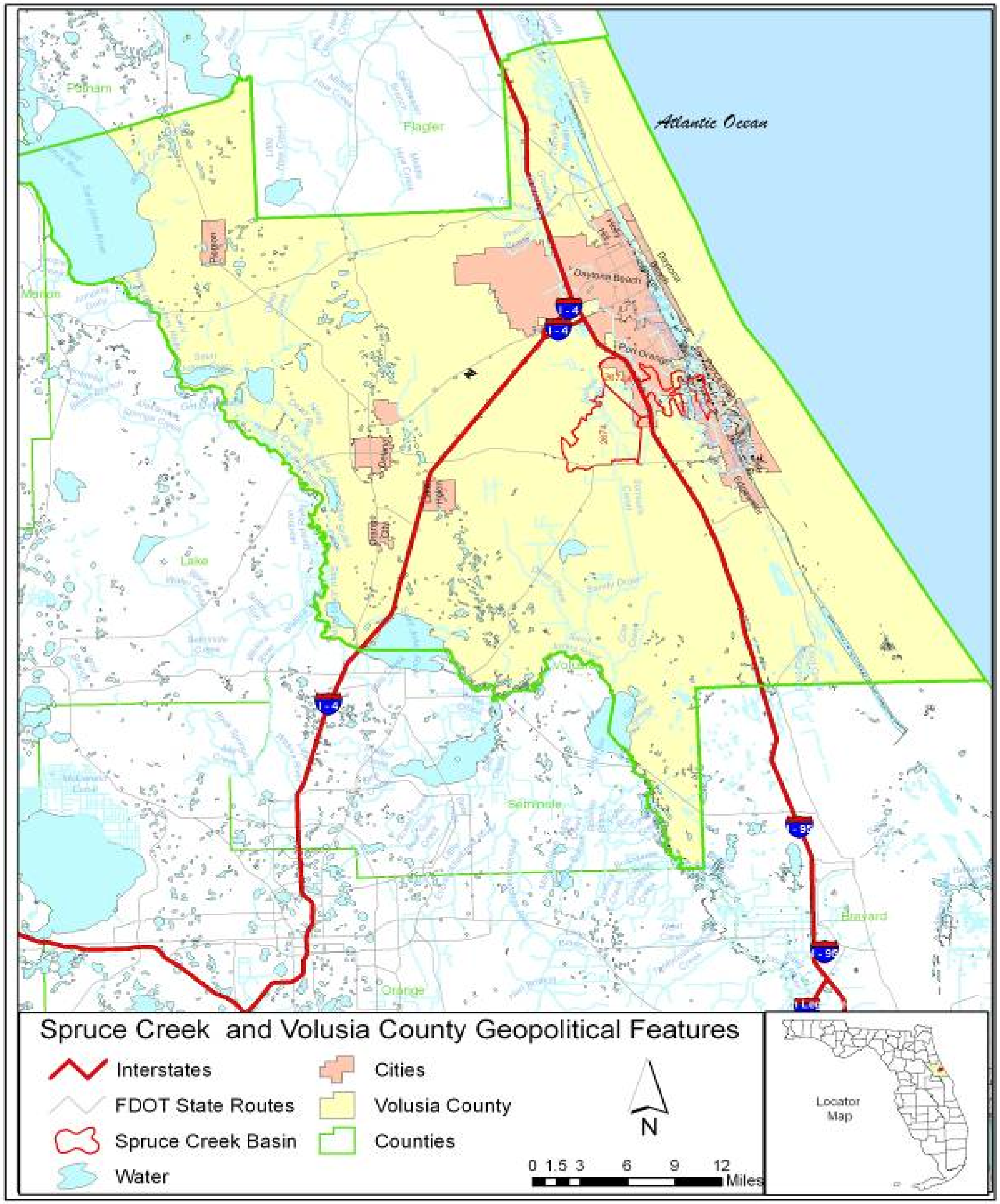


Figure 1.2. Spruce Creek, WBID 2674

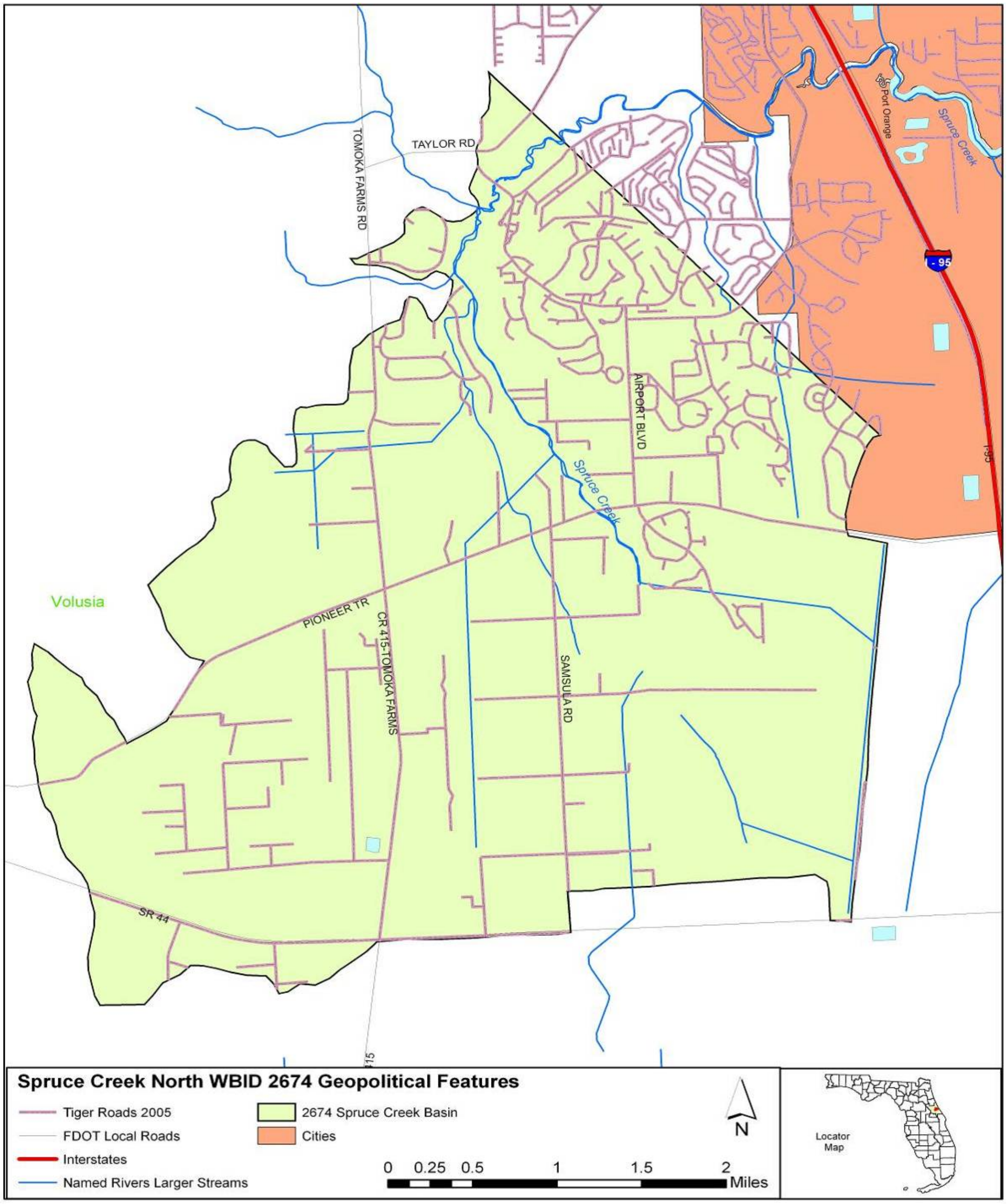


Figure 1.3. WBIDs in the Halifax River Planning Unit

WBID	BASIN_1
2674B	STRICKLAND BAY AT US #
2363A	HALIFAX RIVER
2655	UNNAMED DITCH
2643	UNNAMED DITCHES
2634	TOMOKA RIVER
8118A	GRANDA BLVD
2645	MIZNERS BRANCH
2646	LITTLE TOMOKA RIVER
2640	UNNAMED BRANCH
2641	UNNAMED BRANCH
2642	UNNAMED BRANCH
2652	UNNAMED DITCH
2656	UNNAMED DITCH
2657	INT SPEEDWAY DITCH
8117C	HILTON
2674A	SPRUCE CREEK
2675	SAND CREEK
8117F	SEABREEZE BLVD
2649	PRIEST BRANCH
2650	UNNAMED SLOUGH
8117E	MAIN STREET
2664	REED CANAL
2665	UNNAMED DITCH
2668	PORT ORANGE CANAL
2670	HALIFAX CANAL
2672	ROSE BAY
2673	UNNAMED DRAIN
2666A	SWEETWATER CREEK
8119	HALIFAX RIVER OCEAN 3
2620	BULOW CREEK
8119B	FLAGLER PIER AT FLAGLER BEACH
2363J	PALM COAST
8119A	GAMBLE ROGERS STATE PARK
2363B	HALIFAX RIVER
2634A	TOMOKA RIVER
8118B	BICENTENNIAL PARK
2635	GROVER BRANCH
2653	UNNAMED DRAIN
8117D	SILVER BEACH
2654	DRAINAGE CANALS
2666	UNNAMED DITCH
8117B	DUNLAWTON
8117A	TORONITA
2679	UNNAMED DRAIN
2681	GLENCOE DITCHES
2683	TURNBULL CREEK

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 Spruce Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), Volusia County, local governments, 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 causing impairment of these 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 15 waterbodies and 50 parameters in the Upper East Coast Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was revised in 2006 and 2007.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Spruce Creek and has 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 coliform data for the verification period—which for Group 5 waters was January 1, 1999, through June 30, 2006—by month, season, and year, respectively.

There is a 20.8 percent overall exceedance rate for fecal coliform in Spruce Creek during the verified period. Exceedances occurred in February, April, July, and November and in all seasons (**Tables 2.1** and **2.2**). During the verified period, samples were only collected in 2005 during 5 months, typically with 5 samples in each month. There are a total of 24 samples, ranging from 83 counts per 100 milliliters (counts/100mL) to 1,600 counts/100mL.

When aggregating data by season, the lowest percentage of exceedances occurred in the summer, the highest in fall. As the sample size is small and sampling occurred in only one year, relationships between fecal coliform, seasonality, rainfall, or long-term trends cannot be discerned. Possible relationships will be further assessed using the complete historical dataset in Chapter 5.

There are eight sites with historical data. Five of these sites were sampled during the verified period. Sampling stations are discussed further in **Section 5.1**.

Table 2.1. Summary of Fecal Coliform Data by Month for the Verified Period (January 1, 1999–June 30, 2006)

Month	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Mean Precipitation
January	0	ND	ND	ND	ND	ND	ND	2.51
February	5	230	410	350	324	1	20.00%	2.89
March	0	ND	ND	ND	ND	ND	ND	3.61
April	4	210	450	275	302.5	1	25.00%	2.35
May	0	ND	ND	ND	ND	ND	ND	2.86
June	0	ND	ND	ND	ND	ND	ND	6.15
July	5	220	1,600	360	569	1	20.00%	5.65
August	0	ND	ND	ND	ND	ND	ND	6.48
September	5	100	360	200	195.6	0	0.00%	6.92
October	0	ND	ND	ND	ND	ND	ND	4.9
November	5	83	710	240	316	2	40.00%	2.66
December	0	ND	ND	ND	ND	ND	ND	2.48

ND – No data.
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL
All the observations are from 2005 only.
Mean precipitation is for Daytona Beach International Airport in inches.

Table 2.2. Summary of Fecal Coliform Data by Season for the Verified Period (January 1, 1999–June 30, 2006)

Season	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Mean Total Precipitation
Winter	5	230	410	350	324	1	20.00%	9.01
Spring	4	210	450	275	302.5	1	25.00%	11.36
Summer	10	100	1,600	260	382.3	1	10.00%	19.05
Fall	5	83	710	240	316	2	40.00%	10.04

Coliform counts are #/100 mL
Exceedances represent values above 400 counts/100 mL
All the observations are from 2005 only.
Mean precipitation is for Daytona Beach International Airport in inches

Table 2.3. Summary of Fecal Coliform Data by Year for the Verified Period (January 1, 1999–June 30, 2006)

Year	N	Minimum	Maximum	Median	Mean	No. of Exceedances	% Exceedance	Total Precipitation
2005	24	83	1,600	285	343	5	20.83%	31.36

Table represents years for which data exist.
Coliform counts are #/100mL.
Exceedances represent values above 400 counts/100mL.
Mean precipitation is for Daytona Beach International Airport 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)**

Spruce Creek (WBID 2674) is a Class III fresh waterbody, with a designated use of recreation, propagation, and the maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality 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 criteriafor protection of Class III waters, as established by Rule 62-302, F.A.C., states the following:

> ***Fecal Coliform Bacteria:***
> *The most probable number (MPN) or membrane filter (MF) counts per 100 mL of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*

The criteria states that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. However, there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for fecal coliform bacteria. Therefore, the criterion selected for the TMDL was not to exceed 400 counts/100mL.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

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

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

To be consistent with Clean Water Act definitions, the term "point source" 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 Spruce Creek Watershed

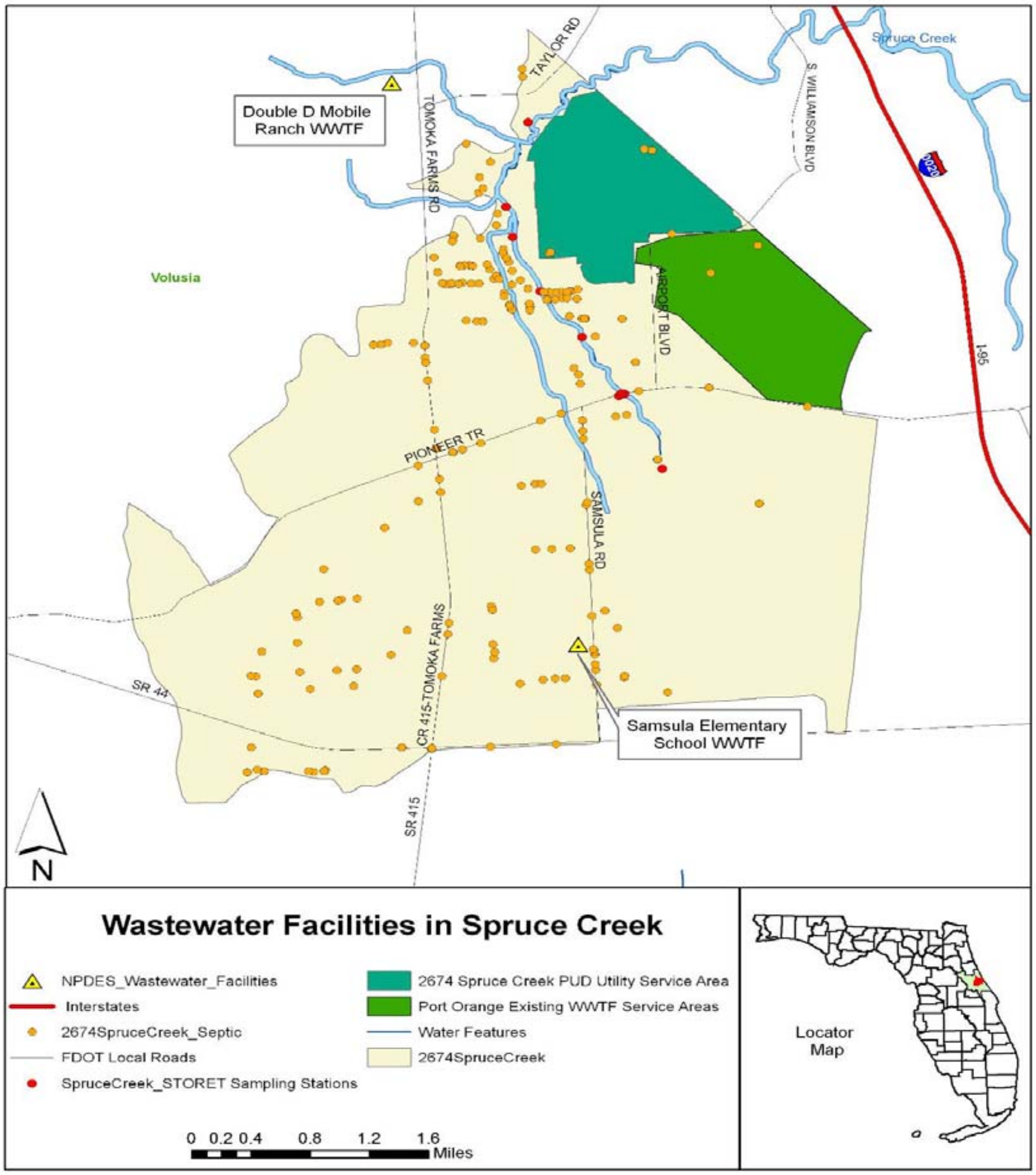
4.2.1 Point Sources

There are no NPDES wastewater facilities located in the watershed. **Figure 4.1** illustrates the locations of 2 state-permitted facilities, along with partial coverage of septic tanks. There is a state permit for Samsula Elementary School (FLA011113) for extended aeration with reuse to 2 drainfields (design flow 0.005 million gallons per day [mgd]). The facility is required to sample monthly for fecal coliform and has a monthly maximum limit of 800 #/100mL and an annual average limit of 200 #/100mL. There is another state permit for the Double D Mobile Ranch WWTF (FLA011181) located just outside WBID 2674; this facility has extended aeration with effluent to 2 percolation ponds and a sprayfield (design flow 0.0075 mgd). It has the same sampling and fecal coliform limits as Samsula Elementary School.

As shown in **Figure 4.1**, the city of Port Orange provides sewer service in the northeastern portion of the watershed. There are currently approximately 2,100 households connected to the city's wastewater system in WBID 2674 and there are also private sewer lines in the Spruce

Creek Fly-In subdivision (a portion of which is included in this WBID) (C. Craig, city of Port Orange, personal communication).

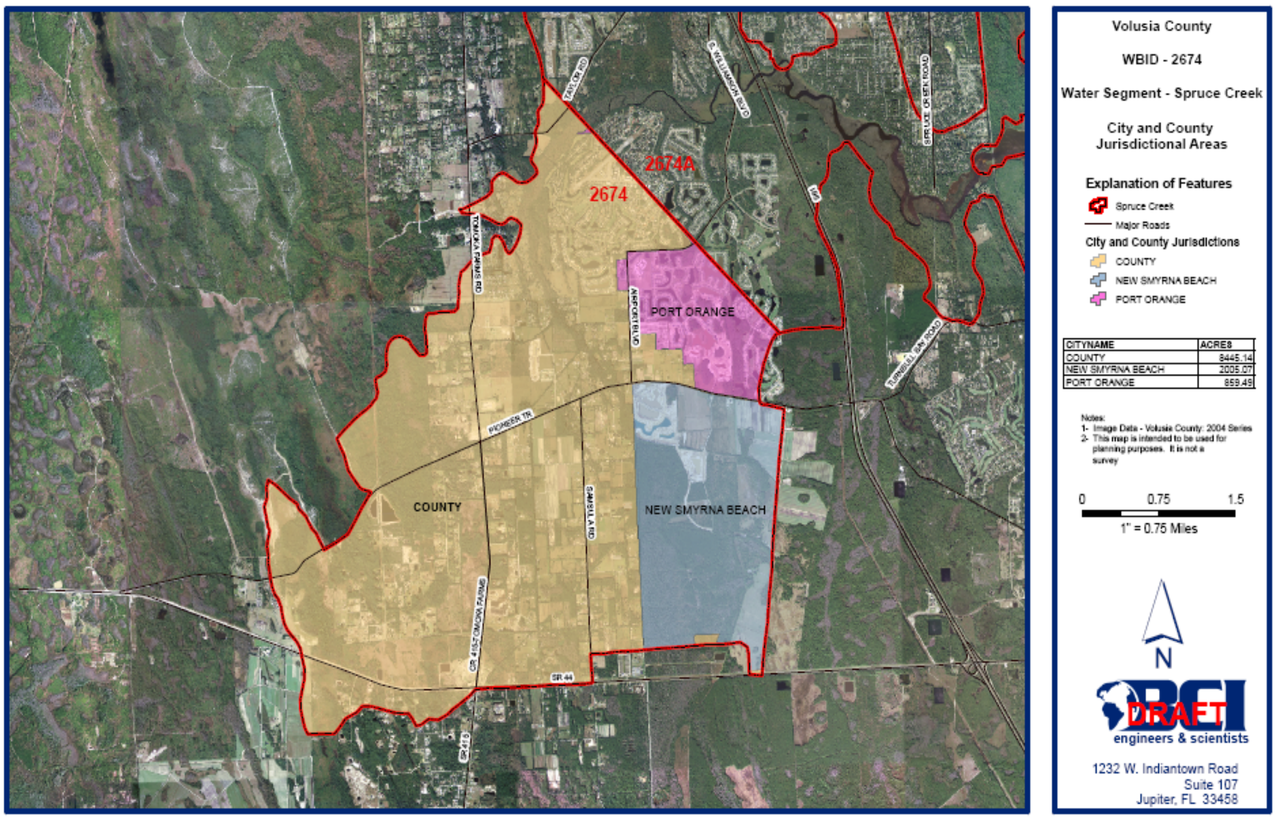
Figure 4.1. Location of Permitted Facilities in the Spruce Creek Watershed



Municipal Separate Storm Sewer System Permittees

Volusia County, Port Orange, and New Smyrna Beach have Phase II NPDES municipal separate storm sewer system (MS4) permits (FLR04E033, FLR04E014, and FLR04E035, respectively) that may cover portions of the Spruce Creek watershed. **Figure 4.2,** provided by BCI Engineers and Scientists, Inc. (C. Farmer, personal communication), illustrates the jurisdictional areas for each permittee.

Figure 4.2. Jurisdictional Areas of Phase II NPDES MS4 Permits in the Spruce Creek Watershed



4.2.2 Land Uses and Nonpoint Sources

Additional coliform loadings to Spruce Creek are generated from nonpoint sources in the watershed. These include loadings from surface runoff, wildlife, pets, leaking or overflowing sewer 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 aggregated to the Level 1 land use codes.

The Spruce Creek watershed is a rural area that is facing increased development pressures. As **Table 4.1** shows, agriculture represents 27.8 percent of the area, followed by urban and built-up (26 percent), and wetlands (19.7 percent). Nearly 20 percent of the area is classified as rural or low- or medium-density residential. Approximately 43.5 percent of the area (4,916 acres) is associated with uplands, water, or wetlands.

Population

According to the U.S Census Bureau, census block population densities in the Spruce Creek watershed in 2000 ranged from 0 to 11,020 persons per square mile, with an average of 181 persons per square mile (**Figure 4.4**). Based on this average, the estimated population in the watershed is 3,194. A more detailed analysis was completed by obtaining population and housing unit information from the 2000 Census at the block level and using GIS to estimate the fraction of each block within this watershed. The fractional area was then applied to the block information to estimate the population and number of housing units.

Based on **Table 4.2,** the population in the watershed is estimated at 3,667, along with 1,657 housing units. The Census Bureau reports that, for all of Volusia County, the total population for 2000 was approximately 443,343, with 211,938 housing units and an average occupancy rate of 87.2 percent (184,723 units). For all of Volusia County, the bureau reported a housing density of 192 houses per square mile. Thus Volusia County ranks 13^{th} in housing densities and population in Florida (U.S. Census Bureau Website, 2000). The estimated average housing density in Spruce Creek is 94 residences per square mile, based on population. This is about one-half that of Volusia County, reflecting the current rural nature of the Spruce Creek watershed.

Table 4.1. Classification of Land Use Categories in the Spruce Creek Watershed

Level 3 Land Use Code	Attribute	Acres	% of Total
2110	Improved pastures (monoculture, planted forage crops)	1824.31	16.13%
4110	Pine flatwoods	1231.07	10.88%
1180	Rural residential	997.91	8.82%
6170	Mixed wetland hardwoods	776.86	6.87%
1200	Residential, medium density–2-5 dwelling units/acre	695.26	6.15%
6300	Wetland forested mixed	651.11	5.76%
1100	Residential, low density–less than 2 dwelling units/acre	540.33	4.78%
6460	Mixed scrub-shrub wetland	387.72	3.43%
4340	Upland mixed coniferous/hardwood	343.74	3.04%
5300	Reservoirs–pits, retention ponds, dams	326.92	2.89%
2130	Woodland pastures	316.63	2.80%
1290	Medium density under construction	297.76	2.63%
6250	Hydric pine flatwoods	263.24	2.33%
3100	Herbaceous upland nonforested	259.47	2.29%
2510	Horse farms	246.19	2.18%
2140	Row crops	207.96	1.84%
2420	Sod farms	181.56	1.61%
3300	Mixed upland nonforested	173.05	1.53%
1820	Golf courses	154.21	1.36%
4410	Coniferous pine	153.65	1.36%
2120	Unimproved pastures	125.07	1.11%
2150	Field crops	114.68	1.01%
7410	Rural land in transition without positive indicators of intended activity	105.85	0.94%
8140	Roads and highways (divided 4-lanes with medians)	84.78	0.75%
6430	Wet prairies	80.36	0.71%
4430	Forest regeneration	79.67	0.70%
8110	Airports	67.97	0.60%
1700	Institutional	60.18	0.53%
1830	Race tracks	59.38	0.52%
1300	Residential, high density–6 or more dwelling units/acre	52.01	0.46%
3200	Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	46.32	0.41%
2430	Ornamentals	45.08	0.40%
4200	Upland hardwood forests	41.64	0.37%
2400	Nurseries and vineyards	38.1	0.34%

Level 3 Land Use Code	Attribute	Acres	% of Total
6210	Cypress	37.89	0.33%
8320	Electrical power transmission lines	32.16	0.28%
2320	Poultry feeding operations	29.23	0.26%
4130	Sand pine	25.73	0.23%
1190	Low density under construction	24.92	0.22%
6410	Freshwater marshes	21.13	0.19%
1400	Commercial and services	16.72	0.15%
1890	Other recreational (stables, go-carts, ...)	16.71	0.15%
2310	Cattle feeding operations	14.23	0.13%
1850	Parks and zoos	12.95	0.11%
4400	Tree plantations	11.22	0.10%
7400	Disturbed land	10.45	0.09%
1900	Open land	9.16	0.08%
2210	Citrus groves	6.47	0.06%
6440	Emergent aquatic vegetation	5.27	0.05%
1550	Other light industrial	4.13	0.04%
7430	Spoil areas	2.68	0.02%
	TOTAL:	**11,310.96**	**100.00%**

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

Tract	Block	Population	Housing Units
832.04	2	401	149
832.04	3	2799	1316
832.04	4	467	192
	TOTAL:	**3,667**	**1,657**
	AVERAGE HOUSEHOLD SIZE:		**2.21**

Data from U.S. Census Bureau Website, 2005, based on Volusia County blocks that are present in the Spruce Creek watershed.

Figure 4.3. Principal Land Uses in the Spruce Creek Watershed

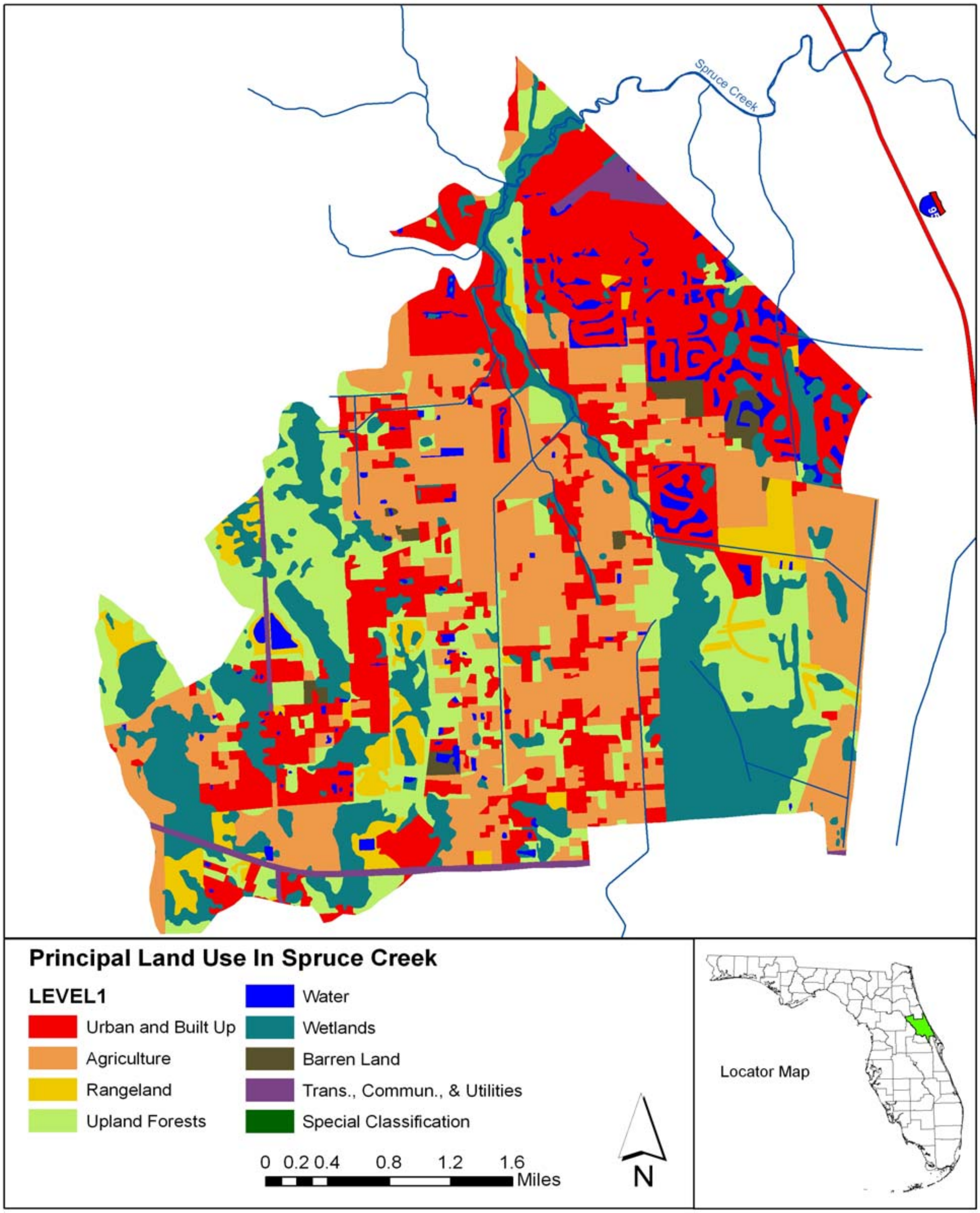
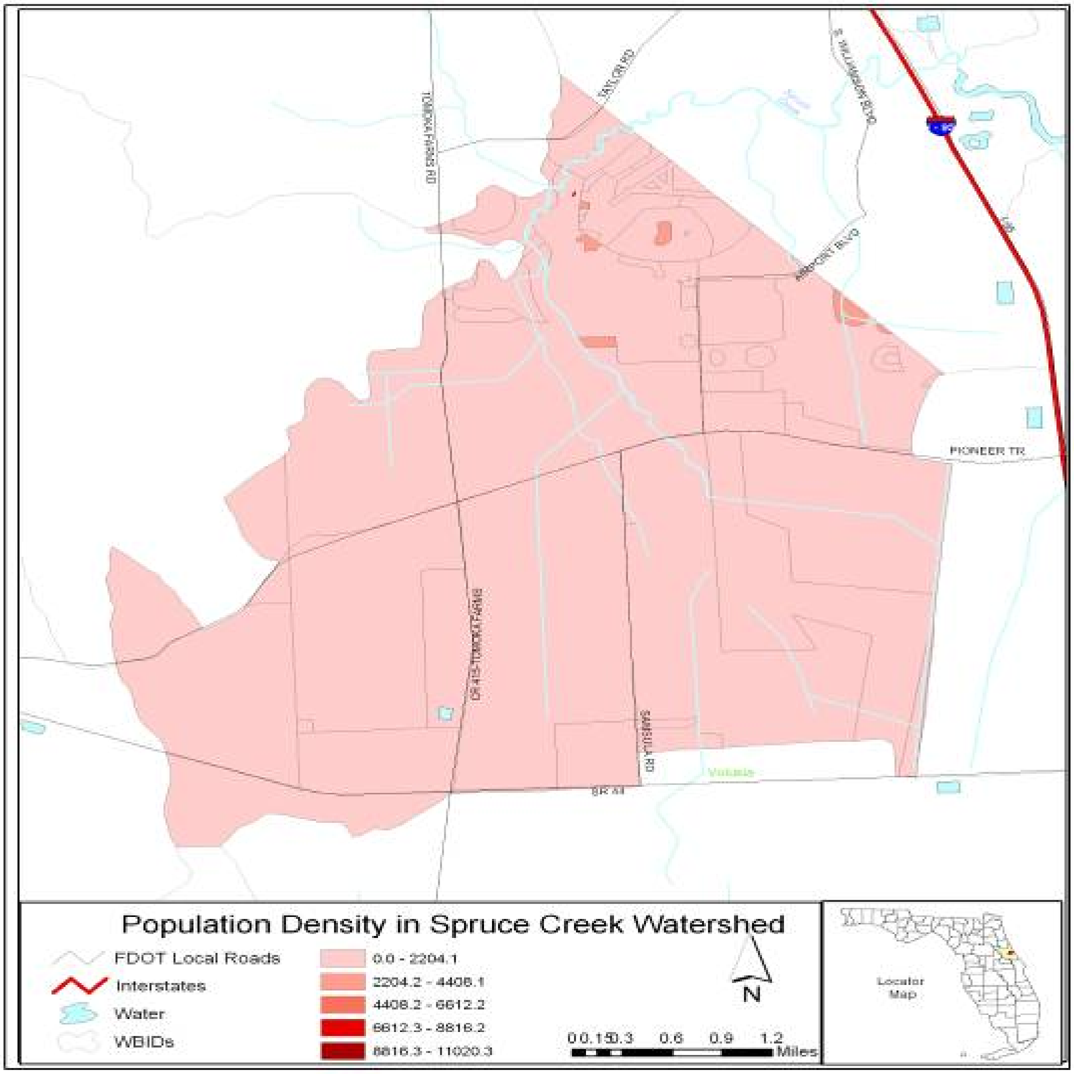


Figure 4.4. Population Density in the Spruce Creek Watershed



Septic Tanks

Based on the 2000 Census figure of 211,938 housing units and the Florida Department of Health (FDOH) estimate of 96,633 permitted septic tanks in Volusia County, approximately 45 percent of the households in the county are using septic tanks. FDOH reports that as of fiscal year 2005–06, there were 96,633 permitted septic tanks in Volusia County (FDOH Website, 2006). From fiscal years 1991–2006 (missing 1992–93), 13,436 permits for repairs were issued, or an average of approximately 960 repairs annually (FDOH Website, 2006) countywide. Simply dividing the number of septic tank repairs by the total number of septic tanks yields an estimated failure rate of 13.9 percent. Assuming that the failure rate is representative of the 14-year period for which data are available, this suggests a rate of 1 percent per year.

As noted previously, there were an estimated 3,667 persons and 1,657 households in the watershed area. The average household in the Spruce Creek watershed has 2.21 persons (see **Table 4.2**). There are no permitted domestic wastewater facilities; however, portions of the Spruce Creek watershed have sewer service provided by the city of Port Orange. Since Port Orange is experiencing rapid population growth, information on the gravity sewer lines for the city (C. Craig, city of Port Orange, personal communication) was overlaid on a 2004 aerial of the watershed to obtain an estimate of the number of households connected to the city wastewater system for comparison with the 2000 Census data. The number of residences connected to the city wastewater system was approximately 1,040.

Using this estimate, along with the 2000 Census calculation of 1,657 households, suggests that approximately 617 residences are using septic tanks (the partial coverage of wastewater facilities in **Figure 4.1** included 230 septic tanks). This indicates that approximately 37 percent of the households are using septic tanks; this figure is similar to the countywide estimate. Assuming an annual 1 percent failure rate for septic systems in the watershed, this represents 6 households. Using 70 gallons/day/person (EPA, 2001), a loading of 3.51 x 10^{10} colonies/day or 1.28 x 10^{13} colonies/year is derived. This estimation is shown in **Table 4.3.**

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

Estimated Population Density and Area	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 Annual Load from Failing Tanks
181 persons/mi^2	17.67	3,667	6	1.00 x 10^4/mL	70	2.21	1.28 x 10^{13}

[1] Based on septic tank repair permits issued in the watershed from 1991–2006 (FDOH–see text).
[2] EPA, 2001.
[3] U.S Census Bureau; see **Table 4.2** for more information on this estimate.

4.3 Source Summary

4.3.1 Summary of Fecal Coliform Loadings to Spruce Creek from Various Sources

Agriculture

According to the *Florida Agricultural Statistical Directory* (Florida Department of Agriculture and Consumer Services [FDACS], 2006), Volusia County has an average of 13,100 cattle and calves and 6,850 beef cattle (**Table 4.4**). Summing improved pasture, unimproved pasture, woodland pasture, and cattle feeding acreages for Volusia County based on 2004 land use gives a total of 42,689 acres. Assuming that the 19,950 cattle are distributed among these land uses provides an estimate of 0.5 cows/acre. Summing the same land uses in the Spruce Creek watershed yields a total of 2,266 acres. Applying the ratio of 0.5 cows/acre provides an estimate of 1,133 cattle in the watershed (**Table 4.5**). Using a fecal contribution of 1 x 10^{11}

organisms/day/cow (EPA, 2001) gives potential daily and annual fecal contributions of 1.13×10^{14} and 4.13×10^{16}, respectively.

Table 4.4. Estimated Cattle Population in Volusia County

Year	Cattle and Calves	Beef Cattle
1997	14,000	10,000
1998	14,000	8,000
1999	13,000	7,000
2000	14,000	7,000
2001	15,000	7,000
2002	15,000	6,500
2003	12,000	6,000
2004	12,000	5,500
2005	11,000	5,500
2006	11,000	6,000
Average	**13,100**	**6,850**

Source: FDACS, 2006.

Table 4.5. Estimated Agricultural Fecal Coliform Loading from Cattle in the Spruce Creek Watershed

Coliform	Pasture Acreage	Cattle/Acre	Estimated No. of Cattle	Estimated Counts/Cow/Day	Estimated Counts/Day	Estimated Counts/Year
Fecal	2,266	0.5	1,133	1×10^{11}	1.13×10^{14}	$4.13 \text{ X } 10^{16}$

The Spruce Creek watershed also has 246 acres characterized as horse farms. Applying the ratio of 0.5 horses/acre provides an estimated horse population of 123 horses in the watershed. Using a fecal contribution of 4.2×10^{8} organisms/day/horse (EPA, 2001) gives potential daily and annual fecal contributions of 5.17×10^{10} and 1.88×10^{13}, respectively (**Table 4.6**).

Table 4.6. Estimated Agricultural Fecal Coliform Loading from Horses in the Spruce Creek Watershed

Coliform	Horse Farm Acreage	Horses/Acre	Estimated No. of Horses	Estimated Counts/Horse/Day	Estimated Counts/Day	Estimated Counts/Year
Fecal	246	0.5	123	4.2×10^{8}	5.17×10^{10}	$1.88 \text{ X } 10^{13}$

Pets

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 4.7**) such as household-to-dog ratio estimates from the American Veterinary Medical Association (AVMA). Using this information yields a potential fecal coliform loading from dogs of 2.32×10^{12}

colonies/day and 8.49 x 10^{14} colonies/year. This is an estimate, as the actual loading from dogs is not known.

Table 4.7. Estimated Fecal Coliform Loading from Dogs in the Spruce Creek Watershed

Pet	Estimated No. of Households	Estimated Household: Pet Ratio[1]	Estimated Total Dog Population in Watershed	Estimated Counts/Pet/Day[2]	Estimated Counts/Day	Estimated Counts/Year
Dogs	1,287	0.361	465	5 x 10^{9}	2.32 x 10^{12}	8.49 X 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

Earlier it was estimated that approximately 1,040 households in the watershed are connected to the city of Port Orange wastewater facility. Using 2.21 people per home, and a 70 gallon/person/day discharge, a daily flow of approximately 6.09 x 10^{5} L is transported through the collection system. An EPA Region 4 memorandum on estimating water quality loadings from MS4 areas (EPA, 2002) suggests that a 5 percent leakage rate from collection systems is realistic. Based on this and EPA values for fecal coliform in raw sewage yield potential loadings of fecal coliform of 1.52 x 10^{11} counts/day (**Table 4.8**) and 5.56 x 10^{13} counts/yr.

Table 4.8. Estimated Loading from Wastewater Collection Systems in the Spruce Creek Watershed

Coliform	Estimated Homes on Central Sewer	Estimated Daily Flow (L)	Daily Leakage (L)	Raw Sewage Counts/100mL	Estimated Counts/Day
Fecal	1,040	6.09 x 10^{5}	3.045 x 10^{4}	5 x 10^{6}	1.52 X 10^{11}

Table 4.9 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 Spruce Creek. For example, where there are improved pasture areas relative to Spruce Creek, is there a riparian buffer area between the pasture and the stream, can cattle directly access the stream, or is there some type of surface conveyance where animal waste can be transported to Spruce Creek? Similarly, what percentage of pet owners pick up their pet's waste, or what percentage of homes with pets are located adjacent to Spruce Creek or a drainage ditch to the river? Finally, what is the age of the septic systems and drainage characteristics in this watershed compared with the county overall that could affect assumptions regarding failure rates?

Table 4.9. Summary of Estimated Potential Annual Fecal Coliform Loading from Various Sources in the Spruce Creek Watershed

Source	Fecal Coliform
Septic Tanks	3.12×10^{13}
Pets	8.49×10^{14}
Cattle	4.13×10^{16}
Horses	1.88×10^{13}
Collection Systems	5.56×10^{13}

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

Although there is a USGS gaging site on Spruce Creek (02248000), the methodology used for this TMDL was the “percent reduction” methodology. Regression to fit the exceedance observations under the “load duration curve” approach yielded very low R^2 values. Later in this chapter, a flow duration curve based on the historical record from the Spruce Creek gage is presented and discussed further. 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 fecal coliform determined the overall required reduction, and therefore the TMDL.

5.1.1 Data Used in the Determination of the TMDL

Eight sampling stations on Spruce Creek have historical coliform observations (**Figure 5.1**). Although the Department established and collected data at six of the stations, the majority of the observations were obtained by the U.S. Geological Survey (USGS) during the 1974–93 period (Station 112WRD 03348000). Five of the Department stations were established and sampled during 2005. **Table 5.1** shows data collection information for each of the stations; **Figure 5.1** shows the location of the sample sites. **Table 5.2** provides a statistical summary of observed historical data, and **Appendix B** contains all of the historical fecal coliform observations from the sampling sites for the planning and verified periods for the Upper East Coast Basin. **Figure 5.2** displays the historical observations over time.

As seen in the statistical summary in **Table 5.2**, individual stations typically had fecal coliform exceedance rates between 20 and 45 percent. A linear regression of fecal coliform versus sampling date in **Figure 5.2** indicated there was no significant trend over time (R^2 = 0.0013). Plots of fecal coliform by season and station as well as by year can be found in **Appendix E.**

Table 5.1. Sampling Station Summary for the Spruce Creek Watershed

Station	STORET ID	Station Owner	Years With Data	N
Spruce Creek near Samsula	112WRD 02248000	USGS	1974–93	99
Spruce Creek near Samsula	21FLSJWM02248000	SJRWMD	1995–98	20
Spruce Creek at Spruce Creek Blvd	21FLA 27010332	Department	1998	1
Spruce Creek @ 25M North of Creek Crossing Rd	21FLCEN 27010081	Department	2005	5
Spruce Creek @ Lacey Rd	21FLCEN 27010082	Department	2005	5
Spruce Creek @ Covered Bridge	21FLCEN 27010093	Department	2005	4
Spruce Creek at C.R. 4118	21FLCEN 27010539	Department	2005	5
Spruce Creek @ Pell Rd	21FLCEN 27010083	Department	2005	5

Table 5.2. Statistical Summary of Historical Data for Spruce Creek

Station	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedance
Spruce Creek near Samsula	99	0	7,200	300	726.49	39	39.40%
Spruce Creek near Samsula	20	10	3,000	300	659.6	9	45.00%
Spruce Creek at Spruce Creek Blvd	1	270	270	270	270	0	0%
Spruce Creek @ 25M North of Creek Crossing Rd	5	230	710	300	380	1	20.00%
Spruce Creek @ Lacey Rd	5	200	1,600	240	504	1	20.00%
Spruce Creek @ Covered Bridge	4	210	420	357.5	336.25	1	25.00%
Spruce Creek at C.R. 4118	5	83	450	360	272.2	1	20.00%
Spruce Creek @ Pell Rd	5	100	410	220	221.4	1	20.00%

Coliform concentrations are counts/100 mL

Figure 5.1. Historical Sampling Sites in the Spruce Creek Watershed

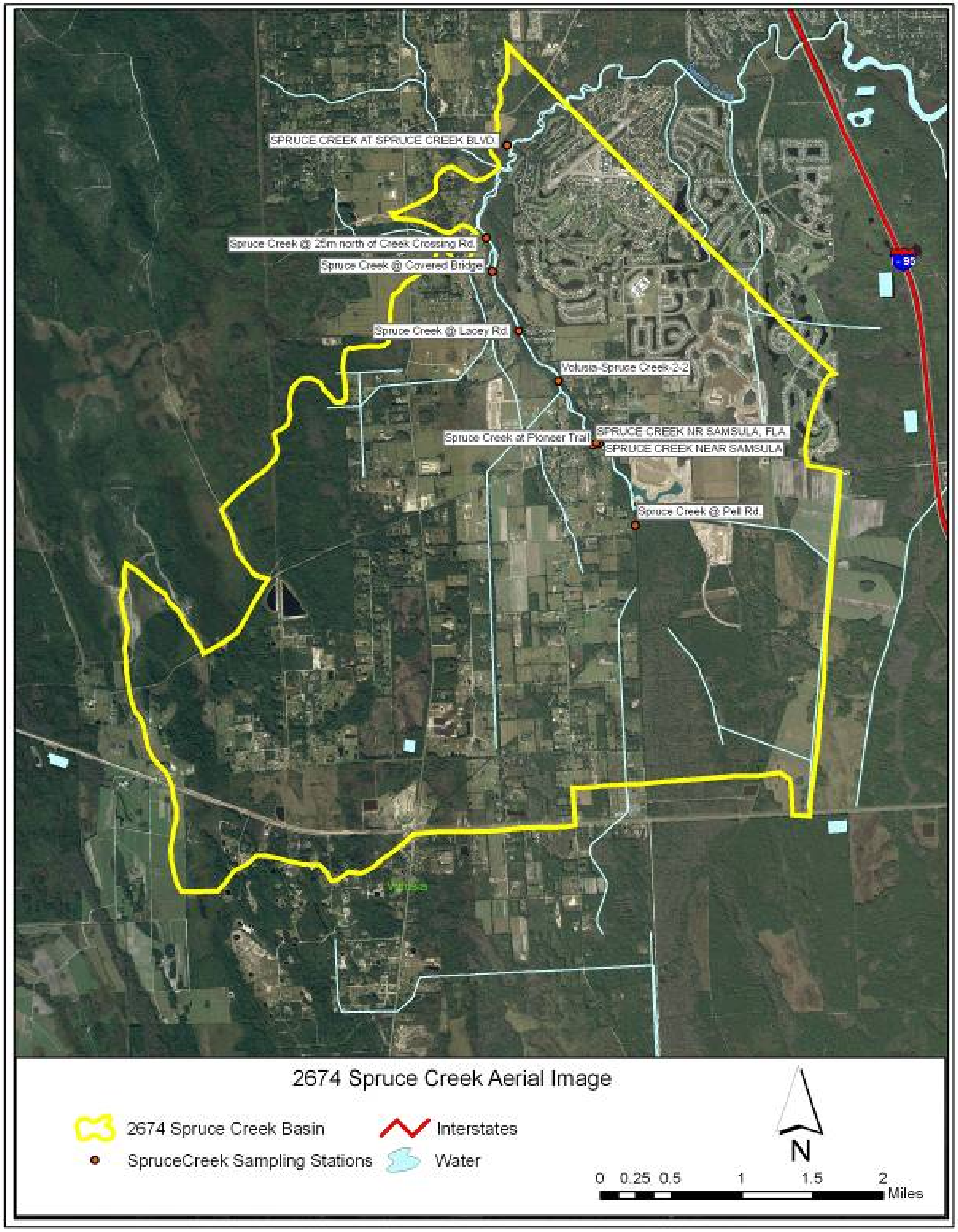
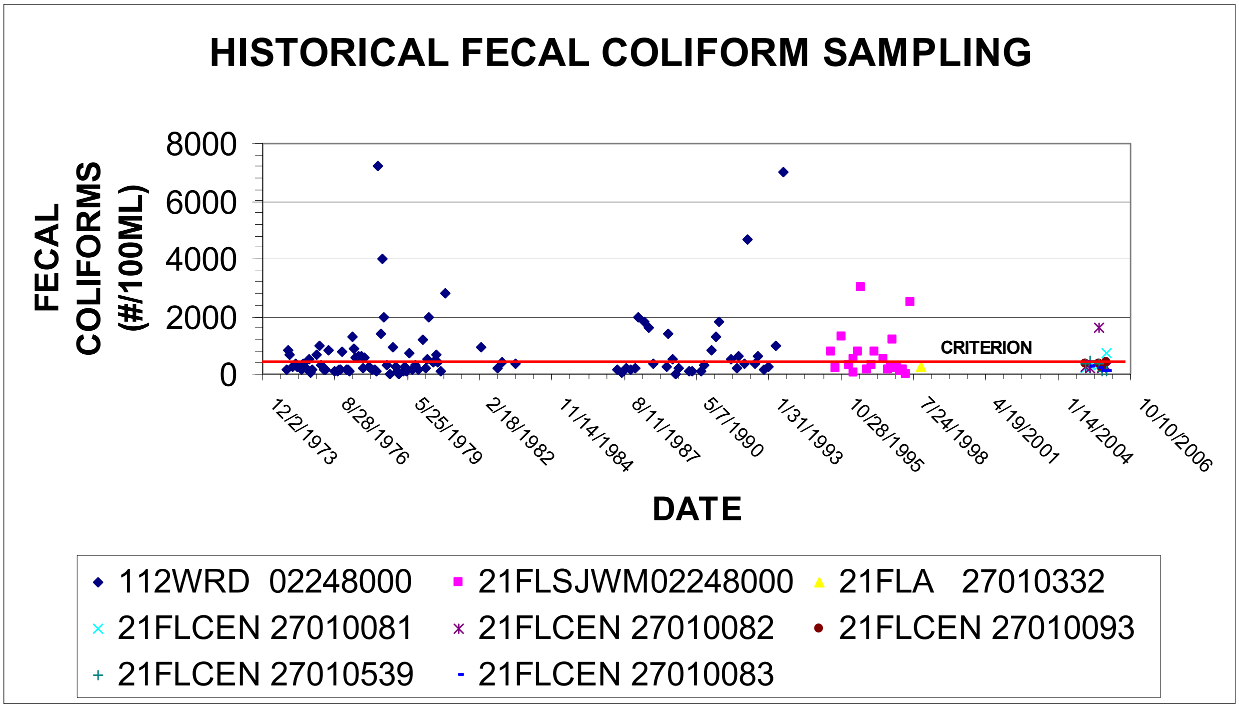


Figure 5.2. Historical Fecal Coliform Observations for Spruce Creek, 1973–2006



5.1.2 TMDL Development Process

A simple 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:

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

After the individual results were calculated, the median of the individual values was calculated, which is 76 percent. This means that in order to meet the state criterion of 400 counts/100mL, a 76 percent reduction in current loading is necessary, and is therefore the TMDL for Spruce Creek. **Table 5.3** shows annual summaries of exceedances used to determine the TMDL, and **Table 5.4** shows the distribution of observations and exceedances by season and month. **Table 5.5** presents the individual exceedances used in the calculation of the TMDL for Spruce Creek.

Table 5.3. Annual Summary of Fecal Coliform Exceedances Used To Develop the TMDL for Spruce Creek, 1974–2005

Year	N	Minimum	Maximum	Median	Mean
1974	3	130	840	670	547
1975	10	75	690	260	298
1976	10	90	1,000	175	376
1977	11	110	1,300	570	497
1978	11	0	7,200	300	1,501
1979	10	18	1,200	165	315
1980	8	100	2,800	450	888
1982	2	200	960	580	580
1983	2	340	400	370	370
1987	4	62	230	180	163
1988	5	210	2,000	1,600	1,194
1989	5	10	1,400	270	482
1990	5	120	830	120	298
1991	5	190	1,800	640	892
1992	5	150	4,700	380	1,236
1993	3	250	7,000	1,000	2,750
1995	3	230	1,300	800	777
1996	7	40	3,000	300	724
1997	6	160	1,200	350	508
1998	5	10	2,500	140	602
2005	24	83	1,600	285	343

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

Table 5.4. Summary of Fecal Coliform Observations by Season and Month Used To Develop the TMDL for Spruce Creek

	Summary of Historical Data		
	# of Samples	# of Exceedances	% Exceedance
Seasons			
Winter	38	9	23.7
Spring	33	20	60.6
Summer	40	10	25
Fall	33	14	42.4
Months			
Jan	12	2	16.7
Feb	14	4	28.6
Mar	12	3	25
April	13	6	46.1
May	10	6	60
June	10	8	80
July	14	4	28.6
Aug	11	4	36.4
Sep	15	2	13.3
Oct	8	2	25
Nov	15	6	40
Dec	10	6	60

Table 5.5. Calculation of Reductions for the Fecal Coliform TMDL for Spruce Creek

Sample Date	Location	Observed Value (Exceedance)	Required Reduction
11/20/1974	Spruce Creek near Samsula	840	52.38%
12/18/1974	Spruce Creek near Samsula	670	40.30%
8/26/1975	Spruce Creek near Samsula	500	20%
12/16/1975	Spruce Creek near Samsula	690	42.03%
1/27/1976	Spruce Creek near Samsula	1,000	60%
5/25/1976	Spruce Creek near Samsula	850	52.94%
12/7/1976	Spruce Creek near Samsula	800	50%
4/18/1977	Spruce Creek near Samsula	1,300	69.23%
5/18/1977	Spruce Creek near Samsula	900	55.56%
6/13/1977	Spruce Creek near Samsula	590	32.20%
7/26/1977	Spruce Creek near Samsula	640	37.50%
8/25/1977	Spruce Creek near Samsula	630	36.51%
10/18/1977	Spruce Creek near Samsula	570	29.82%
4/19/1978	Spruce Creek near Samsula	7,200	94.44%
5/15/1978	Spruce Creek near Samsula	1,400	71.43%
6/14/1978	Spruce Creek near Samsula	4,000	90%
7/10/1978	Spruce Creek near Samsula	2,000	80%

Sample Date	Location	Observed Value (Exceedance)	Required Reduction
11/1/1978	Spruce Creek near Samsula	920	56.52%
6/15/1979	Spruce Creek near Samsula	730	45.21%
12/26/1979	Spruce Creek near Samsula	1,200	66.67%
2/27/1980	Spruce Creek near Samsula	500	20%
3/21/1980	Spruce Creek near Samsula	2,000	80%
6/24/1980	Spruce Creek near Samsula	700	42.86%
11/5/1980	Spruce Creek near Samsula	2,800	85.71%
3/3/1982	Spruce Creek near Samsula	960	58.33%
2/29/1988	Spruce Creek near Samsula	2,000	80%
5/4/1988	Spruce Creek near Samsula	1,800	77.78%
7/5/1988	Spruce Creek near Samsula	1,600	75%
4/11/1989	Spruce Creek near Samsula	1,400	71.43%
5/31/1989	Spruce Creek near Samsula	540	25.93%
12/4/1990	Spruce Creek near Samsula	830	51.81%
1/29/1991	Spruce Creek near Samsula	1,300	69.23%
3/11/1991	Spruce Creek near Samsula	1,800	77.78%
9/3/1991	Spruce Creek near Samsula	530	24.53%
12/16/1991	Spruce Creek near Samsula	640	37.50%
4/7/1992	Spruce Creek near Samsula	4,700	91.49%
9/8/1992	Spruce Creek near Samsula	600	33.33%
5/3/1993	Spruce Creek near Samsula	1,000	60%
8/24/1993	Spruce Creek near Samsula	7,000	94.29%
6/5/1995	Spruce Creek near Samsula	800	50%
11/7/1995	Spruce Creek near Samsula	1,300	69.23%
4/9/1996	Spruce Creek near Samsula	500	20%
6/25/1996	Spruce Creek near Samsula	800	50%
8/7/1996	Spruce Creek near Samsula	3,000	86.67%
2/4/1997	Spruce Creek near Samsula	800	50%
6/2/1997	Spruce Creek near Samsula	500	20%
10/6/1997	Spruce Creek near Samsula	1,200	66.67%
6/10/1998	Spruce Creek near Samsula	2,500	84%
2/1/2005	Spruce Creek @ Pell Rd	410	2.44%
4/5/2005	Spruce Creek at C.R. 4118	450	11.11%
7/26/2005	Spruce Creek @ Lacey Rd	1,600	75%
11/14/2005	Spruce Creek @ Covered Bridge	420	4.76%
11/14/2005	Spruce Creek @ 25M North of Creek Crossing Rd	710	43.66%
	MEDIAN:	**850**	**52.94%**

5.2.3 Critical Conditions/Seasonality

Exceedances in Spruce Creek were investigated for possible association with stream flow and rainfall. **Appendix B** provides historical fecal coliform observations in Spruce Creek. Coliform data are presented by month, season, and year to determine whether certain patterns are evident in the dataset (**Tables 5.3** and **5.4**).

A nonparametric 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 no significant differences among seasons or months (**Appendices C** and **D**). Grouping observations by season increased sample sizes for statistical comparison and, as seen in **Table 5.4**, all seasons have at least a 23 percent exceedance rate. May, June, and December have the greatest exceedance rates. A factor that could likely contribute to monthly or seasonal differences is the pattern of rainfall and stream flow. **Appendix E** presents comparisons of station and seasons.

Rainfall records for the Daytona Beach International Airport (**Appendix F** illustrates rainfall from 1948–2006) were used to determine rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (PRECIP), the cumulative total for the day of and the previous 2 days (DAY3), the cumulative total for the day of and the previous 6 days (DAY7), the cumulative total for the day of and the previous 13 days (DAY14), and the cumulative total for the day of and the previous 29 days (DAY30) were all paired with the respective coliform observation. 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 PRECIP, DAY3, and DAY7 rainfall totals were positive, and negative for the DAY14 and DAY30 rainfall totals.

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 the PRECIP, DAY7, and DAY14 precipitation were not significant, but compared with the DAY3 and DAY30 rainfall totals, regressions were significant (**Appendix H**). A table of historical monthly average rainfall at Daytona International Airport (**Appendix I**) indicates that monthly rainfall totals increase in June and peak in September, and by November return to levels observed in February and March. Data analysis by season (**Table 5.4**) indicates that the highest percentage of exceedances occurs in May and June just prior to the rainy season. **Appendix J** includes a graph of annual and monthly rainfall at Daytona International Airport over the 1948–2006 period, versus the long-term average (49.58 inches) over this period. The year 2005 represented an above-average rainfall year.

Flow data were also analyzed using both the flow for the sampling date as well as a three-day flow average. Spearman correlation coefficients for fecal coliform versus the daily flow (DAILYFLOW) and the three-day average flow (FLOW3DAY) were negative, suggesting an inverse relationship between coliform and discharge. Regressions between fecal coliform and DAILYFLOW or FLOW3DAY were both significant at an α level of 0.05 (**Appendix H**).

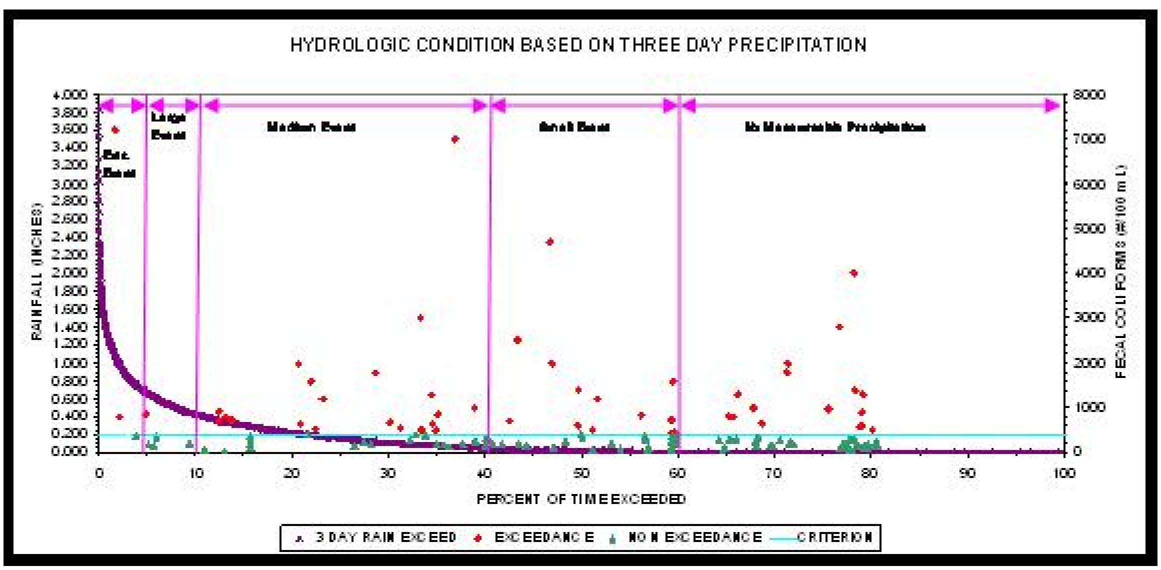
A precipitation duration curve chart, similar to a flow duration curve, was created using precipitation data from Daytona International Airport from 1948 to 2006. Based on the significant relationship between fecal coliform and the DAY3 cumulative precipitation, the DAY3 duration curve was used (**Figure 5.3**). 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–10th percentile), medium precipitation events (10th–40th percentile), small precipitation events (40th–60th percentile), and no recordable precipitation events (60th–100th percentile).

Data show that fecal coliform exceedances occurred over all hydrologic conditions for which data exist, except for one. The largest percentage of exceedances occurred under extreme precipitation events (> 0.66"). If a large percentage of exceedances occur after large and extreme precipitation events, this may indicate that exceedances are nonpoint source driven, perhaps from stormwater conveyance systems or various land uses. It is difficult to draw conclusions from the large and extreme event ranges, however, as sample sizes under these conditions are much smaller than under the other conditions. **Table 5.6** summarizes data and hydrologic conditions. **Figure 5.3** displays these same data.

Table 5.6. Summary of Fecal Coliform Data by Precipitation Condition

Precipitation Event	Event Range	Total Samples	Number of Exceedances	% Exceedance	Number of Nonexceedances	% Nonexceedance
Extreme	>0.66"	4	3	75.00%	1	25.00%
Large	0.42" – 0.66"	4	0	0.00%	0	0.00%
Medium	0.04" – 0.42"	39	20	51.28%	19	48.72%
Small	0.01" – 0.04"	46	14	30.43%	32	69.57%
None/ Not Measurable	<0.01"	51	16	31.37%	35	68.63%

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



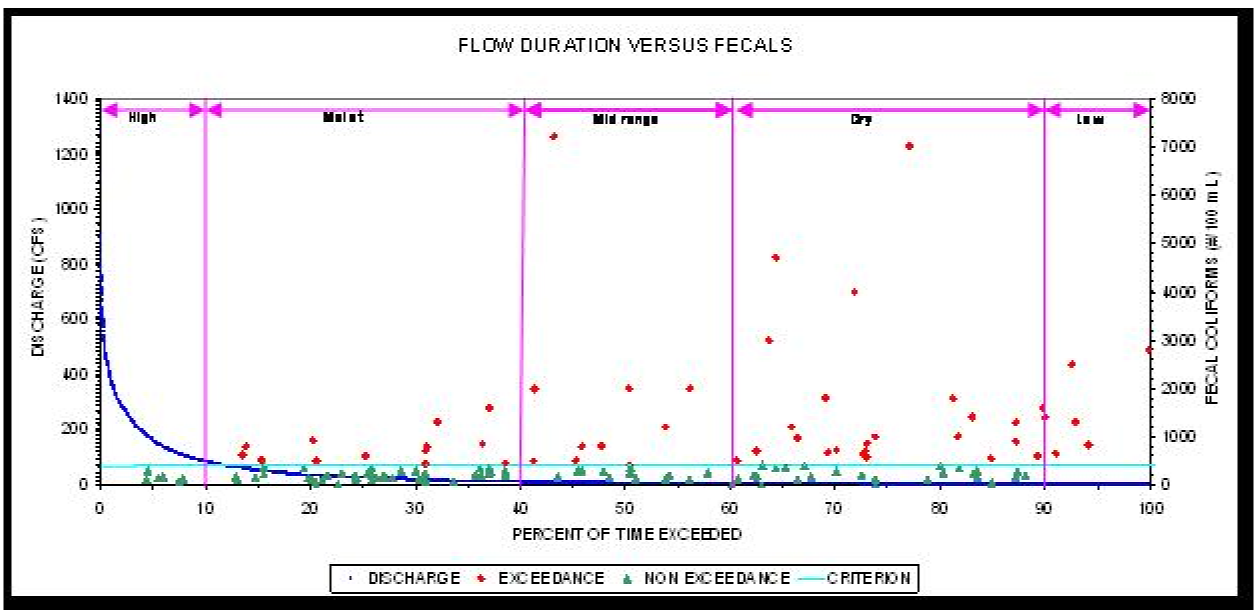
A flow duration curve was also created using the long-term flow records (1951–2007) from USGS gaging station 02248000, located on Spruce Creek (**Figure 5.4**). The chart was divided into high-discharge events represented by the upper percentiles (0–10th percentile), followed by moist events (10th–40th percentile), mid-range events (40th–60th percentile), dry events (60th–90th percentile), and low-flow events (90th–100th percentile). Flows are in cubic feet per second (cfs).

Data show that fecal coliform exceedances occurred over all flow conditions for which data exist except for one (**Table 5.7**). The largest percentage of exceedances occurred under flows between 0.9 and 3.8 cfs. Sample sizes are small for both extremes of the flow duration curve. It is interesting that in the case of the precipitation duration curve, the greatest exceedances occurred under higher rainfall events, while in the flow duration curve the greatest percentage of exceedances occurred during lower flow (and presumably lower rainfall) periods. **Figure 5.4** displays the same data.

Table 5.7. Summary of Fecal Coliform Data by Flow Condition

Precipitation Event	Event Range	Total Samples	Number of Exceedances	% Exceedance	Number of Nonexceedances	% Nonexceedance
High	>83"	6	0	0.00%	6	100.00%
Moist	10.1 - 83	58	13	22.41%	45	77.59%
Mid-range	3.8 – 10.1	24	10	41.67%	14	58.33%
Dry	0.9 – 3.8"	51	25	49.02%	26	50.98%
Low	<0.9	5	5	100.00%	0	0.00%

Figure 5.4. Fecal Coliform Data by Hydrological Condition Based on Stream Flow



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:

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

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

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

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

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

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

WBID	Parameter	TMDL (colonies/100 mL)	WLA		LA (% Reduction)[1]	MOS
			Wastewater (colonies/day)	NPDES Stormwater (% Reduction)[1]		
2674	Fecal Coliform	400	N/A	53%	53%	Implicit

* N/A – Not applicable
[1] Since the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.

6.2 Load Allocation

A fecal coliform reduction of 53 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

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES discharges in the Spruce Creek watershed; however, any future discharge permits issued in the watershed will also be required to meet the state's Class III criteria 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

Both Volusia County (FLR04E033) and New Smyrna Beach (FLR04E035) have Phase II MS4 permits that may include portions of the Spruce Creek watershed, and would be responsible for a 53 percent reduction in current anthropogenic fecal coliform loading. 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.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Department, 2001), an implicit MOS was used in the development of this TMDL. An 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 for fecal coliforms was based on meeting the water quality criterion of 400 counts/100mL without any exceedances, while the actual criterion allows for 10 percent exceedances over the fecal coliform 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, referred to as the BMAP. This document will be developed over the next year in cooperation with local stakeholders, who will attempt to reach consensus on detailed allocations and on how load reductions will be accomplished. The BMAP will include, among other things:

- Appropriate load reduction allocations among the affected parties,
- A description of the load reduction activities to be undertaken, including structural projects, nonstructural BMPs, and public education and outreach,
- A description of further research, data collection, or source identification needed in order to achieve the TMDL,
- Timetables for implementation,
- Confirmed and potential funding mechanisms,
- Any applicable signed agreement(s),
- Local ordinances defining actions to be taken or prohibited,
- Any applicable local water quality standards, permits, or load limitation agreements,
- Milestones for implementation and water quality improvement, and
- Implementation tracking, water quality monitoring, and follow-up measures.

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

As **Tables 4.5** and **4.7** show, potential impacts from cattle and pets could be significant. If livestock and pet owners are educated on the potential impacts their pets are having on Spruce Creek, and they are inclined to take action, this could potentially decrease a source load. When considering the significance of the three-day rainfall, this could be a potentially significant load to the stream.

Earlier in the document, a Spruce Creek/Rose Bay Watershed Master Plan (Volusia County, 1996) was referenced along with current plans for the county to update the document. Implementation measures that reduce stormwater impacts to both water quantity and water quality in the Spruce Creek watershed should be recognized in the BMAP. An element of the BMAP should be additional monitoring of fecal coliform to better refine the potential source estimates presented in Chapter 4, as well the effectiveness of specific actions to reduce those loads.

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Rule 62-40, F.A.C. In 1994, the Department's stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations.

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

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

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

Appendix B: Historical Fecal Coliform Observations in Spruce Creek

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	10/24/1974	112WRD 02248000	Spruce Creek near Samsula	130	
Spruce Creek	2674	11/20/1974	112WRD 02248000	Spruce Creek near Samsula	840	
Spruce Creek	2674	12/18/1974	112WRD 02248000	Spruce Creek near Samsula	670	
Spruce Creek	2674	1/29/1975	112WRD 02248000	Spruce Creek near Samsula	250	
Spruce Creek	2674	2/24/1975	112WRD 02248000	Spruce Creek near Samsula	340	
Spruce Creek	2674	3/25/1975	112WRD 02248000	Spruce Creek near Samsula	270	
Spruce Creek	2674	5/20/1975	112WRD 02248000	Spruce Creek near Samsula	140	
Spruce Creek	2674	6/17/1975	112WRD 02248000	Spruce Creek near Samsula	370	
Spruce Creek	2674	7/29/1975	112WRD 02248000	Spruce Creek near Samsula	200	
Spruce Creek	2674	8/26/1975	112WRD 02248000	Spruce Creek near Samsula	500	
Spruce Creek	2674	9/23/1975	112WRD 02248000	Spruce Creek near Samsula	75	
Spruce Creek	2674	10/16/1975	112WRD 02248000	Spruce Creek near Samsula	140	
Spruce Creek	2674	12/16/1975	112WRD 02248000	Spruce Creek near Samsula	690	
Spruce Creek	2674	1/27/1976	112WRD 02248000	Spruce Creek near Samsula	1,000	
Spruce Creek	2674	2/24/1976	112WRD 02248000	Spruce Creek near Samsula	300	
Spruce Creek	2674	3/25/1976	112WRD 02248000	Spruce Creek near Samsula	130	
Spruce Creek	2674	4/19/1976	112WRD 02248000	Spruce Creek near Samsula	180	
Spruce Creek	2674	5/25/1976	112WRD 02248000	Spruce Creek near Samsula	850	
Spruce Creek	2674	8/17/1976	112WRD 02248000	Spruce Creek near Samsula	90	
Spruce Creek	2674	9/29/1976	112WRD 02248000	Spruce Creek near Samsula	90	
Spruce Creek	2674	10/26/1976	112WRD 02248000	Spruce Creek near Samsula	170	
Spruce Creek	2674	11/8/1976	112WRD 02248000	Spruce Creek near Samsula	150	
Spruce Creek	2674	12/7/1976	112WRD 02248000	Spruce Creek near Samsula	800	
Spruce Creek	2674	1/24/1977	112WRD 02248000	Spruce Creek near Samsula	150	
Spruce Creek	2674	2/22/1977	112WRD 02248000	Spruce Creek near Samsula	130	
Spruce Creek	2674	3/23/1977	112WRD 02248000	Spruce Creek near Samsula	110	
Spruce Creek	2674	4/18/1977	112WRD 02248000	Spruce Creek near Samsula	1,300	

Appendix B: Historical Fecal Coliform Observations in Spruce Creek (continued)

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	5/18/1977	112WRD 02248000	Spruce Creek near Samsula	900	
Spruce Creek	2674	6/13/1977	112WRD 02248000	Spruce Creek near Samsula	590	
Spruce Creek	2674	7/26/1977	112WRD 02248000	Spruce Creek near Samsula	640	
Spruce Creek	2674	8/25/1977	112WRD 02248000	Spruce Creek near Samsula	630	
Spruce Creek	2674	9/28/1977	112WRD 02248000	Spruce Creek near Samsula	200	
Spruce Creek	2674	10/18/1977	112WRD 02248000	Spruce Creek near Samsula	570	
Spruce Creek	2674	12/19/1977	112WRD 02248000	Spruce Creek near Samsula	250	
Spruce Creek	2674	1/28/1978	112WRD 02248000	Spruce Creek near Samsula	160	
Spruce Creek	2674	2/22/1978	112WRD 02248000	Spruce Creek near Samsula	170	
Spruce Creek	2674	3/22/1978	112WRD 02248000	Spruce Creek near Samsula	120	
Spruce Creek	2674	4/19/1978	112WRD 02248000	Spruce Creek near Samsula	7,200	
Spruce Creek	2674	5/15/1978	112WRD 02248000	Spruce Creek near Samsula	1,400	
Spruce Creek	2674	6/14/1978	112WRD 02248000	Spruce Creek near Samsula	4,000	
Spruce Creek	2674	7/10/1978	112WRD 02248000	Spruce Creek near Samsula	2,000	
Spruce Creek	2674	8/9/1978	112WRD 02248000	Spruce Creek near Samsula	300	
Spruce Creek	2674	10/5/1978	112WRD 02248000	Spruce Creek near Samsula	0	
Spruce Creek	2674	11/1/1978	112WRD 02248000	Spruce Creek near Samsula	920	
Spruce Creek	2674	12/12/1978	112WRD 02248000	Spruce Creek near Samsula	240	
Spruce Creek	2674	1/10/1979	112WRD 02248000	Spruce Creek near Samsula	90	
Spruce Creek	2674	2/5/1979	112WRD 02248000	Spruce Creek near Samsula	18	
Spruce Creek	2674	3/22/1979	112WRD 02248000	Spruce Creek near Samsula	78	
Spruce Creek	2674	4/13/1979	112WRD 02248000	Spruce Creek near Samsula	280	
Spruce Creek	2674	5/17/1979	112WRD 02248000	Spruce Creek near Samsula	110	
Spruce Creek	2674	6/15/1979	112WRD 02248000	Spruce Creek near Samsula	730	
Spruce Creek	2674	8/10/1979	112WRD 02248000	Spruce Creek near Samsula	180	
Spruce Creek	2674	9/12/1979	112WRD 02248000	Spruce Creek near Samsula	310	
Spruce Creek	2674	10/25/1979	112WRD 02248000	Spruce Creek near Samsula	150	
Spruce Creek	2674	12/26/1979	112WRD 02248000	Spruce Creek near Samsula	1,200	

Appendix B: Historical Fecal Coliform Observations in Spruce Creek (continued)

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	1/30/1980	112WRD 02248000	Spruce Creek near Samsula	200	
Spruce Creek	2674	2/27/1980	112WRD 02248000	Spruce Creek near Samsula	500	
Spruce Creek	2674	3/21/1980	112WRD 02248000	Spruce Creek near Samsula	2,000	
Spruce Creek	2674	5/27/1980	112WRD 02248000	Spruce Creek near Samsula	400	
Spruce Creek	2674	6/24/1980	112WRD 02248000	Spruce Creek near Samsula	700	
Spruce Creek	2674	7/21/1980	112WRD 02248000	Spruce Creek near Samsula	400	
Spruce Creek	2674	8/26/1980	112WRD 02248000	Spruce Creek near Samsula	100	
Spruce Creek	2674	11/5/1980	112WRD 02248000	Spruce Creek near Samsula	2,800	
Spruce Creek	2674	3/3/1982	112WRD 02248000	Spruce Creek near Samsula	960	
Spruce Creek	2674	11/1/1982	112WRD 02248000	Spruce Creek near Samsula	200	
Spruce Creek	2674	1/4/1983	112WRD 02248000	Spruce Creek near Samsula	400	
Spruce Creek	2674	7/6/1983	112WRD 02248000	Spruce Creek near Samsula	340	E
Spruce Creek	2674	5/4/1987	112WRD 02248000	Spruce Creek near Samsula	180	E
Spruce Creek	2674	6/30/1987	112WRD 02248000	Spruce Creek near Samsula	62	
Spruce Creek	2674	9/1/1987	112WRD 02248000	Spruce Creek near Samsula	230	
Spruce Creek	2674	11/13/1987	112WRD 02248000	Spruce Creek near Samsula	180	
Spruce Creek	2674	1/6/1988	112WRD 02248000	Spruce Creek near Samsula	210	
Spruce Creek	2674	2/29/1988	112WRD 02248000	Spruce Creek near Samsula	2,000	
Spruce Creek	2674	5/4/1988	112WRD 02248000	Spruce Creek near Samsula	1,800	
Spruce Creek	2674	7/5/1988	112WRD 02248000	Spruce Creek near Samsula	1,600	E
Spruce Creek	2674	9/7/1988	112WRD 02248000	Spruce Creek near Samsula	360	
Spruce Creek	2674	3/15/1989	112WRD 02248000	Spruce Creek near Samsula	270	
Spruce Creek	2674	4/11/1989	112WRD 02248000	Spruce Creek near Samsula	1,400	
Spruce Creek	2674	5/31/1989	112WRD 02248000	Spruce Creek near Samsula	540	
Spruce Creek	2674	7/20/1989	112WRD 02248000	Spruce Creek near Samsula	10	E
Spruce Creek	2674	9/7/1989	112WRD 02248000	Spruce Creek near Samsula	190	
Spruce Creek	2674	1/22/1990	112WRD 02248000	Spruce Creek near Samsula	120	>
Spruce Creek	2674	3/12/1990	112WRD 02248000	Spruce Creek near Samsula	120	>
Spruce Creek	2674	7/9/1990	112WRD 02248000	Spruce Creek near Samsula	120	>

Appendix B: Historical Fecal Coliform Observations in Spruce Creek (continued)

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	7/5/1988	112WRD 02248000	Spruce Creek near Samsula	1,600	E
Spruce Creek	2674	8/27/1990	112WRD 02248000	Spruce Creek near Samsula	300	E
Spruce Creek	2674	12/4/1990	112WRD 02248000	Spruce Creek near Samsula	830	E
Spruce Creek	2674	1/29/1991	112WRD 02248000	Spruce Creek near Samsula	1,300	E
Spruce Creek	2674	3/11/1991	112WRD 02248000	Spruce Creek near Samsula	1,800	
Spruce Creek	2674	9/3/1991	112WRD 02248000	Spruce Creek near Samsula	530	
Spruce Creek	2674	11/18/1991	112WRD 02248000	Spruce Creek near Samsula	190	
Spruce Creek	2674	12/16/1991	112WRD 02248000	Spruce Creek near Samsula	640	
Spruce Creek	2674	3/9/1992	112WRD 02248000	Spruce Creek near Samsula	380	
Spruce Creek	2674	4/7/1992	112WRD 02248000	Spruce Creek near Samsula	4,700	
Spruce Creek	2674	7/27/1992	112WRD 02248000	Spruce Creek near Samsula	350	
Spruce Creek	2674	9/8/1992	112WRD 02248000	Spruce Creek near Samsula	600	
Spruce Creek	2674	11/16/1992	112WRD 02248000	Spruce Creek near Samsula	150	
Spruce Creek	2674	1/19/1993	112WRD 02248000	Spruce Creek near Samsula	250	
Spruce Creek	2674	5/3/1993	112WRD 02248000	Spruce Creek near Samsula	1,000	
Spruce Creek	2674	8/24/1993	112WRD 02248000	Spruce Creek near Samsula	7,000	E
Spruce Creek	2674	6/5/1995	21FLSJWM02248000	Spruce Creek near Samsula	800	Q
Spruce Creek	2674	8/8/1995	21FLSJWM02248000	Spruce Creek near Samsula	230	Q
Spruce Creek	2674	11/7/1995	21FLSJWM02248000	Spruce Creek near Samsula	1,300	Q
Spruce Creek	2674	2/7/1996	21FLSJWM02248000	Spruce Creek near Samsula	300	Q
Spruce Creek	2674	4/9/1996	21FLSJWM02248000	Spruce Creek near Samsula	40	Q
Spruce Creek	2674	4/9/1996	21FLSJWM02248000	Spruce Creek near Samsula	500	Q
Spruce Creek	2674	6/25/1996	21FLSJWM02248000	Spruce Creek near Samsula	800	Q

Appendix B: Historical Fecal Coliform Observations in Spruce Creek (continued)

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	8/7/1996	21FLSJWM02248000	Spruce Creek near Samsula	3,000	Q
Spruce Creek	2674	10/14/1996	21FLSJWM02248000	Spruce Creek near Samsula	130	Q
Spruce Creek	2674	12/18/1996	21FLSJWM02248000	Spruce Creek near Samsula	300	Q
Spruce Creek	2674	2/4/1997	21FLSJWM02248000	Spruce Creek near Samsula	800	Q
Spruce Creek	2674	6/2/1997	21FLSJWM02248000	Spruce Creek near Samsula	500	Q
Spruce Creek	2674	8/13/1997	21FLSJWM02248000	Spruce Creek near Samsula	160	Q
Spruce Creek	2674	9/9/1997	21FLSJWM02248000	Spruce Creek near Samsula	190	
Spruce Creek	2674	10/6/1997	21FLSJWM02248000	Spruce Creek near Samsula	1,200	
Spruce Creek	2674	12/1/1997	21FLSJWM02248000	Spruce Creek near Samsula	200	
Spruce Creek	2674	1/12/1998	21FLSJWM02248000	Spruce Creek near Samsula	92	
Spruce Creek	2674	3/3/1998	21FLSJWM02248000	Spruce Creek near Samsula	140	
Spruce Creek	2674	4/20/1998	21FLSJWM02248000	Spruce Creek near Samsula	10	
Spruce Creek	2674	6/10/1998	21FLSJWM02248000	Spruce Creek near Samsula	2,500	
Spruce Creek	2674	11/2/1998	21FLA 27010332	Spruce Creek at Spruce Creek Blvd.	270	
Spruce Creek	2674	2/1/2005	21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd	230	
Spruce Creek	2674	2/1/2005	21FLCEN 27010082	Spruce Creek @ Lacey Rd	270	
Spruce Creek	2674	2/1/2005	21FLCEN 27010093	Spruce Creek @ Covered Bridge	350	
Spruce Creek	2674	2/1/2005	21FLCEN 27010539	Spruce Creek at C.R. 4118	360	A
Spruce Creek	2674	2/1/2005	21FLCEN 27010083	Spruce Creek @ Pell Rd	410	
Spruce Creek	2674	4/5/2005	21FLCEN 27010082	Spruce Creek @ Lacey Rd	210	
Spruce Creek	2674	4/5/2005	21FLCEN 27010083	Spruce Creek @ Pell Rd	250	
Spruce Creek	2674	4/5/2005	21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd	300	
Spruce Creek	2674	4/5/2005	21FLCEN 27010539	Spruce Creek at C.R. 4118	450	
Spruce Creek	2674	7/26/2005	21FLCEN 27010083	Spruce Creek @ Pell Rd	220	
Spruce Creek	2674	7/26/2005	21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd	300	
Spruce Creek	2674	7/26/2005	21FLCEN 27010539	Spruce Creek at C.R. 4118	360	
Spruce Creek	2674	7/26/2005	21FLCEN 27010093	Spruce Creek @ Covered Bridge	365	A
Spruce Creek	2674	7/26/2005	21FLCEN 27010082	Spruce Creek @ Lacey Rd	1,600	

Appendix B: Historical Fecal Coliform Observations in Spruce Creek (continued)

Waterbody	WBID	Sample Date	Station	Location	Value (#/100mL)	Remark Code
Spruce Creek	2674	9/20/2005	21FLCEN 27010083	Spruce Creek @ Pell Rd	100	
Spruce Creek	2674	9/20/2005	21FLCEN 27010539	Spruce Creek at C.R. 4118	108	A
Spruce Creek	2674	9/20/2005	21FLCEN 27010082	Spruce Creek @ Lacey Rd	200	
Spruce Creek	2674	9/20/2005	21FLCEN 27010093	Spruce Creek @ Covered Bridge	210	
Spruce Creek	2674	9/20/2005	21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd	360	
Spruce Creek	2674	11/14/2005	21FLCEN 27010539	Spruce Creek at C.R. 4118	83	
Spruce Creek	2674	11/14/2005	21FLCEN 27010083	Spruce Creek @ Pell Rd	127	
Spruce Creek	2674	11/14/2005	21FLCEN 27010082	Spruce Creek @ Lacey Rd	240	
Spruce Creek	2674	11/14/2005	21FLCEN 27010093	Spruce Creek @ Covered Bridge	420	
Spruce Creek	2674	11/14/2005	21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd	710	A

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

Remark Codes:

A – Value reported is the mean of two or more determinations.
E – Extra samples taken in compositing process.
Q – Sample held beyond normal holding time.
> - Actual value is known to be greater than value reported

Appendix C: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Season in Spruce Creek

Grouping variable is SEASON

Group	Count	Rank Sum
FALL	33	2356.500
SPRING	33	2955.500
SUMMER	40	2700.000
WINTER	38	2428.000

Kruskal-Wallis Test Statistic = 7.738
Probability is 0.052 assuming Chi-square distribution with 3 df

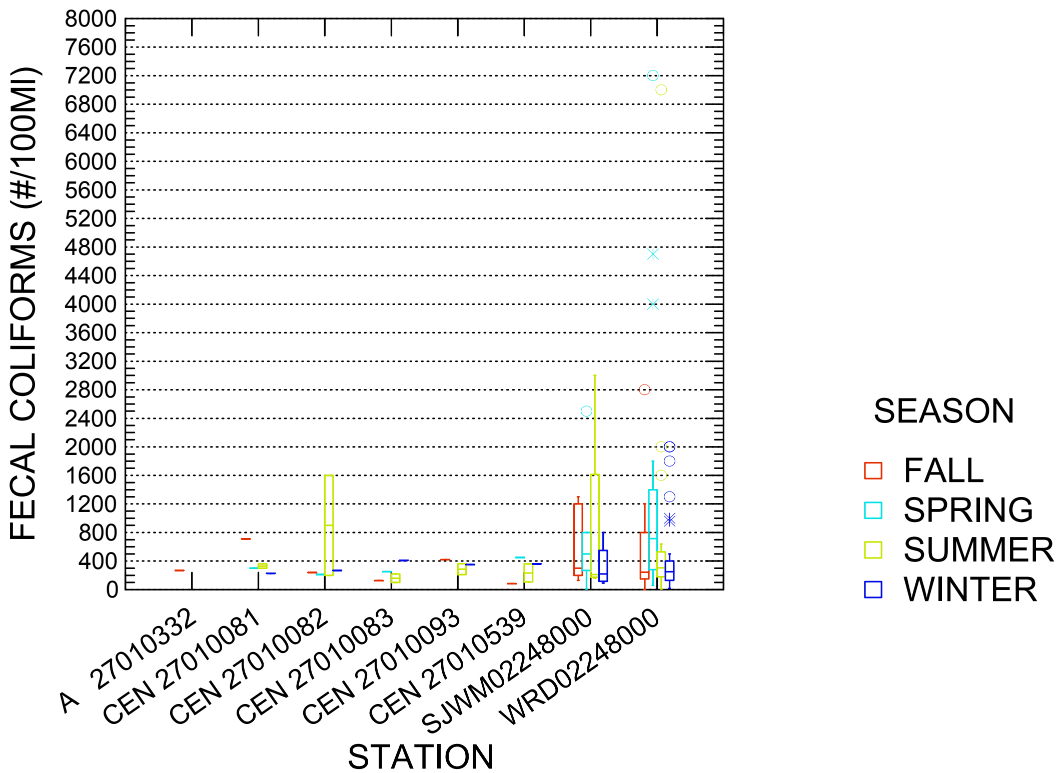
Appendix D: Kruskal–Wallis Analysis of Fecal Coliform Observations versus Month in Spruce Creek

Kruskal-Wallis One-Way Analysis of Variance for 144 cases
Dependent variable is FECALCOLIFO
Grouping variable is MONTH

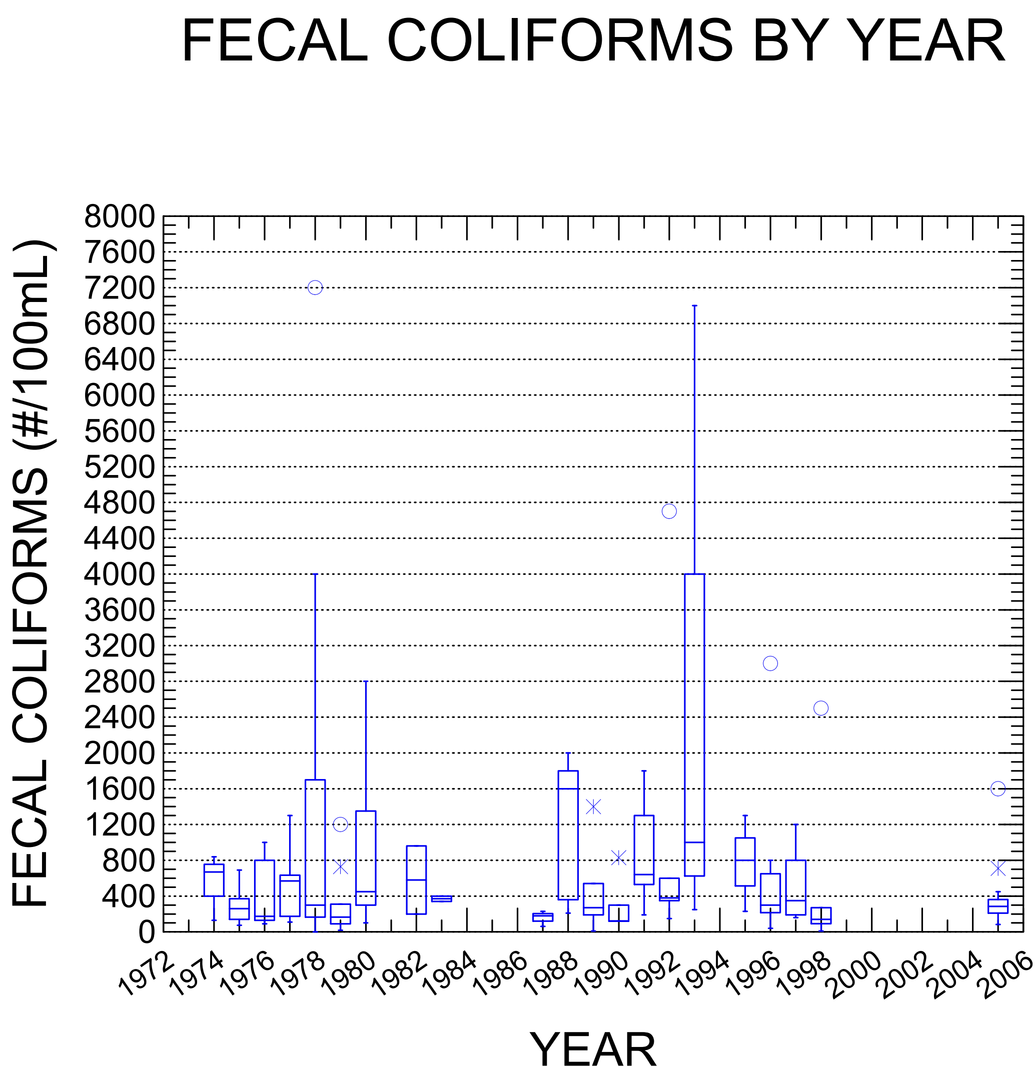
Group	Count	Rank Sum
APRIL	13	1038.500
AUG	11	788.000
DEC	10	918.000
FEB	14	1017.000
JAN	12	678.500
JULY	14	1122.500
JUNE	10	1017.500
MAR	12	732.500
MAY	10	899.500
NOV	15	1062.000
OCT	8	376.500
SEPT	15	789.500

Kruskal-Wallis Test Statistic = 18.767
Probability is 0.065 assuming Chi-square distribution with 11 df

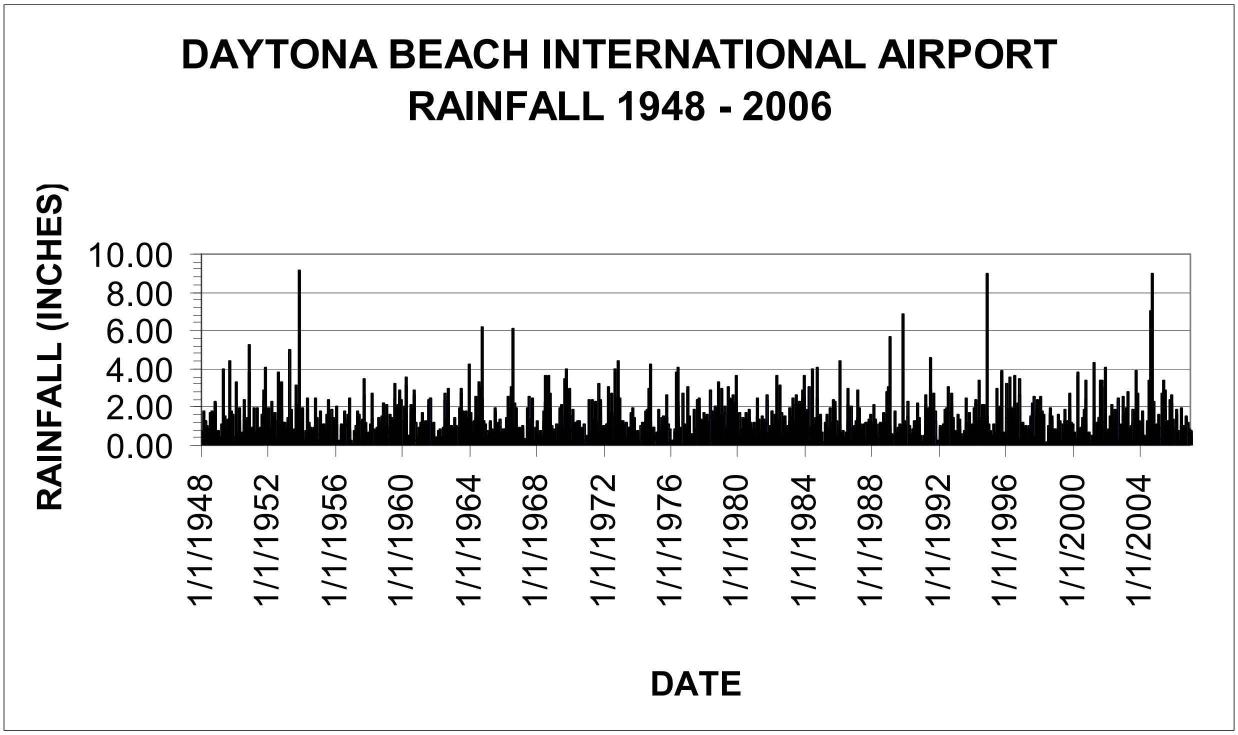
Appendix E: Chart of Fecal Coliform Observations by Season, Station, and Year (1972–2006) in Spruce Creek



STORET ID	Station
112WRD 02248000	Spruce Creek near Samsula
21FLSJWM02248000	Spruce Creek near Samsula
21FLA 27010332	Spruce Creek at Spruce Creek Blvd..
21FLCEN 27010081	Spruce Creek @ 25M North of Creek Crossing Rd
21FLCEN 27010082	Spruce Creek @ Lacey Rd
21FLCEN 27010093	Spruce Creek @ Covered Bridge
21FLCEN 27010539	Spruce Creek at C.R. 4118
21FLCEN 27010083	Spruce Creek @ Pell Rd


FECAL COLIFORMS BY YEAR
FECAL COLIFORMS (#/100mL)
8000
7600
7200
6800
6400
6000
5600
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
YEAR

Appendix F: Chart of Rainfall for Daytona International Airport, 1948–2006



Appendix G: Spearman Correlation Matrix Analysis for Precipitation, Flow, and Fecal Coliform in Spruce Creek

Spearman Correlation Matrix

	YEAR	MONTH	FECALCOLIFO	DAILYFLOW	FLOW3DAY
YEAR	1.000				
MONTH	0.002	1.000			
FECALCOLIFO	0.028	0.019	1.000		
DAILYFLOW	0.168	0.121	-0.379	1.000	
FLOW3DAY	0.166	0.118	-0.401	0.991	1.000
PRECIP	-0.059	0.181	0.092	0.089	0.046
DAY3	-0.154	0.185	0.167	0.067	0.031
DAY7	-0.190	0.078	0.136	0.103	0.090
DAY14	-0.046	0.161	-0.087	0.415	0.404
DAY30	0.195	0.165	-0.246	0.618	0.617

	PRECIP	DAY3	DAY7	DAY14	DAY30
PRECIP	1.000				
DAY3	0.695	1.000			
DAY7	0.396	0.622	1.000		
DAY14	0.261	0.422	0.642	1.000	
DAY30	0.119	0.207	0.294	0.665	1.000

Appendix H: Analysis of Fecal Coliform Observations versus Precipitation and Flow in Spruce Creek

Fecal Coliform Data Versus Day of Sampling Precipitation

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.089 Squared multiple R: 0.008

Adjusted squared multiple R: 0.001 Standard error of estimate: 1048.654

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	613.993	93.748	0.000	.	6.549	0.000
PRECIP	466.578	439.146	0.089	1.000	1.062	0.290

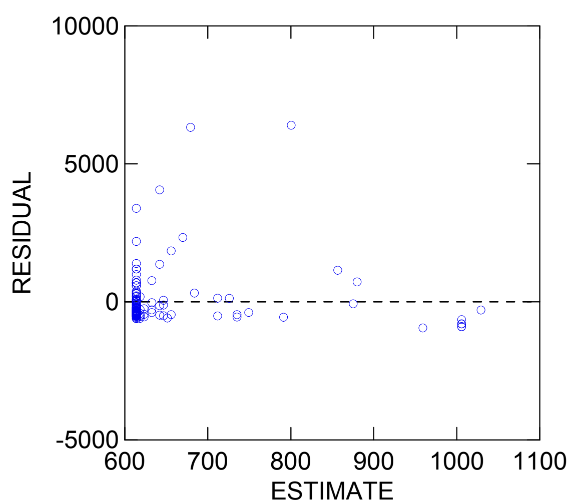
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1241350.295	1	1241350.295	1.129	0.290
Residual	1.56154E+08	142	1099675.333		

*** WARNING ***
Case 41 is an outlier (Studentized Residual = 7.204)
Case 44 is an outlier (Studentized Residual = 4.093)
Case 65 has large leverage (Leverage = 0.123)
Case 93 is an outlier (Studentized Residual = 6.998)
Case 107 has large leverage (Leverage = 0.109)
Case 108 has large leverage (Leverage = 0.109)
Case 109 has large leverage (Leverage = 0.109)
Case 110 has large leverage (Leverage = 0.109)
Case 111 has large leverage (Leverage = 0.109)

Durbin-Watson D Statistic 2.010
First Order Autocorrelation -0.006

Plot of residuals against predicted values



Fecal Coliform Data Versus Day of Sampling and 2 Days Prior Precipitation

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.222 Squared multiple R: 0.049

Adjusted squared multiple R: 0.043 Standard error of estimate: 1026.457

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	538.421	94.889	0.000	.	5.674	0.000
DAY3	1251.974	460.666	0.222	1.000	2.718	0.007

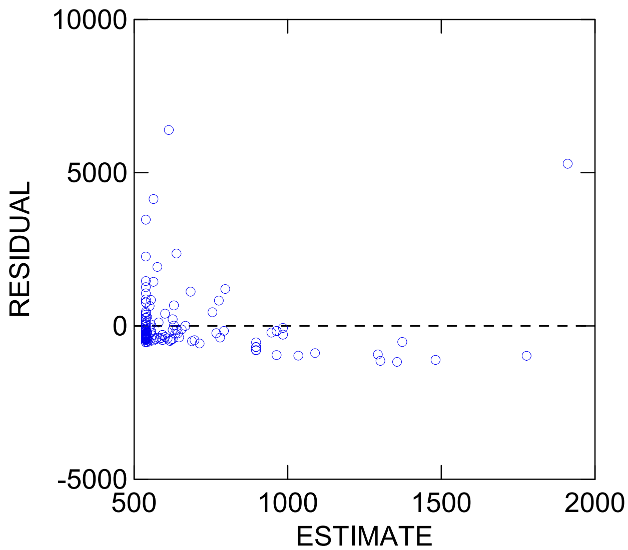
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7782147.827	1	7782147.827	7.386	0.007
Residual	1.49613E+08	142	1053613.378		

*** WARNING ***
Case 41 has large leverage (Leverage = 0.211)
Case 41 is an outlier (Studentized Residual = 6.619)
Case 44 is an outlier (Studentized Residual = 4.286)
Case 68 has large leverage (Leverage = 0.170)
Case 93 is an outlier (Studentized Residual = 7.305)

Durbin-Watson D Statistic 2.009
First Order Autocorrelation -0.005

Plot of residuals against predicted values



Fecal Coliform Data Versus Day of Sampling and 6 Days Prior Precipitation

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.114 Squared multiple R: 0.013

Adjusted squared multiple R: 0.006 Standard error of estimate: 1045.949

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	564.330	107.362	0.000	.	5.256	0.000
DAY7	905.302	661.978	0.114	1.000	1.368	0.174

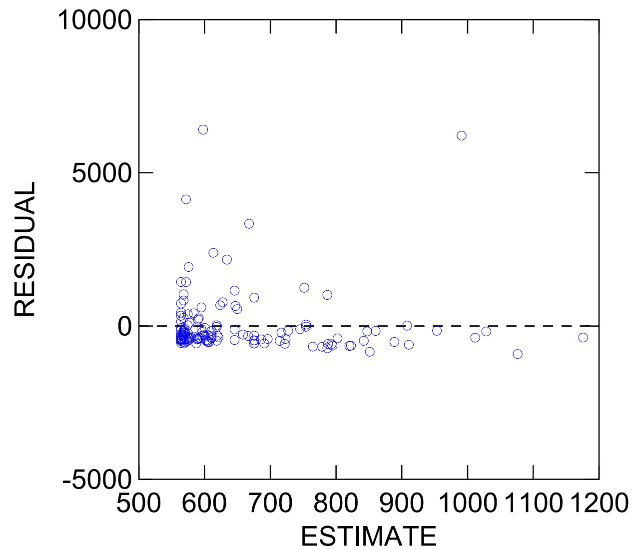
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2046067.022	1	2046067.022	1.870	0.174
Residual	1.55349E+08	142	1094008.314		

*** WARNING ***
Case 41 is an outlier (Studentized Residual = 7.131)
Case 44 is an outlier (Studentized Residual = 4.191)
Case 69 has large leverage (Leverage = 0.142)
Case 93 is an outlier (Studentized Residual = 7.149)

Durbin-Watson D Statistic 2.036
First Order Autocorrelation -0.019

Plot of residuals against predicted values



Fecal Coliform Data Versus Day of Sampling and 13 Days Prior Precipitation

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.009 Squared multiple R: 0.000

Adjusted squared multiple R: 0.000 Standard error of estimate: 1052.773

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	659.745	127.092	0.000	.	5.191	0.000
DAY14	-78.903	748.769	-0.009	1.000	-0.105	0.916

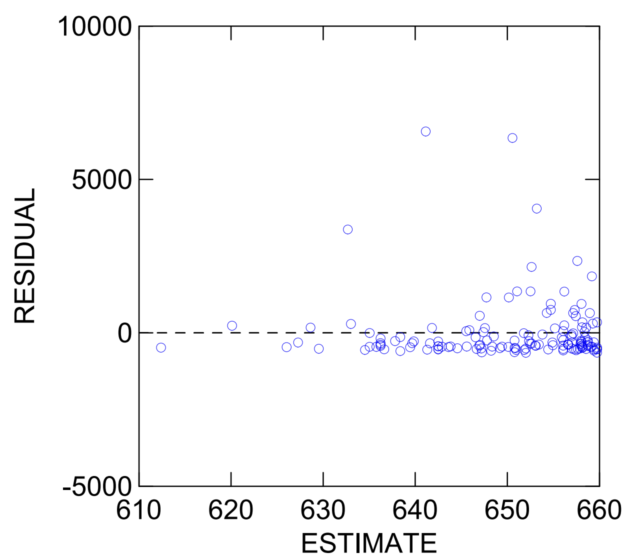
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	12307.377	1	12307.377	0.011	0.916
Residual	1.57383E+08	142	1108330.565		

*** WARNING ***
Case 41 is an outlier (Studentized Residual = 7.351)
Case 44 is an outlier (Studentized Residual = 4.064)
Case 93 is an outlier (Studentized Residual = 7.001)
Case 118 has large leverage (Leverage = 0.122)

Durbin-Watson D Statistic 2.009
First Order Autocorrelation -0.006

Plot of residuals against predicted values



Fecal Coliform Data Versus Day of Sampling and 30 Days Prior Precipitation

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.199 Squared multiple R: 0.039

Adjusted squared multiple R: 0.033 Standard error of estimate: 1031.815

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	964.940	156.125	0.000	.	6.181	0.000
DAY30	-2449.889	1013.880	-0.199	1.000	-2.416	0.017

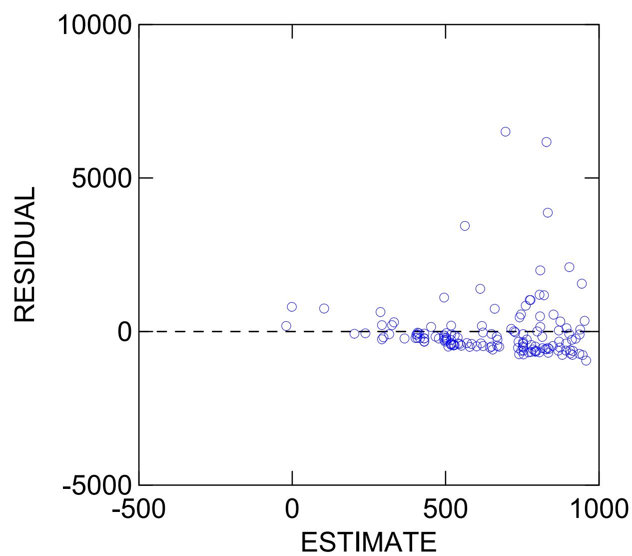
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	6216168.816	1	6216168.816	5.839	0.017
Residual	1.51179E+08	142	1064641.400		

*** WARNING ***
Case 41 is an outlier (Studentized Residual = 7.440)
Case 44 is an outlier (Studentized Residual = 3.961)
Case 93 is an outlier (Studentized Residual = 6.946)

Durbin-Watson D Statistic 1.995
First Order Autocorrelation 0.000

Plot of residuals against predicted values



Fecal Coliform Data Versus Flow

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.183 Squared multiple R: 0.034

Adjusted squared multiple R: 0.027 Standard error of estimate: 1034.982

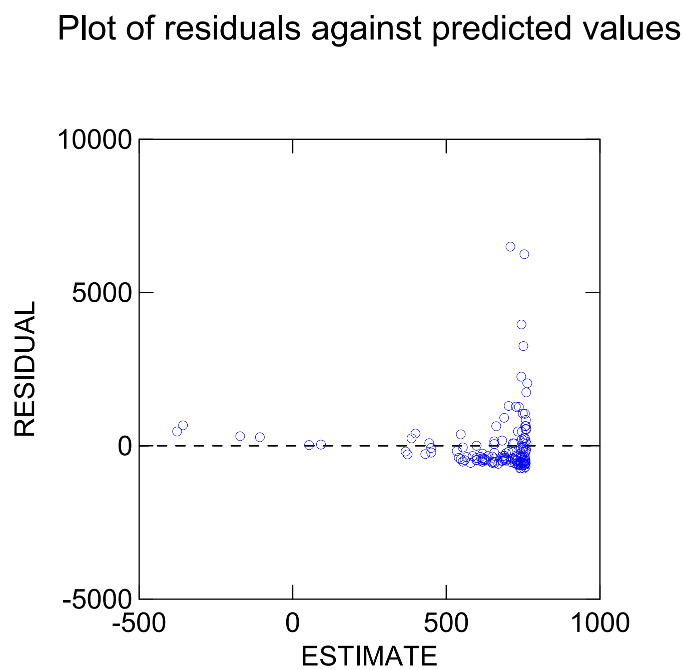
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	765.435	100.679	0.000	.	7.603	0.000
DAILYFLOW	-6.412	2.886	-0.183	1.000	-2.222	0.028

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	5286508.397	1	5286508.397	4.935	0.028
Residual	1.52109E+08	142	1071188.304		

*** WARNING ***
Case 16 has large leverage (Leverage = 0.115)
Case 38 has large leverage (Leverage = 0.134)
Case 41 is an outlier (Studentized Residual = 7.389)
Case 44 is an outlier (Studentized Residual = 4.040)
Case 87 has large leverage (Leverage = 0.206)
Case 93 is an outlier (Studentized Residual = 7.016)
Case 100 has large leverage (Leverage = 0.199)

Durbin-Watson D Statistic 2.033
First Order Autocorrelation -0.018



Fecal Coliform Data Versus 3- Day Average Flow

Dep Var: FECALCOLIFO N: 144 Multiple R: 0.187 Squared multiple R: 0.035

Adjusted squared multiple R: 0.028 Standard error of estimate: 1034.211

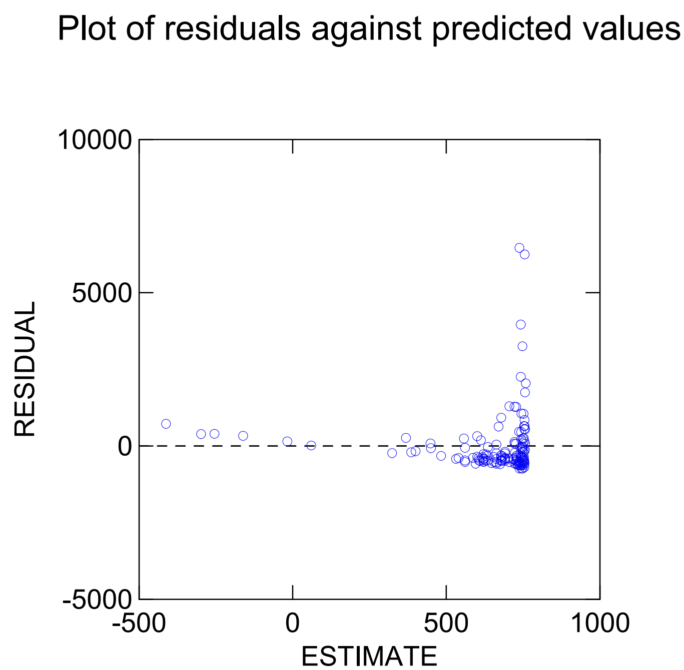
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	760.318	98.926	0.000	.	7.686	0.000
FLOW3DAY	-5.195	2.288	-0.187	1.000	-2.270	0.025

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	5513257.613	1	5513257.613	5.155	0.025
Residual	1.51882E+08	142	1069591.478		

*** WARNING ***
Case 16 has large leverage (Leverage = 0.126)
Case 38 has large leverage (Leverage = 0.155)
Case 41 is an outlier (Studentized Residual = 7.354)
Case 44 is an outlier (Studentized Residual = 4.045)
Case 87 has large leverage (Leverage = 0.170)
Case 93 is an outlier (Studentized Residual = 7.022)
Case 100 has large leverage (Leverage = 0.212)

Durbin-Watson D Statistic 2.029
First Order Autocorrelation -0.016



Appendix I: Monthly and Annual Precipitation at Daytona International Airport, 1948–2006

Year(s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Totals
1948	4.52	1.22	5.13	2.37	0.49	2.4	10.43	7.33	9.82	8.29	1.07	1.93	55
1949	0.37	1.95	2.01	7.12	1.4	4.24	5.97	11.5	6.26	3.65	1.86	3.93	50.22
1950	0.15	0.59	3.53	2.79	2.13	6.45	5.56	3.88	5.86	13	0.74	2.54	47.22
1951	0.77	2.46	1.18	3.28	2.53	2.66	3.8	4.19	14	8.54	3.15	2.88	49.46
1952	0.66	6.76	3.01	1.66	4.39	1.35	1.25	9.02	11.9	5.41	1.96	0.71	48.1
1953	1.75	3.35	7.75	4.97	1.46	1.37	8.67	19.9	10	12.9	2.3	4.85	79.29
1954	0.37	0.86	2.33	6.29	3.21	2.35	3.5	3.04	1.88	4.91	3.98	1.24	33.96
1955	2.47	1.43	1.84	1.78	1.55	7.76	5.67	2.64	6.66	3.17	2.61	1.22	38.8
1956	2.55	0.9	0.25	2.42	2.48a	7.41	3.01	4.06	1.94	5.82	0.46	0.06	31.36
1957	0.97	1.62	3.13	1.73	5.65	4.23	10.53	4.01	10.7	1.8	0.82	1.34	46.48
1958	3.94	4.73	5.52	2.24	2.27	6.06	1.96	4	2.19	8.52	1.77	1.95	45.15
1959	4.53	2.13	7.7	3.17	2.4	8.13	5.68	3.6	5.26	7.12	4.26	2.26	56.24
1960	1.16	9.13	7.52	0.76	0.62	10.8	8.7	6.84	11	0.97	0.53	1.24	59.18
1961	1.96	3.7	1.17	2.16	2.39	6.81	5.16	7.68	3.2	2.25	2.85	0.73	40.06
1962	0.9	0.82	1.82	0.78	0.16	7.96	10.04	8.5	8.84	3.57	2.49	0.71	46.59
1963	2.91	5.83	1.46	1.4	6.82	7.42	6.89	2.01	5.43	2.71	7.98	2.17	53.03
1964	5.29	2.65	4.84	3.61	2.58	4.73	7.67	10.8	11.4	3.54	3.13	2.52	62.76
1965	2.22	3	3.05	1	0.08	9	3.72	2.97	4.33	3.65	0.97	2.14	36.13
1966	2.89	5.58	0.36	2.56	6.77	15.2	7.09	7.93	4.49	4.6	1.19	1.6	60.25
1967	1.26	3.98	0.31	0	0.73	7.51	9.04	3.02	5.56	0.19	0	2.98	34.58
1968	0.42	1.73	1.79	0.4	4.79	14.4	6.25	11.1	6.07	7.44	2.43	1.38	58.17
1969	1.53	2.03	2.74	0.12	6.47	2.47	2.61	9.4	8.89	6.97	1.96	5.03	50.22
1970	3.94	3.79	3.59	2.08	1.68	2.62	3.65	3.61	3.54	3.87	0.31	0.72	33.4
1971	0.61	5.48	2	2.57	3.12	4.73	3.2	3.97	7.2	9.53	1.33	2.49	46.23
1972	2.37	3.97	6.66	1.41	4.02	7.06	3.22	8.29	0.42	3.08	10.96	2.48	53.94
1973	4.66	2.02	2.63	3.09	2.41	4.32	4.69	7.58	5.14	4.4	0.75	2.54	44.23
1974	0.3	1.1	3.19	0.44	2.66	8.65	6.31	9.96	10.5	1.42	0.48	2.2	47.21
1975	1.66	2.27	1.52	2.96	2.99	9	6.89	3.16	6.61	5.84	1.46	0.83	45.19
1976	0.6	0.7	2.03	4.27	12.33	11.1	1.07	3.8	5.1	1.9	3.38	6	52.32
1977	4.69	2.45	1.43	0.41	4.61	1.15	2.23	7.91	6.55	1.46	3.04	4.74	40.67
1978	2.89	5.98	2.31	3.3	0.56	7.48	5.53	7.99	4.63	8.31	0.07	4.89	53.94
1979	7.1	1.94	4.08	3.96	6.13	3.03	11.69	5.24	15.2	2.13	7.96	0.56	69.02
1980	3.75	0.76	2.41	2.54	3.62	5.57	5.82	4.13	1.83	2.42	3.12	1.39	37.36
1981	0.32	5.54	3	0.29	1.74	1.03	4.69	7.19	7.59	1.08	2.57	4.64	39.68
1982	2.46	2.08	5.81	6.04	4.68	8.29	5.31	3.21	4.96	3.23	1.58	2.53	50.18
1983	2.51	5.96	7.71	6.17	3.86	6.37	1.92	6.82	8.57	10.1	2.01	12	73.99
1984	1.46	3.44	1.31	5.29	6.04	2.84	6.77	4.02	10.7	1.09	3.52	0.2	46.71
1985	0.79	0.58	1.49	3.14	3.42	6.81	2.16	9.83	10.6	4.08	0.41	2.05	45.38
1986	7.16	1.28	1.85	0.44	0.99	3.5	14.43	3.47	3.58	3.47	5.08	2.76	48.01
1987	2.21	6.64	7.94	0.28	2.65	3.81	2.78	4.89	5.63	2.77	5.87	0.25	45.72
1988	5.36	1.72	4.57	1.68	1.78	2.39	2.94	4.79	6.81	1.24	6.7	0.93	40.91

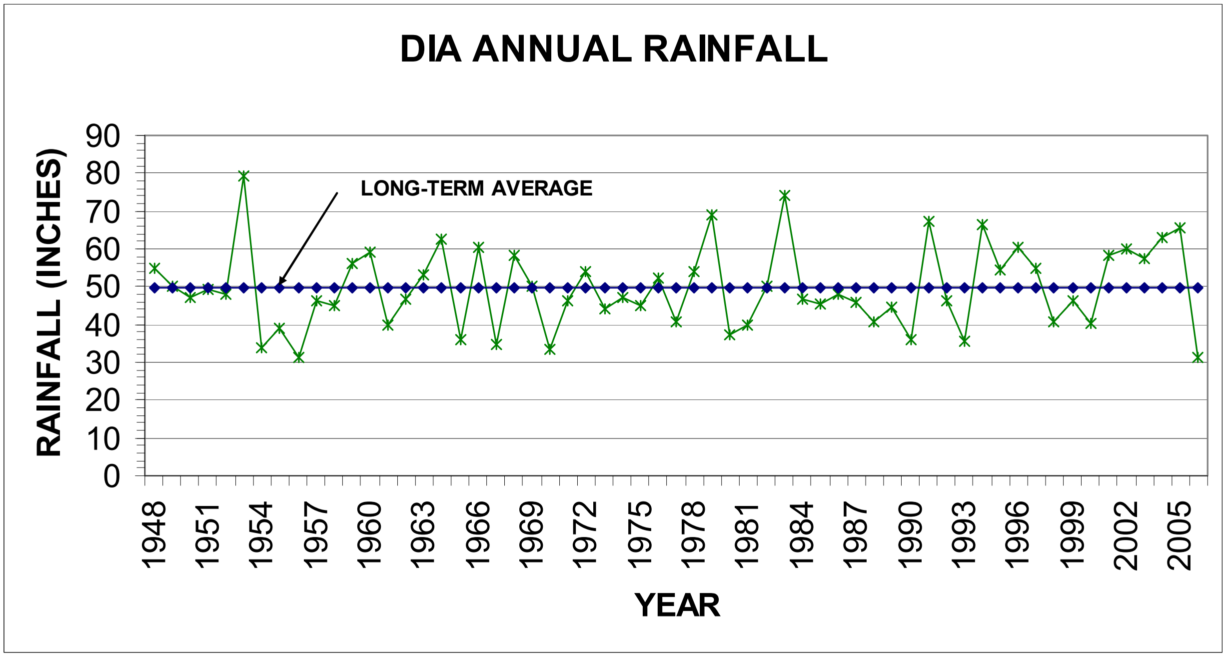
Year(s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Totals
1989	6.82	0.64	2.01	2.92	2.02	1.84	2.44	4.47	5.04	11.6	0.88	3.93	44.65
1990	1.42	5.61	1.94	1.48	1.45	2.71	5.85	7	1.61	5.88	0.83	0.34	36.12
1991	2.25	1.65	8.11	5.57	6.79	12.7	11.97	7.6	5.52	2.94	0.61	1.51	67.19
1992	2.42	1.71	2.28	2.81	3.13	10.6	0.16	8.86	6.57	5.21	2.15	0.47	46.41
1993	4.29	3.02	5.56	0.33	0.65	2.19	5.05	2.66	2.74	5.53	1.83	1.86	35.71
1994	5.6	2.66	3.44	5.05	3.09	6.54	6.91	7.08	5.93	4.72	12.91	2.71	66.64
1995	1.53	1.39	2.01	1.34	1.26	6.61	6.59	10.7	14.1	3.99	1.44	3.44	54.44
1996	5.53	1.32	12.15	2.22	2.28	11.4	1.9	5.7	3.92	11.2	0.96	2.01	60.49
1997	2.03	0.46	2.3	3.3	3.77	6.38	7.69	7.91	4.78	5.29	3.02	7.76	54.69
1998	4.33	7.25	3.97	0.14	0.16	0.83	5.63	7.56	5.79	1.84	1.66	1.35	40.51
1999	4.88	1.81	1.01	1.48	1.47	8.54	4.03	3.58	7.05	7.84	3.12	1.56	46.37
2000	1.8	0.65	8.48	1.15	0.32	3.08	5.09	3.17	13.6	0.93	1.14	0.8	40.16
2001	0.88	0.38	9.98	0.28	1.77	5.26	9.55	3.57	16.1	3.22	6.92	0.35	58.27
2002	2.01	2.76	1.51	2.53	1.66	12.3	7.35	11.6	3.86	2.94	1.85	9.61	59.94
2003	0.51	5.17	10.57	0.81	0.96	7.05	7.3	6.55	4.15	7.95	4.75	1.53	57.3
2004	1.25	4.47	1.1	1.19	0.49	5.2	10.34	18	16.5	1.34	0.93	2.24	62.97
2005	2.6	1.25	5.51	3.17	7.97	13.7	2.73	4.29	7.35	13.5	1.87	1.85	65.77
2006	0.24	4.33	0.08	1.11	0.78	5.72	4.48	4.81	2.97	2.53	1.1	3.21	31.36

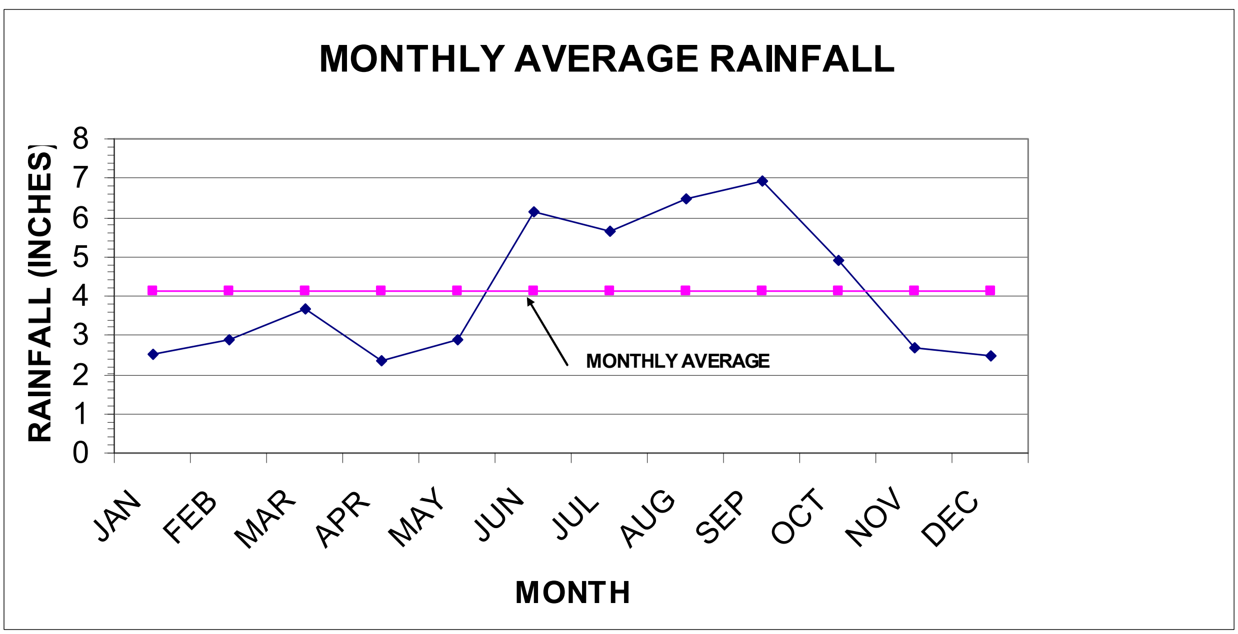
Max value	**7.16**	**9.13**	**12.15**	**7.12**	**12.33**	**15.2**	**14.43**	**19.9**	**16.5**	**13.5**	**12.91**	**12**	**79.29**
Min value	**0.15**	**0.38**	**0.08**	**0**	**0.08**	**0.83**	**0.16**	**2.01**	**0.42**	**0.19**	**0**	**0.06**	**31.36**
Mean	**2.52**	**2.89**	**3.66**	**2.37**	**2.89**	**6.15**	**5.65**	**6.48**	**6.92**	**4.9**	**2.66**	**2.48**	**49.58**
Median	**2.21**	**2.13**	**2.63**	**2.22**	**2.4**	**6.37**	**5.56**	**5.7**	**5.93**	**3.87**	**1.87**	**2.01**	**47.22**
# years	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**	**59**

FLAGS: a = 1, b = 2, c = 3, …, or z = 26 or more missing days

Rainfall is in inches, and represents data from Daytona Beach International Airport.

Appendix J: Annual Precipitation at Daytona International Airport, 1948–2006, and Monthly Average Precipitation





Appendix K: Response to Comments Received Following the January 15, 2008, Public Meeting

BCI engineers & scientists

January 25, 2008

Mr. Jan Mandrup-Poulsen, Environmental Administrator
Watershed Assessment Section
Florida Department of Environmental Protection
Mail Station 3555
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RE: Public Comment for Proposed Total Maximum Daily Loads (TMDLs) in Spruce Creek for Fecal Coliform (WBID 2674) and Nutrients and Dissolved Oxygen (WBID 2674A), Volusia County, Florida

Dear Mr. Mandrup-Poulsen:

The following comments were prepared by BCI Engineers & Scientists, Inc. (BCI) on behalf of Volusia County.

Proposed TMDL for Fecal Coliforms in Spruce Creek (WBID 2674):

1. It has been brought to the attention of FDEP that the Volusia County Environmental Health Laboratory data collected for fecal coliform was not included in the data used to develop the TMDL. After review, it is noted that the samples taken were not within WBID 2674.

   Although the data meets the criteria of the Impaired Waters Rule (IWR) for exceedances, the data set used is limited. Additional sampling should be done to support TMDL development and BMAP implementation.

2. Figure 4.2 Principal Land Uses in the Spruce Creek Watershed does not appear to accurately illustrate the current conditions. Please explain how the land use maps are used in the establishment of the TMDL in regards to percent reduction and allocation requirements. Updated information should be obtained and used in TMDL development and BMAP implementation.

Proposed TMDL for Nutrients and Dissolved Oxygen (WBID 2674A):

1. It has been brought to the attention of FDEP that the Volusia County Environmental Health Laboratory data collected for DO & Nutrients was not included in the data used to develop the TMDL. It is our understanding that FDEP is reviewing this information to determine if it will affect the listing of the waterbody and the TMDL development. Therefore, the TMDL should not be adopted until the information has been reviewed and incorporated into the TMDL if applicable.

2. Figure 4.2 Principal Land Uses in the Spruce Creek Watershed does not appear to accurately illustrate the current conditions. Please explain how the land use maps are used in the establishment of the TMDL in regards to percent reduction and allocation

requirements. Updated information should be obtained and used in TMDL development and BMAP implementation.

3. The relationship between DO and phosphorus concentrations is indirect and should be tested and confirmed. The correlation of DO and BOD is stronger and may suggest a different focus for eliminating the DO impairment.

On behalf of Volusia County, BCI would like to request an extension of the commenting period based on the information provided above. Therefore, allowing Volusia County and FDEP to review and evaluate the additional data to determine if it will have an affect on the TMDL.

Please contact myself or Gene Medley at (561) 741-8838 if you have any questions or would like to discuss any of the information.

Sincerely,

Carolyn Farmer
Environmental Scientist

CF/mp

cc: Jennifer Gihring, FDEP
Wayne Magley, FDEP
John Gamble, Volusia County

Response to Comment 1: As described in Chapter 5, there were over 140 fecal coliform measurements collected over the 1974–2005 period. Exceedances of the 400 colonies/100mL occurred throughout the period. Monitoring should be a component of the basin management action plan (BMAP), particularly as part of a more detailed source identification element and assessment of various strategies to reduce coliform contributions from anthropogenic activities.

Response to Comment 2: Principal land uses illustrated in **Figure 4.3** and summarized in **Table 4.1** were based on the 2004 land use coverages provided to the Department from the St. Johns Water Management District and represent the most current coverage made available to the Department. The land use figure and table were presented to illustrate the general features of the watershed and were not used in the establishment of the TMDL. The percent reduction calculations were based upon fecal coliform measurements taken at ambient stations located along Spruce Creek. Section 4.3 of the document identified **Potential** sources that might contribute fecal coliforms to Spruce Creek. Pasture and horse farm acreage information from the land use summary was used to obtain estimates of potential fecal coliform contributions from these activities. As part of the BMAP process, updated and more detailed land use information could assist in further refining fecal coliform sources and cost effective measures to reduce coliforms.

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