TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Nutrients

In

Moncrief Creek (WBID 2228)

Lower St. Johns River Basin, Florida

Prepared by:

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March 2006

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S. Code §1251 et.seq., as amended by the Water Quality Act of 1987 (PL 100-4), the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for Nutrients in Moncrief Creek (WBID 2228) located in the Lower St. Johns River Basin. Subsequent actions must be consistent with this TMDL.

______________________________________ __________

James D. Giattina, Director Date
Water Management Division

Acknowledgments

EPA would like to acknowledge that the contents of this report and the Total Maximum Daily Load (TMDL) contained herein were developed by the Florida Department of Environmental Protection (FDEP). For this reason, some of the text and figures may not read as though EPA is the primary author. EPA is officially establishing this TMDL for nutrients in Moncrief Creek (WBID 2228) in order to meet requirements pursuant to the Consent Decree entered in the case of Florida Wildlife Federation et al. v. Carol Browner, et al., Case No. 98-356-CIV-Stafford.

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Web sites

Florida Department of Environmental Protection, Bureau of Watershed Management, TMDL Program

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

2000 305(b) Report

http://www.dep.state.fl.us/water/305b/index.htm

Criteria for Surface Water Quality Classifications

http://www/dep.state.fl.us/legal/legaldocuments/rules/ruleslistnum.htm

Basin Status Report for the Lower St. Johns River Basin

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

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

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

U.S. Environmental Protection Agency, National STORET Program

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

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for nutrients for the Moncrief Creek watershed in the Trout River Planning Unit. The creek was verified impaired for nutrients, based on elevated annual average chlorophyll concentrations, and was included on the Verified List of impaired waters for the Lower St. Johns River Basin that was adopted by Secretarial Order in May 2004. The TMDL establishes the allowable loadings to Moncrief Creek that would restore the waterbody so that it meets its applicable water quality criteria for nutrients, based on a chlorophyll threshold.

1.2 Identification of Waterbody

Moncrief Creek is located in the City of Jacksonville, Duval County, in northeast Florida (Figure 1.1). The creek, which is a second order stream with marine or estuarine and freshwater characteristics, is approximately 1.8 miles long with an approximate 5.92 square-mile (mi^2) drainage area that flows into the Trout River, which flows into the St. Johns River (**Figures 1.1 and 1.2**). The Moncrief Creek watershed is located on the western edge of the City of Jacksonville and, as a result, is highly urban. Additional information about the stream's hydrology and geology are available in the Basin Status Report for the Lower St. Johns River Basin (Florida Department of Environmental Protection [FDEP], 2004).

For assessment purposes, the Department has divided the St. Johns River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Moncrief Creek lies within one WBID, 2228, as shown in **Figure 1.2**, which this TMDL addresses.

Moncrief Creek is part of the Trout River Planning Unit (PU). Planning units are groups of WBIDs, which in turn are part of a larger basin, in this case the Lower St. Johns River Basin. The Trout River planning unit consists of 18 WBIDs. **Figure 1.3** shows the location of these WBIDs, Moncrief Creek's location in the planning unit, and a list of other WBIDs in the PU.

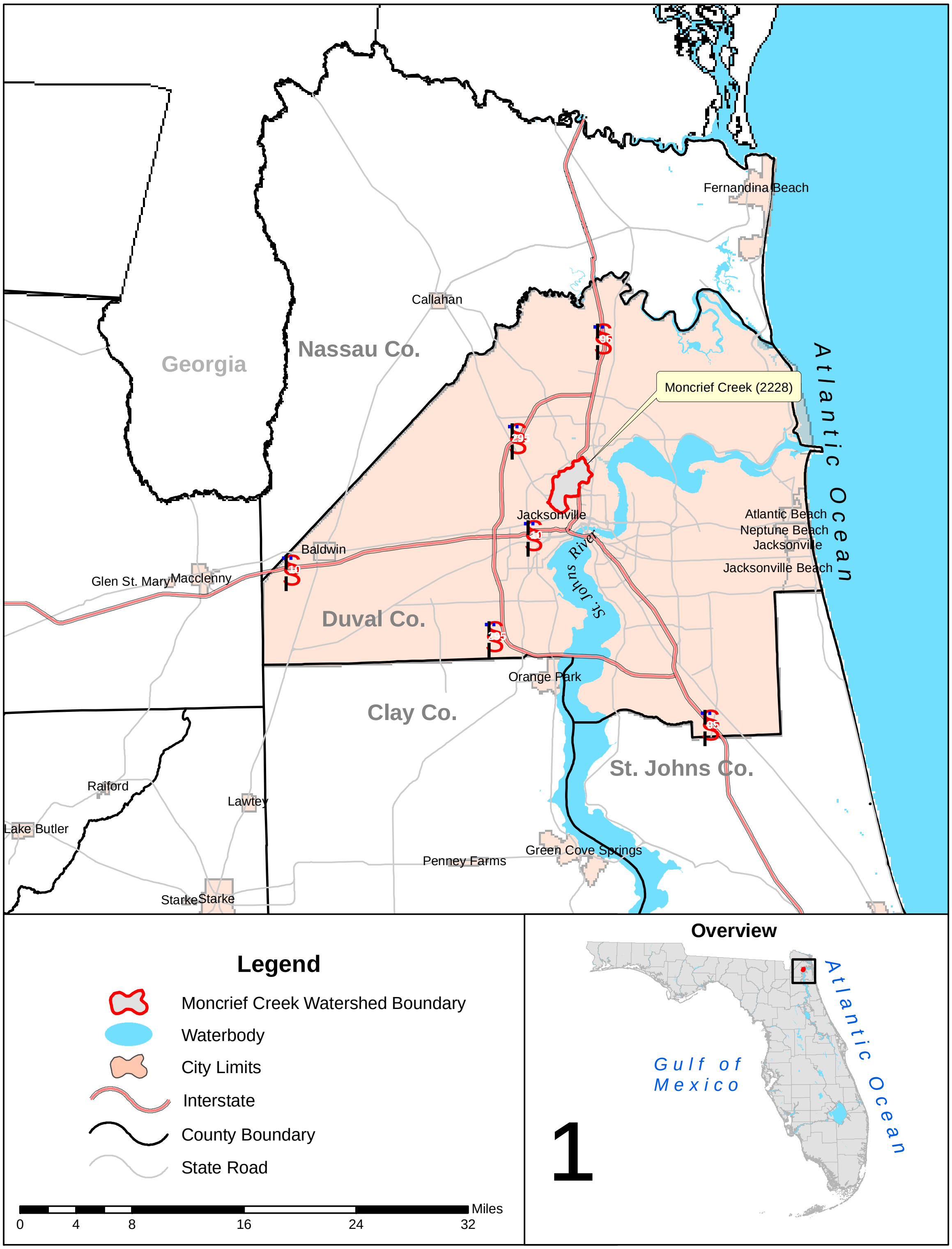


Figure 1.1. Location of Moncrief Creek and Major Geopolitical Features in the SJRB

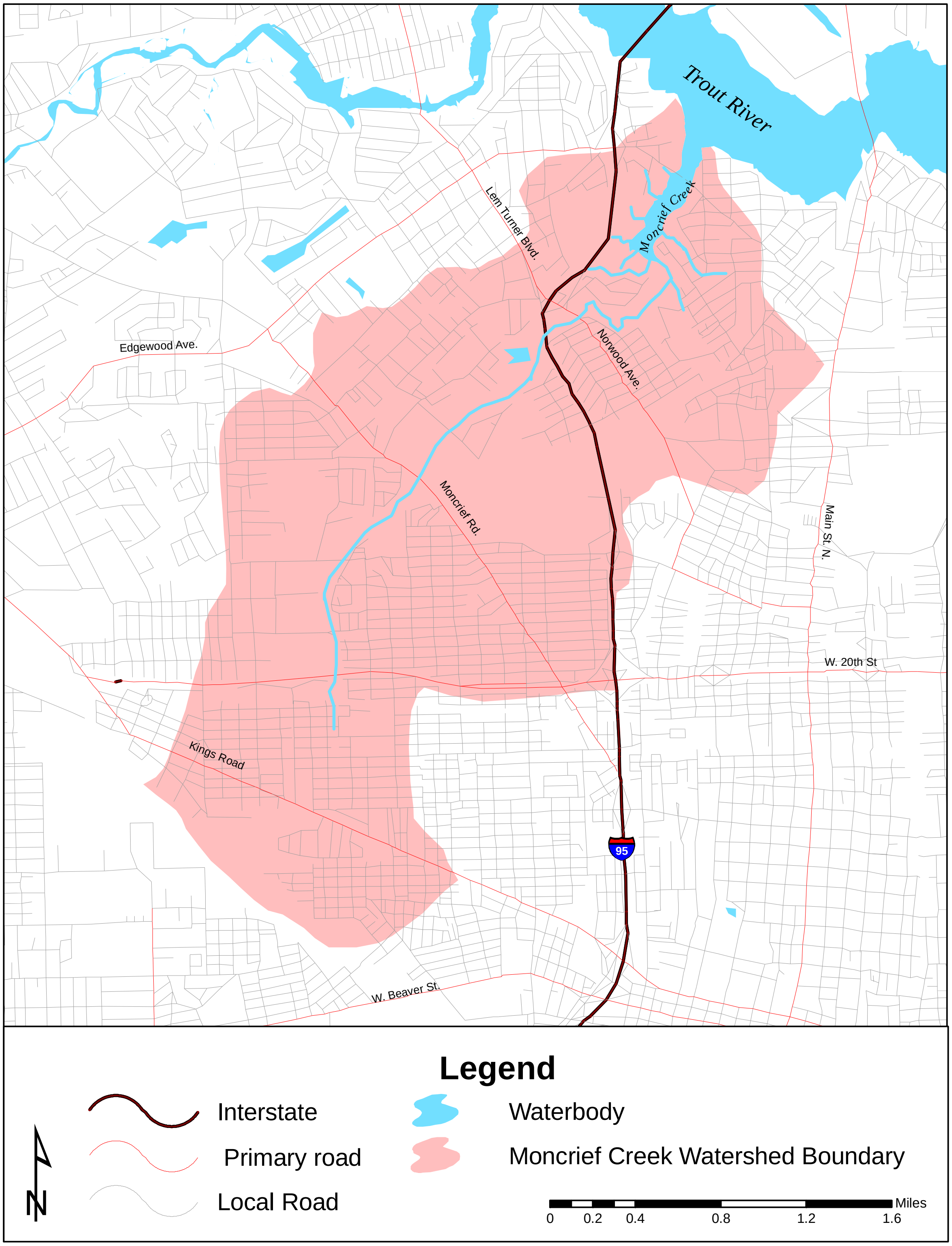
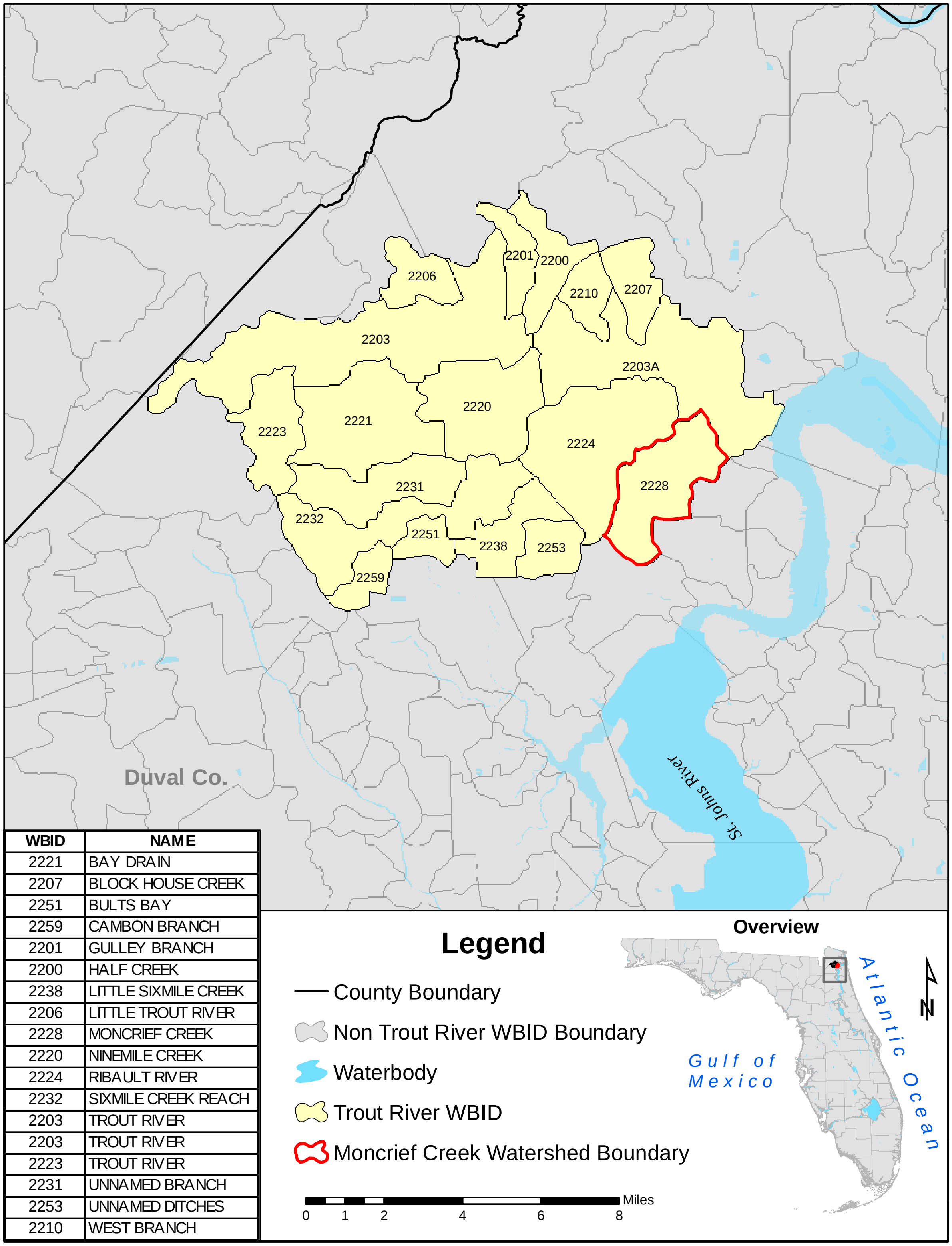


Figure 1.2. Moncrief Creek Watershed



WBID	NAME
2221	BAY DRAIN
2207	BLOCK HOUSE CREEK
2251	BULTS BAY
2259	CAMBON BRANCH
2201	GULLEY BRANCH
2200	HALF CREEK
2238	LITTLE SIXMILE CREEK
2206	LITTLE TROUT RIVER
2228	MONCRIEF CREEK
2220	NINEMILE CREEK
2224	RIBAULT RIVER
2232	SIXMILE CREEK REACH
2203	TROUT RIVER
2203	TROUT RIVER
2223	TROUT RIVER
2231	UNNAMED BRANCH
2253	UNNAMED DITCHES
2210	WEST BRANCH

Figure 1.3. WBIDs in the Trout River Planning Unit

1.3 Background

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

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

This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of nutrients that caused the verified impairment of nutrients Moncrief Creek. These activities will depend heavily on the active participation of the St. Johns River Water Management District, the City of Jacksonville, Jacksonville Electric Authority (JEA), local businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the EPA a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant source in each of these impaired waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4)] Florida Statutes [F.S.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 55 waterbodies and 277 parameters in the Lower St. Johns River Basin. However, the Florida Watershed Restoration Act (FWRA - Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Moncrief Creek and has verified the creek is impaired for nutrients based on data in the Department's IWR database. **Table 2.1** shows the annual mean chlorophyll values based on data available in the IWR. Values higher than11 µg/L threshold for esturine waters are highlighted in yellow. **Tables 2.2** through **2.4** provide summary results for total nitrogen (TN), total phosphorous (TP) and corrected chlorophyll for the verification period, which for Group 2 waters is January 1, 1996 – June 30, 2003, by season, month, and year, respectively.

Table 2.1. Annual Corrected Chlorophyll Values for Verified Period (January 1, 1996 – June 30, 2003)

Year	Annual Mean (µg/L)
1996	9.32
1997	7.06
1998	2.84
1999	19.94
2000	10.40
2001	18.81

Moncrief Creek was analyzed using estuarine thresholds for chlorophyll. The chlorophyll thresholds for estuarine waters are more stringent than those for freshwater streams (11 µg/L and 20 µg/L, respectively). The tables show that TN concentrations tend to be more elevated in

February and March, and again in October and November, which correspond to the winter and spring seasons, respectively. May tends to have the lowest TN concentrations followed by September; however, several months only have a few observations, making it difficult to make a strong correlation. On an annual basis, 2002 exhibits the lowest TN concentrations, and is considerably lower than most other years. However, there are only three observations from 2002.

TP concentrations tend to be greatest in November and December, followed by March, June, and August. Seasonally, TP concentrations are the lowest in the winter months (January – March), and increase through the spring (April – June) and summer (July – September), and are highest in the fall (October – December). It is interesting to note that while TP concentrations are generally lowest in the winter, TN tends to be elevated during this time. Annually, TP median and mean concentrations appear to have an increasing trend from 1997 – 2001.

Corrected chlorophyll values tend to be highest during August, followed by June, April, and February. Seasonally, summer and spring exhibit the highest corrected chlorophyll concentrations, followed by winter and fall. This is not surprising, as one would expect chlorophyll concentrations to increase in the summer and spring when the water temperatures and day length increase. Median and mean values are highest in 1999, followed by 2001. There was a slight downward trend in median values from 1996 – 1998, before they increased considerably in 1999. It should be noted that the median TN concentration is highest in 1999. Annual precipitation is included in **Table 2.3**. Based on annual total precipitation, TN, TP, or corrected chlorophyll values do not appear to be influenced by precipitation.

The Department is also required to identify the limiting nutrient for waters impaired elevated nutrient levels. In Moncrief Creek, the limiting nutrient is nitrogen. This is evident when looking at the cumulative distribution plot based on paired TN and TP values. The median TN/TP value is 6.83. The minimum is 2.50 and the maximum is 12.48. If the median ratio value is below 10, then the waterbody is considered to be nitrogen limited, if above 30 then phosphorous limited, and if between 10 and 30 then it is considered to be co-limited; however waters can exhibit more than one limitation type which can be determined by observing the cumulative distribution plot of TN/TP ratios for the data. The cumulative distribution plot for Moncrief Creek is include as **Appendix A**.

While this TMDL is for TN, TP is also a very important factor in controlling chlorophyll concentrations and, as such, TP is included in many of the tables, figures, and discussions for comparison purposes throughout this document.

With respect to sampling stations, many stations have only a few samples, which make it difficult to analyze. However, there is a slight increase in the median TN values at Moncrief Road, which peaks at Lem Turner Boulevard, before decreasing downstream. This appears to be a significant trend because, as discussed previously, TN is the limiting nutrient. Significant TP median values are seen at 33rd Street and Norwood Avenue. These two sites have the highest median values, although there is only one value from 33rd Street. There is a decrease in TP values from Norwood Avenue to the mouth. Most of the chlorophyll data have been collected near the mouth of Moncrief Creek. Nonetheless, the highest chlorophyll median is from Highway 111, which is four times higher than that at the mouth, the next downstream station. Sampling stations are discussed further in **Section 5.1**.

Table 2.2. Summary of TN, TP, and Corrected Chlorophyll Data by Season for Verified Period (January 1, 1996 – June 30, 2003)

TN (mg/L)					
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
Winter	8	0.48	1.85	1.09	1.14
Spring	16	0.11	1.52	0.88	0.89
Summer	11	0.45	1.47	0.87	0.93
Fall	12	0.67	1.70	1.32	1.28
TP (mg/L)					
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
Winter	7	0.10	0.24	0.17	0.16
Spring	16	0.10	0.30	0.14	0.17
Summer	9	0.09	0.28	0.16	0.18
Fall	12	0.10	0.59	0.17	0.21
Corrected Chlorophyll (µg/L)					
Month	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
Winter	7	1.00	34.67	2.06	7.54
Spring	12	1.00	52.10	7.70	14.06
Summer	7	1.00	46.08	20.00	17.04
Fall	10	1.00	17.31	4.26	5.35

Table 2.3. Annual Summaries of TN, TP, and Corrected Chlorophyll Data for Verified Period (January 1, 1996 – June 30, 2003)

TN (mg/L)						
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Annual Precipitation (inches)**
1996	6	0.67	1.52	1.14	1.10	60.63
1997	6	0.29	1.50	0.83	0.81	57.27
1998	8	0.70	1.85	1.25	1.25	56.72
1999	6	0.97	1.47	1.16	1.17	42.44
2000	9	0.58	1.81	0.95	1.07	39.77
2001	9	0.59	1.70	1.01	1.08	49.14
2002	3	0.11	0.57	0.45	0.38	54.72
TP (mg/L)						
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Annual Precipitation (inches)**
1996	6	0.10	0.30	0.14	0.17	60.63
1997	6	0.10	0.24	0.13	0.15	57.27
1998	9	0.09	0.20	0.16	0.15	56.72
1999	6	0.10	0.28	0.19	0.18	42.44
2000	9	0.10	0.59	0.22	0.22	39.77
2001	8	0.10	0.36	0.22	0.21	49.14
Corrected Chlorophyll (µg/L)						
Year	**N**	**Minimum**	**Maximum**	**Median**	**Mean**	**Annual Precipitation (inches)**
1996	5	1.00	52.10	5.25	13.19	60.63
1997	6	1.00	20.00	3.64	5.78	57.27
1998	7	1.00	5.98	2.78	3.09	56.72
1999	6	2.06	46.08	15.78	18.57	42.44
2000	7	1.00	29.09	6.91	10.92	39.77
2001	5	4.51	34.67	11.16	16.84	49.14

Table 2.4. Summary of TN, TP, and Corrected Chlorophyll Data by Month for Verified Period (January 1, 1996 – June 30, 2003)

TN (mg/L)					
Month	N	Minimum	Maximum	Median	Mean
January	2	0.59	1.03	0.81	0.81
February	5	0.48	1.81	1.16	1.14
March	1	1.85	1.85	3.00	1.85
April	6	0.29	1.48	0.99	0.96
May	2	0.11	0.58	0.35	0.35
June	8	0.70	1.52	0.88	0.97
July	2	0.57	1.03	0.80	0.80
August	7	0.45	1.47	0.87	1.01
September	2	0.63	0.95	0.79	0.79
October	6	0.67	1.60	1.01	1.13
November	1	1.70	1.70	1.70	1.70
December	5	1.17	1.57	1.47	1.37
TP (mg/L)					
Month	N	Minimum	Maximum	Median	Mean
January	1	0.17	0.17	0.17	0.17
February	5	0.10	0.24	0.10	0.15
March	1	0.20	0.20	0.20	0.20
April	6	0.10	0.21	0.12	0.13
May	1	0.12	0.12	0.12	0.12
June	9	0.12	0.30	0.21	0.19
July	1	0.16	0.16	0.16	0.16
August	6	0.09	0.28	0.20	0.19
September	2	0.10	0.24	0.17	0.17
October	6	0.10	0.18	0.15	0.15
November	1	0.36	0.36	0.36	0.36
December	5	0.11	0.59	0.22	0.26
Corrected Chlorophyll (µg/L)					
Month	N	Minimum	Maximum	Median	Mean
January	1	1.00	1.00	1.00	1.00
February	5	1.00	34.67	2.06	9.29
March	1	5.34	5.34	5.34	5.34
April	6	4.45	26.81	6.01	9.42
May	0	---	---	---	---
June	6	1.00	52.10	12.71	18.70
July	1	1.07	1.07	1.07	1.07
August	5	1.00	46.08	23.05	23.44
September	1	1.00	1.00	1.00	1.00
October	6	1.00	6.60	4.70	4.45
November	0	---	---	---	---
December	4	2.67	17.31	3.40	6.69

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)**

Moncrief Creek is a Class III marine waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to this TMDL is the narrative nutrient criteria.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Florida's nutrient criterion is narrative, stating that nutrient concentrations of a waterbody shall not be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. A nutrient-related target was needed to represent levels at which an imbalance in flora or fauna would occur. While the IWR provides a threshold for nutrient impairment based on annual average chlorophyll levels, the threshold is not a standard and need not be used as a water quality target for TMDLs. The IWR threshold was developed using statewide average conditions, and specifically allows the use of alternative, site-specific thresholds that more accurately reflect conditions beyond which an imbalance in flora or fauna occurs in a waterbody (Subsection 62-303.450, F.A.C.).

IWR methodology requires a minimum of 10 chlorophyll measurements over the verified period. For estuarine waters, FDEP deemed the problematic threshold as an annual average chlorophyll *a* concentration of 11 µg/L, or a 50 percent increase over the historic minimum for two or more consecutive years. A minimum of one observation for each quarter (Jan. – March, April – June, July – Sept., and Oct. – Dec.) of a calendar year is required to calculate annual chlorophyll average. Quarterly measurements are averaged to calculate the annual average.

The entire length of Moncrief Creek was assessed initially as a marine waterbody and was verified impaired based on the marine thresholds for chlorophyll. **Table 2.1** shows annual average chlorophyll for 1999 and 2001 exceeded this tthreshold. Further analysis indicates the upper reaches above Lem Turner Boulevard, are fresher than marine. In analyzing data for this TMDL, FDEP considered stations below and including Lem Turner Boulevard as marine and those stations above as fresh. However, as discussed in **Section 6.4**, the TMDL for nutrients are based on the marine criteria.

Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

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

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

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

4.2 Potential Sources of Coliforms in Moncrief Creek Watershed

4.2.1 Point Sources

There are currently four permitted industrial wastewater facilities in the Moncrief Creek watershed. However, only one of the facilities (Millennium Specialty Chemicals, discussed in the next several paragraphs) discharges into Moncrief Creek. Two of the other three facilities are car wash businesses (Speed Wash, permit #FLA011464, and Jax Car Wash, permit #FLA011552), that recycle their wash water and are not permitted to discharge into surface waters. A third facility, First Student, Incorporated (permit #FLR05F474), is located within the watershed, but the outfall for this facility is located in McCoy Creek, an adjoining watershed. **Figure 4.1** shows the location of currently permitted facilities in the Moncrief Creek watershed.

Millennium Specialty Chemicals (permit #FL0000884) is an organic chemicals manufacturing facility. The facility is permitted to discharge 0.600 MGD boiler and cooling tower (non-contact) blow down, steam condensate wastewater, and stormwater (treated separately from other waste) into the estuarine portion of Moncrief Creek. In addition to the surface water discharge, a permit issued to Millennium Specialty Chemicals in 2003 allows the First-Tee Golf Course to use 1.3 MGD of the facility's stormwater for course irrigation water; this facility does not appear to have a discharge permit and is therefore assumed to be covered under Millennium Chemical Specialty's permit.

Under the current permit (issued September 1, 2003), the facility is not required to monitor or report to the Department chlorophyll, TN, or TP values. Therefore, it was not possible to determine impacts on the stream from this discharge. The facility uses a 1 million gallon effluent treatment pond before discharging into Moncrief Creek. Departmental records indicate that numerous upsets have occurred as a result of water leaking through the berm, with some reaching West Branch Creek – a small tributary to Moncrief Creek which flows near the treatment pond. The pond was upgraded as a result of these upsets around 2000. A Compliance Evaluation Inspection (CEI) dated April 16, 2001 indicated that the new pond was not holding water and the facility manager estimated that 20,000 gallons per day were percolating from the pond. A subsequent CEI dated February 19, 2002 indicate that further upgrades to the pond appear to have fixed the percolation and leaking issues. Department District staff has indicated that before the upgrades to the pond were made, the pond was being treated for excessive algal growth, using a copper based biocide. It is not known how much, if any, of that algal– rich water may have reached Moncrief Creek. It is also not known what the effects of such upsets, if any, have had on the nutrient and chlorophyll concentrations in Moncrief Creek.

While Millennium Specialty Chemicals is not required to monitor for nutrients in effluent, limited data from the Department's fifth – year bioassay inspections of the facility contains some nutrient data. Some of these data are presented in **Table 4.1**. Data seem to indicate that TN values in the effluent are not elevated, as the highest value is 0.96 mg/L; the median TN value for all TN data is 1.06 mg/L. In contrast, the median TP value for all data is 0.171 mg/L, which is considerably less than the values shown in the table.

Table 4.1. TN and TP Data from Millennium Specialty Chemicals Fifth – Year Reports

Sample Date	TN	NO_2NO_3	TKN	TP
1/14/2002	0.96	0.48	0.48	0.77
9/13/1999	0.30	0.06	0.24	0.55
2/24/1997	0.74	0.087	0.65	0.8

Municipal Separate Storm Sewer System Permittees

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

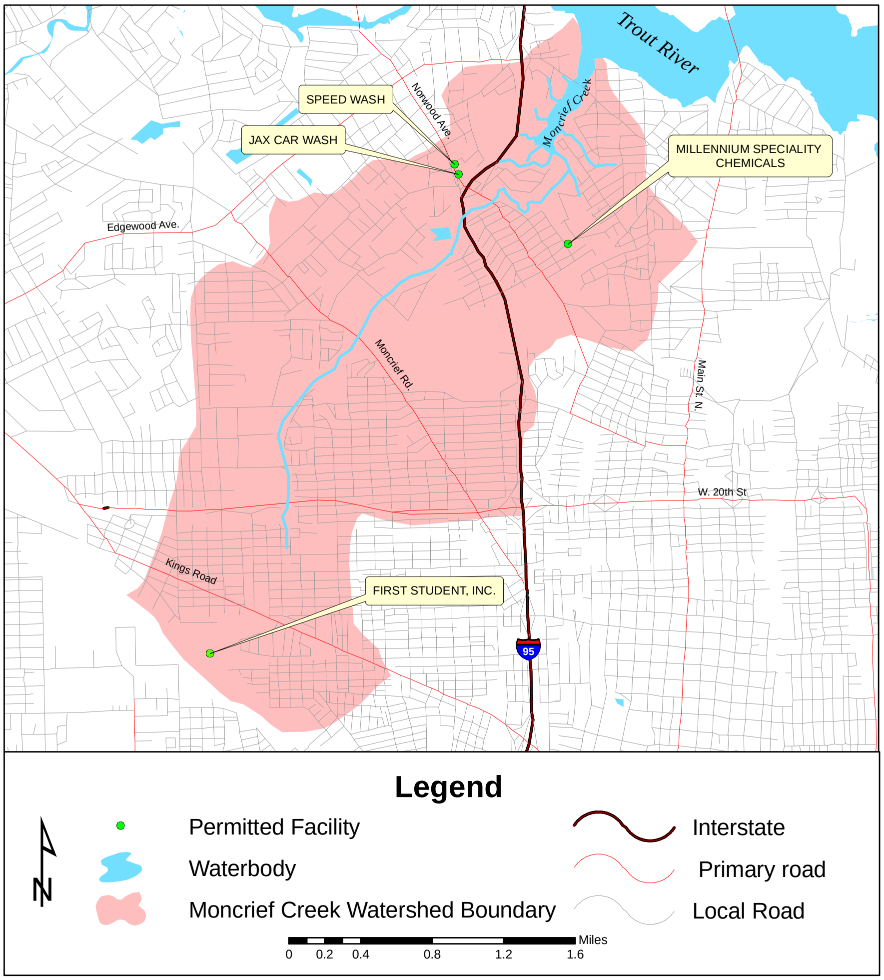


Figure 4.1. NPDES Permitted Facilities in the Moncrief Creek Watershed

4.2.2 Land Uses and Nonpoint Sources

Additional nutrient loadings to Moncrief Creek are generated from nonpoint sources in the basin. Potential nonpoint sources of nutrients include loadings from surface runoff, leaking or overflowing sewage lines, and leaking septic tanks.

4.2.2.1 Land Uses

The spatial distribution and acreage of different land use categories were identified using the 2000 land use coverage contained in the Department's Geographic Information System (GIS) library, initially provided by the SJRWMD. Land use categories and acreages in the watershed were aggregated using the Level 3 codes tabulated in **Table 4.2.** **Figure 4.2** shows the principal land uses in the watershed based on Level 1 land use.

The Moncrief Creek watershed is a highly urban area, occupying approximately 5.92 mi^2. As shown in **Table 4.2**, the majority of the land is high density residential (42.23 percent), followed by medium density residential (15.44 percent). Non-natural land uses, including residential areas, institutional uses, commercial services, golf courses, etc., comprise 86.5 percent of the watershed area or 3,281 acres. Natural land use types, such as mixed wetland hardwoods, upland mixed coniferous/hardwoods, streams, mixed scrub-shrub wetlands, etc., comprise 13.5 percent, or 510 acres.

There are no livestock or agricultural land use types in the watershed, and should not be significant source of nutrients. However, the area is highly urbanized. As a result, it is very possible that some homeowners or businesses apply fertilizers to their yard; the Department is currently unable to quantify the amount of fertilizer that is applied in this basin. There is at least one golf course, which most likely uses some fertilizer. If fertilizers are applied in excess or before a rain event, it is quite possible these activities could contribute to instream nutrient levels. Excess nutrients from such activities could be leaching into shallow aquifer, and subsequently reaching Moncrief Creek as ground water inputs or as part of the base flow.

Table 4.2. Classification of Land Use Categories

Level 3 Land Use Code	Attribute	Acres	Percent of Total Area
1300	Residential, high density - 6 or more dwelling units/acre	1,600.57	42.23%
1200	Residential, medium density - 2-5 dwelling units/acre	585.15	15.44%
1400	Commercial and services	412.92	10.90%
1700	Institutional	256.50	6.77%
8140	Roads and highways (divided 4-lanes with medians)	118.08	3.12%
6170	Mixed wetland hardwoods	101.42	2.68%
4340	Upland mixed coniferous/hardwood	73.31	1.93%
5100	Streams and waterways	61.74	1.63%
6420	Saltwater marshes	57.10	1.51%
4200	Upland hardwood forests	55.11	1.45%
1900	Open land	53.99	1.42%
8120	Railroads	47.32	1.25%
8130	Bus and truck terminals	44.67	1.18%
1540	Oil & gas processing	40.82	1.08%
3100	Herbaceous upland nonforested	37.98	1.00%
1510	Food processing	35.88	0.95%
6300	Wetland forested mixed	29.72	0.78%
7400	Disturbed land	28.17	0.74%
1860	Community recreational facilities	23.49	0.62%
1100	Residential, low density - less than 2 dwelling units/acre	20.16	0.53%
5300	Reservoirs - pits, retention ponds, dams	17.74	0.47%
1550	Other light industrial	16.80	0.44%
1480	Cemeteries	13.46	0.36%
6460	Mixed scrub-shrub wetland	12.27	0.32%
1520	Timber processing	11.73	0.31%
6210	Cypress	8.46	0.22%
1800	Recreational	6.16	0.16%
7430	Spoil areas	5.52	0.15%
1180	Rural residential	4.98	0.13%
8340	Sewage treatment	3.38	0.09%
8310	Electrical power facilities	2.38	0.06%
8200	Communications	1.95	0.05%
6410	Freshwater marshes	1.01	0.03%
	Total:	**3,789.94**	**100.00%**

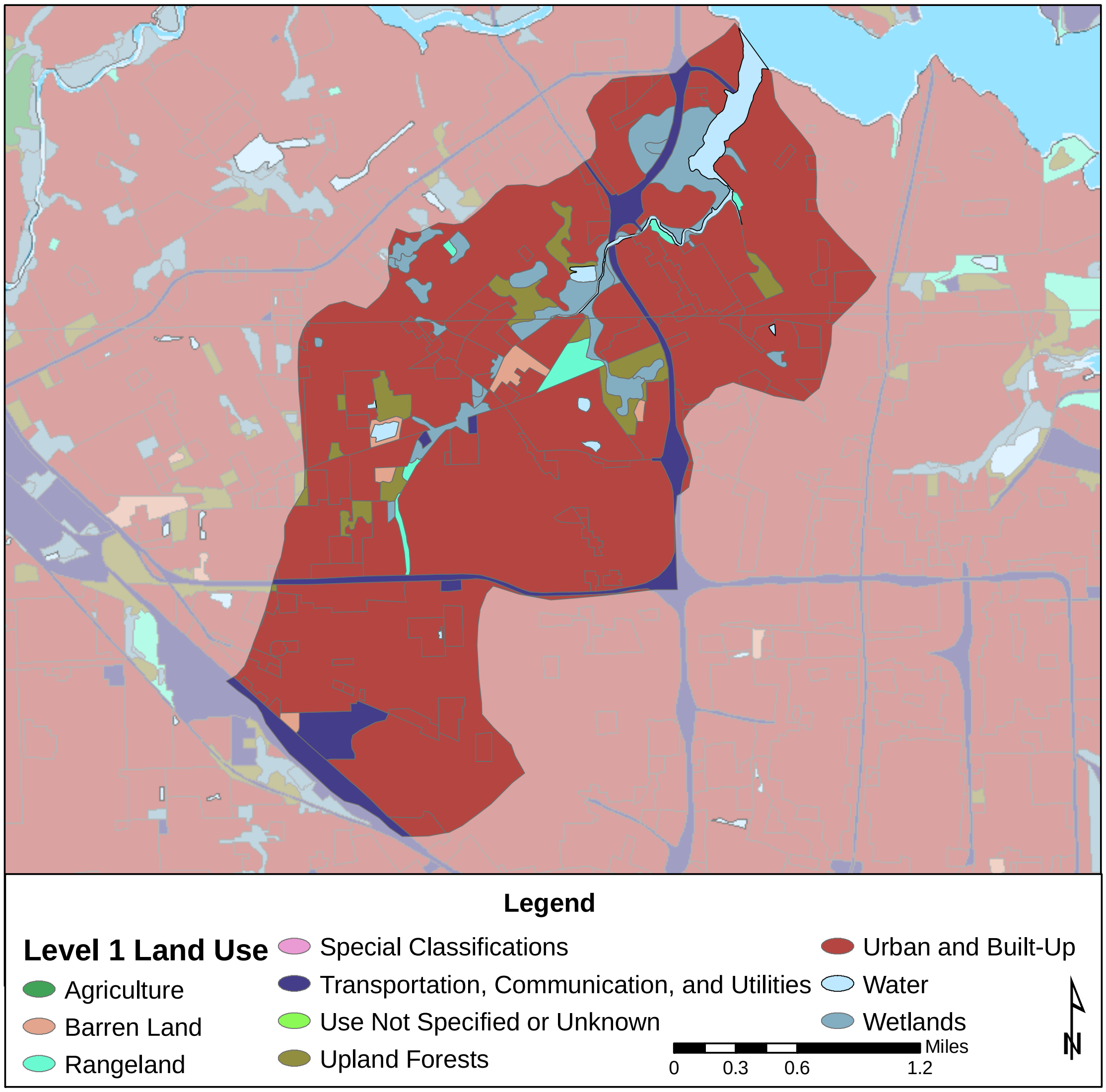


Figure 4.2. Principal Land Uses (Level 1) in the Moncrief Creek Watershed

Table 4.3 shows estimates of TN and TP loadings from various land uses. Data presented in this table are from the SJRWMD's Pollutant Load Screening Model (PLSM), designed to estimate loading of various parameters from watersheds that drain to the mainstem of the St. Johns River, which takes into consideration such things as land uses, soil types, and rainfall. The model was used to evaluate several tributaries in the St. Johns River Basin, including Moncrief Creek. Although the model was calibrated to several tributaries in the St. Johns River Basin, Moncrief Creek was not included as a calibrated stream in the model due to lack of data.

The model produced seasonal outputs of estimated TN and TP loads. The model is based on a three season year (December – March, April – July, and August – November) which is reflected in the table. Loads are based on the long – term rainfall average from Jacksonville International Airport (JIA). Based on model results, the estimated TN loading is 44,150 pounds per year to Moncrief Creek, with 38,713 (88 percent) pounds of that being bio - available. The model estimates an annual TP loading of 10,354 pounds, of which 10,023 pounds are bio – available (98 percent).

Table 4.3. Estimates of Annual TN and TP Loadings from the PLSM

Parameter	December - March	April - July	August - November	Estimated Annual Loading
TN	12,027.30	11,695.95	20,427.12	44,150.37
Bio - Available Nitrogen	10,167.18	10,677.89	17,867.55	38,712.62
TP	2,002.20	2,740.30	5,611.49	10,354.00
Bio - Available Phosphorous	1,916.13	2,679.73	5,426.97	10,022.83

4.2.2.2 Atmospheric Deposition

In some areas of the country, atmospheric loading of nitrogen can be significant. Atmospheric loadings to Moncrief Creek have been estimated, based on available data, and are shown in **Table 4.4**. Data were obtained from the National Atmospheric Deposition Program (NADP) for their Okefenokee National Wildlife Refuge monitoring site (site GA09). This site is the closest one to the Moncrief Creek watershed having nitrogen data. The site is located in Charlton County, GA., approximately 36 miles to the northwest of the watershed. The site has atmospheric deposition records dating from June 3, 1997 to present. Data available for this site include wet weather loadings of ammonia (NH_4) and Nitrate (NO_3).

Data were calculated by first estimating the surface area of Moncrief Creek and significant tributaries, which was estimated to be 68 acres. Annual precipitation weighted means were then used to calculate NO_3 and NH_4 wet weather loadings. The combined NO_3 and NH_4 annual loading is estimated to be as high as 1,454 pounds. It should be noted that a certain amount of this loading will be retained in the watershed, and part of it is implicit in the runoff estimated in the PLSM model.

Table 4.4. Estimates of Nitrogen Loading from Atmospheric Deposition

	NH_4			NO_3		NH_4+NO_3	
Year	Estimated Surface Area (Acres)	Annual Precipitation - Weighted Mean Concentration (lb/acre)	Est. Loading (lb)	Annual Precipitation - Weighted Mean Concentration (lb/acre)	Est. Loading (lb)	Annual Precipitation - Weighted Mean Concentration (lb/acre)	Est. Loading (lb)
1997	68	0.90	61.46	10.96	750.55	11.86	806.53
1998	68	2.93	199.38	28.09	1,923.93	31.02	2,109.27
1999	68	1.32	89.95	15.70	1,075.23	17.02	1,157.33
2000	68	2.69	182.89	20.48	1,402.93	23.17	1,575.58
2001	68	2.84	193.39	18.14	1,242.85	20.99	1,427.17
2002	68	2.58	175.40	17.13	1,173.39	19.71	1,340.22
2003	68	2.78	188.89	18.10	1,239.83	20.88	1,419.67
2004	68	2.87	194.89	23.50	1,609.82	26.37	1,792.96
AVERAGE:	**68**	**2.36**	**160.78**	**19.01**	**1,302.32**	**21.38**	**1,453.59**

4.2.2.3 Septic Tanks

Septic tanks, by their very nature, can be a source of significant loading to groundwater and surface waters. The issue is exacerbated by faulty or poorly maintained systems, systems which are not properly installed, or in areas with high densities of septic tanks.

Using data supplied by the Department of Revenue and Department of Health (DoH), it is estimated that approximately 57 percent of residences within Duval County are connected to a wastewater treatment plant, with the rest utilizing septic tanks (Department of Revenue cadastral data, 2003, and DoH Website). The DoH reports that as of fiscal year 2003-2004, there were 88,834 permitted septic tanks in Duval County (DoH Website), but this number does not reflect those that may have been removed from service.

To focus on the Moncrief Creek watershed, the Department obtained septic tank repair permit data from JEA for their service area, which includes the Moncrief Creek watershed. The data include septic tank repair permit records issued from March 1990 – April 2004, areas serviced by a wastewater treatment facility (WWTF), and areas where high numbers of failing septic tanks are present. This information is presented graphically in **Figure 4.3**. The data show there were 114 permits for repairs issued during this time in the watershed, or an average of 8.1 repairs per year.

Some areas of the watershed, mostly in the northern portion, are in septic tank phase out areas, or areas that have the highest priority to be sewered to eliminate septic tanks due to high failure rates. Approximately 8.78 percent of the watershed is included in one of these areas. Of the 114 repair permits issued, 37 (32.46 percent) are within a septic tank phase out area. This is shown in **Figure 4.3**.

It is difficult to accurately estimate the loading from septic tanks, mainly for the reasons presented previously. However, estimates can be made using DoH septic tank estimated septic tank numbers and published estimates of TN and TP medians in septic wastewater (Anderson et al, undated) in FL. Results of this analysis are presented in **Table 4.5**. Based on DoH data, there are an estimated 707 septic tanks in the Moncrief Creek watershed, and an estimated average of 2.6 persons per household. Based on an average use of 70 gallons/person/day (USEPA, 2001), the estimated annual TN and TP loadings could be as high as 14,133 pounds and 5,871 pounds, respectively. These estimates do not consider increased loading from failing septic tanks or tanks that may have been removed from service. Additionally, these estimates are based on actual septic tank effluent, and do not consider attenuation, which would be very difficult to calculate, as this would have to be based on site specific information. Therefore, these estimates represent the worst case scenario for septic tank loadings.

Table 4.5. Estimation of TN and TP Loading from Septic Tanks

TN		TP	
Estimated Mean Concentration (mg/L)	Estimated Loading (lb/year)	Estimated Mean Concentration (mg/L)	Estimated Loading (lb/year)
36.06	14,113	15.00	5,871

These estimates are based upon 707 septic tanks, 70 gall./person/day, and 2.6 persons/household. See text for more information

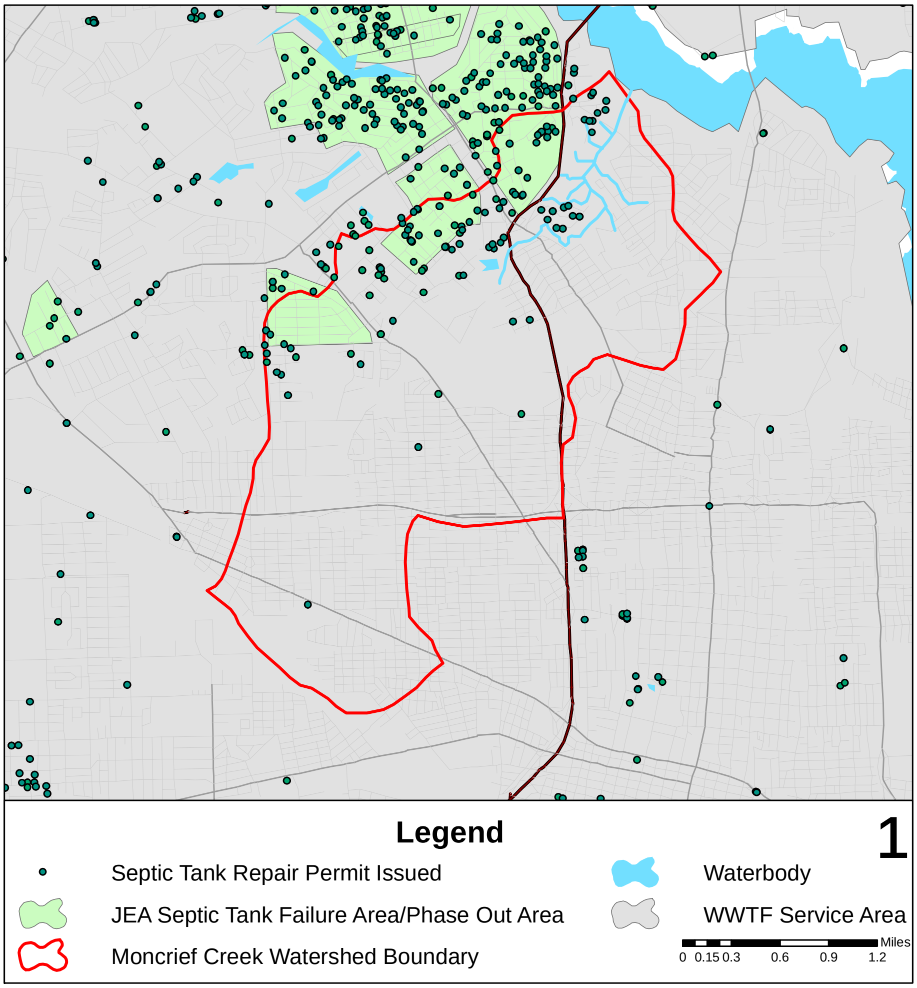


Figure 4.3. Septic Tank Repair Permits Issued March 1990 – April 2004 for Moncrief Creek Area

4.2.2.4 Leaking or Overflowing Wastewater Collection Systems

As noted previously, it has been estimated that 57 percent of households in Duval County are connected to wastewater facilities. Assuming there are 7,685 homes in the watershed, with 2.6 people per home, and a 70 gallon per person per day discharge, and also assuming that the countywide average of 57 percent are connected to a WWTF applies in Moncrief Creek, a daily flow of approximately 3.00 x 10^6 L (0.793 MGD) is transported through the collection system. The EPA Protocol for Developing Pathogen TMDLs (EPA, 2001) suggests that a 5% leakage rate from collection systems is realistic. Assuming that untreated wastewater has an average TN concentration of 35 mg/L and 10 mg/L TP (USEPA, 1999) then the estimated annual loading for TN and TP could be as high as 4,227 pounds and 1,206 pounds, respectively (**Table 4.6**).

Table 4.6. Estimated Loading from the Wastewater Collection Systems

Parameter	Estimated Homes on Central Sewer	Estimated Daily Flow (gallons)	Daily Leakage (gallons)	Estimated Concentration (mg/L)	Estimated Loading (lb/year)
TN	4,380	793,000	39,650	35	4,227
TP	4,380	793,000	39,650	10	1,206

4.2.2.5 Agricultural Sources

According to level 3 land use, there are no agricultural type land uses in the Moncrief Creek watershed. As noted in **Section 4.2.2**, the majority of the land use (86.5 percent) consists of residential and commercial and services, and other non-natural categories.

4.3 Summary of Sources

Table 4.7 summarizes the estimates based on the assumptions discussed above from various nonpoint sources. It is important to note that this is most likely not a complete list (there are most likely sources which the Department is unaware), and represents estimates of potential loadings. Based on information discussed above, there is a loading of nearly 62,500 pounds of TN from nonpoint sources alone.

Table 4.7. Summary of Estimated Potential Nutrient Loading From Various Nonpoint Sources in the Moncrief Creek Watershed

Source	TN	TP	NH_4	NO_3
Land Use	44,150.37	10,354		
Atmospheric Deposition (wet weather)			160.78	1,302.32
Septic Tanks	14,113	5,871		
Wastewater Collection Systems	4,227	1,206		
ESTIMATE TOTALS:	**62,490.37**	**17,431**	**160.78**	**1,302.35**

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Determination of Loading Capacity

The methodology used for this TMDL was based on the regression analysis method. This method relies on the relationship of the limiting nutrient, in this case TN, to chlorophyll. A regression analysis was performed, and the results were used to determine the required reduction.

5.1.1 Data Used in the Determination of the TMDL

There are seven sampling stations in Moncrief Creek that have historical TN and TP observations, three of those stations have corrected chlorophyll observations. The primary data collector of historical data is the SJRWMD, with some data being collected by the Department and the City of Jacksonville. As discussed previously, the Department, upon further analysis of the data, feels that lower portion of the creek (from the mouth to, and including, Lem Turner Boulevard) exhibit more marine characteristics than fresh, and therefore the upper portion should be looked at using freshwater thresholds. This division is expressed in the summary tables below. **Table 5.1** shows summaries, by station, of the Department's data inventory for Moncrief Creek. **Table 5.2** provides a brief overview of data from each site, and **Figure 5.1** shows the location of the sample sites. **Figures 5.2**, **5.3**, and **5.4** are charts showing the observed historical TN, TP, and corrected chlorophyll data over time. **Table 5.5** shows the median concentrations by sampling site, and **Appendix C** contains all historical observations for TN, TP, and corrected chlorophyll from all sites.

Table 5.1. Sampling Station Summary for the Moncrief Creek Watershed

TN				
Station	**STORET ID**	**Station Owner**	**Year(s) with Data**	**No. Observations**
MONCRIEF CREEK NEAR MOUTH	21FLSJWM20030115	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1995 - 2001	38
MONCRIEF CREEK AT HWY 111	21FLSJWMLSJ907	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1992 - 1993	4
MONCRIEF CREEK AT TALLULAH AVE	21FLSJWMMNCTA	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1994 - 1995	9
MONCRIEF CR. AT NORWOOD AVE.	21FLSJWMMCCR	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	2000 - 2001	4
MONCRIEF CREEK AT LEM TURNER RD	21FLJXWQTR114	CITY OF JACKSONVILLE	1995 - 1996	2
MONCRIEF CR AT MONCRIEF ROAD	21FLA 20030726	FL. DEPARTMENT OF ENVIRONMENTAL PROTECTION	2000 - 2001	3
MONCRIEF CREEK AT 33RD. STREET	21FLJXWQTR316	CITY OF JACKSONVILLE	1995, 2002	4
MONCRIEF CR @ 26TH ST.	21FLA 20030576	FL. DEPARTMENT OF ENVIRONMENTAL PROTECTION	1998	1
TP				
Station	**STORET ID**	**Station Owner**	**Year(s) with Data**	**N**
MONCRIEF CREEK NEAR MOUTH	21FLSJWM20030115	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1995 - 2001	38
MONCRIEF CREEK AT HWY 111	21FLSJWMLSJ907	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1992 - 1993	4
MONCRIEF CREEK AT TALLULAH AVE	21FLJXWQMNCTA	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1994 - 1995	8
MONCRIEF CR. AT NORWOOD AVE.	21FLSJWMMCCR	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	2000 - 2001	4
MONCRIEF CREEK AT LEM TURNER RD	21FLJXWQTR114	CITY OF JACKSONVILLE	1995 - 1996	2
MONCRIEF CR AT MONCRIEF ROAD	21FLA 20030726	FL. DEPARTMENT OF ENVIRONMENTAL PROTECTION	2000	2
MONCRIEF CREEK AT 33RD. STREET	21FLJXWQTR316	CITY OF JACKSONVILLE	1995	1
MONCRIEF CR @ 26TH ST.	21FLA 20030576	FL. DEPARTMENT OF ENVIRONMENTAL PROTECTION	1998	1
CHLOROPHYLL				
Station	**STORET ID**	**Station Owner**	**Year(s) with Data**	**N**
MONCRIEF CREEK NEAR MOUTH	21FLSJWM20030115	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1995 - 2001	38
MONCRIEF CREEK AT HWY 111	21FLSJWMLSJ907	ST. JOHNS RIVER WATER MANAGEMENT DISTRICT	1992 - 1993	4
MONCRIEF CR AT MONCRIEF ROAD	21FLA 20030726	FL. DEPARTMENT OF ENVIRONMENTAL PROTECTION	2000	1

Table 5.2. Historical TN, TP, and Corrected Chlorophyll Statistics

TN (mg/L)					
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
MONCRIEF CREEK NEAR MOUTH	38	0.29	1.85	1.13	1.11
MONCRIEF CREEK AT HWY 111	4	1.03	1.49	1.24	1.22
MONCRIEF CREEK AT TALLULAH AVE, JACKSONVILLE	9	0.59	2.13	1.21	1.34
MONCRIEF CR. AT NORWOOD AVE., JAX	4	0.63	1.70	1.28	1.39
MONCRIEF CREEK AT LEM TURNER ROAD	2	0.79	2.62	1.71	1.71
MONCRIEF CR AT MONCRIEF ROAD	3	0.58	0.95	0.71	0.59
MONCRIEF CREEK AT 33RD. STREET	4	0.11	1.04	0.54	0.51
MONCRIEF CR @ 26TH ST.	1	0.82	0.82	0.82	0.82
TP (mg/L)					
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
MONCRIEF CREEK NEAR MOUTH	39	0.10	0.30	0.17	0.15
MONCRIEF CREEK AT HWY 111	4	0.13	0.26	0.21	0.23
MONCRIEF CREEK AT TALLULAH AVE, JACKSONVILLE	8	0.12	0.39	0.21	0.20
MONCRIEF CR. AT NORWOOD AVE., JAX	4	0.24	0.59	0.36	0.30
MONCRIEF CREEK AT LEM TURNER ROAD	2	0.19	0.24	0.21	0.21
MONCRIEF CR AT MONCRIEF ROAD	2	0.10	0.12	0.11	0.11
MONCRIEF CREEK AT 33RD. STREET	1	0.27	0.27	0.27	0.27
MONCRIEF CR @ 26TH ST.	1	0.09	0.09	0.09	0.09
CORRECTED CHLOROPHYLL (µg/L)					
Station	**N**	**Minimum**	**Maximum**	**Median**	**Mean**
MONCRIEF CREEK NEAR MOUTH	38	1.00	52.10	11.59	5.07
MONCRIEF CREEK AT HWY 111	4	2.40	69.23	28.20	20.58
MONCRIEF CR AT MONCRIEF ROAD	1	1.00	1.00	1.00	1.00

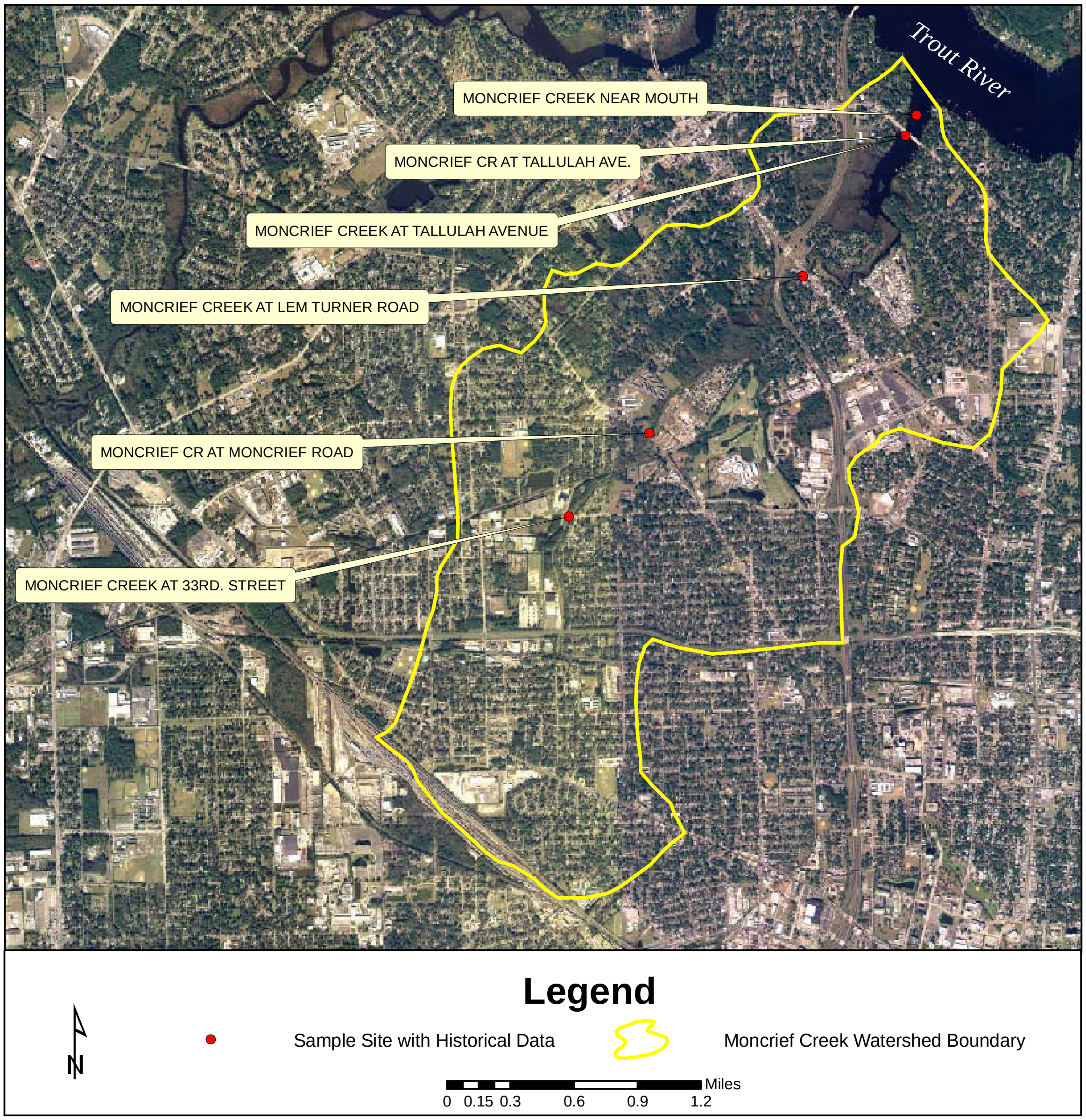


Figure 5.1. Sampling sites with historical data

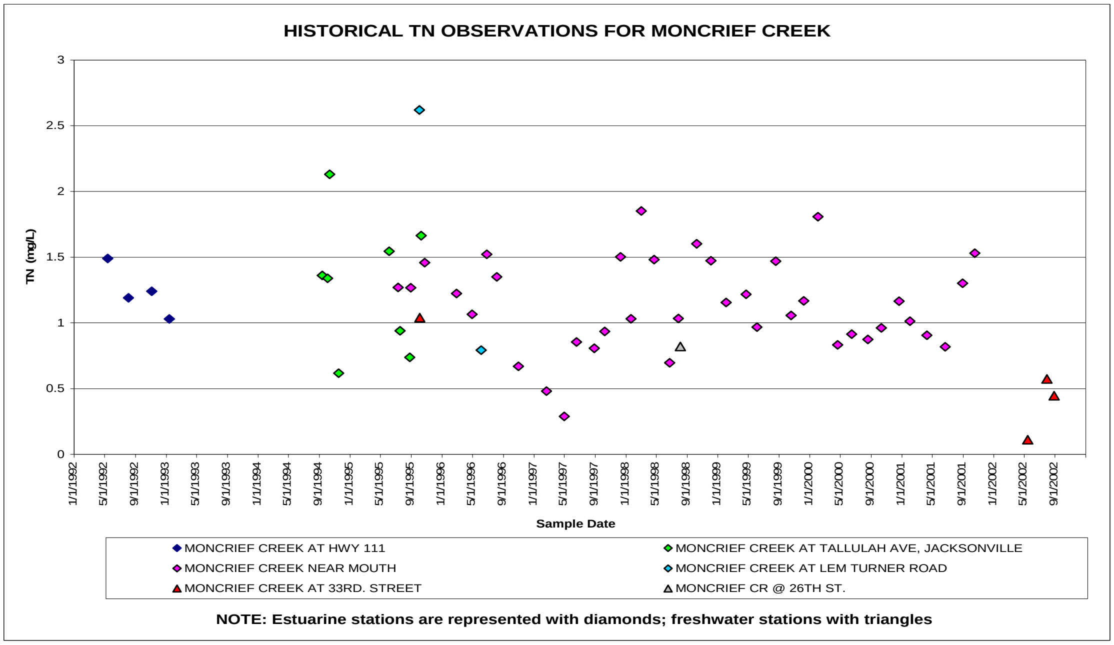


Figure 5.2. Historical TN Observations

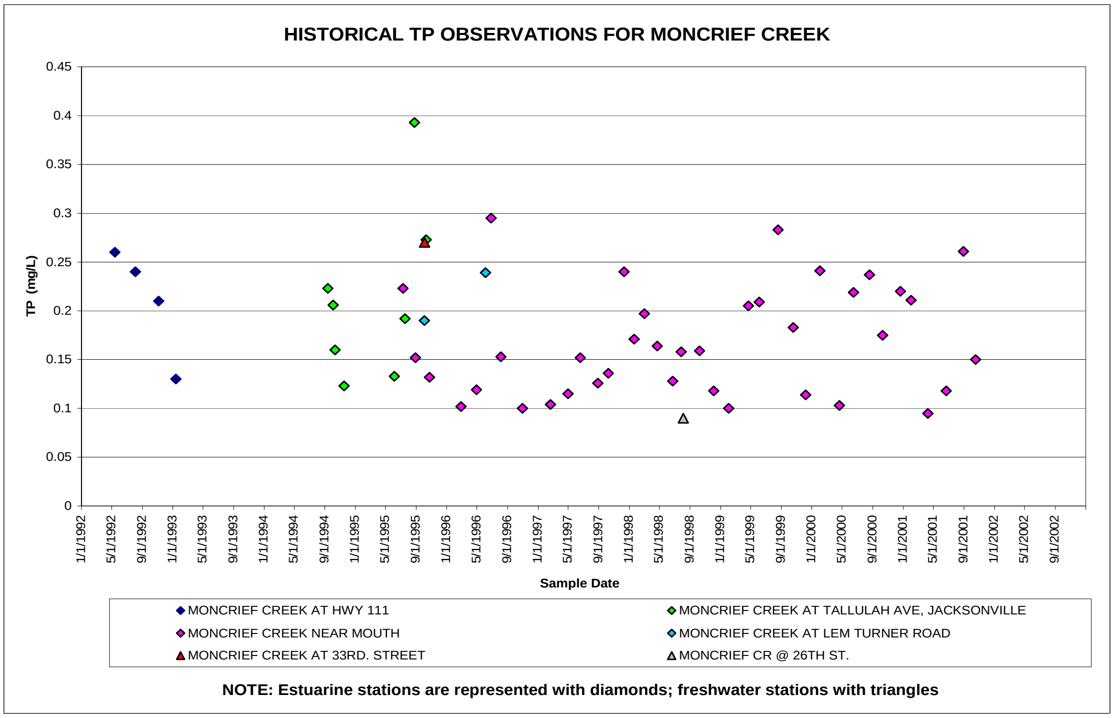


Figure 5.3. Historical TP Observations

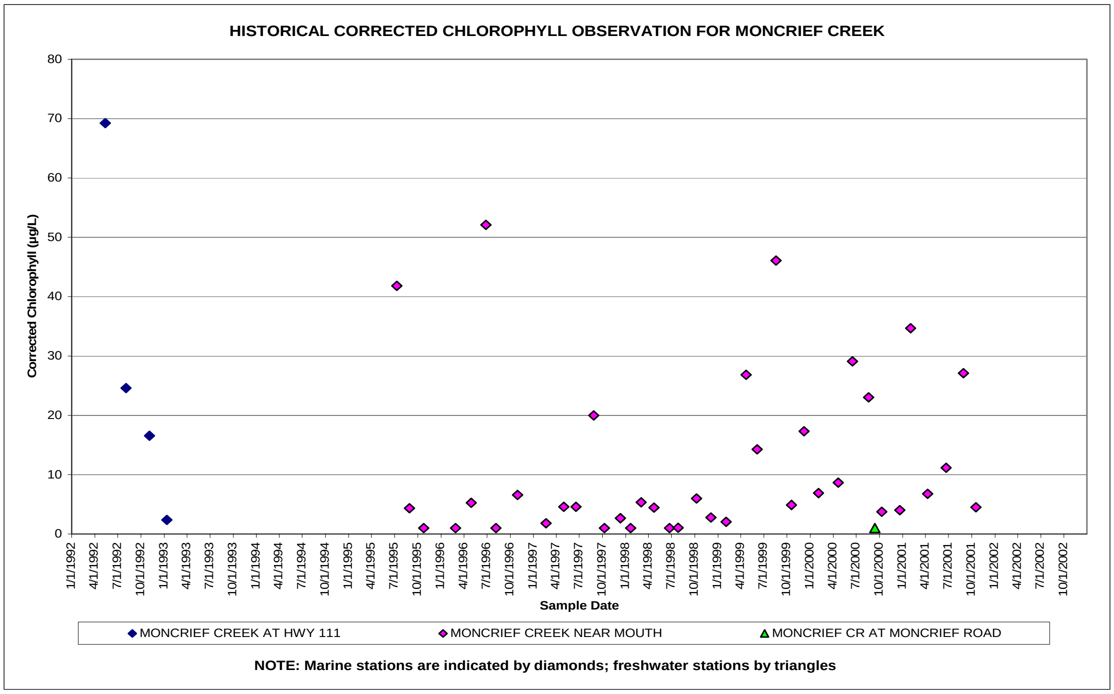


Figure 5.4. Historical Corrected Chlorophyll Observations

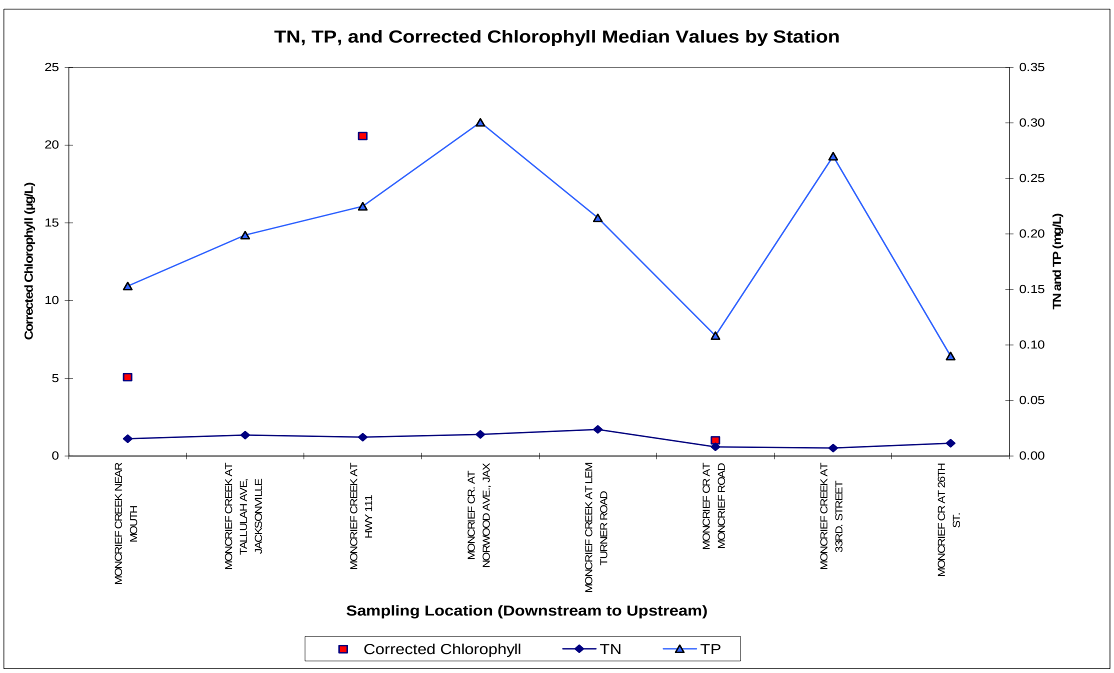


Figure 5.5. Mean TN, TP, and corrected Chlorophyll data

5.1.2 TMDL Development Process

Due to time constraints, a regression analysis approach was used to develop this TMDL, and the required reduction of TN. An assumption of this TMDL is if the concentration of TN is reduced, so too will the chlorophyll concentrations.

Correlations were performed by comparing TN and other parameters, such as TP, and chlorophyll concentrations, along with other available data that could be paired, such as other nitrogen and phosphorous species, month, season, and precipitation. Data did not show a particularly strong correlation between any of the analysis. Results of these correlations can be seen in **Appendix D**.

Particular attention was paid to the relationship between TN and the other parameters. TN did not show a strong correlation to corrected or uncorrected chlorophyll (R^2 = 0.033 and 0.054, respectively). The regression of TN and corrected chlorophyll is presented as **Figure 5.6**. Due to the low R^2 value, other regressions were considered which may yield a stronger correlation.

It was found that a stronger correlation exists between organic nitrogen (calculated by subtracting NH_4 from TKN) and corrected chlorophyll (R^2 = 0.13; significant at an alpha level of 0.05). The result of this regression analysis is presented as **Figure 5.7**. Organic nitrogen is a component of TN, and therefore, after calculating the needed reduction of organic nitrogen, this can then be used to calculate the required TN reduction needed to reduce chlorophyll concentrations such that annual averages do not exceed 11 µg/L. Analysis shows a strong correlation between TN and organic nitrogen (R^2 = 0.89) for Moncrief Creek.

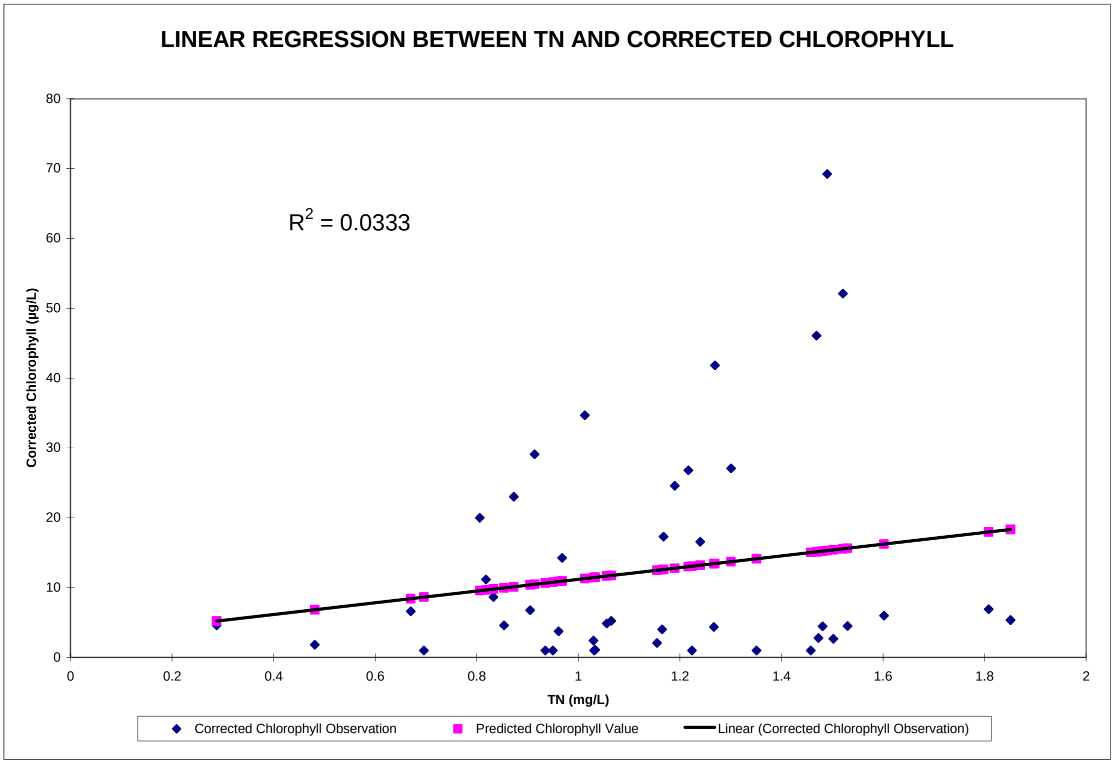


Figure 5.6. Regression of TN and corrected chlorophyll

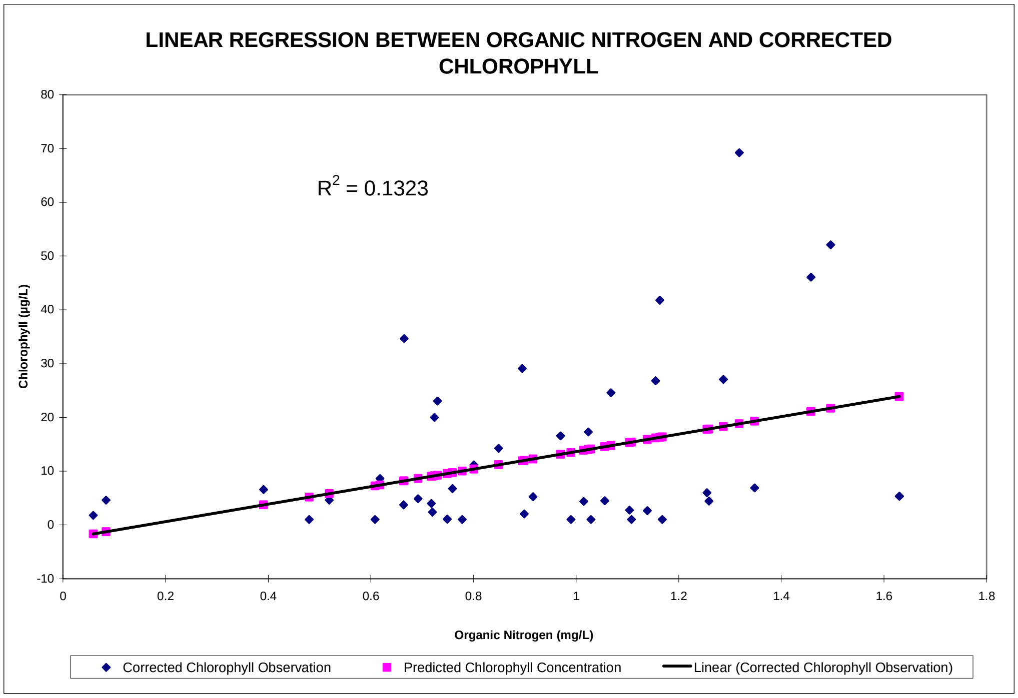


Figure 5.7. Regression of Organic Nitrogen and Corrected Chlorophyll

The resulting equation for the regression between organic nitrogen and corrected chlorophyll is:

$$y = 16.397x - 3.1675$$

This equation was then used to determine the organic nitrogen concentration at which chlorophyll concentrations would not exceed 11 µg/l. The resulting concentration was found to be 0.86 mg/L organic nitrogen (which equaled 10.93 µg/l chlorophyll). Results of this regression are included as **Appendix E**.

Organic nitrogen data were then analyzed further, to determine which years had median concentrations which exceeded 0.86 mg/l. Annual median organic nitrogen values for years which it could be calculated are presented in **Table 5.3**. A table of TN, organic nitrogen, and organic nitrogen percent of TN is included as **Appendix F**.

Table 5.3. Annual Median Organic Nitrogen Concentrations

Year	Median Organic Nitrogen Concentration (mg/l)	N
1992	1.068	3
1993	0.720	1
1994	1.040	4
1995	0.723	14
1996	0.953	6
1997	0.622	6
1998	1.067	10
1999	0.962	6
2000	0.691	8
2001	0.818	8
2002	0.260	3

Annual medians exceeding 0.86 mg/L are highlighted in yellow

As Table 5.3 shows, there were five years in which the annual organic nitrogen median exceeded 0.86 mg/L. Data from these years was used to calculate this TMDL, and are presented in **Table 5.4**.

Table 5.4. TN and Organic Nitrogen Concentrations Used for TMDL

Sample Date	Observed TN Value (mg/l)	Organic Nitrogen (mg/l)	Percent of TN that is Organic Nitrogen
5/13/1992	1.49	1.318	88.46%
8/3/1992	1.19	1.068	89.75%
11/4/1992	1.24	0.97	78.23%
9/12/1994	1.36	0.964	70.88%
10/3/1994	1.339	1.115	83.27%
10/11/1994	2.13	1.87	87.79%
11/16/1994	0.617	0.353	57.21%
2/27/1996	1.224	0.99	80.88%
4/29/1996	1.065	0.916	86.01%
6/4/1996	0.793	0.678	85.50%
6/26/1996	1.521	1.496	98.36%
8/5/1996	1.351	1.168	86.45%
10/30/1996	0.67	0.391	58.36%
1/20/1998	1.031	1.029	99.81%
3/2/1998	1.851	1.63	88.06%
3/2/1998	1.851	1.63	88.06%
4/22/1998	1.481	1.259	85.01%
6/23/1998	0.696	0.608	87.36%
7/27/1998	1.033	0.749	72.51%
7/27/1998	1.033	0.749	72.51%
8/4/1998	0.82	0.26	31.71%
10/8/1998	1.602	1.255	78.34%
12/4/1998	1.473	1.104	74.95%
2/2/1999	1.155	0.899	77.84%
4/22/1999	1.217	1.155	94.91%
6/4/1999	0.968	0.849	87.71%
8/18/1999	1.469	1.458	99.25%
10/18/1999	1.056	0.692	65.53%
12/7/1999	1.168	1.024	87.67%
MEDIAN:	**1.217**	**1.024**	**85.50%**

After determining the median organic nitrogen value for those years which exceeded 0.86 mg/L, the required reduction in organic nitrogen loading was calculated, using:

$$\frac{\textbf{(median organic N value) – (median organic N value not allowing chlorophyll to exceed 11 µg/L)}}{\textbf{(median organic nitrogen value)}}$$

Applying the appropriate numbers to the equation yielded:

$$\frac{(1.024\ mg/L) - (0.86\ mg/L)}{(1.024\ mg/L)} = .1602 \text{ or } 16.02\%$$

As the above equation indicates, a 16.02 percent reduction in organic nitrogen loading will decrease the chlorophyll concentrations such that the annual average will not exceed 11 µg/L.

The final step is to calculate, using the information calculated for organic nitrogen, how much TN reduction is required. This was done by determining the median percentage of organic nitrogen included in TN. As with the other calculations, only data from those years where the median exceeded 0.86 mg/l, which is shown in **Table 5.4** along with the percentages, were used. As the table shows, the median organic nitrogen component of TN is 85.5 percent. This 85.5 percent was then used to calculate the required TN reduction, using the equation:

1-((median percentage of organic nitrogen) x (required organic nitrogen reduction))

When the appropriate numbers are substituted into the equation:

1 – ((0.855 mg/L) x (.1602)) = .1370 or 13.70 %

According to the above calculation, a 14 percent reduction in TN loading is required to meet an annual average corrected chlorophyll concentration of 11 µg/L, and is therefore the TMDL.

5.1.3 Critical Conditions/Seasonality

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

Historical TN, TP, and chlorophyll observations in Moncrief Creek are provided in **Appendix C**.

Simple correlation analysis (Spearman correlation matrix) were performed on the TN, TP, and chlorophyll datasets to determine whether there were significant differences among monthly, seasonal, precipitation data, or among themselves. As discussed previously, there was no correlation between TN and corrected chlorophyll (R^2 = 0.033), but there was a limited correlation between organic nitrogen and corrected chlorophyll (R^2 = 0.13). TP and chlorophyll showed a much stronger correlation, with and R^2 of 0.466 (**Appendix D**). It is very difficult to evaluate possible patterns among months due to the small sample sizes. For example, the range in monthly observations for TN varies from 1 to 8 between months, with six months having two or fewer observations. The sample sizes for TP are similar, again with six months having two or fewer samples.

Grouping observations by season increased sample sizes for statistical comparison and, as seen in **Table 2.2**, for TN the fall (October - December) and winter (January – March) seasons had the highest threshold exceedance rate (75 percent); summer (July – September) had the least (36 percent). For TP, the highest exceedance rate occurred in the spring (April - June), with a 38 percent exceedance rate. The greatest percent of chlorophyll exceedances traditionally occur in the summer (57 percent). This should not be surprising, as warmer water temperatures typically spur an increase in algal growth. A likely factor that could contribute to these monthly or seasonal differences would be the pattern of rainfall.

Rainfall records for the Jacksonville International Airport (JIA) (**Appendix G** illustrates rainfall from 1990 – 2004) were used to determine rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (1D), the cumulative total for the day of and the previous two days (3D), the cumulative total for the day of and the previous six days (7D) were all paired with TN, TP, and chlorophyll observations. A simple correlation matrix was generated that summarized the correlation between the various rainfall and TN, TP, and chlorophyll measures (included in **Appendix D**).

The correlation between TN and the one day precipitation was positive, while the three and seven day precipitation totals were negative. This may indicate that any nonpoint TN reaching the stream is mostly driven by short rain events, or perhaps gets washed off in the earlier part of larger rain events. Organic nitrogen showed a similar trend, although the three day rainfall correlation was slightly positive. For TP and chlorophyll (both corrected and uncorrected) all correlations were positive, suggesting that as rainfall increases, so do in-stream values.

Hydrologic conditions were analyzed using rainfall, since no flow data were available. A loading curve type chart, that would normally be applied to flow events, was created using precipitation data from JIA from 1990 – 2004 instead. The chart was divided in the same manner as if flow was being analyzed, where extreme precipitation events represent the upper percentiles (0-5th percentile), followed by large precipitation events (5th – 10th percentile), medium precipitation events (10th – 40th percentile), small precipitation events (40th – 60th percentile), and no recordable precipitation events (60th – 100th percentile). Three day (day of and two days prior) precipitation accumulations were used in the analysis.

Data show that TN exceeded the estuarine threshold over all hydrologic conditions; however, the least percentage of exceedances (37 percent) occurred when no measurable precipitation was reported. The greatest percentage of exceedances (80 percent) occurred within large precipitation events. If a large percentage of exceedances occur during no measurable precipitation days, it is suspected that point sources are contributing. Likewise, if a large percentage of exceedances are found to be occurring after large and extreme precipitation events, this may indicate that exceedances are more nonpoint source driven; perhaps from stormwater conveyance systems or various land uses. With respect to TN in Moncrief Creek, there is no discernable upward or downward trend relative to precipitation; there is a high occurrence of exceedances of the threshold under most conditions. This would seem to indicate that exceedances of the TN threshold are a result of many sources – point and nonpoint. **Table 5.4** is a summary of TN data by hydrologic condition. **Figure 5.8** shows the same data visually.

The TP comparison doesn't show a general upward or downward trend either. There is some decrease in threshold exceedances in the large and medium precipitation event ranges, before increasing again in the small event range. As with TN, exceedances of the TP threshold are most likely a combination of point and nonpoint sources. **Table 5.5** is a summary of data and hydrologic conditions for TP, and **Figure 5.9** shows the same data visually.

Corrected chlorophyll data exhibit the same trend as TN and TP, where extreme events and small events have the greatest percentage of individual exceedances of the threshold. There is a general decrease in this number in the large and medium event ranges, and in fact there are no exceedances in the large event range. A summary of data and hydrologic conditions for corrected chlorophyll are shown in **Table 5.6** and **Figure 5.10**.

Table 5.5. Summary of TN Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Excedances	Percent Non-Exceedance
Extreme	>2.1"	10	6	60.00%	4	40.00%
Large	1.33" - 2.1"	5	4	80.00%	1	20.00%
Medium	0.18" - 1.33"	18	10	55.56%	8	44.44%
Small	0.01" - 0.18"	13	10	76.92%	3	23.08%
None/Not Measurable	<0.01"	19	7	36.84%	12	63.16%

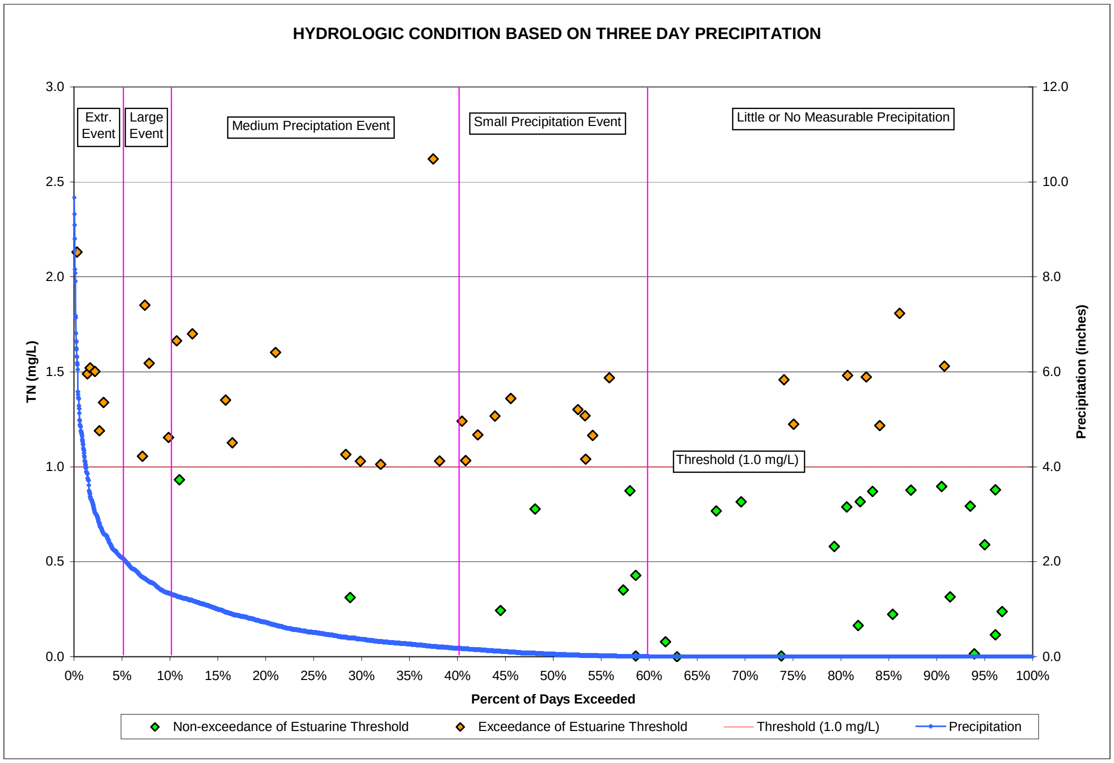


Figure 5.8. TN data by hydrological condition based on rainfall

Table 5.6. Summary of TP Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Excedances	Percent Non-Exceedance
Extreme	>2.1"	9	8	88.89%	1	11.11%
Large	1.33" - 2.1"	5	1	20.00%	4	80.00%
Medium	0.18" - 1.33"	16	7	43.75%	9	56.25%
Small	0.01" - 0.18"	12	8	66.67%	4	33.33%
None/Not Measurable	<0.01"	18	3	16.67%	15	83.33%

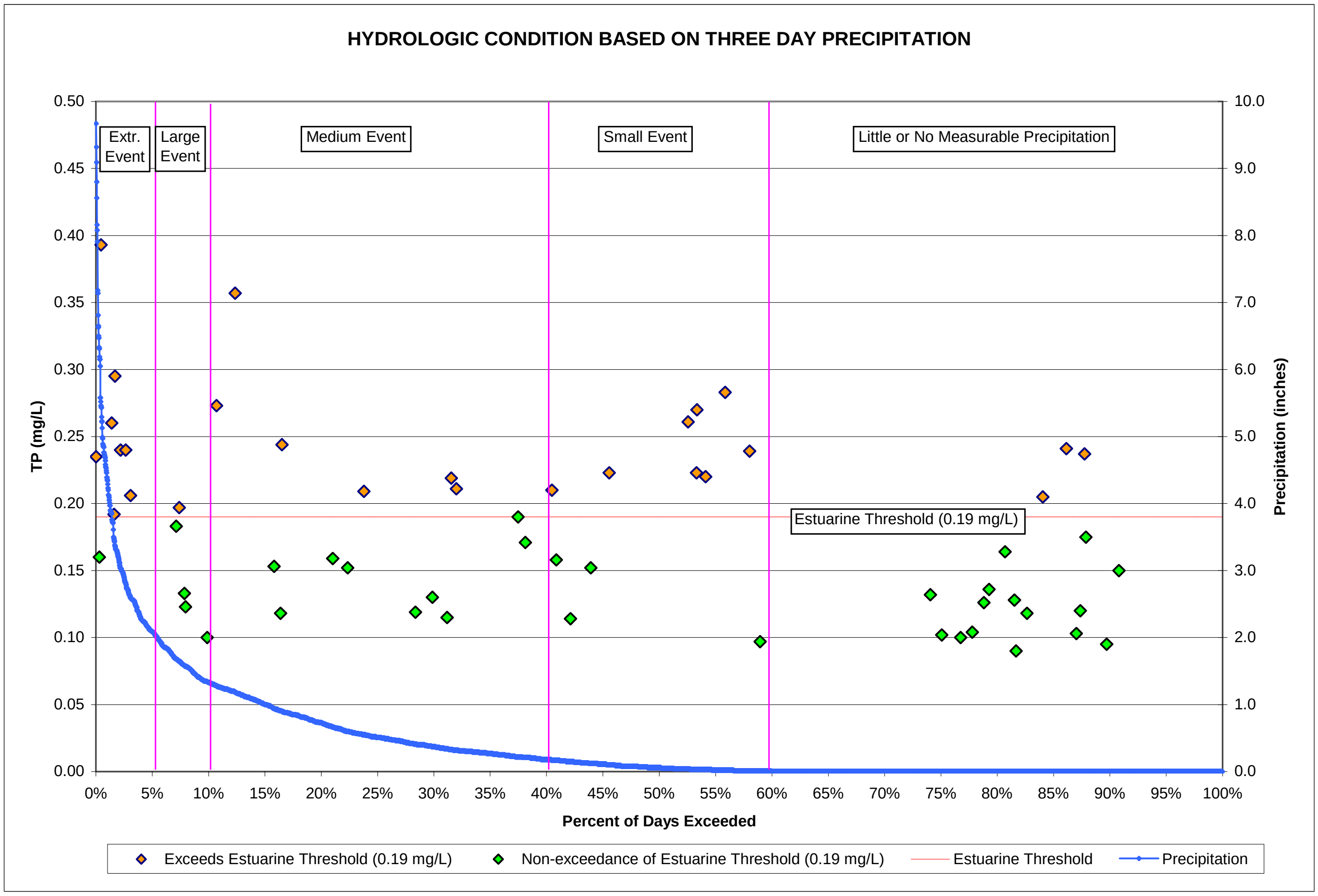


Figure 5.9. TP Data by Hydrological Condition Based on Rainfall

Table 5.7. Summary of Corrected Chlorophyll Data by Hydrological Condition

Precipitation Event	Event Range	Total Values	Number of Exceedances	Percent Exceedance	Number of Non-Exceedances	Percent Non-Exceedance
Extreme	>2.1"	4	3	75.00%	1	25.00%
Large	1.33" - 2.1"	3	0	0.00%	3	100.00%
Medium	0.18" - 1.33"	11	4	36.36%	7	63.64%
Small	0.01" - 0.18"	9	5	55.56%	4	44.44%
None/Not Measurable	<0.01"	16	3	18.75%	13	81.25%

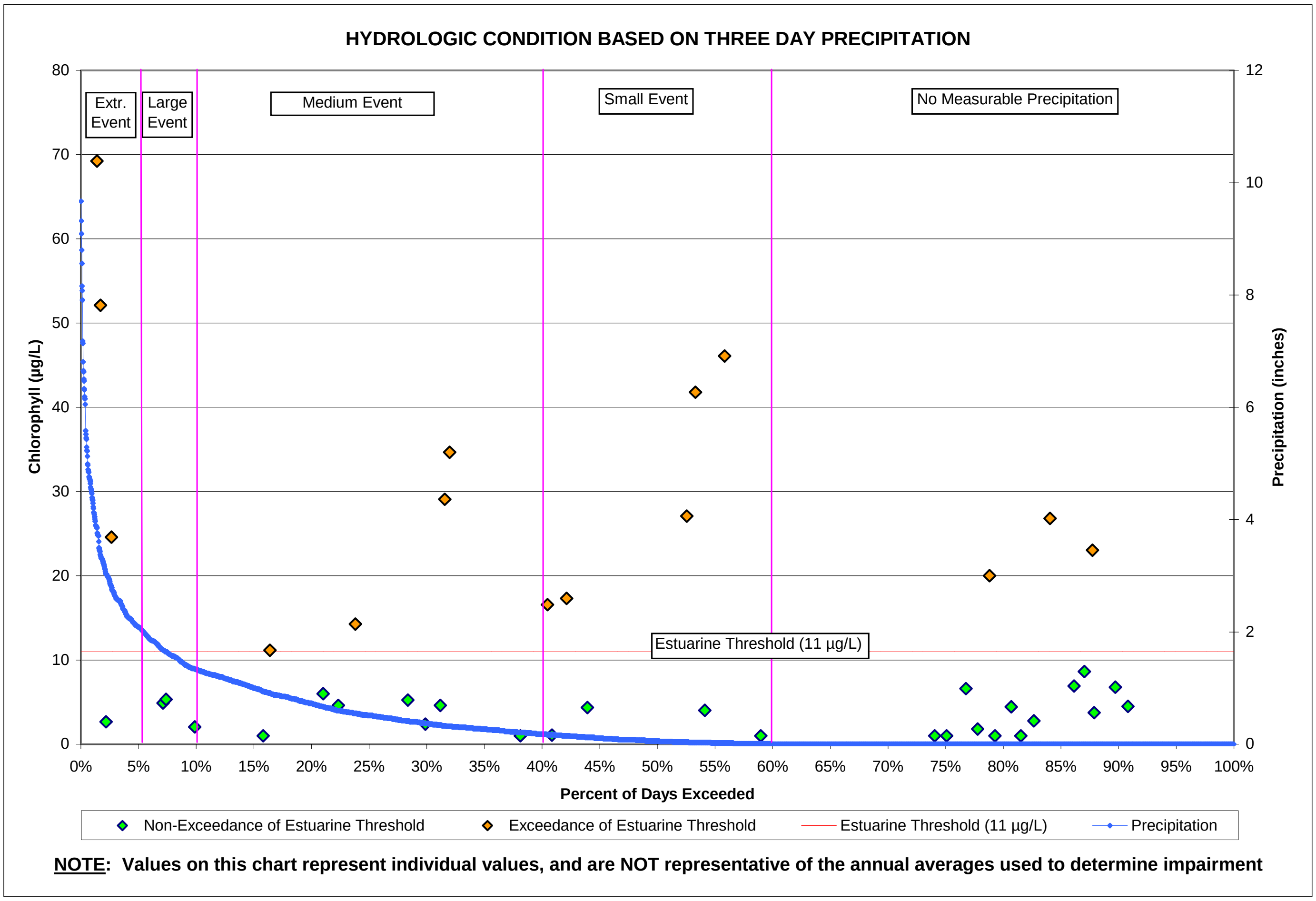


Figure 5.10. Corrected Chlorophyll Data by Hydrological Condition Based on Rainfall

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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

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

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. This TMDL for Moncrief Creek is expressed in terms of percent reduction, and represent the required reduction of TN to allow the creek to meet the applicable chlorophyll threshold **(Table 6.1).**

Table 6.1. TMDL Components for Moncrief Creek

WBID	Parameter	TMDL (Percent Reduction)	WLA		LA (Percent Reduction)	MOS
			Wastewater	NPDES Stormwater		
2228	Total Nitrogen (TN)	14%	N/A*	14%	14%	Implicit

- Currently, no facilities in the Moncrief Creek watershed are required to report TN concentrations in wastewater to the Department. This TMDL recommends that all current and future discharge permits in the basin be required to monitor and report TN values to the Department as part of permitted activities.

6.2 Load Allocation (LA)

A TN reduction of 14 percent is required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

Presently, there are no permitted NPDES facilities which are required to monitor and report TN concentrations in effluent to the Department. However, it is recommended that all current and future permittees within the Moncrief Creek watershed be required to monitor TN as part of permitted activities, and report effluent concentrations to the Department.

6.3.2 NPDES Stormwater Discharges

The WLA for the City of Jacksonville and FDOT's MS4 permit (permit FL000012) is a 14 percent reduction in current anthropogenic TN loading from the MS4. It should be noted that any MS4 permittee will only be responsible for reducing the loads associated with stormwater outfalls for which it owns or otherwise has responsible control, and is not responsible for reducing other nonpoint source loads within its jurisdiction.

6.4 Margin of Safety (MOS)

Consistent with the recommendations of the Allocation Technical Advisory Committee (FDEP, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. A MOS was incorporated into this TMDL by calculating the TMDL based on a chlorophyll value of 11 µg/L. Chlorophyll impairment is determined by an annual average of 11 µg/L, which could allow individual chlorophyll concentrations to exceed 11 µg/L (since it is an average), provided that the annual average itself does not exceed 11 µg/L. This TMDL is based on a chlorophyll concentration of less than 11 µg/L during all sampling events, and as such if reductions in this TMDL are met, observed individual chlorophyll concentrations should not exceed 11 µg/L, resulting in lower annual averages.

A secondary MOS was included by basing the TMDL on the more stringent estuarine threshold. The upper portions of the creek are fresh, while the lower portion is estuarine. Freshwater streams have a higher annual average chlorophyll threshold than do estuarine waters – 20 µg/L. This TMDL, which applies to all of Moncrief Creek, is more stringent in the freshwater portions of the stream than if the freshwater threshold had been applied to upper reaches of the creek. By doing so, higher concentrations of chlorophyll and TN from the upper reaches are precluded from flowing through the lower estuarine portion, causing exceedances of the estuarine thresholds.

Chapter 7: Recommendations

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

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

References

Anderson, Damann L., A. L. Lewis, and K. M. Sherman. "Unsaturated Zone Monitoring Below Subsurface Wastewater Systems Serving Individual Homes in Florida." Ayres Associates, Tamps, FL. Undated document.

Florida Administrative Code. Chapter 62-302, Surface Water Quality Standards.

Florida Administrative Code. Chapter 62-303, Identification of Impaired Surface Waters.

Florida Department of Environmental Protection. 2001. Ocklawaha Basin Status Report. Tallahassee, Florida. Available at http://www.dep.state.fl.us/water/tmdl/stat_rep.htm.

Florida Department of Environmental Protection. February 2001. *A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida.* Tallahassee, Florida: Bureau of Watershed Management.

Florida Department of Environmental Protection. March 2003. Lower St. Johns Basin Status Report. Tallahassee, Florida. Available at http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

Florida Department of Health Web site. 2005. Available at http://www.doh.state.fl.us/.

Florida Department of Health Web site. 2005. Available at http://www.doh.state.fl.us/environment/OSTDS/statistics/NewInstallations.htm

Florida Department of Health Web site. 2005. Available at http://doh.state.fl.us/environment/ostds/statistics/repairs.htm

Florida Watershed Restoration Act. Chapter 99-223, Laws of Florida.

Hand, Joe, Mark Friedman. "Typical Water Quality Values for Florida's Lakes, Streams, and Estuaries." Florida Department of Environmental Regulation, July 1989.

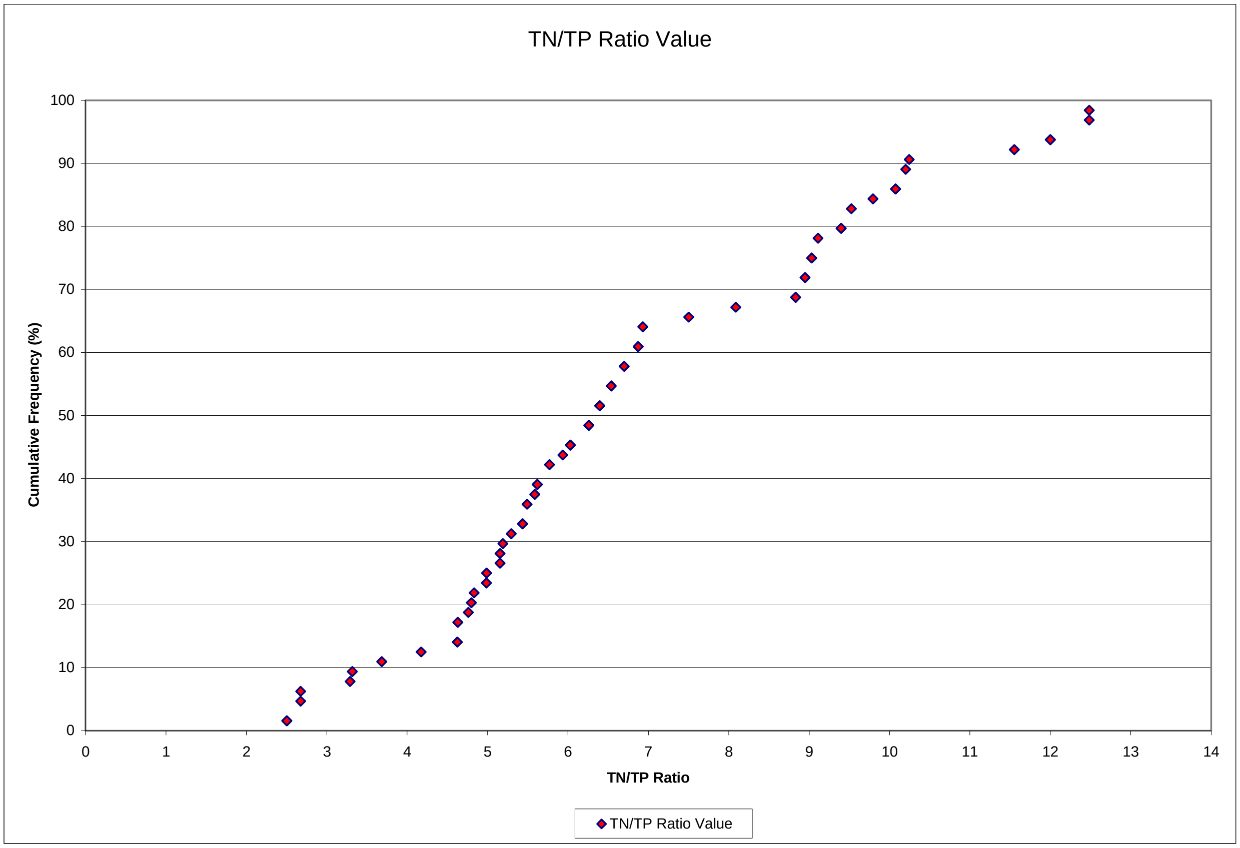
National Atmospheric Deposition Program (NRSP-3). 2005. NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820.

USEPA. "Protocol for Developing Nutrient TMDLs," First Edition. Office of Water, Washington, D.C., EPA 841-B-99-007. November 1999.

USEPA. "Protocol for Developing Pathogen TMDLs," First Edition. Office of Water, Washington, D.C., EPA 841-R-00-002. January 2001.

Appendices

Appendix A: TN and TP Ratio Cumulative Distribution Plot for Moncrief Creek



Appendix B: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

The rule requires the state's water management districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this study was conducted.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as municipal separate storm sewer systems (MS4s). However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the fifteen counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix C: Historical TN, TP, and Corrected Chlorophyll Data for Moncrief Creek

Sample Date	Station	Location	TN (mg/L)	Remark Code	TP (mg/L)	Remark Code	Corrected Chlorophyll (µg/L)	Remark Code
5/13/1992	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.49	+	0.26		69.23	
8/3/1992	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.19	+	0.24		24.59	
11/4/1992	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.24	+	0.21		16.57	
11/4/1992	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.24	+	0.21		16.57	
1/12/1993	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.03	+	0.13		2.4	
1/12/1993	21FLSJWMLSJ907	MONCRIEF CREEK AT HWY 111	1.03	+	0.13		2.4	
9/12/1994	21FLSJWMMNCTA	MONCRIEF CREEK AT TALLULAH AVE	1.36	+	0.223			
10/3/1994	21FLSJWMMNCTA	MONCRIEF CREEK AT TALLULAH AVE	1.339	+	0.2			
10/3/1994	21FLSJWMMNCTA	MONCRIEF CREEK AT TALLULAH AVE			0.206			
10/11/1994	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	2.13	C	0.16			
11/16/1994	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	0.617		0.123			
6/5/1995	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	1.545	C	0.133			
7/10/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.269	+	0.223		41.8	
7/10/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.269	+	0.223		41.8	
7/18/1995	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	0.939	C	0.192			
8/25/1995	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	0.738	C	0.393			
8/25/1995	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	0.586	C				
8/29/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.267	+	0.152		4.36	
8/29/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.267	+	0.152		4.36	
10/3/1995	21FLJXWQTR114	MONCRIEF CREEK AT LEM TURNER RD	2.62	C	0.19			
10/4/1995	21FLJXWQTR316	MONCRIEF CREEK AT 33RD. STREET	1.04	C	0.27			
10/10/1995	21FLJXWQMNCTA	MONCRIEF CREEK AT TALLULAH AVE	1.663	C	0.273			
10/24/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.458	+	0.132		1	&
10/24/1995	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.458	+	0.132		1	&
2/27/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.224	+	0.102		1	&
2/27/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.224	+	0.102		1	&
4/29/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.065	+	0.119		5.25	
4/29/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.065	+	0.119		5.25	
6/4/1996	21FLJXWQTR114	MONCRIEF CREEK AT LEM TURNER RD	0.79	J	0.24			
6/4/1996	21FLJXWQTR114	MONCRIEF CREEK AT LEM TURNER RD	0.793	J	0.239			
6/26/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.521	+	0.295		52.1	
6/26/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.521	+	0.295		52.1	
8/5/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.351	+	0.153		1	&
8/5/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.351	+	0.153		1	&
10/30/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.67	+	0.1		6.6	
10/30/1996	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.67	+	0.1		6.6	
2/19/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.481	+	0.104		1.8	Q

Sample Date	Station	Location	TN (mg/L)	Remark Code	TP (mg/L)	Remark Code	Corrected Chlorophyll (µg/L)	Remark Code
2/19/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.481	+	0.104		1.8	Q
4/30/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.288	+	0.115		4.6	
4/30/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.288	+	0.115		4.6	
6/18/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.854	+	0.152		4.6	
6/18/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.854	+	0.152		4.6	
8/27/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.806	+	0.126		20	
8/27/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.806	+	0.126		20	
10/8/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.935	+	0.136		1	&
10/8/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.935	+	0.136		1	&
12/10/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.502	+	0.24		2.67	
12/10/1997	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.502	+	0.24		2.67	
1/20/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.031	+	0.171		1	&
1/20/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.031	+	0.171		1	&
3/2/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.851	+	0.197		5.34	
3/2/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.851	+	0.197		5.34	
4/22/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.481	+	0.164		4.45	
4/22/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.481	+	0.164		4.45	
6/23/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.696	+	0.128		1	&
6/23/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.696	+	0.128		1	&
7/27/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.033	+	0.158		1.07	
7/27/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.033	+	0.158		1.07	
8/4/1998	21FLA 20030576	MONCRIEF CR @ 26TH ST.	0.82	+	0.09			
10/8/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.602	+	0.159		5.981	
10/8/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.602	+	0.159		5.981	
12/4/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.473	+	0.118		2.777	
12/4/1998	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.473	+	0.118		2.777	
2/2/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.155	+	0.1		2.056	
4/22/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.217	+	0.205		26.807	
6/4/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.968	+	0.209		14.258	
8/18/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.469	+	0.283		46.084	
10/18/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.056	+	0.183		4.886	
12/7/1999	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.168	+	0.114		17.311	
2/2/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.808	+	0.241		6.905	
4/20/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.833	+	0.103		8.632	
5/25/2000	21FLA 20030726	MONCRIEF CR AT MONCRIEF ROAD	0.58	+	0.12			
6/15/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.914	+	0.219		29.086	
8/18/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.873	+	0.237		23.045	
9/12/2000	21FLA 20030726	MONCRIEF CR AT MONCRIEF ROAD	0.95	+	0.097		1	&
10/10/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.961	+	0.175		3.738	
12/20/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.165	+	0.22		4.018	
12/20/2000	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.151	+	0.206		3.765	
12/28/2000	21FLSJWMMCCR	MONCRIEF CR. AT NORWOOD AVE.	1.565	+	0.585			
1/30/2001	21FLA 20030726	MONCRIEF CR AT MONCRIEF ROAD	0.586	+				
2/1/2001	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.013	+	0.211		34.67	J
4/9/2001	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.905	+	0.095		6.763	
6/12/2001	21FLSJWMMCCR	MONCRIEF CR. AT NORWOOD AVE.	1.217	+	0.244			
6/21/2001	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	0.818	+	0.118		11.163	
8/29/2001	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.301	+	0.261		27.087	
9/14/2001	21FLSJWMMCCR	MONCRIEF CR. AT NORWOOD AVE.	0.629	+	0.235			
10/17/2001	21FLSJWM20030115	MONCRIEF CREEK NEAR MOUTH	1.53	+	0.15		4.508	
11/14/2001	21FLSJWMMCCR	MONCRIEF CR. AT NORWOOD	1.7	+	0.357			

Sample Date	Station	Location	TN (mg/L)	Remark Code	TP (mg/L)	Remark Code	Corrected Chlorophyll (µg/L)	Remark Code
		AVE.						
5/15/2002	21FLJXWQTR316	MONCRIEF CREEK AT 33RD. STREET	0.11	+				
7/30/2002	21FLJXWQTR316	MONCRIEF CREEK AT 33RD. STREET	0.573	+				
8/28/2002	21FLJXWQTR316	MONCRIEF CREEK AT 33RD. STREET	0.445	+				

REMARK CODES:

C - Calculated Value
+ - Calculated Value
J - Estimated. Value shown in not a result analytical measurement
& - Chlorophyll value changed to 1 µg/L by Department to reflect minimum detection limit
Q - Sample held beyond normal holding time

It should be noted that some of these values were viewed as duplicates and therefore were not included in the analysis of this TMDL

Appendix D: Correlations for TN, TP, Chlorophyll, and Other Parameters in Moncrief Creek

	TN	Corr. Chlorophyll	Org. Nitrogen	Uncorr. Chlorophyll	TKN	NO2NO3	NH4	TP	1D_PREC	3D_PREC	7D_PREC
TN	1										
Corr. Chlorophyll	0.183	1									
Org. Nitrogen	0.948	0.371	1								
Uncorr. Chlorophyll	0.232	0.978	0.429	1							
TKN	0.964	0.367	0.989	0.429	1						
NO2NO3	0.346	-0.539	0.059	-0.582	0.092	1					
NH4	0.090	-0.041	-0.099	-0.017	0.047	0.187	1				
TP	0.020	0.683	0.109	0.741	0.141	-0.334	0.181	1			
1D_PREC	0.226	0.556	0.276	0.618	0.286	-0.169	-0.088	0.324	1		
3D_PREC	-0.090	0.423	0.005	0.495	0.014	-0.344	-0.136	0.528	0.741	1	
7D_PREC	-0.192	0.176	-0.129	0.313	-0.120	-0.249	-0.117	0.435	0.645	0.885	1

Appendix E: Regression Analysis of Organic Nitrogen and Corrected Chlorophyll

Organic Nitrogen Concentration (mg/L)	Expected Chlorophyll Concentration (µg/L)	Organic Nitrogen Concentration (mg/L)	Expected Chlorophyll Concentration (µg/L)
0.20	0.11	0.61	6.83
0.21	0.28	0.62	7.00
0.22	0.44	0.63	7.16
0.23	0.60	0.64	7.33
0.24	0.77	0.65	7.49
0.25	0.93	0.66	7.65
0.26	1.10	0.67	7.82
0.27	1.26	0.68	7.98
0.28	1.42	0.69	8.15
0.29	1.59	0.70	8.31
0.30	1.75	0.71	8.47
0.31	1.92	0.72	8.64
0.32	2.08	0.73	8.80
0.33	2.24	0.74	8.97
0.34	2.41	0.75	9.13
0.35	2.57	0.76	9.29
0.36	2.74	0.77	9.46
0.37	2.90	0.78	9.62
0.38	3.06	0.79	9.79
0.39	3.23	0.80	9.95
0.40	3.39	0.81	10.11
0.41	3.56	0.82	10.28
0.42	3.72	0.83	10.44
0.43	3.88	0.84	10.61
0.44	4.05	0.85	10.77
0.45	4.21	0.86	10.93
0.46	4.38	0.87	11.10
0.47	4.54	0.88	11.26
0.48	4.70	0.89	11.43
0.49	4.87	0.90	11.59
0.50	5.03	0.91	11.75
0.51	5.19	0.92	11.92
0.52	5.36	0.93	12.08
0.53	5.52	0.94	12.25
0.54	5.69	0.95	12.41
0.55	5.85	0.96	12.57
0.56	6.01	0.97	12.74
0.57	6.18	0.98	12.90
0.58	6.34	0.99	13.07
0.59	6.51	1.00	13.23
0.60	6.67	1.01	13.39

An organic nitrogen concentration of 0.86 mg/L will yield a chlorophyll concentration of around 11 µg/L

Appendix F: TN and Organic Nitrogen Data for Moncrief Creek

Sample Date	TN (mg/L)	ORG N (mg/L)	Percent Organic Nitrogen
5/13/1992	1.49	1.318	88.46%
8/3/1992	1.19	1.068	89.75%
11/4/1992	1.24	0.97	78.23%
1/12/1993	1.03	0.72	69.90%
9/12/1994	1.36	0.964	70.88%
10/3/1994	1.339	1.115	83.27%
10/11/1994	2.13	1.87	87.79%
11/16/1994	0.617	0.353	57.21%
6/5/1995	1.545	1.31	84.79%
7/10/1995	1.269	1.163	91.65%
7/18/1995	0.939	0.806	85.84%
8/25/1995	0.586	0.487	83.11%
8/25/1995	0.586	0.545	93.00%
8/25/1995	0.586	0.545	93.00%
8/25/1995	0.586	0.545	93.00%
8/25/1995	0.586	0.639	109.04%
8/25/1995	0.586	0.639	109.04%
8/29/1995	1.267	1.015	80.11%
10/3/1995	2.62	2.18	83.21%
10/4/1995	1.04	0.6	57.69%
10/10/1995	1.663	1.56	93.81%
10/24/1995	1.458	1.108	75.99%
2/27/1996	1.224	0.99	80.88%
4/29/1996	1.065	0.916	86.01%
6/4/1996	0.793	0.678	85.50%
6/26/1996	1.521	1.496	98.36%
8/5/1996	1.351	1.168	86.45%
10/30/1996	0.67	0.391	58.36%
2/19/1997	0.481	0.059	12.27%
4/30/1997	0.288	0.084	29.17%
6/18/1997	0.854	0.519	60.77%
8/27/1997	0.806	0.724	89.83%
10/8/1997	0.935	0.778	83.21%
12/10/1997	1.502	1.139	75.83%
1/20/1998	1.031	1.029	99.81%
3/2/1998	1.851	1.63	88.06%
3/2/1998	1.851	1.63	88.06%
4/22/1998	1.481	1.259	85.01%
6/23/1998	0.696	0.608	87.36%
7/27/1998	1.033	0.749	72.51%
7/27/1998	1.033	0.749	72.51%
8/4/1998	0.82	0.26	31.71%
10/8/1998	1.602	1.255	78.34%
12/4/1998	1.473	1.104	74.95%
2/2/1999	1.155	0.899	77.84%
4/22/1999	1.217	1.155	94.91%
6/4/1999	0.968	0.849	87.71%
8/18/1999	1.469	1.458	99.25%
10/18/1999	1.056	0.692	65.53%
12/7/1999	1.168	1.024	87.67%
2/2/2000	1.808	1.348	74.56%
4/20/2000	0.833	0.618	74.19%
5/25/2000	0.58	0.340672	58.74%
8/18/2000	0.873	0.73	83.62%

Sample Date	TN (mg/L)	ORG N (mg/L)	Percent Organic Nitrogen
9/12/2000	0.95	0.47992	50.52%
10/10/2000	0.961	0.664	69.09%
12/20/2000	1.165	0.718	61.63%
12/28/2000	1.565	1.12	71.57%
1/30/2001	0.586	0.28752	49.06%
2/1/2001	1.013	0.665	65.65%
4/9/2001	0.905	0.759	83.87%
6/12/2001	1.217	0.876	71.98%
8/29/2001	1.301	1.287	98.92%
9/14/2001	0.629	0.322	51.19%
10/17/2001	1.53	1.056	69.02%
11/14/2001	1.7	1.27	74.71%
5/15/2002	0.11	0.09	81.82%
7/30/2002	0.573	0.26	45.38%
8/28/2002	0.445	0.302	67.87%

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