**FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION**

Division of Environmental Assessment and Restoration,

Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

## Draft TMDL Report

# Dissolved Oxygen and Nutrient TMDLs for Trout River, WBID 2203

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**June 2009**

# Acknowledgments

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# Contents

*Chapter 1: INTRODUCTION* 1

**1.1 Purpose of Report** 1

**1.2 Identification of Waterbody** 1

**1.3 Background** 5

*Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM* 6

**2.1 Statutory Requirements and Rulemaking History** 6

**2.2 Information on Verified Impairment** 6

*Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS* 10

**3.1 Classification of the Waterbody and Criteria Applicable to the TMDL** 10

**3.2 Applicable Water Quality Standards and Numeric Water Quality Target** 10

*3.2.1 Dissolved Oxygen Criterion* 10

*Chapter 4: ASSESSMENT OF SOURCES* 12

**4.1 Types of Sources** 12

**4.2 Potential Sources of Nutrients in the Trout River Watershed** 12

*4.2.1 Point Sources* 12

*4.2.2 Land Uses and Nonpoint Sources* 15

**4.3 Source Summary** 21

*4.3.1 Summary of Nutrient Loadings to Trout River from Various Sources* 21

*Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY* 29

**5.1 Determination of Loading Capacity** 29

*5.1.1 Data Used in the Determination of the TMDL* 29

*5.1.2 TMDL Development Process* 37

*5.1.3 Critical Conditions/Seasonality* 40

*Chapter 6: DETERMINATION OF THE TMDL* 41

**6.1 Expression and Allocation of the TMDL** 41

**6.2 Load Allocation** 42

**6.3 Wasteload Allocation** 42

*6.3.1 NPDES Wastewater Discharges* 42

*6.3.2 NPDES Stormwater Discharges* 42

**6.4 Margin of Safety** 42

***Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND*** *43*

**7.1 Basin Management Action Plan** 43

***References*** *45*

***Appendices*** *46*

**Appendix A: Background Information on Federal and State Stormwater Programs** 46

**Appendix B: Historical DO, Corrected Chla, TN, TP, BOD5 Observations in Trout River, 1967–2008** 47

**Appendix C: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Season in Trout River** 58

**Appendix D: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Month in Trout River** 60

**Appendix E: Chart of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations by Season, Station, and Year in Trout River** 63

**Appendix F: Chart of Rainfall for Jacksonville International Airport, 1948–2008** 80

**Appendix G: Spearman Correlation Matrix Analysis for Water Quality Parameters in Trout River** 81

**Appendix H: Linear Regression Analysis of DO and Corrected Chla Observations versus Nutrients and BOD in Trout River** 87

**Appendix I: Monthly and Annual Precipitation at Jacksonville International Airport, 1955–2008** 92

**Appendix J: Annual and Monthly Average Precipitation Jacksonville International Airport** 94

## List of Tables


*Table 2.1. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003) 7*

*Table 2.2. Summary of DO Data by Month for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003) 7*

*Table 2.3. Summary of DO Data by Season for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003) 8*

*Table 2.4. Summary of DO Data by Year for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003) 8*

*Table 2.5. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Verified Period (January 1, 2001 – June 30, 2008) 8*

*Table 4.1. Classification of Land Use Categories in the Trout River (WBID 2203) Watershed 15*

*Table 4.2. Description of Hydrologic Soil Classes from the SSURGO Database 18*

*Table 4.3. Estimated Average Household Size in the Trout River Watershed 20*

*Table 4.4. Estimated Nitrogen and Phosphorus Annual Loading from Septic Tanks in the Trout River Watershed 20*

*Table 4.5. Estimated Annual Average TN and TP Loads from Agriculture in the Trout River Watershed 21*

*Table 4.6. Estimated Urban and Built-up Annual Nitrogen and Phosphorus Loading in the Trout River Watershed 23*

*Table 4.7. Estimated Forest/Wetland/Water/Open Lands Annual Nitrogen and Phosphorus Loading in Trout River Watershed 24*

*Table 4.8. Estimated Annual Nitrogen and Phosphorus Loading to WBID 2203 from WBIDs 2223 and 2201 25*

*Table 4.9. Summary of Estimated Potential Annual Nitrogen and Phosphorus Loading from Various Sources in the Trout River Watershed 27*

*Table 5.1. Sampling Station Summary for the Trout River Watershed 30*

*Table 5.2. Statistical Summary of Historical Data for Trout River 30*

*Table 5.3. Summary Statistics for Major Water Quality Parameters Measured in Trout River 31*

*Table 5.4. Statistical Summary of Historical DO Data by Year for Trout River 36*

*Table 5.5. Statistical Summary of Historical DO Data by Season for Trout River 37*

*Table 5.6. Seasonal Summary Statistics for DO, TEMP, TN, TP, BOD5, and CHLAC for Trout River WBID 2203 38*

*Table 5.7. Summary Statistics for DO, TN, and TP from Three Reference Stream Sites (Statewide DO Study 2004-2005)* 39
*Table 6.1. TMDL Components for Trout River* 42

## List of Figures

*Figure 1.1. Location of the Trout River (WBID 2203) in Duval County ____ 2*
*Figure 1.2. Location of the Trout River (WBID 2203) in Duval County and Major Hydrological Features in the Area ____ 3*
*Figure 1.3. WBIDs in the Trout River Planning Unit ____ 4*
*Figure 4.1. Location of Permitted Facilities in the Trout River Watershed ____ 13*
*Figure 4.2. Stormwater Infrastructure in the Trout River Watershed, WBID 2203 ____ 14*
*Figure 4.3. Principal Level 2 Land Uses in the Trout River Watershed, WBID 2203, in 2004 ____ 17*
*Figure 4.4. Hydrologic Soil Groups Distribution in the Trout River Watershed ____ 19*
*Figure 4.5. Contributing Watersheds to the Middle Trout River WBID 2203 ____ 26*
*Figure 5.2. Historical DO Observations for Trout River ____ 33*
*Figure 5.3. Historical Corrected Chla Observations for Trout River ____ 33*
*Figure 5.4. Historical TN Observations for Trout River ____ 34*
*Figure 5.5. Historical TP Observations for Trout River ____ 34*
*Figure 5.6. Historical BOD5 Observations for Trout River ____ 35*

## *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**

**2008 305(b) Report**

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

**Criteria for Surface Water Quality Classifications**

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

**Basin Assessment Report for the Lower St. Johns River Basin**

**http://www.dep.state.fl.us/water/basin411/sj_lower/assessment.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 dissolved oxygen (DO) and nutrients for the Trout River in the Trout River Planning Unit of the Lower St. Johns River Basin. The river was verified as impaired for DO, and was included on the cycle 1 Verified List of impaired waters for the Lower St. Johns River Basin that was adopted by Secretarial Order in May 2004. Since the DO impairment was associated with nutrients, Trout River was verified as impaired for nutrients in the cycle 2 assessment and placed on the Lower St. Johns River Basin verified list that was adopted by Secretarial Order in May 2009. This TMDL establishes the allowable loadings to Trout River that would restore the waterbody so that it meets its applicable water quality criterion for DO and nutrients.

## 1.2 Identification of Waterbody

The Trout River is located in Duval County, in northeast Florida, in the west central part of the county. This TMDL is for one of the three WBIDs within the total Trout River watershed (**Figures 1.1** and **1.2**). The Trout River (Middle Reach, WBID 2203) is approximately 8.8 miles in length, drains an area of approximately 15.5 miles, and adjoins WBID 2203A on its western side. Water flows through WBID 2203 and through WBID 2203A before reaching the St. Johns River. The two watersheds occupy a combined area of approximately 27.6 mi², which is situated between the St. Johns River and the Duval/Nassau county line. The downstream segment WBID (2203A) is predominantly marine and tidally influenced, while WBID 2203 is not. Additional information about the creek's hydrology and geology are available in the Basin Status Report for the Lower St. Johns Basin (Florida Department of Environmental Protection [FDEP], 2004).

For assessment purposes, the Department has divided the St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. The Trout River consists of three segments – 2203A, 2203, and 2223. This TMDL is addresses the middle segment, WBID 2203, as shown in **Figure 1.2** for dissolved oxygen and nutrients.

The Trout River is part of the Trout River Planning Unit. Planning units are groups of smaller watersheds (WBIDs) that are part of a larger basin unit, in this case the Lower St. Johns River Basin. The Trout River Planning Unit consists of 18 WBIDs. **Figure 1.3** shows the locations of these WBIDs and the Trout River's location in the planning unit.

Figure 1.1. Location of the Trout River (WBID 2203) in Duval County

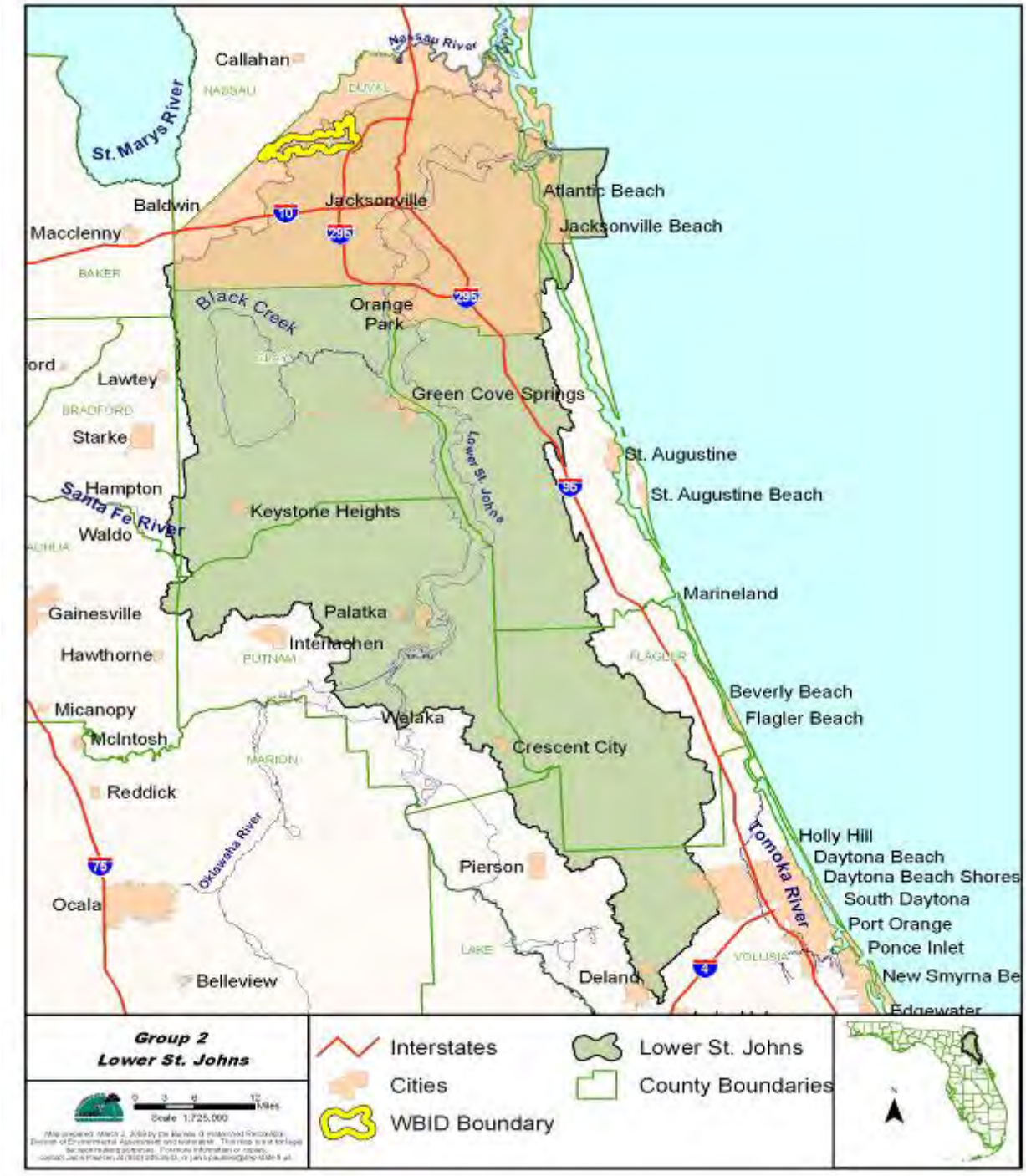
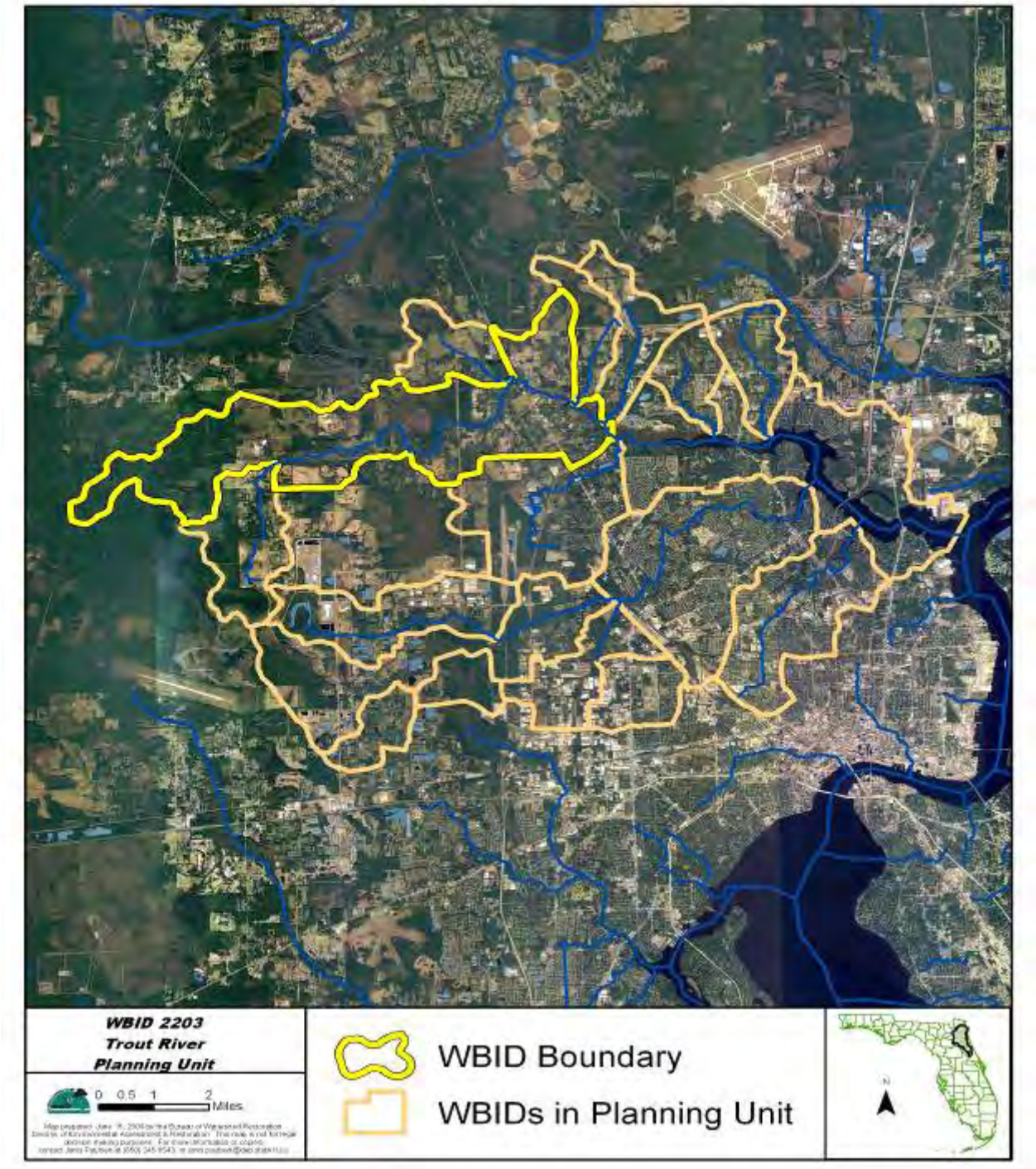


Figure 1.2. Location of the Trout River (WBID 2203) in Duval County and Major Hydrological Features in the Area

## Figure 1.3. WBIDs in the Trout River Planning Unit



## 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.

A nutrient TMDL was adopted in April 2008 for the mainstem of the Lower St. Johns River that required between a 30 and 50 percent reduction in anthropogenic loadings of nitrogen to the marine portion of the Lower St. Johns River. A Basin Management Action Plan, or BMAP, was adopted in October 2008 that outlined a number of activities designed to reduce the amount of total nitrogen (TN) to the marine portion of the Lower St. Johns River. These activities will depend heavily on the active participation of the St. Johns River Water Management District (SJRWMD), local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies including tributaries to the Lower St. Johns such as the Trout River.

# 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 55 waterbodies in the Lower St. Johns River Basin. However, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rulemaking process, the Environmental Regulation Commission adopted the new methodology as Rule 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001; the rule was modified in 2006 and 2007.

## 2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in the Trout River watershed and verified in the cycle 1 assessment that this waterbody segment was impaired for DO, based on data in the Department's IWR database. **Tables 2.1** through **2.4** summarize the DO data for the cycle 1 verification period, which for Group 2 waters was January 1, 1996, through June 30, 2003, by overall, month, season, and year, respectively. The DO impairment was reaffirmed in the cycle 2 verification period, which for Group 2 waters was January 1, 2001, through June 30, 2008 (**Table 2.5**).

There was a 63.8 percent overall exceedance rate for DO in the Trout River during the verified period (**Table 2.1**). Exceedances occured in all seasons and in all months except February and November (**Tables 2.2** and **2.3**). During the verified period, samples ranged from 0.5 to 8.62 milligrams per liter (mg/L). As DO solubility is influenced by both salinity and water temperature, ranges in DO saturation were also evaluated. DO saturation ranged from 7.0 to 99.3 percent, averaging 47.1 percent. Fewer than 10 percent of the DO saturation values were less than 21 percent.

When aggregating data by season, the lowest percentage of exceedances occurred in the winter and the highest in spring. Possible relationships between DO and other water quality parameters will be further assessed using the complete historical dataset in Chapter 5.

## Table 2.1. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003)

| Waterbody (WBID) | Parameter | Dissolved Oxygen |
|---|---|---|
| Trout River (2203) | Total number of samples | 69 |
| | IWR-required number of exceedances for the Verified List | 11 |
| | Number of observed exceedances | 44 (63.8%) |
| | Number of observed nonexceedances | 25 |
| | Number of seasons during which samples were collected | 4 |
| | Highest observation (mg/L) | 8.62 |
| | Lowest observation (mg/L) | 0.5 |
| | Median observation (mg/L) | 4.03 |
| | Mean observation (mg/L) | 4.26 |
| | Median value for 34 BOD observations (mg/L) | 2.0 |
| | Median value for 40 TN observations (mg/L) | 1.22 |
| | Median value for 40 TP observations (mg/L) | 0.51 |
| | Possible causative pollutant by IWR | TP |
| | **FINAL ASSESSMENT** | **Impaired** |

## Table 2.2. Summary of DO Data by Month for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003)

| Month | N | Minimum | Maximum | Median | Mean | No of Exceedances | % Exeedance | Mean Precipitation |
|---|---|---|---|---|---|---|---|---|
| January | 6 | 3.00 | 7.63 | 6.40 | 6.00 | 1 | 16.67 | 2.03 |
| February | 2 | 5.00 | 5.98 | 5.49 | 5.49 | 0 | 0.00 | 3.32 |
| March | 8 | 3.84 | 8.62 | 5.80 | 5.63 | 3 | 37.50 | 4.05 |
| April | 6 | 1.50 | 4.45 | 4.00 | 3.39 | 6 | 100.00 | 1.99 |
| May | 9 | 2.10 | 5.19 | 3.40 | 3.45 | 8 | 88.89 | 1.85 |
| June | 9 | 1.20 | 5.45 | 3.30 | 3.21 | 8 | 88.89 | 9.08 |
| July | 3 | 1.60 | 2.69 | 2.60 | 2.29 | 3 | 100.00 | 7.71 |
| August | 7 | 1.20 | 6.26 | 2.80 | 3.61 | 5 | 71.43 | 5.50 |
| September | 3 | 1.56 | 4.80 | 4.40 | 3.58 | 3 | 100.00 | 8.63 |
| October | 5 | 0.50 | 5.29 | 4.20 | 3.20 | 4 | 80.00 | 3.55 |
| November | 3 | 5.29 | 7.70 | 7.30 | 6.76 | 0 | 0.00 | 1.33 |
| December | 8 | 2.90 | 7.80 | 5.40 | 5.29 | 3 | 37.50 | 3.63 |

DO units are mg/L.
Mean precipitation is for Jacksonville International Airport, in inches.

### Table 2.3. Summary of DO Data by Season for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003)

| Season | N | Minimum | Maximum | Median | Mean | No of Exceedances | % Exeedance | Mean Total Precipitation |
|---|---|---|---|---|---|---|---|---|
| Winter | 16 | 3.00 | 8.62 | 6.00 | 5.75 | 4 | 25.00 | 9.40 |
| Spring | 24 | 1.20 | 5.45 | 3.30 | 3.35 | 22 | 91.67 | 12.92 |
| Summer | 13 | 1.20 | 6.26 | 2.70 | 3.30 | 11 | 84.62 | 21.84 |
| Fall | 16 | 0.50 | 7.80 | 5.20 | 4.91 | 7 | 43.75 | 8.51 |

DO units are mg/L.
Mean total precipitation is for Jacksonville International Airport, in inches.

### Table 2.4. Summary of DO Data by Year for the Cycle 1 Verified Period (January 1, 1996 – June 30, 2003)

| Year | N | Minimum | Maximum | Median | Mean | No of Exceedances | % Exeedance | Total Precipitation |
|---|---|---|---|---|---|---|---|---|
| 1996 | 16 | 1.60 | 8.62 | 4.70 | 4.85 | 9 | 56.25 | 60.63 |
| 1997 | 6 | 1.99 | 6.80 | 5.50 | 4.76 | 2 | 33.33 | 57.27 |
| 1998 | 7 | 2.59 | 6.90 | 4.20 | 4.49 | 5 | 71.43 | 56.72 |
| 1999 | 7 | 2.90 | 6.75 | 5.30 | 5.25 | 2 | 28.57 | 42.44 |
| 2000 | 9 | 1.56 | 7.63 | 4.00 | 4.21 | 6 | 66.67 | 39.77 |
| 2001 | 5 | 3.00 | 3.84 | 3.50 | 3.40 | 5 | 100.00 | 49.14 |
| 2002 | 16 | 0.50 | 7.70 | 2.60 | 3.18 | 13 | 81.25 | 54.72 |
| 2003 | 3 | 3.79 | 5.31 | 4.45 | 4.52 | 2 | 66.67 | 44.47 |

DO units are mg/L.
Mean total precipitation is for Jacksonville International Airport, in inches.

### Table 2.5. Summary of DO Monitoring Data for the Trout River (WBID 2203) During the Verified Period (January 1, 2001 – June 30, 2008)

| Waterbody (WBID) | Parameter | Dissolved Oxygen |
|---|---|---|
| Trout River (2203) | Total number of samples | 96 |
| | IWR-required number of exceedances for the Verified List | 14 |
| | Number of observed exceedances | 60 (62.5%) |
| | Number of observed nonexceedances | 36 |
| | Number of seasons during which samples were collected | 4 |
| | Highest observation (mg/L) | 9.39 |
| | Lowest observation (mg/L) | 0.5 |
| | Median observation (mg/L) | 3.85 |

| | | |
|---|---|---|
| | Mean observation (mg/L) | 4.30 |
| | Median value for 34 BOD observations (mg/L) | 2.0 |
| | Median value for 40 TN observations (mg/L) | 1.43 |
| | Median value for 40 TP observations (mg/L) | 0.296 |
| | Possible causative pollutant by IWR | TP |
| | **FINAL ASSESSMENT** | **Impaired** |

# 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)** |

The Trout River (WBID 2203) is a Class III freshwater waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the impairment addressed by this TMDL is for DO and nutrients.

## 3.2 Applicable Water Quality Standards and Numeric Water Quality Target

### *3.2.1 Dissolved Oxygen Criterion*

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. The water quality criterion for the protection of Class III freshwater waters, as established by Rule 62-302, F.A.C., states the following:

> ***Dissolved Oxygen Criteria:***
> *Shall not be less than 5.0. Normal daily and seasonal fluctuations above these levels shall be maintained.*

DO concentrations in ambient waters can be controlled by many factors, including the DO solubility, which is controlled by temperature and salinity; DO enrichment processes influenced by reaeration, which is controlled by flow velocity; photosynthesis of phytoplankton, periphyton, and other aquatic plants; DO consumption from the decomposition of organic materials in the water column and sediment and oxidation of some reductants such as ammonia and metals; and respiration by aquatic organisms.

The nutrient criterion in Rule 62-302, F.A.C., is expressed as a narrative:

> ***Nutrients:***
> *In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna [Note:*

*For Class III waters in the Everglades Protection Area, this criterion has been numerically interpreted for phosphorus in Section 62-302.540, F.A.C.].*

To assess whether this narrative criterion was being exceeded, the IWR provides thresholds for nutrient impairment in estuaries based on annual average chla levels. The following language is found in Rule 62-303, F.A.C.:

***62-303.353 Nutrients in Estuaries and Open Coastal Waters.***
*Estuaries, estuary segments, or open coastal waters shall be included on the planning list for nutrients if their annual mean chlorophyll a for any year is greater than 11 μg/l or if data indicate annual mean chlorophyll a values have increased by more than 50% over historical values for at least two consecutive years.*

***62-303.450 Interpretation of Narrative Nutrient Criteria.***
*(1) A water shall be placed on the verified list for impairment due to nutrients if there are sufficient data from the last five years preceding the planning list assessment, combined with historical data (if needed to establish historical chlorophyll a levels or historical TSIs), to meet the data sufficiency requirements of subsection 62-303.350(2), FA.C. If there are insufficient data, additional data shall be collected as needed to meet the requirements. Once these additional data are collected, the Department shall determine if there is sufficient information to develop a site-specific threshold that better reflects conditions beyond which an imbalance in flora or fauna occurs in the water segment. If there is sufficient information, the Department shall re-evaluate the data using the site-specific thresholds. If there is insufficient information, the Department shall re-evaluate the data using the thresholds provided in Rules 62-303.351-.353, F.A.C., for streams, lakes, and estuaries, respectively. In any case, the Department shall limit its analysis to the use of data collected during the five years preceding the planning list assessment and the additional data collected in the second phase. If alternative thresholds are used for the analysis, the Department shall provide the thresholds for the record and document how the alternative threshold better represents conditions beyond which an imbalance in flora or fauna is expected to occur.*

Although the annual average chlorophyll a concentration did not exceed the IWR stream thresholds (2007 annual average = 3.2 ug/L), nutrients were considered impaired based on the DO impairment being linked to nutrients. The median TP concentration over the cycle 2 verified period of 0.295 mg/L (40 samples) exceeded the stream threshold of 0.22 mg/L used in the identification of a causative pollutant to DO impairments.

# 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.

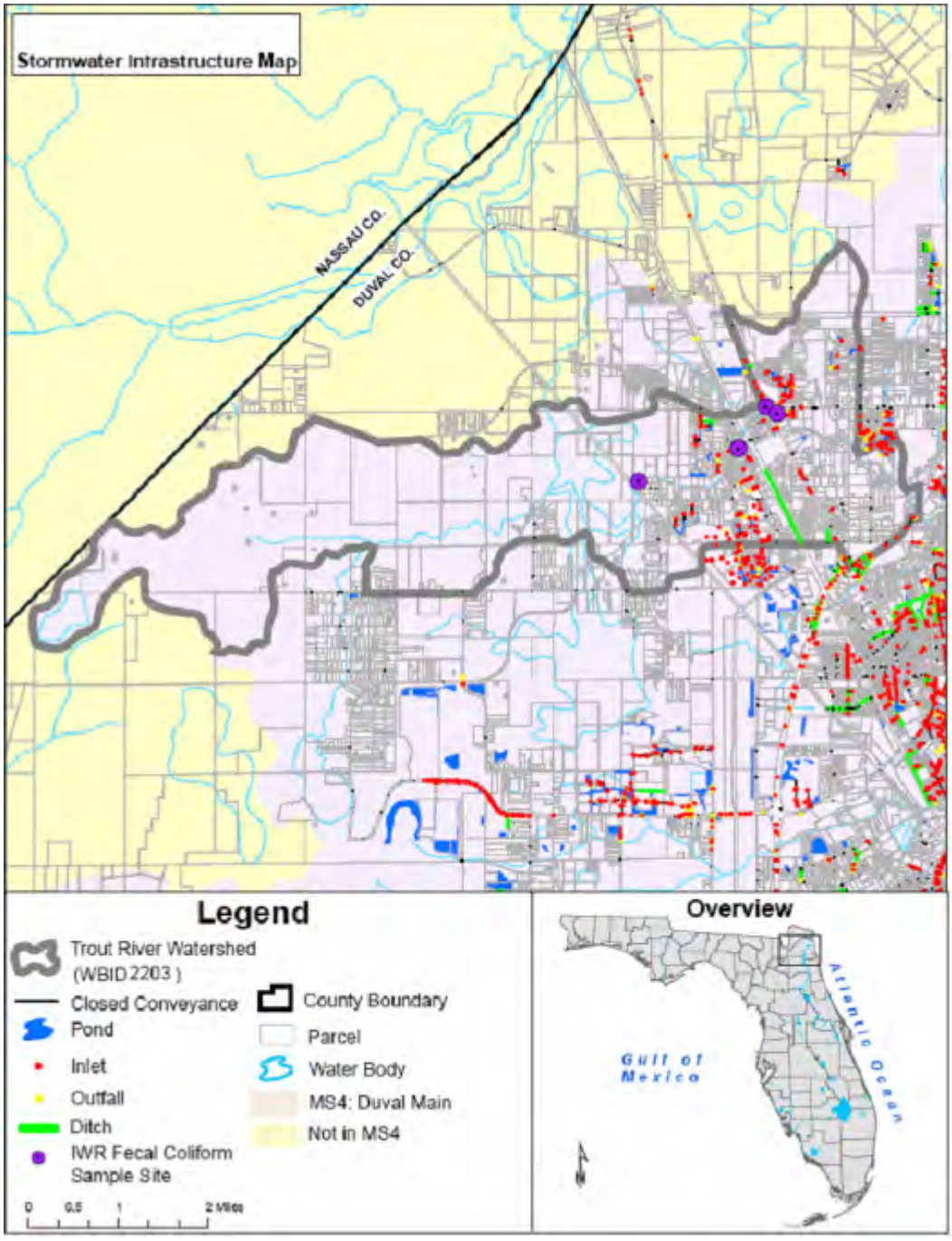
## 4.2 Potential Sources of Nutrients in the Trout River Watershed

### *4.2.1 Point Sources*

There are currently no facilities with a NPDES Domestic or Industrial permit to discharge wastewater in WBID 2203 (**Figure 4.1**). The City of Jacksonville has developed a GIS coverage of the stormwater infrastructure (**Figure 4.2)**. There are 33 outfalls and 212 inlets. Outfalls represent points where a conveyance of stormwater discharges into a separate stormwater system, channelized or natural waterway. Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or the low point of an area to provide collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008).

## Figure 4.1. Location of Permitted Facilities in the Trout River Watershed

Figure 4.2. Stormwater Infrastructure in the Trout River Watershed, WBID 2203




## Municipal Separate Storm Sewer System Permittees

The city of Jacksonville and Florida Department of Transportation (FDOT) District 2 are copermittees for a Phase I NPDES municipal separate storm sewer system (MS4) permit (Permit FLS000012) that includes all areas of the Trout River watershed.

### *4.2.2 Land Uses and Nonpoint Sources*

Nutrient loadings to Trout River are generated from nonpoint sources in the watershed. These potential sources include loadings from surface runoff, ground water inflow, leakage from collection systems, and 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 2 codes tabulated in **Table 4.1.**

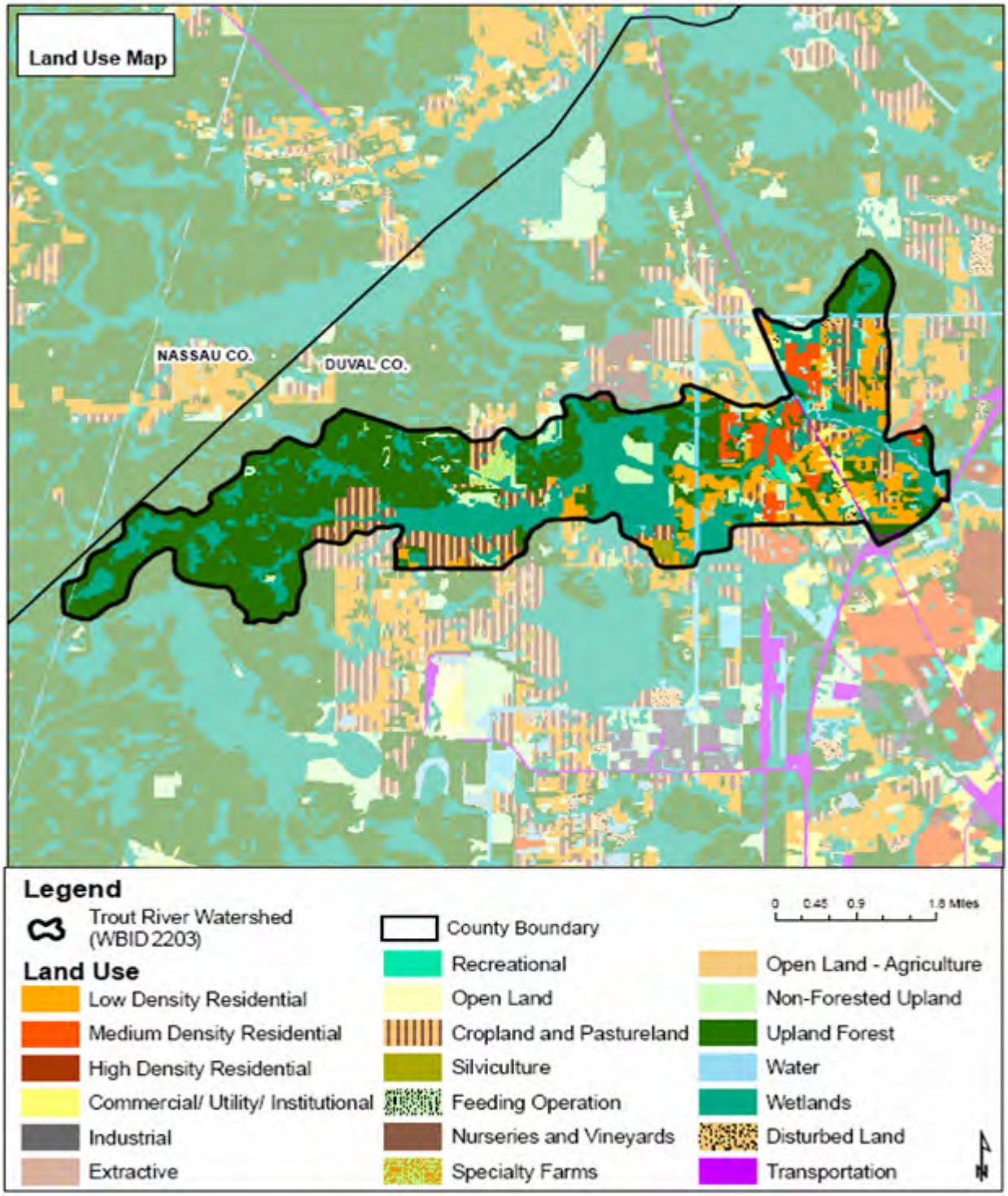
The principal land uses in WBID 2303 (**Figure 4.3**) are coniferous pine (21.7 percent), and wetland forested mixed (10.9 percent). Residential areas total only 14.1 percent (1,402.0 acres); there are no high-density residential areas, only medium- and low-density residential and rural (**Table 4.1**), mainly in the eastern part of the watershed. Human-impacted areas represent 27.95 percent (2,772.2 acres); and natural areas cover 72.05 percent (7,145.6 acres). The watershed has some agricultural areas. For example, there are 45.4 acres of cattle-feeding operations comprising 0.46 percent of land use, and a 4.4-acre poultry-feeding operation comprising 0.04% of land use, in the eastern part of the watershed.

Table 4.1. Classification of Land Use Categories in the Trout River (WBID 2203) Watershed

| Level 2 Land Use Code | Attribute | Acres | % of Total |
|---|---|---|---|
| 1100 | Residential, low density - less than 2 dwelling units/acre | 1024.58 | 10.33 |
| 1200 | Residential, medium density - 2-5 dwelling units/acre | 377.45 | 3.81 |
| 1400 | Commercial and services | 79.85 | 0.81 |
| 1500 | Industrial | 1.3 | 0.01 |
| 1600 | Extractive | 2.14 | 0.02 |
| 1700 | Institutional | 31.16 | 0.31 |
| 1800 | Parks and zoos | 10.42 | 0.11 |
| 2100 | Cropland and Pastureland | 938.36 | 9.46 |
| 2300 | Feeding operations | 49.78 | 0.50 |
| 2400 | Nurseries and Vineyards | 11.53 | 0.12 |
| 2500 | Specialty farms | 87.81 | 0.89 |
| 3100 | Herbaceous upland nonforested | 147.19 | 1.48 |
| 3200 | Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub | 232.44 | 2.34 |
| 3300 | Mixed upland nonforested | 55.55 | 0.56 |
| 4100 | Upland conifierous forests | 403.91 | 4.07 |
| 4200 | Upland hardwood forests | 2.55 | 0.03 |

| Level 2 Land Use Code | Attribute | Acres | % of Total |
|---|---|---|---|
| 4300 | Upland hardwood forests cont. | 283.58 | 2.86 |
| 4400 | Tree plantations | 2934.58 | 29.59 |
| 5100 | Streams and waterways | 40.62 | 0.41 |
| 5300 | Reservoirs - pits, retention ponds, dams | 44.29 | 0.45 |
| 6100 | Wetland hardword forests | 538.28 | 5.43 |
| 6200 | Wetland coniferous forests | 146.91 | 1.48 |
| 6300 | Wetland forested mixed | 1081.75 | 10.91 |
| 6400 | Vegetated non-forested wetlands | 1183.9 | 11.94 |
| 7400 | Disturbed land | 49.95 | 0.50 |
| 8100 | Transportation | 66.73 | 0.67 |
| 8300 | Utilities | 91.12 | 0.92 |
| | | | |
| | **TOTAL** | **9917.73** | **100.00** |

Figure 4.3. Principal Level 2 Land Uses in the Trout River Watershed, WBID 2203, in 2004



## Soil Characteristics

The Soil Survey Geographic Database (SSURGO) in the Department's GIS database from the SJRWMD was accessed to provide coverage of hydrologic soil groups in the Trout River watershed (**Figure 4.4**). **Table 4.2** briefly describes the major hydrology soil classes. Soil groups A and B/D are the most common in the watershed, with type D found in the lower portion of the watershed and along the stream corridor.

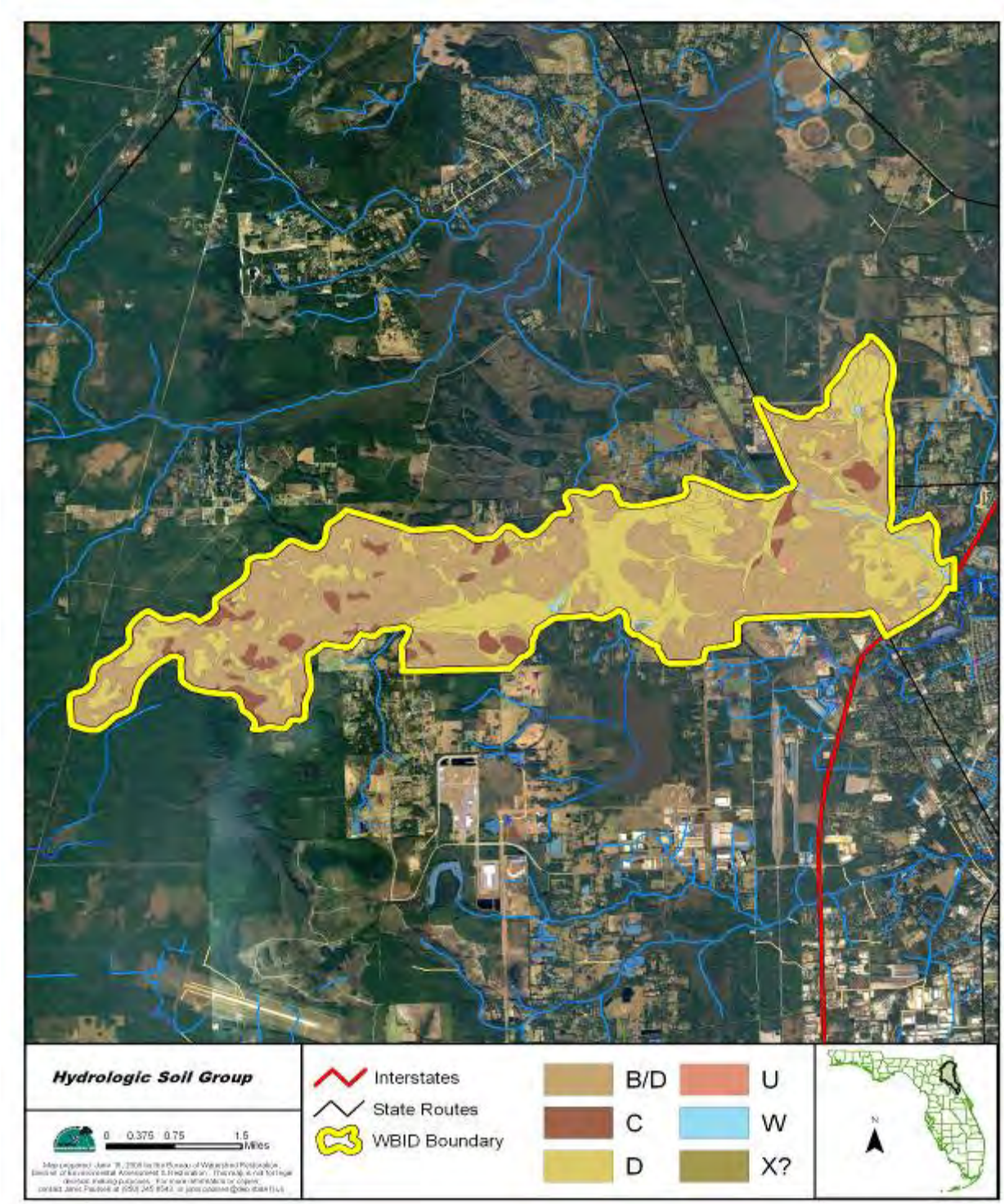
### Table 4.2. Description of Hydrologic Soil Classes from the SSURGO Database

| Hydrology Class | Description |
|---|---|
| A | High infiltration rates. Soils are deep, well-drained to excessively drained sands and gravels. |
| A/D | Drained/undrained hydrology class of soils that can be drained and are classified. |
| B | Moderate infiltration rates. Deep and moderately deep, moderately well- and well-drained soils that have moderately coarse textures. |
| B/D | Drained/undrained hydrology class of soils that have moderately coarse textures. |
| C | Slow infiltration rates. Soils with layers impeding downward movement of water, or soils that have moderately fine or fine textures. |
| C/D | Drained/undrained hydrology class of soils that can be drained and classified. |
| D | Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer. |

## Population

Population and housing unit information from the 2000 census at the block level was obtained from the U.S Census Bureau. GIS was used to estimate the fraction of each block in the Trout River watershed and then applied to the block information to estimate the population and number of housing units. Based on **Table 4.3**, the population in the watershed is estimated at 2,325 people living in 923 households.

## Figure 4.4. Hydrologic Soil Groups Distribution in the Trout River Watershed



### Septic Tanks

It is estimated that approximately 78 percent of the Duval County residences are connected to a wastewater treatment plant, while the rest are using septic tanks (WSEA Septic Files from PBS & J 2007, and DoH Website). Based on the 2000 census estimates, it was assumed that 137 residences in the Trout River watershed are using septic tanks. Using 70 gallons/day/person (EPA, 1999), and drainfield total nitrogen (TN) and total phosphorus (TP) concentrations of 36 mg/L and 15 mg/L, respectively, potential annual ground water loads of TN and TP were calculated. This is a screening level calculation, and soil types, the age of the system, vegetation, proximity to a receiving water, and other factors will influence the degree of attenuation of this load (**Table 4.4**).

#### Table 4.3. Estimated Average Household Size in the Trout River Watershed

| Tract | Block | Population | Housing Units |
|---|---|---|---|
| 105 | 3 | 187 | 70 |
| 105 | 4 | 770 | 330 |
| 105 | 5 | 899 | 339 |
| 105 | 9 | 165 | 69 |
| 106 | 1 | 1 | 0 |
| 106 | 9 | 303 | 114 |
| 107 | 4 | 0 | 0 |
| | **Total** | **2,325** | **923** |
| | | **AVERAGE HOUSEHOLD SIZE:** | **2.52** |

Data from U.S. Census Bureau Website, 2005, based on Duval County blocks that are present in the Trout River watershed.

#### Table 4.4. Estimated Nitrogen and Phosphorus Annual Loading from Septic Tanks in the Trout River Watershed

| Estimated No. Households on Septic | Estimated No. Persons Per Household[1] | Gallons/ Person/ Day[2] | TN in Drainfield (mg/L) | TP in Drainfield (mg/L) | Estimated Annual TN Load (lbs/yr) | Estimated Annual TP Load (lbs/yr) |
|---|---|---|---|---|---|---|
| 137 | 2.52 | 70 | 36 | 15 | 2,650 | 1,104 |

[1] U.S Census Bureau; see **Table 4.3** for more information on this estimate.
[2] EPA, 1999.

## 4.3 Source Summary

### *4.3.1 Summary of Nutrient Loadings to Trout River from Various Sources*

Screening level estimates of annual nitrogen and phosphorus loadings to the watershed were developed based on the 2004 land use and hydrologic soil groups. GIS shapefiles of land use and hydrologic soil groups were used to determine the acreage associated with various Level 2 land uses and soils. Estimates for annual runoff coefficients and event mean concentrations (EMCs) were based on Harper and Baker (2007) and Gao (2006). A screening level estimate of annual runoff was calculated by multiplying the long-term annual average rainfall of 52.44 inches (Jacksonville International Airport, 1955-2007) by the respective runoff coefficient and area. Estimates of annual nitrogen and phosphorus loading were obtained by multiplying the annual runoff by the corresponding EMC. A more detailed loading analysis could be performed based on development of site specific runoff coefficients, EMCs, and knowledge of Best Management Practices (BMPs) that have been implemented in the watershed.

#### Agriculture

At the level 3 land use category, nine agricultural codes were identified in the Trout River watershed. Improved and unimproved pasture represented approximately 6.1% of the watershed area or 603 acres. Field crops represented approximately 3.2% of the watershed area or 318 acres. Aggregating land use to Level 1 for the Trout River watershed yields 1,087 acres in agriculture and 435 acres in rangeland. **Table 4.5** summarizes the screening level estimates for nitrogen and phosphorus loads from agricultural sources.

Table 4.5. Estimated Annual Average TN and TP Loads from Agriculture in the Trout River Watershed

| LAND USE CLASSIFICATION | SOIL GROUP | ACRES | ANNUAL RUNOFF COEFFICIENT | GROSS RUNOFF (ACREFT) | ESTIMATED TN LOAD (LBS) | ESTIMATED TP LOAD (LBS) |
|---|---|---|---|---|---|---|
| Cropland and Pastureland | C | 127.15 | 0.166 | 92.24 | 700.23 | 108.17 |
| | D | 156.56 | 0.226 | 154.62 | 1173.83 | 181.33 |
| | B/D | 653.81 | 0.089 | 254.29 | 1930.44 | 298.21 |
| | W | 0.8 | 0.435 | 1.52 | 11.54 | 1.78 |
| Feeding operations | C | 1.28 | 0.166 | 0.93 | 7.05 | 1.09 |
| | B/D | 44.71 | 0.089 | 17.39 | 132.01 | 20.39 |
| | D | 3.79 | 0.226 | 3.74 | 28.42 | 4.39 |
| Nurseries and vineyards | B/D | 11.54 | 0.089 | 4.49 | 34.07 | 5.26 |
| Specialty farms | D | 3.6 | 0.226 | 3.56 | 26.99 | 4.17 |
| | B/D | 64.57 | 0.089 | 25.11 | 190.65 | 29.45 |
| | C | 19.64 | 0.166 | 14.25 | 108.16 | 16.71 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Herbaceous upland nonforested | D | 13.64 | 0.226 | 13.47 | 42.15 | 2.02 |
| | B/D | 127.44 | 0.089 | 49.57 | 155.10 | 7.42 |
| | C | 6.07 | 0.166 | 4.40 | 13.78 | 0.66 |
| Shrub and brushland (wax myrtle or saw palmetto, occasionally scru | D | 35.83 | 0.226 | 35.39 | 110.73 | 5.30 |
| | B/D | 196.63 | 0.089 | 76.48 | 239.30 | 11.44 |
| | W | 0.01 | 0.435 | 0.02 | 0.06 | 0.00 |
| Mixed upland nonforested | B/D | 27.9 | 0.089 | 10.85 | 33.95 | 1.62 |
| | D | 27.61 | 0.226 | 27.27 | 85.33 | 4.08 |
| | | | | | | |
| | **SUM** | **1,522.58** | | **789.57** | **5,023.78** | **703.51** |

## Urban Areas

There are 1,527 acres in the Level 1 category of urban and built-up in the watershed and 158 acres in transportation, communication, and utilities. Low density residential represents 1,009 acres of the 1,527 acres in the urban and built-up category and approximately 10 percent of the total acreage in the watershed. **Table 4.6** summarizes the screening level estimates for nitrogen and phosphorus loads from urban and built-up categories in the watershed.

## Table 4.6. Estimated Urban and Built-up Annual Nitrogen and Phosphorus Loading in the Trout River Watershed

| LAND USE CLASSIFICATION | SOIL GROUP | ACRES | ANNUAL RUNOFF COEFFICIENT | GROSS RUNOFF (ACREFT) | ESTIMATED TN LOAD (LBS) | ESTIMATED TP LOAD (LBS) |
|---|---|---|---|---|---|---|
| Residential, low density - less than 2 dwelling units/acre | C | 41.08 | 0.166 | 29.80 | 130.55 | 15.49 |
| | D | 296.04 | 0.226 | 292.38 | 1280.84 | 151.95 |
| | B/D | 681.76 | 0.083 | 247.28 | 1083.29 | 128.51 |
| | W | 2.12 | 0.435 | 4.03 | 17.65 | 2.09 |
| | U | 3.53 | 0.435 | 6.71 | 29.40 | 3.49 |
| Residential, medium density - 2-5 dwelling units/acre | B/D | 280.26 | 0.108 | 132.27 | 745.02 | 117.69 |
| | D | 64.12 | 0.252 | 70.61 | 397.72 | 62.83 |
| | C | 32.24 | 0.186 | 26.21 | 147.60 | 23.32 |
| | W | 0.04 | 0.435 | 0.08 | 0.43 | 0.07 |
| | U | 0.76 | 0.435 | 1.44 | 8.14 | 1.29 |
| Commercial and services | D | 11.82 | 0.435 | 22.47 | 109.44 | 16.02 |
| | B/D | 60.36 | 0.35 | 92.32 | 449.66 | 65.82 |
| | U | 7.68 | 0.435 | 14.60 | 71.11 | 10.41 |
| Industrial | B/D | 1.3 | 0.241 | 1.37 | 5.59 | 1.04 |
| | D | 0 | 0.35 | 0.00 | 0.00 | 0.00 |
| Extractive | D | 0.39 | 0.375 | 0.64 | 2.00 | 0.26 |
| | B/D | 1.75 | 0.278 | 2.13 | 6.65 | 0.87 |
| Institutional | B/D | 14.8 | 0.241 | 15.59 | 50.89 | 11.03 |
| | C | 1.48 | 0.309 | 2.00 | 6.53 | 1.41 |
| | D | 1.27 | 0.35 | 1.94 | 6.34 | 1.37 |
| | U | 13.62 | 0.435 | 25.89 | 84.54 | 18.32 |
| Recreational | B/D | 4.95 | 0.089 | 1.93 | 6.02 | 0.29 |
| | D | 2.26 | 0.226 | 2.23 | 6.98 | 0.33 |
| | W | 0.05 | 0.435 | 0.10 | 0.30 | 0.01 |
| | U | 3.17 | 0.435 | 6.03 | 18.86 | 0.90 |
| Disturbed land | D | 15.6 | 0.226 | 15.41 | 67.08 | 8.38 |
| | B/D | 34.34 | 0.089 | 13.36 | 58.15 | 7.27 |
| | W | 0 | 0.435 | 0.00 | 0.00 | 0.00 |
| Transportation | B/D | 29.75 | 0.293 | 38.09 | 169.98 | 22.80 |
| | D | 6.26 | 0.375 | 10.26 | 45.78 | 6.14 |
| | U | 30.43 | 0.435 | 57.85 | 258.13 | 34.63 |
| | W | 0.28 | 0.435 | 0.53 | 2.38 | 0.32 |
| Utilities | C | 1.98 | 0.35 | 3.03 | 13.51 | 1.81 |
| | B/D | 39.18 | 0.293 | 50.17 | 223.86 | 30.03 |
| | D | 44.78 | 0.375 | 73.38 | 327.47 | 43.93 |
| | W | 5.16 | 0.435 | 9.81 | 43.77 | 5.87 |
| | | | | | | |
| | **SUM** | **1,734.61** | | **1,271.91** | **5,875.65** | **795.99** |

### Forest/Wetland/Water/Open Lands Areas

Estimates for nitrogen and phosphorus loadings from land uses in the forest, wetland, and water level 2 classifications are summarized in **Table 4.7**. Wetlands and upland forests represented 30 and 36 percent, respectively of the acreage in the watershed.

Table 4.7. Estimated Forest/Wetland/Water/Open Lands Annual Nitrogen and Phosphorus Loading in Trout River Watershed

| LAND USE CLASSIFICATION | SOIL GROUP | ACRES | ANNUAL RUNOFF COEFFICIENT | GROSS RUNOFF (ACREFT) | ESTIMATED TN LOAD (LBS) | ESTIMATED TP LOAD (LBS) |
|---|---|---|---|---|---|---|
| Upland coniferous forests | D | 82.28 | 0.226 | 81.2613736 | 254.2790272 | 12.16117087 |
| | B/D | 288.14 | 0.089 | 112.0662902 | 350.672232 | 16.77128066 |
| | C | 27.25 | 0.166 | 19.767695 | 61.85608281 | 2.958334395 |
| | U | 6.01 | 0.435 | 11.4247095 | 35.74962973 | 1.7097649 |
| | W | 0.2 | 0.435 | 0.38019 | 1.189671539 | 0.056897334 |
| Upland hardwood forests | B/D | 2.55 | 0.089 | 0.9917715 | 3.103401789 | 0.148423564 |
| Upland hardword forests cont. | B/D | 181.48 | 0.089 | 70.5830164 | 220.8648458 | 10.56310132 |
| | W | 0.33 | 0.435 | 0.6273135 | 1.962958039 | 0.093880602 |
| | D | 65.29 | 0.226 | 64.4817098 | 201.7729422 | 9.65001028 |
| | C | 33.46 | 0.166 | 24.2725532 | 75.95245985 | 3.632508949 |
| | U | 2.99 | 0.435 | 5.6838405 | 17.7855895 | 0.85061515 |
| Tree plantations | B/D | 2255.49 | 0.089 | 877.2277257 | 2744.977138 | 131.2815153 |
| | C | 255.76 | 0.166 | 185.5334192 | 580.5618987 | 27.76600385 |
| | D | 423.18 | 0.226 | 417.9410316 | 1307.800179 | 62.54696508 |
| | U | 0.07 | 0.435 | 0.1330665 | 0.416385038 | 0.019914067 |
| Streams and waterways | D | 10.24 | 0.435 | 19.465728 | 66.20780736 | 5.826287048 |
| | B/D | 0.13 | 0.435 | 0.2471235 | 0.840528804 | 0.073966535 |
| | C | 0.16 | 0.435 | 0.304152 | 1.03449699 | 0.091035735 |
| | U | 0.84 | 0.435 | 1.596798 | 5.431109198 | 0.477937609 |
| | W | 29.25 | 0.435 | 55.6027875 | 189.118981 | 16.64247033 |
| Reservoirs - pits, retention ponds, dams | W | 8.42 | 0.435 | 16.005999 | 54.4404041 | 4.790755561 |
| | B/D | 24.56 | 0.435 | 46.687332 | 158.795288 | 13.97398534 |
| | D | 11.34 | 0.435 | 21.556773 | 73.31997417 | 6.452157727 |
| Wetland hardwood forests | D | 362.22 | 0.435 | 688.562109 | 2997.723998 | 112.4146499 |
| | C | 0.6 | 0.435 | 1.14057 | 4.965585552 | 0.186209458 |
| | B/D | 175.21 | 0.435 | 333.0654495 | 1450.033741 | 54.37626529 |
| | W | 0.26 | 0.435 | 0.494247 | 2.151753739 | 0.080690765 |
| Wetland coniferous forests | B/D | 44.81 | 0.435 | 85.1815695 | 370.846481 | 13.90674304 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | D | 101.09 | 0.435 | 192.1670355 | 836.6184058 | 31.37319022 |
| | C | 0.54 | 0.435 | 1.026513 | 4.469026997 | 0.167588512 |
| | W | 0.44 | 0.435 | 0.836418 | 3.641429405 | 0.136553603 |
| Wetland forested mixed | B/D | 406.43 | 0.435 | 772.6031085 | 3363.604893 | 126.1351835 |
| | D | 663.08 | 0.435 | 1260.481926 | 5487.634113 | 205.7862792 |
| | C | 8.52 | 0.435 | 16.196094 | 70.51131484 | 2.644174306 |
| | W | 2.75 | 0.435 | 5.2276125 | 22.75893378 | 0.853460017 |
| | U | 0.2 | 0.435 | 0.38019 | 1.655195184 | 0.062069819 |
| | X? | 0.79 | 0.435 | 1.5017505 | 6.538020977 | 0.245175787 |
| Vegetated non-forested wetlands | B/D | 262.95 | 0.435 | 499.8548025 | 2176.167868 | 81.60629506 |
| | D | 896.6 | 0.435 | 1704.39177 | 7420.24001 | 278.2590004 |
| | C | 3.53 | 0.435 | 6.7103535 | 29.214195 | 1.095532312 |
| | W | 16.68 | 0.435 | 31.707846 | 138.0432783 | 5.176622938 |
| | X? | 4.13 | 0.435 | 7.8509235 | 34.17978055 | 1.281741771 |
| | | | | | | |
| | **SUM** | **6,660.25** | | **7,643.22** | **30,829.13** | **1,244.33** |

### Upstream Drainage Area of Trout River

The upper segment of the Trout River (WBID 2223) and Gulley Branch (WBID 2201) are contributing watersheds to the middle Trout River WBID (2203) (**Figure 4.5**). The same procedure used for the middle Trout River WBID was used to estimate annual TN and TP loading from the upper Trout and Gulley Branch watersheds (**Table 4.8**).

Table 4.8. Estimated Annual Nitrogen and Phosphorus Loading to WBID 2203 from WBIDs 2223 and 2201

| WBID | Land Use Category | Acres | Gross Runoff (ACREFT) | ESTIMATED TN LOAD (LBS) | ESTIMATED TP LOAD (LBS) |
|---|---|---|---|---|---|
| 2223 | Urban | 422.71 | 183.01 | 792.95 | 94.31 |
| 2223 | Agriculture | 682.44 | 3,24.01 | 2,000.27 | 274.64 |
| 2223 | Forest/ Wetland/ Water | 1,304.94 | 1507.05 | 6,079.69 | 246.43 |
| | SUM | 2,410.09 | 2,014.07 | 8,872.91 | 615.37 |
| | | | | | |
| 2201 | Urban | 399.97 | 270.92 | 1,217.00 | 153.82 |
| 2201 | Agriculture | 218.56 | 124.72 | 752.23 | 101.65 |
| 2201 | Forest/ Wetland/ Water | 637.47 | 697.10 | 2,726.70 | 112.91 |
| | SUM | 1,256 | 1,092.74 | 4,695.93 | 368.37 |
| | | | | | |
| | **TOTAL** | 3,666.1 | 3,106.81 | 13,568.84 | 983.74 |

## Figure 4.5. Contributing Watersheds to the Middle Trout River WBID 2203

**Table 4.9** summarizes the estimates from various land uses in the watershed. It is important to note that this is not a complete list and represents estimates of potential loadings. In addition, proximity to the waterbody, site specific soil characteristics, and rainfall frequency and magnitude are just a few of the factors that could influence and determine the actual loadings from these sources that reach the Trout River. For example, where are the improved pasture and high-density residential areas relative to the Trout River, and is there a riparian buffer area between these land uses and the stream? What types of BMPs, both structural and nonstructural, have been implemented for specific land uses in the watershed that reduce the actual nutrient loads delivered to the Trout River? Finally, the age and condition of the septic systems and drainage characteristics in the watershed could affect assumptions about the assimilation and/or retention of nutrients.

### Table 4.9. Summary of Estimated Potential Annual Nitrogen and Phosphorus Loading from Various Sources in the Trout River Watershed

| Source | Total Nitrogen (lbs/yr) | Total Phosphorus (lbs/yr) |
|---|---|---|
| Septic Tanks* | 11,065 | 4,611 |
| Urban and Built-up | 18,562 | 4,578 |
| Agriculture | 7,931.0 | 1,195.3 |
| Forest/Wetland/Water/Open Lands | 1,962.5 | 82.0 |
| Upper Trout (WBID 2223) | 8,872.91 | 615.37 |
| Gulley Branch (WBID 2201) | 4,695.93 | 368.37 |

* potential contribution to ground water

The screening model approach described previously resulted in an estimated annual surface runoff of 12,811 acre-feet or 11.3 inches per year, based on the combined upper Trout, middle Trout, and Gulley Branch watershed area. Dividing the combined estimated TN load by the surface runoff volume yielded an average TN concentration of 1.58 mg/L. The average and median TN concentrations from the available data were 1.64 and 1.45 mg/L, respectively. Dividing the combined estimated TP load by the surface runoff volume yielded an average TP concentration of 0.107 mg/L. The average and median TP concentrations from the available data were 0.314 and 0.291 mg/L, respectively. As this information was not available, flow and nutrient contributions from ground water inputs to the middle Trout River were not included in this screening level calculation, but would likely have an influence on instream concentrations.

A USGS gaging station (02246599) was located in the upper Trout WBID near the confluence with the middle Trout River WBID from October 1, 2002 through August 10, 2006. The average total discharge for the years 2003 – 2005 at this station was 4,011 acre-feet. A gross surface runoff of 2,017 acre-feet was estimated from the simple screening model. Note that the screening model assumed a long-term rainfall value of 52.44 inches, while the rainfall average

over the 2003 – 2005 period was 59.46 inches and ground water contributions were not included in the screening model.

Camp Dresser & McKee, Inc. is currently working with the City of Jacksonville on an update to the Master Stormwater Management Plan and are using the Watershed Management Model (WMM) to develop nutrient loads for subbasins. The Trout River Basin is one of the basins in which the WMM is being applied.

# Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

## 5.1 Determination of Loading Capacity

### *5.1.1 Data Used in the Determination of the TMDL*

Eight sampling stations on the Trout River have historical DO observations (**Figure 5.1**). **Table 5.1** contains summary information on each of the stations. **Table 5.2** provides a statistical summary of DO observations at each station, and **Appendix B** contains historical DO, corrected chla (CHLAC), TN, TP, and BOD available observations from sampling sites in WBID 2203. **Figure 5.2** displays the historical observations of DO over time. DO exceedance rates by station range between 50 and 100 percent. A linear regression of DO versus sampling date in **Figure 5.2** was not significant at an alpha (α) level of 0.05 ($R^2$ = 0.007). **Appendix E** contains plots of DO by season, station, and year.

**Figures 5.3** through **5.6** present historical CHLAC, TN, TP, and BOD observations, respectively. Linear regressions of TN and TP versus sampling date were not significant at an α level of 0.05. **Appendix E** contains additional plots by season, station, and year. A Statistical summary of major water quality parameters from the available data is presented in **Table 5.3**.

## Table 5.1. Sampling Station Summary for the Trout River Watershed

| Station | STORET ID | Station Owner | Years With Data | N |
|---|---|---|---|---|
| TROUT RIVER AT DINSMORE, FLA. | 112WRD 02246600 | USGS | 1966–1974 | 5 |
| TROUT R US 1 OFF PERRETS DAIRY | 21FLA 20030123 | FDEP | 1975–2008 | 20 |
| TROUT RIVER AT U.S. 1 AT BOAT RAMP PIER | 21FLJXWQTR123 | City of Jacksonville | 1984–2007 | 194 |
| TROUT RIVER AT OLD KINGS ROAD | 21FLJXWQTREE10 | City of Jacksonville | 2002–2007 | 28 |
| TROUT RIVER-DINSMORE @ US 1 BRIDGE | FLVOL TRR010 | Volunteer | 1995-1997 | 17 |
| TROUT RIVER AT OLD KINGS RD | 21FLA 20030753 | FDEP | 2002–2007 | 16 |
| SJ2-SS-2046 TROUT RIVER | FLGW 27947 | FDEP | 2005 | 2 |
| TROUT R @ END OF COLORADO SPRINGS RD | 21FLA 20030047 | FDEP | 2006-2007 | 8 |

## Table 5.2. Statistical Summary of Historical Data for Trout River

| Station | N | Minimum | Maximum | Median | Mean | Exceedances | % Exceedance |
|---|---|---|---|---|---|---|---|
| TROUT RIVER AT DINSMORE, FLA. | 5 | 3.00 | 7.20 | 3.60 | 4.26 | 4 | 80.00 |
| TROUT R US 1 OFF PERRETS DAIRY | 20 | 0.50 | 8.10 | 3.55 | 3.82 | 14 | 70.00 |
| TROUT RIVER AT U.S. 1 AT BOAT RAMP PIER | 194 | 1.19 | 17.60 | 4.30 | 4.68 | 119 | 61.34 |
| TROUT RIVER AT OLD KINGS ROAD | 28 | 1.10 | 9.39 | 4.84 | 4.94 | 14 | 50.00 |
| TROUT RIVER-DINSMORE @ US 1 BRIDGE | 17 | 1.00 | 7.80 | 4.50 | 4.46 | 11 | 64.71 |
| TROUT RIVER AT OLD KINGS RD | 16 | 1.20 | 7.60 | 2.90 | 4.03 | 10 | 62.50 |
| SJ2-SS-2046 TROUT RIVER | 2 | 4.56 | 4.57 | 4.57 | 4.57 | 2 | 100.00 |
| TROUT R @ END OF COLORADO SPRINGS RD | 8 | 2.20 | 8.80 | 4.60 | 4.99 | 5 | 62.50 |

DO concentrations are mg/L.

## Table 5.3. Summary Statistics for Major Water Quality Parameters Measured in Trout River

| PARM | N | MIN | 25% | MEDIAN | MEAN | 75% | MAX |
|---|---|---|---|---|---|---|---|
| BOD (mg/L) | 55 | 0.7 | 1.0 | 2.0 | 2.0 | 2.0 | 13.0 |
| CHLAC (ug/L) | 25 | 1.0 | 1.0 | 1.0 | 3.8 | 3.5 | 25.0 |
| CHLORIDE (mg/L) | 142 | 0 | 0 | 0 | 308 | 21 | 7700 |
| COLOR (PCU) | 48 | 30 | 100 | 200 | 241 | 400 | 600 |
| COND (uS/cm) | 186 | 54 | 219 | 1028 | 5122 | 6400 | 30600 |
| DO (mg/L) | 290 | 0.50 | 3.00 | 4.33 | 4.60 | 5.89 | 17.60 |
| DOSAT (%) | 287 | 6.19 | 36.30 | 48.50 | 50.97 | 62.49 | 192.55 |
| NH4 (mg/L) | 151 | 0.00 | 0.00 | 0.04 | 0.35 | 0.50 | 2.20 |
| NO3O2 (mg/L) | 62 | 0.01 | 0.03 | 0.06 | 0.07 | 0.11 | 0.24 |
| PH (su) | 288 | 5.50 | 6.40 | 6.70 | 6.71 | 7.02 | 8.43 |
| SO4 (mg/L) | 29 | 0.80 | 19.88 | 60.00 | 213.56 | 287.50 | 1000.00 |
| TEMP (C) | 296 | 5.00 | 16.50 | 22.60 | 21.55 | 26.55 | 34.20 |
| TKN (mg/L) | 62 | 0.62 | 1.12 | 1.35 | 1.57 | 1.80 | 3.40 |
| TN (mg/L) | 62 | 0.64 | 1.20 | 1.45 | 1.64 | 1.86 | 3.51 |
| TOC (mg/L) | 27 | 10.00 | 15.00 | 20.00 | 27.70 | 41.75 | 68.00 |
| TORTHO (MG/L) | 15 | 0.188 | 0.212 | 0.282 | 0.309 | 0.378 | 0.583 |
| TP (mg/L) | 49 | 0.034 | 0.170 | 0.291 | 0.314 | 0.436 | 0.860 |
| TSS (mg/L) | 59 | 1 | 4 | 5 | 9 | 16 | 35 |
| TURB (NTU) | 45 | 1 | 4 | 7 | 8 | 9 | 39 |

## Figure 5.1. Historical Sampling Sites in the Trout River Watershed

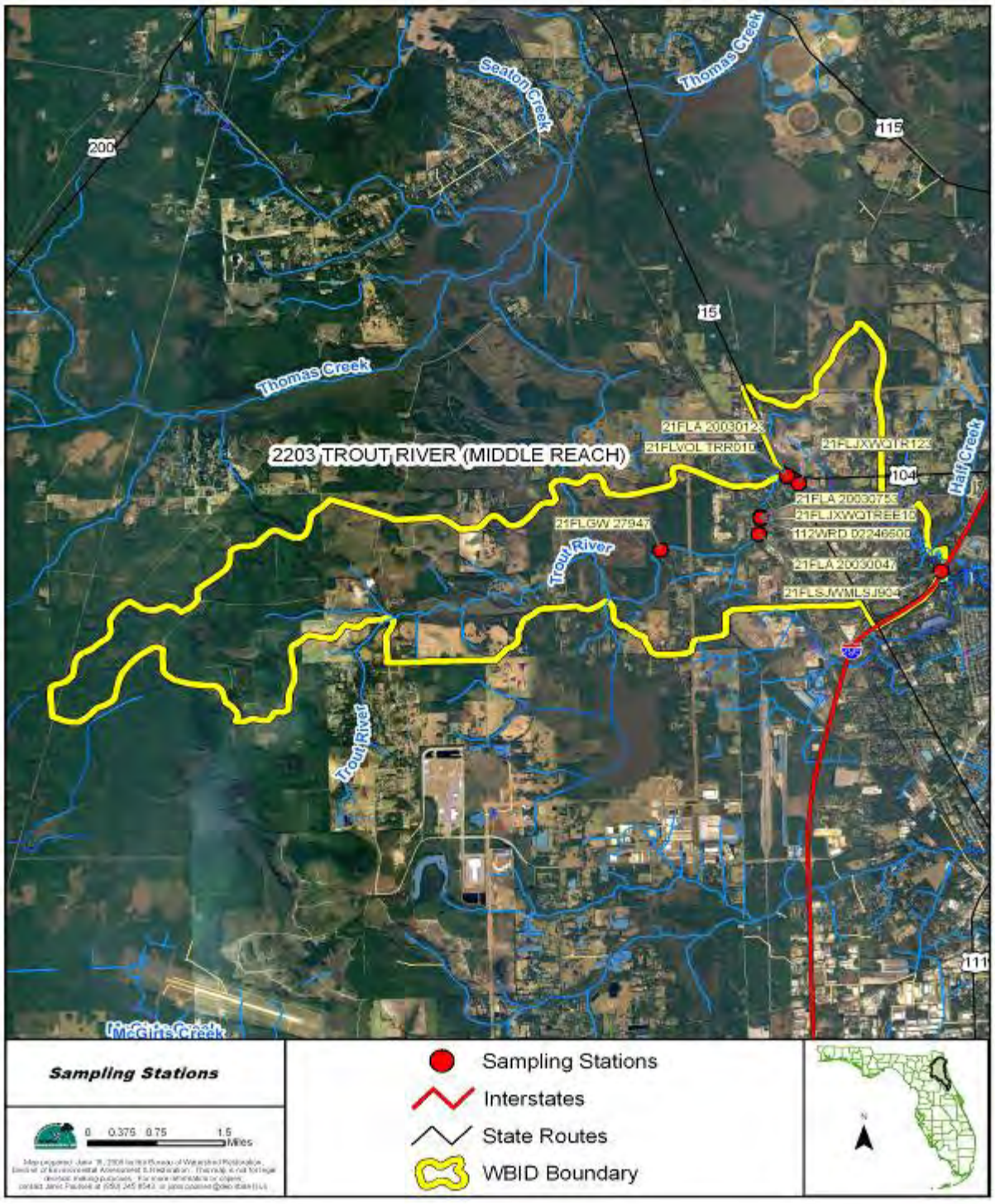


Figure 5.2. Historical DO Observations for Trout River

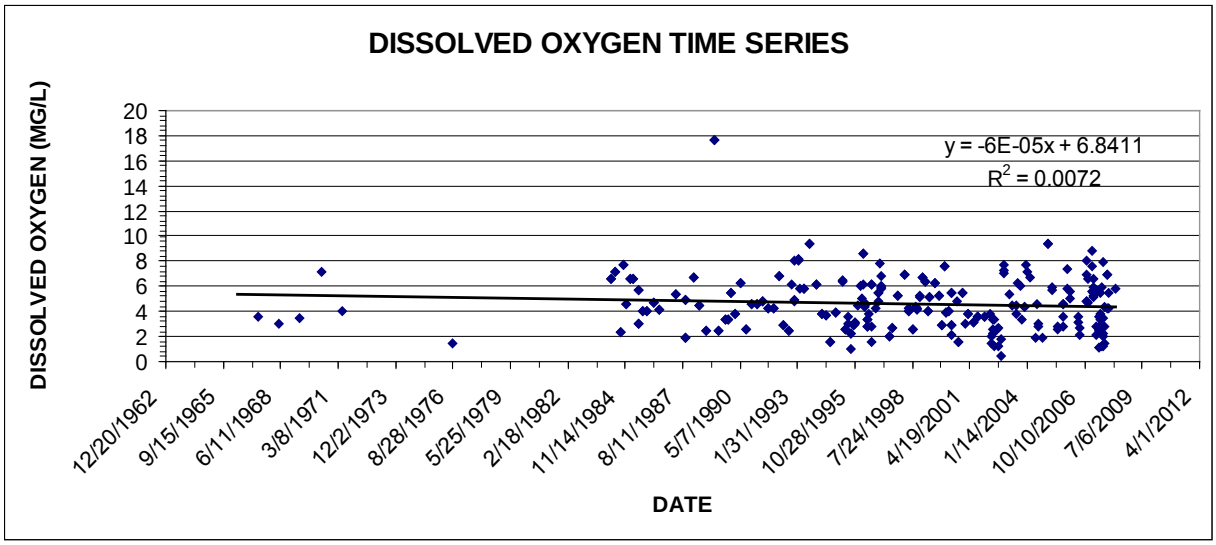



Figure 5.3. Historical Corrected Chla Observations for Trout River

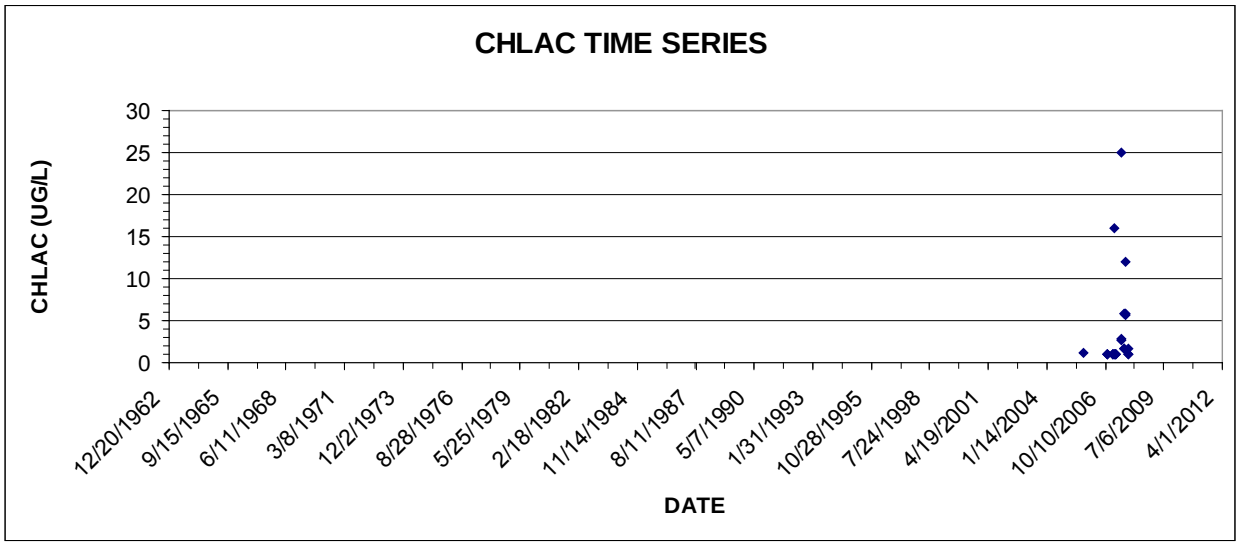


Figure 5.4. Historical TN Observations for Trout River

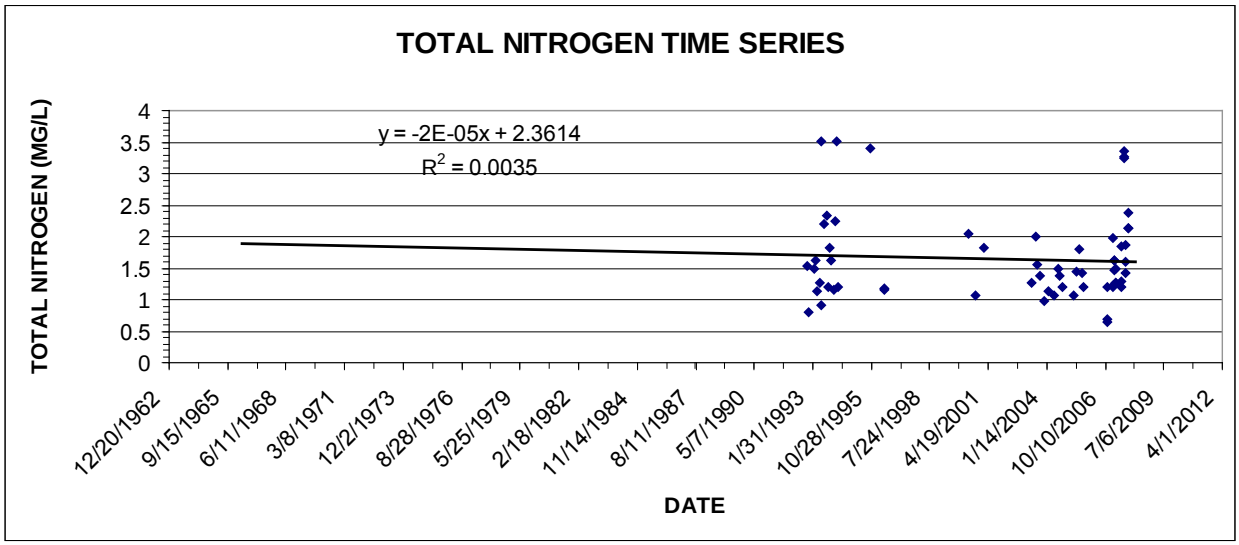
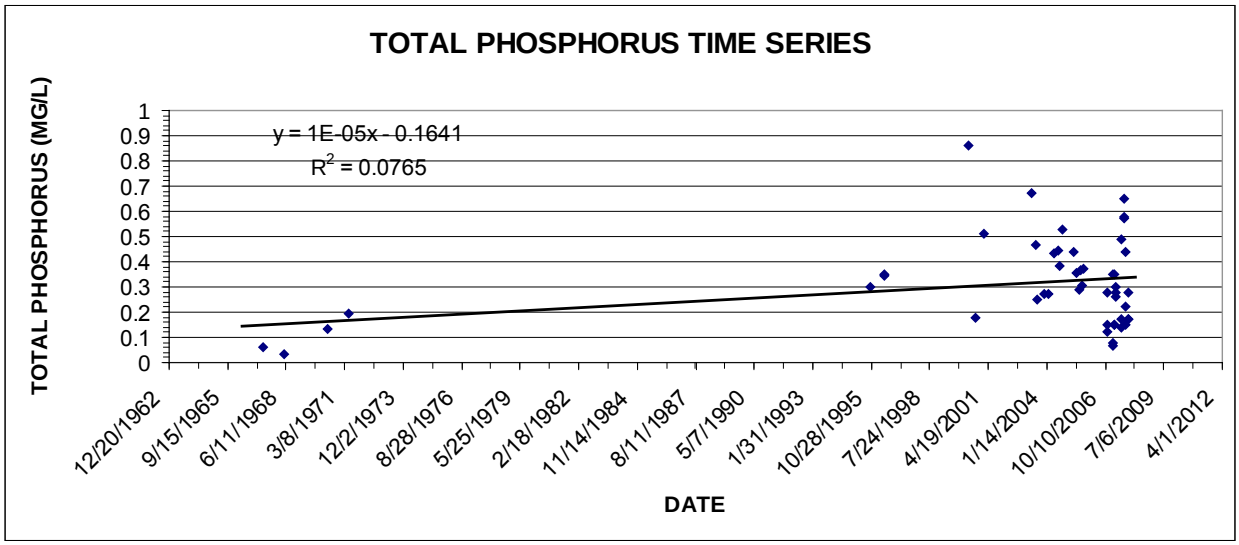
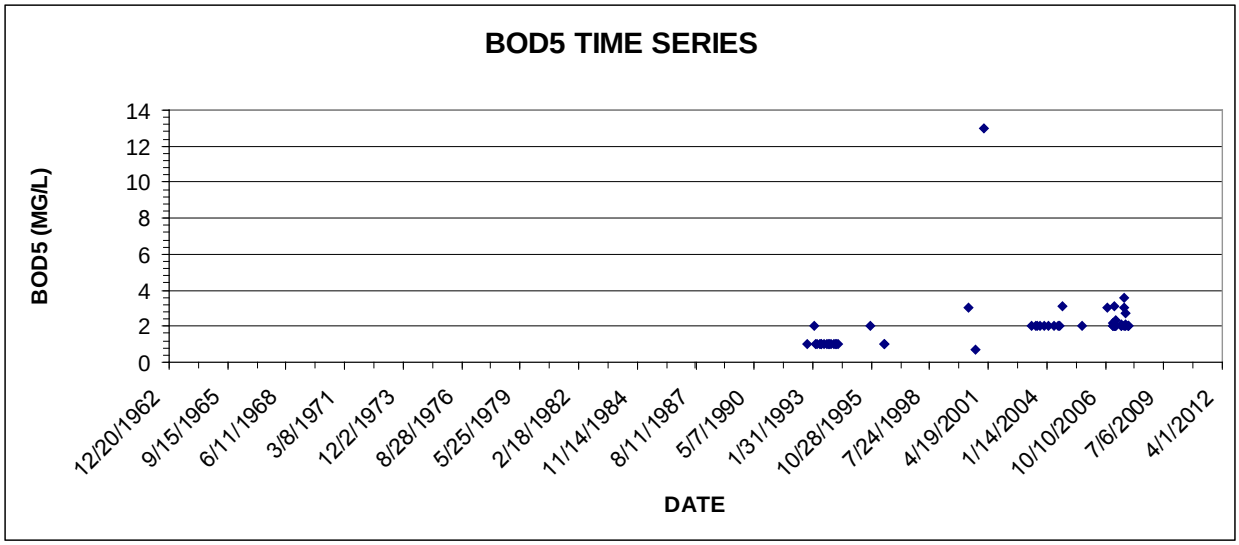



Figure 5.5. Historical TP Observations for Trout River



## Figure 5.6. Historical BOD5 Observations for Trout River




Available DO measurements were also summarized by year (**Table 5.4**) and by season (**Table 5.5**). A nonparametric test (Kruskal-Wallis) was applied to the DO, DOSAT, CHLAC, TN, TP, and BOD5 datasets to determine whether there were significant difference among seasons (**Appendix C**). At an α level of 0.05, differences were significant among seasons for DO,DOSAT,TN, TP, and BOD5. A similar test for differences among months was significant for DO, DOSAT, CLAC, TN, TP, and BOD5 (**Appendix D**).

## Table 5.4. Statistical Summary of Historical DO Data by Year for Trout River

| Year | N | Minimum | Maximum | Median | Mean | Exceedances | % Exceedance |
|---|---|---|---|---|---|---|---|
| 1985 | 15 | 2.1 | 8.65 | 3.9 | 4.43 | 12 | 80.00 |
| 1986 | 5 | 2.8 | 6.5 | 3.2 | 3.80 | 4 | 80.00 |
| 1987 | 6 | 1.7 | 6 | 4.4 | 4.00 | 3 | 50.00 |
| 1988 | 7 | 2.5 | 7.8 | 4.6 | 4.77 | 4 | 57.14 |
| 1989 | 4 | 4 | 7.2 | 5.25 | 5.43 | 2 | 50.00 |
| 1991 | 11 | 2.01 | 6.59 | 3.63 | 4.14 | 7 | 63.64 |
| 1992 | 13 | 1.52 | 9.66 | 3.57 | 4.40 | 8 | 61.54 |
| 1993 | 13 | 1.59 | 9.56 | 4.64 | 4.75 | 7 | 53.85 |
| 1994 | 12 | 2.68 | 11.5 | 4.5 | 4.93 | 9 | 75.00 |
| 1995 | 13 | 1.85 | 9.56 | 4.47 | 4.64 | 7 | 53.85 |
| 1996 | 10 | 1.55 | 6.42 | 4.705 | 4.34 | 7 | 70.00 |
| 1997 | 20 | 2.63 | 7.7 | 5.89 | 5.43 | 7 | 35.00 |
| 1998 | 20 | 2.74 | 8.46 | 5.505 | 5.43 | 7 | 35.00 |
| 1999 | 18 | 2.35 | 9.32 | 5.045 | 5.40 | 8 | 44.44 |
| 2000 | 19 | 3.78 | 8.42 | 5.13 | 5.43 | 9 | 47.37 |
| 2001 | 20 | 1 | 9.96 | 4.66 | 5.06 | 11 | 55.00 |
| 2002 | 20 | 1.97 | 8.19 | 5.02 | 4.38 | 9 | 45.00 |
| 2003 | 20 | 1.23 | 10.5 | 4.605 | 4.71 | 13 | 65.00 |
| 2004 | 20 | 1.57 | 11.68 | 4.06 | 4.49 | 12 | 60.00 |
| 2005 | 19 | 2.01 | 8.38 | 4.58 | 4.78 | 13 | 68.42 |
| 2006 | 10 | 3.59 | 7.56 | 5.985 | 5.69 | 3 | 30.00 |
| 2007 | 14 | 1.6 | 9.73 | 5.81 | 5.23 | 6 | 42.86 |
| 2008 | 2 | 3.72 | 4.11 | 3.915 | 3.92 | 2 | 100.00 |

Table 5.5. Statistical Summary of Historical DO Data by Season for Trout River

| Season | N | Minimum | Maximum | Median | Mean | Exceedances | % Exceedance |
|---|---|---|---|---|---|---|---|
| WINTER | 78 | 2.45 | 11.50 | 6.07 | 6.37 | 15 | 16.67% |
| SPRING | 83 | 1.60 | 11.68 | 4.77 | 5.01 | 44 | 53.01% |
| SUMMER | 76 | 1.23 | 7.70 | 3.30 | 3.53 | 65 | 85.53% |
| FALL | 74 | 1.00 | 9.32 | 4.32 | 4.45 | 46 | 62.16% |

DO concentrations are mg/L.

### *5.1.2 TMDL Development Process*

A Spearman correlation matrix was used to assess potential relationships between DO and other water quality parameters (**Appendix G**). At an alpha (α) level of 0.05, correlations between DO and DOSAT, TN, TP, and water temperature (TEMP) were significant. A simple linear regression of DO versus TEMP explained 27 percent of the variance in DO (**Appendix H**).

Based on a median TP concentration of 0.296 mg/L during the Cycle 2 verification period, phosphorus was identified as the causative pollutant linked to the DO impairment and the associated nutrient impairment listing.

In order to determine the influence of nutrients on DO without the confounding effects of water temperature on all these variables, the general linear model (GLM) was used to develop an expression that included TEMP, TN, and TP. Based on 30 cases with DO, TN, TP, and TEMP observations, the following expression was significant at an α level of 0.05 and explained nearly 72 percent of the variance in DO:

$$DO = 8.471 - 0.098*TEMP - 23.699*TP + 2.315*TN + 0.670*TP*TEMP + 2.202*TN*TP - 0.131*TN*TEMP$$

Since DO is influenced by water temperature, the TMDL was developed using the historical record of TN, TP, and TEMP values (**Appendix B**).

## Table 5.6. Seasonal Summary Statistics for DO, TEMP, TN, TP, BOD5, and CHLAC for Trout River WBID 2203

| SEASON | | DISSOLVED OXYGEN (MG/L) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 65 | 3.00 | 3.80 | 5.09 | 6.38 | 6.35 | 6.80 | 17.60 |
| SPRING | 79 | 1.10 | 1.91 | 2.80 | 3.60 | 3.78 | 4.55 | 7.20 |
| SUMMER | 77 | 1.00 | 1.28 | 2.29 | 2.96 | 3.44 | 4.36 | 9.40 |
| FALL | 69 | 0.50 | 2.90 | 4.19 | 4.85 | 5.17 | 6.20 | 9.39 |
| | | | | | | | | |
| **SEASON** | | **WATER TEMPERATURE ($^{O}$ C)** | | | | | | |
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 66 | 8.10 | 9.72 | 13.10 | 16.00 | 15.73 | 18.30 | 22.06 |
| SPRING | 81 | 15.00 | 16.61 | 23.00 | 25.50 | 25.03 | 27.75 | 30.50 |
| SUMMER | 78 | 23.00 | 23.40 | 25.40 | 26.98 | 27.42 | 29.67 | 34.20 |
| FALL | 71 | 5.00 | 10.09 | 14.00 | 16.37 | 16.52 | 18.90 | 26.10 |
| | | | | | | | | |
| **SEASON** | | **TOTAL NITROGEN (MG/L)** | | | | | | |
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 13 | 1.14 | 1.14 | 1.21 | 1.61 | 1.70 | 1.86 | 3.51 |
| SPRING | 14 | 0.91 | 0.94 | 1.13 | 1.23 | 1.27 | 1.28 | 2.04 |
| SUMMER | 22 | 1.06 | 1.14 | 1.37 | 1.58 | 1.89 | 2.20 | 3.51 |
| FALL | 13 | 0.64 | 0.65 | 0.93 | 1.54 | 1.58 | 2.14 | 3.41 |
| | | | | | | | | |
| **SEASON** | | **TOTAL PHOSPHORUS (MG/L)** | | | | | | |
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 8 | 0.068 | 0.068 | 0.113 | 0.211 | 0.241 | 0.350 | 0.510 |
| SPRING | 14 | 0.034 | 0.039 | 0.196 | 0.323 | 0.337 | 0.435 | 0.860 |
| SUMMER | 19 | 0.140 | 0.145 | 0.228 | 0.370 | 0.368 | 0.484 | 0.650 |
| FALL | 8 | 0.120 | 0.120 | 0.160 | 0.221 | 0.218 | 0.280 | 0.300 |
| | | | | | | | | |
| **SEASON** | | **BOD5 (MG/L)** | | | | | | |
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 13 | 1.0 | 1.0 | 1.0 | 2.0 | 2.6 | 2.1 | 13.0 |
| SPRING | 12 | 1.0 | 1.0 | 1.0 | 1.5 | 1.6 | 2.0 | 3.0 |
| SUMMER | 20 | 0.7 | 0.9 | 2.0 | 2.0 | 2.0 | 2.1 | 3.6 |
| FALL | 10 | 1.0 | 1.0 | 1.0 | 2.0 | 1.7 | 2.0 | 3.0 |
| | | | | | | | | |
| **SEASON** | | **CHLAC (UG/L)** | | | | | | |
| | N | MIN | 5% | 25% | MEDIAN | MEAN | 75% | MAX |
| WINTER | 6 | 1.0 | 1.0 | 1.0 | 1.0 | 3.5 | 1.0 | 16.0 |
| SPRING | 3 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| SUMMER | 10 | 1.2 | 1.2 | 1.7 | 4.2 | 6.4 | 5.8 | 25.0 |
| FALL | 6 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.0 | 1.7 |

In light of the adopted nutrient TMDL for the Lower St. Johns River requiring between a 30 and 50 percent reduction in anthropogenic nitrogen loads to the marine portion of the river, the GLM

model for DO was used to estimate the DO concentration with the historic data set temperature following a 30 percent reduction in TN and reductions in TP. The historic average TEMP was 21.56 $^{o}$C and the historic TN and TP concentrations were 1.64 and 0.314 mg/L, respectively. After checking several combinations of TN (at 30 percent reduction) with various TP reductions, the model predicted that with a 30 percent reduction in TN (1.15 mg/L) and a 70 percent reduction in TP (0.094 mg/L) the mean DO concentration would be 5.1 mg/l. The historic mean DO was 4.6 mg/L (**Table 5.3**).

The Upper Trout River segment (WBID 2223) exceeded the listing thresholds for DO in the Cycle 2 assessment, however a "natural condition" determination was made. The determination was based upon existing land uses, biological, and chemical characteristics of the segment. The median TN and TP concentrations for the Upper Trout River segment for the Cycle 2 verified period were 0.55 and 0.068 mg/L. In constrast, the median TN and TP concentrations for the same period in the Middle Trout River segment were 1.43 and 0.296 mg/L, respectively.

As part of a year-long statewide study of DO in Florida streams and lakes during the 2004 – 2005 period, datasondes were deployed quarterly for three day intervals. During each deployment, water quality samples were collected for analysis and during two of the deployments, biological assessments were conducted. Three reference streams are located near the Trout River in Nassau County. **Table 5.7** summarizes DO and nutrient observations from these three sites. Both the Alligator Creek and Thomas Creek sites had DO measurements below 5 mg/L. The proposeed reduction in TN would result in a concentration similar to the reference site values, while the TP predicted concentration would be within the range observed at these sites.

### Table 5.7. Summary Statistics for DO, TN, and TP from Three Reference Stream Sites (Statewide DO Study 2004-2005)

| **Measurement*** | **STREAM SITE** | | |
|---|---|---|---|
| | NAS206GS Alligator Creek | NAS207LV Thomas Creek | NAS348LV Deep Creek |
| Dissolved Oxygen | | | |
| Ave of daily aves | 5.27 | 4.14 | 5.62 |
| Ave of daily min | 4.91 | 3.82 | 5.15 |
| Ave of daily max | 5.65 | 4.41 | 6.02 |
| | | | |
| Total Nitrogen | | | |
| Average | 1.03 | 1.11 | 0.86 |
| Minimum | 0.93 | 0.69 | 0.72 |
| Maximum | 1.14 | 1.40 | 0.95 |
| | | | |
| Total Phosphorus | | | |
| Average | 0.234 | 0.049 | 0.027 |
| Minimum | 0.185 | 0.022 | 0.019 |
| Maximum | 0.307 | 0.079 | 0.032 |

* All measurements in mg/L

### *5.1.3 Critical Conditions/Seasonality*

A nonparametric test (Kruskal-Wallis) was applied to the DO, DO saturation (DOSAT), corrected chla, TN, and TP datasets to determine whether there were significant differences among months or seasons. At an alpha (α) level of 0.05, there were significant differences among seasons for DO, DOSAT,CHLAC and TN and DO, DOSAT, and CHLAC showed significant differences among months (**Appendices C** and **D**). As seen in **Table 5.5**, all seasons had at least a 16 percent exceedance rate. All months had exceedance rates of at least 9 percent (January), while June, July, and September had the highest exceedance rates (88 percent). The percent reductions in TN and TP were calculated based upon the long-term average TEMP, TN, and TP based upon the historic record..

# 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 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 Trout River are expressed in terms of a percent reduction in total phosphorus, to meet both the DO and nutrient criteria (**Table 6.1**).

Table 6.1. TMDL Components for Trout River

| WBID | Parameter | TMDL (mg/L) | WLA | | LA (% Reduction)[1] | MOS |
|---|---|---|---|---|---|---|
| | | | Wastewater (mg/L) | NPDES Stormwater (% Reduction)[1] | | |
| 2203 | TN | 1.15 | N/A | 30% | 30% | Implicit |
| 2203 | TP | 0.094 | NA | 70% | 70% | Implicit |

[1] As 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 TN reduction of 30 percent and a 70 percent reduction in TP are 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 Trout River watershed; however, any future discharge permits issued in the watershed will also be required to meet the state's Class III criterion for DO and contain appropriate discharge limitations on nitrogen and phosphorus that will comply with the TMDL.

### *6.3.2 NPDES Stormwater Discharges*

The City of Jacksonville and 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 includes all areas of the Trout River watershed and would be responsible for a 30 percent reduction in current anthropogenic TN loading and a 70 percent reduction in current anthropogenic TP 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. The TMDL was based upon long-term averages for TEMP, TN, and TP based upon the historic data. Under these conditions, a mean DO was predicted that would exceed the minimum criterion of 5 mg/L. Information was also presented for reference streams in the same geographic area for which mean DO levels were naturally below 5 mg/L.

# Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

## 7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the Department will determine the best course of action regarding its implementation. Depending upon the pollutant(s) causing the waterbody impairment and the significance of the waterbody, the Department will select the best course of action leading to the development of a plan to restore the waterbody. **Often** this will be accomplished cooperatively with stakeholders by creating a Basin Management Action Plan, referred to as the BMAP. Basin Management Action Plans are the primary mechanism through which TMDLs are implemented in Florida [see Subsection 403.067(7) F.S.]. A single BMAP may provide the conceptual plan for the restoration of one or many impaired waterbodies.

If the Department determines a BMAP is needed to support the implementation of this TMDL, a BMAP will be developed through a transparent stakeholder-driven process intended to result in a plan that is cost-effective, technically feasible, and meets the restoration needs of the applicable waterbodies. Once adopted by order of the Department Secretary, BMAPs are enforceable through wastewater and municipal stormwater permits for point sources and through BMP implementation for nonpoint sources. Among other components, BMAPs typically include:

- Water quality goals (based directly on the TMDL);
- Refined source identification;
- Load reduction requirements for stakeholders (quantitative detailed allocations, if technically feasible);
- 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;
- Implementation funding mechanisms;
- An evaluation of future increases in pollutant loading due to population growth;
- Implementation milestones, project tracking, water quality monitoring, and adaptive management procedures; and
- Stakeholder statements of commitment (typically a local government resolution).

BMAPs are updated through annual meetings and may be officially revised every five years. Completed BMAPs in the state have improved communication and cooperation among local stakeholders and state agencies, improved internal communication within local governments,

applied high-quality science and local information in managing water resources, clarified obligations of wastewater point source, MS4 and non-MS4 stakeholders in TMDL implementation, enhanced transparency in DEP decision-making, and built strong relationships between DEP and local stakeholders that have benefited other program areas.

However, in some basins, and for some parameters, particularly those with fecal coliform impairments, the development of a BMAP using the process described above will not be the most efficient way to restore a waterbody, such that it meets its' designated uses. Why? Because fecal coliform impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Addressing these problems requires good old fashioned detective work that is best done by those in the area. There are a multitude of assessment tools that are available to assist local governments and interested stakeholders in this detective work. The tools range from the simple – such as Walk the WBIDs and GIS mapping - to the complex such as Bacteria Source Tracking. Department staff will provide technical assistance, guidance, and oversight of local efforts to identify and minimize fecal coliform sources of pollution. Based on work in the Lower St Johns River tributaries and the Hillsborough River basin, the Department and local stakeholders have developed a logical process and tools to serve as a foundation for this detective work. In the near future, the Department will be releasing these tools to assist local stakeholders with the development of local implementation plans to address fecal coliform impairments. In such cases, the Department will **rely on these local initiatives** as a more cost-effective and simplified approach to identify the actions needed to put in place a roadmap for restoration activities, while still meeting the requirements of Chapter 403.067(7), F.S.

Earlier in the document, reference was made to the BMAP that was adopted in October 2008 that outlined implementation activities in the marine portion of the Lower St. Johns River to achieve the nutrient TMDL. Since the Trout River represents a contributing watershed to the Lower St. Johns River, applicable activities undertaken in the Trout River watershed as part of the Lower St. Johns River BMAP should be beneficial in addressing the DO and nutrient impairment in the Trout River.

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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 DO, Corrected Chla, TN, TP, BOD5 Observations in Trout River, 1967–2008

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| 112WRD02246600 | 5/10/1967 | 3.6 | | | | 0.0589 |
| 112WRD02246600 | 5/1/1968 | 3 | | | | 0.0341 |
| 112WRD02246600 | 4/29/1969 | 3.5 | | | | |
| 112WRD02246600 | 5/13/1970 | 7.2 | | | | 0.1333 |
| 112WRD02246600 | 5/20/1971 | 4 | | | | 0.1956 |
| FLA20030123 | 8/25/1976 | 1.4 | | | | |
| FLJXWQTR123 | 3/13/1984 | 6.6 | | | | |
| FLJXWQTR123 | 3/13/1984 | 6.6 | | | | |
| FLJXWQTR123 | 5/22/1984 | 7.1 | | | | |
| FLJXWQTR123 | 5/22/1984 | 7.1 | | | | |
| FLJXWQTR123 | 8/28/1984 | 2.3 | | | | |
| FLJXWQTR123 | 8/28/1984 | 2.3 | | | | |
| FLJXWQTR123 | 10/5/1984 | 7.7 | | | | |
| FLJXWQTR123 | 10/5/1984 | 7.7 | | | | |
| FLJXWQTR123 | 12/6/1984 | 4.6 | | | | |
| FLJXWQTR123 | 12/6/1984 | 4.6 | | | | |
| FLJXWQTR123 | 2/5/1985 | 6.6 | | | | |
| FLJXWQTR123 | 2/5/1985 | 6.6 | | | | |
| FLJXWQTR123 | 3/26/1985 | 6.6 | | | | |
| FLJXWQTR123 | 3/26/1985 | 6.6 | | | | |
| FLJXWQTR123 | 6/27/1985 | 3 | | | | |
| FLJXWQTR123 | 6/27/1985 | 3 | | | | |
| FLJXWQTR123 | 6/27/1985 | 5.7 | | | | |
| FLJXWQTR123 | 6/27/1985 | 5.7 | | | | |
| FLJXWQTR123 | 9/23/1985 | 4 | | | | |
| FLJXWQTR123 | 9/23/1985 | 4 | | | | |
| FLJXWQTR123 | 12/4/1985 | 4 | | | | |
| FLJXWQTR123 | 12/4/1985 | 4 | | | | |
| FLJXWQTR123 | 3/20/1986 | 4.7 | | | | |
| FLJXWQTR123 | 3/20/1986 | 4.7 | | | | |
| FLJXWQTR123 | 6/25/1986 | 4.1 | | | | |
| FLJXWQTR123 | 6/25/1986 | 4.1 | | | | |
| FLJXWQTR123 | 4/9/1987 | 5.4 | | | | |
| FLJXWQTR123 | 4/9/1987 | 5.4 | | | | |
| FLJXWQTR123 | 9/16/1987 | 4.9 | | | | |
| FLJXWQTR123 | 9/16/1987 | 4.9 | | | | |
| FLJXWQTR123 | 9/24/1987 | 1.9 | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLJXWQTR123 | 9/24/1987 | 1.9 | | | | |
| FLJXWQTR123 | 2/12/1988 | 6.65 | | | | |
| FLJXWQTR123 | 2/12/1988 | 6.7 | | | | |
| FLJXWQTR123 | 5/20/1988 | 4.5 | | | | |
| FLJXWQTR123 | 5/20/1988 | 4.5 | | | | |
| FLJXWQTR123 | 9/22/1988 | 2.5 | | | | |
| FLJXWQTR123 | 9/22/1988 | 2.5 | | | | |
| FLJXWQTR123 | 2/15/1989 | 17.6 | | | | |
| FLJXWQTR123 | 2/15/1989 | 17.6 | | | | |
| FLJXWQTR123 | 4/26/1989 | 2.5 | | | | |
| FLJXWQTR123 | 4/26/1989 | 2.5 | | | | |
| FLJXWQTR123 | 8/18/1989 | 3.3 | | | | |
| FLJXWQTR123 | 8/18/1989 | 3.3 | | | | |
| FLJXWQTR123 | 10/10/1989 | 3.4 | | | | |
| FLJXWQTR123 | 10/10/1989 | 3.4 | | | | |
| FLJXWQTR123 | 12/1/1989 | 5.5 | | | | |
| FLJXWQTR123 | 12/1/1989 | 5.5 | | | | |
| FLJXWQTR123 | 1/30/1990 | | | | | |
| FLJXWQTR123 | 1/30/1990 | | | | | |
| FLJXWQTR123 | 2/8/1990 | 3.8 | | | | |
| FLJXWQTR123 | 2/8/1990 | 3.8 | | | | |
| FLJXWQTR123 | 4/23/1990 | | | | | |
| FLJXWQTR123 | 4/23/1990 | | | | | |
| FLJXWQTR123 | 5/9/1990 | 6.3 | | | | |
| FLJXWQTR123 | 5/9/1990 | 6.3 | | | | |
| FLJXWQTR123 | 8/7/1990 | | | | | |
| FLJXWQTR123 | 8/7/1990 | | | | | |
| FLJXWQTR123 | 8/23/1990 | 2.55 | | | | |
| FLJXWQTR123 | 8/23/1990 | 2.6 | | | | |
| FLJXWQTR123 | 10/16/1990 | | | | | |
| FLJXWQTR123 | 10/16/1990 | | | | | |
| FLJXWQTR123 | 11/15/1990 | 4.6 | | | | |
| FLJXWQTR123 | 11/15/1990 | 4.6 | | | | |
| FLJXWQTR123 | 2/22/1991 | 4.6 | | | | |
| FLJXWQTR123 | 2/22/1991 | 4.6 | | | | |
| FLJXWQTR123 | 3/19/1991 | | | | | |
| FLJXWQTR123 | 3/19/1991 | | | | | |
| FLJXWQTR123 | 4/16/1991 | | | | | |
| FLJXWQTR123 | 4/16/1991 | | | | | |
| FLJXWQTR123 | 6/5/1991 | 4.8 | | | | |
| FLJXWQTR123 | 6/5/1991 | 4.8 | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLJXWQTR123 | 9/5/1991 | 4.3 | | | | |
| FLJXWQTR123 | 9/5/1991 | 4.3 | | | | |
| FLJXWQTR123 | 9/16/1991 | | | | | |
| FLJXWQTR123 | 9/16/1991 | | | | | |
| FLJXWQTR123 | 10/21/1991 | | | | | |
| FLJXWQTR123 | 10/21/1991 | | | | | |
| FLJXWQTR123 | 12/4/1991 | 4.3 | | | | |
| FLJXWQTR123 | 12/4/1991 | 4.3 | | | | |
| FLJXWQTR123 | 2/4/1992 | | | | | |
| FLJXWQTR123 | 2/4/1992 | | | | | |
| FLJXWQTR123 | 3/11/1992 | 6.8 | | | | |
| FLJXWQTR123 | 3/11/1992 | 6.8 | | | | |
| FLJXWQTR123 | 4/22/1992 | | | | | |
| FLJXWQTR123 | 4/22/1992 | | | | | |
| FLJXWQTR123 | 6/2/1992 | 2.9 | | | | |
| FLJXWQTR123 | 6/2/1992 | 2.9 | | | | |
| FLJXWQTR123 | 8/4/1992 | | | | | |
| FLJXWQTR123 | 8/4/1992 | | | | | |
| FLJXWQTR123 | 9/9/1992 | 2.5 | | | | |
| FLJXWQTR123 | 9/9/1992 | 2.5 | | | | |
| FLJXWQTR123 | 10/20/1992 | | | | | |
| FLJXWQTR123 | 10/20/1992 | | | | | |
| FLJXWQTREE10 | 10/20/1992 | 6.15 | | 1 | 1.54 | |
| FLJXWQTR123 | 12/1/1992 | 4.85 | | | | |
| FLJXWQTR123 | 12/1/1992 | 4.9 | | | | |
| FLJXWQTREE10 | 12/1/1992 | 8.05 | | | 0.81 | |
| FLJXWQTR123 | 1/26/1993 | | | | | |
| FLJXWQTR123 | 1/26/1993 | | | | | |
| FLJXWQTREE10 | 2/23/1993 | 8.06 | | 2 | 1.48 | |
| FLJXWQTR123 | 2/25/1993 | 8.2 | | | | |
| FLJXWQTR123 | 2/25/1993 | 8.2 | | | | |
| FLJXWQTREE10 | 3/23/1993 | 5.86 | | 1 | 1.62 | |
| FLJXWQTR123 | 4/22/1993 | | | | | |
| FLJXWQTR123 | 4/22/1993 | | | | | |
| FLJXWQTREE10 | 4/26/1993 | | | 1 | 1.13 | |
| FLJXWQTREE10 | 5/24/1993 | | | 1 | 1.27 | |
| FLJXWQTR123 | 5/26/1993 | 5.8 | | | | |
| FLJXWQTR123 | 5/26/1993 | 5.8 | | | | |
| FLJXWQTREE10 | 6/22/1993 | | | 1 | 0.91 | |
| FLJXWQTREE10 | 7/5/1993 | | | 1 | 3.51 | |
| FLJXWQTR123 | 7/7/1993 | | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLJXWQTR123 | 7/7/1993 | | | | | |
| FLJXWQTREE10 | 8/2/1993 | | | 1 | 2.2 | |
| FLJXWQTR123 | 9/1/1993 | 9.4 | | | | |
| FLJXWQTR123 | 9/1/1993 | 9.4 | | | | |
| FLJXWQTREE10 | 9/28/1993 | | | 1 | 2.33 | |
| FLJXWQTREE10 | 10/17/1993 | | | 1 | 1.2 | |
| FLJXWQTR123 | 10/19/1993 | | | | | |
| FLJXWQTR123 | 10/19/1993 | | | | | |
| FLJXWQTREE10 | 11/9/1993 | | | 1 | 1.83 | |
| FLJXWQTR123 | 12/13/1993 | 6.2 | | | | |
| FLJXWQTR123 | 12/13/1993 | 6.2 | | | | |
| FLJXWQTREE10 | 12/14/1993 | | | 1 | 1.62 | |
| FLJXWQTREE10 | 1/25/1994 | | | 1 | 1.15 | |
| FLJXWQTR123 | 2/1/1994 | | | | | |
| FLJXWQTR123 | 2/1/1994 | | | | | |
| FLJXWQTREE10 | 2/15/1994 | | | 1 | 2.25 | |
| FLJXWQTREE10 | 3/15/1994 | | | 1 | 3.51 | |
| FLJXWQTR123 | 3/21/1994 | 3.8 | | | | |
| FLJXWQTR123 | 3/21/1994 | 3.8 | | | | |
| FLJXWQTR123 | 4/19/1994 | | | | | |
| FLJXWQTR123 | 4/19/1994 | | | | | |
| FLJXWQTREE10 | 4/19/1994 | | | 1 | 1.2 | |
| FLJXWQTR123 | 6/21/1994 | 3.7 | | | | |
| FLJXWQTR123 | 6/21/1994 | 3.7 | | | | |
| FLJXWQTR123 | 8/10/1994 | | | | | |
| FLJXWQTR123 | 8/10/1994 | | | | | |
| FLJXWQTR123 | 8/30/1994 | 1.6 | | | | |
| FLJXWQTR123 | 8/30/1994 | 1.6 | | | | |
| FLJXWQTR123 | 10/18/1994 | | | | | |
| FLJXWQTR123 | 10/18/1994 | | | | | |
| FLJXWQTR123 | 12/7/1994 | 3.9 | | | | |
| FLJXWQTR123 | 12/7/1994 | 3.9 | | | | |
| FLJXWQTR123 | 1/30/1995 | | | | | |
| FLJXWQTR123 | 1/30/1995 | | | | | |
| FLJXWQTR123 | 3/21/1995 | 6.43 | | | | |
| FLJXWQTR123 | 3/21/1995 | 6.4 | | | | |
| FLJXWQTR123 | 4/19/1995 | | | | | |
| FLJXWQTR123 | 4/19/1995 | | | | | |
| FLJXWQTR123 | 5/18/1995 | 2.58 | | | | |
| FLJXWQTR123 | 5/18/1995 | 2.6 | | | | |
| FLVOL TRR010 | 7/7/1995 | 3.6 | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLVOL TRR010 | 7/10/1995 | 3 | | | | |
| FLVOL TRR010 | 8/15/1995 | 1 | | | | |
| FLJXWQTR123 | 8/22/1995 | 2.24 | | | | |
| FLJXWQTR123 | 8/22/1995 | 2.2 | | | | |
| FLJXWQTR123 | 10/4/1995 | 2.87 | | | | |
| FLJXWQTR123 | 10/4/1995 | 2.9 | | 2 | 3.41 | 0.3 |
| FLJXWQTR123 | 10/31/1995 | 3.07 | | | | |
| FLJXWQTR123 | 10/31/1995 | 3.1 | | | | |
| FLVOL TRR010 | 12/18/1995 | 4.5 | | | | |
| FLVOL TRR010 | 1/23/1996 | 6 | | | | |
| FLVOL TRR010 | 2/23/1996 | 5 | | | | |
| FLJXWQTR123 | 3/12/1996 | 8.63 | | | | |
| FLJXWQTR123 | 3/12/1996 | 8.6 | | | | |
| FLVOL TRR010 | 3/27/1996 | 6.2 | | | | |
| FLVOL TRR010 | 4/23/1996 | 4.4 | | | | |
| FLVOL TRR010 | 5/17/1996 | 4.6 | | | | |
| FLJXWQTR123 | 5/22/1996 | 2.8 | | | | |
| FLJXWQTR123 | 5/22/1996 | 2.8 | | | | |
| FLJXWQTR123 | 6/4/1996 | 3.34 | | 1 | 1.165 | 0.345 |
| FLJXWQTR123 | 6/4/1996 | 3.3 | | 1 | 1.17 | 0.35 |
| FLVOL TRR010 | 6/28/1996 | 3.8 | | | | |
| FLVOL TRR010 | 7/30/1996 | 1.6 | | | | |
| FLJXWQTR123 | 8/15/1996 | 6.18 | | | | |
| FLJXWQTR123 | 8/15/1996 | 6.2 | | | | |
| FLVOL TRR010 | 8/21/1996 | 2.8 | | | | |
| FLVOL TRR010 | 10/19/1996 | 4.2 | | | | |
| FLJXWQTR123 | 11/12/1996 | | | | | |
| FLJXWQTR123 | 11/12/1996 | | | | | |
| FLVOL TRR010 | 12/3/1996 | 4.8 | | | | |
| FLJXWQTR123 | 12/5/1996 | 5.53 | | | | |
| FLJXWQTR123 | 12/5/1996 | 5.5 | | | | |
| FLVOL TRR010 | 12/23/1996 | 7.8 | | | | |
| FLVOL TRR010 | 1/15/1997 | 6.8 | | | | |
| FLVOL TRR010 | 1/29/1997 | 5.8 | | | | |
| FLJXWQTR123 | 2/6/1997 | 5.96 | | | | |
| FLJXWQTR123 | 2/6/1997 | 6 | | | | |
| FLJXWQTR123 | 6/26/1997 | 1.98 | | | | |
| FLJXWQTR123 | 6/26/1997 | 2 | | | | |
| FLJXWQTR123 | 7/28/1997 | 2.67 | | | | |
| FLJXWQTR123 | 7/28/1997 | 2.7 | | | | |
| FLJXWQTR123 | 11/3/1997 | 5.28 | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLJXWQTR123 | 11/3/1997 | 5.3 | | | | |
| FLJXWQTR123 | 3/3/1998 | 6.89 | | | | |
| FLJXWQTR123 | 3/3/1998 | 6.9 | | | | |
| FLJXWQTR123 | 5/12/1998 | 4.24 | | | | |
| FLJXWQTR123 | 5/12/1998 | 4.2 | | | | |
| FLJXWQTR123 | 5/27/1998 | 4.02 | | | | |
| FLJXWQTR123 | 5/27/1998 | 4 | | | | |
| FLJXWQTR123 | 7/27/1998 | 2.57 | | | | |
| FLJXWQTR123 | 7/27/1998 | 2.6 | | | | |
| FLJXWQTR123 | 9/15/1998 | 4.35 | | | | |
| FLJXWQTR123 | 9/15/1998 | 4.4 | | | | |
| FLJXWQTR123 | 10/19/1998 | 4.17 | | | | |
| FLJXWQTR123 | 10/19/1998 | 4.2 | | | | |
| FLJXWQTR123 | 12/8/1998 | 5.18 | | | | |
| FLJXWQTR123 | 12/8/1998 | 5.2 | | | | |
| FLJXWQTR123 | 1/20/1999 | 6.75 | | | | |
| FLJXWQTR123 | 1/20/1999 | 6.75 | | | | |
| FLJXWQTR123 | 3/10/1999 | 6.38 | | | | |
| FLJXWQTR123 | 3/10/1999 | 6.38 | | | | |
| FLJXWQTR123 | 4/21/1999 | 3.98 | | | | |
| FLJXWQTR123 | 4/21/1999 | 3.98 | | | | |
| FLJXWQTR123 | 5/26/1999 | 5.19 | | | | |
| FLJXWQTR123 | 5/26/1999 | 5.19 | | | | |
| FLJXWQTR123 | 8/25/1999 | 6.26 | | | | |
| FLJXWQTR123 | 8/25/1999 | 6.26 | | | | |
| FLJXWQTR123 | 10/19/1999 | 5.29 | | | | |
| FLJXWQTR123 | 10/19/1999 | 5.29 | | | | |
| FLJXWQTR123 | 12/15/1999 | 2.9 | | | | |
| FLJXWQTR123 | 12/15/1999 | 2.9 | | | | |
| FLJXWQTR123 | 1/31/2000 | 7.63 | | | | |
| FLJXWQTR123 | 1/31/2000 | 7.63 | | | | |
| FLJXWQTR123 | 3/2/2000 | 3.95 | | | | |
| FLJXWQTR123 | 3/2/2000 | 3.95 | | | | |
| FLJXWQTR123 | 4/26/2000 | 4.03 | | | | |
| FLJXWQTR123 | 4/26/2000 | 4.03 | | | | |
| FLA20030123 | 5/25/2000 | 2.1 | | 3 | 2.039 | 0.86 |
| FLJXWQTR123 | 6/7/2000 | 2.88 | | | | |
| FLJXWQTR123 | 6/7/2000 | 2.88 | | | | |
| FLJXWQTR123 | 6/13/2000 | 5.45 | | | | |
| FLJXWQTR123 | 6/13/2000 | 5.45 | | | | |
| FLJXWQTR123 | 6/13/2000 | | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLA20030123 | 9/12/2000 | 4.8 | | 0.7 | 1.06 | 0.18 |
| FLJXWQTR123 | 9/21/2000 | 1.56 | | | | |
| FLJXWQTR123 | 9/21/2000 | 1.56 | | | | |
| FLJXWQTR123 | 12/5/2000 | 5.52 | | | | |
| FLJXWQTR123 | 12/5/2000 | 5.52 | | | | |
| FLA20030123 | 1/31/2001 | 3 | | 13 | 1.819 | 0.51 |
| FLJXWQTR123 | 3/7/2001 | 3.84 | | | | |
| FLJXWQTR123 | 3/7/2001 | 3.84 | | | | |
| FLJXWQTR123 | 6/19/2001 | 3.08 | | | | |
| FLJXWQTR123 | 6/19/2001 | 3.08 | | | | |
| FLJXWQTR123 | 8/29/2001 | | | | | |
| FLJXWQTR123 | 8/29/2001 | 3.52 | | | | |
| FLJXWQTR123 | 8/29/2001 | 3.52 | | | | |
| FLJXWQTR123 | 8/29/2001 | 3.52 | | | | |
| FLJXWQTR123 | 12/20/2001 | 3.54 | | | | |
| FLJXWQTR123 | 12/20/2001 | 3.54 | | | | |
| FLJXWQTR123 | 3/27/2002 | 3.85 | | | | |
| FLA20030123 | 4/24/2002 | | | | | |
| FLA20030123 | 4/24/2002 | 2 | | | | |
| FLA20030753 | 4/24/2002 | | | | | |
| FLA20030753 | 4/24/2002 | 1.5 | | | | |
| FLA20030123 | 5/20/2002 | | | | | |
| FLA20030123 | 5/20/2002 | 2.2 | | | | |
| FLA20030753 | 5/20/2002 | | | | | |
| FLA20030753 | 5/20/2002 | 2.6 | | | | |
| FLJXWQTR123 | 5/30/2002 | 3.37 | | | | |
| FLA20030123 | 6/13/2002 | | | | | |
| FLA20030123 | 6/13/2002 | 3.4 | | | | |
| FLA20030753 | 6/13/2002 | | | | | |
| FLA20030753 | 6/13/2002 | 1.2 | | | | |
| FLA20030123 | 8/12/2002 | | | | | |
| FLJXWQTR123 | 8/12/2002 | 2.6 | | | | |
| FLA20030123 | 8/20/2002 | | | | | |
| FLA20030123 | 8/20/2002 | 1.2 | | | | |
| FLA20030753 | 8/20/2002 | | | | | |
| FLA20030753 | 8/20/2002 | 2.7 | | | | |
| FLA20030123 | 10/7/2002 | 0.5 | | | | |
| FLA20030753 | 10/7/2002 | 1.8 | | | | |
| FLA20030123 | 11/20/2002 | | | | | |
| FLA20030123 | 11/20/2002 | 7.7 | | | | |
| FLA20030753 | 11/20/2002 | | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLA20030753 | 11/20/2002 | 7.3 | | | | |
| FLA20030123 | 12/5/2002 | | | | | |
| FLJXWQTR123 | 12/5/2002 | 7.02 | | | | |
| FLJXWQTR123 | 3/13/2003 | 5.31 | | | | |
| FLJXWQTREE10 | 4/22/2003 | 4.45 | | | | |
| FLJXWQTREE10 | 4/22/2003 | | | 2 | 1.276 | 0.67 |
| FLJXWQTR123 | 6/25/2003 | 3.79 | | | | |
| FLJXWQTREE10 | 7/8/2003 | 4.42 | | | | |
| FLJXWQTREE10 | 7/8/2003 | | | 2 | 2.001 | 0.467 |
| FLJXWQTREE10 | 8/5/2003 | 6.23 | | | | |
| FLJXWQTREE10 | 8/5/2003 | | | 2 | 1.549 | 0.252 |
| FLJXWQTREE10 | 9/10/2003 | | | 2 | 1.371 | |
| FLJXWQTREE10 | 9/10/2003 | 6.03 | | | | |
| FLJXWQTR123 | 9/29/2003 | 3.33 | | | | |
| FLJXWQTREE10 | 11/18/2003 | | | | | |
| FLJXWQTREE10 | 11/18/2003 | 4.41 | | | | |
| FLJXWQTREE10 | 11/25/2003 | | | 2 | 0.971 | 0.272 |
| FLJXWQTREE10 | 11/25/2003 | 4.39 | | | | |
| FLJXWQTR123 | 12/15/2003 | 7.71 | | | | |
| FLA20030753 | 1/13/2004 | | | | | |
| FLA20030753 | 1/13/2004 | 7.1 | | | | |
| FLJXWQTREE10 | 2/18/2004 | | | | | |
| FLJXWQTREE10 | 2/18/2004 | | | 2 | 1.144 | 0.271 |
| FLJXWQTR123 | 3/3/2004 | 6.68 | | | | |
| FLJXWQTREE10 | 5/25/2004 | | | 2 | 1.056 | 0.435 |
| FLJXWQTREE10 | 5/25/2004 | 1.85 | | | | |
| FLJXWQTR123 | 6/23/2004 | 4.56 | | | | |
| FLA20030753 | 7/28/2004 | 3 | | | | |
| FLJXWQTREE10 | 8/3/2004 | | | 2 | 1.5 | 0.447 |
| FLJXWQTREE10 | 8/3/2004 | 2.74 | | | | |
| FLJXWQTREE10 | 8/24/2004 | | | 2 | 1.371 | 0.385 |
| FLJXWQTR123 | 9/23/2004 | 1.91 | | | | |
| FLJXWQTREE10 | 9/29/2004 | | | 3.1 | 1.202 | 0.527 |
| FLJXWQTR123 | 12/29/2004 | 9.38 | | | | |
| FLJXWQTREE10 | 12/29/2004 | 9.39 | | | | |
| FLJXWQTR123 | 3/23/2005 | 5.65 | | | | |
| FLJXWQTREE10 | 3/23/2005 | 5.97 | | | | |
| FLJXWQTREE10 | 4/26/2005 | | | | 1.06 | 0.438 |
| FLJXWQTREE10 | 6/2/2005 | | | | 1.435 | 0.358 |
| FLJXWQTR123 | 6/22/2005 | 2.83 | | | | |
| FLJXWQTREE10 | 6/22/2005 | 2.53 | | | | |

| Station | Sample Date | DO (mg/L) | Corr Chla (μg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLJXWQTREE10 | 7/12/2005 | | | | 1.801 | 0.291 |
| FLJXWQTREE10 | 8/23/2005 | | | | | 0.365 |
| FLJXWQTREE10 | 9/6/2005 | | | 2 | 1.412 | 0.303 |
| FLJXWQTR123 | 9/20/2005 | 2.77 | | | | |
| FLJXWQTREE10 | 9/20/2005 | 3.61 | | | | |
| FLGW 27947 | 9/21/2005 | 4.57 | 1.2 | | 1.197 | 0.37 |
| FLGW 27947 | 9/21/2005 | 4.56 | | | | |
| FLJXWQTR123 | 12/5/2005 | 5.8 | | | | |
| FLJXWQTREE10 | 12/5/2005 | 7.36 | | | | |
| FLJXWQTR123 | 1/24/2006 | 5.62 | | | | |
| FLJXWQTREE10 | 1/24/2006 | 5.04 | | | | |
| FLJXWQTR123 | 6/14/2006 | 3.58 | | | | |
| FLJXWQTREE10 | 6/14/2006 | 3.16 | | | | |
| FLJXWQTR123 | 7/17/2006 | 2.14 | | | | |
| FLJXWQTREE10 | 7/17/2006 | 2.64 | | | | |
| FLA20030047 | 11/13/2006 | 4.8 | 1 | | 0.641 | 0.12 |
| FLA20030123 | 11/13/2006 | | 1 | | | |
| FLA20030123 | 11/13/2006 | 4.8 | | | 1.194 | 0.28 |
| FLA20030753 | 11/13/2006 | | 1 | | | |
| FLA20030753 | 11/13/2006 | 6.9 | | | 0.689 | 0.15 |
| FLA20030123 | 11/14/2006 | | | | | |
| FLA20030123 | 11/14/2006 | 8.1 | | 3 | | |
| FLJXWQTR123 | 12/7/2006 | 6.56 | | | | |
| FLJXWQTREE10 | 12/7/2006 | 4.64 | | | | |
| FLA20030047 | 2/20/2007 | 8.8 | 1 | 2 | 1.21 | 0.076 |
| FLA20030123 | 2/20/2007 | | | | | |
| FLA20030123 | 2/20/2007 | | 1 | | | |
| FLA20030123 | 2/20/2007 | 5.6 | | 2.2 | 1.988 | 0.35 |
| FLA20030753 | 2/20/2007 | | | | | |
| FLA20030753 | 2/20/2007 | 7.6 | 1 | 2 | 1.213 | 0.068 |
| FLJXWQTR123 | 3/12/2007 | 5.91 | | | | |
| FLJXWQTREE10 | 3/12/2007 | 5.47 | | | | |
| FLA20030047 | 3/20/2007 | | | | | |
| FLA20030047 | 3/20/2007 | 6.59 | 1 | 2 | 1.624 | 0.15 |
| FLA20030123 | 3/20/2007 | | | | | |
| FLA20030123 | 3/20/2007 | | 16 | | | |
| FLA20030123 | 3/20/2007 | 5.3 | | 3.1 | 1.469 | 0.35 |
| FLA20030753 | 3/20/2007 | | | | | |
| FLA20030753 | 3/20/2007 | 5.1 | 1 | 2 | 1.612 | 0.15 |
| FLA20030047 | 4/17/2007 | | | | | |
| FLA20030047 | 4/17/2007 | 2.8 | 1 | 2 | 1.259 | 0.28 |

| Station | Sample Date | DO (mg/L) | Corr Chla (µg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLA20030123 | 4/17/2007 | | | | | |
| FLA20030123 | 4/17/2007 | | 1 | | | |
| FLA20030123 | 4/17/2007 | 5.7 | | 2.3 | 1.491 | 0.26 |
| FLA20030753 | 4/17/2007 | | | | | |
| FLA20030753 | 4/17/2007 | 2.1 | 1 | 2 | 1.275 | 0.3 |
| FLJXWQTR123 | 6/11/2007 | 3.6 | | | | |
| FLJXWQTREE10 | 6/11/2007 | 1.1 | | | | |
| FLJXWQTR123 | 6/25/2007 | 2.61 | | | | |
| FLJXWQTREE10 | 6/25/2007 | 2.42 | | | | |
| FLA20030047 | 7/17/2007 | | | | | |
| FLA20030047 | 7/17/2007 | 3.4 | 2.8 | 2 | 1.189 | 0.14 |
| FLA20030123 | 7/17/2007 | | | | | |
| FLA20030123 | 7/17/2007 | 3.6 | 25 | 2.1 | 1.845 | 0.49 |
| FLA20030753 | 7/17/2007 | | | | | |
| FLA20030753 | 7/17/2007 | 3.8 | 2.6 | 2 | 1.281 | 0.17 |
| FLJXWQTR123 | 7/17/2007 | 5.42 | | | | |
| FLJXWQTREE10 | 7/17/2007 | 2.96 | | | | |
| FLJXWQTREE10 | 7/24/2007 | 5.89 | | | | |
| FLJXWQTR123 | 8/13/2007 | 1.19 | | | | |
| FLA20030047 | 8/21/2007 | | | | | |
| FLA20030047 | 8/21/2007 | | | | | |
| FLA20030047 | 8/21/2007 | | 1.7 | 2 | 3.271 | 0.57 |
| FLA20030123 | 8/21/2007 | | | | | |
| FLA20030123 | 8/21/2007 | | | | | |
| FLA20030123 | 8/21/2007 | 3.5 | 5.8 | 3 | 3.347 | 0.65 |
| FLJXWQTREE10 | 8/21/2007 | 7.88 | | | | |
| FLA20030047 | 8/22/2007 | 2.2 | | | | |
| FLA20030753 | 8/22/2007 | | | | | |
| FLA20030753 | 8/22/2007 | 2 | 1.7 | 3.6 | 3.243 | 0.58 |
| FLJXWQTR123 | 8/27/2007 | 1.21 | | | | |
| FLA20030047 | 9/18/2007 | | | | | |
| FLA20030047 | 9/18/2007 | | 12 | | | |
| FLA20030047 | 9/18/2007 | 4.4 | | 2.7 | 1.43 | 0.15 |
| FLA20030123 | 9/18/2007 | | | | | |
| FLA20030123 | 9/18/2007 | | 5.6 | | | |
| FLA20030123 | 9/18/2007 | 1.4 | | 2 | 1.856 | 0.44 |
| FLA20030753 | 9/18/2007 | | | | | |
| FLA20030753 | 9/18/2007 | | 5.8 | | | |
| FLA20030753 | 9/18/2007 | 2.8 | | 2.1 | 1.61 | 0.22 |
| FLA20030047 | 11/6/2007 | | | | | |
| FLA20030047 | 11/6/2007 | 6.9 | 1 | 2 | 2.138 | 0.17 |

| Station | Sample Date | DO (mg/L) | Corr Chla (μg/L) | BOD5 (mg/L | TN (mg/L) | TP (mg/L) |
|---|---|---|---|---|---|---|
| FLA20030123 | 11/6/2007 | | | | | |
| FLA20030123 | 11/6/2007 | | 1.7 | | | |
| FLA20030123 | 11/6/2007 | 4.2 | | 2 | 2.375 | 0.28 |
| FLA20030753 | 11/6/2007 | | | | | |
| FLA20030753 | 11/6/2007 | | 1 | | | |
| FLA20030753 | 11/6/2007 | 6.9 | | 2 | 2.138 | 0.17 |
| FLJXWQTR123 | 12/11/2007 | 4.21 | | | | |
| FLJXWQTREE10 | 12/11/2007 | 5.49 | | | | |
| FLA20030123 | 3/17/2008 | 5.8 | | | | |

## Appendix C: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Season in Trout River

Kruskal-Wallis One-Way Analysis of Variance for 290 cases
Dependent variable is DO
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 69 | 12164.000 |
| SPRING | 79 | 8850.500 |
| SUMMER | 77 | 7163.500 |
| WINTER | 65 | 14017.000 |

Kruskal-Wallis Test Statistic = 97.517
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 287 cases
Dependent variable is DOSAT
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 69 | 10828.000 |
| SPRING | 79 | 9752.000 |
| SUMMER | 74 | 7798.000 |
| WINTER | 65 | 12950.000 |

Kruskal-Wallis Test Statistic = 51.333
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 25 cases
Dependent variable is VCHLAC
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 6 | 51.000 |
| SPRING | 3 | 21.000 |
| SUMMER | 10 | 194.000 |
| WINTER | 6 | 59.000 |

Kruskal-Wallis Test Statistic = 15.045
Probability is 0.002 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 62 cases
Dependent variable is TN
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 13 | 384.000 |
| SPRING | 14 | 278.000 |
| SUMMER | 22 | 835.000 |
| WINTER | 13 | 456.000 |

Kruskal-Wallis Test Statistic = 9.312
Probability is 0.025 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 49 cases
Dependent variable is TP
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 8 | 134.000 |
| SPRING | 14 | 358.500 |
| SUMMER | 19 | 581.500 |
| WINTER | 8 | 151.000 |

Kruskal-Wallis Test Statistic = 7.094
Probability is 0.069 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 55 cases
Dependent variable is VBOD5
Grouping variable is SEASON$

| Group | Count | Rank Sum |
|---|---|---|
| FALL | 10 | 245.000 |
| SPRING | 12 | 281.000 |
| SUMMER | 20 | 634.500 |
| WINTER | 13 | 379.500 |

Kruskal-Wallis Test Statistic = 2.981
Probability is 0.395 assuming Chi-square distribution with 3 df

## Appendix D: Kruskal–Wallis Analysis of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations versus Month in Trout River

Kruskal-Wallis One-Way Analysis of Variance for 290 cases
Dependent variable is DO
Grouping variable is MONTH

| Group | Count | Rank Sum |
|---|---|---|
| 1 | 11 | 2458.000 |
| 2 | 19 | 4334.500 |
| 3 | 35 | 7224.500 |
| 4 | 16 | 1693.000 |
| 5 | 28 | 3784.000 |
| 6 | 35 | 3373.500 |
| 7 | 17 | 1479.500 |
| 8 | 31 | 2511.500 |
| 9 | 29 | 3172.500 |
| 10 | 16 | 2044.000 |
| 11 | 15 | 3076.500 |
| 12 | 38 | 7043.500 |

Kruskal-Wallis Test Statistic = 111.295
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 287 cases
Dependent variable is DOSAT
Grouping variable is MONTH

| Group | Count | Rank Sum |
|---|---|---|
| 1 | 11 | 2182.000 |
| 2 | 19 | 3919.000 |
| 3 | 35 | 6849.000 |
| 4 | 16 | 1567.000 |
| 5 | 28 | 4204.000 |
| 6 | 35 | 3981.000 |
| 7 | 17 | 1787.000 |
| 8 | 30 | 2885.000 |
| 9 | 27 | 3126.000 |
| 10 | 16 | 2017.000 |
| 11 | 15 | 2783.000 |
| 12 | 38 | 6028.000 |

Kruskal-Wallis Test Statistic = 61.226
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 25 cases
Dependent variable is VCHLAC
Grouping variable is MONTH

| Group | Count | Rank Sum |
|---|---|---|
| 2 | 3 | 21.000 |
| 3 | 3 | 38.000 |
| 4 | 3 | 21.000 |
| 7 | 3 | 62.000 |
| 8 | 3 | 53.500 |
| 9 | 4 | 78.500 |
| 11 | 6 | 51.000 |

Kruskal-Wallis Test Statistic = 16.347
Probability is 0.012 assuming Chi-square distribution with 6 df

Kruskal-Wallis One-Way Analysis of Variance for 62 cases
Dependent variable is TN
Grouping variable is MONTH

| Group | Count | Rank Sum |
|---|---|---|
| 1 | 2 | 55.000 |
| 2 | 6 | 186.000 |
| 3 | 5 | 215.000 |
| 4 | 7 | 139.000 |
| 5 | 3 | 79.000 |
| 6 | 4 | 60.000 |
| 7 | 6 | 239.500 |
| 8 | 7 | 326.500 |
| 9 | 9 | 269.000 |
| 10 | 3 | 113.500 |
| 11 | 8 | 227.000 |
| 12 | 2 | 43.500 |

Kruskal-Wallis Test Statistic = 16.146
Probability is 0.136 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 49 cases
Dependent variable is TP
Grouping variable is MONTH

| Group | Count | Rank Sum |
|---|---|---|
| 1 | 1 | 43.000 |
| 2 | 4 | 58.000 |
| 3 | 3 | 50.000 |
| 4 | 5 | 154.500 |
| 5 | 6 | 111.000 |
| 6 | 3 | 93.000 |
| 7 | 5 | 128.000 |
| 8 | 7 | 266.000 |
| 9 | 7 | 187.500 |
| 10 | 1 | 26.500 |
| 11 | 7 | 107.500 |

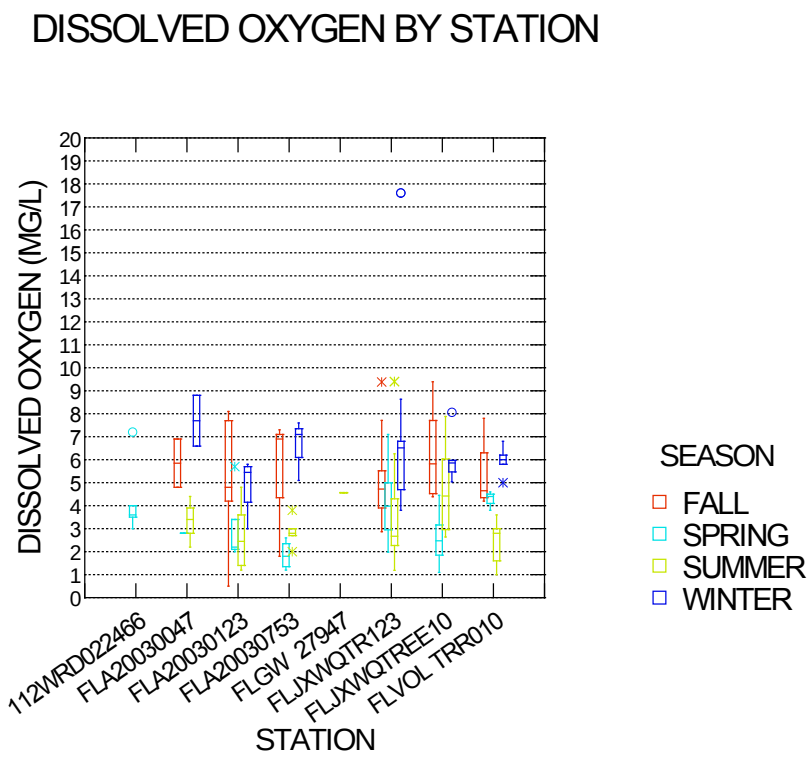
Kruskal-Wallis Test Statistic = 16.521
Probability is 0.086 assuming Chi-square distribution with 10 df

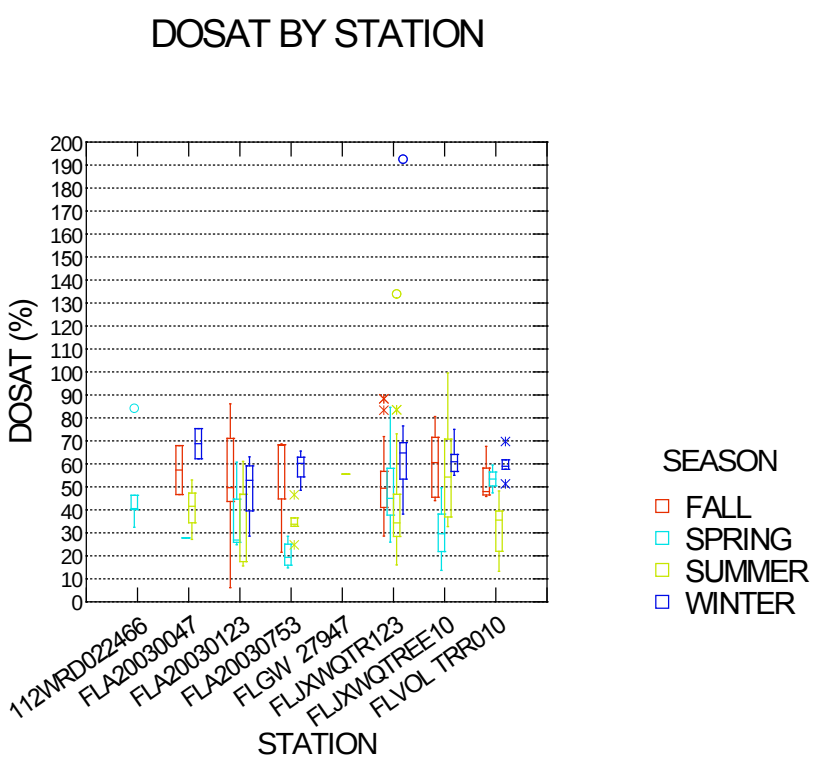
Kruskal-Wallis One-Way Analysis of Variance for 55 cases
Dependent variable is VBOD5
Grouping variable is MONTH

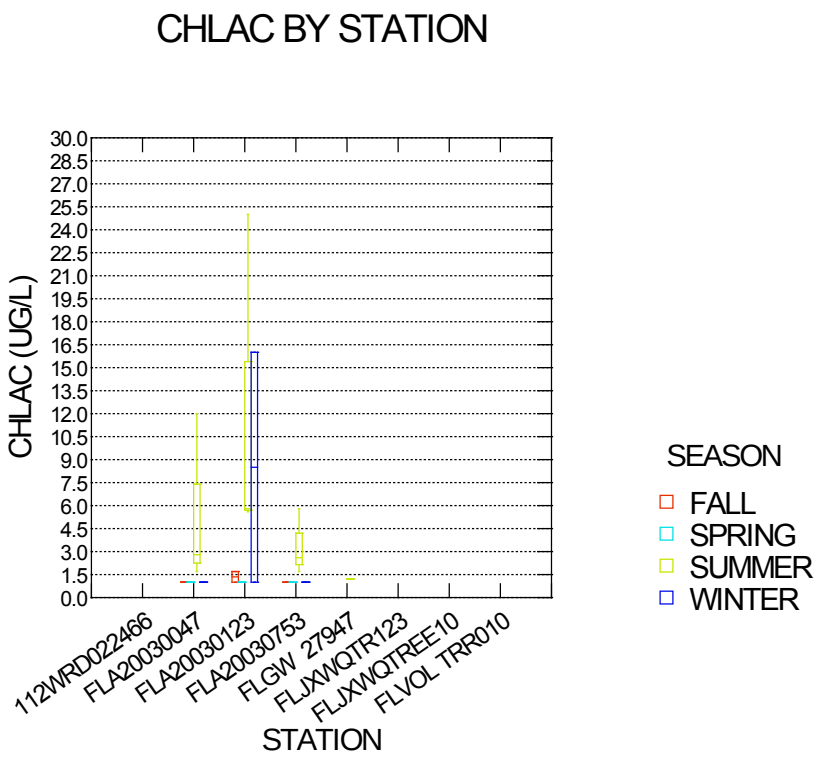
| Group | Count | Rank Sum |
|---|---|---|
| 1 | 2 | 65.000 |
| 2 | 6 | 180.000 |
| 3 | 5 | 134.500 |
| 4 | 6 | 160.000 |
| 5 | 3 | 91.000 |
| 6 | 3 | 30.000 |
| 7 | 5 | 147.500 |
| 8 | 7 | 238.000 |
| 9 | 8 | 249.000 |
| 10 | 3 | 51.000 |
| 11 | 6 | 184.000 |
| 12 | 1 | 10.000 |

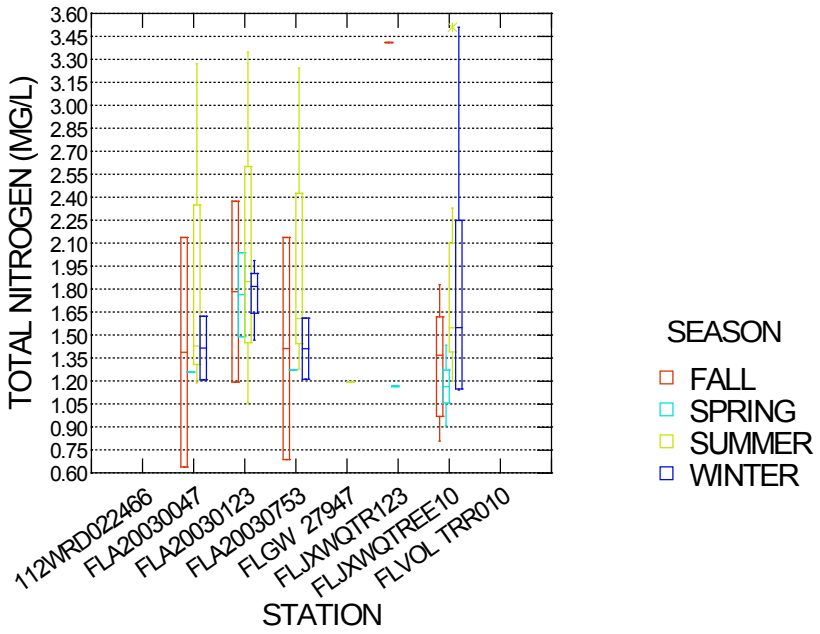
Kruskal-Wallis Test Statistic = 9.515
Probability is 0.575 assuming Chi-square distribution with 11 df

## Appendix E: Chart of DO, DOSAT, Corrected Chla, TN, TP, and BOD5 Observations by Season, Station, and Year in Trout River

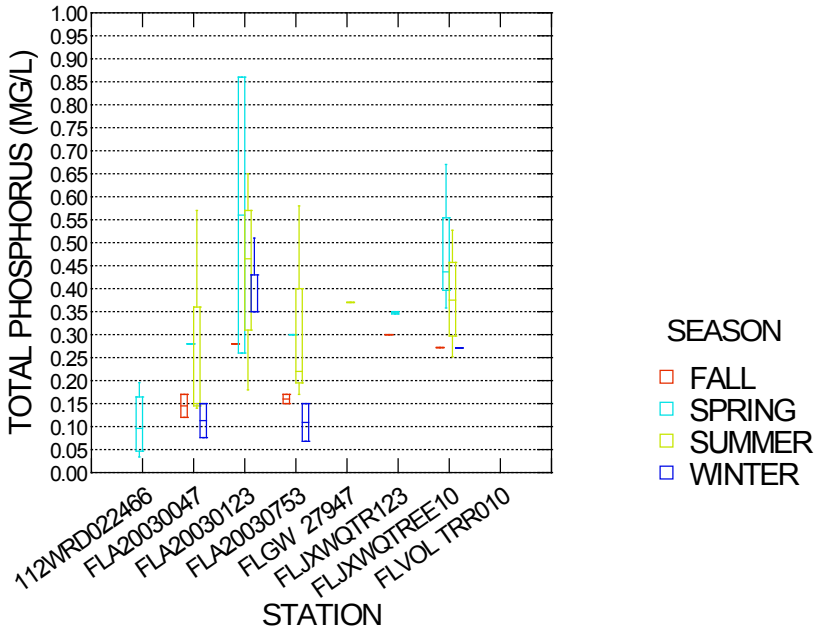



DOSAT BY STATION
DOSAT (%)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

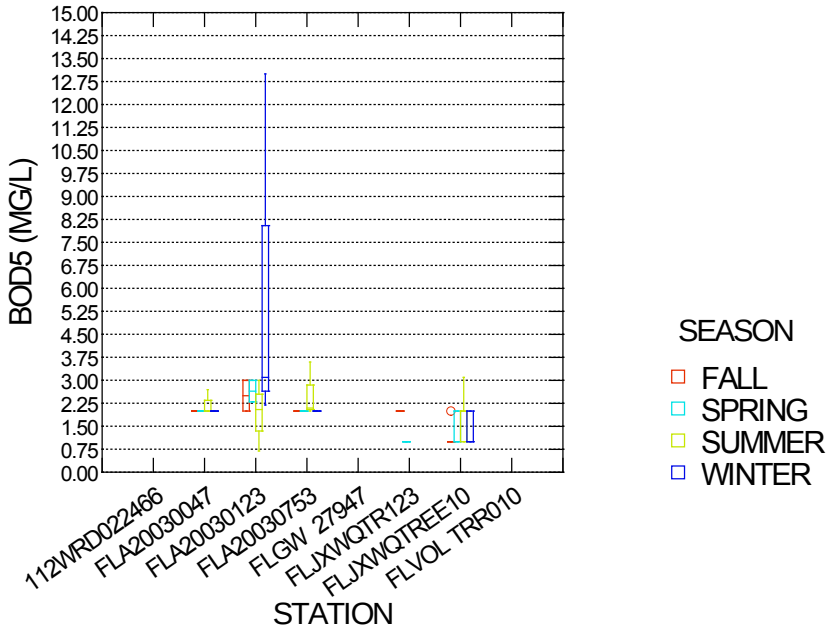

CHLAC BY STATION
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER


TOTAL NITROGEN BY STATION
TOTAL NITROGEN (MG/L)
3.60
3.45
3.30
3.15
3.00
2.85
2.70
2.55
2.40
2.25
2.10
1.95
1.80
1.65
1.50
1.35
1.20
1.05
0.90
0.75
0.60
112WRD022466
FLA20030047
FLA20030123
FLA20030753
FLGW 27947
FLJXWQTR123
FLJXWQTREE10
FLVOL TRR010
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

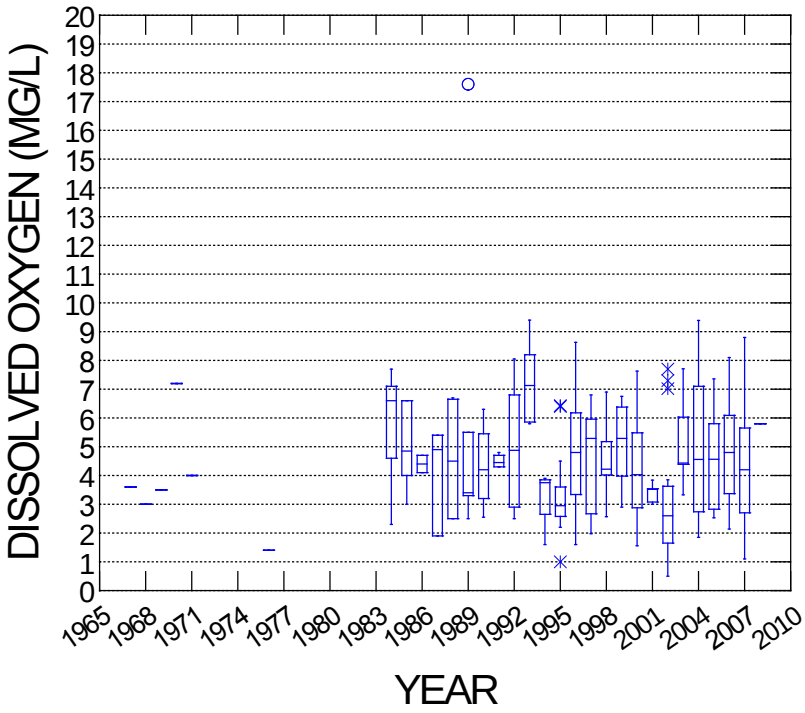
## TOTAL PHOSPHORUS BY STATION



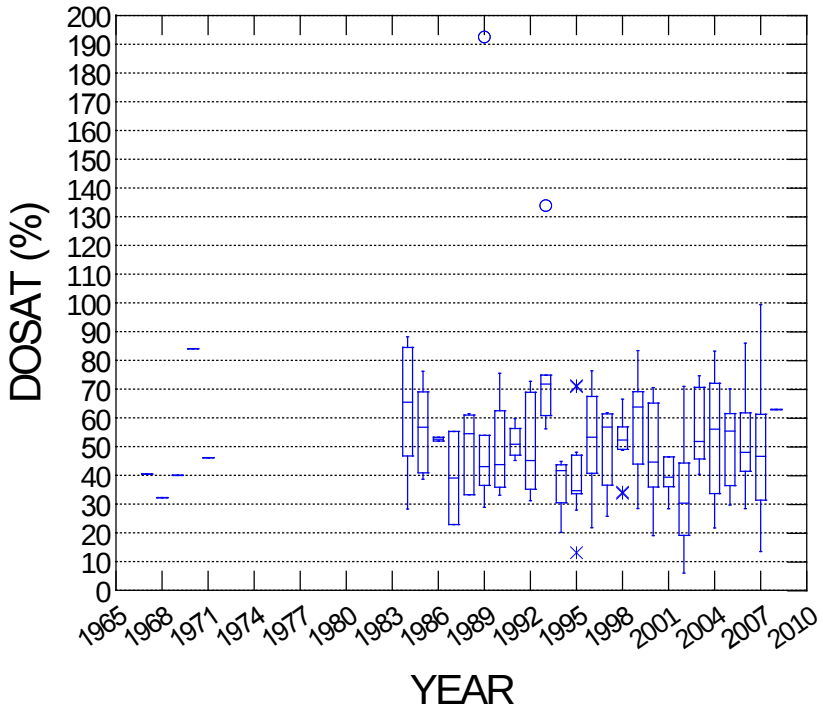

## BOD5 BY STATION

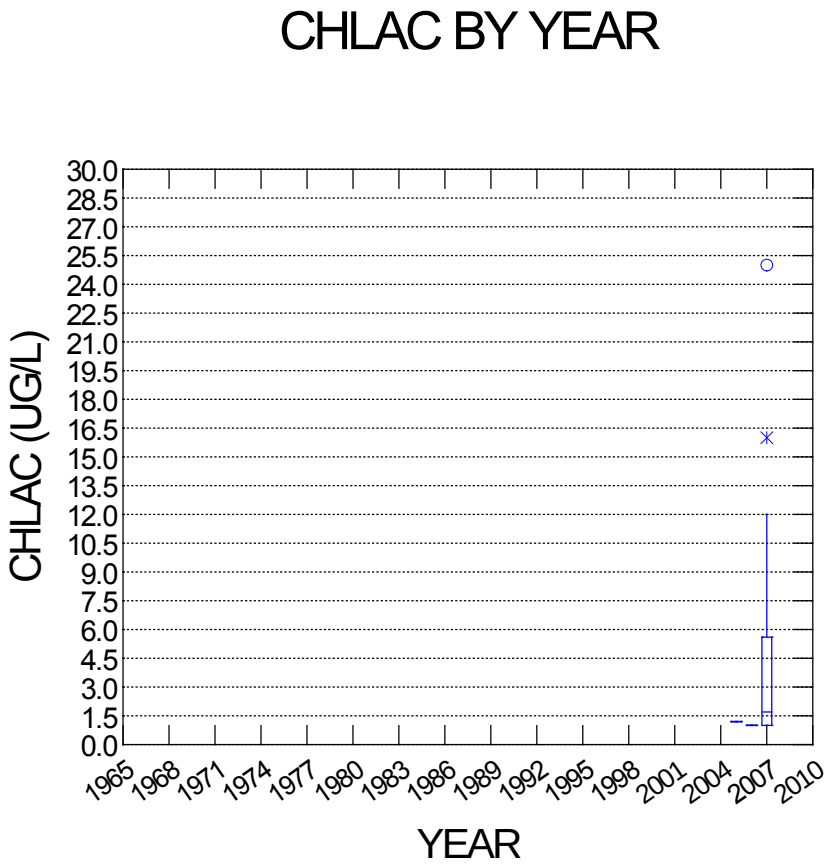


# DISSOLVED OXYGEN BY YEAR

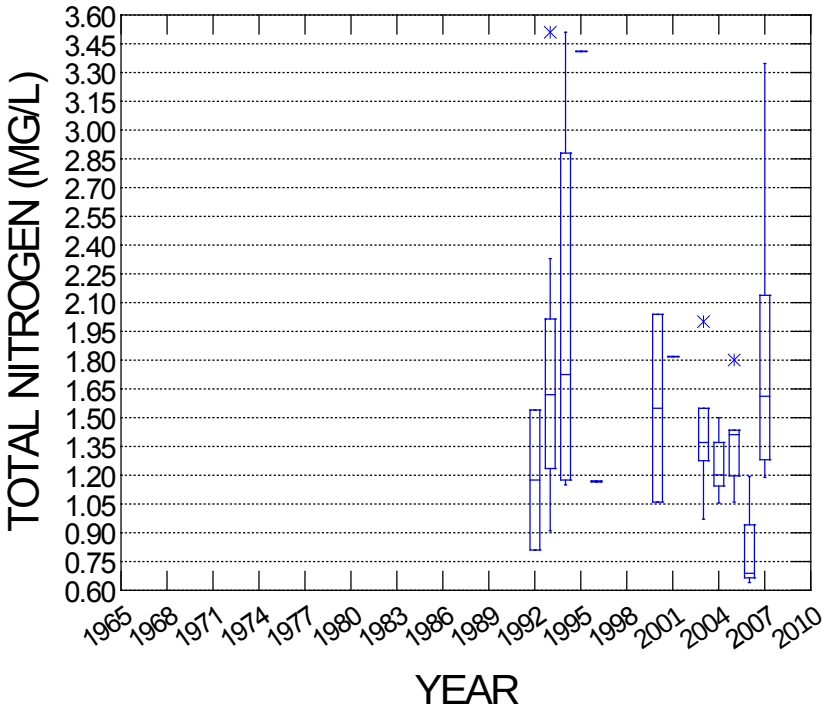


# DOSAT BY YEAR

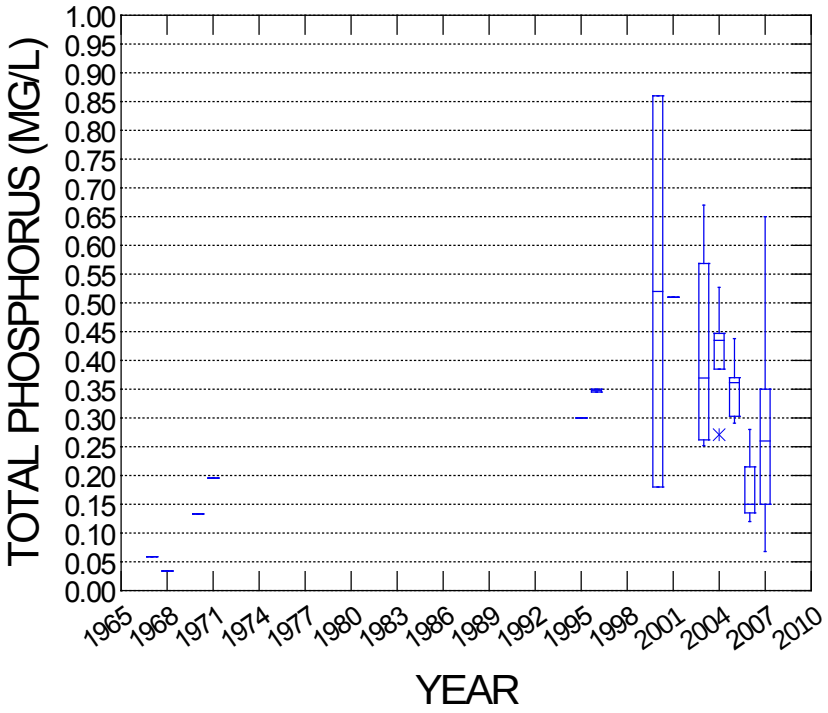


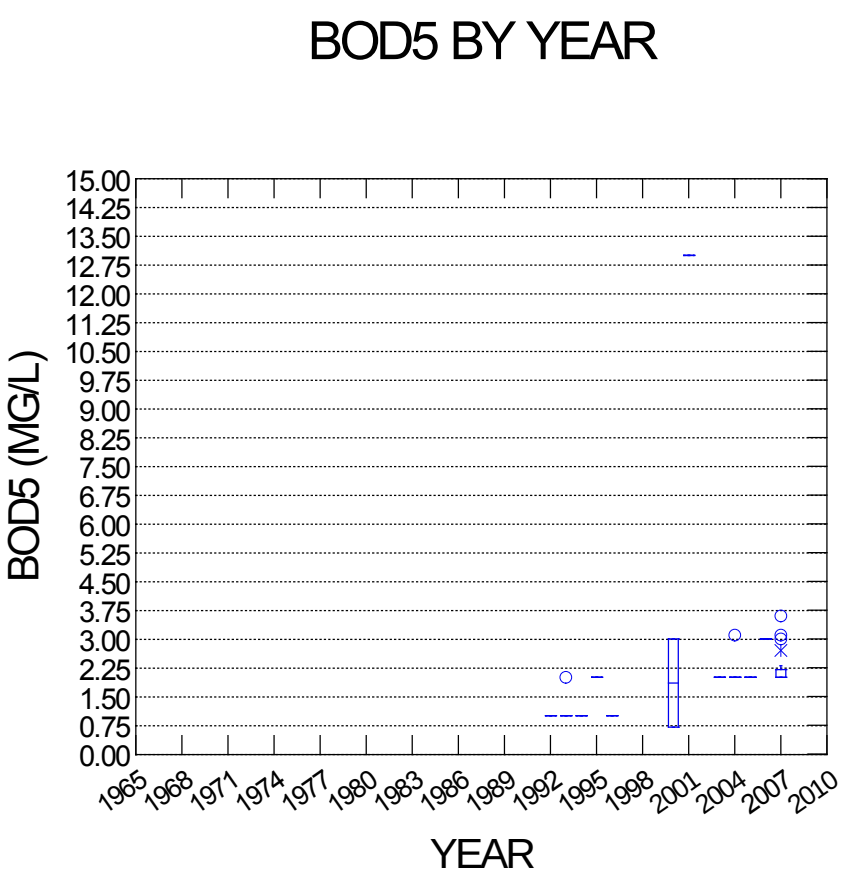

CHLAC BY YEAR
CHLAC (UG/L)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

# TOTAL NITROGEN BY YEAR

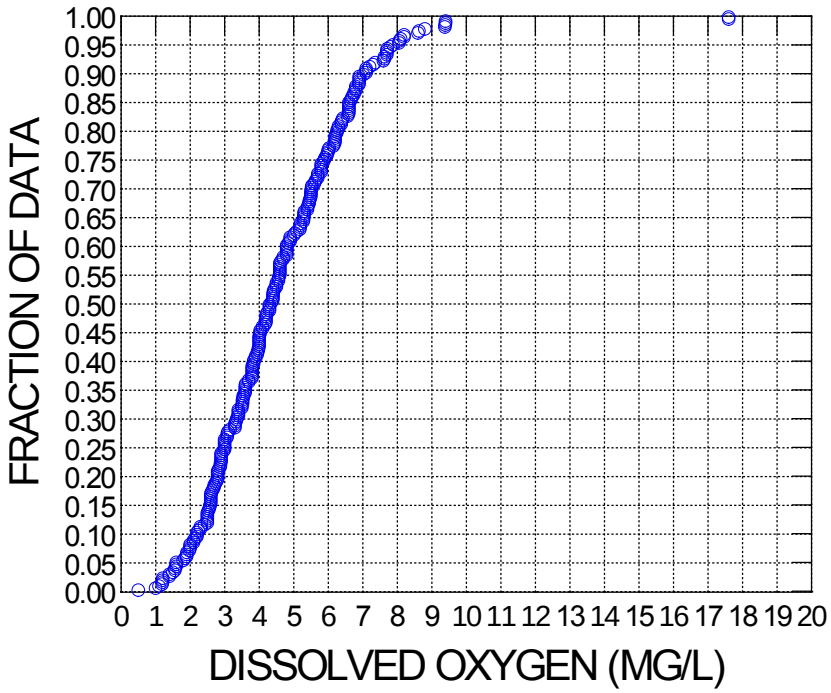


# TOTAL PHOSPHORUS BY YEAR

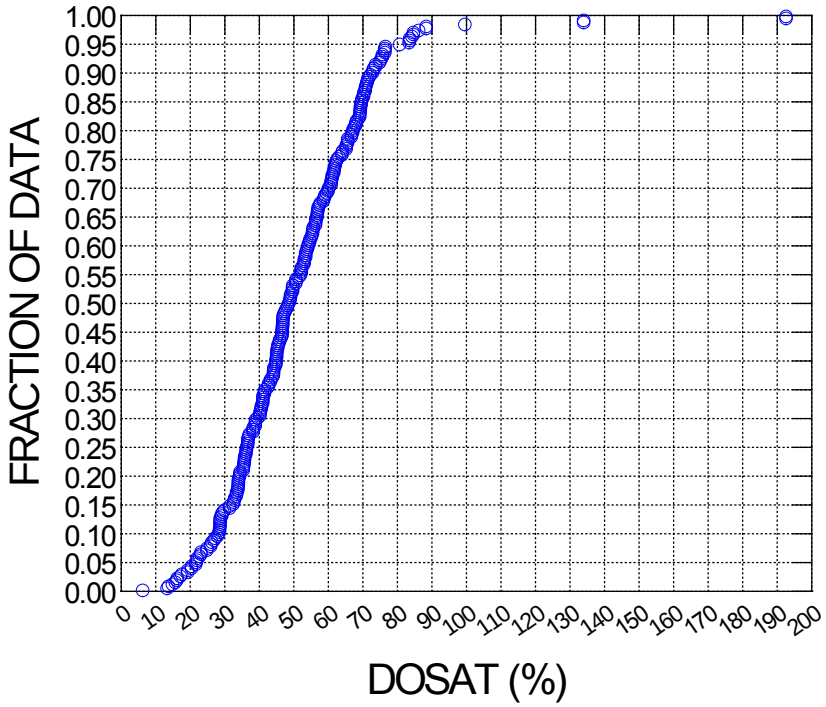



BOD5 BY YEAR
BOD5 (MG/L)
15.00
14.25
13.50
12.75
12.00
11.25
10.50
9.75
9.00
8.25
7.50
6.75
6.00
5.25
4.50
3.75
3.00
2.25
1.50
0.75
0.00
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
YEAR

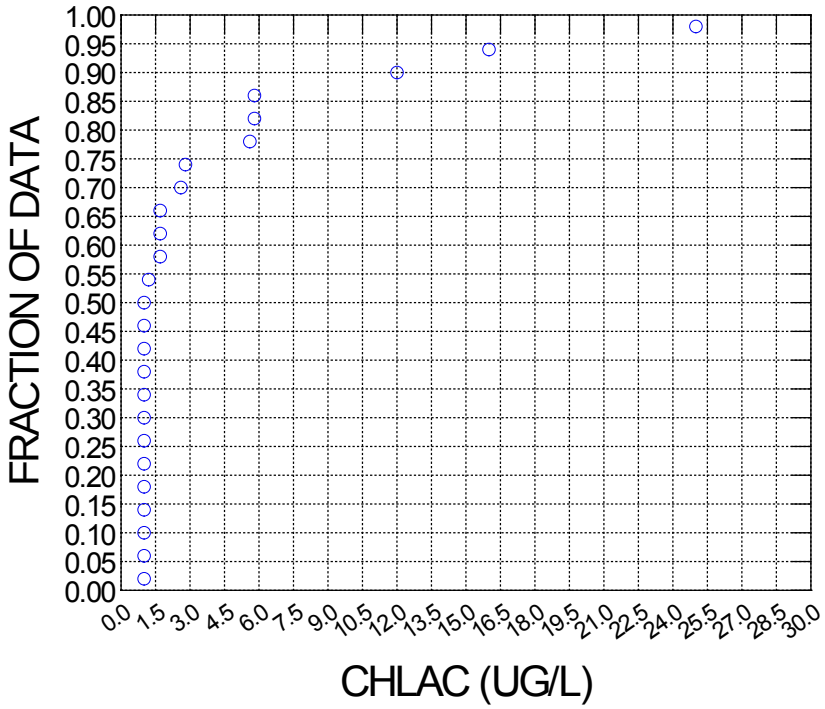
# CUMULATIVE FREQUENCY PLOT DO



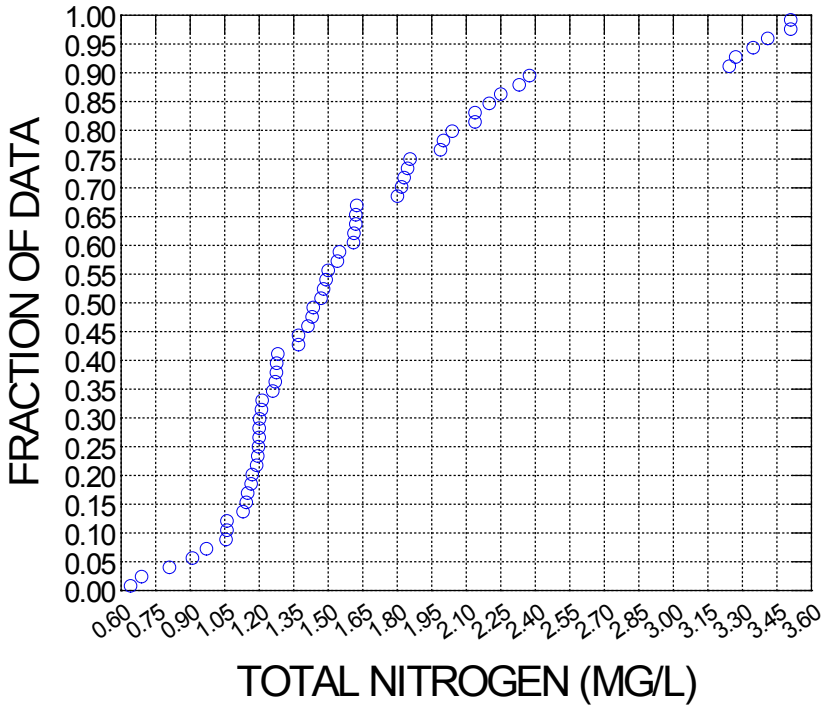
# CUMULATIVE FREQUENCY PLOT DOSAT



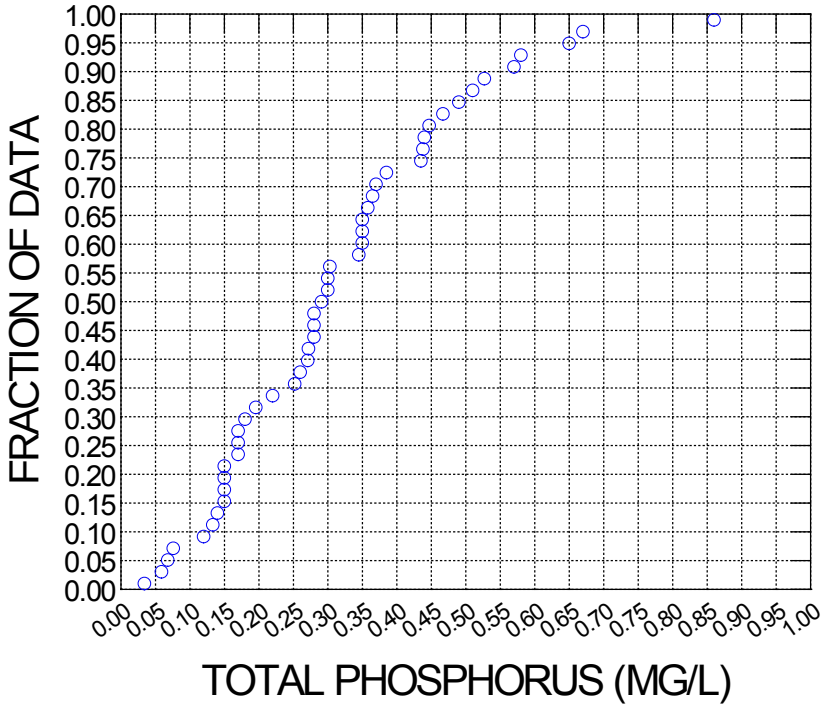
# CUMULATIVE FREQUENCY PLOT CHLAC



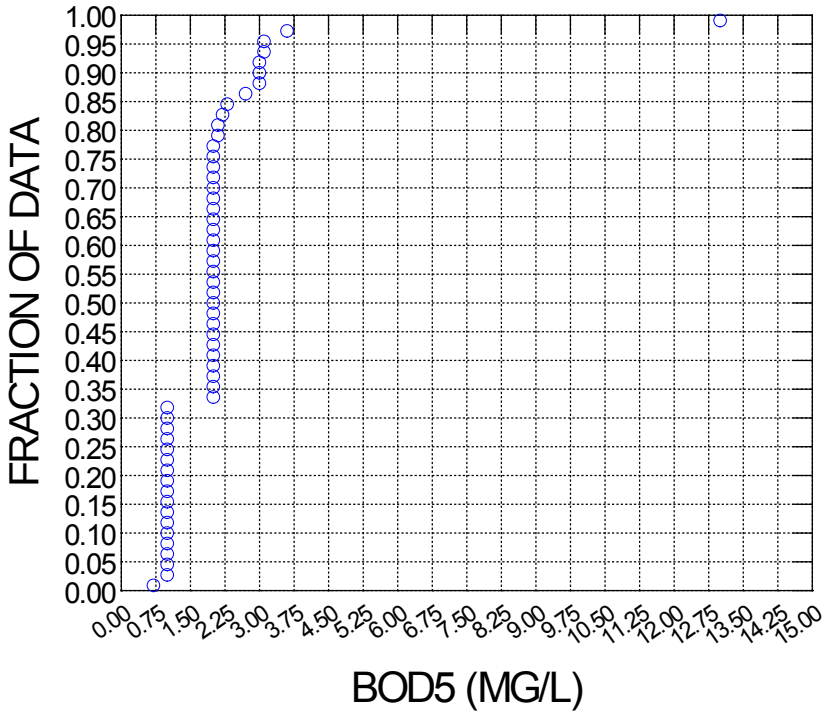
# CUMULATIVE FREQUENCY PLOT TN



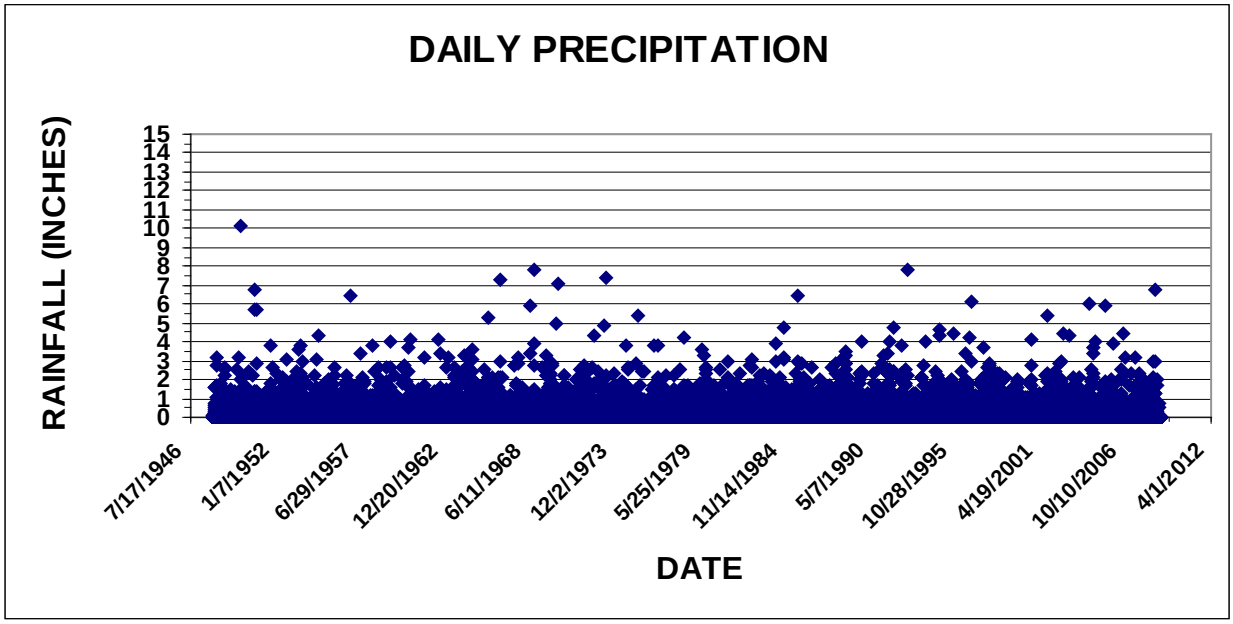
# CUMULATIVE FREQUENCY PLOT TP



# CUMULATIVE FREQUENCY PLOT BOD5



## Appendix F: Chart of Rainfall for Jacksonville International Airport, 1948–2008



# Appendix G: Spearman Correlation Matrix Analysis for Water Quality Parameters in Trout River

## Spearman correlation matrix

| | PRECIP | PRECIP3DAY | PRECIP7DAY | PRECIP14DAY | JULIANDATE |
|---|---|---|---|---|---|
| PRECIP | 1 | | | | |
| PRECIP3DAY | 0.545 | 1 | | | |
| PRECIP7DAY | 0.343 | 0.623 | 1 | | |
| PRECIP14DAY | 0.274 | 0.426 | 0.694 | 1 | |
| JULIANDATE | -0.093 | 0.002 | -0.111 | -0.13 | 1 |
| BOD5 | -0.036 | 0.078 | -0.079 | -0.196 | 0.685 |
| CHLORIDE | -0.037 | 0.054 | -0.054 | -0.111 | 0.55 |
| CHLAC | 0.417 | 0.272 | 0.405 | 0.449 | 0.448 |
| COLOR | -0.006 | -0.182 | -0.178 | 0.027 | 0.15 |
| COND | 0.007 | 0.018 | -0.065 | -0.167 | 0.048 |
| DO | -0.013 | -0.046 | -0.072 | -0.136 | -0.084 |
| NO2NO3 | 0.091 | 0.217 | 0.3 | 0.21 | 0.015 |
| AMMONIA | 0.082 | -0.016 | 0.014 | -0.02 | -0.288 |
| TKN | -0.061 | -0.228 | -0.18 | 0.053 | 0.159 |
| TN | -0.056 | -0.197 | -0.135 | 0.088 | 0.161 |
| DOSAT | 0.034 | 0.01 | -0.034 | -0.069 | -0.097 |
| PH | 0.022 | 0.004 | -0.102 | -0.246 | 0.367 |
| TOTALORTHOP | -0.205 | -0.004 | 0.184 | 0.246 | -0.039 |
| TP | 0.168 | 0.05 | -0.046 | 0.054 | -0.035 |
| SULFATE | -0.081 | 0.31 | 0.228 | -0.027 | -0.141 |
| TEMPC | 0.174 | 0.139 | 0.095 | 0.218 | 0.035 |
| TOC | -0.176 | -0.648 | -0.599 | -0.358 | 0.508 |
| TSS | 0.023 | 0.153 | 0.045 | -0.116 | 0.383 |
| TURBIDITY | 0.343 | 0.209 | 0.089 | 0.178 | -0.241 |

## Spearman correlation matrix (continued)

| | BOD5 | CHLORIDE | CHLAC | COLOR | COND |
|---|---|---|---|---|---|
| BOD5 | 1 | | | | |
| CHLORIDE | 0.202 | 1 | | | |
| CHLAC | 0.621 | 0.114 | 1 | | |
| COLOR | -0.032 | -0.617 | 0.113 | 1 | |
| COND | 0.323 | 0.409 | 0.285 | -0.646 | 1 |
| DO | -0.167 | -0.069 | -0.479 | 0.212 | -0.315 |
| NO2NO3 | -0.047 | -0.084 | 0.549 | -0.066 | 0.139 |
| AMMONIA | 0.307 | 0.141 | 0.673 | 0.003 | 0.275 |
| TKN | 0.209 | -0.124 | 0.307 | 0.435 | -0.162 |
| TN | 0.2 | -0.109 | 0.351 | 0.439 | -0.167 |
| DOSAT | -0.173 | -0.114 | -0.302 | 0.239 | -0.283 |
| PH | 0.449 | 0.163 | 0.124 | -0.634 | 0.207 |
| TOTALORTHOP | 0.674 | -0.214 | . | 0.498 | . |
| TP | 0.364 | -0.304 | 0.584 | 0.381 | 0.27 |
| SULFATE | 0.348 | 0.976 | 0.237 | -0.644 | 0.978 |
| TEMPC | 0.102 | -0.114 | 0.883 | -0.071 | 0.349 |
| TOC | -0.11 | -0.66 | -0.09 | 0.939 | -0.74 |
| TSS | 0.357 | 0.423 | 0.469 | -0.217 | 0.655 |
| TURBIDITY | 0.265 | -0.371 | 0.484 | 0.173 | 0.353 |

| | DO | NO2NO3 | AMMONIA | TKN | TN |
|---|---|---|---|---|---|
| DO | 1 | | | | |
| NO2NO3 | -0.219 | 1 | | | |
| AMMONIA | -0.161 | 0.204 | 1 | | |
| TKN | -0.22 | -0.088 | 0.123 | 1 | |
| TN | -0.23 | 0.005 | 0.143 | 0.989 | 1 |
| DOSAT | 0.962 | -0.125 | -0.156 | -0.22 | -0.225 |
| PH | -0.037 | 0.509 | -0.16 | -0.323 | -0.284 |
| TOTALORTHOP | . | 0.093 | 0.525 | 0.507 | 0.508 |
| TP | -0.53 | 0.188 | 0.462 | 0.296 | 0.328 |
| SULFATE | -0.19 | 0.302 | 0.457 | -0.359 | -0.339 |
| TEMPC | -0.597 | 0.337 | 0.088 | 0.25 | 0.267 |
| TOC | 0.111 | -0.354 | -0.074 | 0.714 | 0.692 |
| TSS | -0.404 | 0.197 | 0.527 | 0.141 | 0.159 |
| TURBIDITY | -0.101 | 0.395 | 0.37 | 0.142 | 0.184 |

## Spearman correlation matrix (continued)

| | DOSAT | PH | TOTALORTHOP | TP | SULFATE |
|---|---|---|---|---|---|
| DOSAT | 1 | | | | |
| PH | -0.014 | 1 | | | |
| TOTALORTHOP | . | . | 1 | | |
| TP | -0.442 | -0.033 | 0.3 | 1 | |
| SULFATE | -0.209 | 0.695 | . | 0.155 | 1 |
| TEMPC | -0.385 | 0.127 | . | 0.525 | 0.082 |
| TOC | 0.091 | -0.607 | . | 0.174 | -0.712 |
| TSS | -0.38 | 0.569 | -0.097 | 0.219 | 0.585 |
| TURBIDITY | -0.065 | 0.146 | -0.075 | 0.537 | 0.331 |

| | TEMPC | TOC | TSS | TURBIDITY |
|---|---|---|---|---|
| TEMPC | 1 | | | |
| TOC | -0.155 | 1 | | |
| TSS | 0.399 | -0.219 | 1 | |
| TURBIDITY | 0.277 | -0.017 | 0.416 | 1 |

## Pair-wise frequency table

| | PRECIP | PRECIP3DAY | PRECIP7DAY | PRECIP14DAY | JULIANDATE |
|---|---|---|---|---|---|
| PRECIP | 423 | | | | |
| PRECIP3DAY | 423 | 423 | | | |
| PRECIP7DAY | 423 | 423 | 423 | | |
| PRECIP14DAY | 423 | 423 | 423 | 423 | |
| JULIANDATE | 423 | 423 | 423 | 423 | 423 |
| BOD5 | 55 | 55 | 55 | 55 | 55 |
| CHLORIDE | 142 | 142 | 142 | 142 | 142 |
| CHLAC | 25 | 25 | 25 | 25 | 25 |
| COLOR | 48 | 48 | 48 | 48 | 48 |
| COND | 186 | 186 | 186 | 186 | 186 |
| DO | 290 | 290 | 290 | 290 | 290 |
| NO2NO3 | 62 | 62 | 62 | 62 | 62 |
| AMMONIA | 151 | 151 | 151 | 151 | 151 |
| TKN | 62 | 62 | 62 | 62 | 62 |
| TN | 62 | 62 | 62 | 62 | 62 |
| DOSAT | 287 | 287 | 287 | 287 | 287 |
| PH | 288 | 288 | 288 | 288 | 288 |
| TOTALORTHOP | 15 | 15 | 15 | 15 | 15 |
| TP | 49 | 49 | 49 | 49 | 49 |
| SULFATE | 29 | 29 | 29 | 29 | 29 |
| TEMPC | 296 | 296 | 296 | 296 | 296 |
| TOC | 27 | 27 | 27 | 27 | 27 |
| TSS | 59 | 59 | 59 | 59 | 59 |
| TURBIDITY | 45 | 45 | 45 | 45 | 45 |

## Pair-wise frequency table (continued)

| | BOD5 | CHLORIDE | CHLAC | COLOR | COND |
|---|---|---|---|---|---|
| BOD5 | 55 | | | | |
| CHLORIDE | 27 | 142 | | | |
| CHLAC | 13 | 8 | 25 | | |
| COLOR | 35 | 36 | 15 | 48 | |
| COND | 31 | 47 | 15 | 33 | 186 |
| DO | 30 | 102 | 14 | 31 | 184 |
| NO2NO3 | 54 | 33 | 15 | 42 | 35 |
| AMMONIA | 53 | 122 | 15 | 42 | 57 |
| TKN | 53 | 33 | 15 | 42 | 35 |
| TN | 54 | 33 | 15 | 42 | 35 |
| DOSAT | 30 | 101 | 14 | 31 | 184 |
| PH | 31 | 103 | 15 | 33 | 185 |
| TOTALORTHOP | 11 | 15 | 0 | 14 | 0 |
| TP | 37 | 36 | 15 | 45 | 35 |
| SULFATE | 21 | 21 | 14 | 29 | 29 |
| TEMPC | 31 | 102 | 15 | 32 | 185 |
| TOC | 24 | 16 | 14 | 27 | 27 |
| TSS | 51 | 34 | 14 | 39 | 31 |
| TURBIDITY | 38 | 33 | 15 | 42 | 31 |

| | DO | NO2NO3 | AMMONIA | TKN | TN |
|---|---|---|---|---|---|
| DO | 290 | | | | |
| NO2NO3 | 34 | 62 | | | |
| AMMONIA | 100 | 61 | 151 | | |
| TKN | 34 | 61 | 61 | 62 | |
| TN | 34 | 62 | 61 | 61 | 62 |
| DOSAT | 287 | 34 | 99 | 34 | 34 |
| PH | 286 | 35 | 100 | 35 | 35 |
| TOTALORTHOP | 0 | 14 | 14 | 15 | 14 |
| TP | 34 | 44 | 44 | 45 | 44 |
| SULFATE | 27 | 24 | 24 | 24 | 24 |
| TEMPC | 287 | 35 | 100 | 35 | 35 |
| TOC | 26 | 27 | 27 | 27 | 27 |
| TSS | 30 | 58 | 58 | 58 | 58 |
| TURBIDITY | 30 | 44 | 44 | 44 | 44 |

## Pair-wise frequency table (continued)

| | DOSAT | PH | TOTALORTHOP | TP | SULFATE |
|---|---|---|---|---|---|
| DOSAT | 287 | | | | |
| PH | 286 | 288 | | | |
| TOTALORTHOP | 0 | 0 | 15 | | |
| TP | 34 | 34 | 15 | 49 | |
| SULFATE | 27 | 29 | 0 | 27 | 29 |
| TEMPC | 287 | 287 | 0 | 35 | 28 |
| TOC | 26 | 27 | 0 | 27 | 24 |
| TSS | 30 | 31 | 15 | 41 | 24 |
| TURBIDITY | 30 | 31 | 14 | 44 | 24 |

| | TEMPC | TOC | TSS | TURBIDITY |
|---|---|---|---|---|
| TEMPC | 296 | | | |
| TOC | 27 | 27 | | |
| TSS | 31 | 24 | 59 | |
| TURBIDITY | 31 | 27 | 41 | 45 |

# Appendix H: Linear Regression Analysis of DO and Corrected Chla Observations versus Nutrients and BOD in Trout River

Dep Var: DO N: 30 Multiple R: 0.179 Squared multiple R: 0.032

Adjusted squared multiple R: 0.000 Standard error of estimate: 2.049

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 5.092 | 0.576 | 0.000 | . | 8.837 | 0.000 |
| VBOD5 | -0.174 | 0.181 | -0.179 | 1.000 | -0.963 | 0.344 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 3.896 | 1 | 3.896 | 0.928 | 0.344 |
| Residual | 117.537 | 28 | 4.198 | | |

*** WARNING ***
Case 256 has large leverage (Leverage = 0.902)

Durbin-Watson D Statistic 1.114
First Order Autocorrelation 0.417

Dep Var: DO N: 34 Multiple R: 0.339 Squared multiple R: 0.115

Adjusted squared multiple R: 0.087 Standard error of estimate: 1.866

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 6.344 | 0.850 | 0.000 | . | 7.464 | 0.000 |
| TN | 0.985 | 0.483 | -0.339 | 1.000 | -2.039 | 0.050 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 14.481 | 1 | 14.481 | 4.157 | 0.050 |
| Residual | 111.467 | 32 | 3.483 | | |

Durbin-Watson D Statistic 1.037
First Order Autocorrelation 0.442

Dep Var: DO N: 34 Multiple R: 0.732 Squared multiple R: 0.536

Adjusted squared multiple R: 0.490 Standard error of estimate: 1.395

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 10.406 | 2.239 | 0.000 | . | 4.647 | 0.000 |
| TN | -1.136 | 1.410 | -0.391 | 0.066 | -0.806 | 0.427 |
| VTEMPC | -0.261 | 0.101 | -0.880 | 0.134 | -2.588 | 0.015 |
| VTEMPC*TN | 0.036 | 0.058 | 0.407 | 0.036 | 0.618 | 0.541 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 67.538 | 3 | 22.513 | 11.563 | 0.000 |
| Residual | 58.410 | 30 | 1.947 | | |

*** WARNING ***
Case 398 has large leverage (Leverage = 0.472)

Durbin-Watson D Statistic 2.336
First Order Autocorrelation -0.196

Dep Var: DO N: 287 Multiple R: 0.523 Squared multiple R: 0.273

Adjusted squared multiple R: 0.271 Standard error of estimate: 1.846

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 8.545 | 0.396 | 0.000 | . | 21.581 | 0.000 |
| VTEMPC | -0.182 | 0.018 | -0.523 | 1.000 | -10.349 | 0.000 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 365.110 | 1 | 365.110 | 107.092 | 0.000 |
| Residual | 971.655 | 285 | 3.409 | | |

*** WARNING ***
Case 53 is an outlier (Studentized Residual = 7.485)
Case 54 is an outlier (Studentized Residual = 7.485)
Case 130 is an outlier (Studentized Residual = 3.975)
Case 131 is an outlier (Studentized Residual = 3.975)

Durbin-Watson D Statistic 1.223
First Order Autocorrelation 0.388

Dep Var: DO N: 34 Multiple R: 0.741 Squared multiple R: 0.550

Adjusted squared multiple R: 0.505 Standard error of estimate: 1.276

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 10.605 | 1.332 | 0.000 | . | 7.962 | 0.000 |
| VTEMPC | -0.252 | 0.064 | -0.876 | 0.304 | -3.943 | 0.000 |
| TP | -14.114 | 4.934 | -1.421 | 0.061 | -2.861 | 0.008 |
| VTEMPC*TP | 0.458 | 0.198 | 1.367 | 0.043 | 2.310 | 0.028 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 59.646 | 3 | 19.882 | 12.210 | 0.000 |
| Residual | 48.851 | 30 | 1.628 | | |

*** WARNING ***
Case 245 has large leverage (Leverage = 0.441)
Case 256 has large leverage (Leverage = 0.443)

Durbin-Watson D Statistic 2.333
First Order Autocorrelation -0.203

Dep Var: DO N: 30 Multiple R: 0.846 Squared multiple R: 0.716

Adjusted squared multiple R: 0.642 Standard error of estimate: 1.100

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 8.471 | 2.058 | 0.000 | . | 4.117 | 0.000 |
| VTEMPC | -0.098 | 0.127 | -0.357 | 0.059 | -0.776 | 0.446 |
| TP | -23.699 | 6.637 | -2.340 | 0.029 | -3.571 | 0.002 |
| TN | 2.315 | 1.486 | 0.881 | 0.039 | 1.558 | 0.133 |
| VTEMPC*TP | 0.670 | 0.216 | 2.026 | 0.029 | 3.104 | 0.005 |
| TP*TN | 2.202 | 2.690 | 0.641 | 0.020 | 0.819 | 0.421 |
| VTEMPC*TN | -0.131 | 0.082 | -1.618 | 0.012 | -1.587 | 0.126 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 70.081 | 6 | 11.680 | 9.655 | 0.000 |
| Residual | 27.824 | 23 | 1.210 | | |

*** WARNING ***
Case 174 has large leverage (Leverage = 0.751)
Case 245 has large leverage (Leverage = 0.625)
Case 398 has large leverage (Leverage = 0.559)

Durbin-Watson D Statistic 2.313
First Order Autocorrelation -0.164

Dep Var: VCHLAC N: 15 Multiple R: 0.538 Squared multiple R: 0.289

Adjusted squared multiple R: 0.096 Standard error of estimate: 5.850

| Effect | Coefficient | Std Error | Std Coef | Tolerance | t | P(2 Tail) |
|---|---|---|---|---|---|---|
| CONSTANT | 2.406 | 7.887 | 0.000 | . | 0.305 | 0.766 |
| TP | -42.369 | 45.409 | -1.369 | 0.030 | -0.933 | 0.371 |
| VTEMPC | 0.105 | 0.419 | 0.130 | 0.244 | 0.252 | 0.806 |
| VTEMPC*TP | 1.644 | 1.642 | 1.685 | 0.023 | 1.001 | 0.338 |

Analysis of Variance

| Source | Sum-of-Squares | df | Mean-Square | F-ratio | P |
|---|---|---|---|---|---|
| Regression | 153.308 | 3 | 51.103 | 1.493 | 0.270 |
| Residual | 376.390 | 11 | 34.217 | | |

*** WARNING ***
Case 245 has large leverage (Leverage = 0.954)
Case 256 has large leverage (Leverage = 2.632)
Case 360 has large leverage (Leverage = 1.278)
Case 386 is an outlier (Studentized Residual = 25.753)

Durbin-Watson D Statistic 2.142
First Order Autocorrelation -0.087

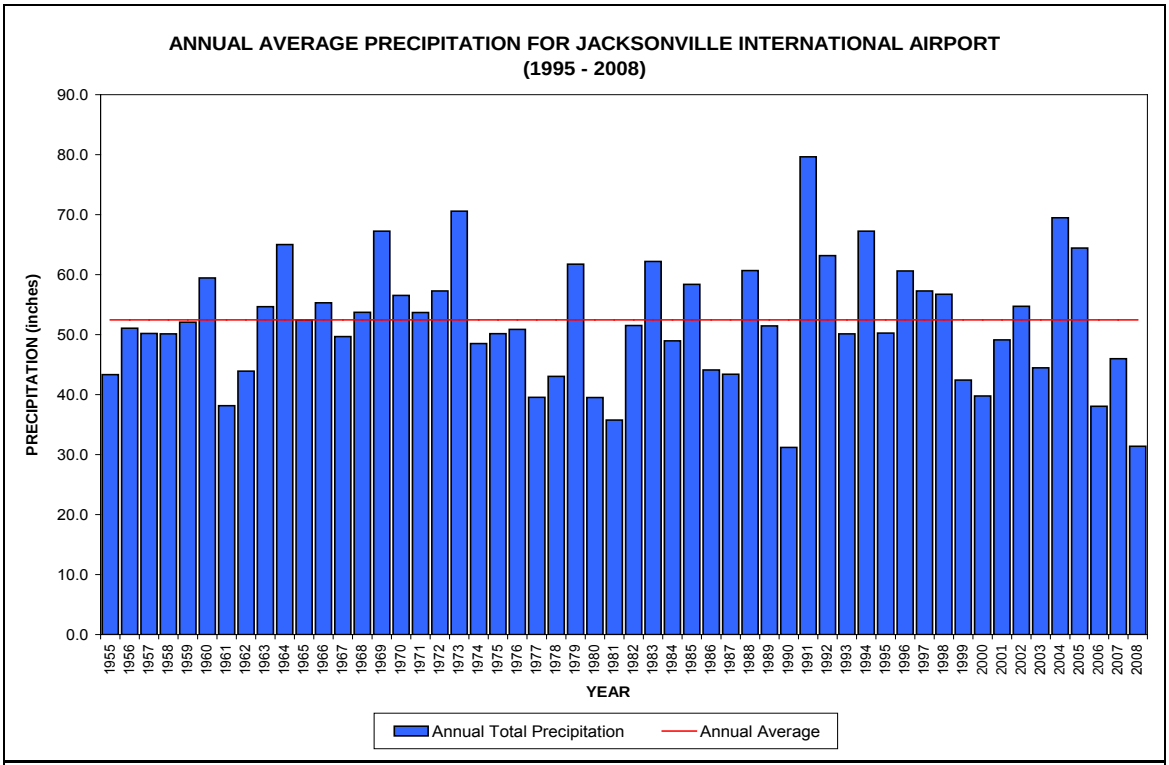
## Appendix I: Monthly and Annual Precipitation at Jacksonville International Airport, 1955–2008

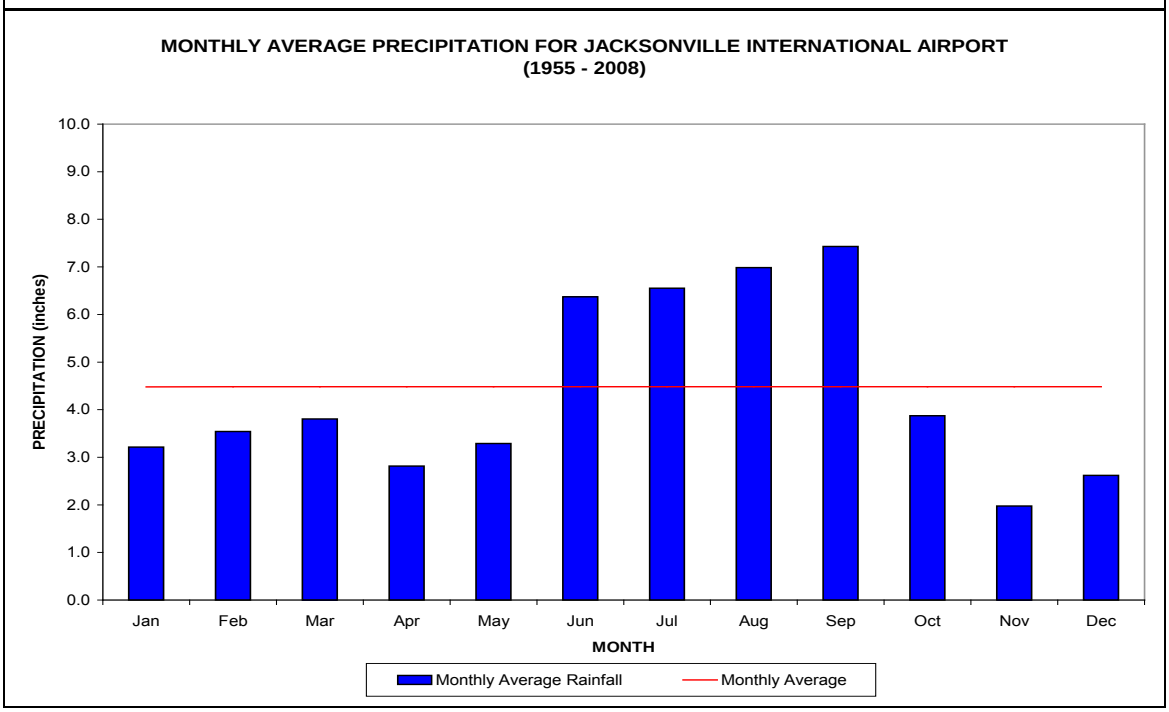
| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1955 | 3.1 | 2.46 | 1.66 | 1.5 | 4.51 | 2.7 | 5.53 | 3.85 | 10.6 | 5.36 | 1.9 | 0.2 | **43.33** |
| 1956 | 2.9 | 2.94 | 0.81 | 2.33 | 3.98 | 7.87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

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | 1.1 | 1.11 | 6.83 | 2.85 | 0.72 | 11.4 | 4.2 | 7.83 | 8.49 | 11.5 | 1.4 | 3.2 | **60.63** |
| 1997 | 2.9 | 1.28 | 1.84 | 4.56 | 3.43 | 6.33 | 7.69 | 8.24 | 3.97 | 4.84 | 2.4 | 9.8 | **57.27** |
| 1998 | 3.5 | 11.1 | 2.64 | 4.71 | 0.96 | 2.95 | 7.29 | 10.1 | 7.65 | 3.01 | 2.4 | 0.4 | **56.72** |
| 1999 | 4.6 | 1.7 | 0.4 | 1.92 | 1.02 | 7.75 | 3.56 | 3.51 | 13 | 3.24 | 0.8 | 0.9 | **42.44** |
| 2000 | 2.8 | 1.17 | 1.79 | 2.6 | 1.15 | 2.43 | 5.69 | 7.38 | 11.6 | 0.23 | 1.6 | 1.4 | **39.77** |
| 2001 | 0.9 | 0.68 | 5.48 | 0.62 | 2.56 | 5.59 | 8.31 | 3.58 | 16 | 0.81 | 1.4 | 3.1 | **49.14** |
| 2002 | 4.5 | 0.82 | 4.38 | 2.41 | 0.47 | 6.24 | 7.8 | 8.14 | 9.31 | 2.58 | 2.7 | 5.4 | **54.72** |
| 2003 | 0.1 | 4.66 | 10.7 | 2.63 | 2.54 | 6.75 | 7.33 | 1.83 | 3.04 | 2.98 | 0.7 | 1.2 | **44.47** |
| 2004 | 1.6 | 4.47 | 1.36 | 2.02 | 1.24 | 17.2 | 8.6 | 9.85 | 16.3 | 1.32 | 2.9 | 2.7 | **69.47** |
| 2005 | 1.9 | 3.56 | 3.67 | 4.53 | 3.51 | 14.8 | 7.37 | 4.43 | 5.76 | 6.49 | 1.1 | 7.4 | **64.44** |
| 2006 | 2.30 | 3.91 | 0.68 | 1.22 | 2.01 | 7.25 | 3.97 | 7.08 | 4.55 | 1.81 | 0.39 | 2.90 | **38.07** |
| 2007 | 2.29 | 2.40 | 2.22 | 1.02 | 1.12 | 6.68 | 9.48 | 3.57 | 5.44 | 8.85 | 0.17 | 2.74 | **45.98** |
| 2008 | 2.63 | 5.22 | 3.50 | 2.34 | 0.66 | 8.21 | 8.73 | 16.83 | 5.84 | 1.62 | 1.01 | 0.59 | **46.01** |
| **AVG** | **3.21** | **3.54** | **3.81** | **2.82** | **3.29** | **6.37** | **6.55** | **6.99** | **7.43** | **3.87** | **1.98** | **2.62** | **52.32** |

Rainfall is in inches, and represents data from JIA.

# Appendix J: Annual and Monthly Average Precipitation Jacksonville International Airport



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