FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration

NORTHEAST DISTRICT • LOWER ST. JOHNS BASIN

Final TMDL Report

DO and Nutrient TMDLs for the Ortega River (WBID 2213P)

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http://www.dep.state.fl.us/legal/Rules/shared/62-303/62-303.pdf

STORET Program

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

2008 305(b) Report

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

Criteria for Surface Water Quality Classifications

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

Basin Status Report for the Lower St. Johns Basin

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

Water Quality Assessment Report for the Lower St. Johns Basin

http://www.dep.state.fl.us/water/basin411/sj_lower/assessment.htm

U.S. Environmental Protection Agency, National STORET Program

Region 4: Total Maximum Daily Loads in Florida

http://www.epa.gov/region4/water/tmdl/florida/

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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 Ortega River in the Lower St. Johns Basin. The river was verified as impaired for both DO and nutrients, and was included on the Verified List of impaired waters for the Lower St. Johns Basin that was adopted by Secretarial Order in May 2009. This TMDL establishes the allowable loadings to the Ortega River that would restore the waterbody so that it meets its applicable water quality criteria for both DO and nutrients.

1.2 Identification of Waterbody

The Ortega River, located in Duval County in northeast Florida, drains an area of approximately 88.6 square miles (mi^2). The waterbody is divided into two parts: the Cedar River portion and the Ortega River portion. The Cedar River flows approximately 2.5 miles from northwest to southeast before converging with the north-flowing Ortega River. The two rivers travel eastward another 1.5 miles and drain into the St. Johns River (**Figures 1.1** and **1.2**). The Ortega River watershed is located within the Jacksonville city limits, in the southern portion of Duval County, and on the west side of the St. Johns River. The watershed is highly urbanized. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Lower St. Johns (Florida Department of Environmental Protection [Department], 2002).

For assessment purposes, the Department has divided the Lower St. Johns Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. This TMDL addresses the Ortega River, WBID 2213P, for DO and nutrients.

The Ortega River is part of the Ortega 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 Basin. The Ortega River Planning Unit consists of 30 WBIDs. **Figure 1.3** shows the locations of these WBIDs and the location of the Ortega River watershed (WBID 2213P) in the 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

Figure 1.1. Location of the Ortega River Watershed (WBID 2213P) in the Lower St. Johns Basin and Major Hydrologic Features in the Area

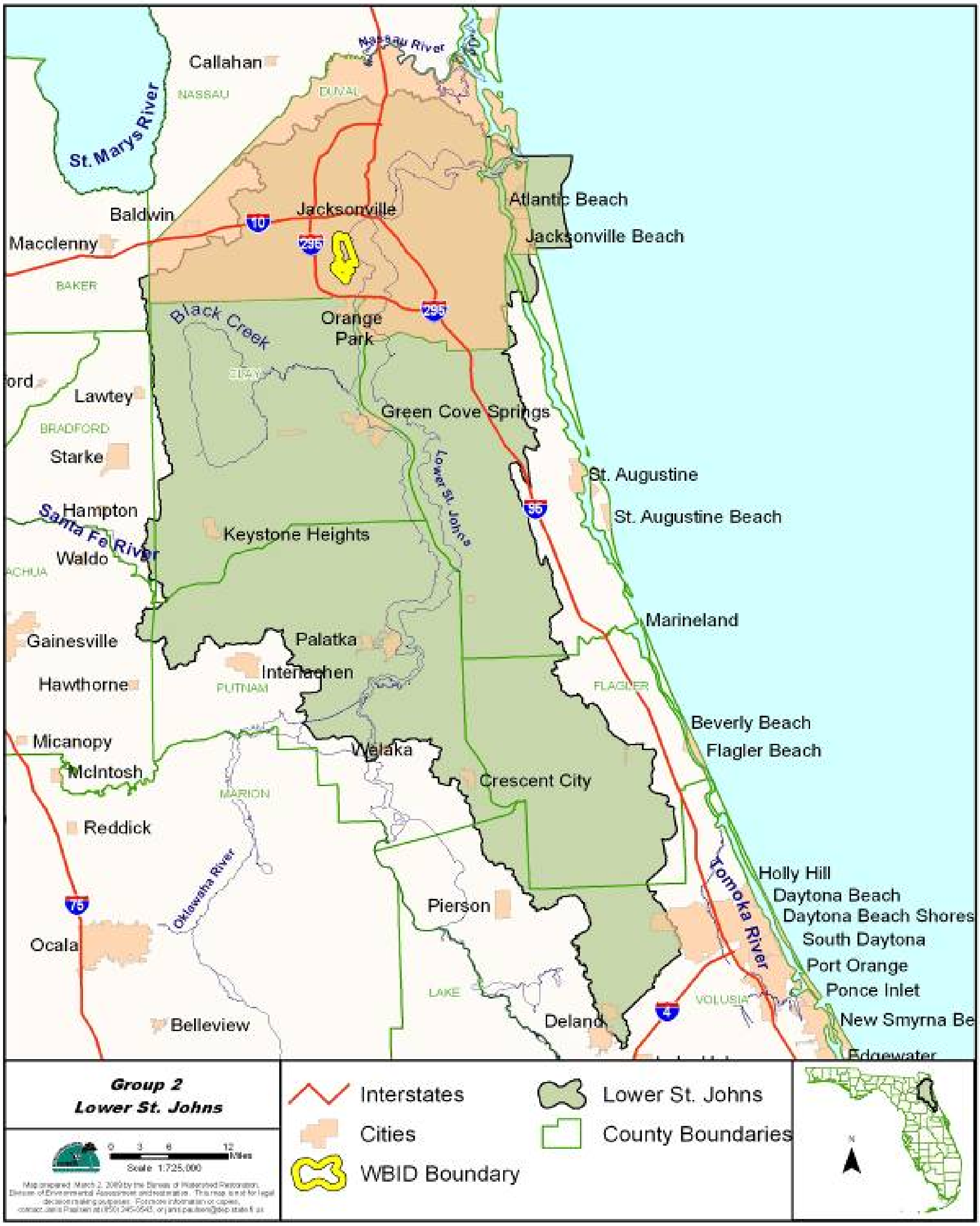
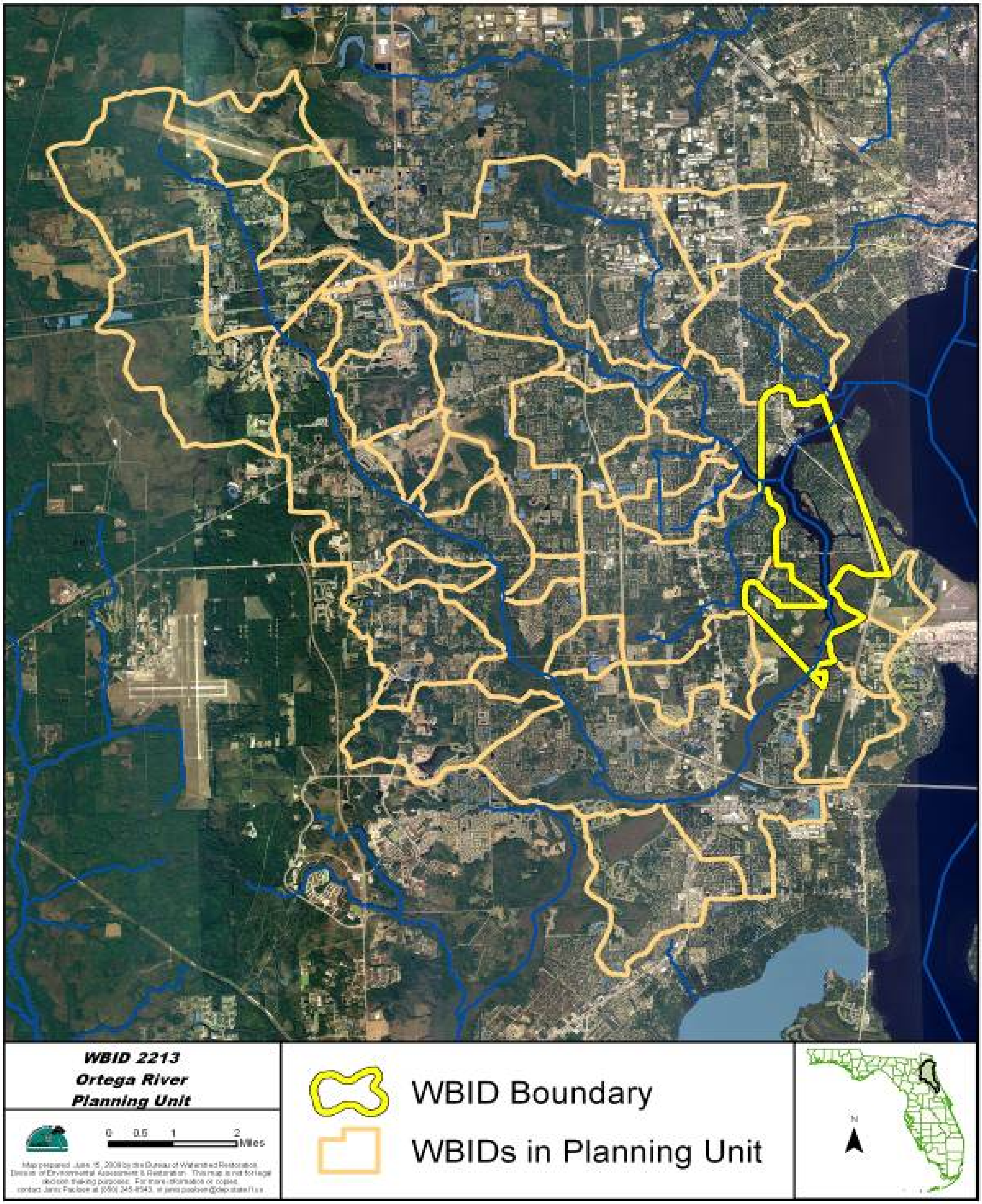


Figure 1.2. Location of the Ortega River Watershed (WBID 2213P) in Duval County and Major Hydrologic Features in the Area

Figure 1.3. WBIDs in the Ortega River Planning Unit



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 a 30 to 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. 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 Ortega 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) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed 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.]); 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 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 Ortega River and has verified that this waterbody segment is impaired for DO and nutrients, based on data in the Department's IWR database. **Table 2.1** summarizes the DO monitoring data for the verified period, which for Group 2 waters was January 1, 2001, through June 30, 2008. **Tables 2.2** through **2.4** summarize the data by month, season, and year, respectively.

There was a 35.7 percent overall exceedance rate for DO in the Ortega River during the verified period (**Table 2.1**). Exceedances occurred in all seasons and in all months except February (**Tables 2.2** and **2.3**). During the verified period, samples ranged from 1.3 to 19.59 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 9.3 to 181.5 percent, with about 16 percent of the saturation values greater than 100 percent. Fewer than 10 percent of the DO saturation values were less than 32 percent.

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

Table 2.5 summarizes annual average corrected chlorophyll *a* (CHLAC) concentrations based on the IWR. During the verified period, the threshold of 20 micrograms per liter (µg/L) was exceeded in 2006. In 2001, 2004, 2007, and 2008, there were insufficient data to calculate an annual average.

Table 2.1. Summary of DO Monitoring Data for the Ortega River (WBID 2213P) During the Verified Period (January 1, 2001–June 30, 2008)

- = Empty cell
* DO percent saturation was 181.5 percent, collected on January 9, 2009, by the city of Jacksonville.
** BOD = Biochemical oxygen demand
*** TP = Total phosphorus

Waterbody (WBID)	Parameter	DO
Ortega River (2213P)	Total number of samples	143
Ortega River (2213P)	IWR-required number of exceedances for the Verified List	20
Ortega River (2213P)	Number of observed exceedances	51 (35.7%)
Ortega River (2213P)	Number of observed nonexceedances	92
Ortega River (2213P)	Number of seasons during which samples were collected	4
Ortega River (2213P)	Highest observation (mg/L)	19.59*
Ortega River (2213P)	Lowest observation (mg/L)	1.3
Ortega River (2213P)	Median observation (mg/L)	5.7
Ortega River (2213P)	Mean observation (mg/L)	5.98
Ortega River (2213P)	Median value for 12 BOD observations (mg/L)**	2
Ortega River (2213P)	Median value for 59 TN observations (mg/L)	1.11
Ortega River (2213P)	Median value for 49 TP observations (mg/L)***	0.158
Ortega River (2213P)	Possible causative pollutant by IWR	TN

Table 2.2. Summary of DO Data by Month for the Verified Period (January 1, 2001–June 30, 2008)

Note: DO is in mg/L.

Month	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Precipitation (inches)
January	5	2.17	19.59	4.7	8.46	3	60.00%	2.03
February	14	5.64	11.6	7.85	8.11	0	0.00%	3.32
March	11	1.3	10.8	8.23	7.50	2	18.18%	4.05
April	17	3.45	8.97	6.62	6.72	3	17.65%	1.99
May	8	3.17	6.7	4.87	5.21	4	50.00%	1.85
June	13	3.5	7.82	5.72	5.72	3	23.08%	9.08
July	5	2	7.46	5.39	5.03	2	40.00%	7.71
August	20	2	10.85	5.42	5.32	7	35.00%	5.50
September	13	2.19	7.94	4.35	4.30	10	76.92%	8.63
October	13	2.6	8.08	4.29	4.33	11	84.62%	3.55
November	10	3.4	6.7	5.5	5.20	4	40.00%	1.33
December	14	3.82	9.145	6.07	6.44	2	14.29%	3.63

Table 2.3. Summary of DO Data by Season for the Verified Period (January 1, 2001–June 30, 2008)

DO is in mg/L.

Season	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exceedances	Mean Total Precipitation (inches)
Winter	24	3.4	9.15	7.91	5.92	5	20.83%	9.40
Spring	38	3.17	8.97	5.97	6.06	10	26.32%	12.92
Summer	51	2	10.85	4.47	4.78	30	58.82%	21.84
Fall	30	1.3	19.59	5.84	7.94	6	20.00%	8.51

Table 2.4. Summary of DO Data by Year for the Verified Period (January 1, 2001–June 30, 2008)

DO is in mg/L.

Year	N	Minimum	Maximum	Median	Mean	Number of Exceedances	% Exeedances	Total Precipitation (inches)
2001	22	3.82	19.59	7.36	7.70	4	18.18%	49.14
2002	10	3.41	10.26	6.45	6.26	4	40.00%	54.72
2003	10	2.05	10.34	4.69	5.34	5	50.00%	44.47
2004	29	2.35	11.6	5.36	5.34	12	41.38%	69.47
2005	25	1.3	9.15	5.75	5.73	9	36.00%	65.49
2006	10	2.19	8.64	5.58	5.9	3	30.00%	38.07
2007	36	2	10.8	5.95	5.79	13	36.11%	45.98
2008	1	3.7	3.7	3.7	3.7	1	100.00%	31.39

Table 2.5. Summary of Annual Average CHLAC for the Verified Period (January 1, 2001–June 30, 2008)

- = Empty cell/no data

Year	Mean	Exceedance
2001	-	-
2002	11.95	no
2003	9.343	no
2004	-	-
2005	5.3	no
2006	38.90	yes
2007	-	-
2008	-	-

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 Ortega River (WBID 2213P) 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 criteria applicable to the impairment addressed by this TMDL are 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 influenced by many factors, including DO solubility, which is controlled by temperature and salinity; DO enrichment processes influenced by reaeration, which is controlled by flow velocity; the 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 chl*a* levels. The following language is found in Rule 62-303, F.A.C.:

62-303.353 Nutrients in Streams.
A stream or stream segment shall be included on the planning list for nutrients if the following biological imbalances are observed:

(1) Algal mats are present in sufficient quantities to pose a nuisance or hinder reproduction of a threatened or endangered species, or

(2) Annual mean chlorophyll a concentrations are greater than 20 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.

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 Ortega River Watershed

4.2.1 Point Sources

There are two NPDES wastewater facilities in the watershed (**Figure 4.1**). The Southwest District WWTF (FL0026468) is located in the watershed; however, it discharges directly to the Lower St. Johns. Advanced Auto AC & Heating (FLG912023) has a petroleum cleanup general permit.

There were 15 NPDES stormwater permits in the Ortega River watershed (**Figure 4.2**). Of the 15, 10 were still active. Of the active permits, 4 were multisector general permits and 6 were small construction general permits.

Figure 4.3 shows the stormwater infrastructure in the WBID. There are 113 outfalls and 1,662 inlets. Outfalls represent points where a conveyance of stormwater discharges into a separate

Figure 4.1. Location of NPDES-Permitted Wastewater Facilities in the Ortega River Watershed (WBID 2213P)

Figure 4.2. Location of NPDES Stormwater Permits in the Ortega River Watershed (WBID 2213P)

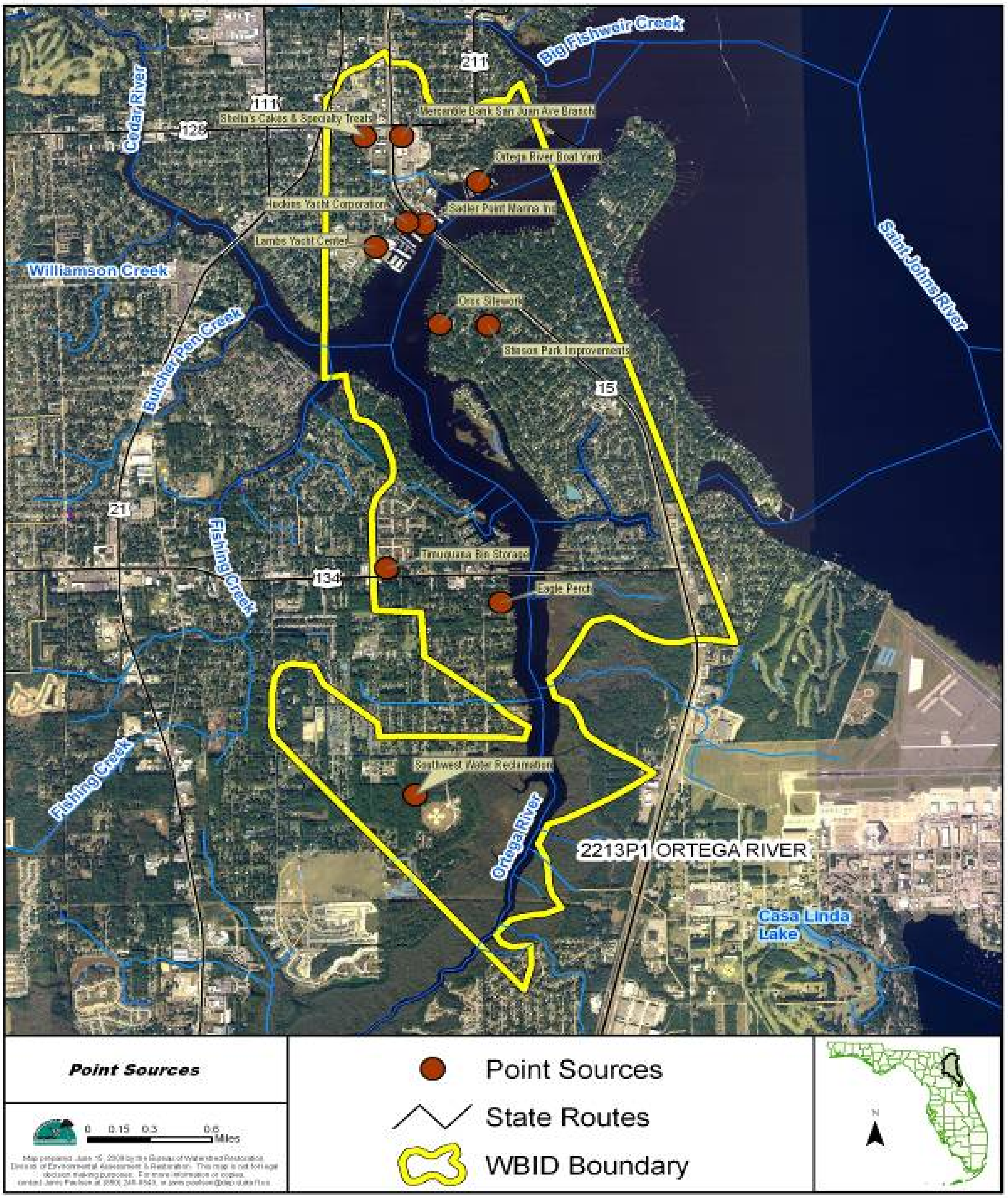
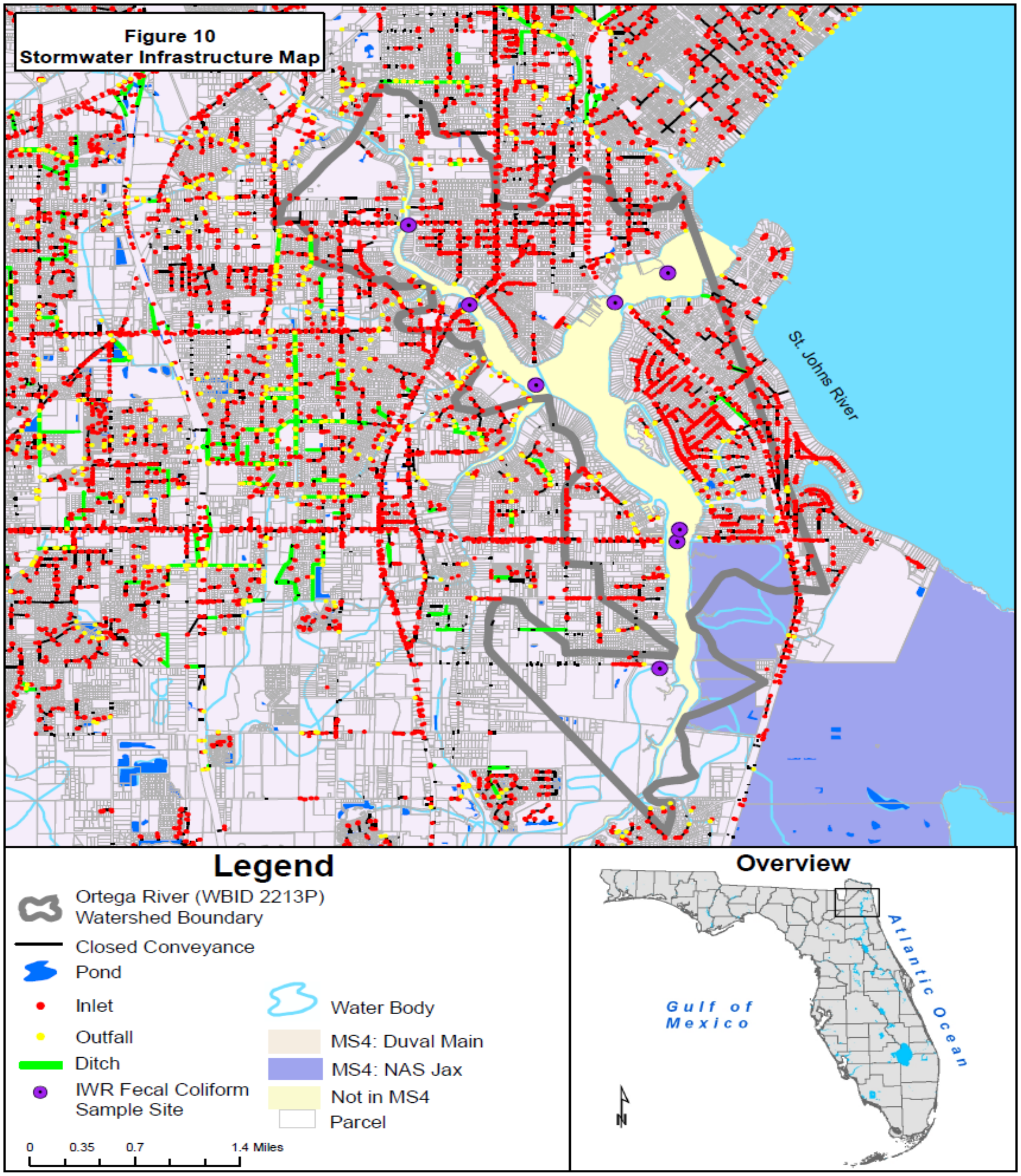


Figure 4.3. Stormwater Infrastructure in the Ortega River Watershed (WBID 2213P)



stormwater system through a channelized or natural waterway. Inlets are a component of the stormwater system located along the curbed edge of paved surfaces or the low point of an area to provide for the collection of stormwater runoff, access for inspection and maintenance, pipe junctions, sediment traps, or conflicts with other utilities (K. Grable, personal communication, October 16, 2008).

Municipal Separate Storm Sewer System Permittees

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 (FLS000012) that includes all of the Ortega River watershed.

4.2.2 Land Uses and Nonpoint Sources

Nutrient loadings to the Ortega 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. Figure 4.4** shows the principal land uses in the watershed aggregated to the Level 1 land use codes.

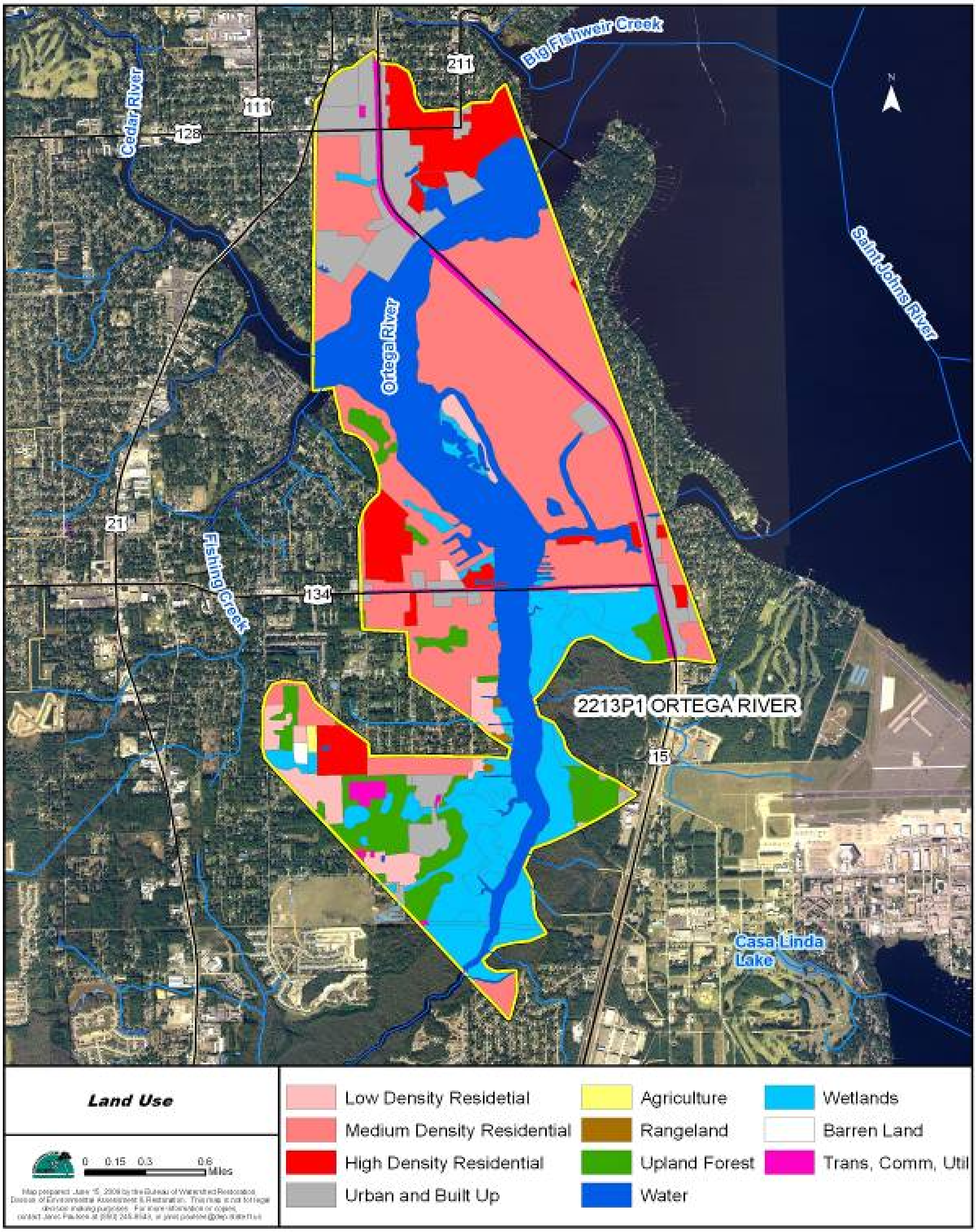
As shown in **Table 4.1**, the total area of the Ortega River watershed is about 4,803 acres. The dominant land use category is urban land (urban and built-up; low-, medium-, and high-density residential; and transportation, communication, and utilities) which accounts for about 65.2 percent of the total watershed area. Of the 3,128 acres of urban lands, residential land use occupies about 2,364 acres, or about 49.3 percent of the watershed area. Natural land use areas, including water/wetlands, upland forest, and barren land, occupy about 1,641 acres, accounting for about 34.2 percent of the total area.

Table 4.1. Classification of Land Use Categories in the Ortega River Watershed (WBID 2213P) in 2004

- = Empty cell

Level 2 Land Use Code	Attribute	Acres	% of Total
1100	Residential, low density – less than 2 dwelling units/acre	142.51	2.97%
1200	Residential, medium density – 2-5 dwelling units/acre	1,639.93	34.14%
1300	Residential, high density – 6 or more dwelling units/acre	588.17	12.25%
1400	Commercial and services	287.6	5.99%
1600	Extractive	3.11	0.06%
1700	Institutional	107.5	2.24%
1800	Recreational	221.28	4.61%
2500	Specialty farms	4.34	0.09%
3100	Herbaceous upland nonforested	15.91	0.33%
3200	Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub)	2.95	0.06%
3300	Mixed upland nonforested	1.31	0.03%
4100	Upland coniferous forests	135.15	2.81%
4200	Upland hardwood forests	19.3	0.40%
4300	Upland hardwood forests cont.	76.53	1.59%
4400	Tree plantations	18.95	0.39%
5100	Streams and waterways	878.78	18.30%
5300	Reservoirs – pits, retention ponds, dams	7.46	0.16%
6100	Wetland hardwood forests	274.85	5.72%
6200	Wetland coniferous forests	47.08	0.98%
6300	Wetland forested mixed	18.11	0.38%
6400	Vegetated nonforested wetlands	158.39	3.30%
7400	Disturbed land	4.91	0.10%
8100	Transportation	127.74	2.66%
8200	Communications	5.18	0.11%
8300	Utilities	16.21	0.34%
-	**TOTAL:**	**4,803.25**	**100.00%**

Figure 4.4. Principal Land Uses in the Ortega River Watershed (WBID 2213P) 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 Ortega River watershed (**Figure 4.5**). **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 Ortega 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 17,792 people living in 7,413 households.

Figure 4.5. Distribution of Hydrologic Soil Groups in the Ortega River Watershed (WBID 2213P)

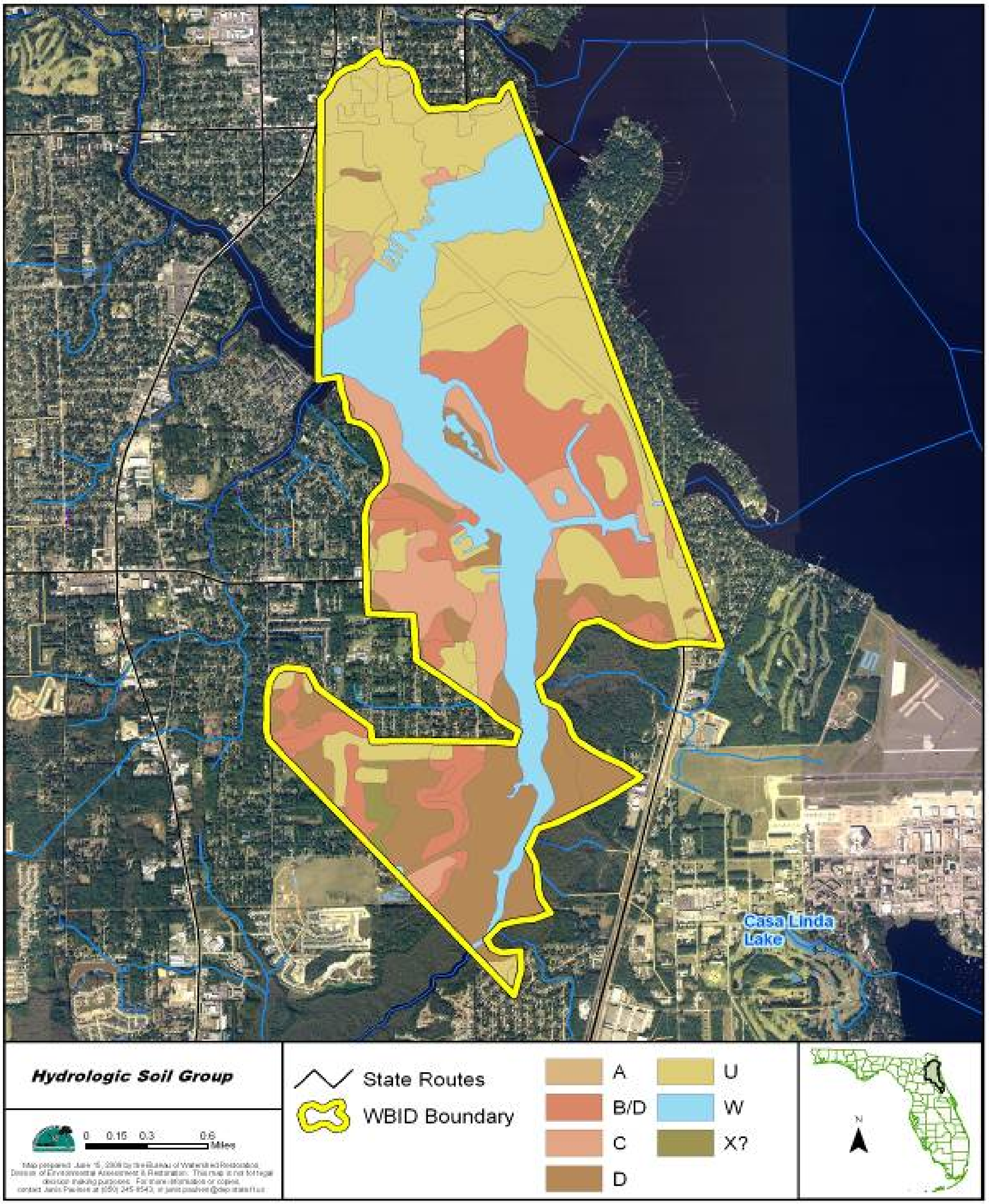


Table 4.3. Estimated Average Household Size in the Ortega River Watershed (WBID 2213P)

- = Empty cell
Data from U.S. Census Bureau Website, 2005, based on Duval County blocks present in the Ortega River watershed

Tract	Population	Housing Units
23	897	463
24	1,422	599
122	1,530	634
123	236	116
124	3,064	1297
125	1,977	754
126.02	973	418
130	1,899	720
131	788	346
133	134	50
134.01	2,895	1256
134.02	1,832	710
135.22	147	57
TOTAL:	**17,794**	**7,420**
-	**AVERAGE HOUSEHOLD SIZE:**	**2.40**

Septic Tanks

Approximately 78 percent of Duval County residences are connected to a wastewater treatment plant, while the rest are using septic tanks (Post Buckley Schuh & Jernigan [PBS&J], 2007, and Florida Department of Health [FDOH] Website). Based on the 2000 census estimates, it was assumed that 1,630 residences in the watershed are using septic tanks. Using an estimate of 70 gallons/day/person (EPA, 1999), and drainfield TN and TP concentrations of 36 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 4.4. Estimated Nitrogen and Phosphorus Annual Loading from Septic Tanks in the Ortega River Watershed (WBID 2213P)

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

Estimated Number of Households on Septic	Estimated Number of People 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)
1,630	2.40	70	36	15	30,031	12,513

4.3 Source Summary

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 [JIA], 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 the development of site-specific runoff coefficients, EMCs, and knowledge of best management practices (BMPs) that have been implemented in the watershed.

4.3.1 Agriculture

At the Level 3 land use category, 9 agricultural codes were identified in the Ortega River watershed. Improved and unimproved pasture represented approximately 6.1 percent of the watershed area, or 603 acres. Field crops represented approximately 3.2 percent of the watershed area, or 318 acres. Aggregating land use to Level 1 for the Ortega 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 Ortega River Watershed

- = Empty cell/no data

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Specialty farms	D	2.05	0.23	2.02	15.37	2.37
-	B/D	2.29	0.09	0.89	6.76	1.04
Herbaceous upland nonforested	D	3.21	0.23	3.17	9.92	0.47
-	B/D	8.24	0.09	3.20	10.03	0.48
-	C	4.46	0.17	3.24	10.12	0.48
Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub	D	1.06	0.23	1.05	3.28	0.16
-	B/D	1.89	0.09	0.74	2.30	0.11
-	B/D	1.27	0.09	0.49	1.55	0.07
-	X?	0.03	0.44	0.06	0.18	0.01
-	**SUM**	**24.5**	**-**	**14.86**	**59.50**	**5.21**

4.3.2 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.

4.3.3 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 4.6. Estimated Urban and Built-up Annual Nitrogen and Phosphorus Loading in the Ortega River Watershed (WBID 2213P)

- = Empty cell/no data

Land Use Classification	Soil Group	Acres	Acres	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Residential, low density–less than 2 dwelling units/acre	B/D	19.06	0.083	6.91	30.29	3.59
-	D	57.95	0.226	57.23	250.73	29.74
-	X?	4	0.435	7.60	33.31	3.95
-	U	28.5	0.435	54.18	237.34	28.16
-	W	0.42	0.435	0.80	3.50	0.41
-	C	32.58	0.166	23.63	103.54	12.28
Residential, medium density–2-5 dwelling units/acre	U	921.47	0.435	1,751.67	9,866.22	1,558.58
-	B/D	385.79	0.108	182.08	1,025.55	162.01
-	C	281.76	0.186	229.02	1,289.95	203.77
-	W	9.87	0.435	18.76	105.68	16.69
-	A	5.84	0.041	1.05	5.89	0.93
-	D	35.24	0.252	38.81	218.58	34.53
Residential, high density - 6 or more dwelling units/acre	U	347.75	0.435	661.06	4,173.06	935.34
-	C	53.55	0.309	72.31	456.47	102.31
-	B/D	165.82	0.24	173.91	1097.86	246.07
-	W	2.68	0.435	5.09	32.16	7.21
-	A	11	0.148	7.11	44.91	10.07
-	D	7.41	0.35	11.33	71.55	16.04
Commercial and services	U	253.25	0.435	481.42	2344.78	343.20
-	B/D	19.46	0.35	29.76	144.97	21.22
-	C	12.38	0.403	21.80	106.19	15.54
-	D	2.41	0.435	4.58	22.31	3.27
-	W	0.04	0.435	0.08	0.37	0.05
Extractive	W	0.76	0.435	1.44	4.52	0.59
-	D	1.66	0.375	2.72	8.51	1.11
-	C	0.69	0.328	0.99	3.09	0.40
Institutional	D	2.77	0.35	4.24	13.83	3.00
-	B/D	16.66	0.241	17.55	57.29	12.41
-	U	55.81	0.435	106.09	346.41	75.06
-	C	13.64	0.309	18.42	60.14	13.03
-	W	0.02	0.435	0.04	0.12	0.03

Land Use Classification	Soil Group	Acres	Acres	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
-	A	18.59	0.186	15.11	49.34	10.69
Recreational	U	32.94	0.435	62.62	195.94	9.37
-	B/D	46.55	0.089	18.10	56.65	2.71
-	C	72.89	0.166	52.88	165.46	7.91
-	A	16.07	0.021	1.47	4.61	0.22
-	D	24.51	0.226	24.21	75.75	3.62
-	W	28.35	0.435	53.89	168.64	8.07
Disturbed lands	D	0.42	0.226	0.41	1.81	0.23
-	B/D	4.49	0.293	5.75	25.03	3.13
Transportation	U	115.05	0.435	218.70	975.95	130.92
-	B/D	5.31	0.293	6.80	30.34	4.07
-	D	0.11	0.375	0.18	0.80	0.11
-	C	7.07	0.35	10.81	48.25	6.47
-	W	0.19	0.435	0.36	1.61	0.22
Communications	C	3.74	0.328	5.36	23.92	3.21
-	B/D	1.45	0.278	1.76	7.86	1.05
Utilities	B/D	3.7	0.278	4.49	20.06	2.69
-	D	0.72	0.375	1.18	5.27	0.71
-	X?	3.12	0.435	5.93	26.47	3.55
-	U	8.64	0.435	16.42	73.29	9.83
-	**SUM**	**3,144.15**	**-**	**4,498.14**	**24,116.17**	**4,069.38**

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

- = Empty cell

Land Use Classification	Soil Group	Acres	Annual Runoff Coefficient	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Upland coniferous forests	D	61.28	0.226	60.52	189.38	9.06
-	B/D	43.93	0.089	17.09	53.46	2.56
-	U	9.21	0.435	17.51	54.78	2.62
-	X?	16.99	0.435	32.30	101.06	4.83
-	C	3.72	0.166	2.70	8.44	0.40
Upland hardwood forests	B/D	1.31	0.089	0.51	1.59	0.08
-	D	1.09	0.226	1.08	3.37	0.16
-	C	16.9	0.166	12.26	38.36	1.83
-	C	39.74	0.166	28.83	90.21	4.31
-	B/D	26.16	0.089	10.17	31.84	1.52
-	W	0	0.435	0.00	0.00	0.00
-	U	8.13	0.435	15.45	48.36	2.31
-	A	0.01		0.00	0.00	0.00
-	D	2.51	0.226	2.48	7.76	0.37
Tree plantations	D	18.95	0.226	18.72	58.56	2.80
Streams and waterways	D	27.42	0.435	52.12	177.29	15.60
-	U	10.72	0.435	20.38	69.31	6.10
-	C	21.76	0.435	41.36	140.69	12.38
-	B/D	9.03	0.435	17.17	58.38	5.14
-	W	809.86	0.435	1539.50	5236.24	460.79
Reservoirs–pits, retention ponds, dams	D	0.38	0.435	0.72	2.46	0.22
-	B/D	1.32	0.435	2.51	8.53	0.75
-	U	1.06	0.435	2.02	6.85	0.60
-	C	1.8	0.435	3.42	11.64	1.02
-	W	2.78	0.435	5.28	17.97	1.58
	A	0.12	0.435	0.23	0.78	0.07
Wetland hardwood forests	C	17.53	0.435	33.32	145.08	5.44
-	D	200.38	0.435	380.91	1658.34	62.19
-	B/D	33.01	0.435	62.75	273.19	10.24
-	U	23.38	0.435	44.44	193.49	7.26
-	W	0.58	0.435	1.10	4.80	0.18

Wetland coniferous forests	D	15.27	0.435	29.03	126.37	4.74
-	B/D	29.9	0.435	56.84	247.45	9.28
-	X?	1.9	0.435	3.61	15.72	0.59
Wetland forested mixed	B/D	10.04	0.435	19.09	83.09	3.12
-	X?	0.24	0.435	0.46	1.99	0.07
-	D	6.97	0.435	13.25	57.68	2.16
-	C	0.86	0.435	1.63	7.12	0.27
Vegetated nonforested wetlands	D	144.3	0.435	274.31	1,194.22	44.78
-	W	1.5	0.435	2.85	12.41	0.47
-	B/D	3.45	0.435	6.56	28.55	1.07
-	U	1.75	0.435	3.33	14.48	0.54
-	C	7.37	0.435	14.01	60.99	2.29
-	**SUM**	**1,634.61**		**2,851.82**	**1,0542.32**	**691.81**

4.3.4 Upstream Areas Draining to the Ortega River

Butcher Pen Creek, the Cedar River and Wills Branch, Fishing Creek, Williamson Creek, and the upper segment of the Ortega River are sub-basins that contribute to the water quality observed in this section of the Ortega River (**Figure 4.6**). The same procedure described earlier to estimate annual TN and TP loading from land uses in the Ortega River was applied to the contributing sub-basins (**Table 4.8**).

Table 4.8. Estimated Annual Nitrogen and Phosphorus Loading to the Ortega River Watershed (WBID 2213P) from Upstream Drainage Areas

Land Use Category	Acres	Gross Runoff (acre-feet)	Estimated TN Load (lbs)	Estimated TP Load (lbs)
Urban	19,166.72	23,711.16	119,755.89	19,475.84
Agriculture	1,467.97	853.44	4,199.08	478.17
Forest/Wetland/ Water	10,207.83	14,056.36	56,777.49	2,437.01
TOTAL:	**30,842.52**	**38,620.96**	**180,732.46**	**22,391.02**

Table 4.9 summarizes the various 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. 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 Ortega River. Other factors include the types of BMPs, both

Figure 4.6. Upstream Areas Draining to the Ortega River (WBID 2213P)

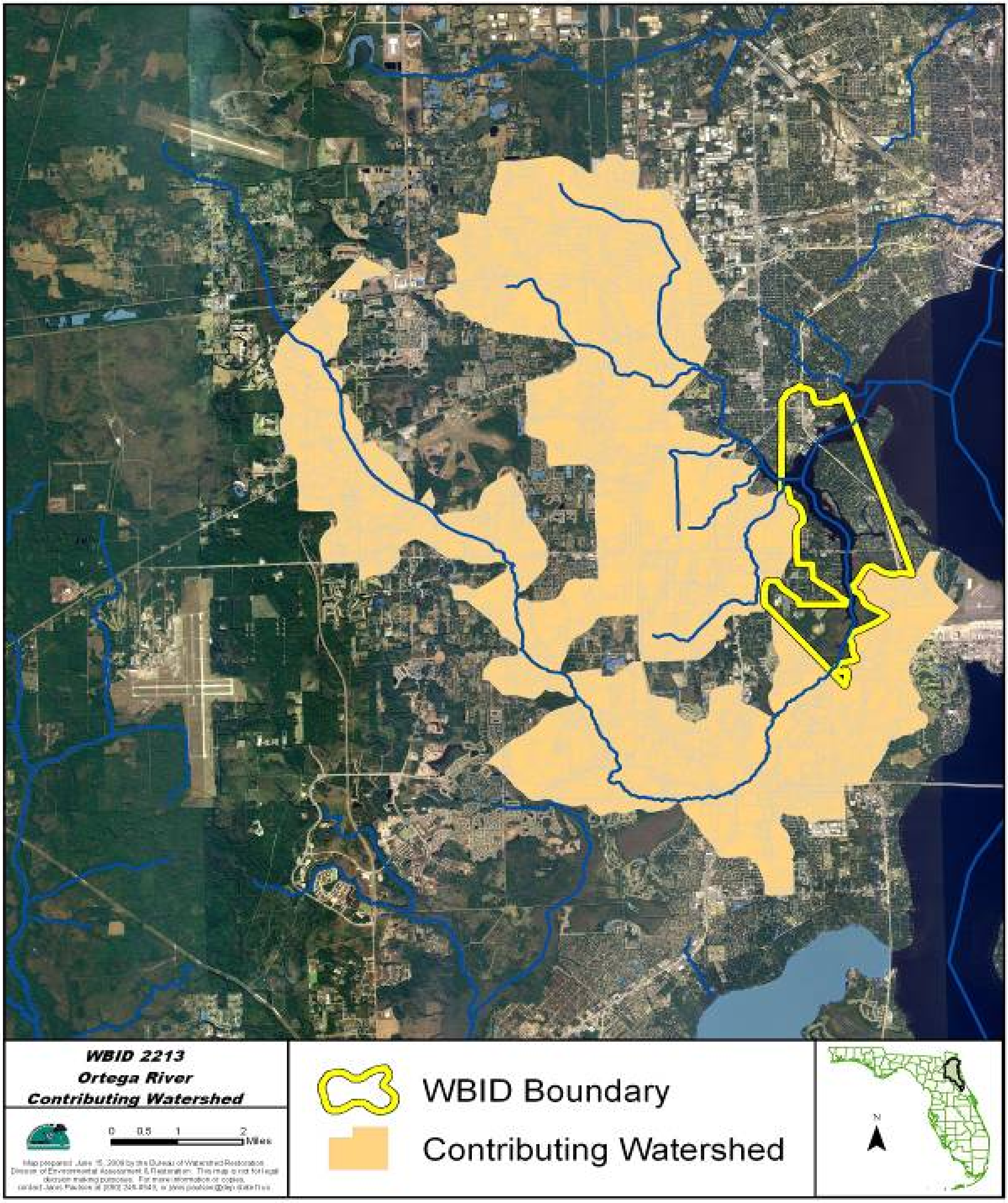


Table 4.9. Summary of Estimated Potential Annual Nitrogen and Phosphorus Loading from Various Sources in the Ortega River Watershed (WBID 2213P)

Source	TN (lbs/yr)	TP (lbs/yr)
Septic Tanks	30,031	12,513
Urban and Built-up	24,116.17	4,069.38
Agriculture	59.50	5.21
Forest/Wetland/Water/ Open Lands	10,542.32	691.81
Upstream Drainage Area	180,732.46	22,391.02

structural and nonstructural, that have been implemented for specific land uses in the watershed that reduce the actual nutrient loads delivered to the Ortega 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.

The screening model estimated an annual surface runoff of 45,985.8 acre-feet, or 15.5 inches, per year based on the Ortega River and contributing watershed areas. Dividing the estimated TN load by the surface runoff volume yielded an average TN concentration of 1.72 mg/L. The average and median TN concentrations from the available data were 1.20 and 1.15 mg/L, respectively. Dividing the estimated TP load by the surface runoff volume yielded an average TP concentration of 0.217 mg/L. The average and median TP concentrations from the available data were 0.257 and 0.167 mg/L, respectively. Flow and nutrient contributions from ground water inputs to the Ortega River were not included in this screening level calculation and would likely influence in-stream concentrations. Tidal exchange with the St. Johns River was also not considered in the calculation.

Camp Dresser & McKee, Inc. (CDM) is currently working with the city of Jacksonville on an update to the Master Stormwater Management Plan and is using the Watershed Management Model (WMM) to develop nutrient loads for sub-basins. The Ortega River is one of the watersheds 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

Twenty six sampling stations on Ortega 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, CHLAC, TN, TP, and BOD5 available observations from sampling sites in WBID 2213P. **Figure 5.2** displays the historical observations of DO over time. DO exceedance rates by station range between 0 and 100 percent. Although the linear regression of DO versus sampling date in **Figure 5.2** had a low R^2 value ($R^2 = 0.007$), it was significant at an alpha (α) level of 0.05. **Appendix E** contains plots of DO by season, station, and year.

Figures 5.3 through **5.6** illustrate historical CHLAC, TN, TP, and BOD5 observations, respectively. Linear regressions of CHLAC, TP, and BOD5 versus sampling date were significant at an α level of 0.05. **Appendix E** contains additional plots by season, station, and year. **Tables 5.3** through **5.5** provide statistical summaries of historical CHLAC, TN, and TP observations, respectively. **Table 5.6** presents a statistical summary of major water quality parameters from the available data.

Figure 5.1. Historical Sampling Sites in the Ortega River (WBID 2213P)

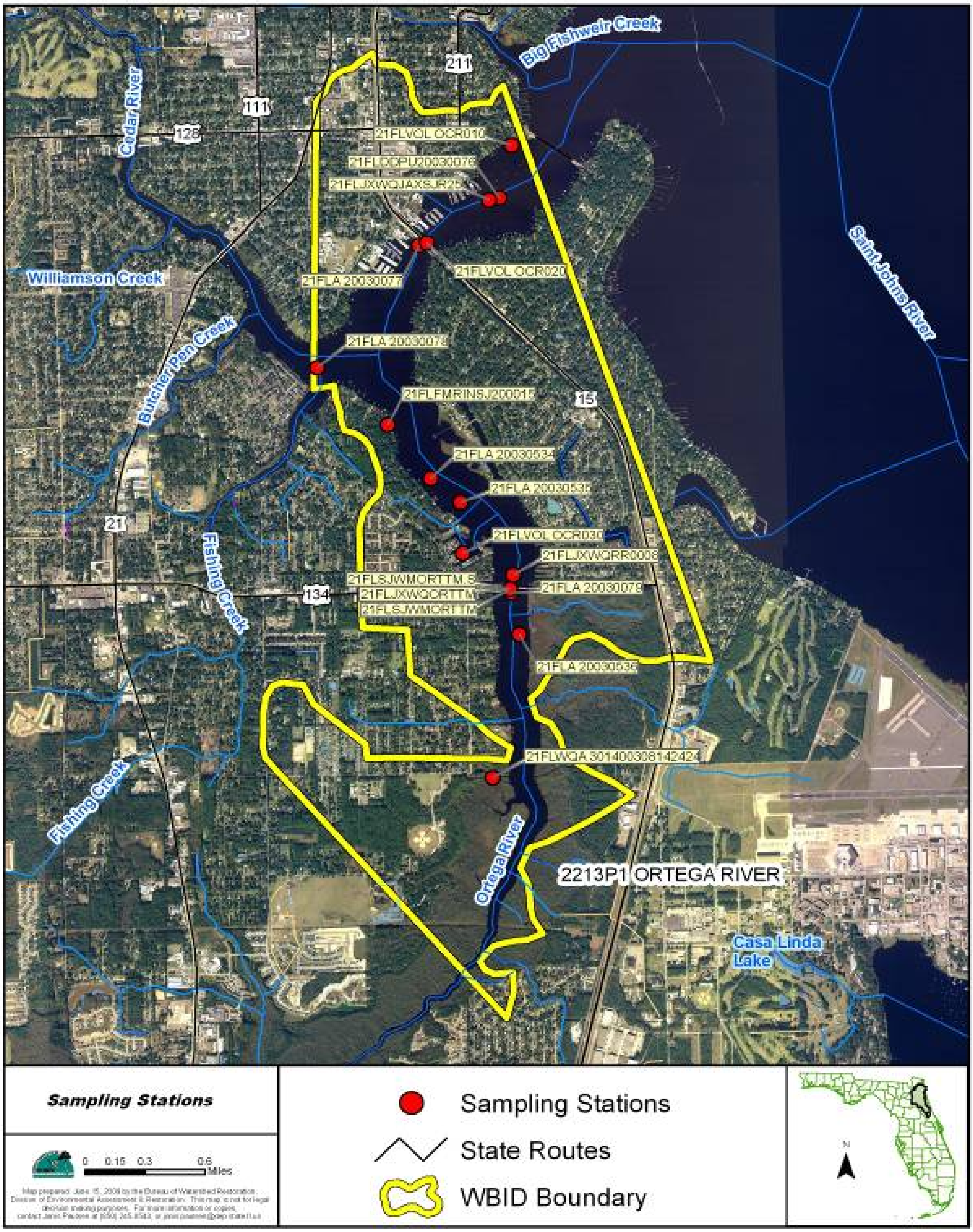


Table 5.1. Sampling Station Summary for the Ortega River

Station	STORET ID	Station Owner	Years With Data	N
Ortega Canal near JEA Pipe Spill Site	21FLWQA 301400308142424	Department	2004–05	10
Ortega River at FLA 211 (San Juan) Bridge	21FLA 20030076	Department	1974–88	27
Ortega R Br Roosevelt Blvd US 17	21FLA 20030077	Department	1971–2007	18
Ortega R Pt Junction Cedar Cr	21FLA 20030078	Department	1971–1979	10
Ortega R Br Timuquana Rd	21FLA 20030079	Department	1971–2007	111
Ortega River N of Villa del Rio Eff	21FLA 20030534	Department	1994	1
Ortega River S of Villa del Rio Eff	21FLA 20030535	Department	1994	1
Ortega River S of Timuquana Road	21FLA 20030536	Department	1994	1
Ortega River at SR 211 (San Juan) Bridge	21FLDDPU20030076	City of Jacksonville	1986–91	58
Nassau/St. Johns - Ortega River	21FLFMRINSJ200015	Department	2000	1
Cedar River at San Juan Ave	21FLJXWQCR85	City of Jacksonville	1984–2007	68
Ortega River Midway Betwn Hwy 17 & San Juan Blvd. Bridges	21FLJXWQJAXSJR25	City of Jacksonville	1991–2004	84
Below Roosevelt Blvd Ortega River near Mouth	21FLJXWQORTRM	City of Jacksonville	1994–95	3
Ortega River above Timaquana Road	21FLJXWQORTTM	City of Jacksonville	1994–95	7
Ortega River at Timaquana Road	21FLJXWQRR0008	City of Jacksonville	1983–91	33
Ortega River near Mouth Below Roosevelt Blvd	21FLSJWMORTRM	SJRWMD	1993–2001	64
Ortega R Nr Mouth Bel Roosevelt Blvd Stormflow	21FLSJWMORTRM.S	SJRWMD	1993–94	6
Ortega River above Timaquana Road	21FLSJWMORTTM	SJRWMD	1993–95	13
Ortega River above Timaquana Road Stormflow	21FLSJWMORTTM.S	SJRWMD	1993–94	9
Cedar River at Blanding Blvd Bridge Rt 21	21FLSJWM20030083	SJRWMD	1995–2007	74
Ortega R-Wayne B. Stevens Boat Ramp	21FLVOL OCR010	Volunteer	1996	7
Ortega R. @ Hwy 17 Bridge	21FLVOL OCR020	Volunteer	1995–96	26
Ortega R.-Ortega Farms	21FLVOL OCR030	Volunteer	1995–96	81
Cedar R @ San Juan Ave	21FLA 20030876	Department	2007–08	10
Cedar River at Dock 200 Yds Ups Blanding Blvd	21FLWQA 301626708144062	Department	2004–05	10
Cedar River at Lighthouse Marine Dock 125 Ft Ds San Juan Ave	21FLWQA 301653708144252	Department	2004–05	10

Table 5.2. Statistical Summary of Historical DO Data for the Ortega River

DO concentrations are mg/L.

Station	N	Minimum	Maximum	Median	Mean	Exceedances	% Exceedances
Ortega Canal near JEA Pipe Spill Site	10	1.30	7.55	3.43	4.05	6	60.00%
Ortega River at Fla 211 (San Juan) Bridge	27	4.10	9.90	7.90	7.66	2	7.41%
Ortega R Br Roosevelt Blvd US 17	18	1.20	11.60	6.70	6.83	4	22.22%
Ortega R Pt Junction Cedar Cr	10	3.00	13.00	6.05	7.17	1	10.00%
Ortega R Br Timuquana Rd	111	2.00	12.95	5.90	6.10	34	30.63%
Ortega River N of Villa del Rio Eff	1	6.60	6.60	6.60	6.60	0	0.00%
Ortega River S of Villa del Rio Eff	1	6.80	6.80	6.80	6.80	0	0.00%
Ortega River S of Timuquana Road	1	4.30	4.30	4.30	4.30	1	100.00%
Ortega River at SR 211 (San Juan) Bridge	58	4.40	15.00	7.80	7.87	2	3.45%
Nassau/St. Johns - Ortega River	1	6.20	6.20	6.20	6.20	0	0.00%
Cedar River at San Juan Ave	68	2.19	17.80	5.78	6.53	22	32.35%
Ortega River Midway Between Hwy 17 & San Juan Blvd. Bridges	84	4.76	19.59	8.03	8.21	2	2.38%
Below Roosevelt Blvd Ortega River near Mouth	3	5.75	6.98	6.53	6.42	0	0.00%
Ortega River above Timaquana Road	7	2.96	6.82	5.28	4.97	3	42.86%
Ortega River at Timaquana Road	33	3.65	13.65	7.60	8.03	1	3.03%
Ortega River near Mouth below Roosevelt Blvd	64	4.20	9.74	6.74	6.73	8	12.50%
Ortega R Nr Mouth bel Roosevelt Blvd Stormflow	6	6.01	9.34	7.39	7.49	0	0.00%
Ortega River above Timaquana Road	13	3.80	8.37	5.40	5.59	5	38.46%
Ortega River above Timaquana Road Stormflow	9	3.80	8.37	5.20	5.45	4	44.44%
Cedar River at Blanding Blvd Bridge Rt 21	74	2.05	13.40	6.39	6.57	17	22.97%
Ortega R-Wayne B. Stevens Boat Ramp	7	3.50	7.00	5.00	5.24	2	28.57%
Ortega R. @ Hwy 17 Bridge	26	4.20	9.40	6.00	6.71	1	3.85%
Ortega R.-Ortega Farms	81	2.00	8.80	5.20	5.38	37	45.68%
Cedar R @ San Juan Ave	10	2.00	9.70	3.60	4.43	7	70.00%
Cedar River at Dock 200 Yds Ups Blanding Blvd	10	3.00	8.57	5.55	5.66	3	30.00%
Cedar River at Lighthouse Marine Dock 125 Ft Ds San Juan Ave	10	2.35	8.05	4.72	5.05	6	60.00%

Table 5.3. Statistical Summary of Historical CHLAC Data for the Ortega River (WBID 2213P)

CHLAC concentrations are ug/L.

Station	N	Minimum	Maximum	Mean	Median
Ortega River at Fla 211 (San Juan) Bridge	5	2.85	22.05	7.97	5.29
Ortega R Br Roosevelt Blvd US 17	2	32.80	37.01	34.90	34.90
Ortega R Br Timuquana Rd	14	1	52.64	13.49	7.37
Ortega River at SR 211 (San Juan) Bridge	3	2.9	8.2	5.46	5.3
Nassau/St. Johns - Ortega River	1	18	18	18	18
Ortega River near Mouth below Roosevelt Blvd	9	2.33	46.14	18.80	17.69
Ortega R Nr Mouth bel Roosevelt Blvd Stormflow	2	10.42	23.6	17.01	17.01
Cedar River at Blanding Blvd Bridge Rt 21	71	1	97.72	27.42	22.87

Table 5.4. Statistical Summary of Historical TN Data for the Ortega River (WBID 2213P)

TN concentrations are mg/L.

Station	N	Minimum	Maximum	Mean	Median
Ortega River at Fla 211 (San Juan) Bridge	23	0.48	2.14	0.97	0.85
Ortega R Br Roosevelt Blvd US 17	4	0.15	1.21	0.78	0.89
Ortega R Pt Junction Cedar Cr	4	0.85	1.35	1.09	1.09
Ortega R Br Timuquana Rd	83	0.17	9.65	1.36	1.26
Ortega River N of Villa del Rio Eff	1	0.79	0.79	0.79	0.79
Ortega River S of Villa del Rio Eff	1	0.79	0.79	0.79	0.79
Ortega River S of Timuquana Road	1	0.71	0.71	0.71	0.71
Ortega River at SR 211 (San Juan) Bridge	52	0.26	3.19	1.16	1.15
Cedar River San Juan Ave	1	0.91	0.91	0.91	0.91
Ortega River Midway Btwn Hwy 17 & San Juan Blvd. Bridges	87	0.41	6.23	1.24	1.09
Below Roosevelt Blvd Ortega River near Mouth	3	0.42	0.64	0.52	0.51
Ortega River above Timaquana Road	6	0.33	1.01	0.71	0.77
Ortega River at Timaquana Road	14	0.63	2.03	1.20	1.04
Ortega River near Mouth below Roosevelt Blvd	58	0.15	1.85	1.26	1.26
Ortega R Nr Mouth Bel Roosevelt Blvd Stormflow	3	0.83	1.13	0.99	1.00
Ortega River above Timaquana Road	14	0.32	1.61	1.07	1.15
Ortega River above Timaquana Road Stormflow	8	0.31	1.37	0.96	1.13
Cedar River at Blanding Blvd Bridge Rt 21	68	0.44	1.76	1.16	1.18

Table 5.5. Statistical Summary of Historical TP Data for the Ortega River (WBID 2213P)

TP concentrations are mg/L

Station	N	Minimum	Maximum	Mean	Median
Ortega River at Fla 211 (San Juan) Bridge	24	0.100	0.310	0.172	0.170
Ortega R Br Roosevelt Blvd US 17	4	0.217	0.518	0.362	0.357
Ortega R Pt Junction Cedar Cr	6	0.200	3.000	0.859	0.495
Ortega R Br Timuquana Rd	84	0.022	5.900	0.473	0.366
Ortega River N of Villa del Rio Eff	1	0.120	0.120	0.120	0.120
Ortega River S of Villa del Rio Eff	1	0.110	0.110	0.110	0.110
Ortega River S of Timuquana Rd	1	0.110	0.110	0.110	0.110
Ortega River at SR 211 (San Juan) Bridge	58	0.010	0.480	0.197	0.180
Cedar River AT San Juan AVE	1	0.154	0.154	0.154	0.154
Ortega River Midway Btwn Hwy 17 & San Juan Blvd. Bridges	58	0.027	3.720	0.208	0.123
Below Roosevelt Blvd Ortega River near Mouth	2	0.069	0.090	0.080	0.080
Ortega River above Timaquana Road	6	0.000	0.432	0.138	0.102
Ortega River at Timaquana Road	34	0.070	0.940	0.383	0.283
Ortega River near Mouth below Roosevelt Blvd	70	0.073	0.315	0.157	0.146
Ortega R Nr Mouth bel Roosevelt Blvd Stormflow	6	0.100	0.220	0.134	0.115
Ortega River above Timaquana Road	16	0.079	0.195	0.127	0.123
Ortega River above Timaquana Road Stormflow	9	0.105	0.190	0.133	0.135
Cedar River at Blanding Blvd Bridge Rt 21	73	0.010	0.454	0.178	0.158

Table 5.6. Summary Statistics for Major Water Quality Parameters Measured in the Ortega River (WBID 2213P)

PARM	N	MIN	25%	MEDIAN	MEAN	75%	MAX
BOD (mg/L)	271	0.0	1.0	1.6	2.0	2.3	11.0
CHLAC (ug/L)	107	1.0	5.7	16.0	23.2	35.5	97.7
CHLORIDE (mg/L)	445	0.0	132.8	1037.0	1842.9	2782.8	21585.0
COLOR (PCU)	267	30	60	100	104	140	500
COND (uS/cm)	574	1	749	4466	19157	10790	18126000
DO (mg/L)	743	1.20	5.20	6.53	6.64	8.00	19.59
DOSAT (%)	589	9.30	60.14	75.00	76.66	91.83	181.45
NH4 (mg/L)	509	0.00	0.02	0.06	0.12	0.11	1.26
NO3O2 (mg/L)	384	0.00	0.03	0.09	0.14	0.22	1.55
PH (su)	722	5.00	7.00	7.29	7.30	7.60	9.00
SO4 (mg/L)	147	4.12	32.25	140.00	234.59	320.00	3060.64
TEMP (C)	743	3.00	18.60	24.50	23.24	28.12	34.00
TKN (mg/L)	433	0.01	0.80	1.00	1.04	1.22	6.10
TN (mg/L)	431	0.15	0.86	1.15	1.20	1.38	9.65
TOC (mg/L)	187	6.3	11.4	13.8	14.9	17.2	37.1
SALINITY (PPT)	532	0.0	0.6	2.4	3.9	5.8	23.5
TP (mg/L)	454	0.000	0.120	0.167	0.257	0.270	5.900
TSS (mg/L)	28	90	369	1468	1888	2244	8716
TURB (NTU)	431	0	8	12	15	19	238

Figure 5.2. Historical DO Observations for the Ortega River (WBID 2213P)

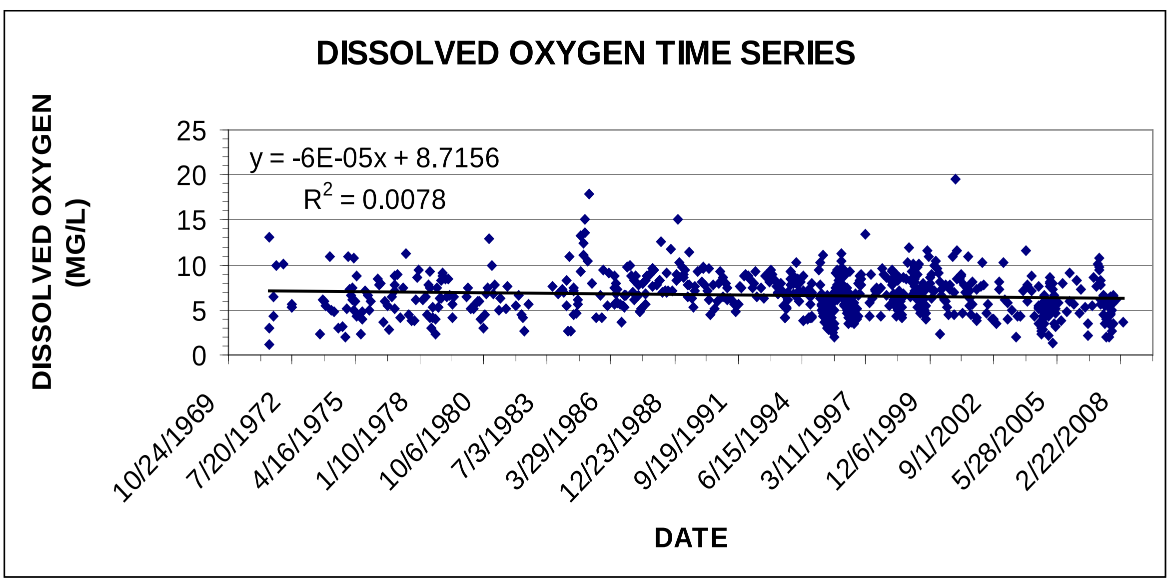


Figure 5.3. Historical CHLAC Observations for the Ortega River (WBID 2213P)

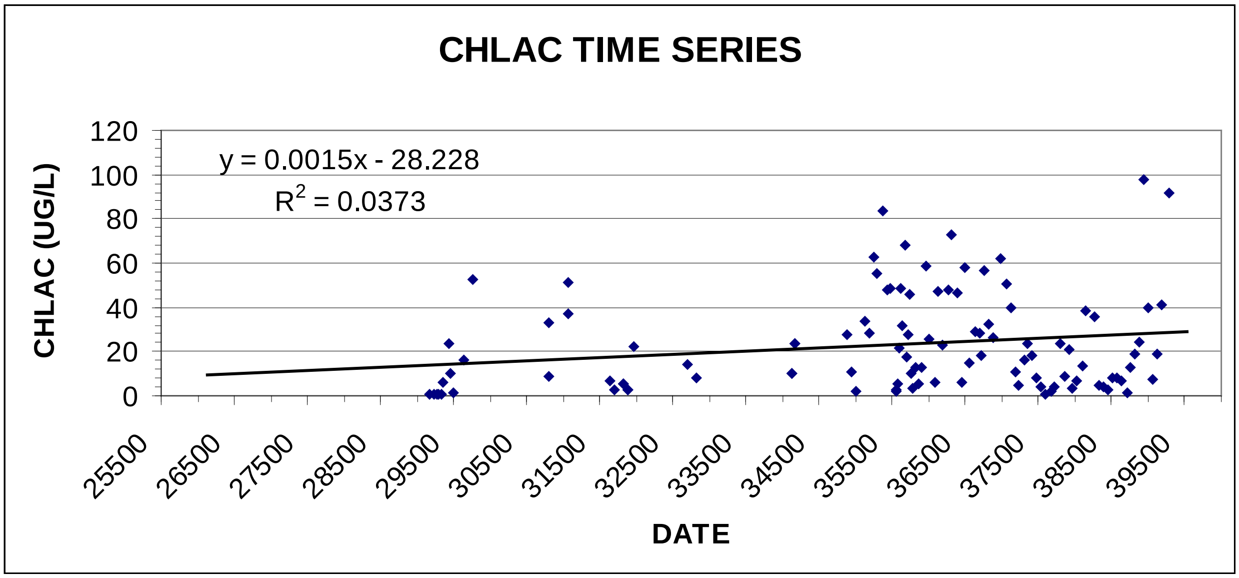


Figure 5.4. Historical TN Observations for the Ortega River (WBID 2213P)

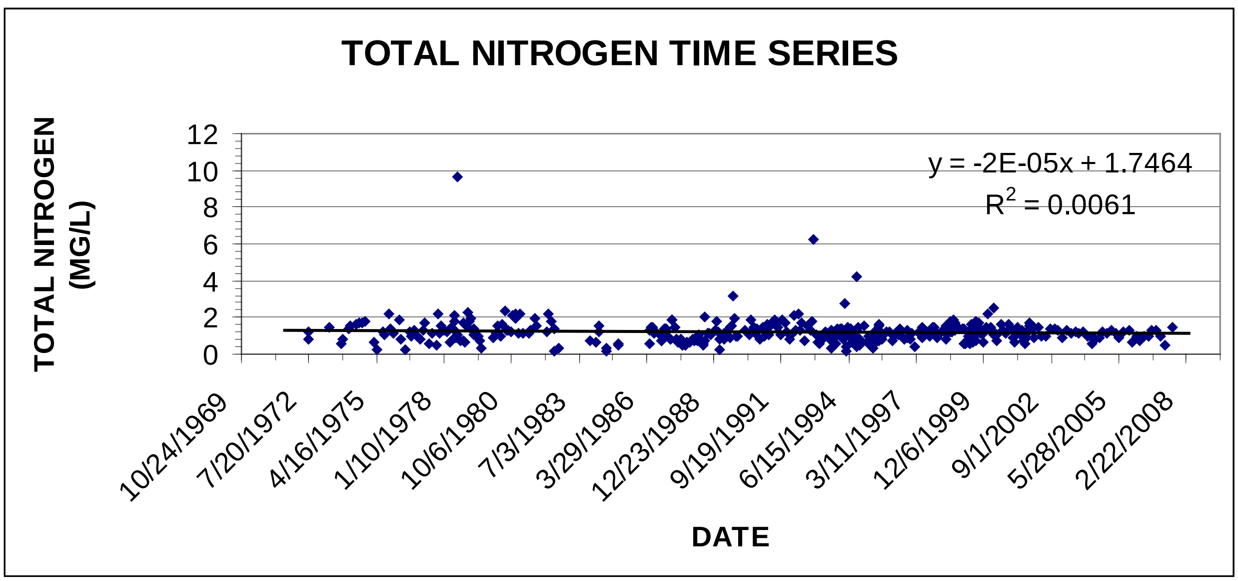


Figure 5.5. Historical TP Observations for the Ortega River (WBID 2213P)

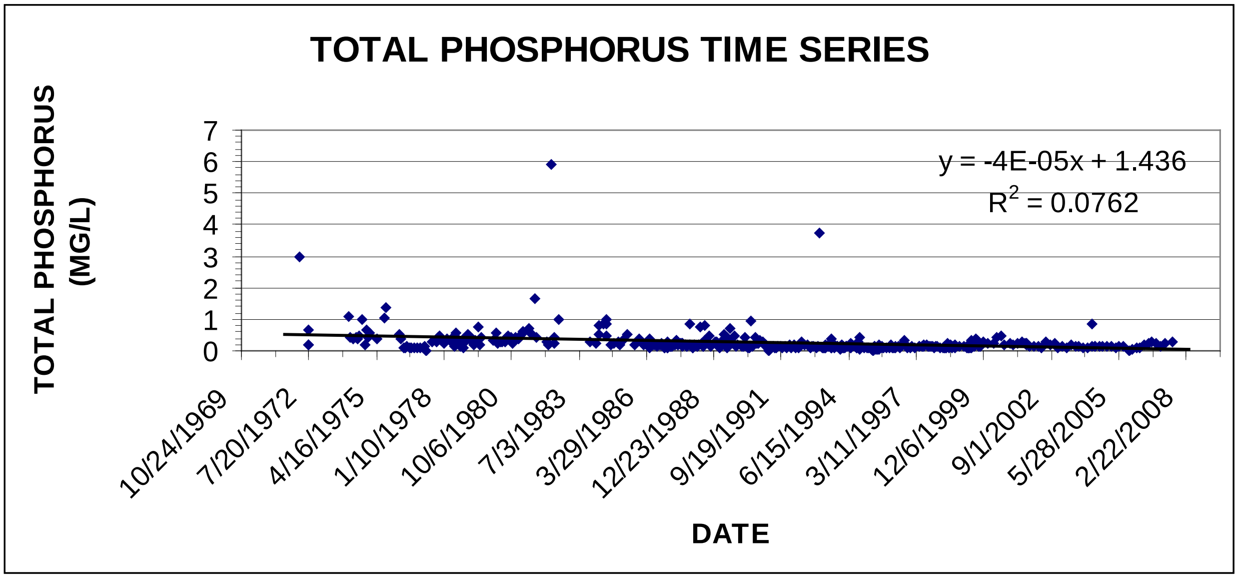
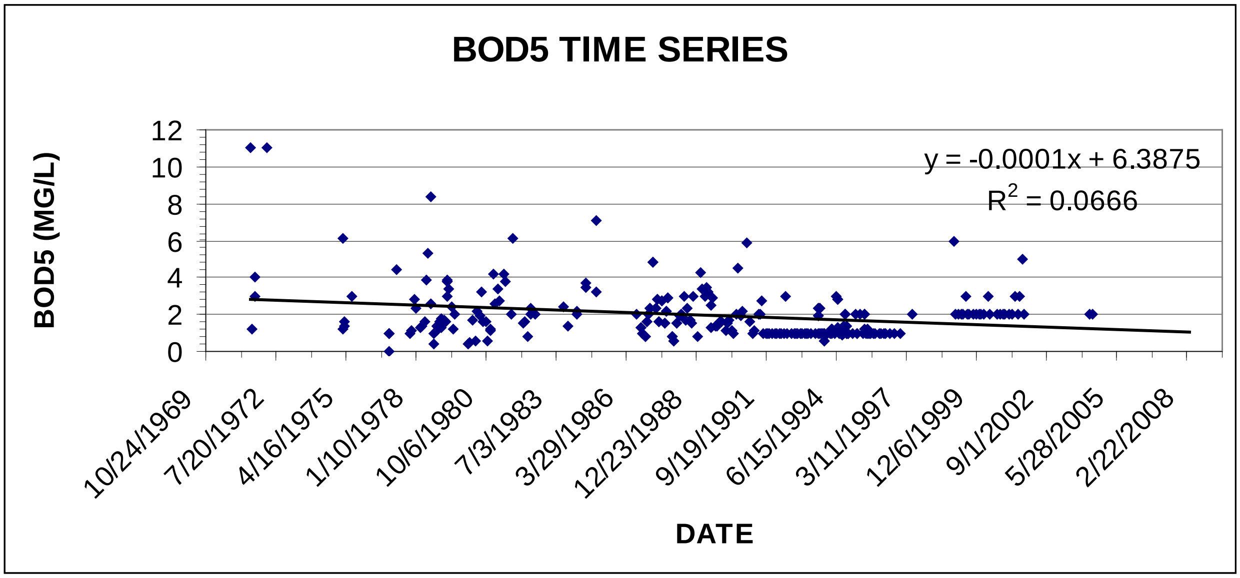


Figure 5.6. Historical BOD5 Observations for the Ortega River (WBID 2213P)



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 some parameters—DO percent saturation (DOSAT), chloride, color (COLOR), nitrogen ammonia (NH4), pH, salinity, total organic carbon (TOC), and water temperature (TEMP)—were significant. A simple linear regression of DO versus TEMP explained only 17 percent of the variance in DO (**Appendix H**).

The Cycle 2 verified impairment for DO was linked to nutrients based on annual average chl*a* concentrations above the IWR stream threshold of 20 μg/L. Nitrogen was identified as the limiting nutrient.

In order to determine the influence of nutrients on DO without the confounding effects of water temperature and color on all these variables, the general linear model (GLM) was used to develop an expression that included TEMP, COLOR, and TN. Based on 234 cases with DO, TN, COLOR, and TEMP observations, the following expression was significant at an α level of 0.05 and explained nearly 35 percent of the variance in DO:

DO = 12.924 – 0.168*TEMP – 0.016*COLOR - 0.484*TN - 0.024*TN*TEMP + 0.006*TN*COLOR

Algal growth is also influenced by water temperature, color, and nutrients. Based on the GLM, the combination of TEMP and COLOR explained 16 percent of the variance in CHLAC. The addition of TN to the GLM explained nearly 28 percent of the variance in CHLAC and was significant at an α level of 0.05.

CHLAC = 48.675 – 1.672*TEMP + 0.110*COLOR – 37.722*TN – 0.002*TEMP*COLOR - 0.176*COLOR*TN + 2.664*TEMP*TN

The TMDL reductions were developed using the historical record of TN, COLOR, and TEMP values (**Appendix B**). The historical average COLOR, DO, and CHLAC were as follows: TEMP, 23.23 °C; TN, 1.19 mg/L; COLOR, 104 platinum cobalt units (PCUs); DO, 6.64 mg/L; and CHLAC, 23.2 μg/L. Summer season averages were as follows: TEMP, 25.62 °C; TN, 1.22 mg/L; COLOR, 116 PCU; DO, 5.39 mg/L; and CHLAC, 30.7 μg/L (**Tables 5.7a** through **5.7f**). Because the adopted nutrient TMDL for the Lower St. Johns River requires a 30 to 50 percent reduction in anthropogenic nitrogen loads to the marine portion of the river, the GLM models for DO and CHLAC were used to predict DO and CHLAC concentrations following a 30 percent reduction in TN. Under the historical average concentrations, the model predicted an average DO concentration of 7.01 mg/L, with a 30 percent reduction in TN. With the summer season averages, the model predicted an average DO concentration of 6.40 mg/L, with a 30 percent reduction in TN.

Table 5.7a. Seasonal Summary Statistics for DO for the Ortega River (WBID 2213P)

DO is in mg/L

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	147	1.30	4.99	7.00	8.30	8.33	9.48	19.59
Spring	204	2.28	4.06	5.50	6.63	6.79	8.11	17.80
Summer	209	1.20	2.70	4.20	5.35	5.39	6.47	13.00
Fall	183	2.00	3.37	5.20	6.60	6.54	7.86	13.20

Table 5.7b. Seasonal Summary Statistics for TEMP for the Ortega River (WBID 2213P)

TEMP is in ° C.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	144	4.50	9.50	13.35	16.46	16.06	18.43	25.57
Spring	209	15.90	19.30	23.00	26.00	25.62	28.08	32.50
Summer	206	3.00	24.65	27.50	29.00	28.67	30.08	34.00
Fall	184	9.50	13.51	16.17	20.50	20.06	23.09	31.30

Table 5.7c. Seasonal Summary Statistics for TN for the Ortega River (WBID 2213P)

TN is in mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	85	0.26	0.60	0.83	1.12	1.20	1.38	6.23
Spring	119	0.15	0.39	0.85	1.08	1.13	1.35	2.72
Summer	124	0.15	0.43	0.92	1.21	1.22	1.40	9.65
Fall	103	0.42	0.58	0.88	1.24	1.24	1.42	4.19

Table 5.7d. Seasonal Summary Statistics for TP for the Ortega River (WBID 2213P)

TP is in mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	87	0.010	0.080	0.113	0.161	0.251	0.261	3.000
Spring	135	0.000	0.085	0.117	0.162	0.294	0.281	5.900
Summer	132	0.060	0.095	0.140	0.195	0.268	0.277	1.640
Fall	100	0.010	0.078	0.117	0.156	0.195	0.224	0.676

Table 5.7e. Seasonal Summary Statistics for BOD5 for the Ortega River (WBID 2213P)

BOD5 is in mg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	64	0.4	0.6	1.0	1.5	2.0	2.0	11.0
Spring	66	0.6	1.0	1.2	2.0	2.2	3.0	4.8
Summer	71	0.4	1.0	1.2	1.9	2.2	2.7	11.0
Fall	70	0.0	0.6	1.0	1.2	1.5	2.0	6.2

Table 5.7f. Seasonal Summary Statistics for CHLAC for the Ortega River (WBID 2213P)

CHLAC is in µg/L.

Season	N	Minimum	5%	25%	Median	Mean	75%	Maximum
Winter	21	1.0	1.0	4.9	12.7	17.4	25.6	51.5
Spring	35	1.0	2.4	6.5	21.7	25.1	40.6	72.8
Summer	24	1.1	5.0	10.6	23.5	30.7	43.3	97.7
Fall	27	1.0	1.0	3.7	7.7	18.6	31.1	83.5

A 30 percent reduction in TN was applied to the available observations for which there were corresponding COLOR and TEMP values. As seen in **Figure 5.7**, a 30 percent reduction in TN is predicted to improve the DO distribution such that values below 4 mg/L are rare. With the TN reduction, the DO distribution is shifted to the right, such that fewer than 1 percent of the DO concentrations are predicted to be below 4.4 mg/L, compared with 2.9 mg/L under existing conditions. Fewer than 5 percent of the DO concentrations are predicted to be below 5.4 mg/L compared with 25 percent of the existing observations.

A similar procedure using the CHLAC GLM yielded an estimated CHLAC concentration of 21.3 µg/L following a 30 percent reduction in TN with the historical average TEMP and COLOR values. With a 30 percent reduction in TN under the summer average conditions, a CHLAC of 21.2 µg/L was estimated. In both cases, there was a reduction in CHLAC compared with the distribution of historical values (historical average, 23.4 µg/L; historical summer average, 24.9 µg/L).

Again, the GLM for CHLAC was applied to the available observations for which there were corresponding COLOR and TEMP values (**Figure 5.8**). With the 30 percent reduction in TN, the GLM predicted a shift in the distribution. The predicted range in CHLAC was smaller relative to the existing distribution. The predicted mean was 19.6 µg/L, compared with the historical mean of 23.2 µg/L. A maximum and 75th percentile CHLAC concentration of 42 and 23 µg/L, respectively, were predicted, compared with historical values of 97.9 and 35.5 µg/L, respectively.

Although the DO GLM predicted that the minimum DO would be below the Class III freshwater criterion of 5.0 mg/L at times, reductions in CHLAC and BOD will have indirect benefits to DO levels, such as reducing sediment oxygen demand. In addition, over 34 percent of the watershed area consists of natural land uses (forests, water, and wetlands). The TMDL is not expected to cause an imbalance in the natural populations of flora and fauna, or cause nuisance conditions that depress DO below natural levels.

Figure 5.7. Cumulative Frequency Plot of Historical DO Observations Versus GLM Estimates Following a 30 Percent Reduction in TN

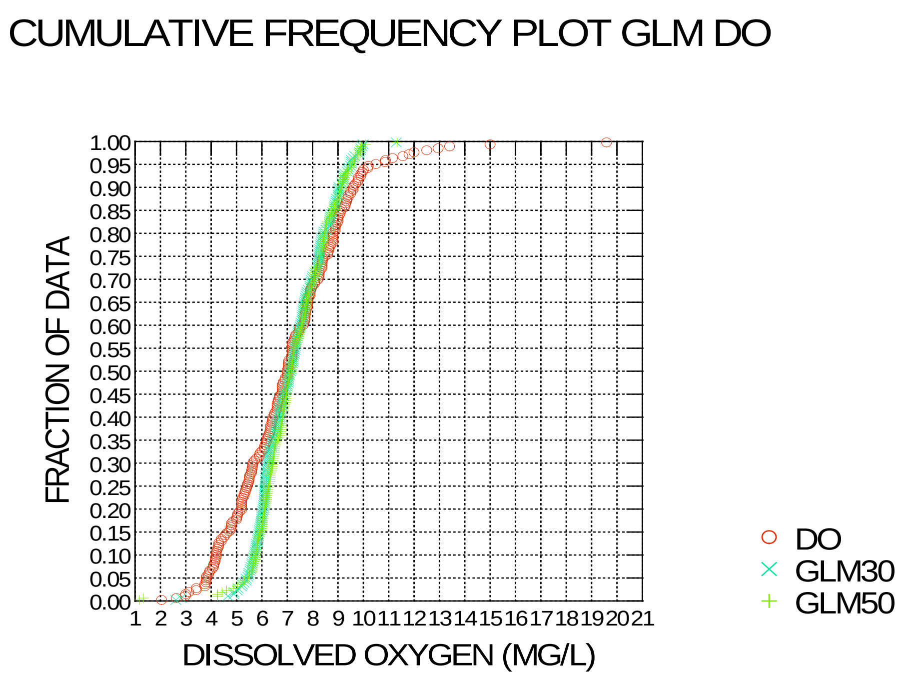
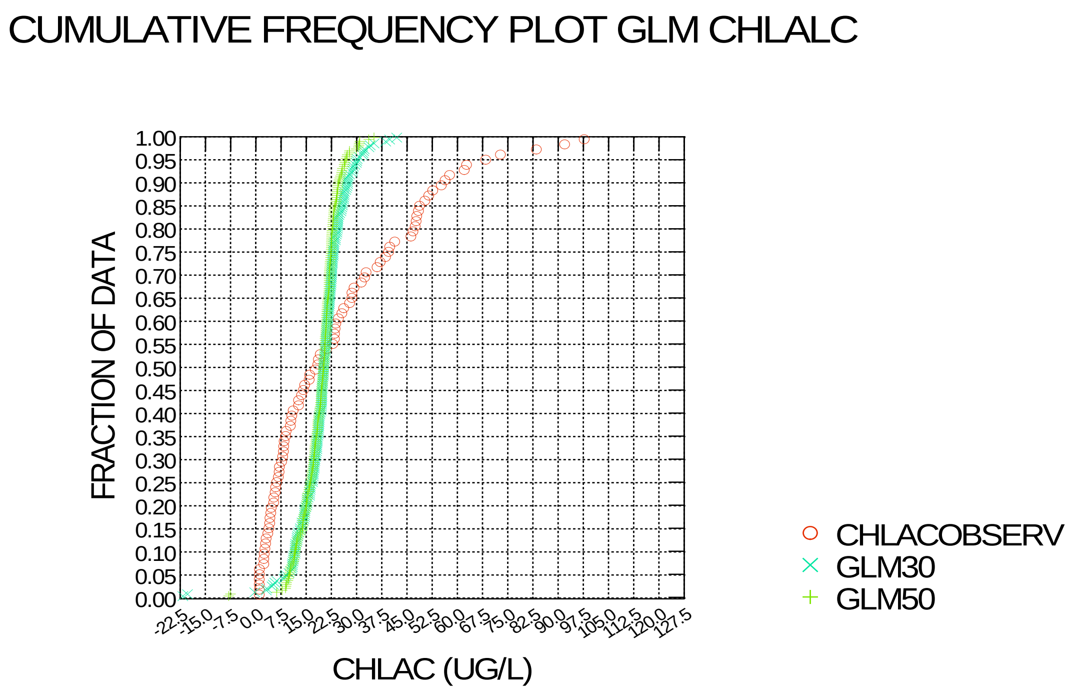


Figure 5.8. Cumulative Frequency Plot of Historical CHLAC Observations Versus GLM Estimates Following a 30 Percent Reduction in TN



5.1.3 Critical Conditions/Seasonality

A nonparametric test (Kruskal-Wallis) was applied to the DO, DOSAT, CHLAC, TN, TP, BOD5, conductance, and chloride datasets to determine whether there were significant differences among seasons or months. At an alpha (α) level of 0.05, there were significant differences among seasons for DO, DOSAT, BOD5, conductance, and chloride (**Appendix C**). Significant differences among months were found for DO, DOSAT, CHLAC, BOD5, conductance, and chloride (**Appendix D**). As seen in **Table 5.8a**, all seasons had at least a 21 percent exceedance rate. All months, except February, had exceedance rates of at least 7 percent, while July through October had the highest exceedance rates (**Table 5.8b**). Consequently, the percent reductions were calculated throughout the year and covered all months and seasons.

Rainfall records for JIA (**Appendices F** and **I**) were used to determine the rainfall amounts associated with individual sampling dates. Rainfall recorded on the day of sampling (PRECIP), the cumulative total for the day of and the previous 2 days (PRECIP3DAY), the cumulative total for the day of and the previous 6 days (PRECIP7DAY), and the cumulative total for the day of and the previous 13 days (PRECIP14DAY) were paired with the respective DO observation. The simple linear regressions between both DO and PRECIP, PRECIP3DAY, PRECIP7DAY, and PRECIP14DAY were all inverse relationships and significant at an alpha (α) level of 0.05. The relationship between DO and PRECIP14DAY had an R^2 value of 0.072.

Table 5.8a. Seasonal Exceedance Rates for DO

Season	# of Observations	# of Exceedances	% Exceedances
Winter	147	7	4.76
Spring	204	34	16.67
Summer	209	87	41.63
Fall	183	40	21.86

Table 5.8b. Monthly Exceedance Rates for DO

Month	# of Observations	# of Exceedances	% Exceedances
January	40	3	7.50%
February	50	0	0.00%
March	57	4	7.02%
April	67	5	7.46%
May	60	12	20.00%
June	77	17	22.08%
July	70	24	34.29%
August	69	23	33.33%
September	70	40	57.14%
October	73	28	38.36%
November	49	9	18.37%
December	61	3	4.92%

The Ortega River was impaired for DO based on exceedances of the Class III freshwater criterion of 5.0 mg/L. Since this portion of the Ortega River is tidally influenced, there are periods when chloride concentrations are greater than 1,500 mg/L at stations in the river, and are considered marine. The Class III DO criterion for predominantly marine waters is a minimum DO of 4.0 mg/L and a daily average of 5.0 mg/L.

Available chloride and DO observations were paired to evaluate the frequency of marine conditions and corresponding exceedances of the DO criterion (**Table 5.9**). During periods when the marine criterion would apply, exceedances of the DO criterion (4.0 mg/L) were less than 1 percent. Unfortunately, nearly 42 percent of the DO observations did not include chloride measurements; however, for at least 25 percent of the DO observations, it appears that the marine criterion would apply.

Table 5.9. Summary Statistics of DO and Chloride Measurements in the Ortega River (WBID 2213P)

DO concentrations are mg/L.

Chlorides	N	DO Minimum	DO Maximum	DO % Exceedances 4 mg/L	DO % Exceedances 5 mg/L
Not Reported	312	1.20	19.59	14.74	32.05
Less than 1,500 mg/L	244	2.00	17.80	10.24	21.72
Greater than 1,500 mg/L	187	3.41	15.00	0.53	8.02

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

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

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

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

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

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**. The TMDL for the Ortega River is expressed in terms of a percent reduction in TN to meet both the DO and nutrient criteria (**Table 6.1**).

Table 6.1. TMDL Components for the Ortega River (WBID 2213P)

[1] As the TMDL represents a percent reduction, it also complies with EPA requirements to express the TMDL on a daily basis.
[2] Not applicable

WBID	Parameter	TMDL (mg/L)	WLA for Wastewater (mg/L)	WLA for NPDES Stormwater (% reduction)[1]	LA (% reduction)[1]	MOS
2213P	TN		N/A[2]	30%	30%	Implicit

6.2 Load Allocation

A TN reduction of 30 percent is required from nonpoint sources. It should be noted that the load allocation includes loading from stormwater discharges that are not part of the NPDES Stormwater Program.

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

There are currently no permitted NPDES discharges in the Ortega 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 that will comply with the TMDL.

6.3.2 NPDES Stormwater Discharges

The city of Jacksonville and FDOT District 2 are co-permittees for a Phase I NPDES MS4 permit (FLS000012) that includes all of the Ortega River watershed and would be responsible for a 30 percent reduction in current anthropogenic TN 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 by basing the TMDL on meeting a the Class III freshwater DO criterion of 5.0 mg/L, although existing data indicate that the Class III marine DO criterion of a minimum of 4.0 mg/L would be appropriate at least 25 percent of the time. Under a 30 percent reduction in TN, DO concentrations are predicted to exceed 4.4 mg/L 99 percent of the time, and concentrations below 5.0 mg/L would occur less than 3 percent of the time.

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 on 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. BMAPs 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 that 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 the following:

- *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 the obligations of wastewater point source, MS4, and non-MS4 stakeholders in TMDL implementation; enhanced transparency in the Department's decision making; and built strong relationships between the Department and local stakeholders that have benefited other program areas.

7.2 Other TMDL Implementation Tools

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. This is 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.

A multitude of assessment tools is 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 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 road map for restoration activities, while still meeting the requirements of Subsection 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 Ortega River represents a contributing watershed to the Lower St. Johns, applicable activities undertaken in the Ortega River watershed as part of the Lower St. Johns River BMAP should be beneficial in addressing the DO and nutrient impairment in the Ortega 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 the 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 FDOT 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, BOD5, CHLAC, TN, and TP Observations in the Ortega River (WBID 2213P), 1971–2008

- = Empty cell/no data

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLA20030077	7/19/1971	1.20	-	-	-	-
FLA20030078	7/19/1971	3.00	11.0	-	-	-
FLA20030078	8/5/1971	13.00	1.2	-	-	-
FLA20030078	9/27/1971	6.40	4.0	-	-	-
FLA20030079	9/27/1971	4.30	3.0	-	-	-
FLA20030078	11/8/1971	10.00	-	-	-	-
FLA20030078	3/7/1972	10.10	11.0	-	-	3.000
FLA20030078	7/18/1972	5.35	-	-	0.85	0.640
FLA20030078	7/19/1972	5.70	-	-	1.21	0.205
FLA20030078	7/20/1972	5.35	-	-	-	0.200
FLA20030079	5/15/1973	-	-	-	1.46	-
FLA20030079	10/9/1973	2.30	-	-	-	-
FLA20030079	11/7/1973	6.20	-	-	0.55	-
FLA20030079	12/4/1973	5.90	-	-	0.81	-
FLA20030079	1/7/1974	5.50	-	-	-	-
FLA20030079	2/25/1974	11.00	-	-	1.40	1.104
FLA20030079	3/19/1974	4.90	-	-	1.53	0.437
FLA20030079	5/13/1974	4.80	-	-	-	0.391
FLA20030079	6/12/1974	-	-	-	1.61	0.428
FLA20030079	7/15/1974	3.00	-	-	-	0.381
FLA20030079	8/12/1974	-	-	-	1.72	0.465
FLA20030079	9/16/1974	3.20	-	-	1.67	0.992
FLA20030079	10/29/1974	2.00	-	-	1.75	0.208
FLA20030079	11/18/1974	5.10	-	-	-	0.676
FLA20030079	12/10/1974	11.00	-	-	-	0.428
FLA20030079	1/6/1975	7.30	-	-	-	0.589
FLA20030079	2/3/1975	6.60	-	-	-	-
FLA20030079	2/24/1975	6.10	1.2	-	-	-
FLA20030079	3/3/1975	7.40	6.1	-	-	-
FLA20030079	3/10/1975	10.80	-	-	0.64	-
FLA20030079	3/24/1975	5.00	1.4	-	-	-
FLA20030079	3/31/1975	5.90	1.6	-	-	-
FLA20030079	4/21/1975	4.30	-	-	0.27	0.363
FLA20030079	5/5/1975	8.80	-	-	-	-
FLA20030079	6/30/1975	2.30	3.0	-	-	-
FLA20030079	7/21/1975	4.00	-	-	1.23	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLA20030079	8/4/1975	4.80	-	-	1.06	1.060
FLA20030079	9/8/1975	7.10	-	-	-	1.360
FLA20030079	10/13/1975	6.70	-	-	2.16	-
FLA20030079	11/3/1975	5.00	-	-	1.36	-
FLA20030079	12/15/1975	6.00	-	-	1.14	-
FLA20030079	3/22/1976	8.40	-	-	1.86	0.518
FLA20030079	4/19/1976	7.70	-	-	0.84	0.357
FLA20030079	5/17/1976	8.00	-	-	-	0.084
FLA20030079	6/21/1976	3.60	-	-	0.28	0.112
FLA20030079	7/19/1976	6.00	-	-	-	0.140
FLA20030079	8/30/1976	5.40	-	-	1.24	0.100
FLA20030079	9/20/1976	2.80	-	-	0.94	0.083
FLA20030079	11/1/1976	6.50	-	-	1.26	0.074
FLA20030076	12/15/1976	8.80	1.0	-	-	-
FLA20030077	12/15/1976	7.70	1.0	-	-	-
FLA20030078	12/15/1976	7.20	1.0	-	-	-
FLA20030079	12/15/1976	5.20	0.0	-	0.95	0.093
FLA20030079	1/17/1977	8.90	-	-	0.83	0.093
FLA20030079	3/14/1977	4.20	-	-	1.30	0.092
FLA20030079	4/6/1977	-	4.4	-	1.74	0.160
FLA20030079	5/2/1977	7.40	-	-	-	0.022
FLA20030079	6/13/1977	11.20	-	-	0.55	-
FLA20030079	7/13/1977	4.40	-	-	1.16	0.263
FLA20030079	9/16/1977	3.75	-	-	0.46	0.280
FLA20030079	10/11/1977	3.80	1.0	-	2.17	0.420
FLA20030079	11/2/1977	6.10	1.1	-	1.12	0.450
FLA20030079	12/8/1977	8.60	2.8	-	1.52	0.340
FLA20030079	1/4/1978	9.50	2.3	-	1.30	0.250
FLA20030079	3/6/1978	6.20	1.3	-	1.23	0.370
FLA20030079	4/5/1978	6.50	1.4	-	0.67	0.340
FLA20030079	5/8/1978	4.50	1.6	-	1.46	0.270
FLA20030079	6/7/1978	7.75	3.9	-	0.90	0.450
FLA20030076	6/26/1978	7.46	-	-	2.14	0.150
FLA20030079	6/26/1978	9.20	-	-	1.79	0.179
FLA20030076	6/27/1978	4.10	-	-	0.88	0.194
FLA20030079	7/5/1978	2.98	5.3	-	1.25	0.570
FLA20030079	7/31/1978	5.30	2.6	-	1.06	0.370
FLA20030079	8/8/1978	4.20	8.4	-	9.65	0.220
FLA20030079	9/13/1978	2.40	0.4	-	-	-
FLA20030079	9/19/1978	3.90	1.0	-	0.76	0.162

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLA20030079	10/18/1978	7.50	-	-	0.71	0.087
FLA20030079	10/23/1978	5.35	1.1	-	1.72	0.370
FLA20030079	11/7/1978	5.37	1.4	-	-	0.360
FLA20030079	11/14/1978	6.30	1.3	-	0.69	-
FLA20030079	12/5/1978	6.35	1.6	-	1.54	0.350
FLA20030079	12/19/1978	8.20	1.6	-	-	-
FLA20030079	1/9/1979	9.05	1.8	-	2.27	0.500
FLA20030079	1/11/1979	8.80	1.3	-	1.82	0.450
FLA20030079	2/21/1979	8.40	1.7	-	1.96	0.310
FLA20030079	3/12/1979	6.40	1.6	-	1.33	0.380
FLA20030076	4/3/1979	-	3.8	-	1.04	0.170
FLA20030077	4/3/1979	-	3.9	-	1.18	0.240
FLA20030078	4/3/1979	-	3.8	-	1.35	0.350
FLA20030079	4/3/1979	8.38	3.0	-	1.29	0.350
FLA20030079	4/30/1979	6.60	3.4	-	1.03	0.340
FLA20030078	6/4/1979	5.64	2.4	-	0.96	0.760
FLA20030079	6/18/1979	4.14	1.2	-	0.70	0.200
FLA20030079	7/11/1979	6.40	2.0	-	0.35	0.420
FLA20030079	11/13/1979	-	-	1.00	-	-
FLA20030079	1/16/1980	6.42	0.4	1.00	0.91	0.320
FLA20030079	2/13/1980	7.48	0.5	1.00	1.16	0.550
FLA20030079	3/19/1980	5.05	1.7	1.00	1.51	0.260
FLA20030079	4/27/1980	-	-	1.00	-	-
FLA20030079	4/28/1980	5.20	0.6	-	0.98	0.280
FLA20030079	5/19/1980	5.55	2.2	5.87	1.61	0.290
FLA20030079	6/30/1980	5.90	1.9	-	2.32	0.280
FLA20030079	7/28/1980	5.90	3.2	23.39	1.27	0.420
FLA20030079	8/27/1980	4.05	1.6	10.41	1.29	0.450
FLA20030079	9/29/1980	3.00	1.6	1.07	1.23	0.410
FLA20030079	10/21/1980	4.40	0.6	-	2.12	0.220
FLA20030079	11/26/1980	6.85	1.2	-	2.16	0.430
FLA20030079	12/8/1980	7.50	1.1	-	1.95	0.400
FLA20030079	1/12/1981	12.95	4.2	-	1.12	0.360
FLA20030079	2/16/1981	10.00	2.6	16.02	2.16	0.480
FLA20030079	3/16/1981	6.80	3.4	-	1.10	0.550
FLA20030079	4/6/1981	7.85	2.7	-	-	0.600
FLA20030079	6/17/1981	5.00	4.2	52.64	1.13	0.720
FLA20030079	7/8/1981	6.35	3.8	-	1.27	0.570
FLA20030079	9/21/1981	5.20	2.0	-	1.94	1.640
FLA20030079	10/19/1981	7.65	6.2	-	1.53	0.440

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLA20030079	3/8/1982	5.51	1.5	-	1.20	0.270
FLA20030079	4/12/1982	6.55	1.7	-	2.21	0.210
FLA20030079	5/24/1982	4.40	0.8	-	1.76	5.900
FLA20030079	6/23/1982	4.20	2.1	-	0.17	0.439
FLA20030079	7/13/1982	2.63	2.3	-	1.42	0.260
FLA20030079	9/7/1982	5.65	2.0	-	0.30	1.000
FLJXWQRR0008	10/5/1983	7.60	2.4	-	-	-
FLJXWQRR0008	12/14/1983	6.80	1.4	-	0.77	0.271
FLJXWQCR85	2/28/1984	7.30	-	-	-	-
FLJXWQRR0008	3/14/1984	7.00	-	-	0.63	0.236
FLA20030077	4/24/1984	8.25	2.1	32.80	1.21	0.518
FLA20030079	4/24/1984	5.50	2.2	8.88	1.55	0.788
FLJXWQCR85	6/4/1984	2.70	-	-	-	-
FLJXWQRR0008	6/26/1984	11.00	-	-	-	0.866
FLJXWQCR85	7/12/1984	2.60	-	-	-	-
FLJXWQRR0008	8/14/1984	7.40	-	-	-	0.843
FLA20030077	8/20/1984	7.05	3.7	-	0.15	0.474
FLA20030079	8/20/1984	4.55	3.5	-	0.34	1.000
FLJXWQCR85	9/25/1984	4.70	-	-	-	-
FLJXWQRR0008	10/23/1984	5.60	-	-	-	0.202
FLJXWQCR85	10/30/1984	6.10	-	-	-	-
FLJXWQRR0008	12/5/1984	9.20	-	-	-	0.243
FLJXWQCR85	12/20/1984	13.20	-	-	-	-
FLA20030077	1/28/1985	11.15	3.2	37.01	0.59	0.217
FLA20030079	1/28/1985	12.50	7.1	51.46	0.49	0.261
FLJXWQCR85	2/13/1985	15.00	-	-	-	-
FLJXWQRR0008	2/19/1985	13.65	-	-	-	0.167
FLJXWQRR0008	4/10/1985	10.40	-	-	-	0.318
FLJXWQCR85	4/25/1985	17.80	-	-	-	-
FLJXWQRR0008	6/11/1985	7.90	-	-	-	0.539
FLJXWQCR85	8/12/1985	4.10	-	-	-	-
FLJXWQRR0008	10/15/1985	6.55	-	-	-	0.196
FLJXWQCR85	11/5/1985	4.20	-	-	-	-
FLJXWQRR0008	12/3/1985	9.40	-	-	-	0.358
FLJXWQCR85	2/3/1986	5.40	-	-	-	-
FLJXWQRR0008	2/26/1986	9.10	-	-	-	0.185
FLDDPU20030076	5/14/1986	8.70	-	-	0.60	0.400
FLJXWQRR0008	5/21/1986	5.60	-	-	-	0.175
FLDDPU20030076	5/22/1986	7.40	-	-	1.30	0.100
FLDDPU20030076	6/9/1986	7.90	-	-	1.50	0.300

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLJXWQCR85	6/12/1986	5.80	-	-	-	-
FLDDPU20030076	6/18/1986	6.80	-	-	1.50	0.210
FLJXWQRR0008	7/8/1986	7.35	-	-	-	0.243
FLDDPU20030076	7/16/1986	5.80	-	-	1.10	0.200
FLA20030076	8/20/1986	5.60	2.0	6.68	1.25	0.170
FLJXWQRR0008	9/8/1986	3.65	-	-	-	0.152
FLA20030076	10/15/1986	5.50	-	3.00	-	-
FLA20030076	10/22/1986	6.70	1.3	-	-	0.170
FLDDPU20030076	10/22/1986	6.70	1.3	-	1.04	0.170
FLJXWQCR85	10/23/1986	5.30	-	-	-	-
FLJXWQRR0008	11/4/1986	6.65	-	-	-	0.242
FLA20030076	11/18/1986	6.60	1.0	-	0.76	0.200
FLDDPU20030076	11/18/1986	6.60	1.0	-	0.76	0.200
FLA20030076	12/16/1986	9.80	0.8	-	1.37	0.100
FLDDPU20030076	12/16/1986	9.80	0.8	-	1.37	0.100
FLA20030076	1/14/1987	9.90	1.6	-	1.38	0.130
FLDDPU20030076	1/14/1987	9.90	1.6	-	1.38	0.130
FLA20030076	2/4/1987	8.75	-	5.29	-	-
FLJXWQRR0008	2/4/1987	-	-	-	-	0.289
FLA20030076	2/11/1987	8.80	2.0	-	0.98	0.100
FLDDPU20030076	2/11/1987	8.80	2.0	5.30	0.98	0.100
FLA20030076	3/10/1987	7.00	2.3	-	0.82	0.160
FLDDPU20030076	3/10/1987	7.00	2.3	-	0.82	0.160
FLJXWQRR0008	3/31/1987	6.20	-	-	-	0.147
FLA20030076	4/8/1987	8.30	-	2.85	-	-
FLA20030076	4/14/1987	8.80	4.8	-	1.84	0.130
FLDDPU20030076	4/14/1987	8.80	4.8	2.90	1.84	0.130
FLA20030076	5/26/1987	7.70	2.3	-	1.46	0.210
FLDDPU20030076	5/26/1987	7.70	2.3	-	1.46	0.210
FLJXWQRR0008	6/2/1987	6.60	-	-	-	0.303
FLA20030076	6/23/1987	4.80	2.8	-	0.85	0.310
FLDDPU20030076	6/23/1987	4.80	2.8	-	0.85	0.310
FLA20030076	7/13/1987	-	-	22.05	-	-
FLA20030076	7/14/1987	5.20	1.6	-	0.67	0.200
FLDDPU20030076	7/14/1987	5.20	1.6	-	0.74	0.200
FLA20030076	8/18/1987	7.90	2.7	-	0.85	0.230
FLDDPU20030076	8/18/1987	7.90	2.7	-	0.85	0.230
FLJXWQRR0008	9/15/1987	5.70	-	-	-	0.135
FLJXWQCR85	9/16/1987	8.23	-	-	-	-
FLA20030076	9/22/1987	6.80	1.5	-	0.52	0.240

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLDDPU20030076	9/22/1987	6.80	1.5	-	0.52	0.240
FLA20030076	10/20/1987	8.80	2.2	-	0.48	0.170
FLDDPU20030076	10/20/1987	8.80	2.2	-	0.48	0.170
FLA20030076	11/17/1987	9.00	2.9	-	0.63	0.150
FLDDPU20030076	11/17/1987	9.00	2.9	-	0.63	0.150
FLA20030076	1/12/1988	9.60	0.8	-	0.67	0.210
FLDDPU20030076	1/12/1988	9.60	0.8	-	0.67	0.210
FLJXWQRR0008	1/12/1988	7.60	-	-	-	0.865
FLA20030076	2/10/1988	9.40	0.6	-	0.78	0.110
FLDDPU20030076	2/10/1988	9.40	0.6	-	0.85	0.110
FLA20030076	3/8/1988	7.80	1.5	-	0.75	0.180
FLDDPU20030076	3/8/1988	7.80	1.5	-	0.75	0.180
FLA20030076	4/26/1988	8.20	1.9	-	0.70	0.120
FLDDPU20030076	4/26/1988	8.20	1.9	-	-	0.120
FLA20030076	5/10/1988	8.30	2.0	-	1.05	0.180
FLDDPU20030076	5/10/1988	8.30	2.0	-	-	0.180
FLJXWQRR0008	5/24/1988	12.60	-	-	-	0.774
FLDDPU20030076	6/21/1988	7.00	3.0	-	0.77	0.220
FLA20030076	7/20/1988	7.20	1.7	-	0.50	0.140
FLDDPU20030076	7/20/1988	7.20	1.7	-	0.55	0.140
FLJXWQRR0008	8/9/1988	7.00	-	-	2.03	0.793
FLDDPU20030076	8/16/1988	9.10	2.3	-	0.77	0.310
FLDDPU20030076	9/20/1988	7.20	1.7	-	1.12	0.270
FLDDPU20030076	10/18/1988	11.80	1.5	-	1.15	0.480
FLDDPU20030076	11/15/1988	7.20	3.0	-	1.07	0.130
FLDDPU20030076	1/17/1989	9.00	0.8	-	1.29	0.290
FLJXWQRR0008	1/25/1989	8.30	-	-	1.76	0.277
FLDDPU20030076	2/14/1989	15.00	4.3	-	1.25	0.200
FLDDPU20030076	3/14/1989	10.20	3.4	-	0.26	0.180
FLJXWQRR0008	3/14/1989	8.55	-	-	0.81	0.112
FLDDPU20030076	4/17/1989	9.70	3.0	-	0.88	0.270
FLDDPU20030076	5/16/1989	8.90	3.5	-	1.15	0.260
FLJXWQRR0008	5/17/1989	8.63	-	-	0.83	0.540
FLDDPU20030076	6/12/1989	9.50	3.2	-	1.15	0.280
FLA20030079	7/10/1989	6.50	1.3	14.15	0.98	0.100
FLDDPU20030076	7/10/1989	7.80	2.5	-	1.25	0.410
FLDDPU20030076	8/14/1989	7.70	2.9	-	1.45	0.230
FLJXWQRR0008	8/16/1989	11.40	-	-	0.86	0.730
FLDDPU20030076	9/11/1989	6.30	1.4	-	1.58	0.300
FLDDPU20030076	10/9/1989	5.30	1.4	-	3.19	0.240

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLJXWQRR0008	10/25/1989	7.60	-	-	1.91	0.470
FLDDPU20030076	11/13/1989	7.20	1.6	8.20	0.96	0.130
FLDDPU20030076	12/11/1989	9.30	1.6	-	0.99	0.200
FLDDPU20030076	2/12/1990	8.10	1.1	-	-	0.130
FLDDPU20030076	3/12/1990	9.60	1.5	-	-	0.140
FLJXWQRR0008	3/27/1990	9.70	-	-	1.32	0.420
FLDDPU20030076	4/9/1990	7.80	1.7	-	-	0.170
FLDDPU20030076	5/14/1990	7.20	1.1	-	-	0.100
FLDDPU20030076	6/11/1990	6.10	1.0	-	1.03	0.100
FLJXWQRR0008	6/19/1990	9.60	-	-	1.85	0.940
FLDDPU20030076	7/16/1990	4.40	2.0	-	1.31	0.160
FLDDPU20030076	8/13/1990	7.70	4.5	-	1.48	0.170
FLJXWQRR0008	8/22/1990	-	-	-	1.12	0.420
FLDDPU20030076	9/17/1990	5.20	1.9	-	1.36	0.220
FLDDPU20030076	10/15/1990	5.90	2.2	-	1.28	0.220
FLJXWQRR0008	11/6/1990	8.02	-	-	0.83	0.330
FLDDPU20030076	12/10/1990	9.30	5.9	-	1.42	0.280
FLJXWQRR0008	1/15/1991	6.38	-	-	1.01	0.180
FLDDPU20030076	1/29/1991	8.60	1.6	-	1.32	0.170
FLDDPU20030076	2/25/1991	8.00	1.0	-	1.66	0.150
FLDDPU20030076	3/26/1991	7.50	1.1	-	1.45	0.010
FLJXWQRR0008	3/26/1991	6.20	-	-	1.07	0.070
FLDDPU20030076	5/20/1991	6.30	2.0	-	1.76	0.140
FLDDPU20030076	6/17/1991	6.00	2.0	-	1.84	0.100
FLDDPU20030076	7/15/1991	5.60	2.7	-	1.63	0.110
FLJXWQJAXSJR25	8/6/1991	4.88	1.0	-	1.48	0.140
FLJXWQJAXSJR25	9/18/1991	5.66	1.0	-	1.07	0.140
FLJXWQJAXSJR25	10/8/1991	7.66	1.0	-	1.89	0.100
FLJXWQJAXSJR25	11/5/1991	7.52	1.0	-	1.71	0.140
FLJXWQJAXSJR25	12/10/1991	8.74	1.0	-	1.24	0.110
FLJXWQJAXSJR25	1/14/1992	9.01	1.0	-	0.82	0.180
FLJXWQJAXSJR25	2/18/1992	8.73	1.0	-	1.09	0.100
FLJXWQJAXSJR25	3/17/1992	8.41	1.0	-	2.12	0.200
FLJXWQJAXSJR25	4/21/1992	7.50	1.0	-	1.29	0.090
FLJXWQJAXSJR25	5/26/1992	7.93	1.0	-	2.15	0.100
FLJXWQJAXSJR25	6/16/1992	9.25	3.0	-	1.26	0.130
FLJXWQJAXSJR25	7/14/1992	6.44	1.0	-	1.67	0.300
FLJXWQJAXSJR25	9/1/1992	7.52	1.0	-	0.69	0.200
FLJXWQJAXSJR25	10/13/1992	6.29	1.0	-	1.56	0.180
FLJXWQJAXSJR25	11/17/1992	8.81	1.0	-	1.27	0.110

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (µg/L)	TN (mg/L)	TP (mg/L)
FLJXWQJAXSJR25	12/8/1992	8.95	1.0	-	1.78	0.160
FLJXWQJAXSJR25	1/12/1993	8.13	1.0	-	6.23	0.160
FLJXWQJAXSJR25	2/9/1993	9.41	1.0	-	1.04	0.110
FLJXWQJAXSJR25	3/9/1993	8.89	1.0	-	0.63	0.140
FLJXWQJAXSJR25	4/13/1993	8.34	1.0	-	0.56	3.720
FLJXWQJAXSJR25	5/11/1993	7.64	1.0	-	0.84	0.080
FLJXWQJAXSJR25	6/8/1993	7.02	1.0	-	1.09	0.100
FLSJWMORTRM	6/9/1993	6.80	-	10.43	-	0.100
FLSJWMORTRM.S	6/9/1993	6.80	-	10.42	-	0.100
FLSJWMORTRM	7/8/1993	8.00	-	23.60	-	0.113
FLSJWMORTRM.S	7/8/1993	8.00	-	23.60	1.00	0.105
FLJXWQJAXSJR25	7/12/1993	7.26	-	-	1.25	0.180
FLJXWQJAXSJR25	8/17/1993	5.44	1.0	-	1.02	0.190
FLSJWMORTTM	8/24/1993	5.40	-	-	-	0.142
FLSJWMORTTM.S	8/24/1993	5.40	-	-	1.09	0.140
FLJXWQJAXSJR25	9/21/1993	6.59	1.0	-	1.26	0.360
FLSJWMORTTM	9/21/1993	4.20	2.3	-	0.76	0.114
FLSJWMORTTM.S	9/21/1993	4.20	2.3	-	0.78	0.105
FLSJWMORTTM	9/22/1993	4.10	1.9	-	0.32	0.117
FLSJWMORTTM.S	9/22/1993	4.10	1.9	-	0.31	0.110
FLSJWMORTTM	10/7/1993	5.20	2.3	-	1.16	0.195
FLSJWMORTTM.S	10/7/1993	5.20	2.3	-	1.29	0.190
FLJXWQJAXSJR25	10/12/1993	5.27	1.0	-	0.74	0.200
FLSJWMORTRM	10/31/1993	7.00	-	-	1.20	0.183
FLSJWMORTTM	10/31/1993	6.20	-	-	0.85	0.112
FLJXWQJAXSJR25	11/2/1993	6.96	1.0	-	0.95	0.160
FLJXWQJAXSJR25	12/7/1993	7.78	1.0	-	0.60	0.130
FLSJWMORTRM	12/21/1993	9.34	1.0	-	1.35	0.156
FLSJWMORTRM.S	12/21/1993	9.34	1.0	-	1.13	0.150
FLSJWMORTTM	12/21/1993	8.37	0.6	-	1.15	0.142
FLSJWMORTTM.S	12/21/1993	8.37	0.6	-	1.17	0.135
FLSJWMORTRM	1/31/1994	7.96	-	-	1.15	0.157
FLSJWMORTTM	1/31/1994	6.82	-	-	0.95	0.121
FLJXWQJAXSJR25	2/8/1994	7.98	1.0	-	1.38	0.060
FLSJWMORTRM	3/2/1994	8.64	-	-	1.13	0.187
FLSJWMORTTM	3/2/1994	6.65	-	-	1.02	0.141
FLJXWQJAXSJR25	3/8/1994	10.19	1.0	-	1.36	0.080
FLSJWMORTRM	3/29/1994	7.73	1.2	-	1.01	0.113
FLSJWMORTRM.S	3/29/1994	7.73	1.2	-	0.83	0.110
FLSJWMORTTM	3/29/1994	6.78	1.2	-	1.14	0.152

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLSJWMORTTM.S	3/29/1994	6.78	1.2	-	-	0.150
FLJXWQJAXSJR25	4/12/1994	8.50	1.0	-	2.72	0.100
FLSJWMORTRM	5/4/1994	6.01	-	-	0.15	0.129
FLSJWMORTRM.S	5/4/1994	6.01	-	-	-	0.120
FLSJWMORTTM	5/4/1994	7.04	-	-	-	0.145
FLSJWMORTTM.S	5/4/1994	7.04	-	-	0.38	0.140
FLJXWQJAXSJR25	5/18/1994	8.10	1.0	-	1.43	0.120
FLJXWQJAXSJR25	6/14/1994	8.69	3.0	-	1.08	0.140
FLSJWMORTRM	7/1/1994	7.05	2.8	-	-	0.200
FLSJWMORTRM.S	7/1/1994	7.05	2.8	-	-	0.220
FLSJWMORTTM	7/1/1994	3.80	1.3	-	1.41	0.112
FLSJWMORTTM.S	7/1/1994	3.80	1.3	-	1.37	0.110
FLJXWQJAXSJR25	7/12/1994	8.71	1.0	-	0.89	0.140
FLJXWQJAXSJR25	8/9/1994	6.95	1.0	-	0.65	0.200
FLSJWMORTTM	9/12/1994	3.92	0.9	-	1.26	0.124
FLJXWQJAXSJR25	9/21/1994	7.31	1.0	-	1.25	0.140
FLSJWMORTTM	10/3/1994	4.16	1.4	-	1.31	0.125
FLSJWMORTTM.S	10/3/1994	4.16	1.4	-	1.30	0.120
FLJXWQORTRM	10/11/1994	6.53	2.0	-	0.42	0.090
FLJXWQORTTM	10/11/1994	4.22	2.0	-	0.88	0.090
FLJXWQJAXSJR25	10/12/1994	5.61	2.0	-	4.19	0.130
FLJXWQJAXSJR25	11/8/1994	7.96	1.0	-	1.49	0.306
FLA20030534	11/14/1994	6.60	1.0	-	0.79	0.120
FLA20030535	11/14/1994	6.80	1.0	-	0.79	0.110
FLA20030536	11/14/1994	4.30	1.4	-	0.71	0.110
FLJXWQORTRM	11/16/1994	6.98	1.0	-	0.64	0.069
FLJXWQORTTM	11/16/1994	4.18	1.0	-	0.51	0.432
FLSJWMORTRM.S	11/30/1994	-	-	-	-	-
FLJXWQJAXSJR25	1/18/1995	-	1.0	-	1.51	0.079
FLJXWQJAXSJR25	3/14/1995	9.43	2.0	-	0.63	0.083
FLVOL OCR030	3/26/1995	7.80	-	-	-	-
FLVOL OCR030	4/1/1995	6.30	-	-	-	-
FLJXWQJAXSJR25	4/5/1995	10.26	1.0	-	0.99	0.099
FLJXWQORTTM	4/6/1995	6.82	1.0	-	-	-
FLVOL OCR030	4/8/1995	5.70	-	-	-	-
FLVOL OCR030	4/15/1995	5.40	-	-	-	-
FLVOL OCR030	4/22/1995	5.00	-	-	-	-
FLVOL OCR030	4/30/1995	5.20	-	-	-	-
FLVOL OCR030	5/6/1995	4.60	-	-	-	-
FLJXWQJAXSJR25	5/9/1995	11.15	2.0	-	0.41	0.027

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLVOL OCR030	5/13/1995	4.30	-	-	-	-
FLVOL OCR030	5/21/1995	5.20	-	-	-	-
FLVOL OCR030	5/28/1995	4.80	-	-	-	-
FLVOL OCR030	6/3/1995	3.60	-	-	-	-
FLJXWQORTRM	6/5/1995	5.75	-	-	0.51	-
FLJXWQORTTM	6/5/1995	5.28	-	-	0.33	0.000
FLSJWMORTTM	6/5/1995	-	-	-	0.88	0.079
FLVOL OCR030	6/10/1995	4.80	-	-	-	-
FLVOL OCR030	6/17/1995	5.00	-	-	-	-
FLJXWQJAXSJR25	6/20/1995	6.21	1.0	-	0.84	0.155
FLVOL OCR030	6/24/1995	6.00	-	-	-	-
FLVOL OCR030	7/1/1995	4.50	-	-	-	-
FLVOL OCR030	7/8/1995	4.90	-	-	-	-
FLSJWM20030083	7/10/1995	4.72	-	27.90	1.19	0.155
FLJXWQJAXSJR25	7/11/1995	6.63	2.0	-	1.17	0.066
FLVOL OCR020	7/11/1995	6.00	-	-	-	-
FLVOL OCR020	7/16/1995	5.60	-	-	-	-
FLSJWMORTTM	7/17/1995	-	1.2	-	1.19	0.113
FLJXWQORTTM	7/18/1995	2.96	2.0	-	1.01	0.072
FLVOL OCR020	7/23/1995	5.60	-	-	-	-
FLVOL OCR030	7/23/1995	3.00	-	-	-	-
FLVOL OCR030	7/29/1995	2.80	-	-	-	-
FLVOL OCR020	8/6/1995	5.60	-	-	-	-
FLJXWQJAXSJR25	8/8/1995	5.92	1.0	-	1.09	0.060
FLVOL OCR030	8/12/1995	3.60	-	-	-	-
FLVOL OCR030	8/19/1995	3.80	-	-	-	-
FLJXWQORTTM	8/25/1995	5.49	1.0	-	0.72	0.113
FLSJWMORTTM	8/25/1995	-	1.2	-	1.61	0.094
FLVOL OCR030	8/26/1995	4.60	-	-	-	-
FLSJWM20030083	8/29/1995	3.12	-	10.70	1.56	0.175
FLVOL OCR030	9/2/1995	3.20	-	-	-	-
FLVOL OCR030	9/9/1995	4.10	-	-	-	-
FLVOL OCR020	9/10/1995	6.00	-	-	-	-
FLJXWQJAXSJR25	9/12/1995	6.67	1.0	-	0.98	0.062
FLVOL OCR030	9/16/1995	2.70	-	-	-	-
FLVOL OCR020	9/17/1995	4.20	-	-	-	-
FLVOL OCR030	9/23/1995	2.70	-	-	-	-
FLVOL OCR030	9/30/1995	4.80	-	-	-	-
FLVOL OCR030	10/7/1995	3.00	-	-	-	-
FLJXWQORTTM	10/10/1995	5.87	1.0	-	0.83	0.120

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLVOL OCR030	10/14/1995	2.50	-	-	-	-
FLVOL OCR030	10/22/1995	2.00	-	-	-	-
FLSJWM20030083	10/24/1995	5.01	-	2.35	1.11	0.107
FLVOL OCR030	10/28/1995	3.50	-	-	-	-
FLVOL OCR030	11/4/1995	3.00	-	-	-	-
FLVOL OCR030	11/11/1995	6.30	-	-	-	-
FLJXWQJAXSJR25	11/14/1995	9.04	1.0	-	1.06	0.083
FLVOL OCR030	11/18/1995	7.20	-	-	-	-
FLVOL OCR020	11/19/1995	7.50	-	-	-	-
FLVOL OCR030	11/25/1995	7.00	-	-	-	-
FLVOL OCR030	12/2/1995	6.60	-	-	-	-
FLVOL OCR020	12/3/1995	7.50	-	-	-	-
FLVOL OCR030	12/9/1995	6.20	-	-	-	-
FLVOL OCR020	12/10/1995	7.80	-	-	-	-
FLJXWQJAXSJR25	12/13/1995	9.47	1.0	-	1.25	0.111
FLVOL OCR030	12/16/1995	6.80	-	-	-	-
FLVOL OCR030	12/23/1995	6.50	-	-	-	-
FLVOL OCR030	12/30/1995	8.30	-	-	-	-
FLVOL OCR020	1/6/1996	9.20	-	-	-	-
FLVOL OCR030	1/6/1996	7.30	-	-	-	-
FLVOL OCR030	1/13/1996	8.80	-	-	-	-
FLVOL OCR020	1/20/1996	9.40	-	-	-	-
FLVOL OCR030	1/20/1996	8.40	-	-	-	-
FLVOL OCR030	1/27/1996	8.60	-	-	-	-
FLVOL OCR030	2/3/1996	7.80	-	-	-	-
FLVOL OCR020	2/12/1996	9.20	-	-	-	-
FLJXWQJAXSJR25	2/13/1996	10.48	1.0	-	1.20	0.091
FLVOL OCR030	2/17/1996	7.90	-	-	-	-
FLVOL OCR020	2/24/1996	9.20	-	-	-	-
FLVOL OCR030	2/24/1996	8.00	-	-	-	-
FLSJWM20030083	2/27/1996	11.20	-	33.90	-	0.181
FLVOL OCR030	3/3/1996	7.60	-	-	-	-
FLVOL OCR030	3/9/1996	6.80	-	-	-	-
FLJXWQJAXSJR25	3/14/1996	9.56	1.0	-	0.73	0.085
FLVOL OCR020	3/17/1996	9.00	-	-	-	-
FLVOL OCR030	3/23/1996	7.40	-	-	-	-
FLVOL OCR030	3/30/1996	5.70	-	-	-	-
FLVOL OCR030	4/7/1996	5.50	-	-	-	-
FLJXWQJAXSJR25	4/10/1996	8.77	1.0	-	0.94	0.078
FLVOL OCR030	4/13/1996	6.50	-	-	-	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLVOL OCR020	4/17/1996	7.30	-	-	-	-
FLVOL OCR030	4/20/1996	6.00	-	-	-	-
FLVOL OCR030	4/27/1996	5.50	-	-	-	-
FLSJWM20030083	4/29/1996	7.04	-	28.60	1.15	0.165
FLVOL OCR020	5/10/1996	5.80	-	-	-	-
FLVOL OCR030	5/11/1996	4.70	-	-	-	-
FLJXWQJAXSJR25	5/14/1996	7.40	1.0	-	1.06	0.117
FLVOL OCR020	5/18/1996	5.80	-	-	-	-
FLVOL OCR030	5/18/1996	6.00	-	-	-	-
FLVOL OCR030	5/25/1996	5.00	-	-	-	-
FLVOL OCR030	6/1/1996	5.40	-	-	-	-
FLVOL OCR030	6/8/1996	5.20	-	-	-	-
FLVOL OCR010	6/9/1996	3.50	-	-	-	-
FLVOL OCR010	6/15/1996	7.00	-	-	-	-
FLVOL OCR030	6/15/1996	4.20	-	-	-	-
FLVOL OCR020	6/16/1996	5.60	-	-	-	-
FLVOL OCR010	6/23/1996	5.40	-	-	-	-
FLVOL OCR020	6/23/1996	5.70	-	-	-	-
FLSJWM20030083	6/26/1996	9.29	-	62.70	1.06	0.134
FLVOL OCR010	6/29/1996	4.80	-	-	-	-
FLVOL OCR030	6/29/1996	4.50	-	-	-	-
FLVOL OCR010	7/7/1996	5.00	-	-	-	-
FLJXWQJAXSJR25	7/9/1996	5.33	1.0	-	1.38	0.079
FLVOL OCR030	7/13/1996	4.30	-	-	-	-
FLVOL OCR020	7/14/1996	5.10	-	-	-	-
FLVOL OCR030	7/22/1996	3.70	-	-	-	-
FLVOL OCR010	7/28/1996	6.00	-	-	-	-
FLVOL OCR020	7/28/1996	6.50	-	-	-	-
FLVOL OCR010	8/4/1996	5.00	-	-	-	-
FLVOL OCR030	8/4/1996	4.00	-	-	-	-
FLSJWM20030083	8/5/1996	4.62	-	55.20	1.25	0.203
FLVOL OCR030	8/10/1996	4.20	-	-	-	-
FLVOL OCR030	8/24/1996	4.40	-	-	-	-
FLVOL OCR030	8/31/1996	5.80	-	-	-	-
FLVOL OCR020	9/2/1996	5.50	-	-	-	-
FLVOL OCR030	9/8/1996	4.50	-	-	-	-
FLJXWQJAXSJR25	9/10/1996	4.76	1.0	-	0.80	0.343
FLVOL OCR030	9/15/1996	3.50	-	-	-	-
FLVOL OCR020	9/22/1996	5.10	-	-	-	-
FLVOL OCR030	9/22/1996	4.90	-	-	-	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLVOL OCR030	9/29/1996	4.40	-	-	-	-
FLVOL OCR020	10/6/1996	6.80	-	-	-	-
FLVOL OCR030	10/7/1996	5.20	-	-	-	-
FLVOL OCR030	10/12/1996	4.10	-	-	-	-
FLVOL OCR020	10/19/1996	5.20	-	-	-	-
FLVOL OCR030	10/19/1996	4.00	-	-	-	-
FLVOL OCR030	10/26/1996	5.20	-	-	-	-
FLSJWM20030083	10/30/1996	5.12	-	83.50	1.27	0.132
FLVOL OCR030	11/3/1996	4.30	-	-	-	-
FLJXWQJAXSJR25	11/5/1996	6.71	-	-	0.89	0.098
FLVOL OCR030	11/16/1996	8.00	-	-	-	-
FLVOL OCR030	11/23/1996	6.80	-	-	-	-
FLJXWQJAXSJR25	12/3/1996	8.83	1.0	-	0.84	0.082
FLVOL OCR030	12/7/1996	7.80	-	-	-	-
FLVOL OCR020	12/8/1996	8.30	-	-	-	-
FLVOL OCR030	12/15/1996	7.80	-	-	-	-
FLVOL OCR030	12/28/1996	8.40	-	-	-	-
FLSJWM20030083	1/2/1997	8.89	-	47.70	1.16	0.119
FLSJWM20030083	2/19/1997	13.40	-	48.40	0.44	0.109
FLSJWMORTRM	4/29/1997	-	-	2.34	1.24	0.133
FLSJWM20030083	4/30/1997	4.25	-	2.70	1.13	0.162
FLJXWQCR85	5/1/1997	5.72	-	-	-	-
FLJXWQCR85	5/27/1997	8.94	2.0	-	0.91	0.154
FLSJWMORTRM	6/3/1997	-	-	5.67	1.48	0.148
FLSJWMORTRM	6/24/1997	-	-	21.69	1.31	0.149
FLSJWM20030083	6/30/1997	6.25	-	48.70	0.97	0.201
FLJXWQCR85	7/30/1997	7.32	-	-	-	-
FLSJWMORTRM	7/31/1997	7.17	-	31.37	1.15	0.167
FLSJWMORTRM	8/26/1997	-	-	-	1.18	0.145
FLSJWM20030083	8/27/1997	7.53	-	68.40	-	0.153
FLSJWMORTRM	9/24/1997	7.04	-	17.69	0.94	0.119
FLSJWM20030083	10/8/1997	7.21	-	27.50	-	0.155
FLJXWQCR85	10/22/1997	4.23	-	-	-	-
FLSJWMORTRM	10/27/1997	7.43	-	46.14	1.46	0.147
FLSJWMORTRM	11/19/1997	9.63	-	10.25	1.44	0.107
FLSJWM20030083	12/10/1997	8.89	-	3.56	1.22	0.138
FLSJWM20030083	1/20/1998	8.69	-	12.70	0.86	0.161
FLJXWQCR85	2/2/1998	6.62	-	-	-	-
FLSJWM20030083	3/2/1998	5.43	-	5.34	1.10	0.114
FLSJWMORTRM	4/20/1998	7.76	-	-	1.33	0.103

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLSJWM20030083	4/22/1998	9.40	-	12.50	-	0.125
FLJXWQCR85	4/28/1998	9.27	-	-	-	-
FLSJWMORTRM	5/6/1998	8.07	-	-	1.34	0.104
FLSJWMORTRM	5/13/1998	6.77	-	-	1.18	0.108
FLSJWMORTRM	5/20/1998	8.11	-	-	1.51	0.130
FLJXWQCR85	5/26/1998	6.41	-	-	-	-
FLSJWMORTRM	5/27/1998	6.08	-	-	0.85	0.116
FLSJWMORTRM	6/3/1998	6.55	-	-	1.28	0.103
FLSJWMORTRM	6/10/1998	8.75	-	-	1.37	0.136
FLSJWMORTRM	6/17/1998	6.46	-	-	1.22	0.184
FLSJWM20030083	6/23/1998	8.93	-	58.70	-	0.246
FLSJWMORTRM	6/24/1998	5.51	-	-	1.22	0.122
FLSJWMORTRM	7/1/1998	5.22	-	-	1.24	0.132
FLSJWMORTRM	7/8/1998	4.32	-	-	1.47	0.118
FLJXWQCR85	7/13/1998	6.53	-	-	-	-
FLSJWMORTRM	7/15/1998	4.97	-	-	1.33	0.151
FLSJWMORTRM	7/22/1998	5.40	-	-	1.78	0.148
FLSJWM20030083	7/27/1998	8.26	-	25.60	1.21	0.181
FLSJWMORTRM	7/29/1998	5.79	-	-	1.41	0.121
FLSJWMORTRM	8/5/1998	6.07	-	-	1.26	0.136
FLSJWMORTRM	8/12/1998	8.64	-	-	1.49	0.131
FLSJWMORTRM	8/19/1998	7.07	-	-	1.21	0.106
FLSJWMORTRM	8/26/1998	6.53	-	-	1.23	0.130
FLJXWQCR85	9/1/1998	5.47	-	-	-	-
FLSJWMORTRM	9/2/1998	5.26	-	-	1.85	0.155
FLSJWMORTRM	9/9/1998	4.33	-	-	1.64	0.149
FLSJWMORTRM	9/16/1998	5.93	-	-	1.82	0.140
FLSJWMORTRM	9/23/1998	4.20	-	-	1.41	0.180
FLSJWMORTRM	9/30/1998	6.32	-	-	1.69	0.162
FLJXWQCR85	10/7/1998	5.37	-	-	-	-
FLSJWMORTRM	10/7/1998	4.40	-	-	1.34	0.139
FLSJWM20030083	10/8/1998	4.22	-	5.74	1.27	0.134
FLSJWMORTRM	10/14/1998	6.73	-	-	1.41	0.073
FLJXWQCR85	10/22/1998	8.58	-	-	-	-
FLSJWM20030083	12/4/1998	8.39	-	47.42	1.42	0.141
FLJXWQCR85	1/4/1999	10.29	-	-	-	-
FLJXWQJAXSJR25	1/12/1999	12.00	6.0	-	1.39	-
FLSJWM20030083	2/2/1999	6.43	-	22.87	1.41	0.123
FLJXWQJAXSJR25	2/10/1999	8.27	2.0	-	0.60	-
FLJXWQJAXSJR25	3/10/1999	9.26	2.0	-	0.60	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLJXWQCR85	3/17/1999	10.04	-	-	-	-
FLSJWMORTRM	4/7/1999	8.18	-	-	-	0.107
FLJXWQCR85	4/14/1999	7.58	-	-	-	-
FLSJWMORTRM	4/14/1999	7.16	-	-	0.94	0.095
FLJXWQJAXSJR25	4/20/1999	8.37	2.0	-	0.66	-
FLSJWMORTRM	4/21/1999	8.61	-	-	-	0.107
FLSJWM20030083	4/22/1999	9.78	-	47.90	1.24	0.184
FLSJWMORTRM	4/28/1999	6.90	-	-	0.83	0.116
FLSJWMORTRM	5/5/1999	8.72	-	-	-	0.120
FLJXWQJAXSJR25	5/12/1999	6.26	2.0	-	0.59	-
FLSJWMORTRM	5/12/1999	6.75	-	-	1.20	0.122
FLJXWQCR85	5/18/1999	5.31	-	-	-	-
FLSJWMORTRM	5/19/1999	9.74	-	-	1.03	0.117
FLSJWMORTRM	5/26/1999	7.35	-	-	1.08	0.111
FLSJWMORTRM	6/2/1999	8.97	-	-	-	0.193
FLSJWM20030083	6/4/1999	6.70	-	72.78	1.63	0.341
FLSJWMORTRM	6/9/1999	6.89	-	-	-	0.180
FLSJWMORTRM	6/16/1999	6.45	-	-	-	0.161
FLSJWMORTRM	6/23/1999	7.26	-	-	-	0.145
FLJXWQJAXSJR25	6/30/1999	10.18	3.0	-	0.68	-
FLSJWMORTRM	6/30/1999	7.03	-	-	1.07	0.200
FLSJWMORTRM	7/7/1999	4.58	-	-	1.38	0.223
FLJXWQJAXSJR25	7/14/1999	6.10	2.0	-	1.01	-
FLSJWMORTRM	7/14/1999	-	-	-	1.28	0.152
FLSJWMORTRM	7/21/1999	-	-	-	1.26	0.238
FLSJWMORTRM	7/28/1999	6.46	-	-	-	0.201
FLSJWMORTRM	8/4/1999	6.06	-	-	1.11	0.232
FLSJWMORTRM	8/11/1999	6.63	-	-	-	0.255
FLJXWQJAXSJR25	8/17/1999	7.92	2.0	-	0.75	-
FLJXWQCR85	8/18/1999	4.67	-	-	-	-
FLSJWM20030083	8/18/1999	4.78	-	46.78	1.76	0.393
FLSJWMORTRM	8/18/1999	5.71	-	-	1.12	0.274
FLSJWMORTRM	8/25/1999	6.16	-	-	1.56	0.262
FLSJWMORTRM	9/1/1999	6.44	-	-	1.12	0.315
FLSJWMORTRM	9/8/1999	5.34	-	-	1.47	0.313
FLSJWMORTRM	9/22/1999	4.91	-	-	1.49	0.157
FLSJWMORTRM	9/29/1999	4.68	-	-	1.69	0.153
FLJXWQCR85	10/5/1999	3.99	-	-	-	-
FLJXWQJAXSJR25	10/13/1999	7.31	2.0	-	1.33	-
FLSJWM20030083	10/18/1999	5.42	-	6.19	1.14	0.163

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLJXWQJAXSJR25	11/8/1999	11.56	-	-	1.16	-
FLJXWQJAXSJR25	12/1/1999	10.87	2.0	-	0.66	-
FLSJWM20030083	12/7/1999	8.59	-	57.66	1.12	0.261
FLJXWQCR85	12/8/1999	7.88	-	-	-	-
FLJXWQCR85	1/10/2000	6.31	-	-	-	-
FLJXWQJAXSJR25	1/12/2000	8.91	2.0	-	1.47	-
FLSJWM20030083	2/2/2000	7.06	-	14.53	1.40	0.218
FLJXWQJAXSJR25	2/9/2000	9.96	2.0	-	2.15	-
FLJXWQCR85	2/15/2000	7.09	-	-	-	-
FLJXWQJAXSJR25	3/8/2000	10.49	2.0	-	1.48	-
FLJXWQCR85	4/3/2000	9.59	-	-	-	-
FLJXWQJAXSJR25	4/12/2000	-	-	-	1.28	-
FLSJWM20030083	4/20/2000	9.09	-	29.22	1.09	0.222
FLJXWQJAXSJR25	5/9/2000	8.11	3.0	-	2.48	-
FLJXWQCR85	5/10/2000	2.28	-	-	-	-
FLJXWQJAXSJR25	6/13/2000	7.25	2.0	-	0.75	-
FLSJWM20030083	6/15/2000	6.64	-	28.55	1.07	0.438
FLFMRINSJ200015	7/11/2000	6.20	-	18.00	-	-
FLJXWQJAXSJR25	8/15/2000	7.86	-	-	-	-
FLSJWM20030083	8/18/2000	5.94	-	56.32	1.60	0.454
FLJXWQJAXSJR25	9/13/2000	5.28	2.0	-	1.29	-
FLJXWQCR85	9/19/2000	4.42	-	-	-	-
FLSJWM20030083	10/10/2000	7.34	-	32.35	1.25	0.178
FLJXWQJAXSJR25	10/24/2000	7.72	2.0	-	1.12	-
FLJXWQJAXSJR25	11/8/2000	-	-	-	-	-
FLJXWQJAXSJR25	12/12/2000	10.86	2.0	-	1.65	-
FLJXWQCR85	12/18/2000	4.44	-	-	-	-
FLSJWM20030083	12/20/2000	6.91	-	26.14	1.41	0.224
FLJXWQJAXSJR25	1/9/2001	19.59	2.0	-	1.34	-
FLSJWM20030083	2/1/2001	8.49	-	-	0.92	0.190
FLJXWQCR85	2/8/2001	11.60	-	-	-	-
FLJXWQJAXSJR25	3/14/2001	8.47	2.0	-	0.67	-
FLSJWM20030083	4/9/2001	8.72	-	62.02	1.43	0.249
FLJXWQJAXSJR25	4/11/2001	8.97	2.0	-	1.14	-
FLJXWQCR85	4/26/2001	4.59	-	-	-	-
FLJXWQJAXSJR25	6/6/2001	7.82	3.0	-	1.07	-
FLSJWM20030083	6/21/2001	6.92	-	50.30	1.32	0.283
FLJXWQJAXSJR25	7/10/2001	7.46	2.0	-	0.73	-
FLJXWQJAXSJR25	8/8/2001	10.85	3.0	-	0.93	-
FLSJWMORTRM	8/15/2001	7.20	-	-	0.54	0.231

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLSJWMORTRM	8/22/2001	5.48	-	-	0.92	0.252
FLSJWM20030083	8/29/2001	5.49	-	39.85	1.19	0.239
FLSJWMORTRM	8/29/2001	6.32	-	-	1.11	0.207
FLJXWQCR85	9/5/2001	4.47	-	-	-	-
FLJXWQJAXSJR25	9/19/2001	7.94	5.0	-	1.24	-
FLJXWQJAXSJR25	10/9/2001	8.08	2.0	-	1.71	-
FLSJWM20030083	10/17/2001	5.63	-	11.09	1.56	0.152
FLJXWQCR85	12/11/2001	4.20	-	-	-	-
FLSJWM20030083	12/11/2001	3.82	-	4.57	0.92	0.152
FLJXWQJAXSJR25	12/18/2001	7.26	-	-	1.44	-
FLSJWM20030083	2/11/2002	7.63	-	15.87	1.50	0.140
FLJXWQCR85	3/20/2002	10.26	-	-	-	-
FLSJWM20030083	4/9/2002	7.85	-	23.41	0.97	0.105
FLJXWQCR85	5/16/2002	4.58	-	-	-	-
FLSJWM20030083	6/10/2002	5.60	-	18.44	0.99	0.281
FLSJWM20030083	8/12/2002	3.90	-	8.40	1.38	0.175
FLJXWQCR85	9/9/2002	3.99	-	-	-	-
FLSJWM20030083	10/11/2002	3.41	-	4.18	1.37	0.218
FLSJWM20030083	12/9/2002	8.07	-	1.00	1.28	0.113
FLJXWQCR85	12/10/2002	7.30	-	-	-	-
FLJXWQCR85	2/3/2003	10.34	-	-	-	-
FLSJWM20030083	2/17/2003	6.13	-	2.35	0.88	0.139
FLSJWM20030083	4/10/2003	3.96	-	4.12	1.27	0.100
FLJXWQCR85	4/23/2003	5.74	-	-	-	-
FLSJWM20030083	6/17/2003	5.04	-	23.79	1.15	0.180
FLSJWM20030083	8/19/2003	2.05	-	9.03	1.23	0.133
FLJXWQCR85	9/9/2003	4.35	-	-	-	-
FLSJWM20030083	10/20/2003	4.29	-	21.01	1.12	0.128
FLJXWQCR85	11/5/2003	4.32	-	-	-	-
FLSJWM20030083	12/10/2003	7.19	-	3.06	1.25	0.114
FLA20030077	1/27/2004	11.60	-	-	-	-
FLSJWM20030083	2/11/2004	7.79	-	7.00	0.95	0.095
FLJXWQCR85	2/25/2004	5.99	-	-	-	-
FLSJWM20030083	4/20/2004	7.17	-	13.58	0.92	0.129
FLJXWQCR85	4/26/2004	8.75	-	-	-	-
FLJXWQJAXSJR25	5/4/2004	-	2.0	-	0.57	0.836
FLSJWM20030083	6/7/2004	4.30	-	38.58	0.84	0.158
FLJXWQJAXSJR25	6/8/2004		2.0	-	0.80	0.126
FLSJWM20030083	8/10/2004	5.36	-	-	0.92	0.147
FLA20030077	8/11/2004	7.60	-	-	-	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLWQA301400308142424	8/18/2004	5.52	-	-	-	-
FLWQA301626708144062	8/18/2004	5.21	-	-	-	-
FLWQA301653708144252	8/18/2004	3.46	-	-	-	-
FLWQA301400308142424	9/20/2004	5.69	-	-	-	-
FLWQA301626708144062	9/20/2004	3.00	-	-	-	-
FLWQA301653708144252	9/20/2004	2.35	-	-	-	-
FLA20030077	9/29/2004	3.70	-	-	-	-
FLJXWQCR85	9/30/2004	2.73	-	-	-	-
FLSJWM20030083	10/7/2004	4.86	-	36.06	1.25	0.161
FLWQA301400308142424	10/25/2004	2.84	-	-	-	-
FLWQA301626708144062	10/25/2004	4.34	-	-	-	-
FLWQA301653708144252	10/25/2004	3.91	-	-	-	-
FLA20030077	11/9/2004	6.70	-	-	-	-
FLWQA301400308142424	11/15/2004	3.40	-	-	-	-
FLWQA301626708144062	11/15/2004	5.92	-	-	-	-
FLWQA301653708144252	11/15/2004	4.78	-	-	-	-
FLJXWQCR85	11/30/2004	5.48	-	-	-	-
FLSJWM20030083	12/6/2004	5.78	-	4.44	1.10	0.137
FLWQA301400308142424	12/13/2004	5.40	-	-	-	-
FLWQA301626708144062	12/13/2004	5.88	-	-	-	-
FLWQA301653708144252	12/13/2004	5.28	-	-	-	-
FLWQA301400308142424	1/10/2005	2.17	-	-	-	-
FLWQA301626708144062	1/10/2005	4.70	-	-	-	-
FLWQA301653708144252	1/10/2005	4.26	-	-	-	-
FLWQA301400308142424	2/8/2005	7.55	-	-	-	-
FLWQA301626708144062	2/8/2005	8.57	-	-	-	-
FLWQA301653708144252	2/8/2005	8.05	-	-	-	-
FLSJWM20030083	2/14/2005	7.91	-	3.87	1.29	0.119
FLWQA301400308142424	3/14/2005	1.30	-	-	-	-
FLWQA301626708144062	3/14/2005	7.31	-	-	-	-
FLWQA301653708144252	3/14/2005	7.91	-	-	-	-
FLJXWQCR85	3/28/2005	5.37	-	-	-	-
FLSJWM20030083	4/12/2005	6.34	-	2.48	1.13	0.109
FLSJWM20030083	4/13/2005	6.35	-	-	-	-
FLWQA301400308142424	4/18/2005	3.45	-	-	-	-
FLWQA301626708144062	4/18/2005	6.62	-	-	-	-
FLWQA301653708144252	4/18/2005	5.84	-	-	-	-
FLWQA301400308142424	5/9/2005	3.17	-	-	-	-
FLWQA301626708144062	5/9/2005	5.08	-	-	-	-
FLWQA301653708144252	5/9/2005	4.66	-	-	-	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLSJWM20030083	6/2/2005	5.72	-	8.28	0.89	0.146
FLJXWQCR85	6/6/2005	5.75	-	-	-	-
FLSJWM20030083	8/4/2005	3.75	-	7.96	1.19	0.141
FLJXWQCR85	8/15/2005	7.95	-	-	-	-
FLSJWM20030083	10/18/2005	4.78	-	6.92	1.28	0.010
FLJXWQCR85	12/12/2005	5.94	-	-	-	-
FLSJWM20030083	12/19/2005	9.15	-	1.07	0.67	0.055
FLSJWM20030083	2/7/2006	5.64	-	12.71	0.97	0.095
FLJXWQCR85	3/28/2006	8.23	-	-	-	-
FLSJWM20030083	4/6/2006	8.25	-	18.61	0.75	0.105
FLJXWQCR85	5/10/2006	4.60	-	-	-	-
FLSJWM20030083	6/7/2006	7.29	-	24.56	0.97	0.188
FLSJWM20030083	8/1/2006	5.24	-	97.72	1.00	0.254
FLJXWQCR85	9/13/2006	2.19	-	-	-	-
FLSJWM20030083	10/4/2006	3.41	-	39.52	1.27	0.300
FLJXWQCR85	11/20/2006	5.52	-	-	-	-
FLSJWM20030083	12/11/2006	8.64	-	7.65	1.29	0.224
FLSJWM20030083	2/5/2007	7.69	-	19.16	0.97	0.163
FLJXWQCR85	2/14/2007	10.11	-	-	-	-
FLA20030077	3/19/2007	9.50	-	-	-	-
FLA20030079	3/19/2007	10.80	-	-	-	-
FLA20030876	3/19/2007	9.70	-	-	-	-
FLSJWM20030083	4/9/2007	6.17	-	41.32	0.46	0.251
FLA20030077	4/16/2007	7.80	-	-	-	-
FLA20030079	4/16/2007	8.30	-	-	-	-
FLA20030876	4/16/2007	5.70	-	-	-	-
FLA20030077	5/14/2007	6.70	-	-	-	-
FLA20030079	5/14/2007	6.60	-	-	-	-
FLA20030876	5/14/2007	6.30	-	-	-	-
FLJXWQCR85	6/4/2007	4.48	-	-	-	-
FLA20030077	6/13/2007	6.10	-	-	-	-
FLA20030079	6/13/2007	5.40	-	-	-	-
FLA20030876	6/13/2007	3.50	-	-	-	-
FLJXWQCR85	6/19/2007	6.42	-	-	-	-
FLA20030077	7/9/2007	6.30	-	-	-	-
FLA20030079	7/9/2007	4.00	-	-	-	-
FLA20030876	7/9/2007	2.00	-	-	-	-
FLJXWQCR85	7/23/2007	5.39	-	-	-	-
FLSJWM20030083	8/1/2007	5.62	-	91.89	1.46	0.291
FLA20030077	8/13/2007	3.50	-	-	-	-

Station	Sample Date	DO (mg/L)	BOD5 (mg/L)	CHLAC (μg/L)	TN (mg/L)	TP (mg/L)
FLA20030079	8/13/2007	3.70	-	-	-	-
FLA20030876	8/13/2007	2.00	-	-	-	-
FLJXWQCR85	8/27/2007	6.27	-	-	-	-
FLA20030077	9/10/2007	6.50	-	-	-	-
FLA20030079	9/10/2007	4.40	-	-	-	-
FLA20030876	9/10/2007	4.60	-	-	-	-
FLA20030077	10/11/2007	4.90	-	-	-	-
FLA20030079	10/11/2007	2.60	-	-	-	-
FLA20030876	10/11/2007	3.30	-	-	-	-
FLA20030077	11/5/2007	6.60	-	-	-	-
FLA20030079	11/5/2007	5.80	-	-	-	-
FLA20030876	11/5/2007	3.50	-	-	-	-
FLJXWQCR85	12/3/2007	6.19	-	-	-	-
FLA20030876	3/21/2008	3.70	-	-	-	-

Appendix C: Kruskal–Wallis Analysis of DO, DOSAT, CHLAC, TN, TP, and BOD5 Observations versus Season in the Ortega River (WBID 2213P)

Kruskal-Wallis One-Way Analysis of Variance for 743 cases
Dependent variable is DO
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	183	67254.500
SPRING	204	79672.500
SUMMER	209	50994.000
WINTER	147	78475.000

Kruskal-Wallis Test Statistic = 159.541
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 589 cases
Dependent variable is DOSAT
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	151	39496.500
SPRING	157	51627.500
SUMMER	155	37736.500
WINTER	126	44894.500

Kruskal-Wallis Test Statistic = 42.606
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 107 cases
Dependent variable is CHLAC
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	27	1214.000
SPRING	35	2034.500
SUMMER	24	1564.000
WINTER	21	965.500

Kruskal-Wallis Test Statistic = 7.422
Probability is 0.060 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 431 cases
Dependent variable is TN
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	103	23660.500
SPRING	119	24236.000
SUMMER	124	27388.500
WINTER	85	17811.000

Kruskal-Wallis Test Statistic = 2.834
Probability is 0.418 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 431 cases
Dependent variable is TN
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	103	23660.500
SPRING	119	24236.000
SUMMER	124	27388.500
WINTER	85	17811.000

Kruskal-Wallis Test Statistic = 2.834
Probability is 0.418 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 271 cases
Dependent variable is BOD5DAY
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	70	7364.000
SPRING	66	10831.500
SUMMER	71	10608.000
WINTER	64	8052.500

Kruskal-Wallis Test Statistic = 22.880
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 445 cases
Dependent variable is CHLORIDE
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	110	23334.500
SPRING	119	30622.500
SUMMER	112	25808.500
WINTER	104	19469.500

Kruskal-Wallis Test Statistic = 17.701
Probability is 0.001 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 574 cases
Dependent variable is CONDUCTANCE
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	138	33250.000
SPRING	164	54257.000
SUMMER	161	49232.000
WINTER	111	28286.000

Kruskal-Wallis Test Statistic = 28.340
Probability is 0.000 assuming Chi-square distribution with 3 df

Kruskal-Wallis One-Way Analysis of Variance for 532 cases
Dependent variable is SALINITY
Grouping variable is SEASON$

Group	Count	Rank Sum
FALL	129	27528.500
SPRING	150	47013.000
SUMMER	155	45268.000
WINTER	98	21968.500

Kruskal-Wallis Test Statistic = 41.101
Probability is 0.000 assuming Chi-square distribution with 3 df

Appendix D: Kruskal–Wallis Analysis of DO, DOSAT, CHLAC, TN, TP, and BOD5 Observations versus Month in the Ortega River (WBID 2213P)

Kruskal-Wallis One-Way Analysis of Variance for 743 cases
Dependent variable is DO
Grouping variable is MONTH

Group	Count	Rank Sum
1	40	22564.000
2	50	28400.000
3	57	27511.000
4	67	30431.500
5	60	22958.000
6	77	26283.000
7	70	17689.000
8	69	19852.000
9	70	13453.000
10	73	18500.000
11	49	18095.000
12	61	30659.500

Kruskal-Wallis Test Statistic = 226.727
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 589 cases
Dependent variable is DOSAT
Grouping variable is MONTH

Group	Count	Rank Sum
1	37	12997.500
2	36	14014.000
3	53	17883.000
4	51	17327.000
5	50	15974.000
6	56	18326.500
7	55	14700.000
8	46	13117.000
9	54	9919.500
10	56	12078.500
11	45	11730.000
12	50	15688.000

Kruskal-Wallis Test Statistic = 64.282
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 107 cases
Dependent variable is CHLAC
Grouping variable is MONTH

Group	Count	Rank Sum
1	5	318.500
2	14	617.500
3	2	29.500
4	18	853.500
5	1	29.000
6	16	1152.000
7	9	586.000
8	13	915.000
9	2	63.000
10	14	750.000
11	3	80.500
12	10	383.500

Kruskal-Wallis Test Statistic = 22.631
Probability is 0.020 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 431 cases
Dependent variable is TN
Grouping variable is MONTH

Group	Count	Rank Sum
1	26	5998.000
2	26	5806.000
3	33	6007.000
4	40	8178.000
5	30	6565.000
6	49	9493.000
7	42	9410.500
8	47	10512.000
9	35	7466.000
10	44	11670.000
11	26	4192.000
12	33	7798.500

Kruskal-Wallis Test Statistic = 17.977
Probability is 0.082 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 454 cases
Dependent variable is TP
Grouping variable is MONTH

Group	Count	Rank Sum
1	25	6630.500
2	29	5274.000
3	33	7139.000
4	44	9661.000
5	37	7057.500
6	54	13415.500
7	47	10843.000
8	49	13381.000
9	36	8896.000
10	44	9346.000
11	25	5192.000
12	31	6449.500

Kruskal-Wallis Test Statistic = 18.838
Probability is 0.064 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 271 cases
Dependent variable is BOD5DAY
Grouping variable is MONTH

Group	Count	Rank Sum
1	19	2413.500
2	17	1755.000
3	28	3884.000
4	26	4194.500
5	19	2723.000
6	21	3914.000
7	27	4455.000
8	19	3036.000
9	25	3117.000
10	26	3520.500
11	20	1879.500
12	24	1964.000

Kruskal-Wallis Test Statistic = 38.706
Probability is 0.000 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 445 cases

Dependent variable is CHLORIDE
Grouping variable is MONTH

Group	Count	Rank Sum
1	29	5513.000
2	38	6721.000
3	37	7235.500
4	38	8085.500
5	34	9170.000
6	47	13367.000
7	40	8605.500
8	40	10234.500
9	32	6968.500
10	49	9476.000
11	25	6012.000
12	36	7846.500

Kruskal-Wallis Test Statistic = 29.848
Probability is 0.002 assuming Chi-square distribution with 11 df

Kruskal-Wallis One-Way Analysis of Variance for 574 cases
Dependent variable is CONDUCTANCE
Grouping variable is MONTH

Group	Count	Rank Sum
1	29	7280.000
2	40	10755.000
3	42	10251.000
4	59	15801.000
5	48	16755.500
6	57	21700.500
7	53	16035.000
8	57	18436.500
9	51	14760.500
10	58	12193.500
11	37	10732.000
12	43	10324.500

Kruskal-Wallis Test Statistic = 49.472
Probability is 0.000 assuming Chi-square distribution with 11 df

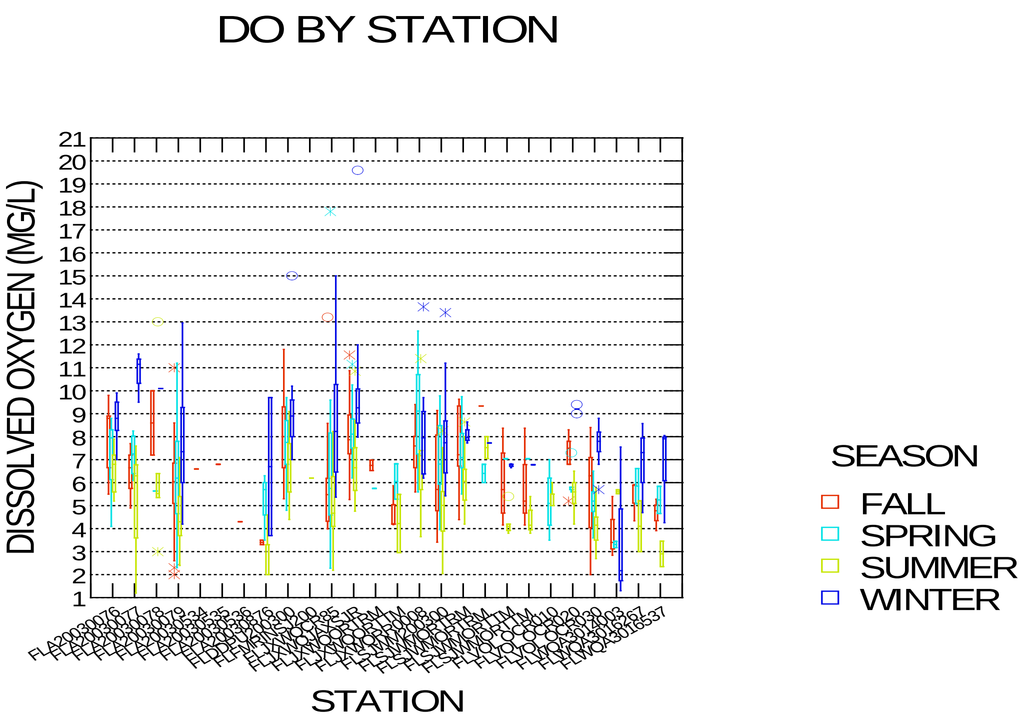
Kruskal-Wallis One-Way Analysis of Variance for 532 cases
Dependent variable is SALINITY

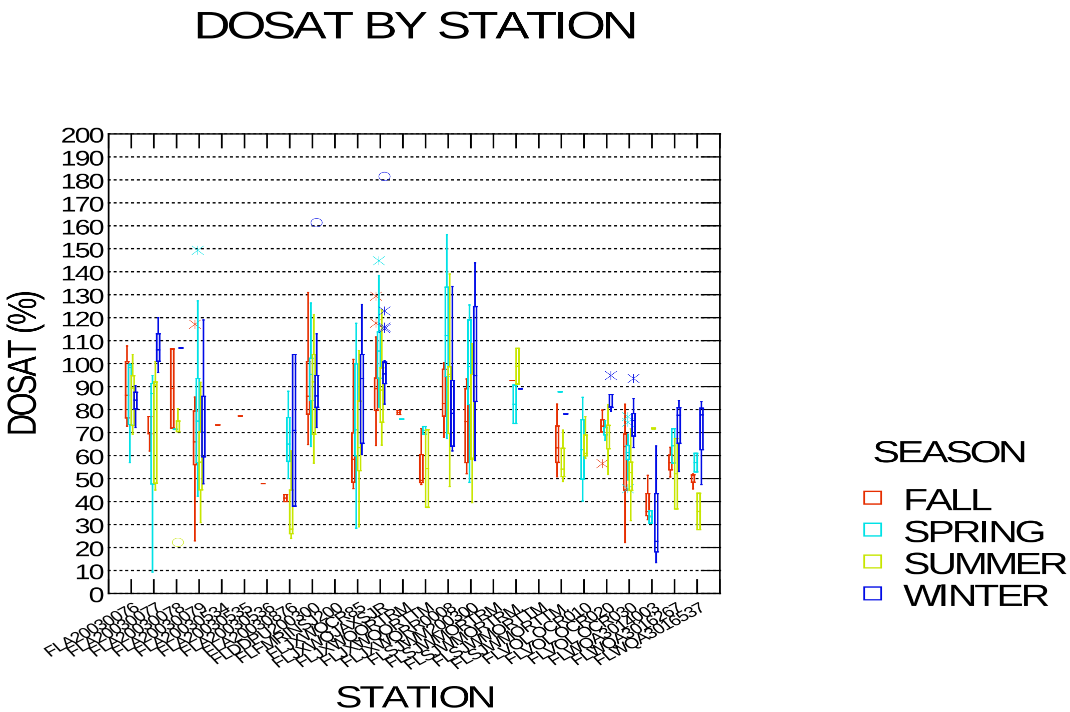
Grouping variable is MONTH

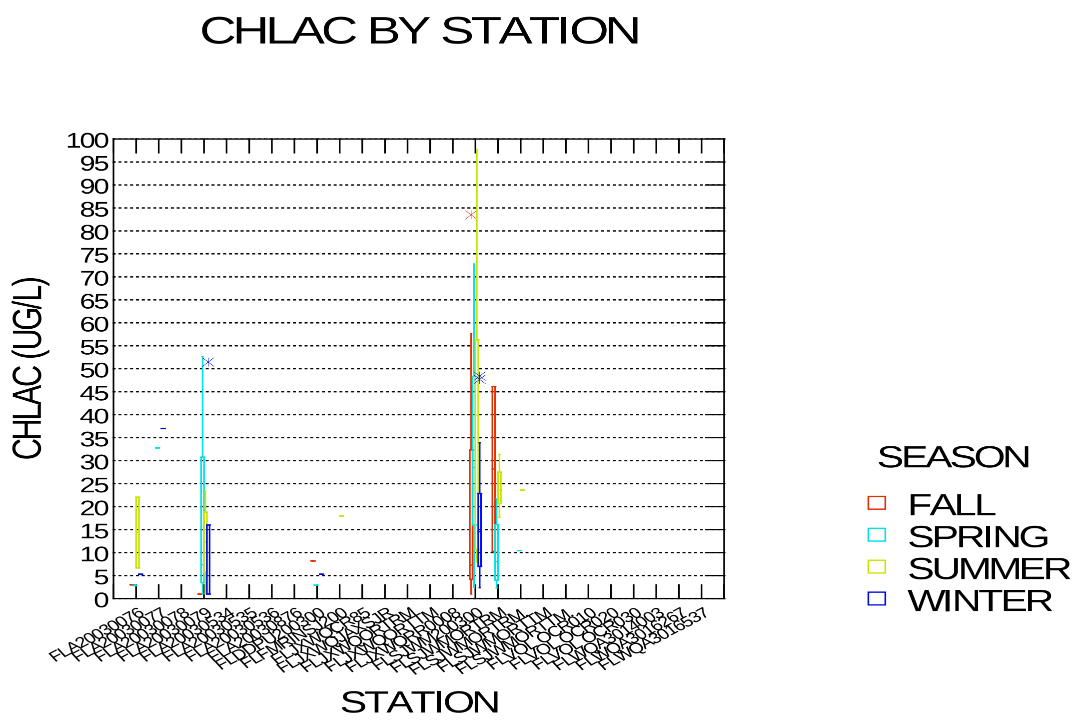
Group	Count	Rank Sum
1	27	6215.500
2	37	7108.000
3	34	8645.000
4	52	12430.500
5	45	15165.000
6	53	19417.500
7	45	14107.000
8	57	17811.000
9	53	3350.000
10	50	9978.500
11	34	8355.000
12	45	9195.000

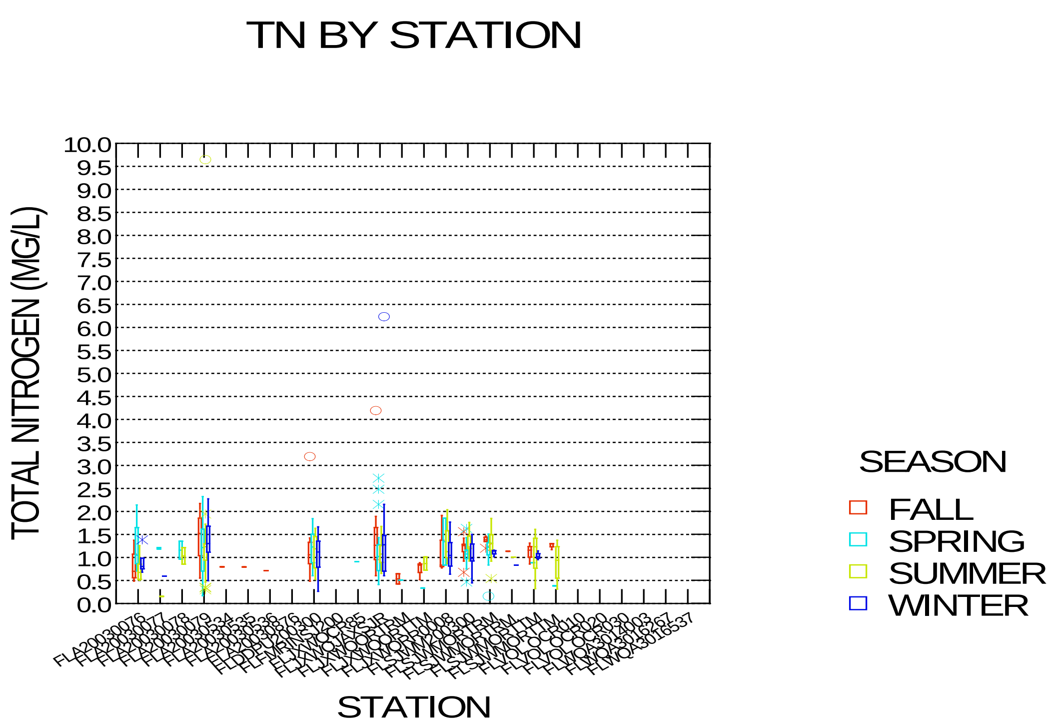
Kruskal-Wallis Test Statistic = 71.152
Probability is 0.000 assuming Chi-square distribution with 11 df

Appendix E: Chart of DO, DOSAT, CHLAC, TN, and TP Observations by Season, Station, and Year in the Ortega River (WBID 2213P)

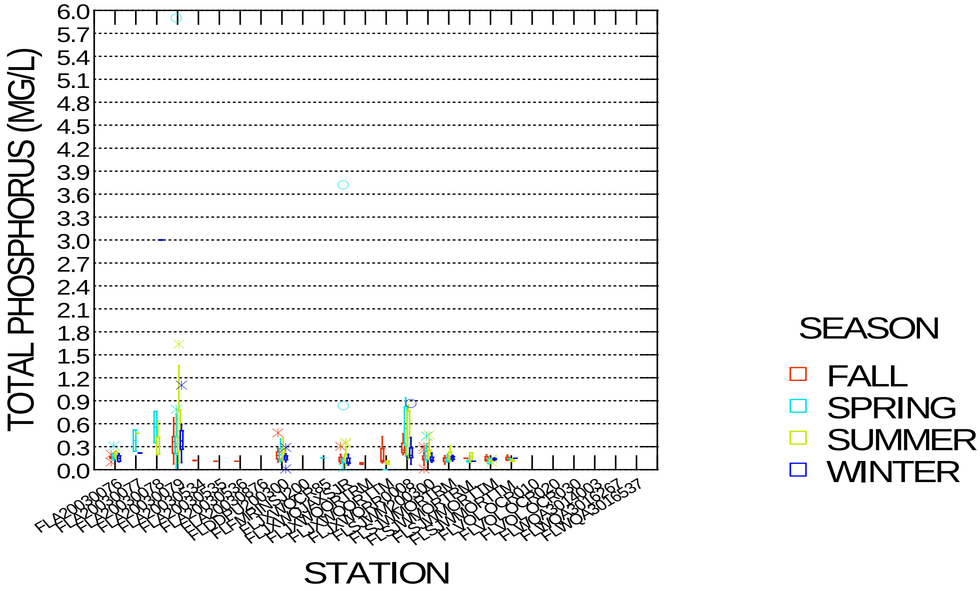



DOSAT BY STATION
DOSAT (%)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

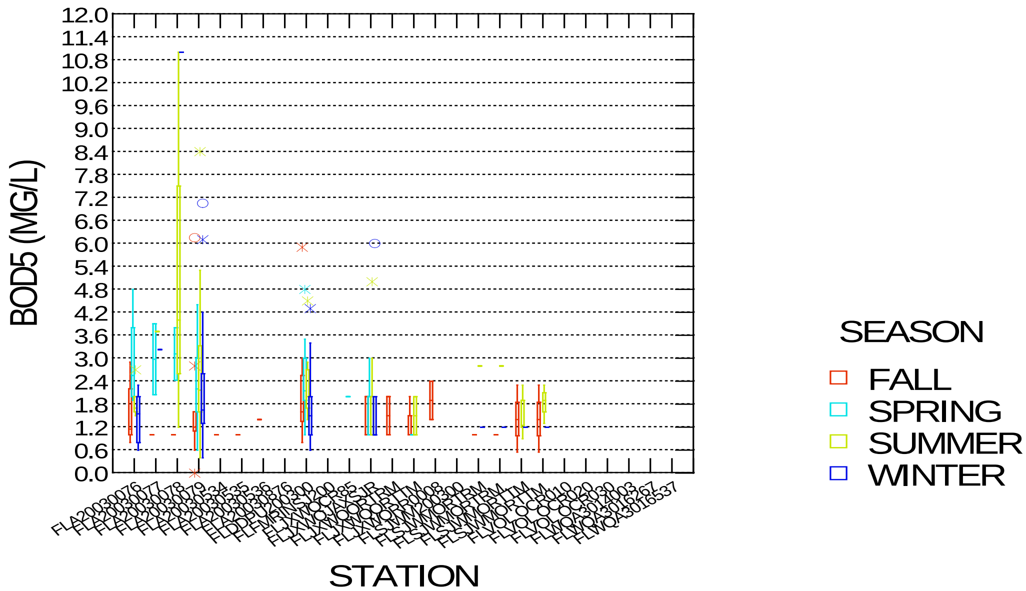

CHLAC BY STATION
CHLAC (UG/L)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

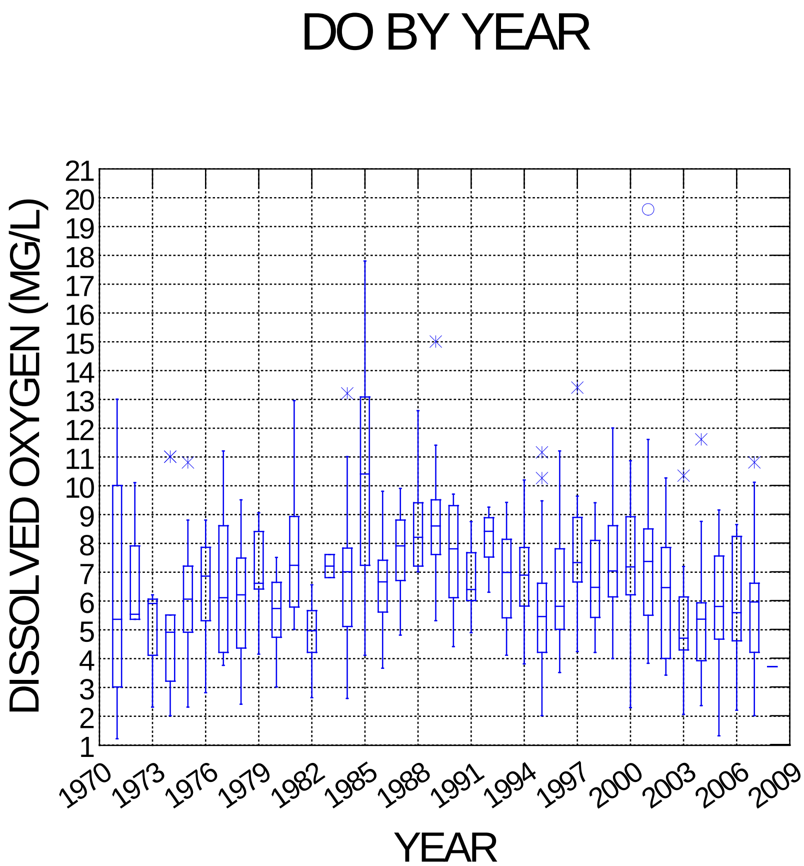

TN BY STATION
TOTAL NITROGEN (MG/L)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
STATION
SEASON
FALL
SPRING
SUMMER
WINTER

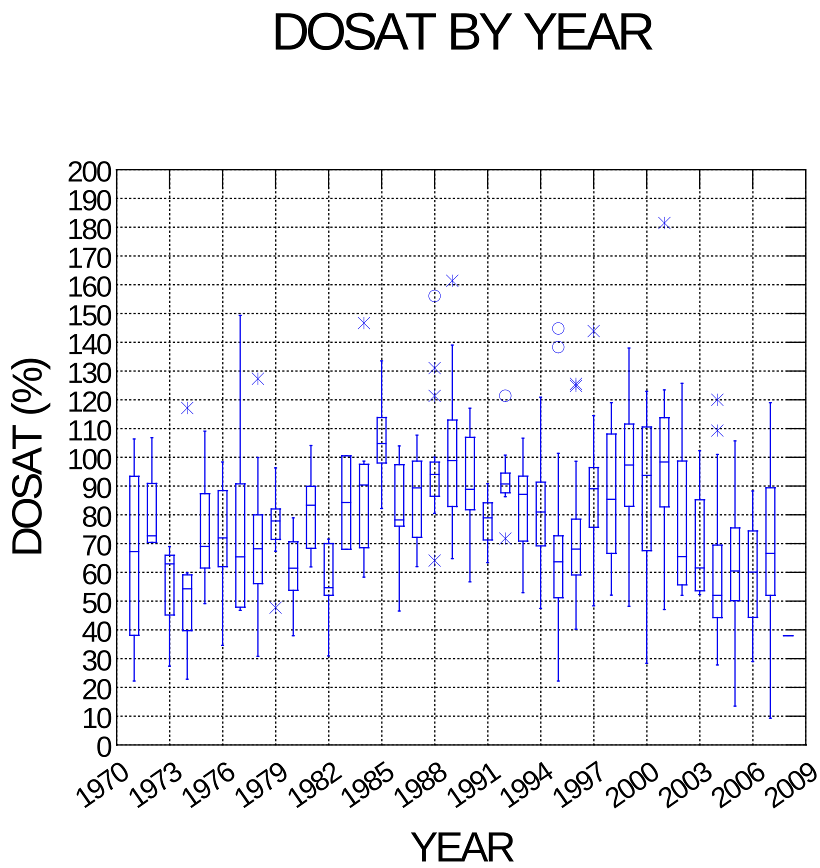
TP BY STATION

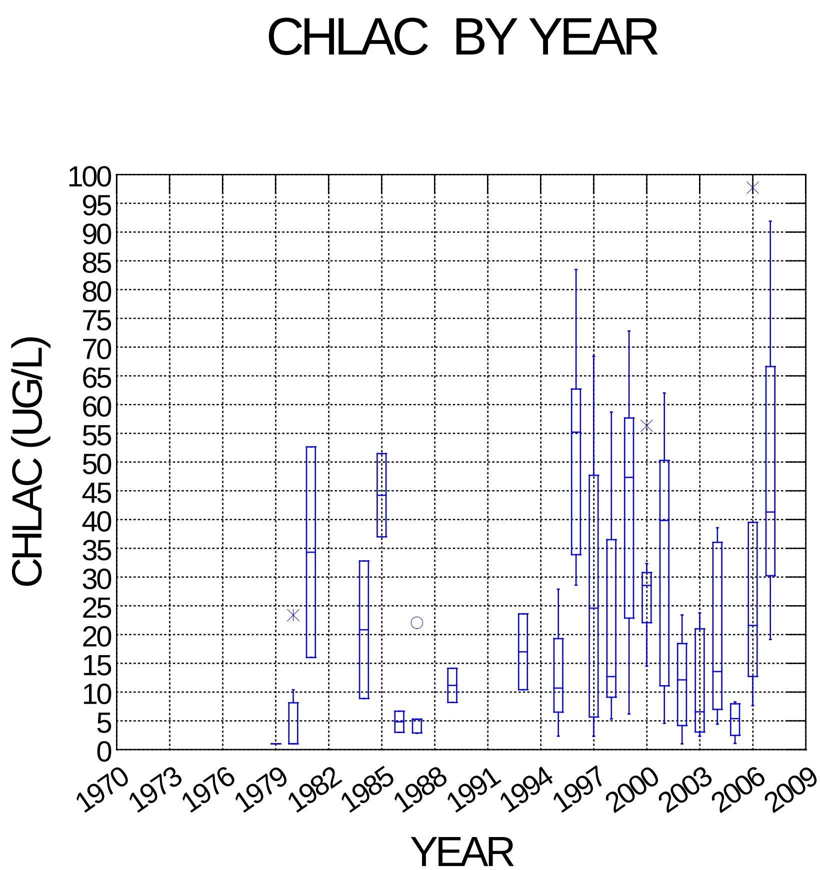


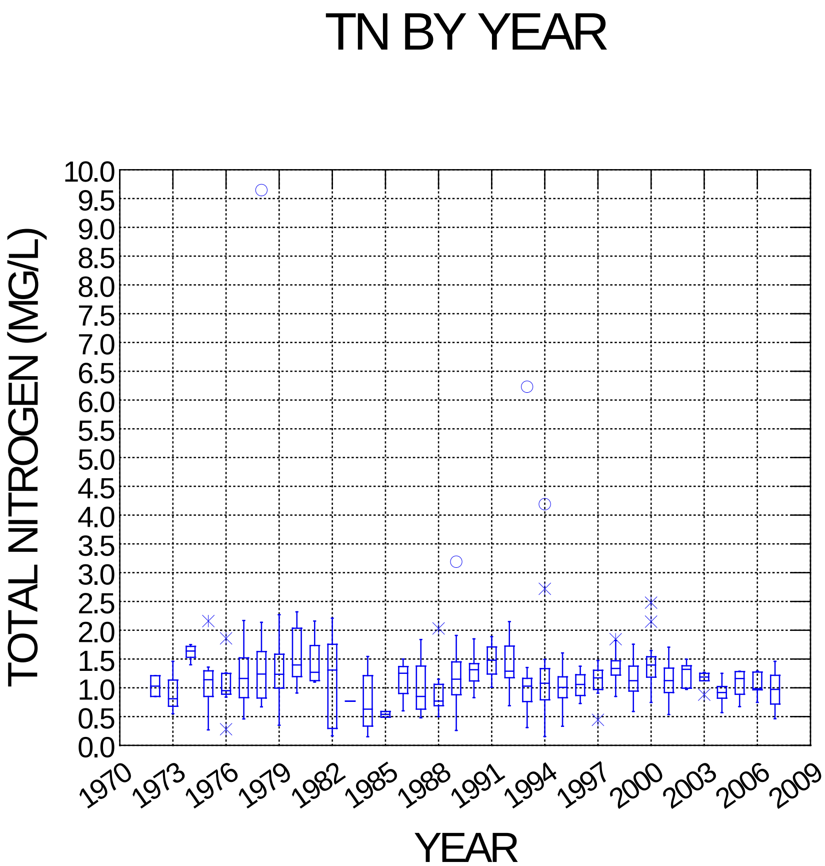
BOD5 BY STATION

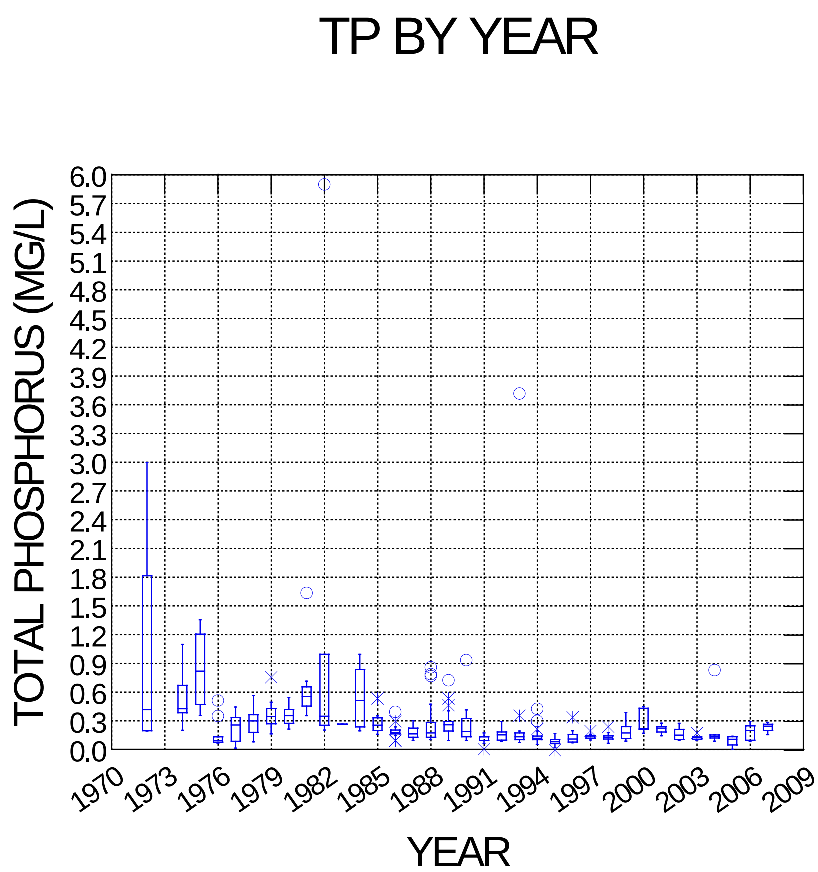


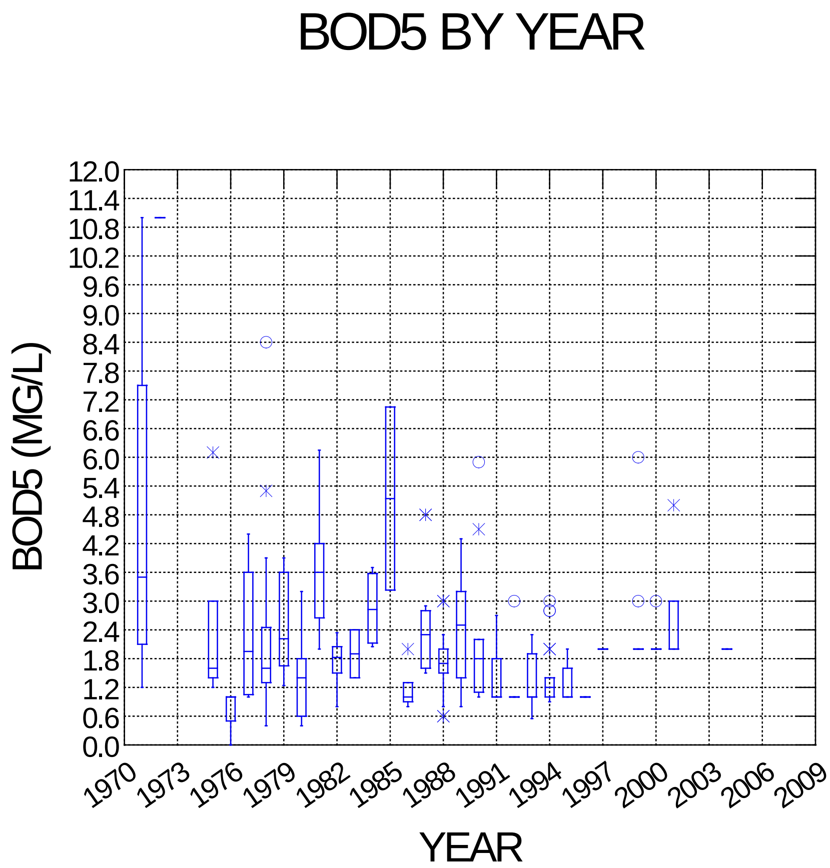

DO BY YEAR
DISSOLVED OXYGEN (MG/L)
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

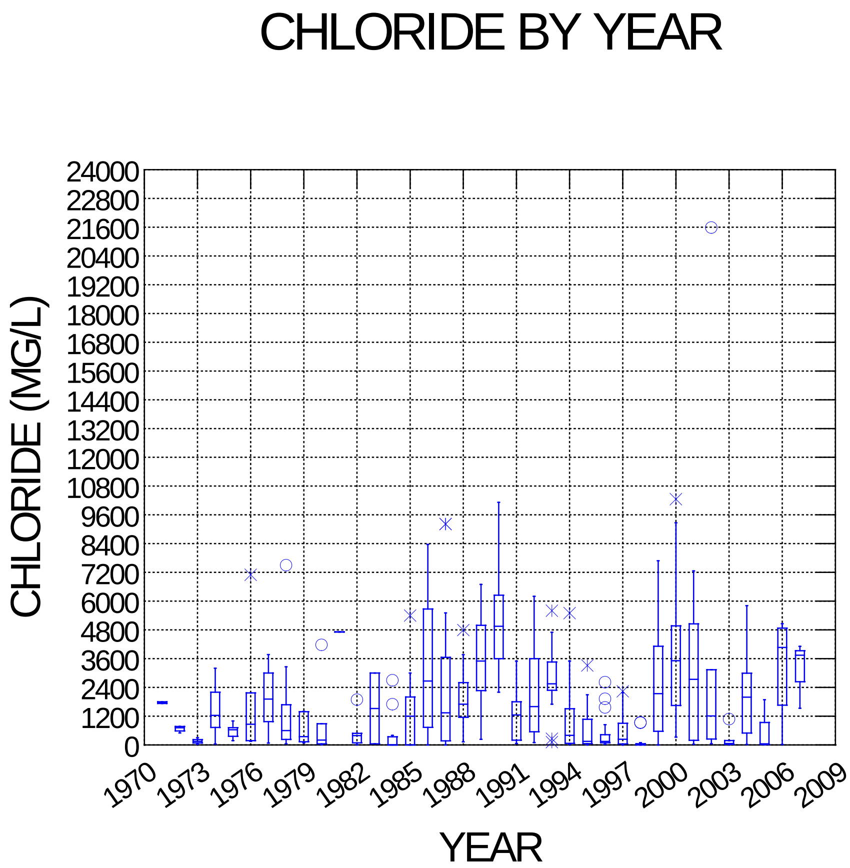

DOSAT BY YEAR
DOSAT (%)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

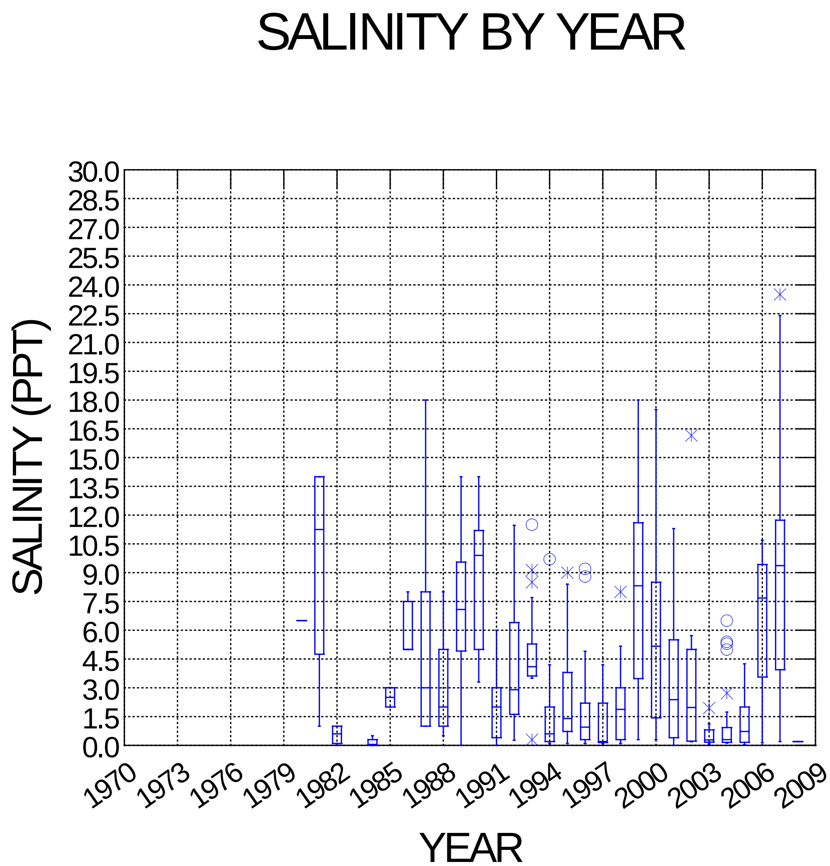

CHLAC BY YEAR
CHLAC (UG/L)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

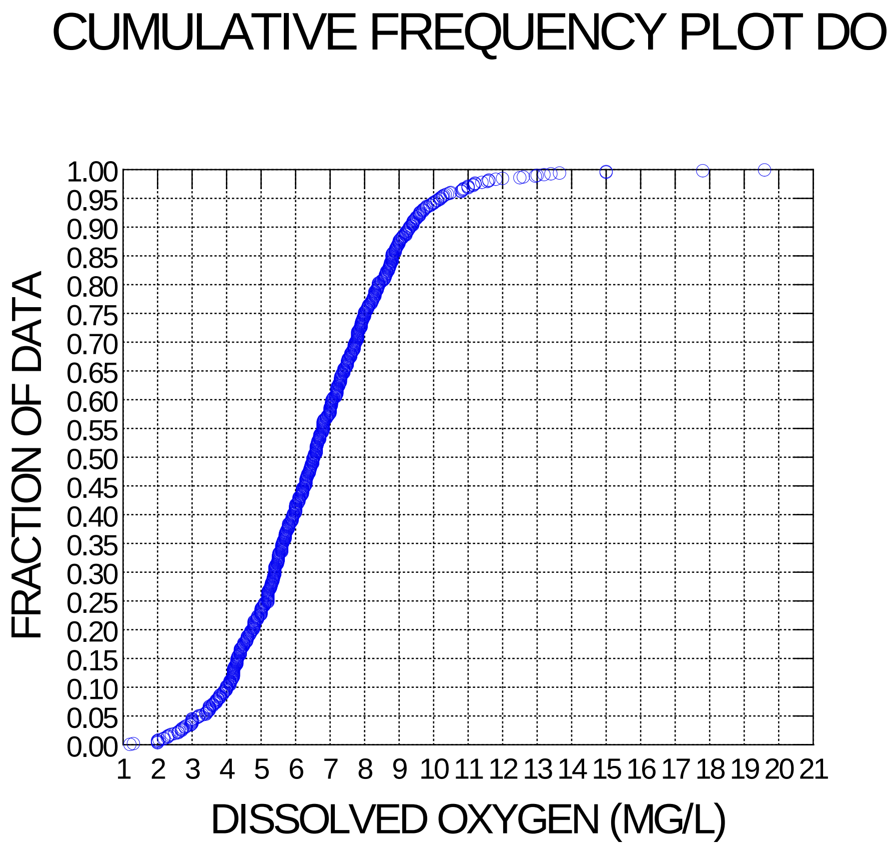

TN BY YEAR
TOTAL NITROGEN (MG/L)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

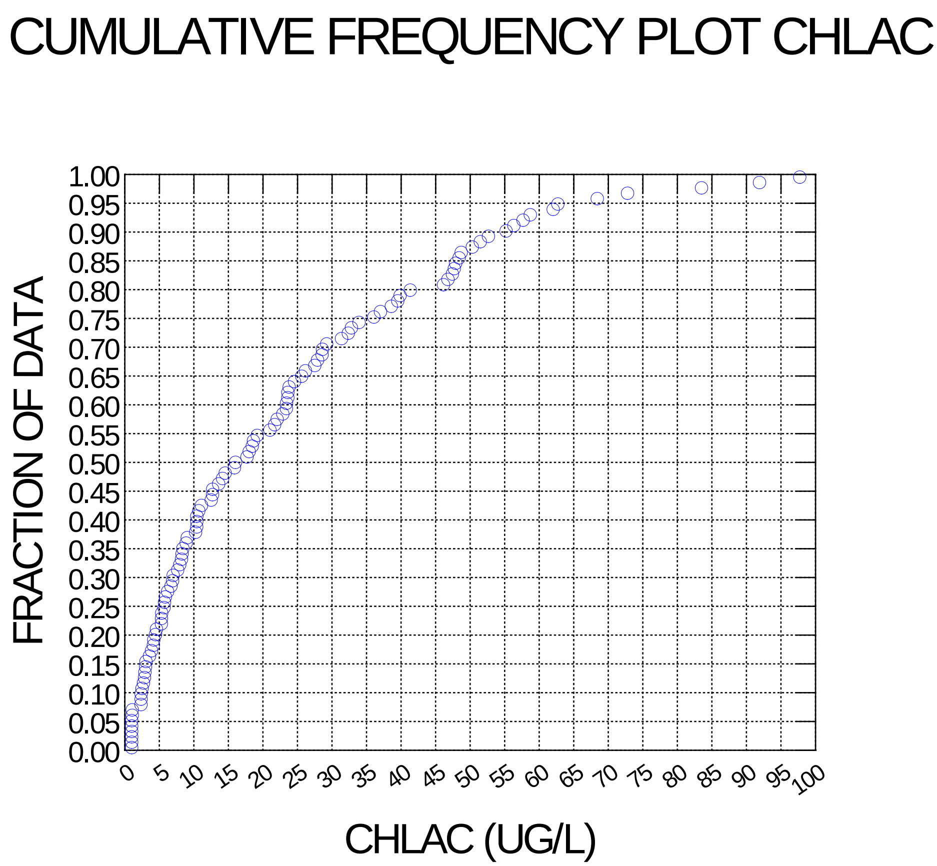

TP BY YEAR
TOTAL PHOSPHORUS (MG/L)
6.0
5.7
5.4
5.1
4.8
4.5
4.2
3.9
3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

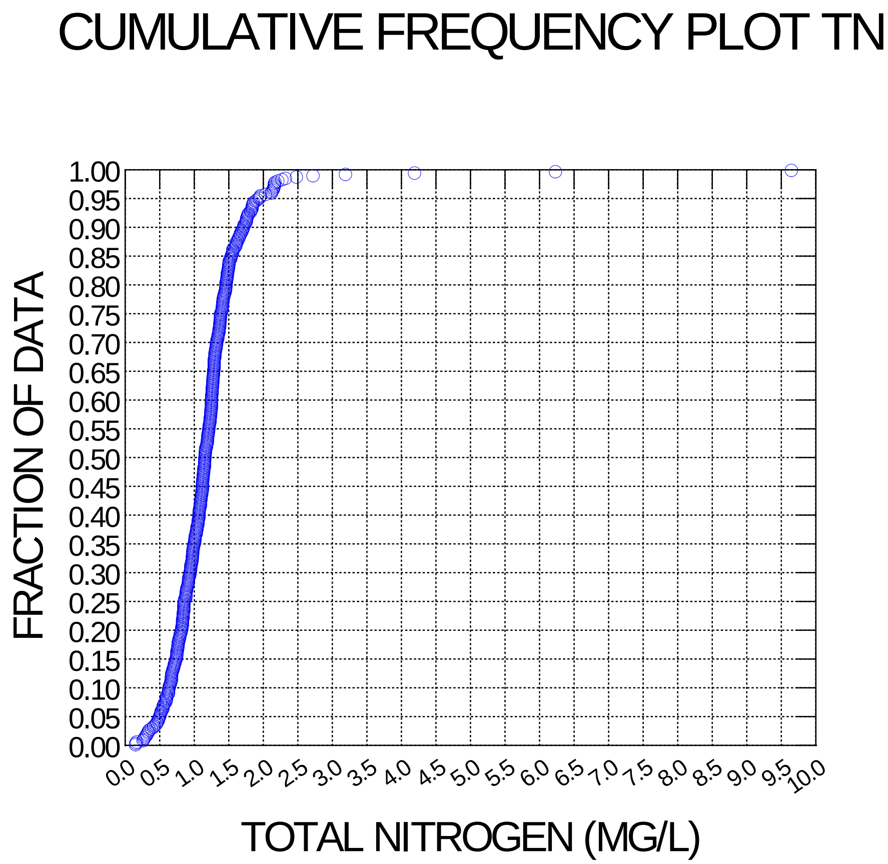

BOD5 BY YEAR
BOD5 (MG/L)
12.0
11.4
10.8
10.2
9.6
9.0
8.4
7.8
7.2
6.6
6.0
5.4
4.8
4.2
3.6
3.0
2.4
1.8
1.2
0.6
0.0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR


CHLORIDE BY YEAR
CHLORIDE (MG/L)
24000
22800
21600
20400
19200
18000
16800
15600
14400
13200
12000
10800
9600
8400
7200
6000
4800
3600
2400
1200
0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR

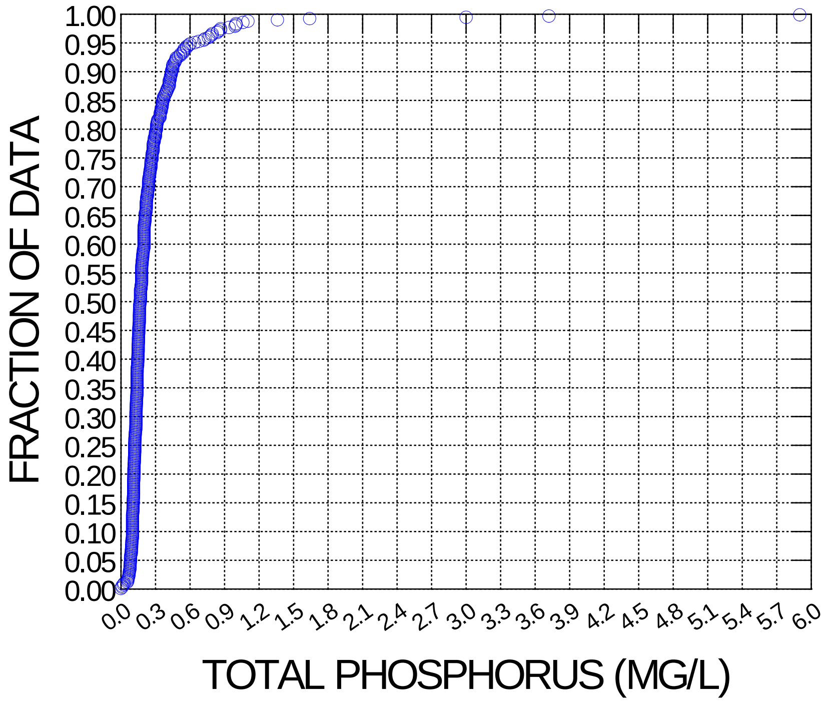

SALINITY BY YEAR
SALINITY (PPT)
30.0
28.5
27.0
25.5
24.0
22.5
21.0
19.5
18.0
16.5
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
YEAR


CUMULATIVE FREQUENCY PLOT DO
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
DISSOLVED OXYGEN (MG/L)

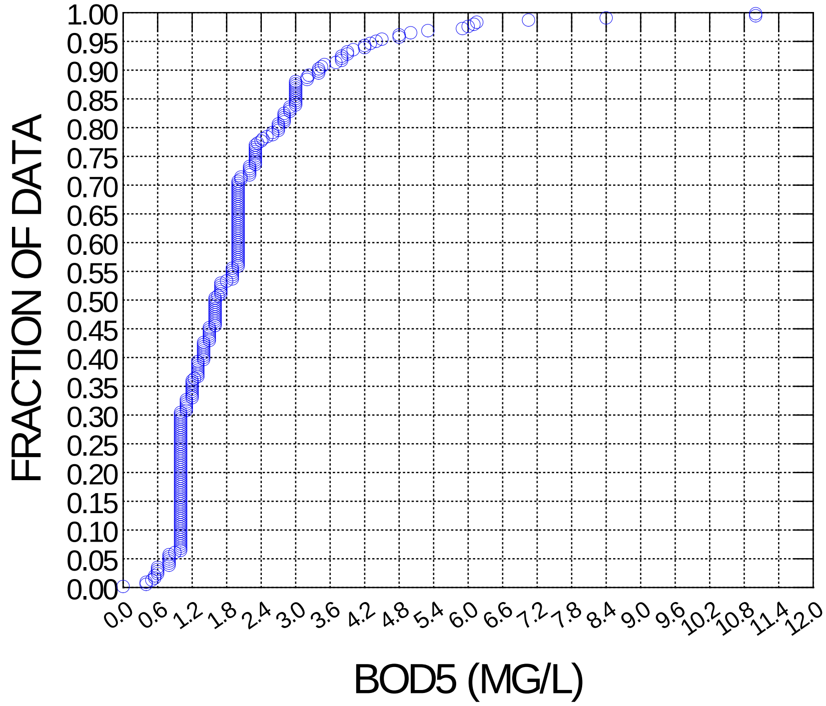

CUMULATIVE FREQUENCY PLOT CHLAC
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
CHLAC (UG/L)


CUMULATIVE FREQUENCY PLOT TN
FRACTION OF DATA
TOTAL NITROGEN (MG/L)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0

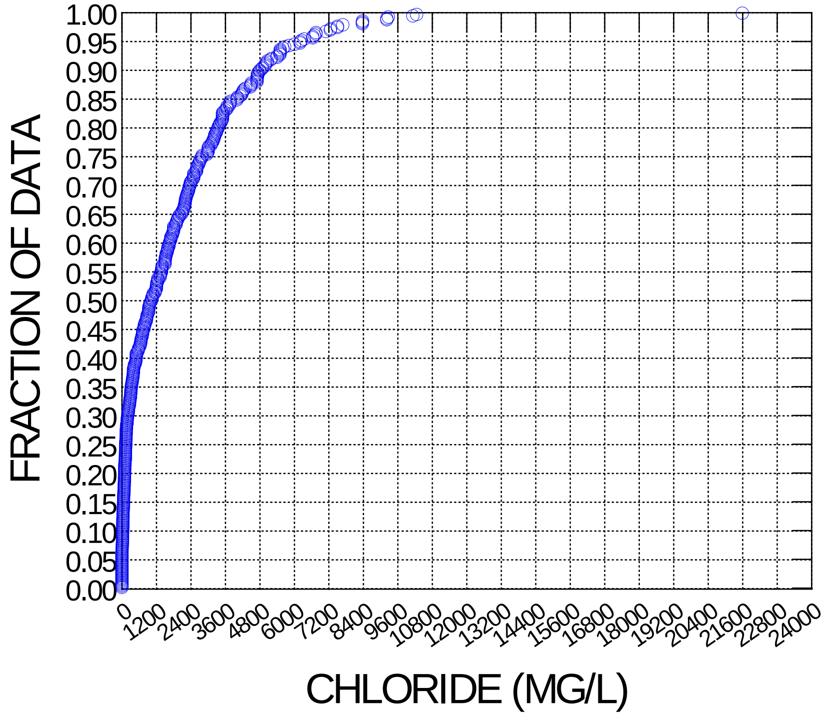
CUMULATIVE FREQUENCY PLOT TP

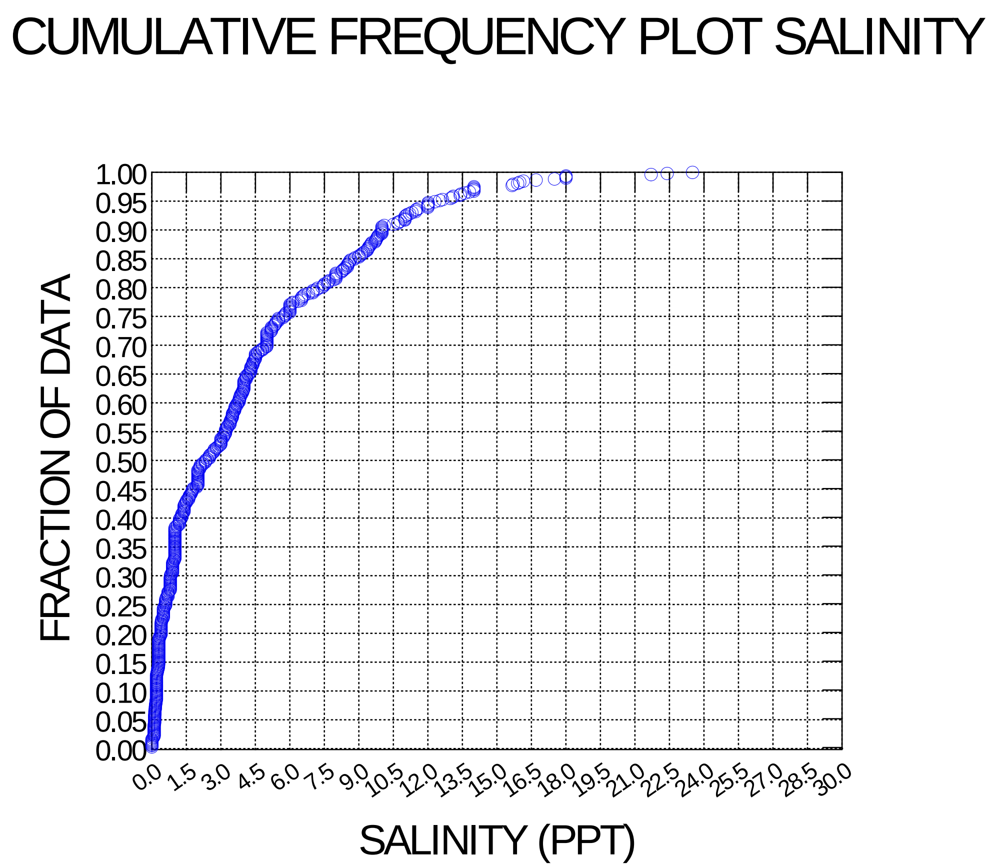


CUMULATIVE FREQUENCY PLOT BOD5

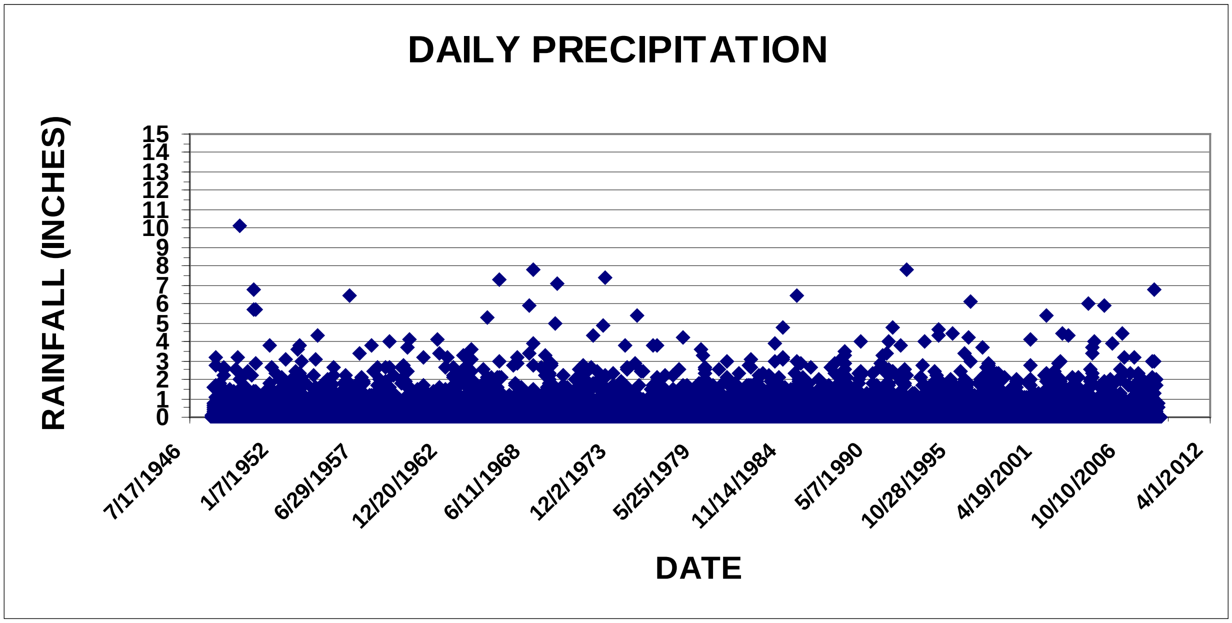


CUMULATIVE FREQUENCY PLOT CHLORIDE




CUMULATIVE FREQUENCY PLOT SALINITY
FRACTION OF DATA
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
1.5
3.0
4.5
6.0
7.5
9.0
10.5
12.0
13.5
15.0
16.5
18.0
19.5
21.0
22.5
24.0
25.5
27.0
28.5
30.0
SALINITY (PPT)

Appendix F: Chart of Rainfall for JIA, 1948–2008



Appendix G: Spearman Correlation Matrix Analysis for Water Quality Parameters in the Ortega River (WBID 2213P)

Spearman correlation matrix

PARM	PRECIP	PRECIP3DAY	PRECIP7DAY	PRECIP14DAY	JULIANDATE
PRECIP	1				
PRECIP3DAY	0.618	1			
PRECIP7DAY	0.401	0.633	1		
PRECIP14DAY	0.291	0.449	0.731	1	
JULIANDATE	0.014	-0.057	-0.008	0.007	1
BOD5	-0.024	-0.097	-0.065	-0.012	-0.161
CHLORIDE	0.001	-0.08	-0.103	-0.199	-0.077
CHLA	-0.001	-0.231	-0.157	-0.275	-0.155
CHLAC	0.054	-0.256	-0.093	-0.165	0.112
COLOR	-0.033	0.086	0.127	0.132	-0.318
CONDUCTANCE	0	-0.05	-0.093	-0.155	0.113
DOC	0.267	0.523	0.643	0.25	-0.071
DO	-0.121	-0.24	-0.251	-0.335	-0.104
DISSSOLIDS	0.002	-0.097	-0.167	-0.322	-0.062
NO2NO3	-0.023	0.05	0.046	0.1	-0.078
AMMONIA	0.051	0.145	0.083	0.103	-0.338
TKN	-0.088	-0.077	-0.057	0.051	0.111
TN	-0.048	-0.022	-0.05	0.081	0.091
ORTHOP	-0.076	-0.242	-0.191	0.036	-0.626
DOSAT	-0.062	-0.181	-0.203	-0.261	-0.039
PH	-0.087	-0.209	-0.254	-0.276	0.063
TOTALORTHOP	0.032	0.104	0.178	0.137	0.008
TP	-0.036	-0.065	-0.084	-0.135	-0.278
SALINITY	-0.017	-0.06	-0.113	-0.157	-0.027
SECCHI	0.036	0.027	-0.067	-0.156	-0.154
SULFATE	0.034	-0.107	-0.194	-0.363	-0.053
TEMPERATUREC	0.171	0.161	0.151	0.228	0.054
TOC	0.015	0.023	0.097	0.087	-0.431
TSS	0.006	-0.034	-0.086	-0.081	-0.064
TURBIDITY	-0.001	0.037	0.018	0.011	0.313

Spearman correlation matrix (continued)

PARM	BOD5	CHLORIDE	CHLA	CHLAC	COLOR
BOD5	1				
CHLORIDE	0.19	1			
CHLA	0.58	0.337	1		
CHLAC	0.593	0.337	0.981	1	
COLOR	0.02	-0.516	-0.311	-0.324	1
CONDUCTANCE	0.098	0.844	0.277	0.341	-0.483
DOC	.	-0.786	0.371	0.371	0.756
DO	-0.046	0.21	0.343	0.262	-0.204
DISSSOLIDS	0.17	0.856	0.233	0.281	-0.444
NO2NO3	-0.196	-0.228	-0.644	-0.611	0.137
AMMONIA	0.104	-0.146	-0.515	-0.571	0.224
TKN	0.023	-0.077	0.435	0.338	0.193
TN	-0.035	-0.098	0.111	-0.009	0.189
ORTHOP	0.672	-0.32	0.429	.	.
DOSAT	0.085	0.349	0.668	0.595	-0.335
PH	0.056	0.429	0.358	0.33	-0.375
TOTALORTHOP	0.106	0.049	-0.049	-0.026	0.098
TP	0.363	0.194	0.319	0.323	0.057
SALINITY	0.241	0.874	0.523	0.461	-0.397
SECCHI	0.062	0.389	-0.24	-0.276	-0.349
SULFATE	0.046	0.945	0.309	0.355	-0.486
TEMPERATUREC	0.197	0.163	0.508	0.451	0.011
TOC	0.136	-0.055	-0.271	-0.261	0.648
TSS	0.209	0.349	0.496	0.454	-0.147
TURBIDITY	0.189	-0.13	0.315	0.304	0.035

Spearman correlation matrix (continued)

PARM	CONDUCTANCE	DOC	DO	DISSSOLIDS	NO2NO3
CONDUCTANCE	1				
DOC	-1	1			
DO	0.117	0.5	1		
DISSSOLIDS	0.853	-0.786	0.028	1	
NO2NO3	-0.173	-0.928	-0.077	-0.246	1
AMMONIA	-0.177	-0.357	-0.272	-0.189	0.439
TKN	-0.035	-0.393	-0.131	-0.106	0.016
TN	-0.067	-1	-0.145	-0.133	0.349
ORTHOP	-0.041	.	-0.137	.	.
DOSAT	0.246	.	0.906	-0.143	-0.163
PH	0.387	-0.5	0.576	0.127	-0.197
TOTALORTHOP	0.027	.	-0.293	0.103	0.193
TP	0.049	0.429	-0.07	0.2	-0.088
SALINITY	0.92	.	0.152	0.779	-0.298
SECCHI	0.393	-0.5	0.072	0.221	-0.094
SULFATE	0.946	-0.786	0.206	0.987	-0.254
TEMPERATUREC	0.217	0.5	-0.394	0.121	-0.345
TOC	-0.368	0.857	-0.232	-0.073	0.146
TSS	0.358	-0.378	0.143	0.355	-0.211
TURBIDITY	-0.06	0.143	0.03	-0.087	-0.075

Spearman correlation matrix (continued)

PARM	PH	TOTALORTHOP	TP	SALINITY	SECCHI
PH	1				
TOTALORTHOP	-0.23	1			
TP	-0.084	0.609	1		
SALINITY	0.39	0.139	0.255	1	
SECCHI	-0.014	-0.071	-0.06	0.185	1
SULFATE	0.282	0.055	0.154	0.936	0.485
TEMPERATUREC	-0.039	0.039	0.064	0.286	-0.1
TOC	-0.357	-0.039	-0.209	-0.455	-0.459
TSS	0.272	-0.02	0.264	0.473	-0.086
TURBIDITY	0.132	-0.045	0.018	-0.043	-0.581

PARM	SULFATE	TEMPERATUREC	TOC	TSS	TURBIDITY
SULFATE	1				
TEMPERATUREC	0.124	1			
TOC	-0.154	-0.013	1		
TSS	0.384	0.275	-0.156	1	
TURBIDITY	-0.094	0.103	-0.269	0.371	1

Pair-wise frequency table

PARM	PRECIP	PRECIP3DAY	PRECIP7DAY	PRECIP14DAY	JULIANDATE
PRECIP	1387				
PRECIP3DAY	1387	1387			
PRECIP7DAY	1387	1387	1387		
PRECIP14DAY	1387	1387	1387	1387	
JULIANDATE	1387	1387	1387	1387	1387
BOD5	290	290	290	290	290
CHLORIDE	500	500	500	500	500
CHLA	125	125	125	125	125
CHLAC	139	139	139	139	139
COLOR	313	313	313	313	313
CONDUCTANCE	922	922	922	922	922
DOC	7	7	7	7	7
DO	1099	1099	1099	1099	1099
DISSSOLIDS	171	171	171	171	171
NO2NO3	542	542	542	542	542
AMMONIA	685	685	685	685	685
TKN	619	619	619	619	619
TN	594	594	594	594	594
ORTHOP	56	56	56	56	56
DOSAT	787	787	787	787	787
PH	1041	1041	1041	1041	1041
TOTALORTHOP	460	460	460	460	460
TP	634	634	634	634	634
SALINITY	802	802	802	802	802
SECCHI	463	463	463	463	463
SULFATE	187	187	187	187	187
TEMPERATUREC	1129	1129	1129	1129	1129
TOC	355	355	355	355	355
TSS	482	482	482	482	482
TURBIDITY	413	413	413	413	413

Pair-wise frequency table (continued)

PARM	BOD5	CHLORIDE	CHLA	CHLAC	COLOR
BOD5	290				
CHLORIDE	233	500			
CHLA	7	119	125		
CHLAC	14	118	117	139	
COLOR	173	270	114	126	313
CONDUCTANCE	208	371	118	119	254
DOC	0	7	6	6	7
DO	234	430	118	119	264
DISSSOLIDS	41	168	107	111	160
NO2NO3	219	346	94	102	247
AMMONIA	271	461	116	117	299
TKN	263	384	122	125	308
TN	255	378	108	108	279
ORTHOP	14	39	8	0	0
DOSAT	218	305	38	38	153
PH	221	416	117	118	258
TOTALORTHOP	146	257	86	90	186
TP	235	398	122	125	282
SALINITY	150	233	53	60	142
SECCHI	115	151	44	50	110
SULFATE	53	180	109	113	179
TEMPERATUREC	239	430	118	121	273
TOC	31	158	105	107	156
TSS	275	431	114	125	304
TURBIDITY	204	335	114	123	272

Pair-wise frequency table (continued)

PARM	CONDUCTANCE	DOC	DO	DISSSOLIDS	NO2NO3
CONDUCTANCE	922				
DOC	3	7			
DO	915	3	1099		
DISSSOLIDS	144	7	152	171	
NO2NO3	400	6	420	147	542
AMMONIA	509	7	551	161	528
TKN	460	7	484	171	517
TN	446	6	466	147	517
ORTHOP	42	0	54	0	0
DOSAT	631	0	787	47	210
PH	872	3	1031	145	390
TOTALORTHOP	324	0	339	148	388
TP	503	7	534	170	503
SALINITY	681	0	799	75	303
SECCHI	337	3	412	52	225
SULFATE	152	7	166	159	142
TEMPERATUREC	909	3	1081	159	423
TOC	266	7	276	148	295
TSS	376	7	401	171	368
TURBIDITY	314	7	331	160	313

Pair-wise frequency table (continued)

PARM	AMMONIA	TKN	TN	ORTHOP	DOSAT
AMMONIA	685				
TKN	582	619			
TN	577	561	594		
ORTHOP	45	8	34	56	
DOSAT	308	248	252	47	787
PH	523	452	438	48	753
TOTALORTHOP	433	447	404	0	119
TP	598	579	547	37	294
SALINITY	322	321	300	0	597
SECCHI	273	288	257	2	248
SULFATE	177	180	156	3	63
TEMPERATUREC	550	489	468	48	787
TOC	328	335	306	10	42
TSS	459	415	405	30	289
TURBIDITY	366	352	325	2	220

PARM	PH	TOTALORTHOP	TP	SALINITY	SECCHI
PH	1041				
TOTALORTHOP	308	460			
TP	503	409	634		
SALINITY	774	219	321	802	
SECCHI	395	238	289	290	463
SULFATE	159	146	180	67	64
TEMPERATUREC	1026	341	536	796	446
TOC	246	314	344	168	169
TSS	394	265	423	213	160
TURBIDITY	326	258	337	183	166

Pair-wise frequency table (continued)

PARM	SULFATE	TEMPERATUREC	TOC	TSS	TURBIDITY
SULFATE	187				
TEMPERATUREC	174	1129			
TOC	150	276	355		
TSS	184	404	160	482	
TURBIDITY	179	340	158	373	413

Appendix H: Linear Regression Analysis of DO and CHLAC Observations versus Nutrients and BOD in the Ortega River (WBID 2213P)

Dep Var: DO   N: 262   Multiple R: 0.081   Squared multiple R: 0.006

Adjusted squared multiple R: 0.003   Standard error of estimate: 2.193

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7.064	0.232	0.000	.	30.427	0.000
BOD5DAY	0.125	0.096	0.081	1.000	1.303	0.194

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	8.166	1	8.166	1.698	0.194
Residual	1250.203	260	4.808		

*** WARNING ***
Case 2 has large leverage (Leverage = 0.161)
Case 8 has large leverage (Leverage = 0.161)
Case 84 has large leverage (Leverage = 0.083)
Case 635 is an outlier (Studentized Residual = 5.971)

Durbin-Watson D Statistic 1.148
First Order Autocorrelation 0.

Dep Var: DO   N: 101   Multiple R: 0.171   Squared multiple R: 0.029

Adjusted squared multiple R: 0.019   Standard error of estimate: 2.056

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.367	0.303	0.000	.	21.019	0.000
CHLAC	0.016	0.009	0.171	1.000	1.726	0.087

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	12.587	1	12.587	2.979	0.087
Residual	418.335	99	4.226		

Durbin-Watson D Statistic 1.678
First Order Autocorrelation 0.155

Dep Var: DO   N: 732   Multiple R: 0.416   Squared multiple R: 0.173

Adjusted squared multiple R: 0.172   Standard error of estimate: 2.021

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10.237	0.300	0.000	.	34.139	0.000
TEMPERATUREC	-0.155	0.013	-0.416	1.000	-12.375	0.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	625.245	1	625.245	153.151	0.000
Residual	2980.257	730	4.083		

*** WARNING ***
Case 155 is an outlier (Studentized Residual = 6.038)
Case 635 is an outlier (Studentized Residual = 5.478)

Durbin-Watson D Statistic 1.326
First Order Autocorrelation 0.327

Dep Var: DO   N: 405   Multiple R: 0.490   Squared multiple R: 0.240

Adjusted squared multiple R: 0.235   Standard error of estimate: 1.839

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	10.954	0.841	0.000	.	13.018	0.000
TEMPERATUREC	-0.159	0.033	-0.457	0.212	-4.835	0.000
TN	0.031	0.636	0.010	0.046	0.049	0.961
TEMPERATUREC*TN	-0.008	0.025	-0.076	0.039	-0.346	0.730

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	429.159	3	143.053	42.304	0.000
Residual	1355.996	401	3.382		

*** WARNING ***
Case 84 has large leverage (Leverage = 0.676)
Case 93 has large leverage (Leverage = 0.062)
Case 288 has large leverage (Leverage = 0.367)
Case 347 has large leverage (Leverage = 0.061)
Case 635 is an outlier (Studentized Residual = 5.819)

Durbin-Watson D Statistic 1.488
First Order Autocorrelation 0.256

Dep Var: DO   N: 743   Multiple R: 0.268   Squared multiple R: 0.072

Adjusted squared multiple R: 0.071   Standard error of estimate: 2.163

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7.247	0.113	0.000	.	64.257	0.000
PRECIP14DAY	-0.286	0.038	-0.268	1.000	-7.576	0.000

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	268.537	1	268.537	57.391	0.000
Residual	3467.193	741	4.679		

*** WARNING ***
Case 155 is an outlier (Studentized Residual = 5.173)
Case 489 has large leverage (Leverage = 0.063)
Case 490 has large leverage (Leverage = 0.063)
Case 635 is an outlier (Studentized Residual = 6.019)
Case 651 has large leverage (Leverage = 0.036)

Durbin-Watson D Statistic 1.221
First Order Autocorrelation 0.384

Dep Var: DO   N: 234   Multiple R: 0.589   Squared multiple R: 0.347

Adjusted squared multiple R: 0.330   Standard error of estimate: 1.871

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	12.924	1.724	0.000	.	7.499	0.000
TN	-0.484	1.162	-0.091	0.060	-0.416	0.678
TEMPERATUREC	-0.168	0.070	-0.469	0.075	-2.394	0.017
COLOR	-0.016	0.011	-0.438	0.032	-1.451	0.148
TEMPERATUREC*TN	-0.024	0.048	-0.124	0.047	-0.504	0.615
TEMPERATUREC*COLOR	0.000	0.000	0.023	0.033	0.079	0.937
TN*COLOR	0.006	0.006	0.255	0.042	0.975	0.331

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	422.564	6	70.427	20.122	0.000
Residual	794.486	227	3.500		

*** WARNING ***
Case 72 has large leverage (Leverage = 0.282)
Case 73 has large leverage (Leverage = 0.306)
Case 139 has large leverage (Leverage = 0.389)
Case 248 has large leverage (Leverage = 0.152)
Case 305 is an outlier (Studentized Residual = 3.974)
Case 554 has large leverage (Leverage = 0.155)
Case 559 is an outlier (Studentized Residual = 5.704)
Case 581 has large leverage (Leverage = 0.138)

Durbin-Watson D Statistic 2.035
First Order Autocorrelation -0.020

Dep Var: CHLAC N: 101 Multiple R: 0.332 Squared multiple R: 0.110

Adjusted squared multiple R: 0.101 Standard error of estimate: 20.978

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	-2.046	7.731	0.000	.	-0.265	0.792
TEMPERATUREC	1.143	0.326	0.332	1.000	3.506	0.001

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	5409.404	1	5409.404	12.292	0.001
Residual	43567.670	99	440.077		

Durbin-Watson D Statistic 1.255
First Order Autocorrelation 0.331

Dep Var: CHLAC N: 99 Multiple R: 0.403 Squared multiple R: 0.162

Adjusted squared multiple R: 0.136 Standard error of estimate: 20.608

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	0.159	19.092	0.000	.	0.008	0.993
COLOR	0.005	0.195	0.011	0.059	0.028	0.978
TEMPERATUREC	1.518	0.789	0.438	0.170	1.924	0.057
TEMPERATUREC*COLOR	-0.005	0.008	-0.285	0.049	-0.668	0.506

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7813.847	3	2604.616	6.133	0.001
Residual	40345.447	95	424.689		

*** WARNING ***
Case 75 has large leverage (Leverage = 0.279)
Case 85 has large leverage (Leverage = 0.278)
Case 119 has large leverage (Leverage = 0.244)
Case 229 has large leverage (Leverage = 0.255)
Case 337 has large leverage (Leverage = 1.893)
Case 338 has large leverage (Leverage = 2.106)
Case 341 has large leverage (Leverage = 0.224)
Case 343 has large leverage (Leverage = 0.303)
Case 344 has large leverage (Leverage = 0.303)

Durbin-Watson D Statistic 1.272
First Order Autocorrelation 0.325

Dep Var: CHLAC N: 89 Multiple R: 0.525 Squared multiple R: 0.276

Adjusted squared multiple R: 0.223 Standard error of estimate: 19.694

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	48.675	40.331	0.000	.	1.207	0.231
COLOR	0.110	0.275	0.224	0.028	0.401	0.689
TEMPERATUREC	-1.672	1.632	-0.483	0.040	-1.024	0.309
TN	-37.722	27.701	-0.483	0.070	-1.362	0.177
TEMPERATUREC*COLOR	-0.002	0.008	-0.127	0.044	-0.281	0.779
TEMPERATUREC*TN	2.664	1.103	1.213	0.035	2.415	0.018
COLOR*TN	-0.176	0.179	-0.520	0.031	-0.981	0.329

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	12109.280	6	2018.213	5.204	0.000
Residual	31802.905	82	387.840		

*** WARNING ***
Case 70 has large leverage (Leverage = 0.624)
Case 71 has large leverage (Leverage = 0.673)
Case 75 has large leverage (Leverage = 0.337)
Case 93 has large leverage (Leverage = 0.560)
Case 95 has large leverage (Leverage = 0.314)
Case 104 has large leverage (Leverage = 0.881)
Case 112 has large leverage (Leverage = 0.396)
Case 116 has large leverage (Leverage = 0.294)
Case 117 has large leverage (Leverage = 0.450)
Case 119 has large leverage (Leverage = 0.269)
Case 120 has large leverage (Leverage = 0.514)
Case 125 has large leverage (Leverage = 0.374)
Case 128 has large leverage (Leverage = 0.724)
Case 130 has large leverage (Leverage = 0.373)
Case 132 has large leverage (Leverage = 1.064)
Case 143 has large leverage (Leverage = 0.779)
Case 144 has large leverage (Leverage = 0.555)
Case 188 has large leverage (Leverage = 0.355)
Case 189 has large leverage (Leverage = 0.355)
Case 192 has large leverage (Leverage = 0.276)
Case 193 has large leverage (Leverage = 0.279)
Case 217 has large leverage (Leverage = 0.304)
Case 218 has large leverage (Leverage = 0.303)
Case 219 has large leverage (Leverage = 0.336)
Case 225 has large leverage (Leverage = 0.343)
Case 226 has large leverage (Leverage = 0.302)
Case 229 has large leverage (Leverage = 0.393)
Case 246 has large leverage (Leverage = 5.417)
Case 305 has large leverage (Leverage = 0.395)
Case 306 has large leverage (Leverage = 0.401)
Case 329 has large leverage (Leverage = 0.307)
Case 337 has large leverage (Leverage = 2.143)
Case 338 has large leverage (Leverage = 2.318)
Case 343 has large leverage (Leverage = 0.324)
Case 344 has large leverage (Leverage = 0.325)
Case 349 has large leverage (Leverage = 0.401)
Case 494 is an outlier (Studentized Residual = 3.378)
Case 595 has large leverage (Leverage = 0.263)
Case 614 has large leverage (Leverage = 0.394)
Case 646 has large leverage (Leverage = 0.278)
Case 739 is an outlier (Studentized Residual = 3.587)

Durbin-Watson D Statistic 1.268
First Order Autocorrelation 0.333

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

Rainfall is in inches, and represents data from JIA.

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

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
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**

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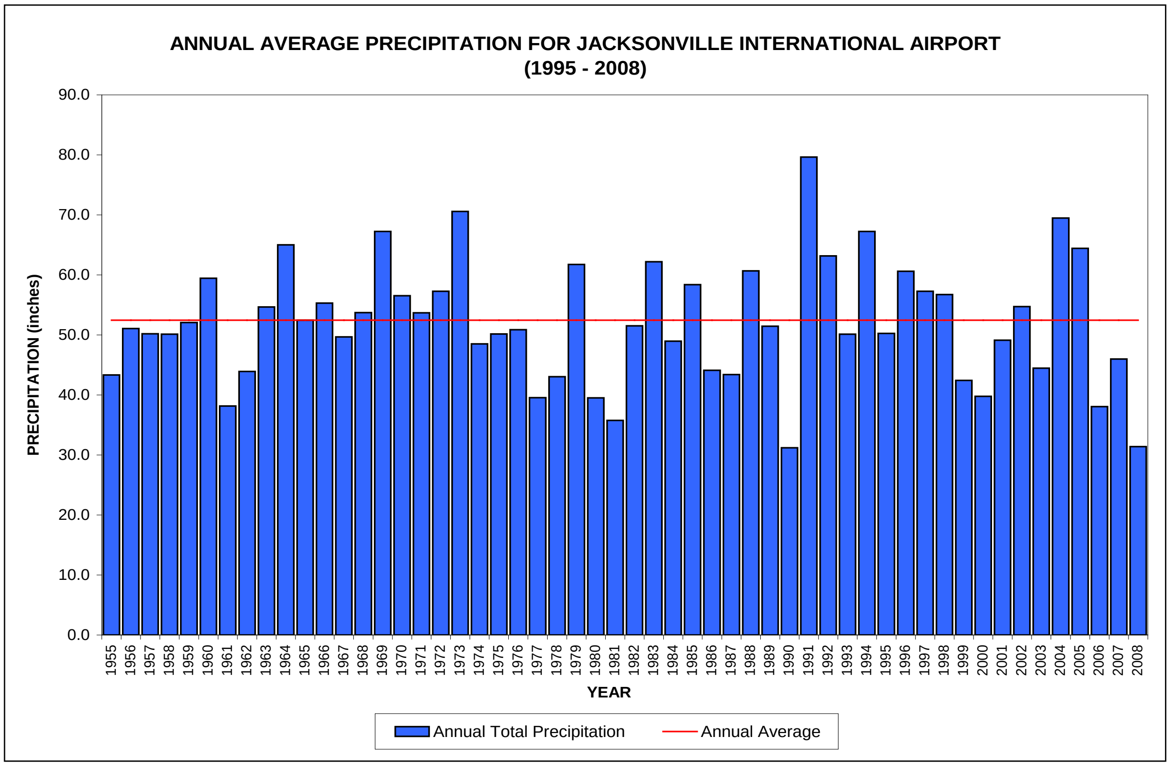
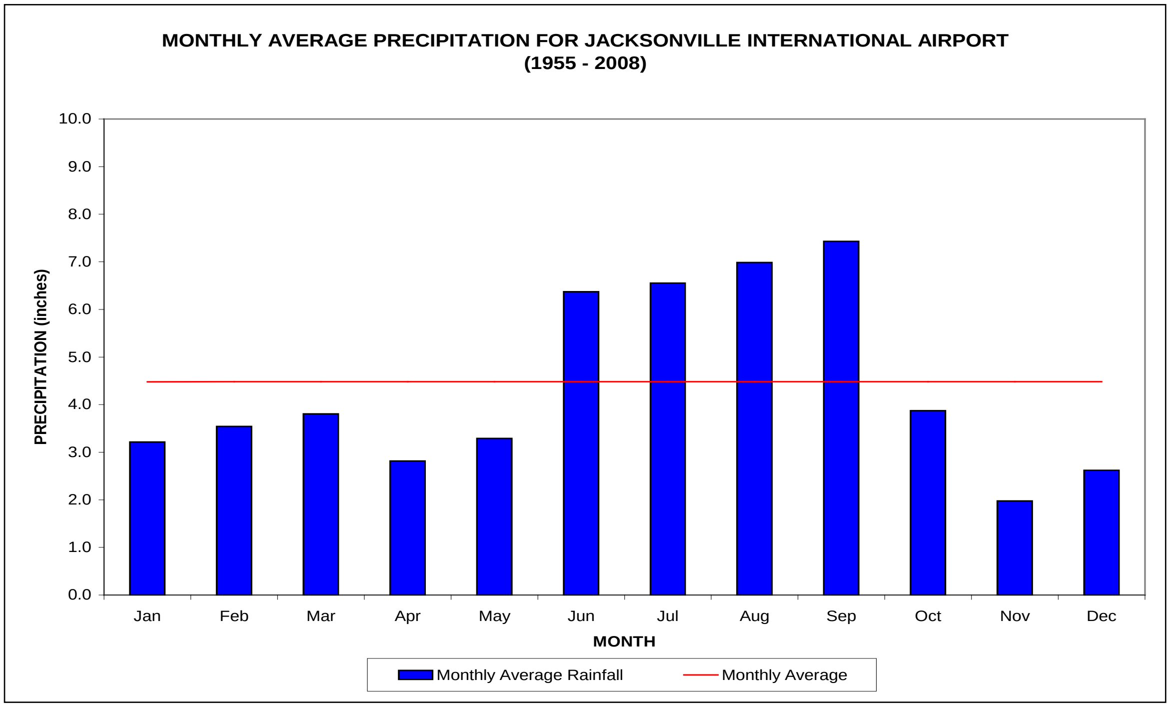
Appendix J: Annual and Monthly Average Precipitation at JIA





Appendix K: Response to Comments

August 4, 2009

John P. Pappas, P.E.
Deputy Director Public Works
City of Jacksonville
214 N. Hogan Street, Suite 1079
Jacksonville, FL 32202

Subject: Draft Total Maximum Daily Loads for the Ortega (WBID 2213P), Trout (WBID 2203), and Arlington (WBID 2265A) Rivers

Dear Mr. Pappas:

Thank you for providing comments on several of our draft Total Maximum Daily Load reports in your letter of July 15th. We appreciate you and your staff taking the time to help us improve the clarity of these reports and have incorporated your suggested changes wherever possible. As you will see below, your comments are reproduced in the order in which they were presented and then our responses are provided.

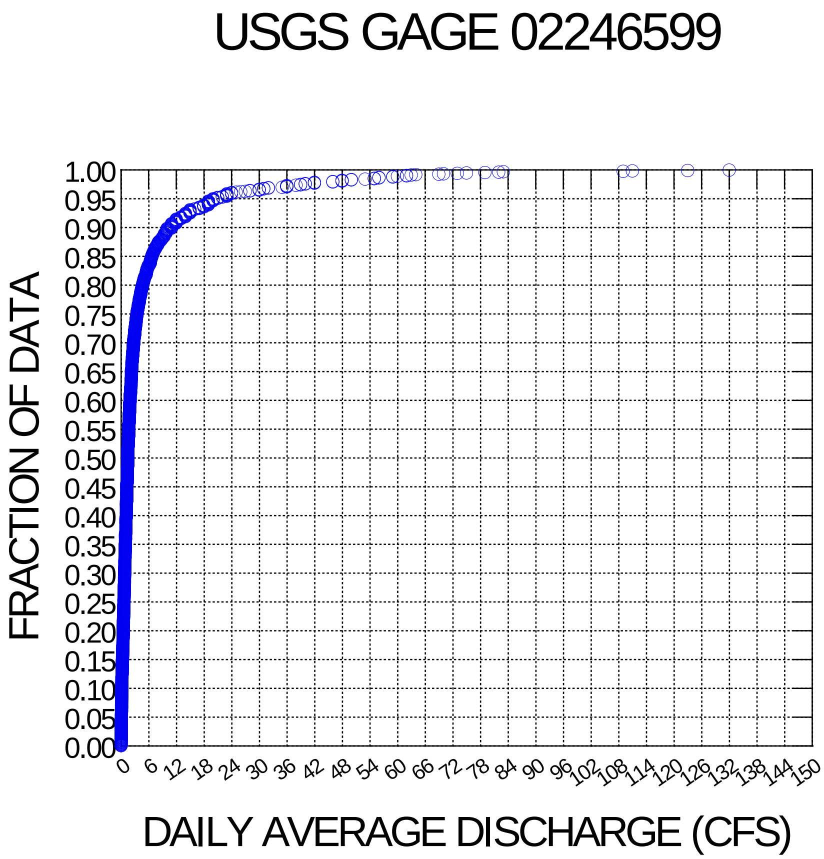
1) Explain why upstream tributary areas to the WBIDs appear to exclude some areas (see Figure 4.4 for Arlington River, Figure 4.6 for Ortega River, Figure 4.5 for Trout River). These figures exclude large sections of upstream tributary area.

Department Response: The intent of these figures and load estimates was to provide an overview of relative contributions of nitrogen and phosphorus from various sources to the impaired WBID from upstream areas, but they were not used to establish the Total Maximum Daily Load reductions. If the City could provide a GIS coverage of the upstream tributary drainage area for these WBIDs, the analysis could be revised. As noted in the documents, it was our understanding that the City has contracted with Camp Dresser & McKee, Inc. to model these sub-basins with the Watershed Management Model to develop discharge and pollutant load information as part of an update to the Master Stormwater Management Plan. Determination of the assimilative capacity described in Chapter 5 was based upon observed relationships between multiple water quality parameters in the impaired waterbody. While the source assessments described in Chapter 4 were not a factor in the development of nutrient reductions, they were included to aid in the development of the Basin Management Action Plan (reduction implementation) process.

2) The measured TN and TP concentrations for the Trout River appear to be higher than would be expected for a relatively undeveloped basin. The higher measured concentrations suggest that there is some load in the watershed that is not accounted for, and/ or the station is affected by high downstream TN and TP concentrations migrating upstream. A portion of this inconsistency could be due to tidal influences from the St Johns River.

John P. Pappas, P.E.
Deputy Director Public Works
City of Jacksonville
August 4, 2009
Page Two

Department Response: As noted in the document, there was a considerable increase in the median TN and TP medians in the Middle Trout River WBID (2203) compared to the upstream segment, i.e., the upper Trout River (WBID 2223). Based on data from the Impaired Waters Rule Run 35 database, the median TN and TP concentrations for WBID 2203 were 1.43 mg/L and 0.296 mg/L respectively, versus medians of 0.55 mg/L and 0.068 mg/L, respectively, in WBID 2223 over the same period. Over the same period, median TN and TP concentrations in the downstream Trout River WBID (2203A) were 0.93 mg/L and 0.13 mg/L, respectively. Regarding your concern over the possible effects of high downstream TN and TP concentrations migrating upstream, flow records from the USGS site (02246599) located near the bottom of the middle Trout River WBID did not reflect any negative flows over the period of record (10/1/2002 – 8/10/2006). Daily flows ranged between 0.04 and 130 cubic feet per second (CFS), with a mean flow of 4.9 CFS. A cumulative frequency plot of flow is presented below. As part of the county stormwater program and Phase 1 MS4 monitoring, has the City identified any possible sources that could help explain the elevated TN and TP levels in this WBID?



John P. Pappas, P.E.
Deputy Director Public Works
City of Jacksonville
August 4, 2009
Page Three

3) For the Trout River, the relatively low estimated TP loads/ concentrations and the high measured TP concentrations indicate an inconsistency between the modeling and observed conditions. The TMDL for the Trout River should be revisited to account for the additional nutrient source.

Department Response: As noted in our response to Item #1, the load/concentration estimates described in Chapter 4 were provided to indicate the relative importance of various sources of nutrients in the watershed. It is our understanding that the City has contracted with Camp Dresser & McKee, Inc. to model the Trout River sub-basin using the Watershed Management Model to develop discharge and pollutant load information as part of an update to your local Master Stormwater Management Plan. The TMDL reductions were not based on model estimated loads and/or concentrations. As discussed in Chapter 5, the assimilative capacity was based upon relationships developed between water quality measurements taken in the middle Trout River WBID.

4) In general, the draft TMDLs for the Arlington, Ortega, and Trout Rivers apply to WBIDs that border the LSJR and are highly tidally influenced. Measured water quality values within these tidally influenced WBIDs are most likely reflective of water quality within the LSJR itself. The reductions needed to protect these WBIDs from impairment will be addressed through the LSJR Mainstem Basin Management Action Plan (BMAP). The projects identified in the Mainstem BMAP will be protective of water quality in these WBIDs and will achieve the specific load reductions.

Department Response: Once statistical relationships between dissolved oxygen, chlorophyll, and nutrients were developed for these impaired waters, the percent reduction in nitrogen required under the Mainstem nutrient TMDL was the starting point to assess whether designated uses would be restored within these tributaries with implementation of nitrogen reductions. In the case of the middle Trout River WBID, the TMDL also requires reduction in the total phosphorus. We concur that implementation of projects that improve water quality in the mainstem of the St. Johns River should also benefit the Arlington and portions of the Ortega and Trout Rivers due to tidal exchange. In recognition of this, the TMDL rule language has been written to allow for recognition of projects that provide co-benefits to the mainstem and each individual tributary.

Please contact Dr. Wayne Magley, at 850/245-8463, if you have any further questions.

Sincerely,

Jan Mandrup-Poulsen, Administrator
Watershed Evaluation and TMDL Section

ec: Wayne Magley, DEP
Lisa Sterling, CDM
Jeff Martin, DEP

August 10, 2009

Mr. Joshua Boan
Environmental Process/Natural Sciences Manager
Environmental Research Administrator
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Tallahassee, FL 32399
Ph: 850-414-5266
Email: joshua.boan@dot.state.fl.us

Re: FDOT Comments on Newly Released Draft TMDLs

Dear Mr. Boan,

The Department appreciates the time and effort you and your staff put into reviewing these draft TMDLs. We have made necessary edits to some draft TMDL reports as a result of your comments. Because of your efforts, the final TMDL will be improved. To aid you in reviewing our responses, we have included your comments, followed by a response to each (in blue), in the order in which they were presented. Please contact me at Jan.Mandrup-Poulsen@dep.state.fl.us. if you have any further questions.

Sincerely

Jan Mandrup-Poulsen, Administrator
Watershed Evaluation and TMDL Section
Florida Department of Environmental Protection

DISTRICT 2 COMMENTS

GENERAL COMMENTS

The following comments relate to multiple TMDLs where specific comments are provided below for each of the TMDL documents.

1. It appears that the nutrient load assessments for the transportation category (Chapter 4) are based upon values presented in Harper (2007) (i.e., 1.64 mg/l TN and 0.22 mg/l TP). Harper's numbers are determined by averaging the average results from eleven different datasets from studies conducted between 1975 and 2005. Each study was given equal weight in the averaging procedure regardless of the number of events sampled and the methodologies used. Between December 2004 and October 2007 roadway runoff water quality data were collected by Johnson Engineering for FDOT District 1 at four locations within District 1. Ten events were sampled for each of the four locations, with samples collected at both the inflows and outflows of existing stormwater treatment ponds. All collection, transfer, and handling procedures were conducted in accordance with FDEP Standard Operating Procedures, and samples were analyzed by certified labs. Average values for TN and TP ***at the pond inflows*** were determined to be 1.17 mg/l and 0.158 mg/l, respectively. [It is perhaps noteworthy to observe that the highest average TN and TP values were measured at the first site sampled (i.e., samples collected between December 2004 and November 2005) which is also the site with the lowest percentage of impervious

area.] Given the changes to roadway management practices that FDOT has undertaken over the past several years and the rigorous quality control used in these studies compared with the older studies, we believe that the numbers presented by Johnson Engineering are more representative than Harper's numbers of present day TN and TP loading conditions. [This comment applies to all nutrient and DO TMDL documents reviewed. This included WBIDs 2410, 2389, 2203, 2213P,2265A, 2460, 2589, 2578.]

Department Response: A copy of the Johnson Engineering Study report was not included with the comments we received. If FDOT could provide the report to Mr. Eric Livingston (Bureau Chief for the Bureau of Watershed Restoration), it will be reviewed for incorporation into the stormwater database and used in estimation of transportation event mean concentrations (EMCs).

1. The load reductions determined for the non-point sources, which include the WLA for the stormwater (under the MS4 permit) and the LA, have not been allocated but simply applied evenly between the WLA for Stormwater and the LA. Sufficient studies have not been completed to determine if an even distribution of the load reductions is justified, therefore some language acknowledging this (within the TMDL and ultimately within the Rule) should be put into both the TMDL documents and ultimately the rules to allow the ability to finalize (and therefore change the assigned reductions) under the BMAP. [This comment applies to all TMDLs reviewed in which there was an WLA-MS4 allocation specified.]

   Department Response: In 2001, the Department submitted to the Governor and Legislature a document outlining the intended process for the allocation of loads under the TMDL Program. One key provision of the proposal was to level the "playing field," such that once stakeholders had the opportunity to meet and discuss what steps needed to be taken and to get appropriate credit for those initiatives already completed, the specific allocations will be set by the agreements reached under the Basin Management Action Plan (BMAP). This process has been successfully used in several adopted BMAPs and has demonstrated the flexibility that remains after setting the initial reductions for stormwater-related allocations (LA and WLA_{sw}) at identical levels.

   The laws of Florida form the underlying basis for the initial equal allocations. In particular, Section 403.067(6)(b), Florida Statutes, states in part that:

   "Allocations may also be made to individual basins and sources or as a whole to all basins and sources or categories of sources of inflow to the water body or water body segments. An initial allocation of allowable pollutant loads among point and nonpoint sources may be developed as part of the total maximum daily load. However, in such cases, the detailed allocation to specific point sources and specific categories of nonpoint sources shall be established in the basin management action plan…"

   Additionally, each of the draft TMDL reports contains language in the NPDES Stormwater Discharges section in Chapter 6 of the reports (repeated below) to address the issue of allocation between the WLA for stormwater and the LA portions of the TMDL:

   "It should be noted that any MS4 permittee is only responsible for reducing the anthropogenic 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."

SPECIFIC COMMENTS
The following are specific comments referenced to the individual TMDL documents reviewed.

Ortega River (WBID 2213P): DO/Nutrients

1. We understand the rationale for using the 30 percent reduction in that it is consistent with the reduction target in the mainstem. It appears, however, from the graph shown in Figure 5.7 that perhaps adequate DO reductions can be achieved with less than a 30 percent reduction. What average DO concentrations result when a 20 percent or 10 percent TN reduction is applied and what percent of the resultant DO concentrations are predicted to be less than 5.0 mg/l? If the goal is to minimize violations, then it seems that the reduction applied should be the minimum reduction needed to achieve satisfactory results.

   Department Response: The following figure includes TN reductions of 10, 20, 30, and 50 percent and the corresponding predicted DO concentrations based on the GLM.

   The following table is based on the GLM predictions for DO.

- = Empty cell

-	10% Reduction	20% Reduction	30% Reduction	50% Reduction
Minimum DO (mg/L)	2.16	1.91	2.61	1.17
% below 5.0 mg/L	3.38%	3.38%	2.52%	3.38%

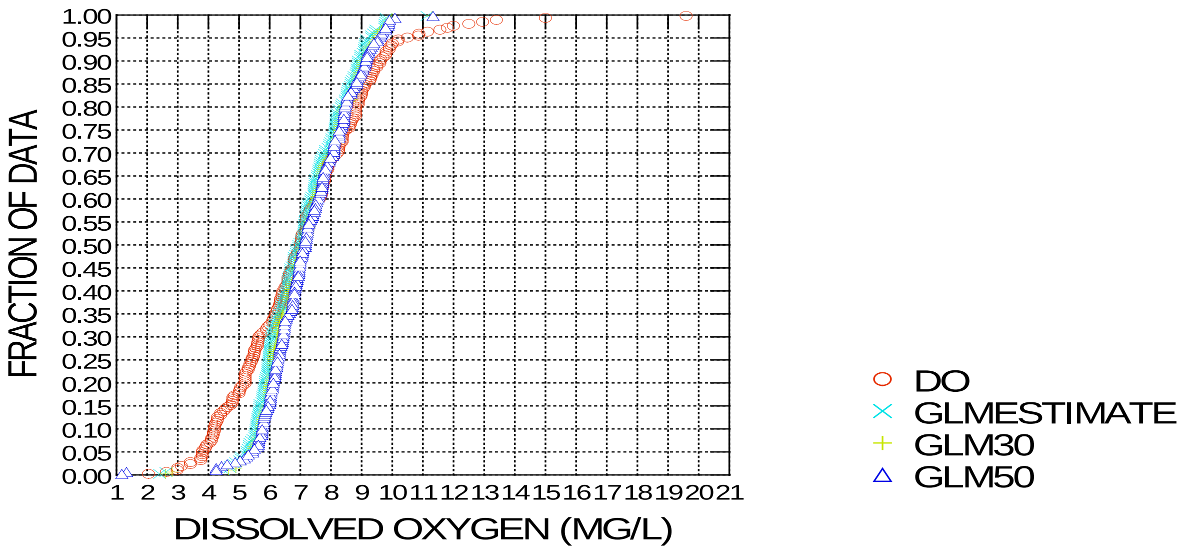
   Reductions were based upon the need to address both the DO and nutrient impairments along with the watershed nitrogen reduction required under the Lower St. Johns River nutrient TMDL.

2. The graphical comparisons of historical DO and Chla with historical values (Figures 5.7 and 5.8) do not include a graph of the case of zero TN reduction computed using the regression equation, so there is no way to see how well the equation predicts DO and Chla using the

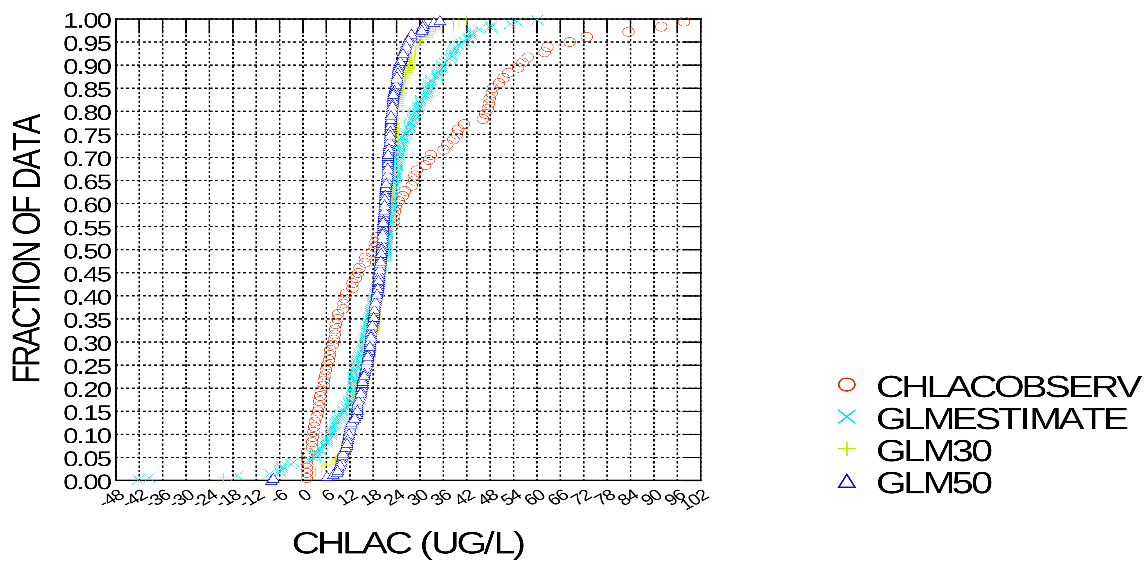
historical values as input. The comparison between actual data and predicted values for the zero reduction condition should be included.

Department Response: The following figures include the GLM predictions for DO and CHLAC under the existing nitrogen concentrations.

CUMULATIVE FREQUENCY PLOT GLM DO



CUMULATIVE FREQUENCY PLOT GLM CHLAC



Note that in the case of CHLAC there were 90 observations versus 238 predictions of CHLAC.

3. The predicted violations of the DO standard in Figure 5.7 appear to be greater for the 50 percent reduction than for the 30 percent reduction in TN indicating a potential problem with the model.

   Department Response: As summarized in the second response, under a 50 percent reduction in TN, 3.38 percent of the predicted DO values would be below 5.0 mg/L versus 2.52 percent under a 30 percent reduction in TN.

Florida Department of Environmental Protection
Division of Environmental Assessment and Restoration
Bureau of Watershed Restoration
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