Proposed

Total Maximum Daily Loads (TMDL)

for

Dissolved Oxygen and Nutrients

In

Ortega River (WBID 2213P1)

and

Cedar River (WBID 2213P2)

March 2013

EPA United States Environmental Protection Agency

Region 4 serving the southeast

TABLE OF CONTENTS

1.0 INTRODUCTION **7**

2.0 PROBLEM DEFINITION **7**

3.0 WATERSHED DESCRIPTION **8**

3.1 CLIMATE 9

3.2 HYDROLOGIC CHARACTERISTICS 9

3.3 LAND USE 9

4.0 WATER QUALITY STANDARDS/TMDL TARGETS **12**

4.1 NUTRIENTS CRITERIA 13

4.1.1 Narrative Nutrient Criteria *13*

4.1.2 Inland Nutrients Criteria *13*

4.2 DISSOLVED OXYGEN CRITERIA 14

4.3 NATURAL CONDITIONS 14

4.4 BIOCHEMICAL OXYGEN DEMAND CRITERIA 15

5.0 WATER QUALITY ASSESSMENT **15**

5.1 WATER QUALITY DATA 15

5.1.1 Dissolved Oxygen *15*

5.1.2 Biochemical Oxygen Demand *16*

5.1.3 Nutrients *16*

6.0 SOURCE AND LOAD ASSESSMENT **23**

6.1 POINT SOURCES 23

6.1.1 Wastewater/Industrial Permitted Facilities *23*

6.1.2 Stormwater Permitted Facilities/MS4s *24*

6.2 NONPOINT SOURCES 25

6.2.1 Urban Areas *25*

6.2.2 Pastures *27*

6.2.3 Clear cut/Sparse *27*

6.2.4 Forests *28*

6.2.5 Water and Wetlands *28*

6.2.6 Quarries/Strip mines *28*

7.0 ANALYTICAL APPROACH **28**

7.1 MECHANISTIC MODELS 29

7.1.1 Loading Simulation Program C++ (LSPC) *29*

7.1.2 Environmental Fluids Dynamic Code (EFDC) *32*

7.1.3 Water Quality Analysis Simulation Program (WASP7) *36*

7.2 SCENARIOS 44

7.2.1 Current Condition 44
7.2.2 Natural Condition 45
8.0 TMDL DETERMINATION 51
8.1 CRITICAL CONDITIONS AND SEASONAL VARIATION 53
8.2 MARGIN OF SAFETY 53
8.3 WASTE LOAD ALLOCATIONS 53
8.3.1 Wastewater/Industrial Permitted Facilities 54
8.3.2 Municipal Separate Storm Sewer System Permits 54
8.4 LOAD ALLOCATIONS 55
9.0 RECOMMENDATIONS/IMPLEMENTATION 55
10.0 REFERENCES 55

LIST OF FIGURES

Figure 2.1 Location of the impaired WBIDs in the Lower St. Johns River Basin. 8
Figure 3.1 Land use surrounding WBIDs 2213P1 and 2213P2 in the Lower St. Johns River Basin. 10
Figure 3.2 Aerial photograph illustrating contributing subwatershed boundaries and WBIDs 2213P1 and 2213P2. 12
Figure 5.1 Water quality monitoring station locations for WBIDs 2213P1 and 2213P2 19
Figure 5.2 Dissolved oxygen concentrations within WBID 2213P1 19
Figure 5.3 Biochemical oxygen demand concentrations within WBID 2213P1 20
Figure 5.4 Total nitrogen concentrations within WBID 2213P1 20
Figure 5.5 Total phosphorus concentrations within WBID 2213P1 21
Figure 5.6 Dissolved oxygen concentrations within WBID 2213P2 21
Figure 5.7 Total nitrogen concentrations within WBID 2213P2 22
Figure 5.8 Total phosphorus concentrations within WBID 2213P2 22
Figure 5.9 Corrected chlorophyll a concentrations within WBID 2213P2 23
Figure 7.1 Location of Cedar River and Ortega River LSPC subwatersheds 30
Figure 7.2 Mean daily flow at USGS 02246300 Ortega River at Jacksonville, FL. 32
Figure 7.3 Flow exceedence at USGS 02246300 Ortega River at Jacksonville, FL. 32
Figure 7.4 LSPC subwatershed boundaries and WASP model grid for the Cedar and Ortega Rivers basin 34
Figure 7.5 Measured verse modeled salinity in Ortega River at station 21FLSJWMIRLUPGC 35
Figure 7.6 Measured verse modeled salinity in Ortega River at station 21FLSJWMIRLUPGC 35
Figure 7.7 Measured verse modeled salinity in Cedar River at station 21FLSJWMIRLUPGC 36

Figure 7.8 Simulated temperature versus measured temperature in Ortega River at station 21FLSJWMIRLUPGC ... 37

Figure 7.9 Simulated temperature versus measured temperature in Ortega River at station 21FLSJWMIRLUPGC ... 38

Figure 7.10 Simulated temperature versus measured temperature in Cedar River at station 21FLSJWMIRLUPGC ... 38

Figure 7.11 Simulated dissolved oxygen versus measured dissolved oxygen in Ortega River at station 21FLSJWMIRLUPGC ... 39

Figure 7.12 Simulated dissolved oxygen versus measured dissolved oxygen in Ortega River at station 21FLSJWMIRLUPGC ... 39

Figure 7.13 Simulated dissolved oxygen versus measured dissolved oxygen in Cedar River at station 21FLSJWMIRLUPGC ... 40

Figure 7.14 Simulated biochemical oxygen demand versus measured biochemical oxygen demand in Ortega River at station 21FLCEN 27010028 ... 40

Figure 7.15 Simulated biochemical oxygen demand versus measured biochemical oxygen demand in Cedar River ... 41

Figure 7.16 Simulated total nitrogen versus measured total nitrogen in Ortega River at station 21FLSJWMIRLUPGC ... 41

Figure 7.17 Simulated total nitrogen versus measured total nitrogen in Cedar River at station 21FLSJWMIRLUPGC ... 42

Figure 7.18 Simulated total phosphorus versus measured total phosphorus in Ortega River at station 21FLSJWMIRLUPGC ... 42

Figure 7.19 Simulated total phosphorus versus measured total phosphorus in Cedar River at station 21FLSJWMIRLUPGC ... 43

Figure 7.20 Simulated chlorophyll-a versus measured chlorophyll-a in Ortega River at station 21FLSJWMIRLUPGC ... 43

Figure 7.21 Simulated chlorophyll-a versus measured chlorophyll-a in Cedar River at station 21FLSJWMIRLUPGC ... 44

Figure 7.22 Natural condition dissolved oxygen in Ortega River ... 46

Figure 7.23 Natural condition dissolved oxygen in Cedar River ... 46

Figure 7.24 Natural condition biochemical oxygen demand in Cedar River ... 47

Figure 7.25 Natural condition total nitrogen in Ortega River ... 47

Figure 7.26 Natural condition total nitrogen in Cedar River ... 48

Figure 7.27 Natural condition total phosphorus in Ortega River ... 48

Figure 7.28 Natural condition total phosphorus in Cedar River ... 49

Figure 7.29 Natural condition chlorophyll a in Ortega River ... 49

Figure 7.30 Natural condition chlorophyll a in Cedar River ... 50

Figure 7.31 Dissolved oxygen concentration cumulative distribution function in Ortega River ... 50

Figure 7.32 Dissolved oxygen concentration cumulative distribution function in Ortega River ... 51

LIST OF TABLES

Table 3.1 Land use distribution for WBIDs 2213P1,2213P2, and their contributing subwatersheds in the Lower St. Johns River basin. 11

Table 4.1 Inland numeric nutrient criteria....... 14

Table 5.1 Water quality monitoring stations located in the impaired WBIDs 17

Table 5.2 Water quality data for the impaired WBIDs 17

Table 6.1 County estimates of Septic Tanks and Repair Permits. 26

Table 6.2 Agricultural Census Data for Commercially and manure fertilized farms in Brevard County, Florida. 27

Table 6.3 Agricultural Census Data for Livestock in Brevard County, Florida....... 27

Table 7.1 Current condition concentrations in the impaired WBIDs 2213P1 and 2213P2....... 44

Table 7.2 Current condition loadings in the impaired WBIDs 2213P1 and 2213P2 45

Table 7.3 Natural condition concentrations in WBIDs 2213P1 and 2213P2....... 51

Table 7.4 Natural condition loadings in WBIDs 2213P1 and 2213P2....... 51

Table 8.1 TMDL Load Allocations for WBID 2231P1. 52

Table 8.2 TMDL Load Allocations for WBID 2231P2. 52

SUMMARY SHEET for WBIDs 2213P1

Total Maximum Daily Load (TMDL)

2006 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
2213P1	Ortega River	Class III Freshwater	Lower St. Johns River	03080103	Duval	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

The TMDL allocations were determined by analyzing the effects of TN, TP, and BOD concentrations and loadings on DO concentrations in the waterbodies. A watershed model was used to predict delivery of pollutant loads to the waterbodies and to evaluate the in-stream impacts of the pollutant loads.

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	229,084	--	68,390	--	70%	70%
Total Phosphorus	--	26,098	--	2,909	--	89%	89%
Biochemical Oxygen Demand	--	270,051	--	57,593	--	79%	79%

Endangered Species Present (Yes or Blank):

USEPA Lead TMDL (USEPA or Blank): USEPA

TMDL Considers Point Source, Non-point Source, or Both: Both

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee(s)	County	Permit Type
FLS000012	City of Jacksonville	Duval	Phase I MS4

SUMMARY SHEET for WBIDs 2213P2

Total Maximum Daily Load (TMDL)

2006 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
2213P2	Cedar River	Class III Freshwater	Lower St. Johns River	03080103	Duval	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

The TMDL allocations were determined by analyzing the effects of TN, TP, and BOD concentrations and loadings on DO concentrations in the waterbodies. A watershed model was used to predict delivery of pollutant loads to the waterbodies and to evaluate the in-stream impacts of the pollutant loads.

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	66,825	--	16,842	--	75%	75%
Total Phosphorus	--	7,720	--	743	--	90%	90%
Biochemical Oxygen Demand	--	96,062	--	17,716	--	82%	82%

Endangered Species Present (Yes or Blank):

USEPA Lead TMDL (USEPA or Blank): USEPA

TMDL Considers Point Source, Non-point Source, or Both: Both

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee(s)	County	Permit Type
FLS000012	City of Jacksonville	Duval	Phase I MS4

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA 1991).

The Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into five groups and water quality is assessed in each group on a rotating five-year cycle. FDEP also established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. The waterbodies addressed in this TMDL report are located in the Lower St. Johns River Basin and are Group 2 waterbodies managed by the St. Johns River Water Management District (SJRWMD).

For the purpose of planning and management, the WMDs divided the district into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. These planning units contain smaller, hydrological based units called drainage basins, which are further divided by FDEP into "water segments". A water segment usually contains only one unique waterbody type (stream, lake, canal, etc.) and is about 5 square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment. The WBIDs in this TMDL report, WBID 2231P1 and 2213P2, Ortega River and Cedar River respectively, both fall under the Ortega River Planning Unit. Both WBIDs are impaired for dissolved oxygen (DO) and nutrients.

2.0 PROBLEM DEFINITION

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (FAC). The IWR is FDEP's methodology for determining whether waters should be included on the state's planning list and verified list. Potential impairments are determined by assessing whether a waterbody meets the criteria for inclusion on the planning list. Once a waterbody is on the planning list, additional data and information will be collected and examined to determine if the water should be included on the verified list.

The TMDLs addressed in this document are being established pursuant to commitments made by the United States Environmental Protection Agency (USEPA) in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action

No. 4: 98CV356-WS, 1998). That Consent Decree established a schedule for TMDL development for waters listed on Florida's USEPA approved 1998 section 303(d) list. The 2006 section 303(d) list identified numerous WBIDs in the Lower St. Johns River Basin as not meeting water quality standards. After assessing all readily available water quality data, USEPA is responsible for developing TMDLs for WBIDs 2213P1 and 2213P2 (Figure 2.1). The parameters addressed for the freshwater segments of Ortega River and Cedar River are DO and nutrients.

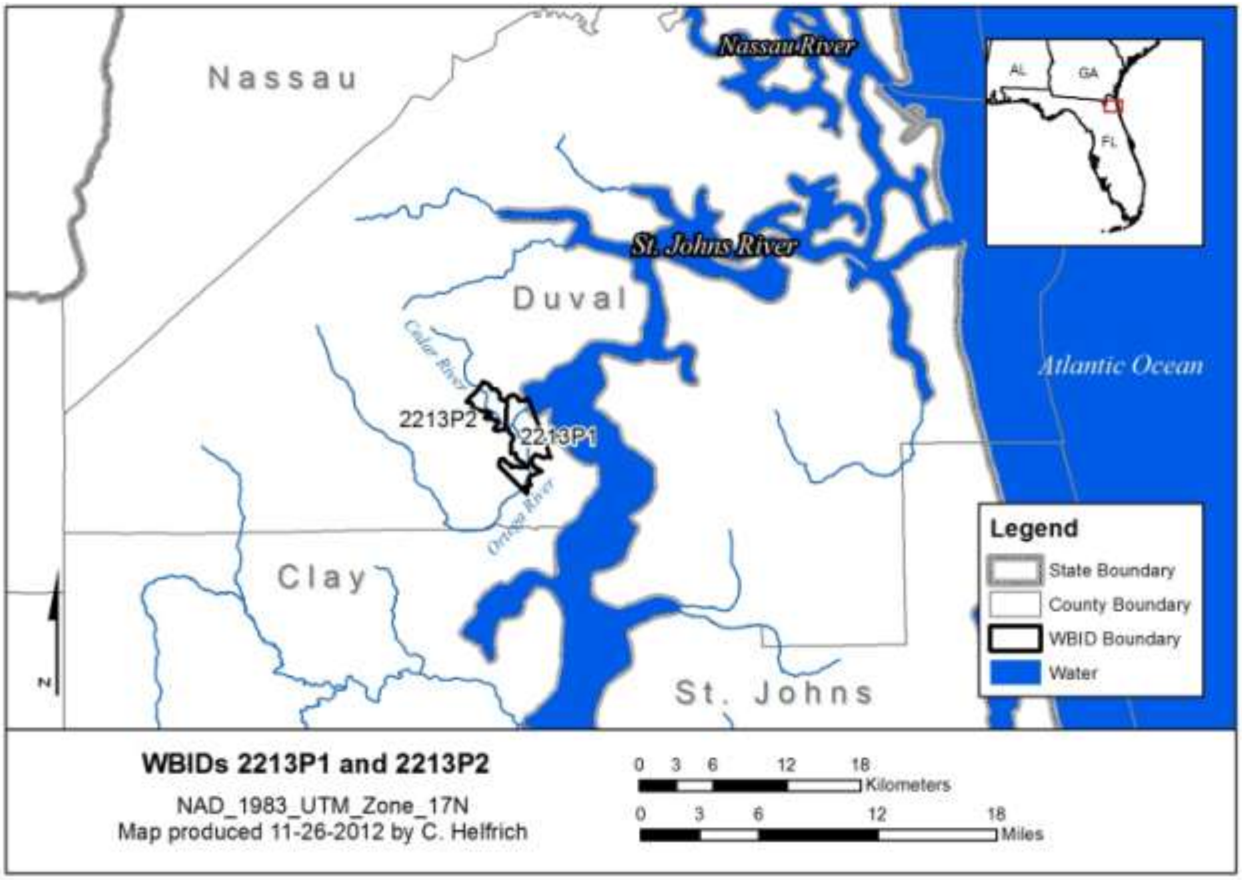

Figure 2.1 Location of the impaired WBIDs in the Lower St. Johns River Basin.

3.0 WATERSHED DESCRIPTION

The Lower St. Johns River Basin (LSJRB) covers an area of 2,646 square miles spanning central to northeast Florida from the confluence of Ocklawaha River in the south to the mouth of St. Johns River in Jacksonville. Counties within or partially included in the basin are Clay, Duval, Flagler, Putnam, St. Johns, and Volusia. The St. Johns River is the longest river in Florida and flows 310 miles in a northerly direction. Other rivers and streams are scattered throughout the LSJRB along with over 500 large and small lakes (FDEP 2006). Three ridge systems border the LSJRB drainage area: the eastern border is defined by the Atlantic Coastal Ridge and the east slopes of the Trail Ridge and Crescent City-Deland Ridge form the western boundary (SJRWMD 1993). Physiographically, hardwood hammock, sandhill, and mixed hardwood pine dominate the upland variety of natural communities, and sand dunes that were once part of ancient shorelines contain scrub habitat. Freshwater wetlands, including hardwood swamp, freshwater marsh, and cypress swamp are prominent systems in the basin. Land that drains to this portion of the St. Johns River is heavily rural, with "urban" use accounting for less than 20%, which is mostly attributed to the metropolitan Jacksonville area. Prominent agricultural commodities in the rural areas are potatoes, cabbage, and timber. Sand and gravel mines operate on the sandy ridges of Clay and Putnam County, while heavy mineral mining occurs on the Trail Ridge along the basin's northwestern boundary (FDEP 2006).

Cedar River and Ortega River are located in south-central Duval County, on the western bank of the St. Johns River, into which they empty. Both WBIDs are considered to be within the southwestern portion of metropolitan Jacksonville.

3.1 Climate

The Lower St. Johns River Basin is located in a transition area between the subtropical climate of southern Florida and the humid continental climate of the southeastern United States (SJRWMD 1993). The average annual temperature in Jacksonville is between 68 and 69 degrees Fahrenheit. The region in which Jacksonville is located experiences a distinct wet season in the summer months, when a measurable amount of rainfall can be expected one day in two. Infrequent heavy rains, coinciding with tropical storms, reach amounts of several inches with durations exceeding 24 hours. Average rainfall during the summer is about 7 inches per month, with average temperatures in the low-80s (°F). Winters are fairly mild due to the southern latitude and proximity to the warm Atlantic Ocean waters. Precipitation during the winter averages 2.85 inches per month, with average temperatures in the high-50's (°F) (NOAA).

3.2 Hydrologic characteristics

Average annual rainfall for the entire LSJRB is approximately 52 inches and elevations range from sea level at the mouth of the St. Johns River to approximately 200 feet on the Trail Ridge (SJRWMD 1993), which makes for a relatively flat basin. Both Cedar River and Ortega River lie in the northern portion of the Lower St. Johns River Basin, on the edge of the Jacksonville city limits in southern Duval County. Cedar River, a second order stream, has a drainage area of about 8.32 square miles and flows south east for 3.6 miles before emptying into Ortega River as its largest tributary (FDEP 2006). Ortega River has a drainage area of approximately 88.6 square miles and flows predominantly northeast, where it converges with Cedar River to flow east for 1.5 miles before discharging into the St. Johns River (FDEP 2009).

3.3 Land Use

Figure 3.1and Table 3.1 represent the land use activity in and surrounding WBIDs 2213P1 and 2213P2. The United States Geological Survey National Hydrography Dataset was used to delineate the drainage area. The majority of the land within the WBID boundaries is developed, and low, medium and high intensity development account for 61 percent of the combined WBID areas. Open water, mostly Cedar River and Ortega River themselves, occupy approximately 18 percent of the WBIDs. Evergreen, deciduous, and mixed forest lands claim a little over five percent of the area, while forested and non-forested wetlands comprise roughly 6.6 and 3.2 percent, respectively. Developed open spaces and golf courses each take up between two and three percent of the WBIDs, and virtually no land is dedicated to pastures or row crops.

The Ortega River contributing watershed includes the Cedar River contributing watershed. Within the Cedar River contributing watershed, 75% of the land use is classified as developed, almost all of which is classified as medium or high intensity development. Only 10 percent of the watershed is classified as wetlands, and 7 percent of the watershed is classified as forested. The remaining area is predominantly distributed between open water and agricultural land uses. Land use in the Ortega River contributing watershed is similar, although only 60 percent of the watershed is classified as developed. A higher percentage of the watershed is classified as wetlands or forests, approximately 14 percent for both classifications.

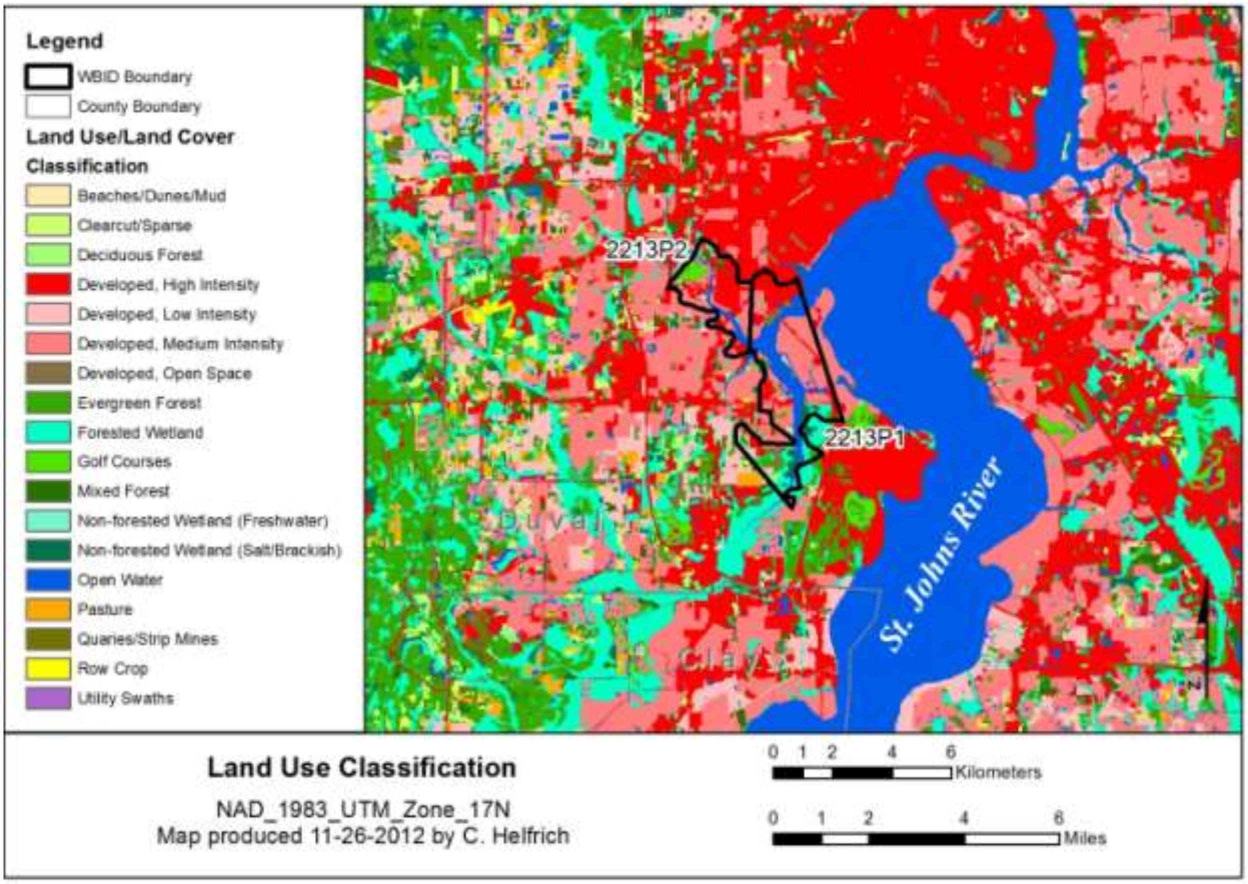

Figure 3.1 Land use surrounding WBIDs 2213P1 and 2213P2 in the Lower St. Johns River Basin

Table 3.1 Land use distribution for WBIDs 2213P1,2213P2, and their contributing subwatersheds in the Lower St. Johns River basin.

Land Use Classification	WBID 2213P1		WBID 2213P2		WBID 2213P1 Contributing Subwatersheds		WBID 2213P2 Contributing Subwatersheds	
	Acres	%	Acres	%	Acres	%	Acres	%
Evergreen Forest	142	4%	5	0%	6920	10%	594	3%
Deciduous Forest	21	1%	0	0%	588	1%	33	0%
Mixed Forest	45	1%	38	3%	1,789	3%	902	4%
Forested Wetland	286	8%	30	2%	9,593	14%	2,069	10%
Non-Forested Wetland (Freshwater)	149	4%	5	0%	161	0%	13	0%
Non-Forested Wetland (Marine)	0	0%	0	0%	246	0%	61	0%
Open Water	735	22%	134	10%	3,084	5%	780	4%
Beaches/Dunes/Mud	0	0%	0	0%	48	0%	5	0%
Pasture	5	0%	0	0%	2,406	3%	322	2%
Row Crop	0	0%	0	0%	455	1%	134	1%
Clearcut/Sparse	15	0%	12	1%	1,606	2%	228	1%
Quaries/Strip Mines	6	0%	0	0%	33	0%	33	0%
Developed, Open Space	96	3%	30	2%	443	1%	248	1%
Developed, Low intensity	126	4%	25	2%	8,036	12%	2,154	11%
Developed, Medium intensity	1,187	35%	458	33%	15,191	23%	6,368	31%
Developed, High intensity	610	18%	528	39%	15,241	23%	6,400	31%
Utility Swaths	0	0%	0	0%	709	1%	82	0%
Golf Courses	0	0%	113	8%	560	1%	134	1%
Totals	3,423	100%	1,378	100%	67,109	100%	20,560	100%

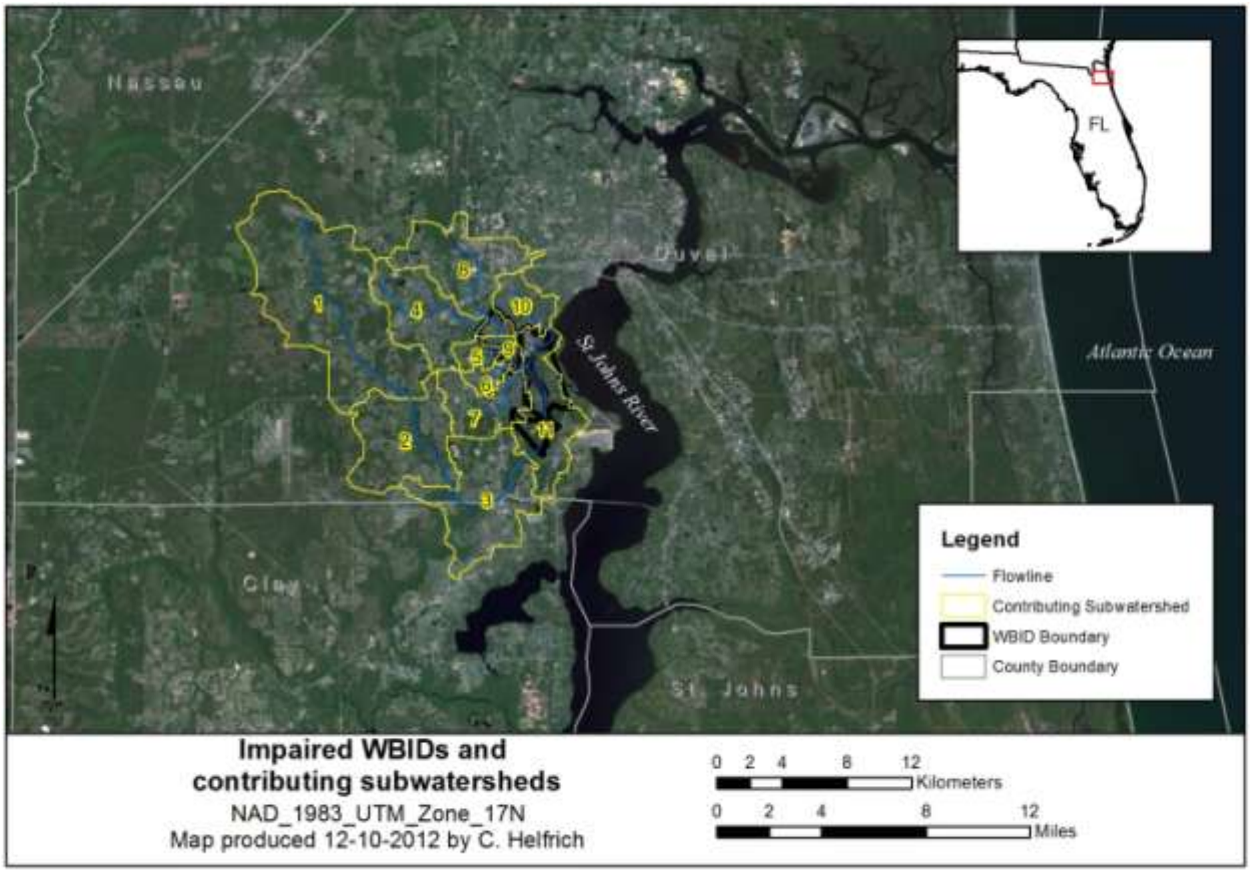

Figure 3.2 Aerial photograph illustrating contributing subwatershed boundaries and WBIDs 2213P1 and 2213P2.

4.0 WATER QUALITY STANDARDS/TMDL TARGETS

The TMDL reduction scenarios will be done to achieve a Florida's dissolved oxygen concentration of 5 mg/L and insure balanced flora and fauna within Cedar River and Ortega River or establish the TMDL to be consistent with a natural condition if the dissolved oxygen standard cannot be achieved.

The waterbodies in the WBIDs 2213P1 and 2213P2 are Class III Freshwater with a designated use of Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife. Designated use classifications are described in Florida's water quality standards. See Section 62-302.400, F.A.C. Water quality criteria for protection of all classes of waters are established in Section 62-302.530, F.A.C. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C., which established minimum criteria that apply to all waters unless alternative criteria are specified. Section 62-302.530, F.A.C. The WBID(s) addressed in this report were listed due to both elevated concentrations of chlorophyll a, dissolved oxygen and/or elevated nitrogen and phosphorus concentrations. While FDEP does not have a streams water quality standard specifically for chlorophyll a, elevated levels of chlorophyll a are frequently associated with a violation of the narrative nutrient standard, which is described below.

4.1 Nutrients Criteria

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. In 1979, FDEP adopted a narrative criterion for nutrients. FDEP recently adopted numeric nutrient criteria (NNC) for many Class III waters in the state, including streams, which numerically interprets part of the state narrative criterion for nutrients. FDEP submitted its NNC to EPA for review pursuant to section 303(c) of the CWA. On November 30, 2012, EPA approved those criteria as consistent with the requirements of the CWA. The state criteria, however, are not yet effective for state law purposes.

Also, in November 2010, EPA promulgated numeric nutrient criteria for Class III inland waters in Florida, including streams. On February 18, 2012, the streams criteria were remanded back to EPA by the U.S. District Court for the Northern District of Florida for further explanation. On November 30, 2012, EPA re-proposed its stream NNC for those flowing waters not covered by Florida's NNC rule.

Therefore, for streams in Florida, the applicable nutrient water quality standard for CWA purposes remains the Class III narrative criterion.

4.1.1 Narrative Nutrient Criteria

Florida's narrative nutrient criteria provide:

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242. Section 62-302.530(48)(a), F.A.C.

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. Section 62-302.530(48)(b), F.A.C.

Chlorophyll and DO levels are often used to indicate whether nutrients are present in excessive amounts. The target for this TMDL is based on levels of nutrients necessary to prevent violations of Florida's DO criterion, set out below.

4.1.2 Inland Nutrients Criteria

While not yet effective as water quality criteria, the FDEP's numeric nutrient criteria represent the state's most recent interpretation of the second part of Florida's narrative criteria, set out at paragraph 62-302.530(47)(b), F.A.C. See section 62-302.531(2). The first part of the narrative criteria, at paragraph 62-302.530(47)(a), F.A.C., also remains applicable to streams in Florida.

Florida's interpretation of its narrative nutrient criteria applies to streams, including (2213P1 and 2213P2). For streams that do not have a site specific criteria, the interpretation provides for biological information to be considered together with nutrient thresholds to determine whether a waterbody is attaining See paragraph 62-302.531(2)(c), F.A.C. The rule provides that the nutrient criteria are attained in a stream segment where information on chlorophyll a levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora and either the average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or the nutrient thresholds set forth in Table 4.1 below are achieved. See paragraph 62-302.531(2)(c).

Florida's interpretation provides that nutrient levels should be expressed as a geometric mean, and concentrations are not to be exceeded more than once in any three calendar year period. Section 62-302.200 (25)(e), F.A.C.

Table 4.1 Inland numeric nutrient criteria

Nutrient Watershed Region	Total Phosphorus Nutrient Threshold	Total Nitrogen Nutrient Threshold
Panhandle West	0.06 mg/L	0.67 mg/L
Panhandle East	0.18 mg/L	1.03 mg/L
North Central	0.30 mg/L	1.87 mg/L
Peninsular	0.12 mg/L	1.54 mg/L
West Central	0.49 mg/L	1.65 mg/L
South Florida	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.

4.2 Dissolved Oxygen Criteria

FDEP has conducted a study to support development of revised DO criteria for freshwaters. These revisions have not yet been adopted by the state, or submitted to EPA for review, and therefore, the applicable criterion is the one referenced above. Should any new or revised criteria for DO in Florida streams become applicable for CWA purposes, this waterbody may be re-assessed and the TMDL may be revised.

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. Section 62-302(30), F.A.C., sets out the water quality criterion for the protection of Class III freshwater waters as:

Shall not be less than 5.0 mg/l. Normal daily and seasonal fluctuations above these levels shall be maintained.

4.3 Natural Conditions

In addition to the standards for nutrients, DO and BOD described above, Florida’s standards include provisions that address waterbodies which do not meet the standards due to natural background conditions.

Florida’s water quality standards provide a definition of natural background:

“Natural Background” shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data. 62-302.200(15), FAC.

Florida's water quality standards also provide that:

Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions. 62-302.300(15) FAC

4.4 Biochemical Oxygen Demand Criteria

Biochemical Oxygen Demand (BOD) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions. [FAC 62-302.530 (11)]

The waterbody addressed in this report is a Class III water having a designated use of Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife. Designated use classifications are described in Florida's water quality standards in Section 62-302.400, FAC. Water quality criteria for protection of all classes of waters are established in Section 62-302.530, FAC. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 FAC, which established minimum criteria that apply to all waters unless alternative criteria are specified Section 62-302.530, FAC. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. The specific criteria addressed in this TMDL document are provided in the following sections.

5.0 WATER QUALITY ASSESSMENT

WBID 2213P1 and WBID 2213P2 are listed as not attaining their designated use on Florida's 1998 303(d) list for DO, fecal coliforms, and nutrients. To determine impairment, an assessment of available data was conducted. The source for current ambient monitoring data was the Impaired Waters Rule (IWR) data Run 44, using data ranging January 1, 2002 to December 31, 2009. The IWR database contains data from various sources within the state of Florida, including the WMDs and counties.

5.1 Water Quality Data

A complete list of water quality monitoring stations in WBIDs 2213P1 and 2213P2 is listed in Table 5.1, and an analysis of water quality data is documented in Table 5.2. Figure 5.1illustrates where the water quality monitoring stations are located within the WBIDs. Figure 5.2 through Figure 5.9 graphically display data from water quality monitoring stations in both WBIDs.

5.1.1 Dissolved Oxygen

There are several factors that affect the concentration of DO in a waterbody. Oxygen can be introduced by wind, diffusion, photosynthesis, and additions of higher DO water (e.g. from tributaries). DO concentrations are lowered by processes that use up oxygen from the water, such as respiration and decomposition, and by additions of water with lower DO (e.g. swamp or groundwater). Natural DO levels are a function of water temperature, water depth and velocity, and relative contributions of groundwater. Decomposition of organic matter, such as dead plants and animals, also consume DO. Dissolved oxygen minimum concentrations were below 2 mg/L. Mean DO concentration in WBID 2213P1 was 5.61 mg/L and ranged from a minimum of 1.30 mg/L to a maximum of 11.60 mg/L. WBID 2213P2 had a mean DO concentration of 5.90 mg/L with concentrations ranging from 1.73 mg/L to 12.40 mg/L.

5.1.2 Biochemical Oxygen Demand

Biochemical oxygen demand is a measure of the amount of oxygen used by bacteria as they stabilize organic matter. The process can be accelerated when there is an overabundance of nutrients, increasing the aerobic bacterial activity in a waterbody. In turn, the levels of DO can become depleted, eliminating oxygen essential for biotic survival, and potentially causing extensive fish kills. Additionally, BOD is used as an indicator to determine the presence and magnitude of organic pollution from sources such as septic tank leakage, fertilizer runoff, and wastewater effluent. Very few BOD measurements were taken in both WBIDs during the modeling timeframe. Only two BOD water quality measurements were collected in WBID 2213P1, both of which were 2 mg/L, and not BOD water quality measurements were collected in 2213P2.

5.1.3 Nutrients

Excessive nutrients in a waterbody can lead to overgrowth of algae and other aquatic plants such as phytoplankton, periphyton and macrophytes. This process can deplete oxygen in the water, adversely affecting aquatic life and potentially restricting recreational uses such as fishing and boating. For the nutrient assessment the monitoring data for total nitrogen, total phosphorus and chlorophyll a are presented. Narrative nutrient criteria are used as the standards for estuarine water bodies, while numeric standards have been developed for freshwater water bodies. The purpose of the nutrient assessment is to present the range, variability and average conditions for each WBID.

5.1.3.1 Total Nitrogen

Total nitrogen (TN) is comprised of nitrate (NO3), nitrite (NO2), organic nitrogen and ammonia nitrogen (NH4). Although nitrogen is a necessary nutrient required for the growth of most plants and animals, not all forms are readily used or metabolized. Increased levels of organic nitrogen can be caused from the decomposition of detritus and sewage, while increased levels in inorganic nitrogen can be cause by erosion and fertilizers. Nitrates, which natural occur in the soil, are components of industrial fertilizers, and are converted to nitrite by microorganisms in the environment. Surface runoff from agricultural lands can increase the natural presence of nitrates in the environment and can lead to eutrophication. Usually, the eutrophication process is observed as a change in the structure of the algal community and includes severe algal blooms that may cover large areas for extended periods. Large algal blooms are generally followed by depletion in DO concentrations as a result of algal decomposition. WBID 2213P1 has two total nitrogen measurements: 0.57 mg/L and 0.80 mg/L, resulting in a mean concentration of 0.69 mg/L. WBID 2213P2 total nitrogen concentration measurements ranged from 0.46 mg/L to 1.59 mg/L, with a mean concentration of 1.12 mg/L.

5.1.3.2 Total Phosphorus

In natural waters, total phosphorus exists in either soluble or particulate forms. Dissolved phosphorus includes inorganic and organic forms, while particulate phosphorus is made up of living and dead plankton, and its adsorbed, amorphous, and precipitated forms. Inorganic forms of phosphorus include orthophosphate and polyphosphates, although polyphosphates are unstable and convert to orthophosphate over time. Orthophosphate is both stable and reactive, making it the form most used by plants. Excessive phosphorus can lead to overgrowth of algae and aquatic plants, the decomposition of which depletes oxygen in the water. Only two measurements were available for WBID 2213P1 resulting in concentrations of 0.13 mg/L and 0.84 mg/L, with an average of 0.48 mg/L. Total phosphorus concentrations in WBID 2213P2 reached a low of 0.01 mg/L, and a maximum of 0.30 mg/L. The mean concentration WBID 2213P2 was 0.16 mg/L.

5.1.3.3 Chlorophyll-a

Chlorophyll is the green pigment in plants that allows them to create energy from light. In a water sample, chlorophyll is indicative of the presence of algae, and chlorophyll-*a* is a measure of the active portion of total chlorophyll. Corrected chlorophyll refers to chlorophyll-*a* measurements that are corrected for the presence of pheophytin, a natural degradation product of chlorophyll that can interfere with analysis because it has an absorption peak in the same spectral region. It is used as a proxy indicator of water quality because of its predictable response to nutrient availability. Increases in nutrients can potentially lead to blooms in phytoplankton biomass, affecting water quality and ecosystem health. No chlorophyll measurements were available for WBID 2213P1. In WBID 2213P2, the corrected chlorophyll-*a* minimum and maximum measurements were 1.00 mg/L and 97.72 mg/L, respectively, with a mean concentration of 20.05 mg/L.

Table 5.1 Water quality monitoring stations located in the impaired WBIDs

WBID	Station Number
223P1	21FLWQA 301400308142424
	21FLA 20030079
	21FLA 20030077
	21FLJXWQJAXSJR25
2213P2	21FLA 20030083
	21FLSJWM20030083
	21FLWQA 301626708144062
	21FLWQA 301653708144252
	21FLJXWQCR85
	21FLA 20030876

Table 5.2 Water quality data for the impaired WBIDs

Parameter	Stats	WBID 2213P1	WBID 2213P2

Parameter	Stats	WBID 2213P1	WBID 2213P2
BOD, 5 Day, 20°C (mg/L)	# of obs	2	0
	min	2	
	max	2	
	mean	2	
	Geomean	2.000	
DO, Analysis by Probe (mg/L)	# of obs	32	152
	min	1.30	1.73
	max	11.60	12.40
	mean	5.61	5.90
	Geomean	5.07	5.53
Nitrogen, Total (mg/L as N)	# of obs	2	44
	min	0.57	0.46
	max	0.80	1.58
	mean	0.68	1.12
	Geomean	0.68	1.09
Phosphorus, Total (mg/L as P)	# of obs	2	43
	min	0.13	0.01
	max	0.84	0.30
	mean	0.48	0.160
	Geomean	0.32	0.14
Chlorophyll-A-corrected (µg/L)	# of obs	0	42
	min		1.00
	max		97.72
	mean		20.05
	Geomean		12.43

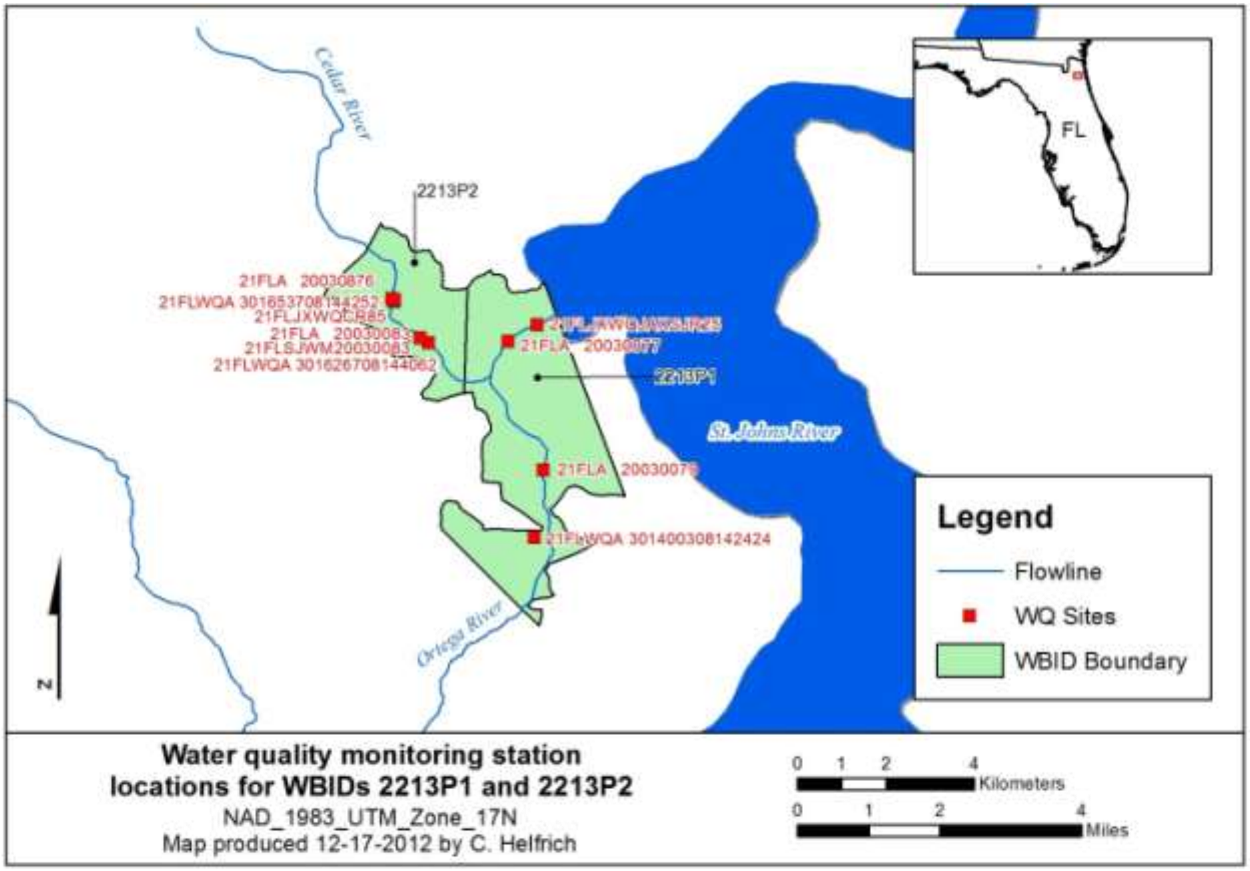

Figure 5.1 Water quality monitoring station locations for WBIDs 2213P1 and 2213P2

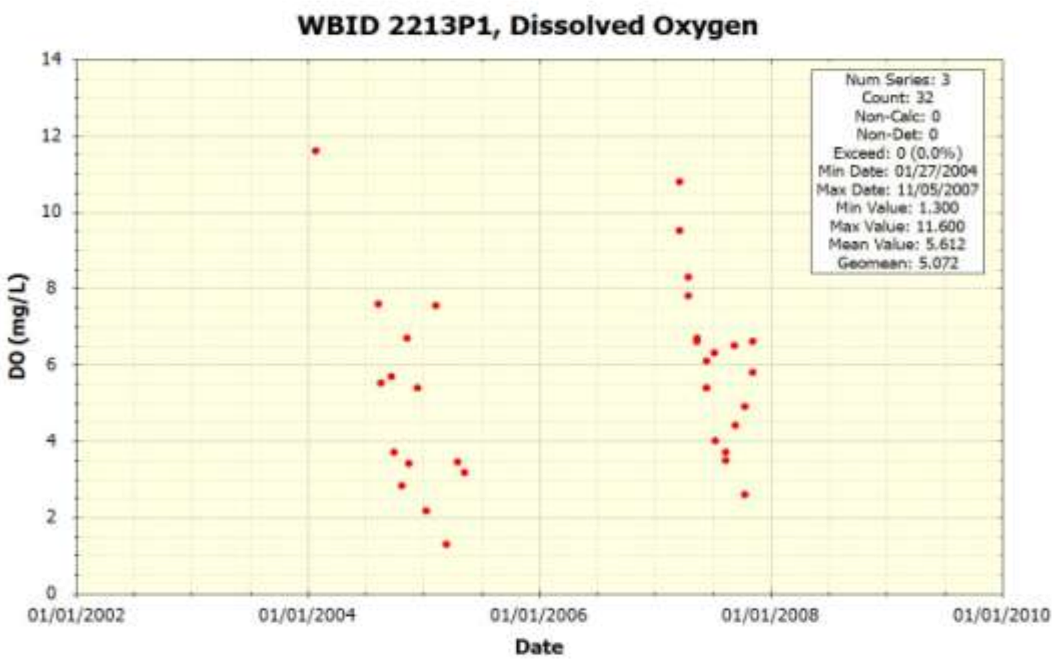

Figure 5.2 Dissolved oxygen concentrations within WBID 2213P1

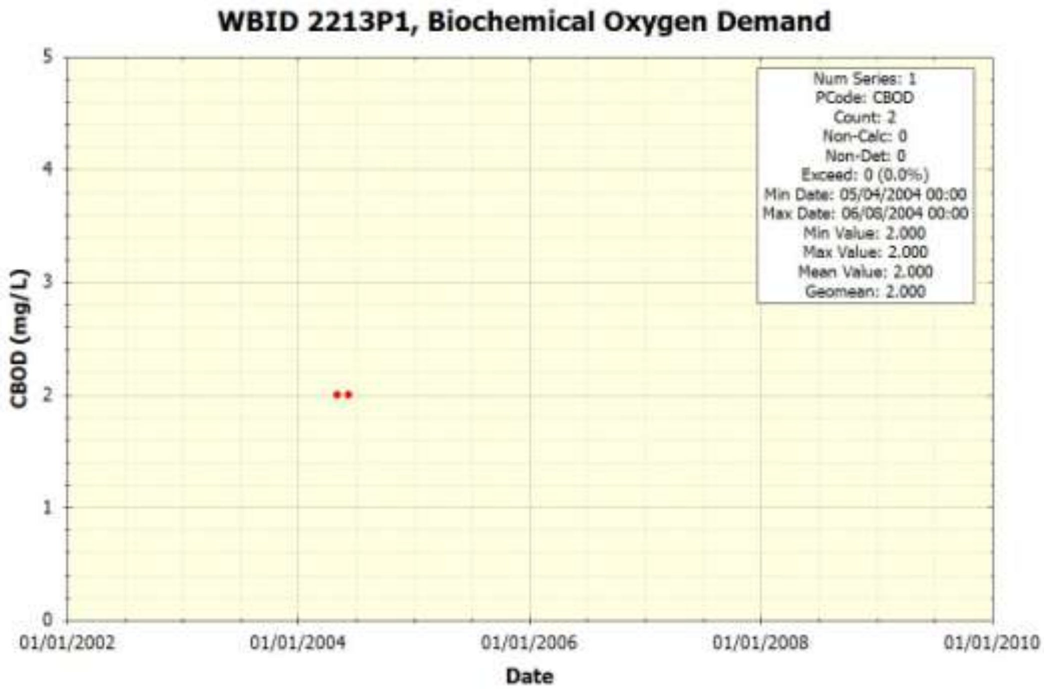

Figure 5.3 Biochemical oxygen demand concentrations within WBID 2213P1

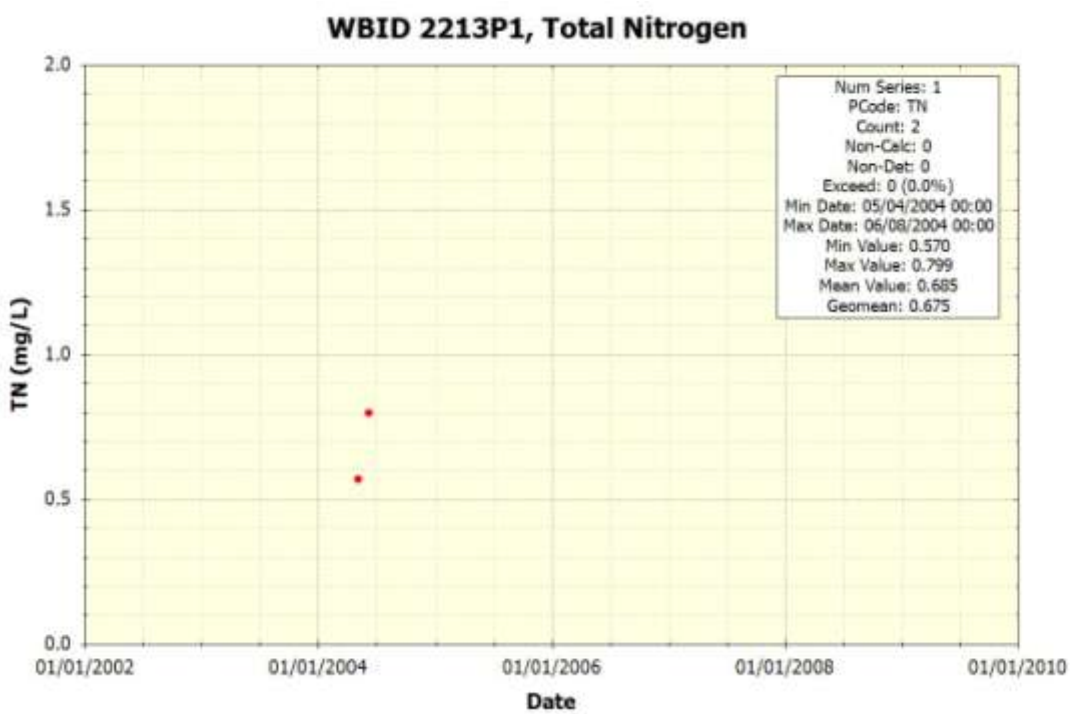

Figure 5.4 Total nitrogen concentrations within WBID 2213P1

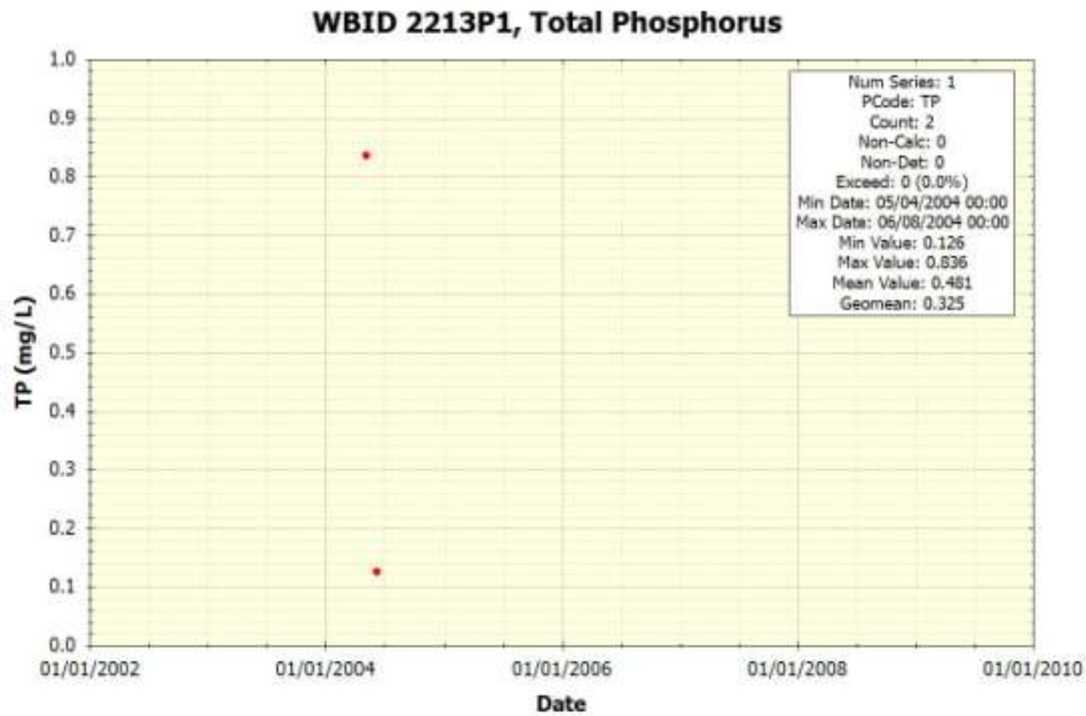

Figure 5.5 Total phosphorus concentrations within WBID 2213P1

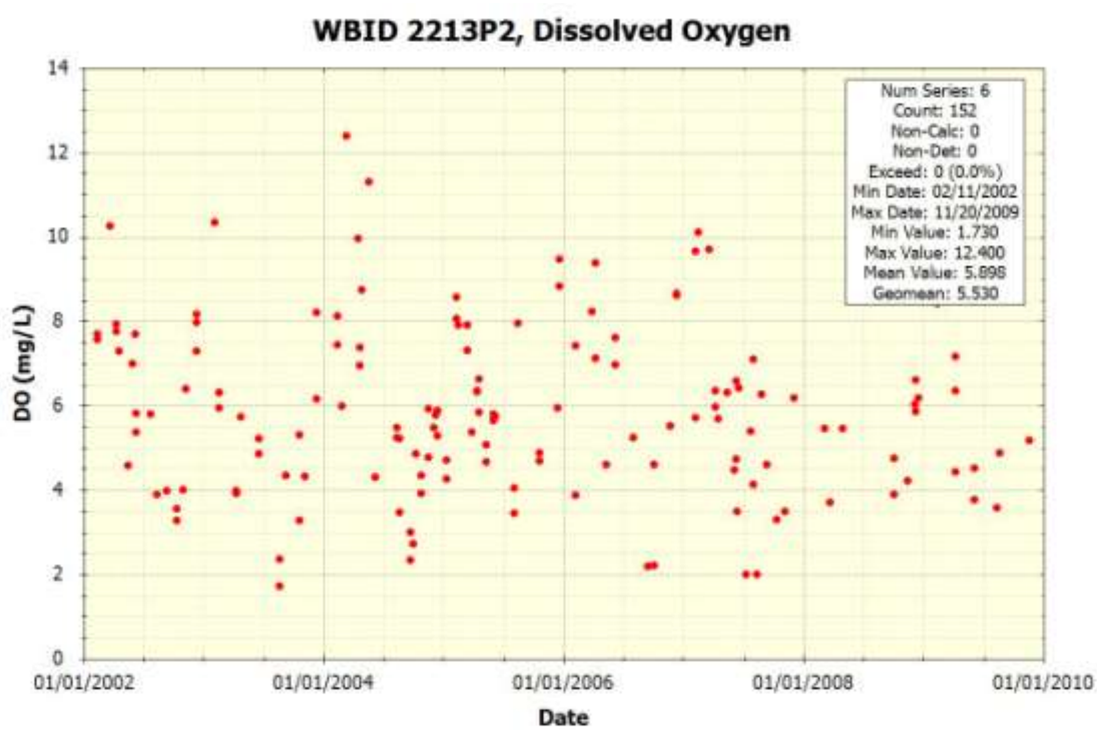

Figure 5.6 Dissolved oxygen concentrations within WBID 2213P2

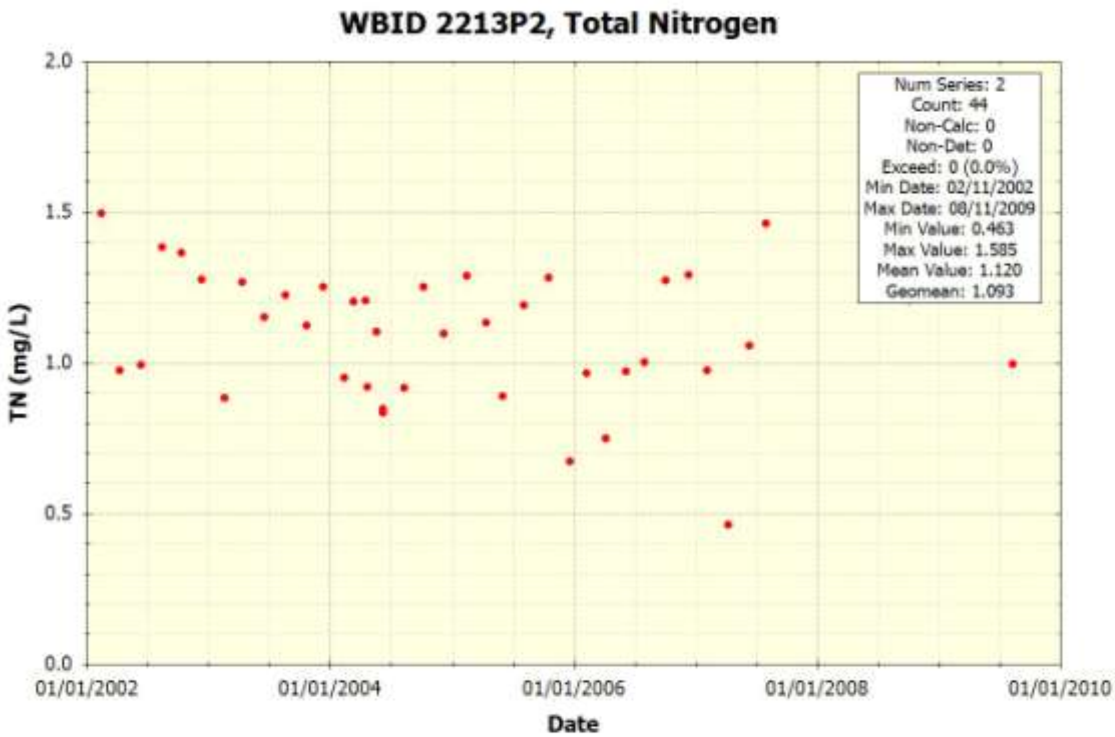

Figure 5.7 Total nitrogen concentrations within WBID 2213P2

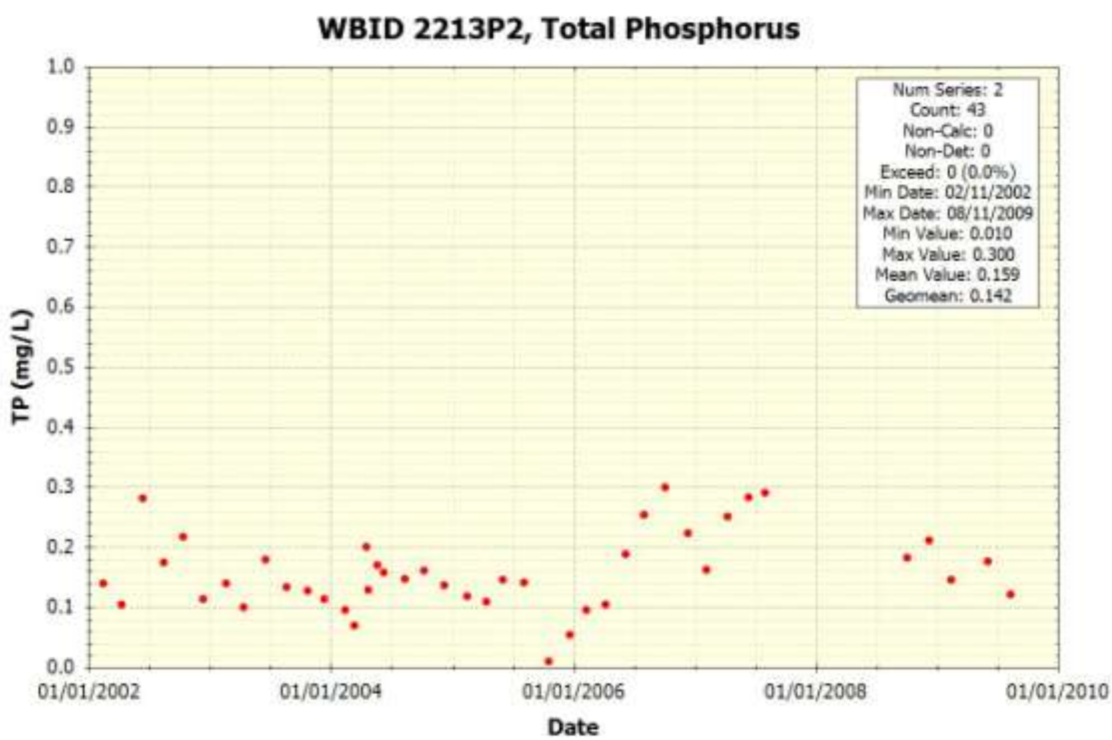

Figure 5.8 Total phosphorus concentrations within WBID 2213P2

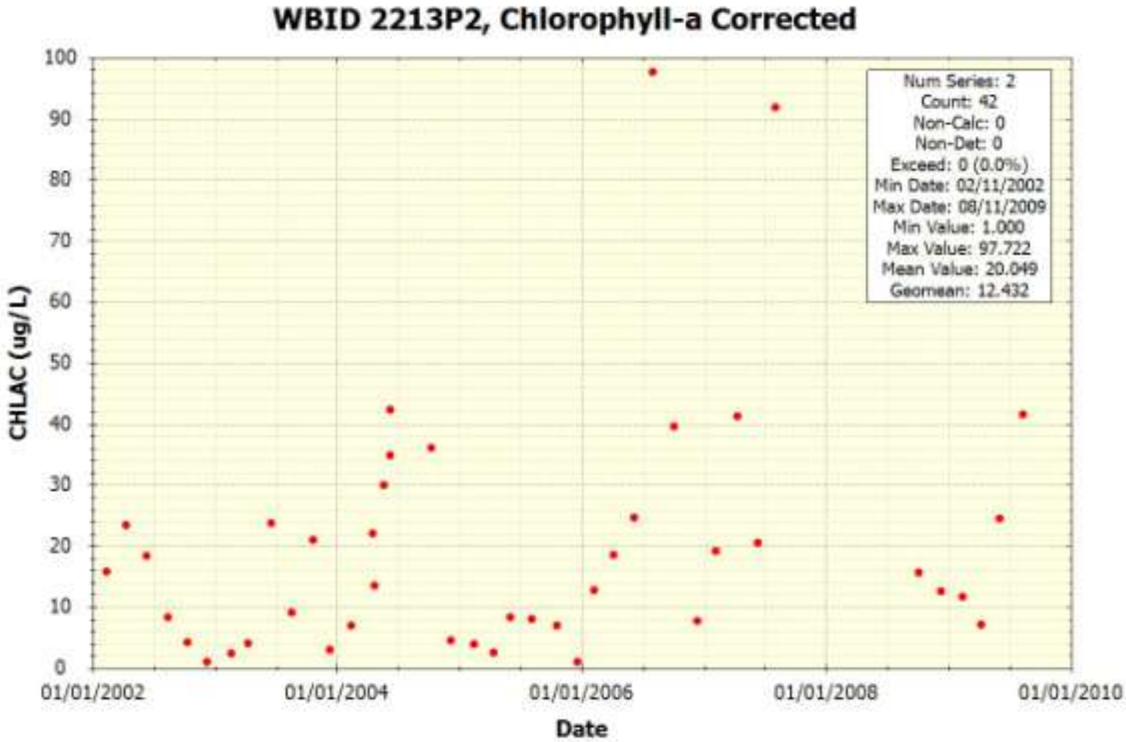

Figure 5.9 Corrected chlorophyll a concentrations within WBID 2213P2

6.0 SOURCE AND LOAD ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of loading contributed by each of these sources. Sources are broadly classified as either point or nonpoint sources. Nutrients can enter surface waters from both point and nonpoint sources.

6.1 Point Sources

A point source is defined as a discernible, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted discharges include continuous discharges such as wastewater treatment facilities as well as some stormwater driven sources such as municipal separate stormwater sewer systems (MS4s), certain industrial facilities, and construction sites over one acre.

6.1.1 Wastewater/Industrial Permitted Facilities

A TMDL wasteload allocation (WLA) is given to wastewater and industrial NPDES permitted facilities discharging to surface waters within an impaired watershed. The only wastewater/inustrial permit within the WBIDs in this report is permitted in Duval County; Facility Number FLG912023, a petroleum cleanup general permit belonging to Advanced Auto AC & Heating. No discharge data was associated with the permit.

6.1.2 Stormwater Permitted Facilities/MS4s

MS4s are point sources also regulated by the NPDES program. According to 40 CFR 122.26(b)(8), an MS4 is "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States.

(ii) Designed or used for collecting or conveying storm water;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works

MS4s may discharge nutrients and other pollutants to waterbodies in response to storm events. In 1990, USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged from the MS4 into local waterbodies. Phase I of the program required operators of "medium" and "large" MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges from MS4s. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality related issues including roadway runoff management, municipal owned operations, hazardous waste treatment, etc.

Phase II of the rule extends coverage of the NPDES stormwater program to certain "small" MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES stormwater program. Only a select subset of small MS4s, referred to as "regulated small MS4s", requires an NPDES stormwater permit. Regulated small MS4s are defined as all small MS4s located in "urbanized areas" as defined by the Bureau of the Census, and those small MS4s located outside of "urbanized areas" that are designated by NPDES permitting authorities.

In October 2000, USEPA authorized FDEP to implement the NPDES stormwater program in all areas of Florida except Indian tribal lands. FDEP's authority to administer the NPDES program is set forth in Section 403.0885, Florida Statutes (FS). The three major components of NPDES stormwater regulations are:

- MS4 permits that are issued to entities that own and operate master stormwater systems, primarily local governments. Permittees are required to implement comprehensive stormwater management programs designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable.
- Stormwater associated with industrial activities, which is regulated primarily by a multisector general permit that covers various types of industrial facilities. Regulated

industrial facilities must obtain NPDES stormwater permit coverage and implement appropriate pollution prevention techniques to reduce contamination of stormwater.

- Construction activity general permits for projects that ultimately disturb one or more acres of land and which require the implementation of stormwater pollution prevention plans to provide for erosion and sediment control during construction.

Stormwater discharges conveyed through the storm sewer system covered by the permit are subject to the WLA of the TMDL. Any newly designated MS4s will also be required to achieve the percent reduction allocation presented in this TMDL.

Both WBIDs covered in this TMDL report, 2213P1 and 2213P2, fall under a single permit ID: FLS000012, the Phase I-C MS4 permit held by the City of Jacksonville in Duval County.

6.2 Nonpoint Sources

Nonpoint sources of pollution are diffuse sources that cannot be identified as entering a waterbody waterbody through a discrete conveyance at a single location. For nutrients, these sources include runoff include runoff of agricultural fields, golf courses, and lawns, septic tanks, and residential developments developments outside of MS4 areas. Nonpoint source pollution generally involves a buildup of pollutants pollutants on the land surface that wash off during rain events and as such, represent contributions from contributions from diffuse sources, rather than from a defined outlet. Potential nonpoint sources are are commonly identified, and their loads estimated, based on land cover data. Most methods calculate calculate nonpoint source loadings as the product of the water quality concentration and runoff water water volume associated with certain land use practices. The mean concentration of pollutants in the the runoff from a storm event is known as the event mean concentration. In order to identify possible possible pollutant sources in the watershed, the land use coverage was reviewed. Figure 3.2 provides a map of the land use in draining to the WBIDs, while Figure 3.2 Aerial photograph illustrating contributing subwatershed boundaries and WBIDs 2213P1 and 2213P2.

lists the land use distribution for the drainage area of the WBIDs. The following sections are organized by land use. Each section provides a description of the land use, the typical sources of nutrient loading (if applicable), and typical total nitrogen and total phosphorus event mean concentrations.

6.2.1 Urban Areas

Urban areas include land uses such as residential, industrial, extractive and commercial. Land uses in this category typically have somewhat high total nitrogen event mean concentrations and average total phosphorus event mean concentrations. Nutrient loading from MS4 and non-MS4 urban areas is attributable to multiple sources including stormwater runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

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 outlined in Chapter 403 FS, was established as a technology-based program that relies upon the implementation of Best Management Practices (BMPs) that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, FAC.

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water." [FAC 62-40-.432(2)(c)]

Nonstructural and structural BMPs are an integral part of the State's stormwater programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of nonpoint source pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimization of impervious surfaces. Technology-based structural BMPs are used to mitigate the increased stormwater peak discharge rate, volume, and pollutant loadings that accompany urbanization.

Urban, residential, and commercial developments are likely a contributing nonpoint source of nutrients and oxygen-demanding substances. A majority of the land use in both WBIDs is attributed to developed areas, including a substantial amount impervious, high intensity development. In the Lower St. Johns River basin, the majority of the total developed land use is located along the St. Johns River in and around Jacksonville. Nearly 12 percent of the contributing land use to WBIDs 2213P1 and 2213P2 is low intensity development. Medium and high intensity development each account for over 23 percent of the contributing subwatershed land area.

Onsite Sewage Treatment and Disposal Systems (Septic Tanks)

As stated above leaking septic tanks or onsite sewage treatment and disposal systems (OSTDs) can contribute to nutrient loading in urban areas. Water from OSTDs is typically released to the ground through on-site, subsurface drain fields or boreholes that allow the water from the tank to percolate (usually into the surficial aquifers) and either transpire to the atmosphere through surface vegetation or add to the flow of shallow ground water. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD receives natural biological treatment in the soil and is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrients, pathogens, and other pollutants to both ground water and surface water.

The State of Florida Department of Health publishes data on new septic tank installations and the number of septic tank repair permits issued for each county in Florida. Table 6.1 summarizes the cumulative number of septic systems installed in Duval County since the 1970 census and the total number of repair permits issued for the ten years between 1999-2000 and 2009-2010 (FDOH 2009). The data do not reflect septic tanks removed from service. Leaking septic systems could be a relevant source of organic and nutrient loading in the watershed.

Table 6.1 County estimates of Septic Tanks and Repair Permits.

County	Number of Septic Tanks (1970-2010)	Number of Repair Permits Issued (2000-2010)
Duval	91,440	3,369

Note: Source: http://www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm

6.2.2 Pastures

Pastures include cropland and improved and unimproved pasturelands, such as non-tilled grasses woodland pastures, feeding operations, nurseries and vineyards; as well as specialty farms. Agricultural activities, including runoff of fertilizers or animal wastes from pasture and cropland and direct animal access to streams, can generate nutrient loading to streams. The highest total nitrogen and total phosphorus event mean concentrations are associated with agricultural land uses.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA NASS 2007). According to the 2007 Census of Agriculture, the number of farms within Duval County was 371. The vast amount of farm acreage was being fertilized in Duval County with commercial fertilizer, lime and soil conditioners at 3,408 acres (Table 6.2); with substantially fewer farms fertilizing with manure. Livestock counts of cattle and pigs are provided in Table 6.3. Due to agricultural census data being collected at the county level, the extent to which these values pertain to agricultural fields within the impaired watershed is not specific.

Land use data and aerial coverage of the area show that the WBIDs also have approximately 2,406 acres of pasture land in their contributing subwatersheds, or three percent of the total area, while one percent is in row crop land uses. Pastures are a likely source of nutrient loading in the contributing watersheds due to the use of fertilizers and animal waste.

Table 6.2 Agricultural Census Data for Commercially and manure fertilized farms in Brevard County, Florida.

County	Commercial		Manure	
	Number of Farms	Number of Acres	Number of Farms	Number of Acres
Duval	138	3,408	22	548

Table 6.3 Agricultural Census Data for Livestock in Brevard County, Florida.

County	Livestock	Number of Farms	Number of Animals
Duval	Cattles and Calves	208	5,457
	Hogs and Pigs	18	108

Note: 1. A farm is defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.

6.2.3 Clear cut/Sparse

The clear cut/sparse land use classification includes recent clear cuts, areas of sparse vegetation or herbaceous dry prairie, shrub and brushland, other early successional areas, and mixed rangeland. Event mean concentrations for clear cut/sparse can be relatively low for total nitrogen and low for total phosphorus. Roughly one percent of the impaired WBIDs' area is comprised of clear cut/sparse land usage. The WBIDs' entire contributing subwatershed area contains approximately two percent of clear cut/sparse land.

6.2.4 Forests

Upland forests include flatwoods, oak, various types of hardwoods, conifers and tree plantations. Wildlife, located within forested areas, deposit their feces onto land surfaces where it can be transported to nearby streams during storm events. Generally, the pollutant load from wildlife is assumed to represent background concentrations. Event mean concentrations for upland forests are low for both total nitrogen and total phosphorus. Forests comprise only five percent of the combined WBID area, while 14 percent of the land in the contributing watersheds is forested. The majority of the forested land is attributed to evergreen and mixed forests adjacent to low intensity development and wetlands.

6.2.5 Water and Wetlands

Wetlands, along with forests, are parts of the ecosystem that can naturally provide services such as stormwater runoff control and water purification. Water and wetlands often have very low nutrient loadings, although decaying organic matter in wetlands can contribute to high organic nutrient concentrations. Wetland land area accounts for just over 14 percent of the Cedar River and Ortega River subwatersheds. Most of the wetland lands are classified as forested westlands,. Roughly five percent of the contributing subwatershed land use is classified as open water.

6.2.6 Quarries/Strip mines

The quarries/strip mines land use classification includes quarries, strip mines, exposed rock and soil, fill areas, reclaimed lands, and holding ponds. These types of land cover are virtually nonexistent in the impaired WBIDs' drainage area.

7.0 ANALYTICAL APPROACH

In the development of a TMDL there needs to be a method for relating current loadings to the observed water quality problem. This relationship could be statistical (regression for a cause and effect relationship), empirical (based on observations not necessarily from the waterbody in question) or mechanistic (physically and/or stochastically based) that inherently relate cause and effect using physical and biological relationships.

Mechanistic models were used in the development of the Cedar and Ortega River TMDLs to relate the physical and biological relationships. A dynamic watershed model was used to predict the quantity of water and pollutants associated with runoff from rain events. The watershed model was linked to a hydrodynamic model that simulated tidal influences in the river. Both models were linked to a water quality simulation model that integrated the loadings and flow from the watershed model with flow from the hydrodynamic model to predict the water quality in the receiving waterbodies.

The period of simulation that was considered in the development of this TMDL is January 1, 2002 to December 31, 2009. The models were used to predict time series for BOD, TN, TP, and DO. The models were calibrated to current conditions and were then used to predict improvements in water quality as function of reductions in loadings.

7.1 Mechanistic Models

7.1.1 Loading Simulation Program C++ (LSPC)

LSPC is the Loading Simulation Program in C++, a watershed modeling system that includes streamlined Hydrologic Simulation Program Fortran (HSPF) algorithms for simulating hydrology, sediment, and general water quality overland as well as a simplified stream fate and transport model. LSPC is derived from the Mining Data Analysis System (MDAS), which was originally developed by USEPA Region 3 (under contract with Tetra Tech) and has been widely used for TMDLs. In 2003, the USEPA Region 4 contracted with Tetra Tech to refine, streamline, and produce user documentation for the model for public distribution. LSPC was developed to serve as the primary watershed model for the USEPA TMDL Modeling Toolbox. LSPC was used to simulate runoff (flow, biological oxygen demand, total nitrogen, total phosphorus and dissolved oxygen) from the land surface using a daily timestep for current and natural conditions. LSPC provided tributary flows and temperature to the EFDC estuary models and tributary water quality concentrations to WASP7 estuary models.

An LSPC model was utilized to estimate the nutrient loads within and discharged from the Cedar and Ortega River watersheds. The LSPC model utilized the data inputs, including land use and weather data, from the larger St. Johns Watershed model that was used in initial development in the Florida Numeric Nutrient Criteria.

In order to evaluate the contributing sources to a waterbody and to represent the spatial variability of these sources within the watershed model, the contributing drainage area was represented by a series of sub-watersheds for each of the models. The sub-watersheds for the St. Johns River Watershed model were developed using the 12-digit hydrologic unit code (HUC12) watershed data layer and the Geological Survey (USGS) National Hydrograph Dataset (NHD). The sub-watersheds were re-delineated at a smaller scale for the Cedar and Ortega River Watershed model, once again using the NHD catchments as well as the USGS National Elevation Dataset Digital Elevation Model (Figure 7.1).

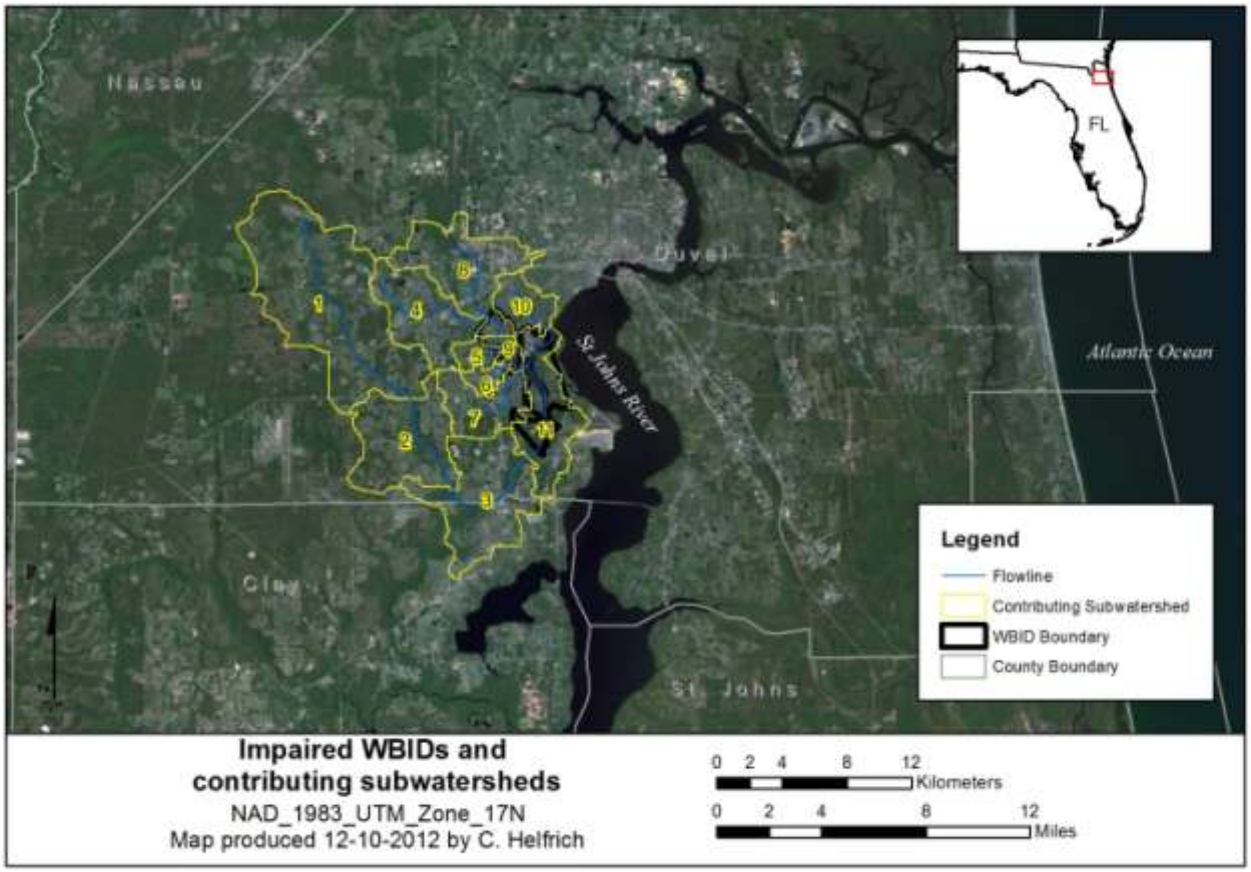

Figure 7.1 Location of Cedar River and Ortega River LSPC subwatersheds

The LSPC model has a representative reach defined for each sub-watershed, and the main channel stem within each sub-watershed was used as the representative reach. The characteristics for each reach include the length and slope of the reach, the channel geometry and the connectivity between the sub-watersheds. Length and slope data for each reach was obtained using the USGS DEM and NHD data.

The attributes supplied for each reach were used to develop a function table (FTABLE) that describes the hydrology of the stream reach by defining the functional relationship between water depth, surface area, water volume, and outflow in the segment. The assumption of a fixed depth, area, volume, outflow relationship rules out cases where the flow reverses direction or where one reach influences another upstream of it in a time-dependent way. LSPC does not model the tidal flow in the low-lying estuaries, and therefore the main St. Johns River Watershed model was calibrated to non-tidally influenced USGS gages. The Cedar and Ortega River Watershed model was linked to the EFDC and WASP models to simulate the areas of the estuary that were tidally influenced.

The watershed model uses land use data as the basis for representing hydrology and nonpoint source loadings. The FDEP Level III Florida Land Use, specifically the St. Johns Water Management District (SJWMD) 2006 dataset, was used to determine the land use representation. The National Landuse Coverage Dataset (NLCD) was used to develop the impervious land use representations.

The SJWMD coverage utilized a variety of land use classes which were grouped and re-classified into 18 land use categories: beaches/dune/mud, open water, utility swaths, developed open space, developed low intensity, developed medium intensity, developed high intensity, clear-cut/sparse, quarries/strip mines, deciduous forest, evergreen forest, mixed forest, golf courses, pasture, row crop, forested wetland, non-forested wetland (salt/brackish), and non-forested wetland (freshwater). The LSPC model requires division of land uses in each sub-watershed into separate pervious and impervious land units. The NLCD 2006 percent impervious coverage was used to determine the percent impervious area associated with each land use category. Any impervious areas associated with utility swaths, developed open space, and developed low intensity, were grouped together and placed into a new land use category named *low intensity development impervious*. Impervious areas associated with medium intensity development and high intensity development were kept separate and placed into two new categories for *medium intensity development impervious* and *high intensity development impervious*, respectively. Finally, any impervious area not already accounted for in the three developed impervious categories, were grouped together into a fourth new category for all remaining impervious land use.

Soil data for the Florida watersheds was obtained from the Soil Survey Geographic Database (SSURGO). The database was produced and distributed by the Natural Resources Conservation Service (NRCS) - National Cartography and Geospatial Center (NCGC). The SSURGO data was used to determine the total area that each hydrologic soil group covered within each sub-watershed. The sub-watersheds were represented by the hydrologic soil group that had the highest percentage of coverage within the boundaries of the sub-watershed. There were four hydrologic soil groups which varied in their infiltrations rates and water storage capacity.

In the watershed models, nonpoint source loadings and hydrological conditions are dependent on weather conditions. Hourly data from weather stations within the boundaries of, or in close proximity to, the sub-watersheds were applied to the watershed model. A weather data forcing file was generated in ASCII format (*.air) for each meteorological station used in the hydrological evaluations in LSPC. Each meteorological station file contained atmospheric data used in modeling the hydrological processes. These data included precipitation, air temperature, dew point temperature, wind speed, cloud cover, evaporation, and solar radiation. These data are used directly, or calculated from the observed data. The St. Johns River Watershed model weather stations contained data through 2009.

The hydrodynamic calibration parameters from the larger St. Johns River Watershed model were used to populate the Cedar and Ortega River watershed model. The St. Johns River Watershed model was calibrated to continuous flow USGS gages, including gage 02246300 Ortega River at Jacksonville, FL (Figure 7.2 and Figure 7.3). Additional information on the calibration of the St. Johns River Watershed can be found in Appendix A. The water quality parameters used measured event mean concentration values. Final water quality calibration can be found in Section 7.1.3.

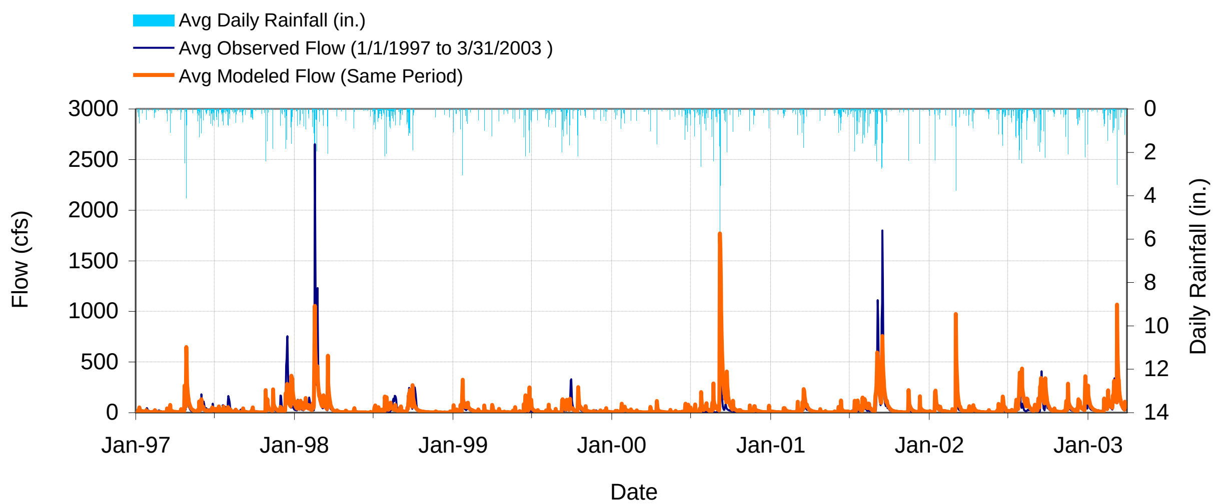

Figure 7.2 Mean daily flow at USGS 02246300 Ortega River at Jacksonville, FL.

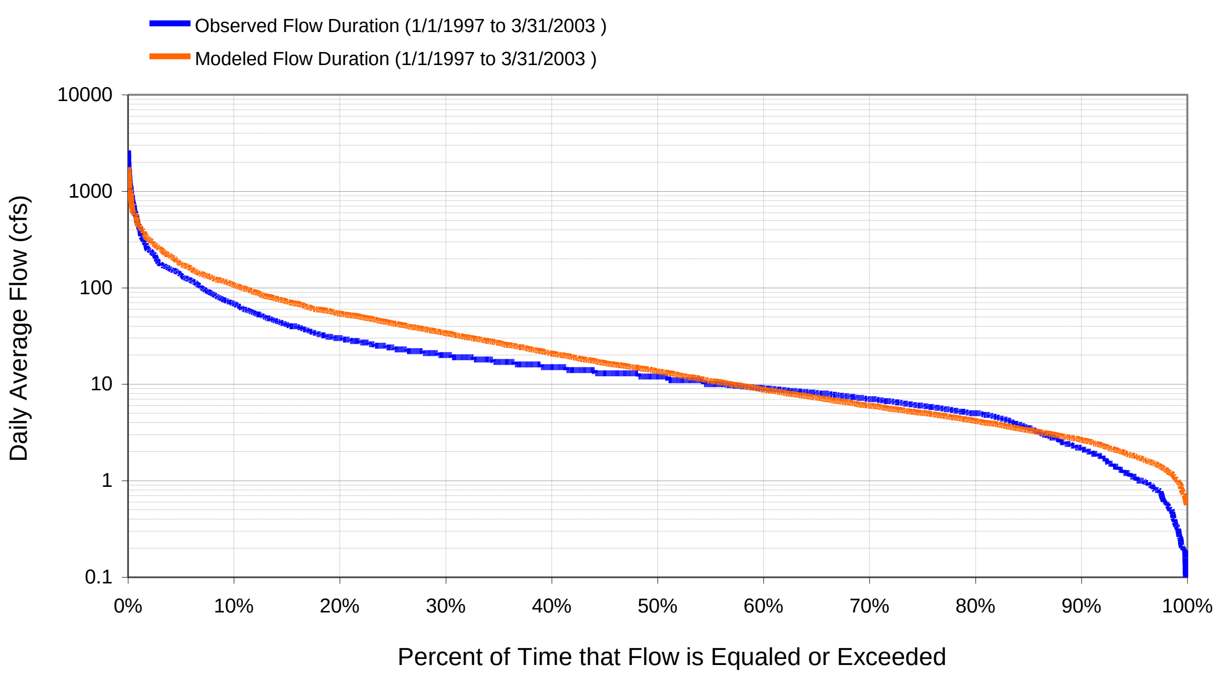

Figure 7.3 Flow exceedence at USGS 02246300 Ortega River at Jacksonville, FL.

7.1.2 Environmental Fluids Dynamic Code (EFDC)

The EFDC model is a part of the USEPA TMDL Modeling Toolbox due to its application in many TMDL-type projects. As such, the code has been peer reviewed and tested and has been freely distributed and supported by Tetra Tech. EFDC was developed by Dr. John Hamrick (Hamrick 1992) and is currently supported by Tetra Tech for USEPA Office of Research and Development (ORD), USEPA Region 4, and USEPA Headquarters. The models, tools, and databases in the TMDL Modeling Toolbox are continually updated and upgraded through TMDL development in Region 4. EFDC is a multifunctional, surface-water modeling system, which includes hydrodynamic, sediment contaminant, and eutrophication components. The EFDC model is capable of 1, 2, and 3-dimensional spatial resolution. The model employs a curvilinear-orthogonal horizontal grid and a sigma or terrain following vertical grid.

The EFDC hydrodynamic model can run independently of a water quality model. The EFDC model simulates the hydrodynamic and constituent transport and then writes a hydrodynamic linkage file for a water quality model such as the Water Quality Analysis Program (WASP7) model. This model linkage, from EFDC hydrodynamics to WASP water quality, has been applied on many USEPA Region 4 projects in support of TMDLs and has been well tested (Wool et al. 2003).

The EFDC model was utilized to simulate three-dimensional circulation dynamics of hydrodynamic state variables (water surface elevation, salinity, and temperature) in the Cedar and Ortega Rivers. The EFDC model predicts water surface elevation, salinity, and temperature, in response to a set of multiple factors: wind speed and direction, freshwater discharge, tidal water level fluctuation, rainfall, surface heat flux, and temperature and salinity associated with boundary fluxes. Solar short wave radiation was calculated using the CE-Qual-W2 method.

The Cedar and Ortega Rivers model used hourly water surface elevation time series data from the National Oceanic and Atmospheric Administration (NOAA) tidal stations to simulate tides at the open boundary. Observed temperature data at water quality stations were used to simulate the temperature at the open boundaries, and average salinity in the St. Johns River was used to simulate salinity. The upstream inland boundary grid cell received LSPC simulated watershed discharges. The Cedar and Ortega EFDC grid was developed using bathymetry data from NOAA.

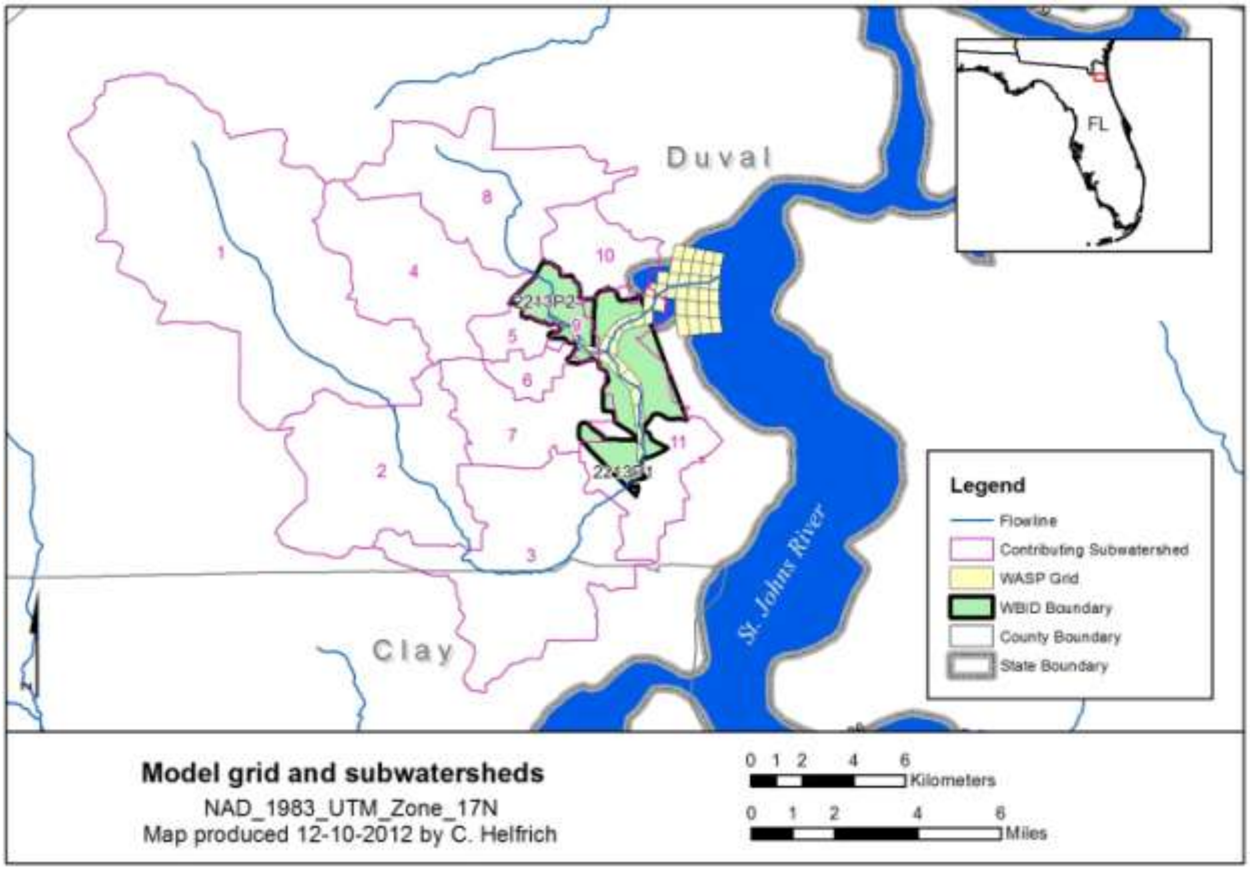

Figure 7.4 LSPC subwatershed boundaries and WASP model grid for the Cedar and Ortega Rivers basin

Because there were no NOAA tidal stations located within the Cedar and Ortega Rivers, water surface elevation within the modeled cells could not be directly calibrated. Salinity measurements from IWR44 data were used to review the Cedar and Ortega Rivers EFDC calibration. Following model review, the salinity and temperature parameters were adjusted accordingly (Figure 7.5 through Figure 7.7).

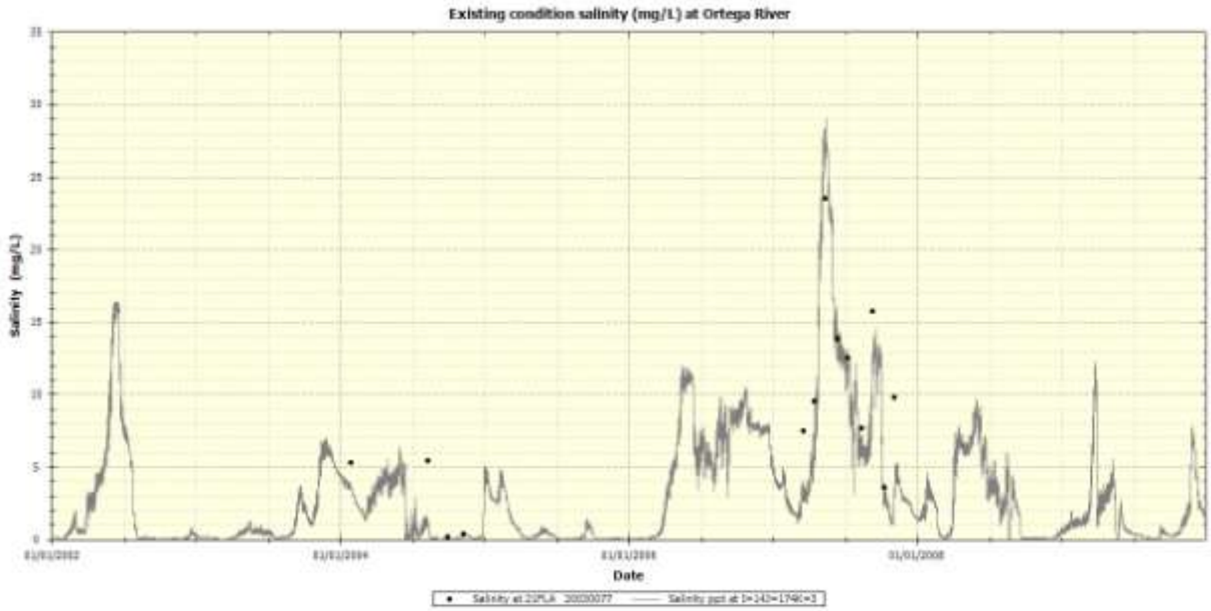

Figure 7.5 Measured verse modeled salinity in Ortega River at station 21FLSJWMIRLUPGC

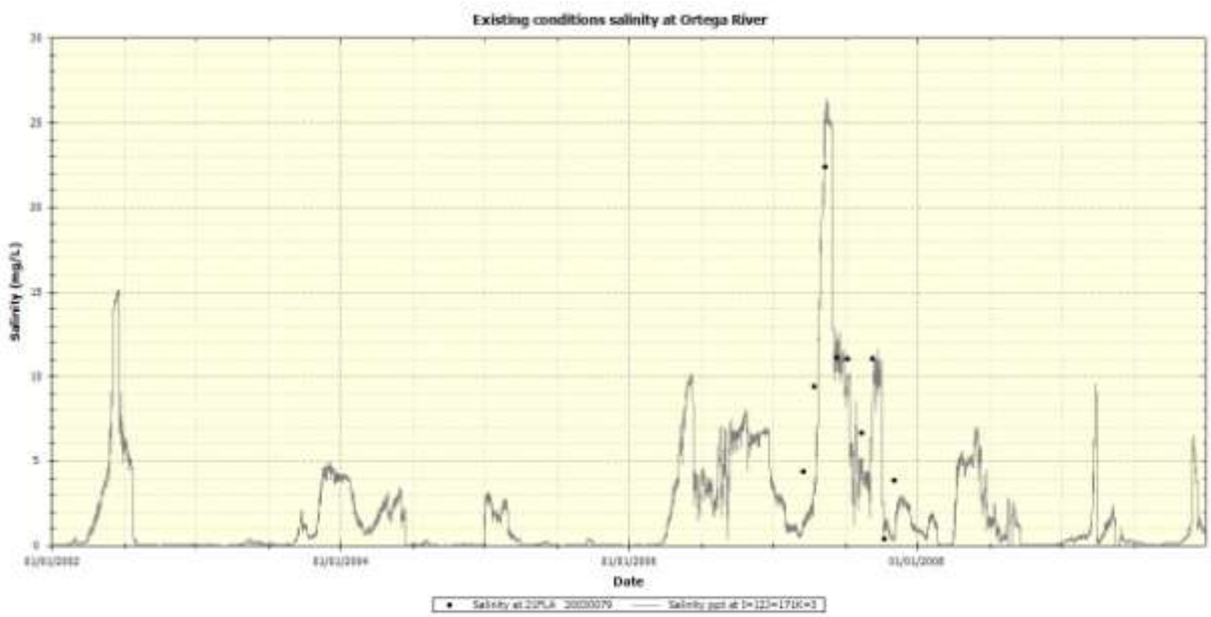

Figure 7.6 Measured verse modeled salinity in Ortega River at station 21FLSJWMIRLUPGC

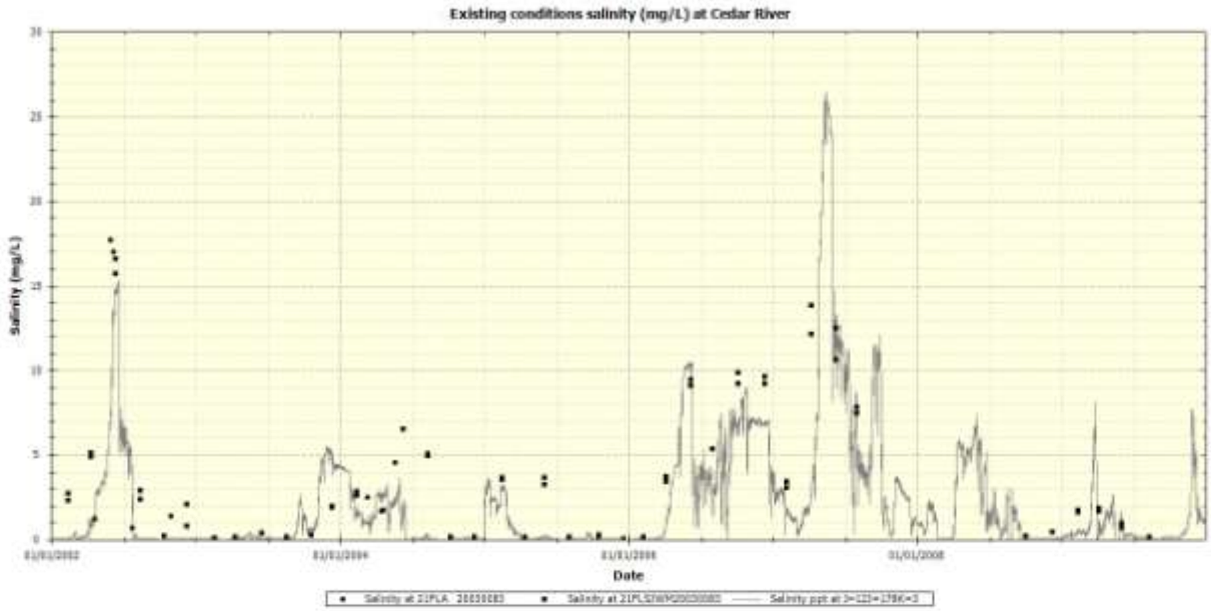

Figure 7.7 Measured verse modeled salinity in Cedar River at station 21FLSJWMIRLUPGC

7.1.3 Water Quality Analysis Simulation Program (WASP7)

The Water Quality Analysis Simulation Program Version 7.4.1 (WASP7) is an enhanced Windows version of the USEPA Water Quality Analysis Simulation Program (WASP) (Di Toro et al., 1983; Connolly and Winfield, 1984; Ambrose, R.B. et al., 1988), with upgrades to the user's interface and the model's capabilities. The major upgrades to WASP have been the addition of multiple BOD components, addition of sediment diagenesis routines, and addition of periphyton routines. The hydrodynamic file generated by EFDC is compatible with WASP7 and it transfers segment volumes, velocities, temperature and salinity, as well as flows between segments. The time step is set in WASP7 based on the hydrodynamic simulation.

WASP7 helps users interpret and predict water quality responses to natural phenomena and man-made pollution for various pollution management decisions. WASP7 is a dynamic compartment-modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading and boundary exchange are represented in the basic program. The purpose of the WASP7 water quality modeling was to reproduce the three-dimensional transport and chemical and biological interactions of major components of water quality in Cedar River and Ortega River. WASP7 modeled total nitrogen (TN) and its speciation, total phosphorus (TP) and its speciation, chlorophyll-a, dissolved oxygen, and carbonaceous biochemical oxygen demand (CBOD). The model predicts these parameters in response to a set of hydrological, meteorological, atmospheric, and chemical and biological factors: loads from point and nonpoint sources, benthic ammonia and phosphate fluxes, sediment oxygen demand (SOD), solar radiation, air temperature, reaeration, offshore and inland boundary conditions.

The Cedar and Ortega Rivers WASP7 model utilized the same grid cells that were developed for the EFDC model. The hydrodynamic simulation from the EFDC model was input into the WASP7 model. Open boundary water quality conditions used measured water quality data from

St. Johns River. Water quality loading from the LSPC model was used to simulate loads coming from rivers and streams into the estuary.

Because the LPSC model simulated TN, TP, and BOD and the WASP model simulated TN and its speciation, TP and its speciation, and CBOD, the water quality concentrations from LSPC were adjusted for WASP simulation prior to being input into the WASP model. TN was speciated into nitrate-nitrite (NOX), ammonia (NH4), and organic nitrogen (ON), and TP was speciated into orthophosphate (PO4) and organic phosphorus (OP). Water quality data in the Cedar and Ortega Rivers watersheds was reviewed to determine the ratio of NOX, NH4, and ON in TN, and the ration of PO4 and OP in TP. The in-stream BOD loads from LSPC were converted to ultimate CBOD using an f-ratio of 1.5.

Water quality parameters from the Ortega & Cedar Creek TMDL model were used for initial parameter population for the Cedar and Ortega WASP7 model. The Cedar and Ortega Rivers model calibration was reviewed against water quality data located in IWR44. Following review, the calibration was adjusted accordingly to provide the best existing scenario model calibration for the water quality parameters of concern. Results at select water quality stations are below, in Figure 7.8 through Figure 7.21.

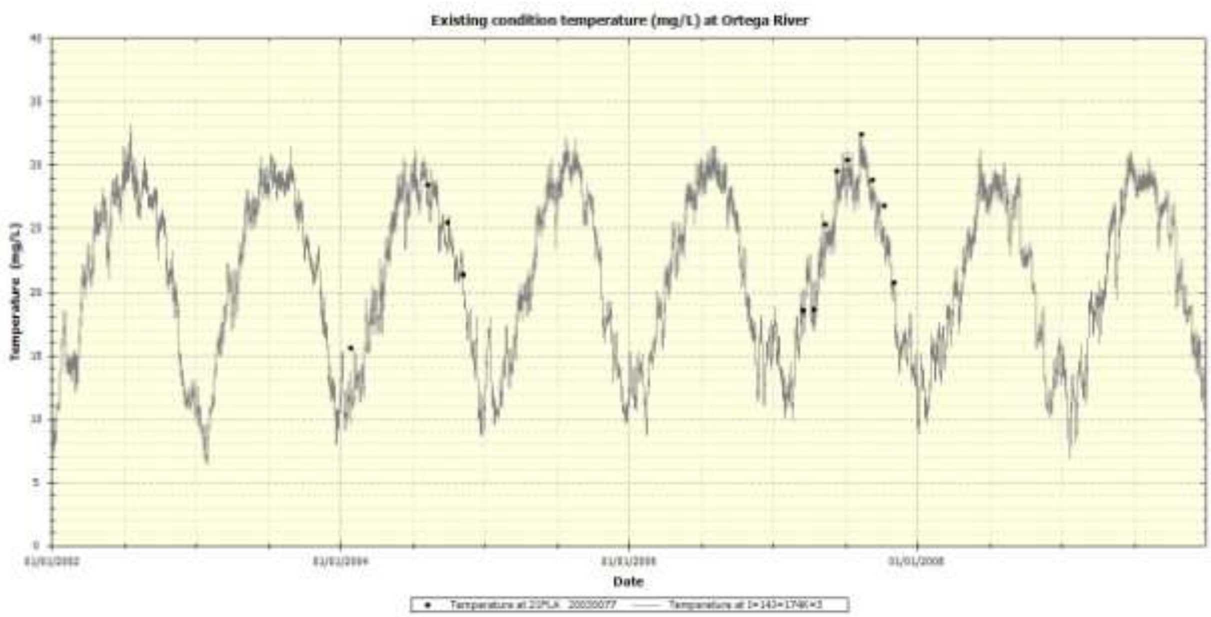

Figure 7.8 Simulated temperature versus measured temperature in Ortega River at station 21FLSJWMIRLUPGC

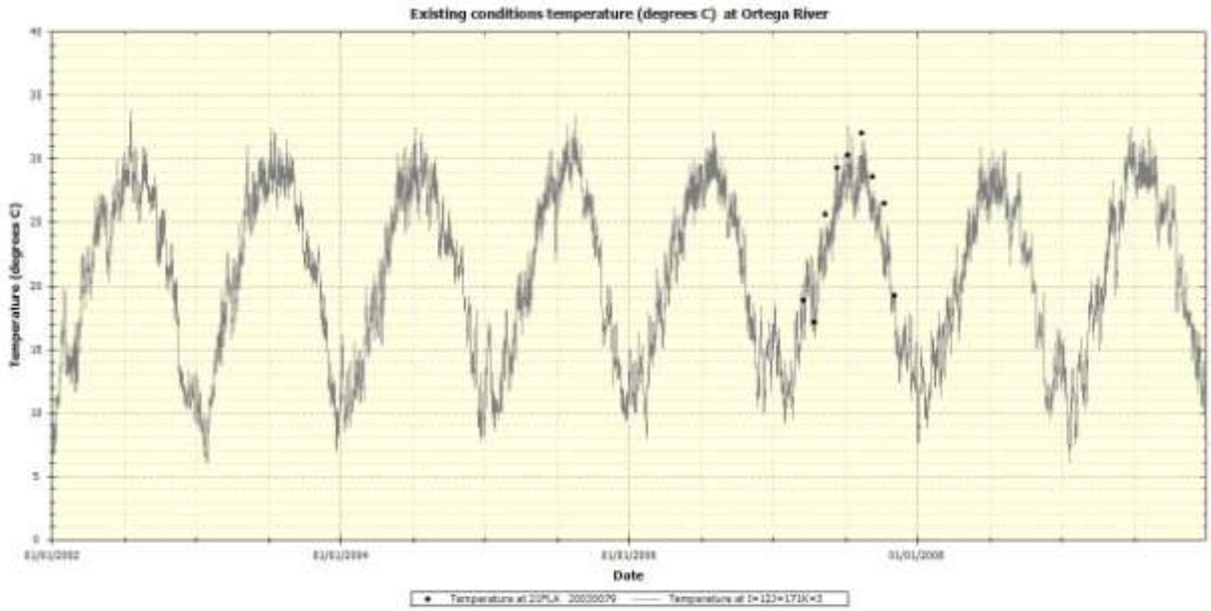

Figure 7.9 Simulated temperature versus measured temperature in Ortega River at station 21FLSJWMIRLUPGC

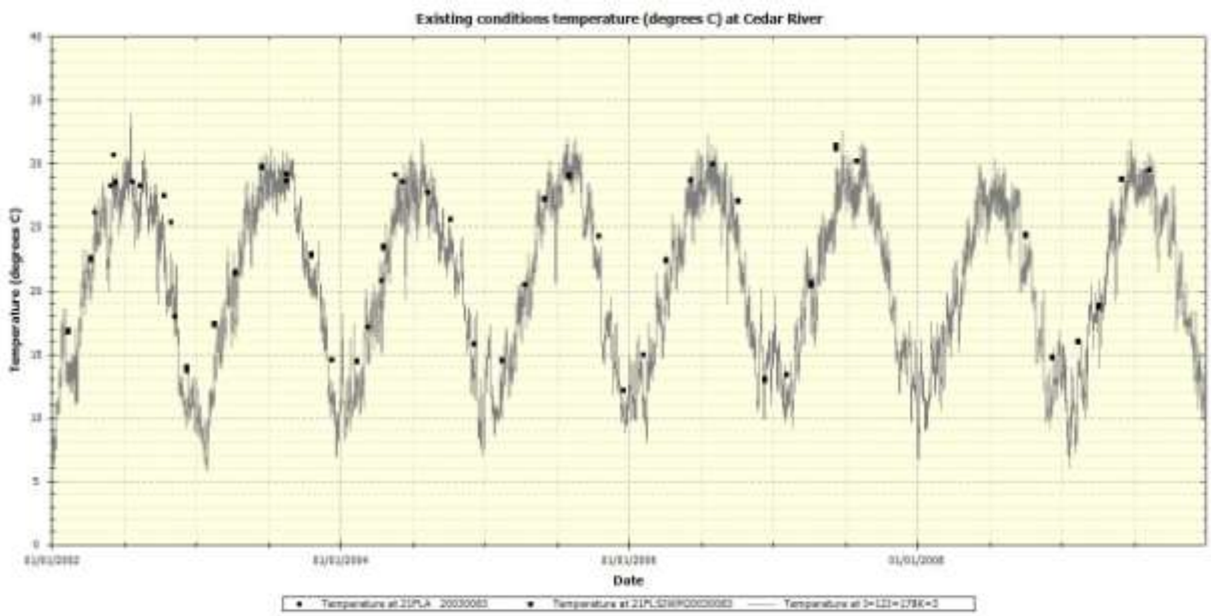

Figure 7.10 Simulated temperature versus measured temperature in Cedar River at station 21FLSJWMIRLUPGC

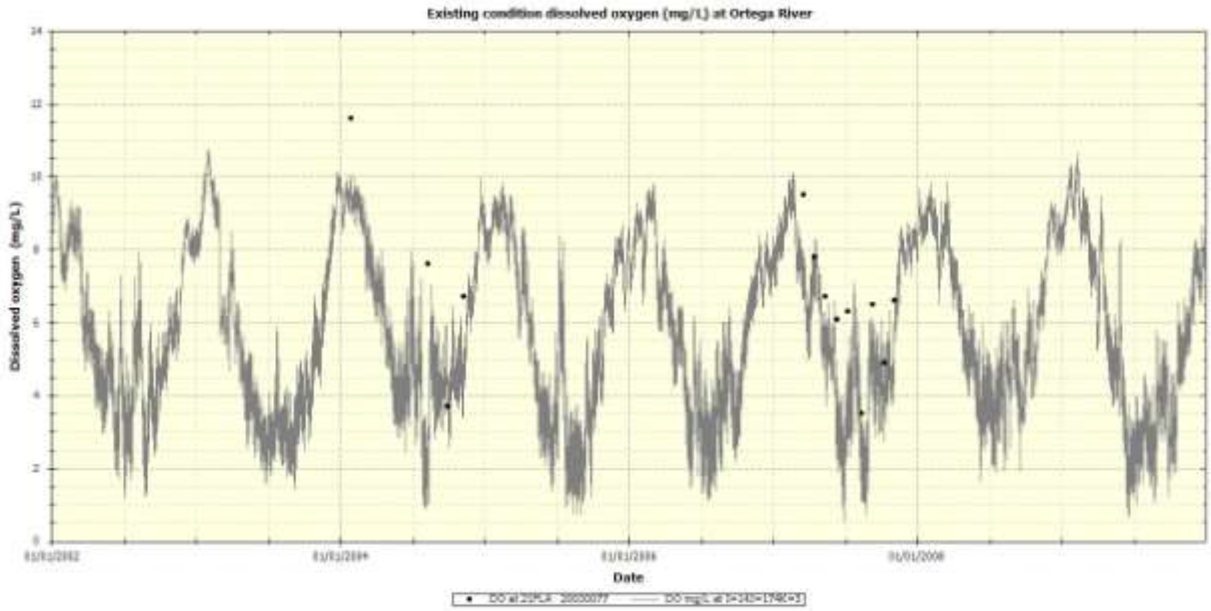

Figure 7.11 Simulated dissolved oxygen versus measured dissolved oxygen in Ortega River at station 21FLSJWMIRLUPGC

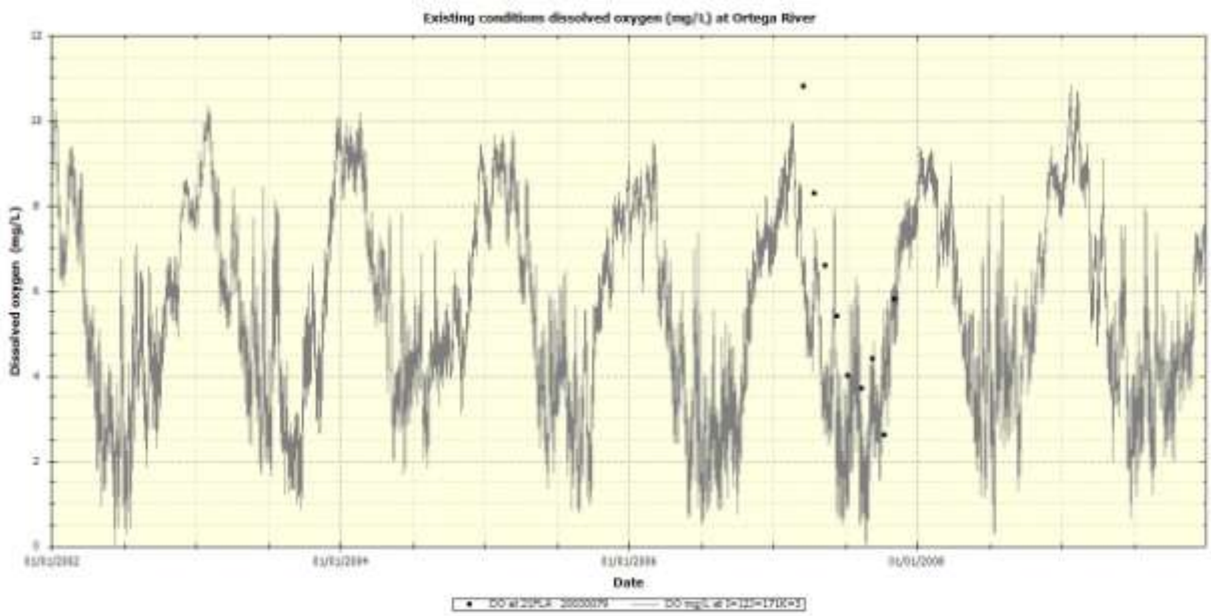

Figure 7.12 Simulated dissolved oxygen versus measured dissolved oxygen in Ortega River at station 21FLSJWMIRLUPGC

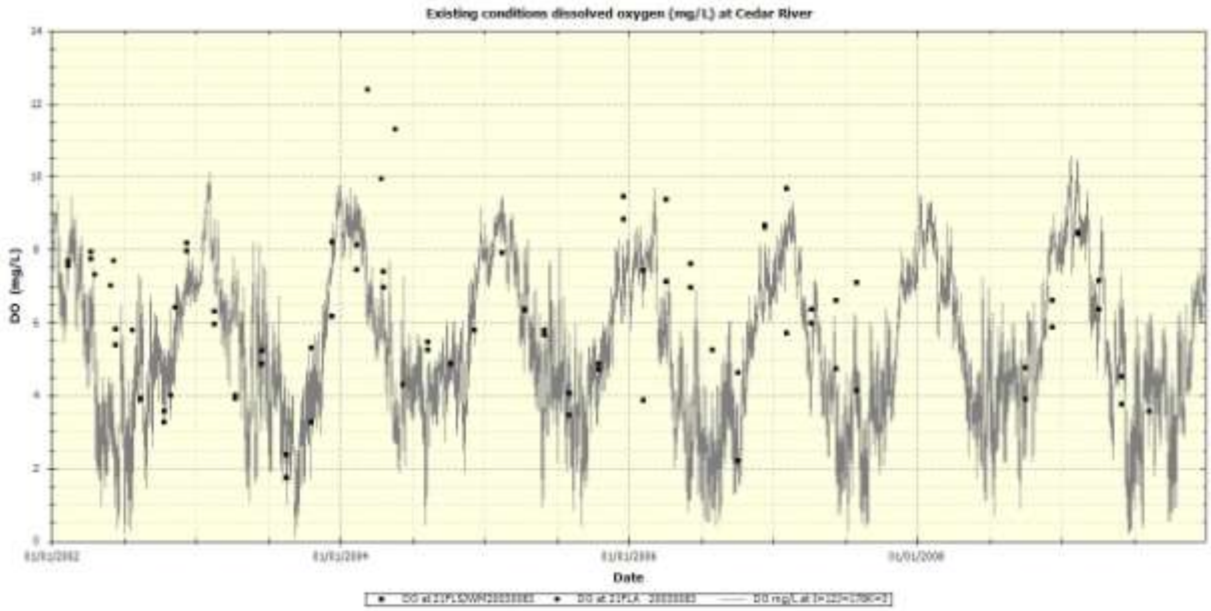

Figure 7.13 Simulated dissolved oxygen versus measured dissolved oxygen in Cedar River at station 21FLSJWMIRLUPGC

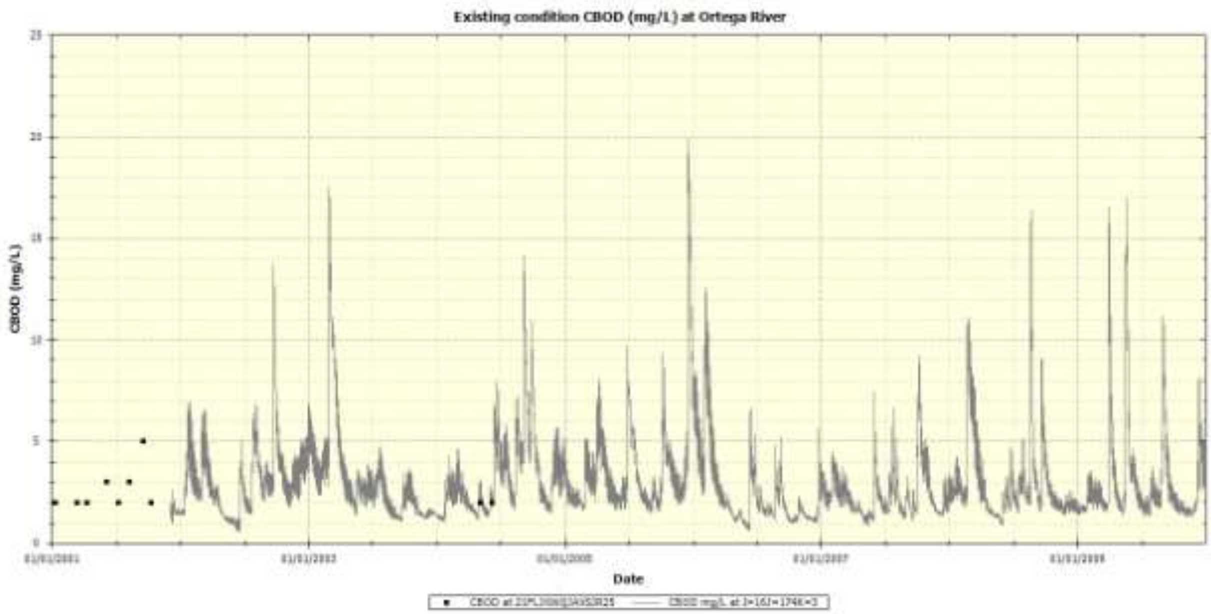

Figure 7.14 Simulated biochemical oxygen demand versus measured biochemical oxygen demand in Ortega River at station 21FLCEN 27010028

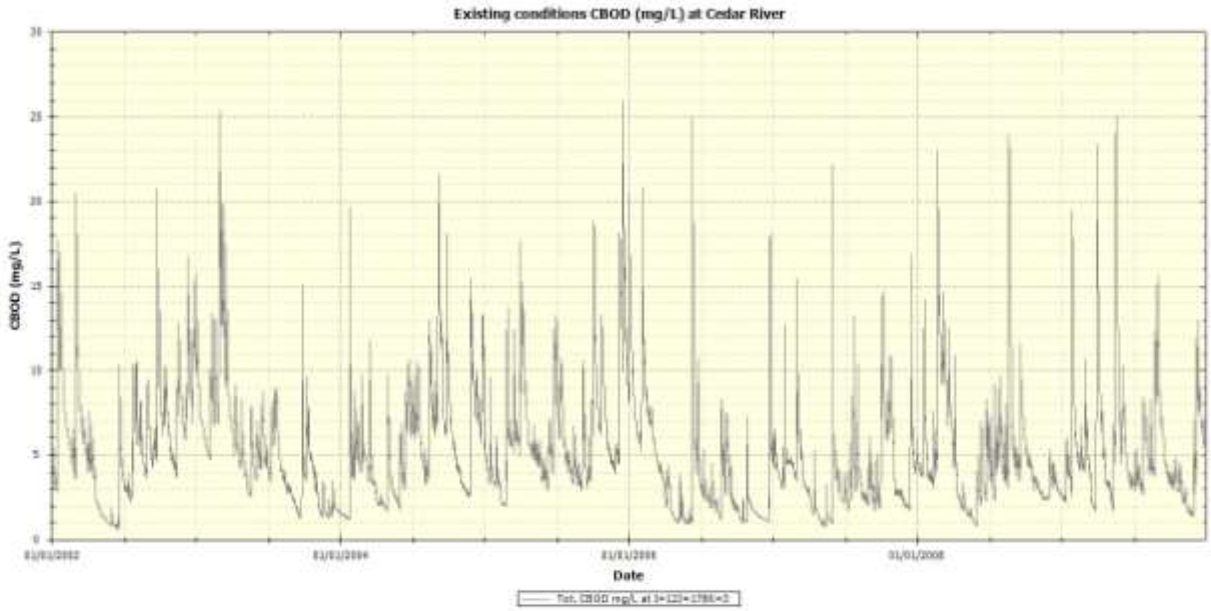

Figure 7.15 Simulated biochemical oxygen demand versus measured biochemical oxygen demand in Cedar River

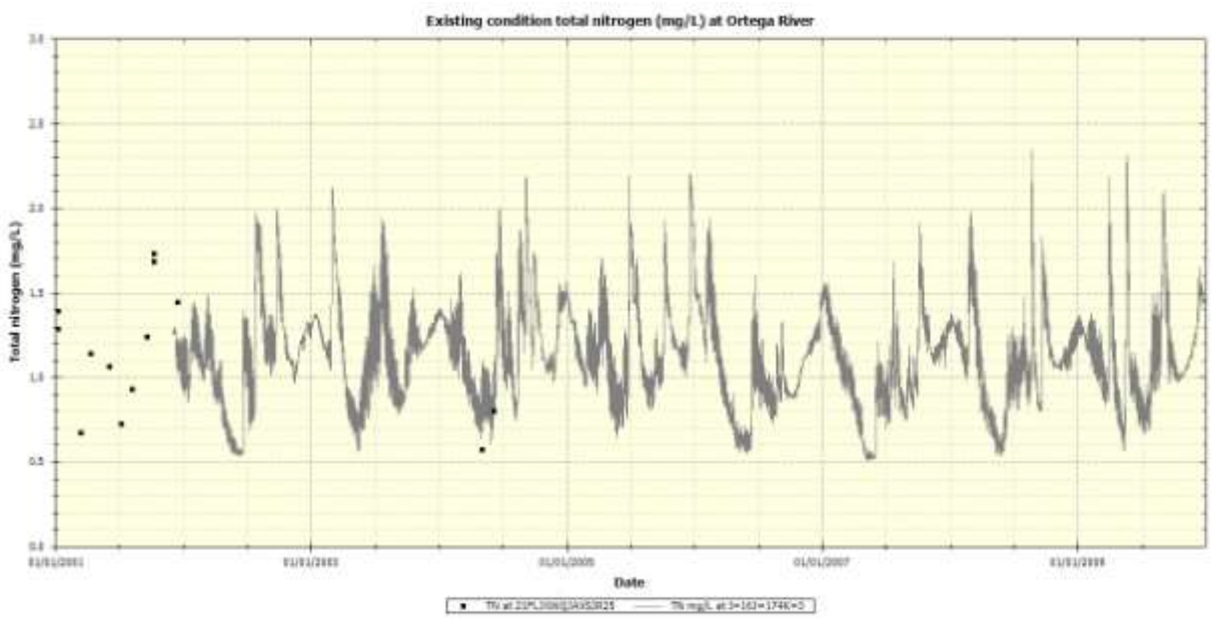

Figure 7.16 Simulated total nitrogen versus measured total nitrogen in Ortega River at station 21FLSJWMIRLUPGC

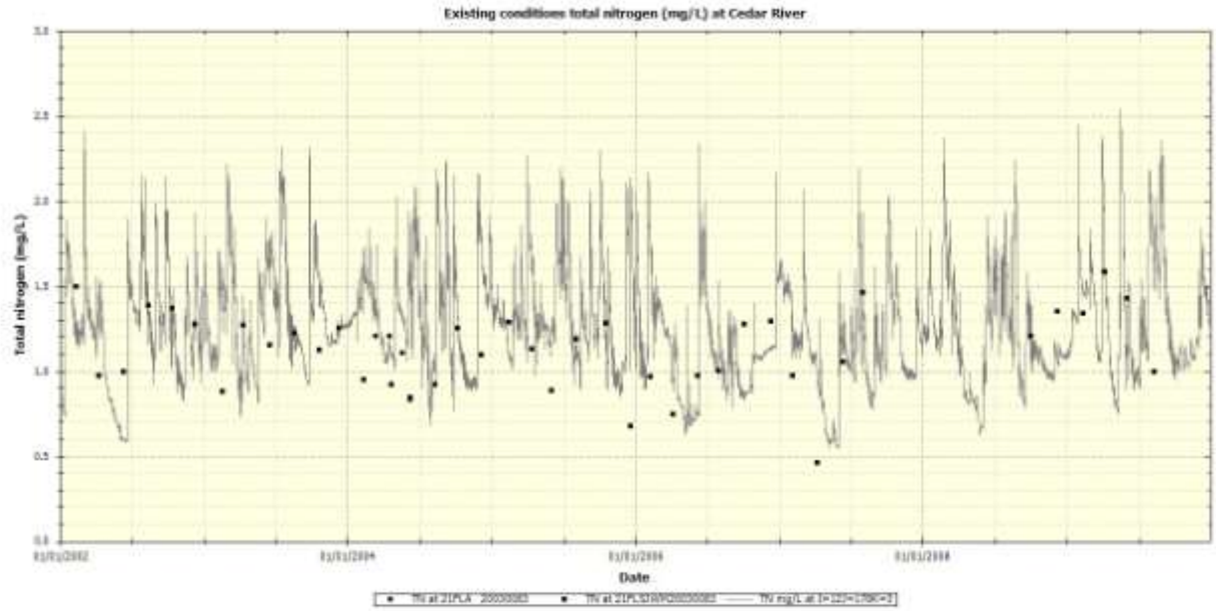

Figure 7.17 Simulated total nitrogen versus measured total nitrogen in Cedar River at station 21FLSJWMIRLUPGC

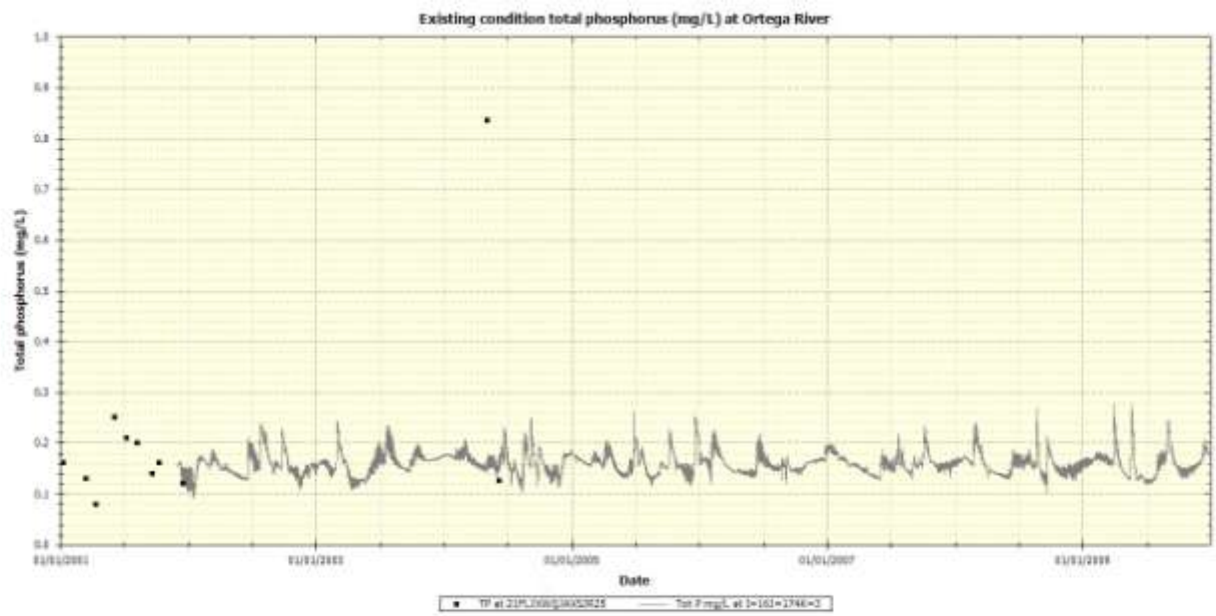

Figure 7.18 Simulated total phosphorus versus measured total phosphorus in Ortega River at station 21FLSJWMIRLUPGC

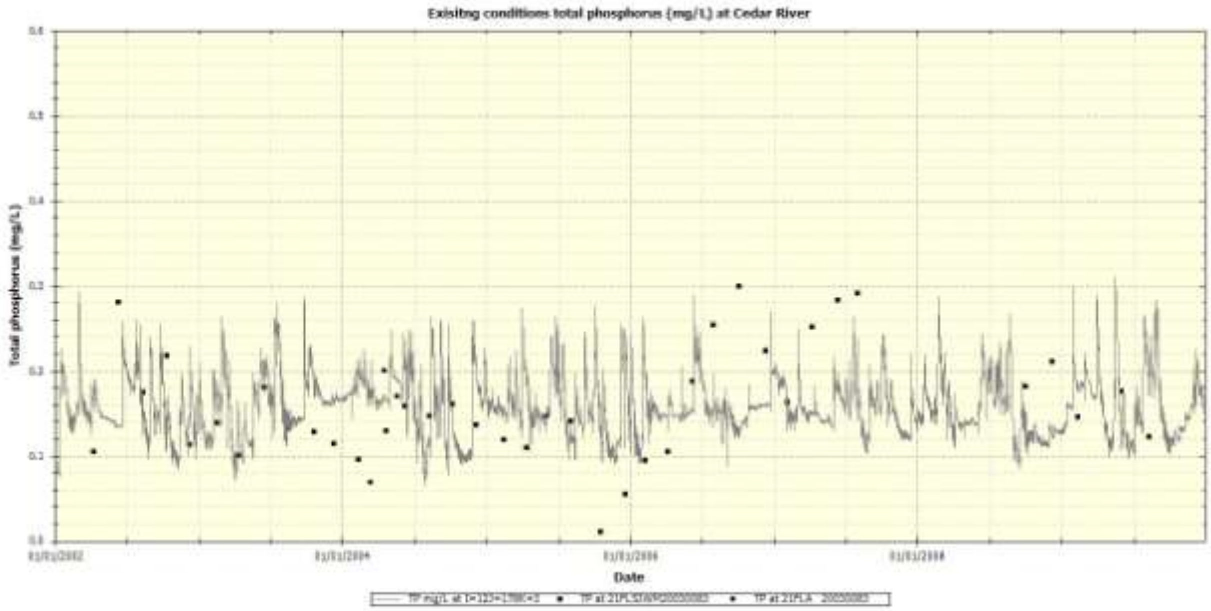

Figure 7.19 Simulated total phosphorus versus measured total phosphorus in Cedar River at station 21FLSJWMIRLUPGC

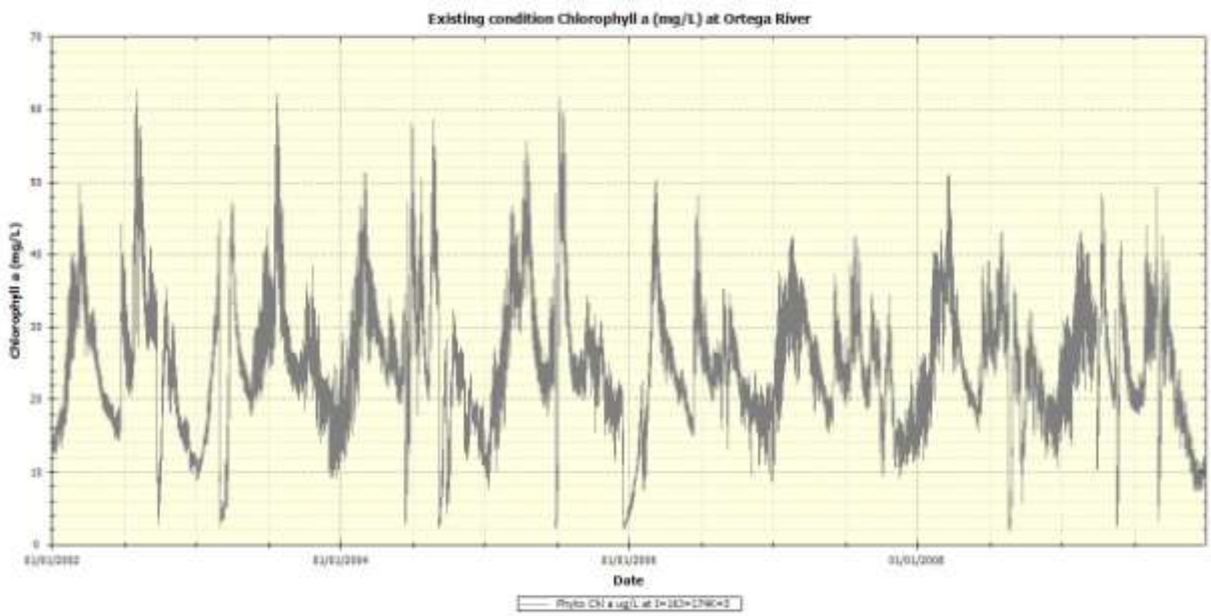

Figure 7.20 Simulated chlorophyll-a versus measured chlorophyll-a in Ortega River at station 21FLSJWMIRLUPGC

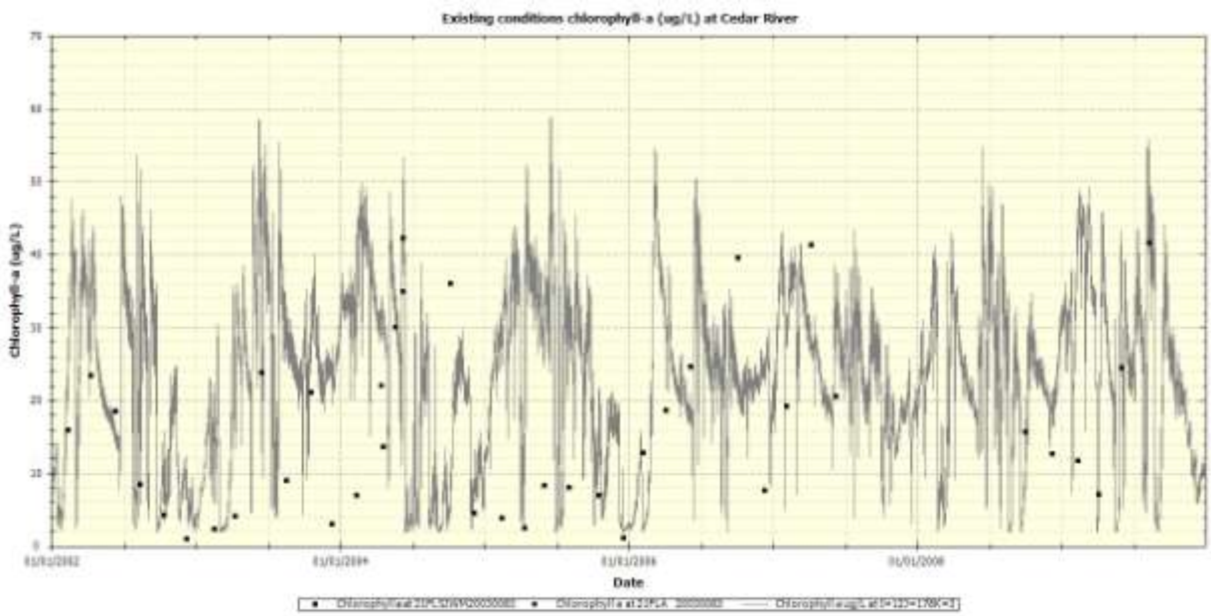

Figure 7.21 Simulated chlorophyll-a versus measured chlorophyll-a in Cedar River at station 21FLSJWMIRLUPGC

7.2 Scenarios

Two modeling scenarios were developed and evaluated in this TMDL determination: a current condition and a natural condition scenario. Concentrations and loadings were evaluated to determine if DO and nutrient concentrations in the natural condition scenario could meet the applicable standards, and the impact of nutrients on the DO concentrations. The results from the scenarios were used to develop the TMDL.

7.2.1 Current Condition

The current condition scenario evaluated current hydrologic and water quality conditions in the watershed, specifically water quality concentration and loadings in WBIDs 2213P1 and 2213P2. The current condition annual average concentrations are presented in Table 7.1. The current condition simulation was used to determine the base loadings for the WBID. These base loadings (Table 7.2), when compared with the TMDL scenarios, were used to determine the percent reduction in nutrient loads that will be needed to achieve water quality standards. Figure 7.8 through Figure 7.21 provide calibrated current condition modeled parameters and their corresponding measured data for the Cedar River and Ortega River.

Table 7.1 Current condition concentrations in the impaired WBIDs 2213P1 and 2213P2

Parameter	WBID 2213P1	WBID 2213P2
Total nitrogen (mg/L)	1.27	1.25
Total phosphorus (mg/L)	0.16	0.16

BOD (mg/L)	3.63	5.15
Dissolved oxygen (mg/L)	5.49	5.3

Table 7.2 Current condition loadings in the impaired WBIDs 2213P1 and 2213P2

Parameter	WBID 2213P1		WBID 2213P2	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	229,084	--	66,825
Total phosphorus (mg/L)	--	26,098	--	7,720
BOD (mg/L)	--	270,051	--	96,062

7.2.2 Natural Condition

The natural condition scenario was developed to estimate water quality conditions if there was no impact from anthropogenic sources. Any point sources located in the model are removed for the natural condition analysis. Land uses that were associated with anthropogenic activities (urban, agriculture, transportation, barren lands and rangeland) were converted to upland forests or forested wetlands based on the current ration of forest and wetland land uses in the model. The natural condition water quality predictions for WBIDs 2213P1 and 2213P2 are presented in Table 7.3 and Table 7.4.

The purpose of the natural conditions scenario was to determine whether water quality standards could be achieved without abating the naturally occurring loads from the watershed. The natural condition modeling scenario indicated that the DO standard is not achievable under natural conditions, indicating that low DO is a naturally occurring phenomenon in Cedar River and Ortega River. However, reducing nutrient concentrations within the watershed does increase DO concentrations. Figure 7.22 through Figure 7.30**Error! Reference source not found.** provide the natural condition scenario output parameters for the WBID's downstream outlet, and Figure 7.31 and Figure 7.32 provide the cumulative distribution function for DO.

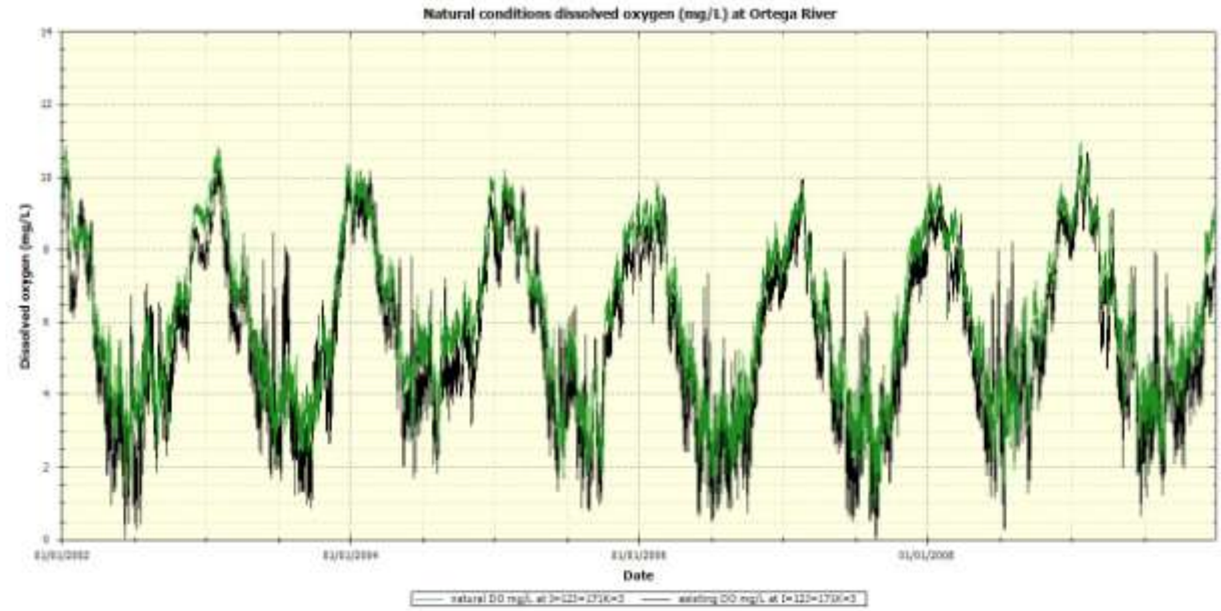

Figure 7.22 Natural condition dissolved oxygen in Ortega River

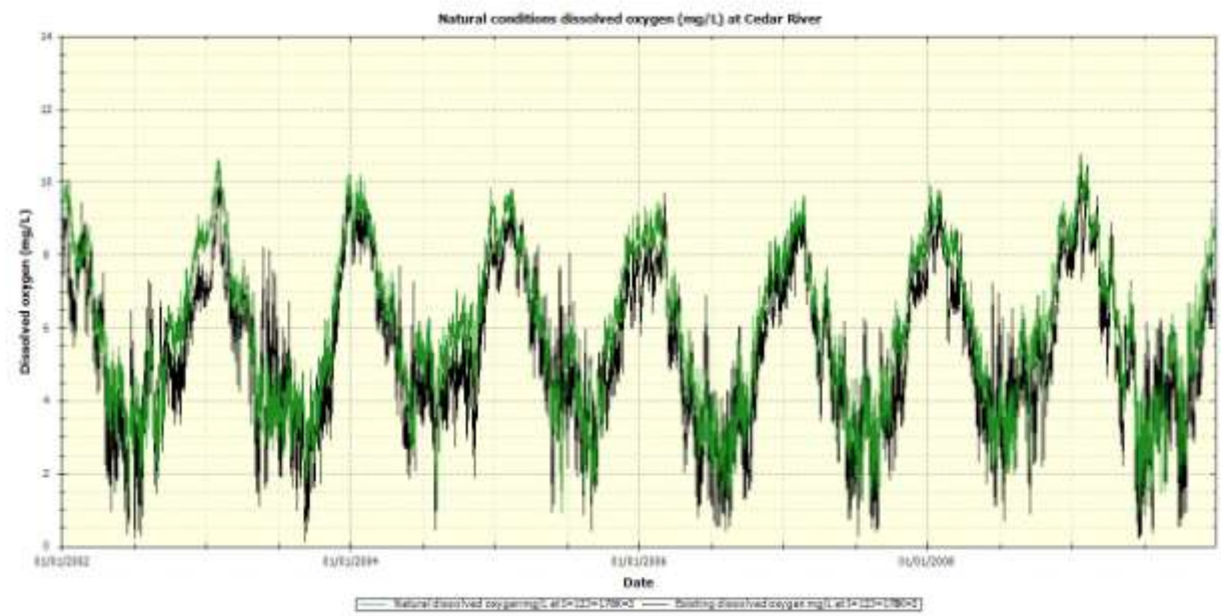

Figure 7.23 Natural condition dissolved oxygen in Cedar River

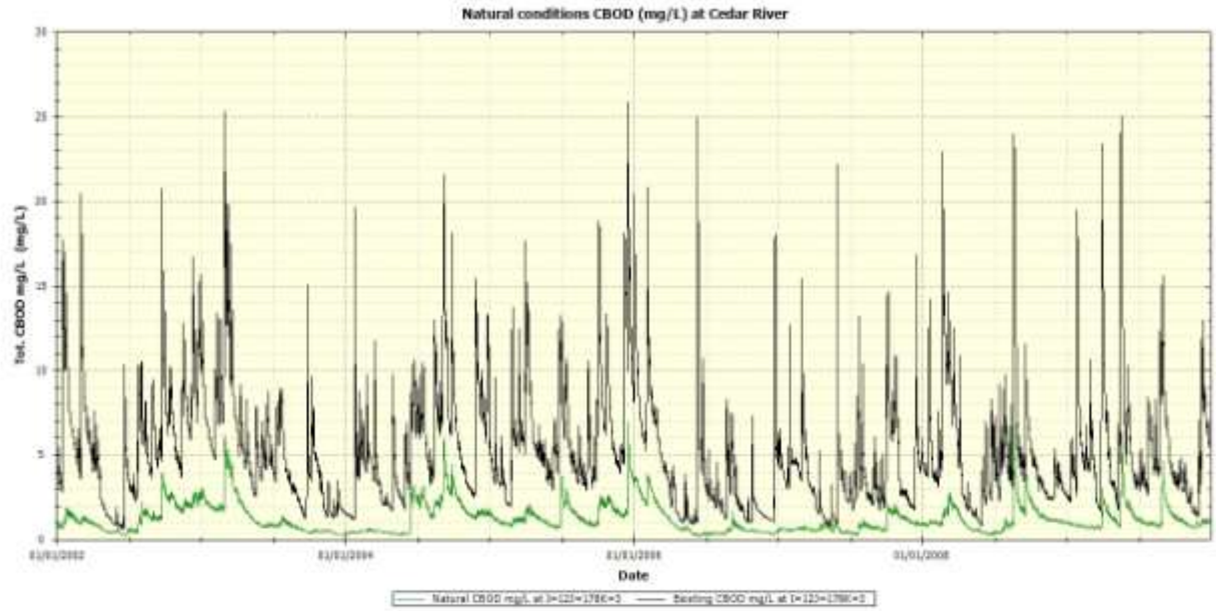

Figure 7.24 Natural condition biochemical oxygen demand in Cedar River

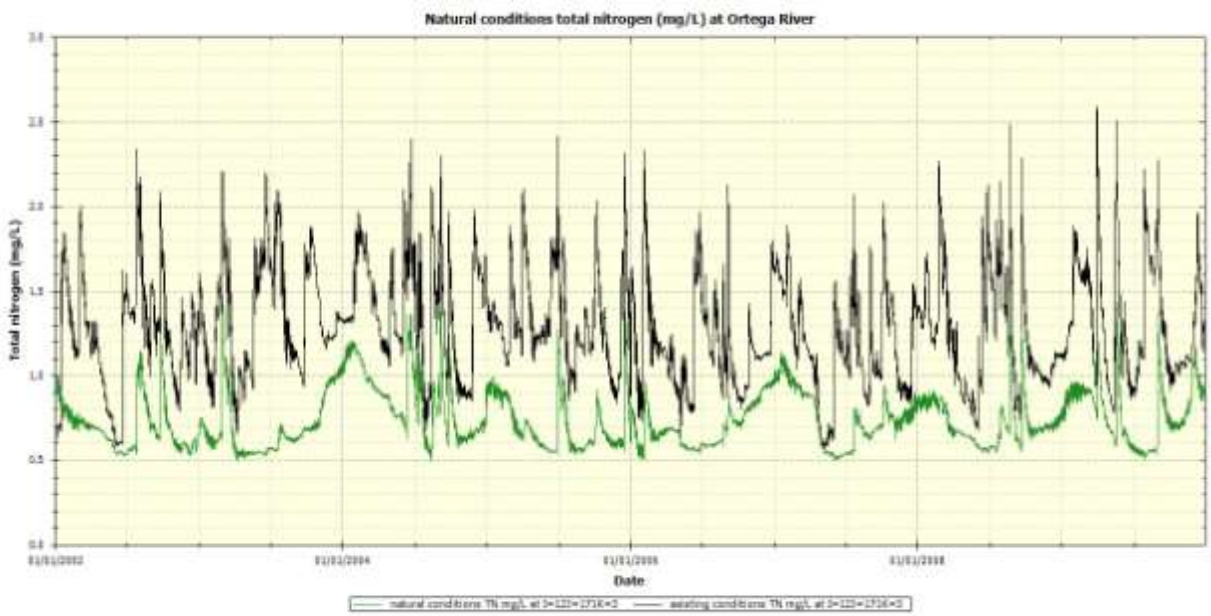

Figure 7.25 Natural condition total nitrogen in Ortega River

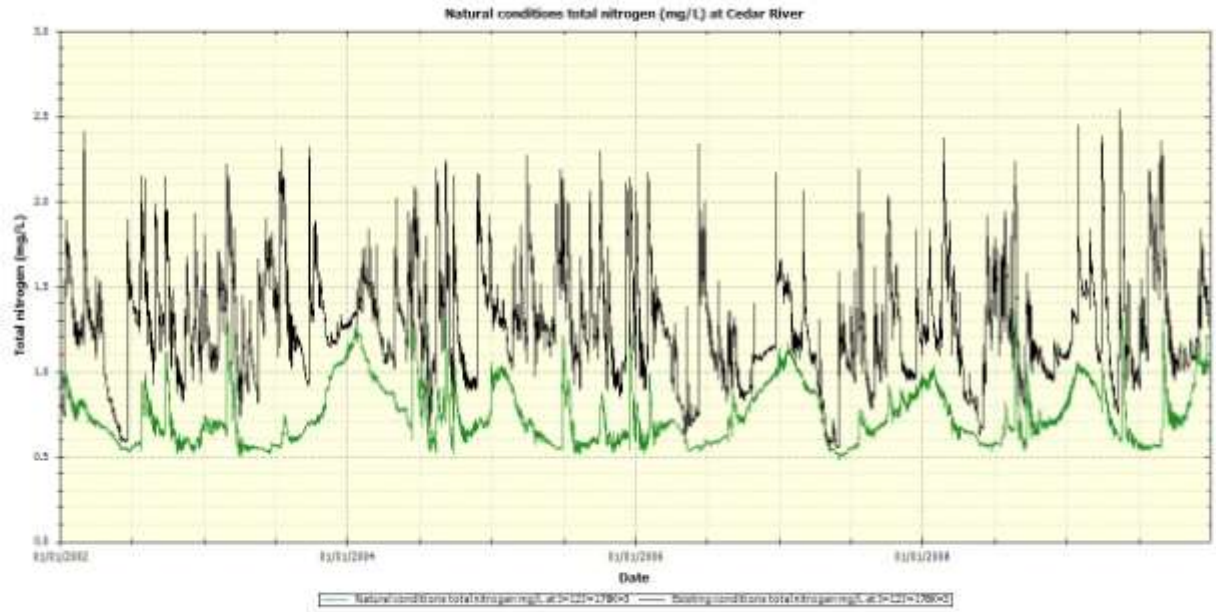

Figure 7.26 Natural condition total nitrogen in Cedar River

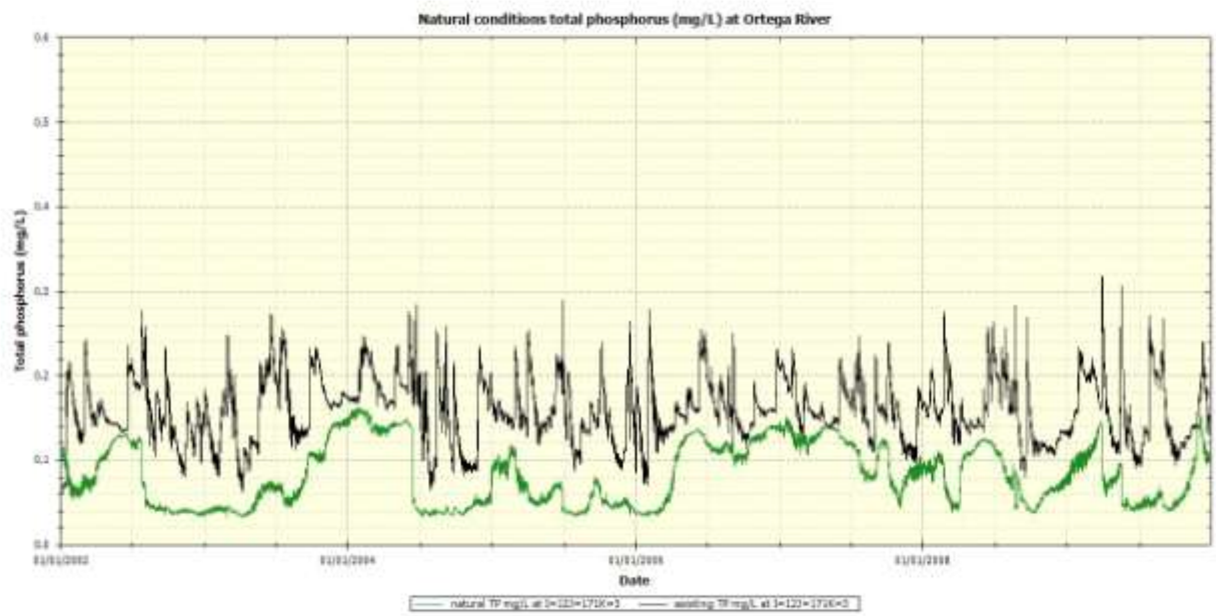

Figure 7.27 Natural condition total phosphorus in Ortega River

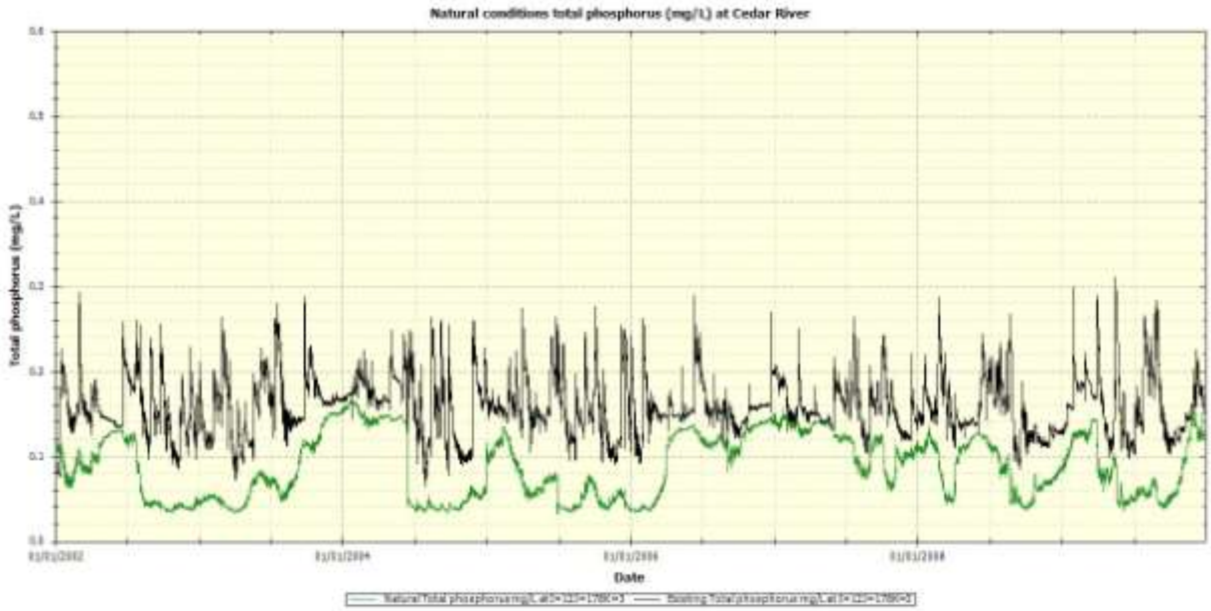

Figure 7.28 Natural condition total phosphorus in Cedar River

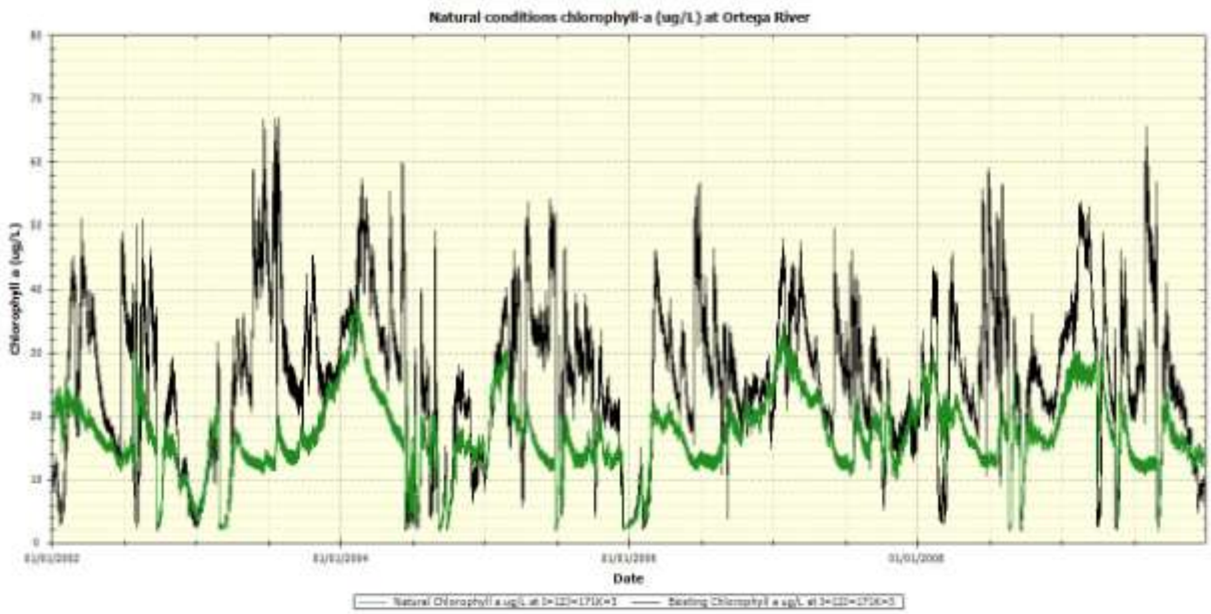

Figure 7.29 Natural condition chlorophyll a in Ortega River

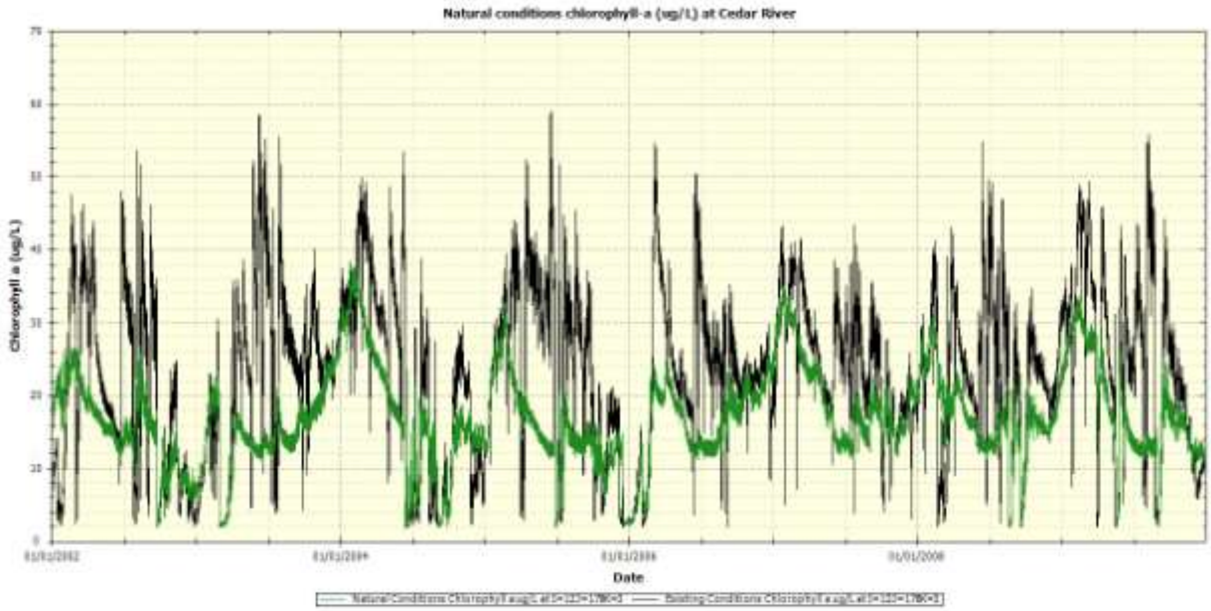

Figure 7.30 Natural condition chlorophyll a in Cedar River

Figure 7.31 Dissolved oxygen concentration cumulative distribution function in Ortega River

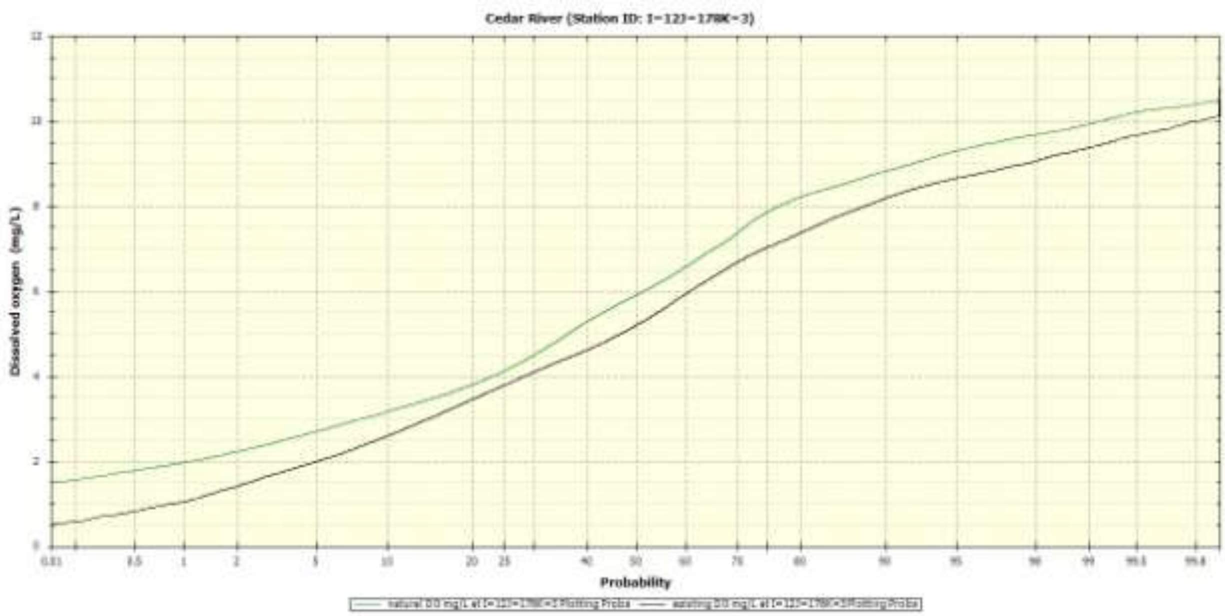

Figure 7.32 Dissolved oxygen concentration cumulative distribution function in Ortega River

Table 7.3 Natural condition concentrations in WBIDs 2213P1 and 2213P2

Parameter	WBID 2213P1	WBID 2213P2
Total nitrogen (mg/L)	0.74	0.74
Total phosphorus (mg/L)	0.08	0.09
BOD (mg/L)	1.00	1.21
Dissolved oxygen (mg/L)	6.12	5.90

Table 7.4 Natural condition loadings in WBIDs 2213P1 and 2213P2

	WBID 2213P1		WBID 2213P2	
Parameter	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	68,390	--	16,842
Total phosphorus (mg/L)	--	2,909	--	743
BOD (mg/L)	--	57,593	--	17,716

8.0 TMDL DETERMINATION

The TMDL for a given pollutant and waterbody is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the equation:

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody and still achieve water quality standards and the waterbody's designated use. In this TMDL development, allowable concentrations from all pollutant sources that cumulatively amount to no more than the TMDL must be set and thereby provide the basis to establish water quality-based controls. These TMDLs are expressed as annual geometric mean concentrations, since the approach used to determine the TMDL targets relied on geometric means. The TMDLs targets were determined to be the conditions needed to restore and maintain a balanced aquatic system. Furthermore, it is important to consider nutrient loading over time, since nutrients can accumulate in waterbodies.

The TMDL was determined for the concentrations and loadings for WBIDs 2213P1 and 2213P2, and included all loadings from upstream sources and streams. During the development of this TMDL, it was determined that the natural condition scenario (removal of all anthropogenic sources and landuses) did not meet the Florida standards for DO, but that the average DO concentration was greater than in the existing condition scenario. The results indicate the low DO is naturally occurring, but that removing excessive nutrients can increase DO. For this reason, the TMDL allocation is set to the natural condition loading to improve nutrients and DO, and prevent further degradation of the system. The allocations for WBIDs 2213P1 and 2213P2 for TN, TP, and BOD are presented in Table 8.1 and Table 8.2.

Table 8.1 TMDL Load Allocations for WBID 2231P1.

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	229,084	--	68,390	--	70%	70%
Total Phosphorus	--	26,098	--	2,909	--	89%	89%
Biochemical Oxygen Demand	--	270,051	--	57,593	--	79%	79%

Table 8.2 TMDL Load Allocations for WBID 2231P2.

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4

Total Nitrogen	--	66,825	--	16,842	--	75%	75%
Total Phosphorus	--	7,720	--	743	--	90%	90%
Biochemical Oxygen Demand	--	96,062	--	17,716	--	82%	82%

8.1 Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The critical condition is the combination of environmental factors creating the "worst case" scenario of water quality conditions in the waterbody. By achieving the water quality standards at critical conditions, it is expected that water quality standards should be achieved during all other times. Seasonal variation must also be considered to ensure that water quality standards will be met during all seasons of the year, and that the TMDLs account for any seasonal change in flow or pollutant discharges, and any applicable water quality criteria or designated uses (such as swimming) that are expressed on a seasonal basis.

The critical condition for nonpoint source concentration and wet weather point source concentrations is typically an extended dry period followed by a rainfall runoff event. During the dry weather period, nutrients build up on the land surface, and are washed off by rainfall. The critical condition for continuous point source concentrations typically occurs during periods of low stream flow when dilution is minimized. Although loading of nonpoint source pollutants contributing to a nutrient impairment may occur during a runoff event, the expression of that nutrient impairment is more likely to occur during warmer months, and at times when the waterbody is poorly flushed.

8.2 Margin of Safety

The Margin of Safety accounts for uncertainty in the relationship between a pollutant load and the resultant condition of the waterbody. There are two methods for incorporating an MOS into TMDLs (USEPA 1991):

- Implicitly incorporate the MOS using conservative model assumptions to develop allocations
- Explicitly specify a portion of the total TMDL as the MOS and use the remainder for Allocations

This TMDL uses an implicit MOS since the TMDL targets for nutrients were set to natural background conditions.

8.3 Waste Load Allocations

Only MS4s and NPDES facilities discharging directly into waterbodies (or upstream tributaries of those segments) are assigned a WLA. The WLAs, if applicable, are expressed separately for continuous discharge facilities (e.g., WWTPs) and MS4 areas, as the former discharges during all weather conditions whereas the later discharges in response to storm events.

8.3.1 Wastewater/Industrial Permitted Facilities

A TMDL wasteload allocation (WLA) is given to wastewater and industrial NPDES-permitted facilities discharging to surface waters within an impaired watershed. There are no NPDES facilities currently located in WBID 2231P1 or WBID 2231P2, or their contributing watersheds.

8.3.2 Municipal Separate Storm Sewer System Permits

The WLA for MS4s are expressed in terms of percent reductions equivalent to the reductions required for nonpoint sources. Given the available data, it is not possible to estimate concentrations coming exclusively from the MS4 areas. Although the aggregate concentration allocations for stormwater discharges are expressed in numeric form, i.e., percent reduction, based on the information available today, it is infeasible to calculate numeric WLAs for individual stormwater outfalls because discharges from these sources can be highly intermittent, are usually characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. For example, municipal sources such as those covered by this TMDL often include numerous individual outfalls spread over large areas. Water quality impacts, in turn, also depend on a wide range of factors, including the magnitude and duration of rainfall events, the time period between events, soil conditions, fraction of land that is impervious to rainfall, other land use activities, and the ratio of stormwater discharge to receiving water flow.

This TMDL assumes for the reasons stated above that it is infeasible to calculate numeric water quality-based effluent limitations for stormwater discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for stormwater sources of nutrients derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that: (1) the permitting authority explains in the permit fact sheet the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these stormwater discharges; and (2) the state will perform ambient water quality monitoring for nutrients for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

All Phase 1 MS4 permits issued in Florida include a re-opener clause allowing permit revisions for implementing TMDLs once they are formally adopted by rule. Florida may designate an area as a regulated Phase II MS4 in accordance with Rule 62-620.800, FAC. Florida's Phase II MS4 Generic Permit has a "self-implementing" provision that requires MS4 permittees to update their stormwater management program as needed to meet their TMDL allocations once those TMDLs are adopted. Permitted MS4s will be responsible for reducing only the loads associated with stormwater outfalls which it owns, manages, or otherwise has responsible control. MS4s are not responsible for reducing other nonpoint source loads within its jurisdiction. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the LA. The MS4 service areas described in Section 6.1.2 of this report are required to meet the percent reduction prescribed in Table 8.1 and Table 8.2 through the implementation of BMPs.

8.4 Load Allocations

The load allocation for nonpoint sources was assigned a percent reduction in nutrient concentrations from the current concentrations coming into each of the WBID addressed in the TMDL report.

9.0 RECOMMENDATIONS/IMPLEMENTATION

The initial step in implementing a TMDL is to more specifically locate pollutant source(s) in the watershed. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the specified load reductions. Components of a B-MAP are:

- Allocations among stakeholders
- Listing of specific activities to achieve reductions
- Project initiation and completion timeliness
- Identification of funding opportunities
- Agreements
- Local ordinances
- Local water quality standards and permits
- Follow-up monitoring

10.0 REFERENCES

Ambrose, RB, TA Wool, JP Connolly and RW Schanz. 1988. WASP4, A Hydrodynamic and Water Quality Model – Model Theory, User's Manual and Programmer's Guide. U.S. Environmental Protection Agency, Athens, GA. EPA/600/3-87-039.

Connolly, J.P. and Winfield, R. 1984. A User's Guide for WASTOX, a Framework for Modeling the Fate of Toxic Chemicals in Aquatic Environments. USEPA, Gulf Breeze, FL. EPA-600/3-84-077.

Di Toro, D.M., J.J. Fitzpatrick, and R.V. Thomann. 1983. Documentation for water quality analysis simulation program (WASP) and model verification program (MVP) No. EPA-600-3-81-044). U.S. EPA U.S Government Printing Office, Washington, DC.

Florida Administrative Code. Chapter 62-40, Water Resource Implementation Rule.

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

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

Florida Department of Environmental Protection (FDEP). 2006. *Fecal and Total Coliform TMDLs for the Cedar River.* Florida Department of Environmental Protection. http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp2/tmdl_document2262A.pdf . Accessed November, 2012.

Florida Department of Environmental Protection (FDEP). 2009. *DO and Nutrient TMDLs for the For the Ortega River, WBID 2213P.* Florida Department of Environmental Protection. http://www.dep.state.fl.us/water/tmdl/docs/tmdls/draft/gp2/ortegarivedonuttmdl.pdf . Accessed November, 2012.

Florida Department of Health (FDOH), 2009, Onsite Sewage Treatment and Disposal Systems Statistical Data, Bureau of Onsite Sewage Programs. http://www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm

Hamrick, J. M., 1992: A Three-Dimensional Environmental Fluid Dynamics Computer Code: Theoretical and Computational Aspects. The College of William and Mary, Virginia Institute of Marine Science. Special Report 317, 63 pp.

National Oceanic and Atmospheric Administration (NOAA). No Date. *Climate Normals for Jacksonville, FL*. National Weather Service Forecast Office, National Oceanic and Atmospheric Administration. http://www.srh.noaa.gov/jax/?n=normals_jax Accessed November 2012.

St. Johns River Water Management District (SJRWMD). 1993. *SWIM Plan for the Lower St. Johns River Basin.* St. Johns River Water Management District, Lower St. Johns River Basin, Florida. < http://www.lsjr.org/pdf/SWIM_Plan_LSJRB_1993.pdf >. Accessed November, 2012.

United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). 2007. *2007 Census of Agriculture.* U.S. Department of Agriculture. <http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Florida/flv1.pdf>. Accessed July 2012

United States Environmental Protection Agency (USEPA). 1991. *Guidance for Water Quality – Based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-440/4-91-001, April 1991.

Wool, T. A., S. R. Davie, and H. N. Rodriguez, 2003: Development of three-dimensional hydrodynamic and water quality models to support TMDL decision process for the Neuse River estuary, North Carolina. J. Water Resources Planning and Management, 129, 295-306.