Proposed

Total Maximum Daily Loads

for the

Julington Creek, Big Davis Creek

and

Sweetwater Creek

WBID 2351, 2356 and 2350

Nutrients and Dissolved Oxygen

September 30, 2009

Region4 serving the southeast

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SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Segment: 2351, 2356 and 2350: Julington Creek, Big Davis Creek and Sweetwater Creek
Lower St. Johns River

2. TMDL Endpoints/Targets: Nutrients and Dissolved Oxygen

3. TMDL Technical Approach Calibration of a watershed and water quality model to current conditions, load reduction scenarios to meet water quality standards.

4. TMDL Waste Load and Load Allocation:

		Current Condition		TMDL Condition		Percent
WBID	Constituent	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	Reduction
2351	Total Nitrogen	**	41810	**	21724	48%
	Total Phosphorus	**	6345	**	2598	59%
	BOD	**	185582	**	92014	50%
2356	Total Nitrogen	**	11440	**	8362	27%
	Total Phosphorus	**	1323	**	786	41%
	BOD	**	56773	**	41907	26%
2350	Total Nitrogen	**	12047	**	7172	40%
	Total Phosphorus	**	1643	**	741	55%
	BOD	**	54549	**	32050	41%

5. Endangered Species Present: No

6. USEPA Lead TMDL or Other: USEPA

7. TMDL Considers Point Sources/Non Point Sources: MS4 and Non Point Source

8. Major NPDES Discharges to surface waters addressed in USEPA TMDL: Yes

1. 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 State of 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. Water quality is assessed in each group on a rotating five-year cycle. Lower St. Johns is a Group 3 basin; it was designated for TMDL development by a consent decree. FDEP established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. Julington Creek, Big Davis Creek and Sweetwater Creek (WBID 2351, 2356 and 2350) reside in 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.

2. Problem Definition

The TMDLs addressed in this document are being established pursuant to commitments made by the United States Environmental Protection Agency (EPA) 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 EPA approved 1998 section 303(d) list. The 1998 section 303(d) list identified numerous Water Body Identifications (WBIDs) in the Upper St. Johns River Basin as not supporting water quality standards (WQS). After assessing all readily available water quality data, EPA is responsible for developing a TMDL in WBIDs 2351 and 2356 Julington and Big Davis Creeks (Figure 1). The parameters addressed in these TMDLs are Nutrients and Dissolved Oxygen.

Most waterbodies in the Lower St. Johns River Basin are designated as Class III waters having a designated use for recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The level of impairment is denoted as threatened, partially or not supporting designated uses. A waterbody that is classified as threatened currently meets WQS but trends indicate the designated use may not be met in the next listing cycle. A waterbody classified as partially supporting designated uses is defined as somewhat impacted by pollution and water quality criteria are exceeded on some frequency. For this category, water quality is considered moderately impacted. A waterbody that is categorized as not supporting is highly impacted by pollution and water quality criteria are exceeded on a regular or frequent basis. In such waterbodies, water quality is considered severely impacted.

To determine the status of surface water quality in the state, 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 Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). 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.

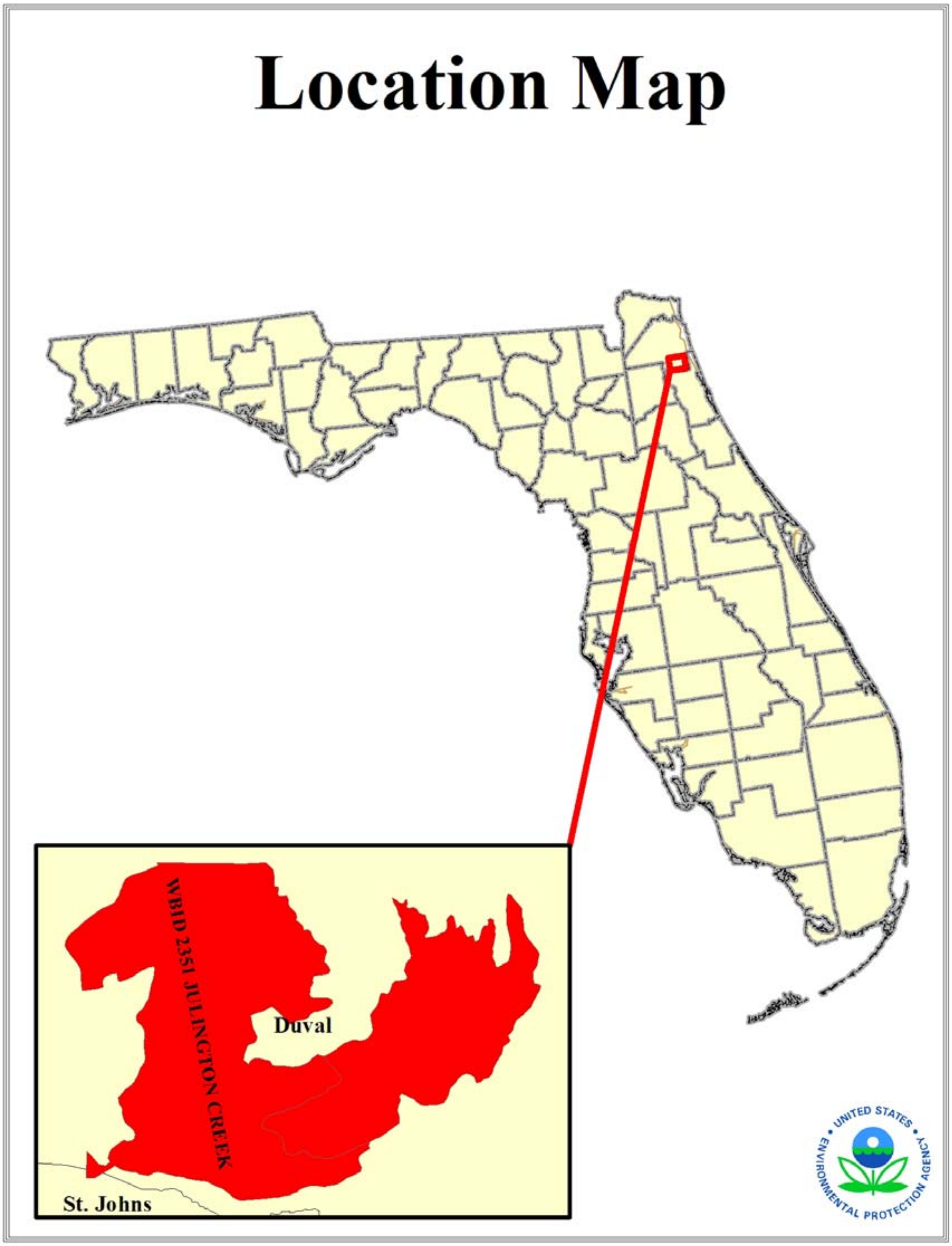

Figure 1 Location Map Julington and Big Davis Creek

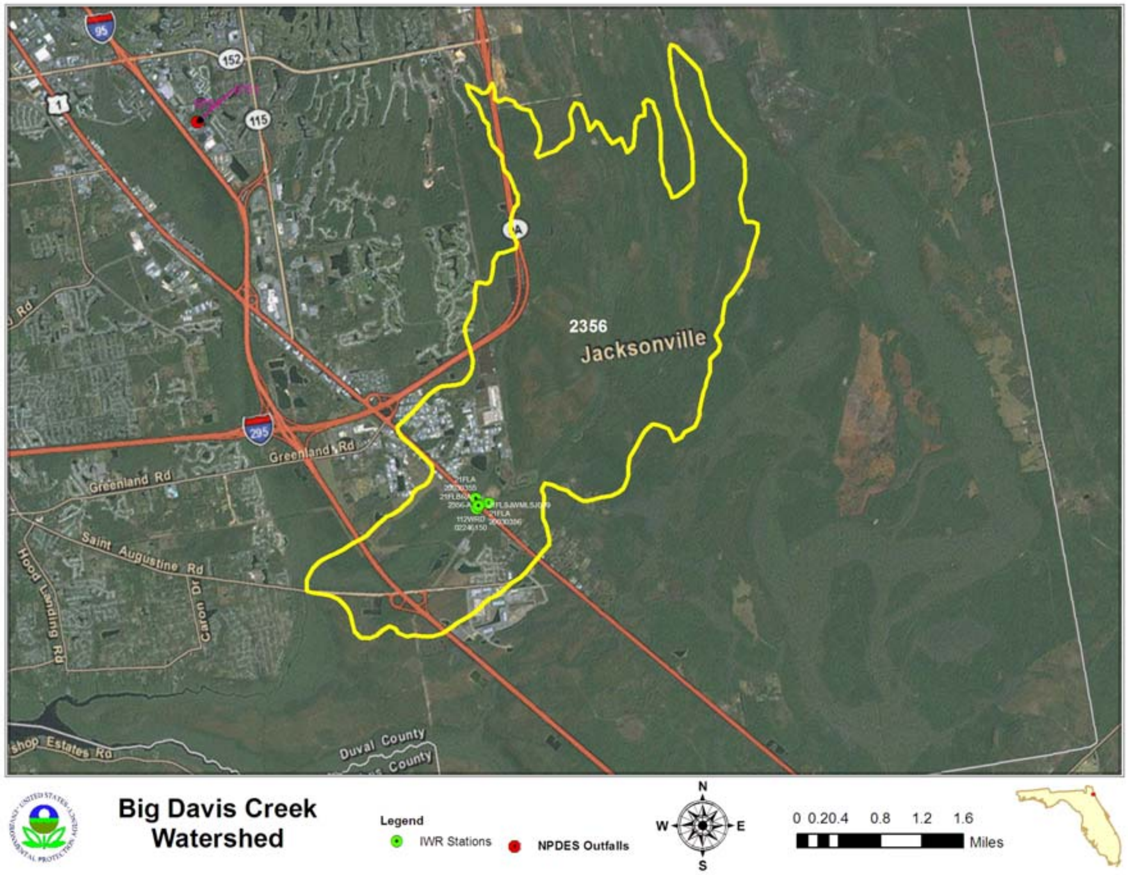

Figure 2 Location Map Big Davis Creek

Most waterbodies in the Lower Johns River Basin are designated as Class III waters having a designated use for recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The level of impairment is denoted as threatened, partially or not supporting designated uses. A waterbody that is classified as threatened currently meets WQS but trends indicate the designated use may not be met in the next listing cycle. A waterbody classified as partially supporting designated uses is defined as somewhat impacted by pollution and water quality criteria are exceeded on some frequency. For this category, water quality is considered moderately impacted. A waterbody that is categorized as not supporting is highly impacted by pollution and water quality criteria are exceeded on a regular or frequent basis. In such waterbodies, water quality is considered severely impacted.

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3. Watershed Description

Julington, Big Davis and Sweetwater Creeks lie in southern Brevard County just west of the city of Melbourne. They are an element of the Lower St. Johns River, being located upstream of where US Highway 192 crosses the Lower St Johns River.

4. Water Quality Standards/TMDL Targets

The waterbodies in the Julington, Big Davis and Sweetwater Creeks WBID 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. Several of the WBIDs addressed in this report were listed due to elevated concentrations of chlorophyll *a*. While there is no 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:

The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. FDEP has not adopted a numeric nutrient criterion for Class III waters. Therefore, the Class III narrative criterion applies to Julington, Big Davis and Sweetwater Creeks:

> 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 Section 62-302.300, 62-302.700, and 62-4.242, FAC. 62-302.530(48)(b), 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. 62-302.530(48)(b), F.A.C.

Because the State of Florida does not have numeric criteria for nutrients, chlorophyll and DO levels are used to indicate whether nutrients are present in excessive amounts.

4.2. Dissolved Oxygen Criteria:

Numeric criteria for DO are expressed in terms of minimum and daily average concentrations. Rule 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

5. Water Quality Assessment

2351 and 2356 Julington Creek and Big Davis Creek were listed as not attaining its designated uses on Florida's 1998 303(d) list for nutrients and dissolved oxygen.

To determine impairment an assessment of available data was conducted. The source for current ambient monitoring data for WBID 2351 and 2356 Julington Creek and Big Davis Creek was the Impaired Waters Rule (IWR) data Run 35.

5.1. Water Quality Data

The tables and figures below present the station locations and time series data for dissolved oxygen, total nitrogen, total phosphorus, and chlorophyll a observations for Julington Creek and Big Davis Creek.

5.1.1. 2351 Julington Creek

Table 1 provides a list of the water quality monitoring stations in the Julington Creek WBID including the date range of the observations and the number of observations.

Table 1 Water Quality Monitoring Stations for WBID 235: Julington Creek

Station ID	Station Name	Start Date	End Date	# of Obs
21FLA 20030153	JULINGTON CR @ SR 13	3/22/1999 12:23	3/22/1999 12:27	5
21FLA 20030317	JULINGTON CREEK AT HOOD'S LANDIN	3/22/1999 11:55	3/22/1999 11:55	3
21FLA 20030516	JULINGTON CR 1/2 MI S OF ST AUGUSTINE RD	1/27/2004 9:55	1/27/2004 9:55	2
21FLA 20030517	JULINGTON CREEK AT ST AUGUSTINE RD	3/22/1999 11:28	9/17/2007 12:07	39
21FLA 20030597	JULINGTON CREEK AT 50 M ABOVE US 1	3/22/1999 8:55	2/25/2008 9:30	33
21FLA 20030598	JULINGTON CREEK AT GREENLAND RD	3/22/1999 9:40	11/20/2007 8:40	47
21FLJXWQJAXSJR 35A	JULINGTON CK. 100M WEST OF SR.13 BRDG.	1/12/1999 9:25	12/18/2001 12:04	147
21FLJXWQJC3	JULINGTON CREEK AT GREENLAND RD	2/22/2005 14:34	11/26/2007 11:30	26
21FLJXWQJC317	JULINGTON CREEK AT HOOD LANDING DRIVE	6/25/1997 9:55	9/18/1997 9:14	2
21FLJXWQJC339	Julington Creek at US 1	8/10/2004 0:00	12/13/2007 12:28	48
21FLJXWQJC440	JULINGTON CREEK AT OLD ST. AUGUSTINE RD	3/4/1996 13:18	11/26/2007 13:54	157
21FLSJWM2003015 3	JULINGTON CREEK AT HWY 13 BRIDGE	2/27/1996 13:45	8/1/2007 8:07	492
21FLSJWMD-JCGR	Julington Creek at Greenland Rd; DET-37	5/11/2004 12:20	9/21/2005 14:45	93
21FLSJWMJC339N	Julington Creek at Philips Highway, Usptream side	8/9/2005 12:30	9/27/2005 13:15	2
21FLSJWMJULCM	Julington Creek at SR 13 Bridge	4/20/1998 14:30	12/29/2003 11:05	372
21FLVOL JUC010	BUTLERS CR NEAR MOUTH W/JULIAN CR.	1/21/1996 10:00	12/21/1996 9:00	22
21FLVOL JUC020	JULINGTON CR. AT SR13	1/2/1996 7:55	12/29/1996 8:30	42
21FLVOL JUC040	JULINGTON CR. NEAR OLD ST. AUGUSTINE RD.	1/11/1996 8:30	12/5/1996 7:30	25

Figure 3 shows where the water quality monitoring stations are located in the WBID that were used for the assessment and development of the TMDL.

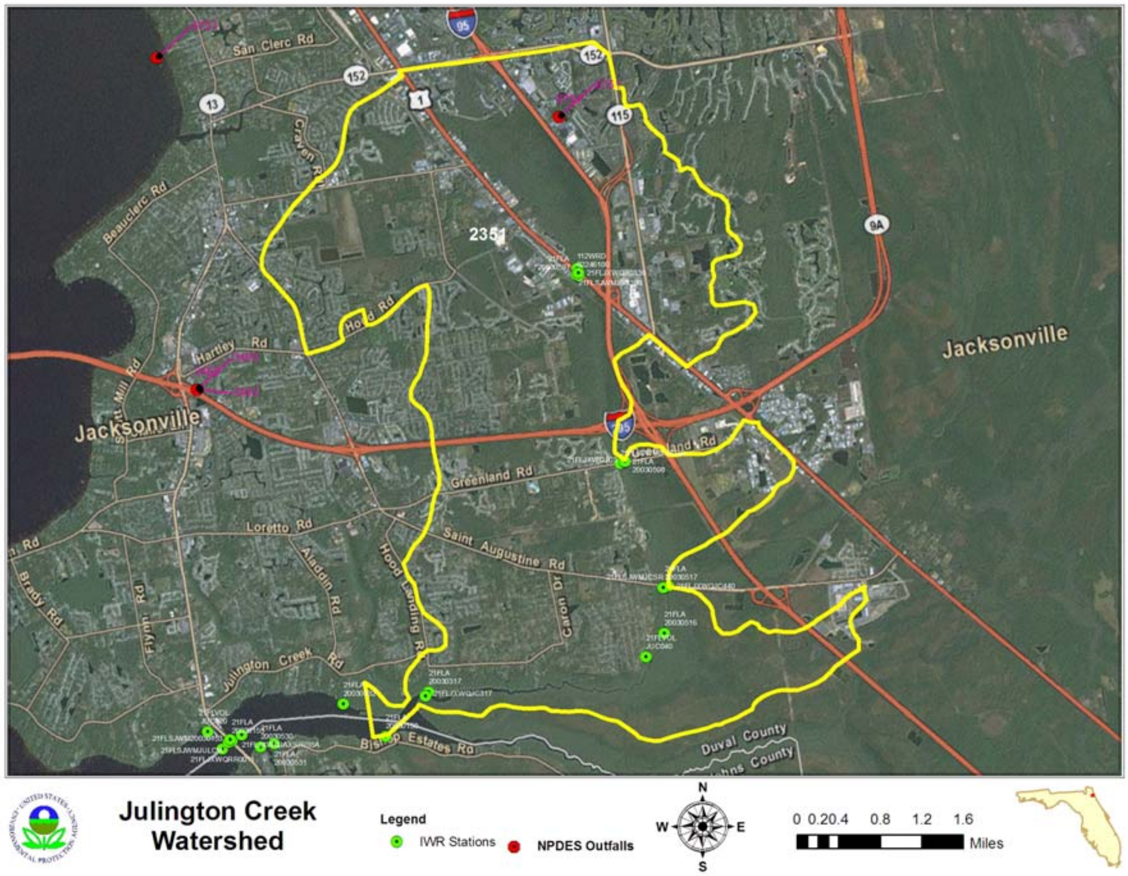

Figure 3 Station Locations for WBID: 2351 Julington Creek

Dissolved Oxygen

Figure 4 provides a time series plot for the measured dissolved oxygen concentrations in Julington Creek. There were 17 monitoring stations used in the assessment that included a total of 621 observations of which 152 (24%) fell below the water quality standard of 5 mg/l dissolved oxygen. The minimum value was 0.42 mg/l, the maximum was 15.2 mg/l and the average was 6.12 mg/l.

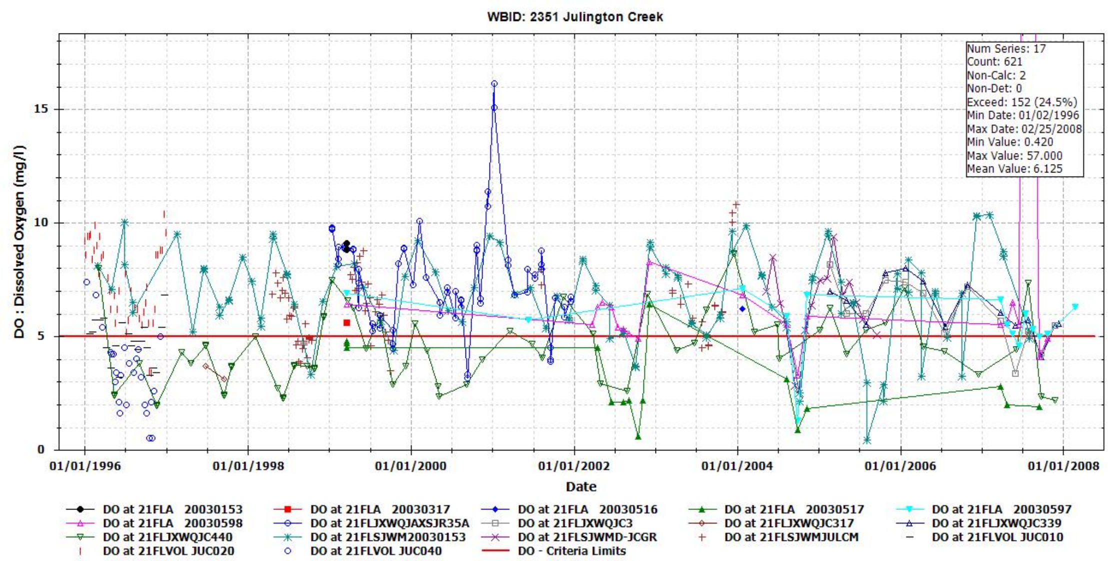

Figure 4 WBID: 2351 Julington Creek Measured Dissolved Oxygen

Biological Oxygen Demand

Figure 5 provides a time series plot for the measured BOD concentrations in Julington Creek. There were 9 monitoring stations used in the assessment that included a total of 28 observations. The minimum value was 0.3 mg/l, the maximum was 3.0 mg/l and the average was 1.54 mg/l.

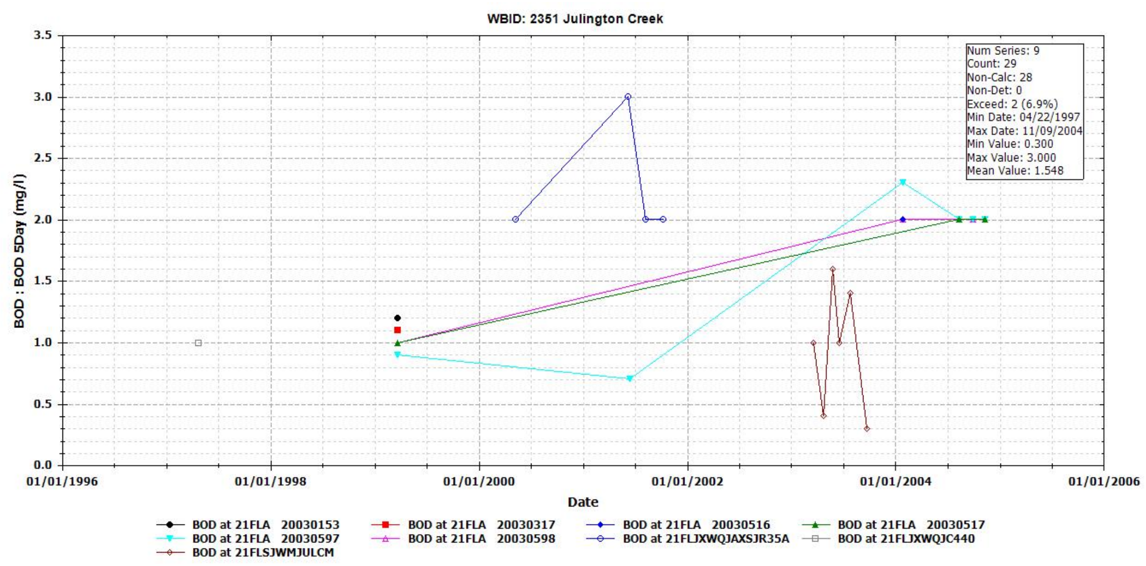

Figure 5 WBID 2351: Julington Creek Measured BOD

Nutrients

For the nutrient assessment the monitoring data for total nitrogen, total phosphorus and chlorophyll a are presented. While Florida is currently working on the development and promulgation of numeric nutrient criteria, the current standards for nutrients are narrative criteria. The purpose of the nutrient assessment is to present the range, variability and average conditions for the WBID.

Total Nitrogen

Figure 6 provides a time series plot for the measured total nitrogen concentrations in Julington Creek. There were 8 monitoring stations used in the assessment that included a total of 237 observations. The minimum value was 0.46 mg/l, the maximum was 2.52 mg/l and the average was 1.17 mg/l.

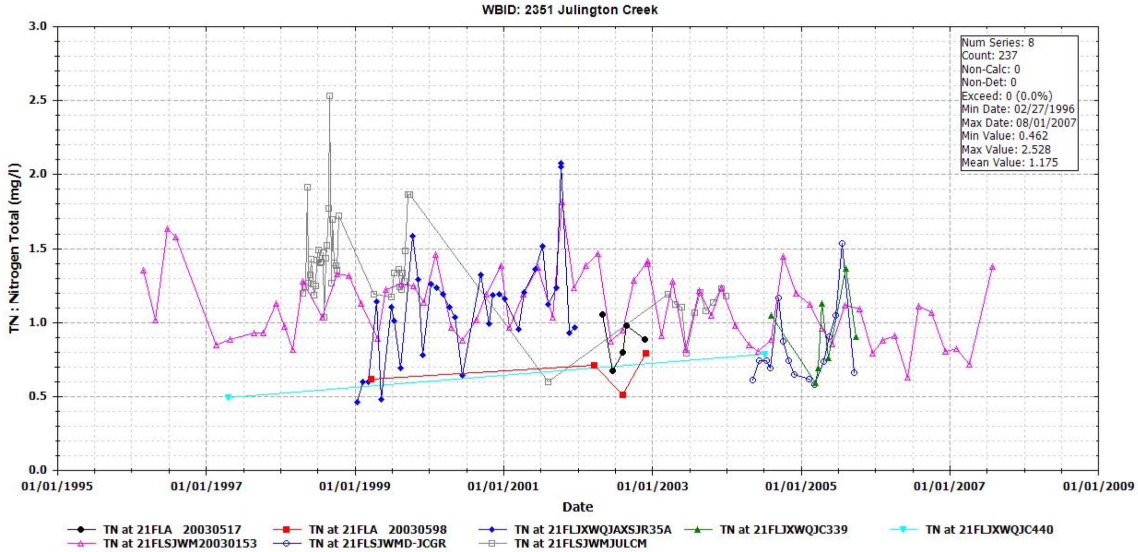

Figure 6 WBID: 2351Julington Creek Measured Total Nitrogen

Total Phosphorus

Figure 7 provides a time series plot for the measured total phosphorus concentrations in Julington Creek. There were 8 monitoring stations used in the assessment that included a total of 242 observations. The minimum value was 0.037 mg/l, the maximum was 0.354 mg/l and the average was 0.091 mg/l.

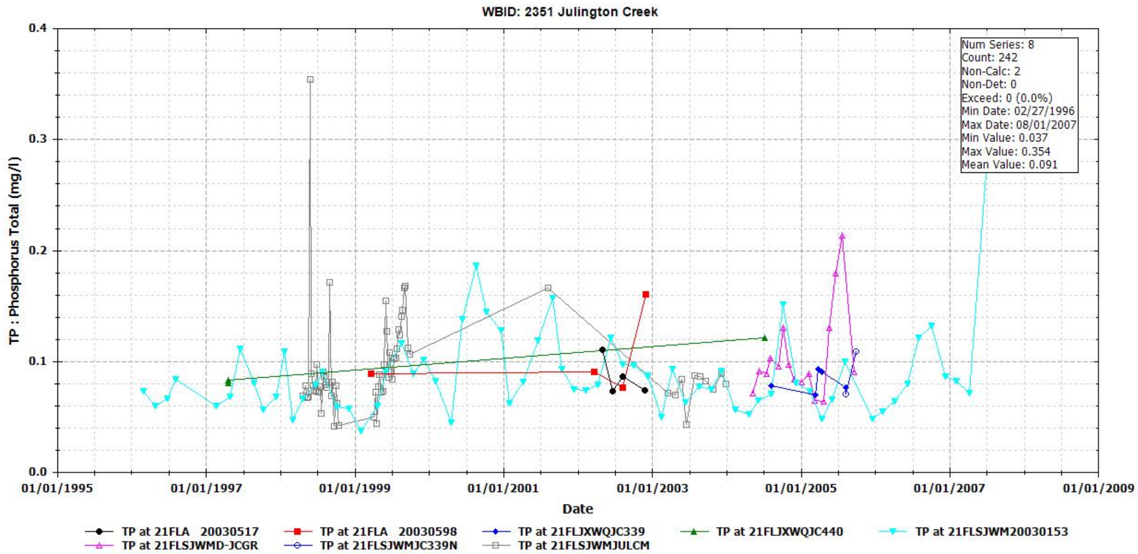

Figure 7 WBID: 2351Julington Creek Measured Total Phosphorus

Chlorophyll a

Figure 8 provides a time series plot for corrected chlorophyll a concentrations in Julington Creek. There were 9 monitoring stations used in the assessment that included a total of 225 observations. The minimum value was 1.00 µg/l, the maximum was 104 µg/l and the average was 8.35 µg/l.

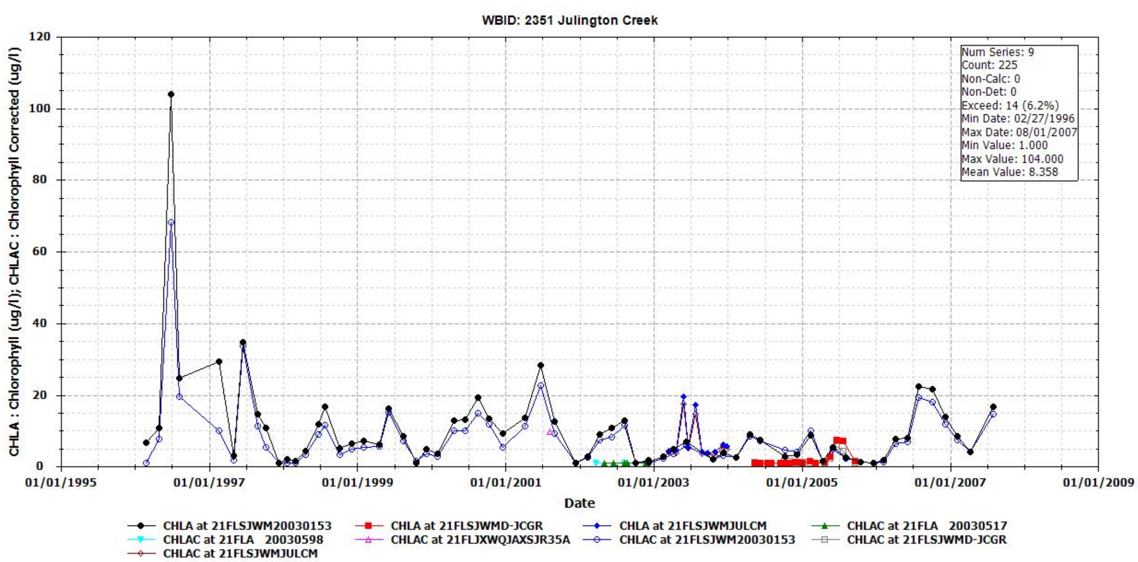

Figure 8 WBID: 2351 Julington Creek Measured Chlorophyll a Concentrations

5.1.2. 2356 Big Davis Creek

Table 2 provides a list of the water quality monitoring stations in the Big Davis Creek WBID including the date range of the observations and the number of observations.

Table 2 Water Quality Monitoring Stations for WBID 2356: Big Davis Creek

Station ID	Station Name	Start Date	End Date	# of Obs
21FLA 20030355	LITTLE DAVIS CR E US1 @ AVENUES SPORTS BAR DRIVEWAY	3/1/2002 0:00	12/6/2007 13:10	97
21FLA 20030356	BIG DAVIS CR E OF US 1 S OF GOLF DRIVING RANGE	3/1/2002 0:00	12/6/2007 12:50	97
21FLBRA 2356-A	2356 - Big Daivs Creek - Bridge on Hwy 1	4/1/2008 0:00	5/1/2008 8:26	3
21FLJXWQJC441	BIG DAVIS CREEK AT U.S. 1	3/1/1996 0:00	11/26/2007 11:52	367
21FLSJWMLSJ099	BIG DAVIS CREEK AT US1	1/1/1996 0:00	8/1/2007 9:10	647

Figure 9 shows where the water quality monitoring stations are located in the WBID that were used for the assessment and development of the TMDL.

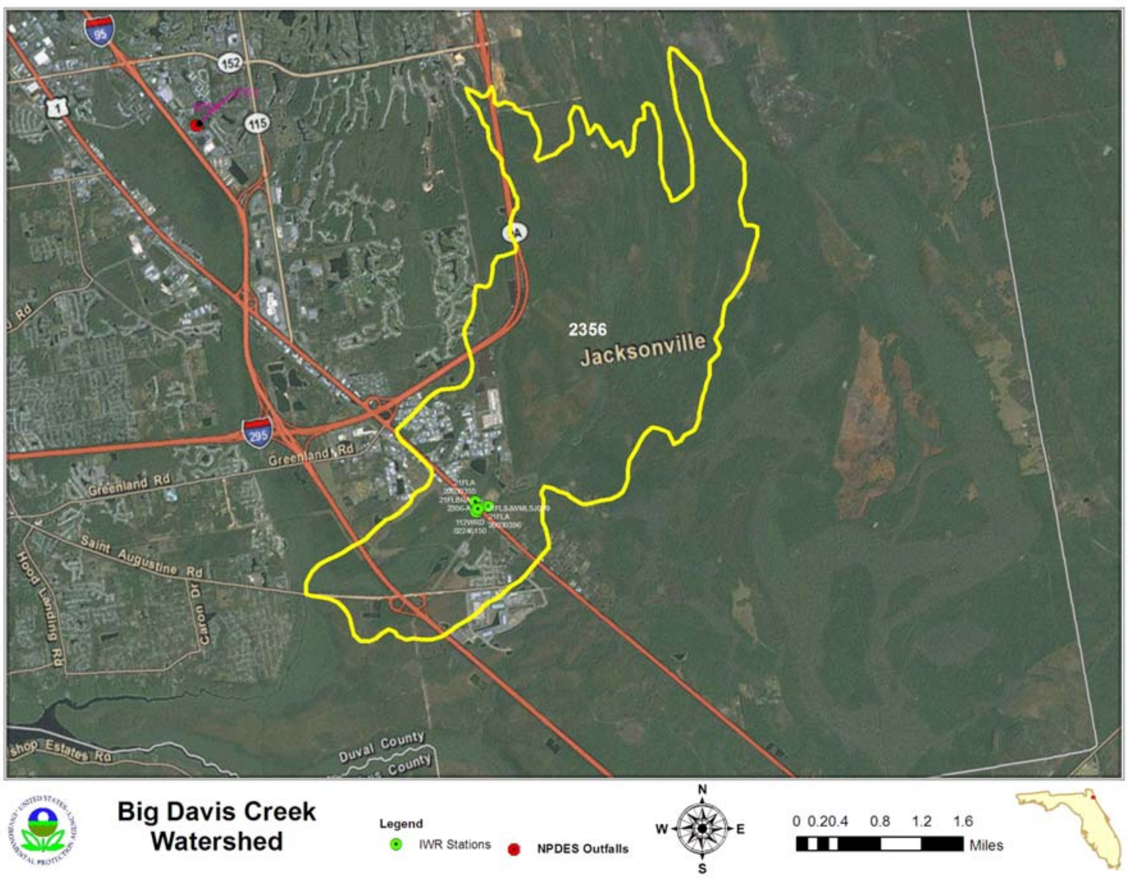

Figure 9 Station Locations for WBID: 2356 Big Davis Creek

Dissolved Oxygen

Figure 4 provides a time series plot for the measured dissolved oxygen concentrations in Big Davis Creek. There were 5 monitoring stations used in the assessment that included a total of 351 observations of which 49 (14%) fell below the water quality standard of 5 mg/l dissolved oxygen. The minimum value was 0.84 mg/l, the maximum was 9.15 mg/l and the average was 6.05 mg/l.

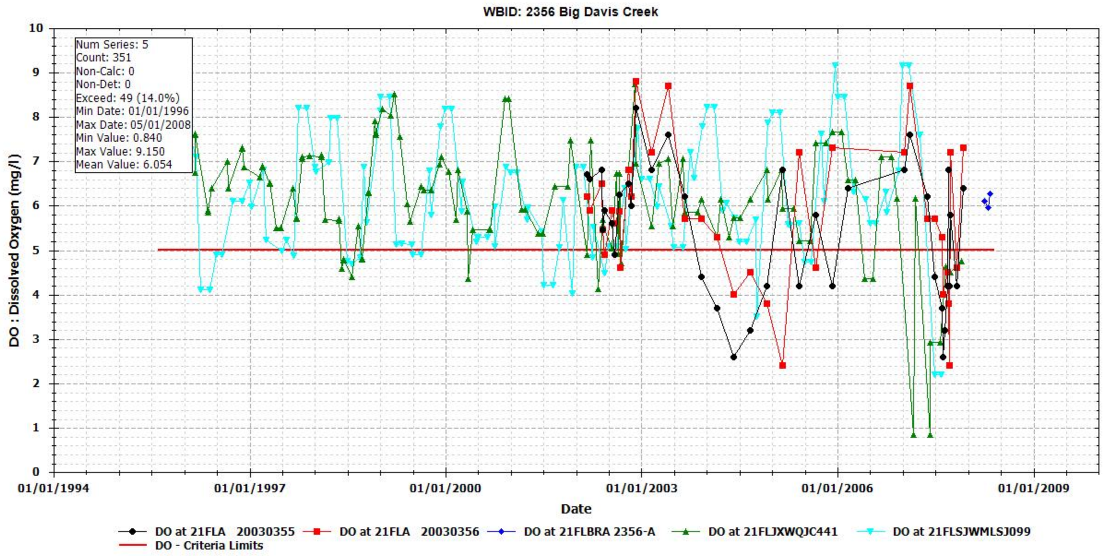

Figure 10 WBID: 2356 Big Davis Creek Measured Dissolved Oxygen

Biological Oxygen Demand

Figure 5 provides a time series plot for the measured BOD concentrations in Big Davis Creek. There were 3 monitoring stations used in the assessment that included a total of 48 observations. The minimum value was 0.2 mg/l, the maximum was 4.7 mg/l and the average was 2.14 mg/l.

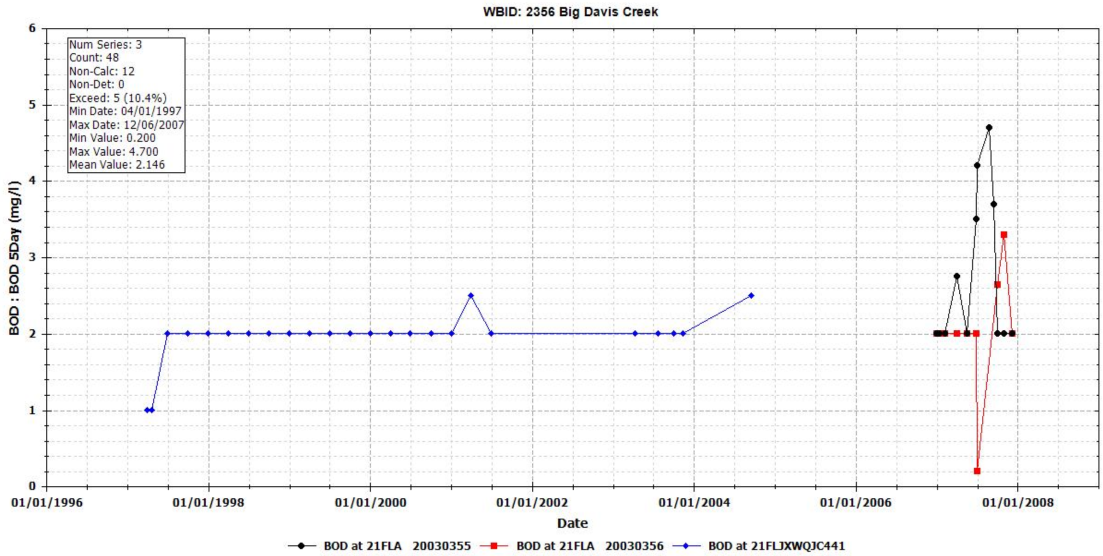

Figure 11 WBID: 2356 Big Davis Creek Measured BOD

Nutrients

For the nutrient assessment the monitoring data for total nitrogen, total phosphorus and chlorophyll a are presented. While Florida is currently working on the development and promulgation of numeric nutrient criteria, the current standards for nutrients are narrative criteria. The purpose of the nutrient assessment is to present the range, variability and average conditions for the WBID.

Total Nitrogen

Figure 6 provides a time series plot for the measured total nitrogen concentrations in Big Davis Creek. There were 4 monitoring stations used in the assessment that included a total of 201 observations. The minimum value was 0.19 mg/l, the maximum was 3.3 mg/l and the average was 0.84 mg/l.

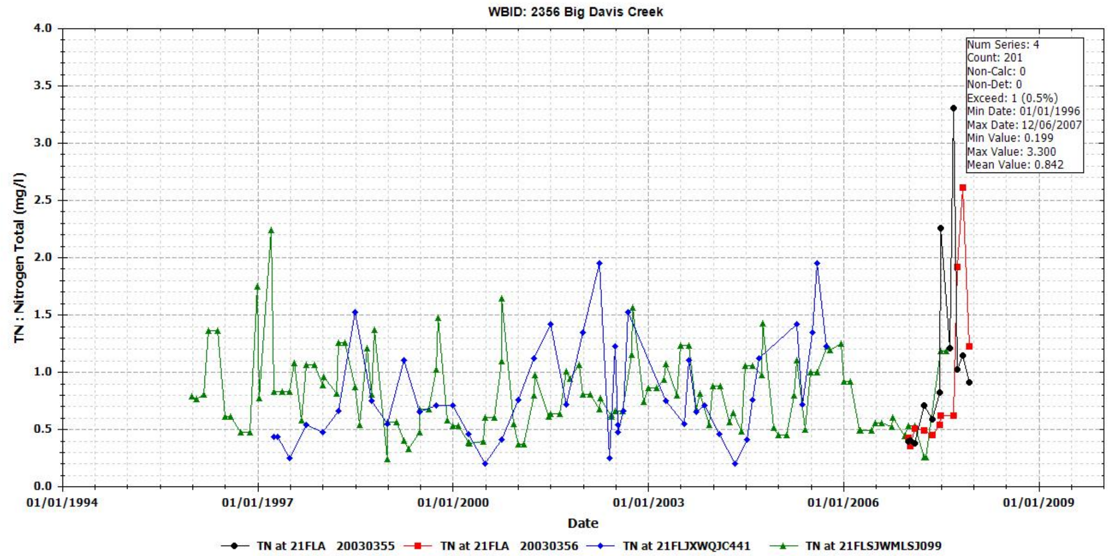

Figure 12 WBID: 2356 Big Davis Creek Measured Total Nitrogen

Total Phosphorus

Figure 7 provides a time series plot for the measured total phosphorus concentrations in Big Davis Creek. There were 4 monitoring stations used in the assessment that included a total of 182 observations. The minimum value was 0.034 mg/l, the maximum was 0.60 mg/l and the average was 0.105 mg/l.

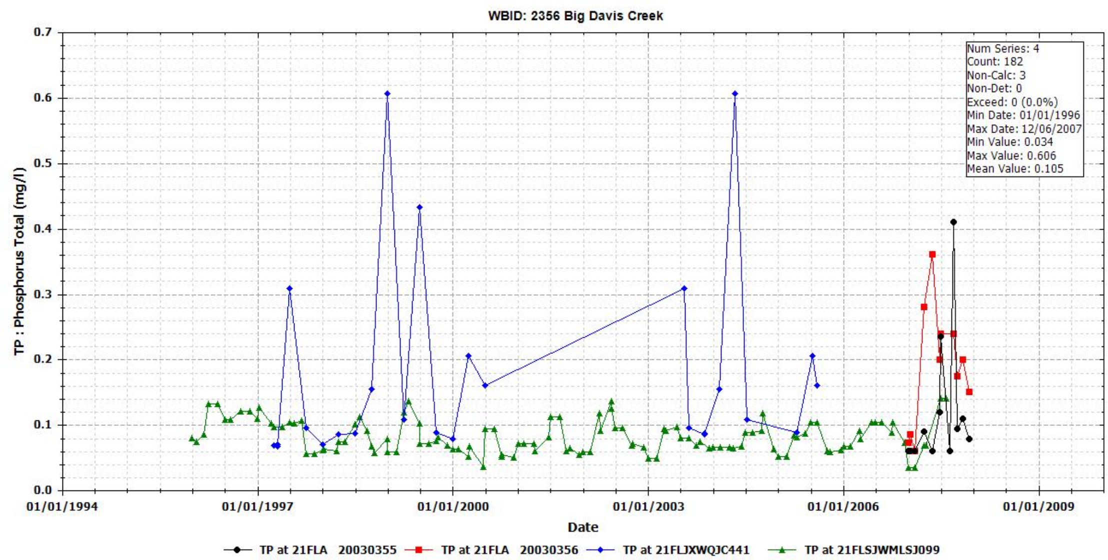

Figure 13 WBID: 2356 Big Davis Creek Measured Total Phosphorus

Chlorophyll a

Figure 8 provides a time series plot for corrected chlorophyll a concentrations in Big Davis Creek. There were 3 monitoring stations used in the assessment that included a total of 151 observations. The minimum value was 1.00 µg/l, the maximum was 93 µg/l and the average was 3.03 µg/l.

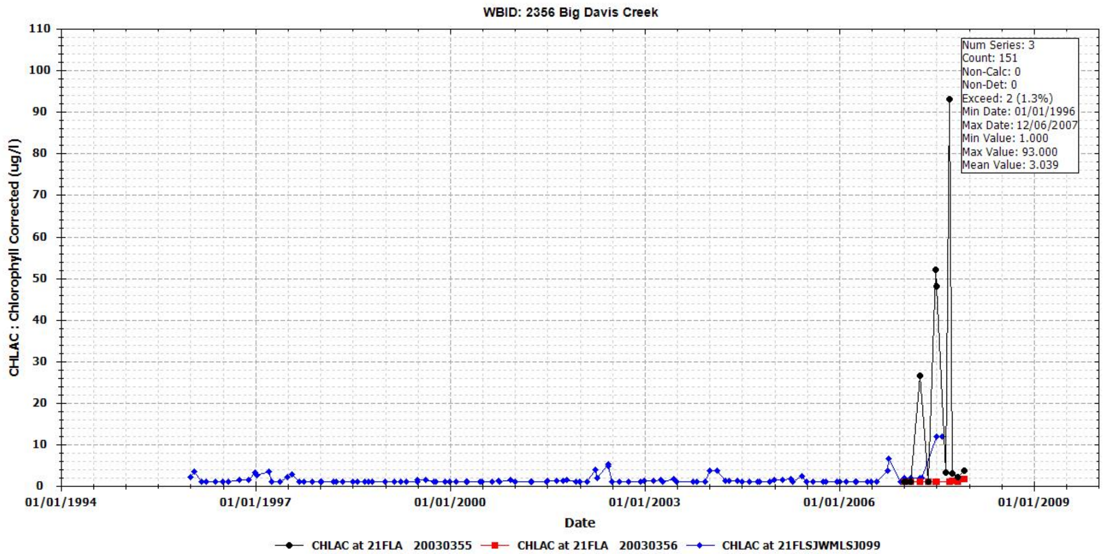

Figure 14 WBID: 2356 Big Davis Creek Measured Chlorophyll a Concentrations

6. 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. A point source is defined as a discernable, 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 facilities, including certain urban stormwater discharges such as municipal separate stormwater systems (MS4 areas), certain industrial facilities, and construction sites over one acre, are stormwater driven sources considered “point sources” in this document.

Nonpoint sources of pollution are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For nutrients, these sources include runoff of agricultural fields, golf courses, and lawns, septic tanks, and residential developments outside of MS4 areas. Nonpoint sources generally, but not always, involve accumulation of nutrients on land surfaces and wash-off as a result of rainfall events.

6.1. Point Sources

There are no continuous permitted point sources dischargers in the Julington Creek and Big Davis Creek Watershed.

6.1.1. Municipal Separate Stormwater System Permits

Municipal Separate Stormwater Systems (MS4s) are point sources also regulated by the NPDES program. According to 40 CFR 122.26(b)(8), a municipal separate storm sewer (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."

Municipal Separate Storm Sewer Systems (MS4s) may discharge nutrients and other pollutants to waterbodies in response to storm events. In 1990, USEPA developed rules establishing Phase I of the National Pollutant Discharge Elimination System (NPDES) stormwater program, designed to prevent harmful pollutants from being washed by stormwater runoff into Municipal Separate Storm Sewer Systems (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.

There is one permitted MS4s in the Julington Creek and Big Davis Creek watershed (Table 3).

Table 3 MS4 Permits Potentially Impacted by TMDL

Permit Name	Permit Number	County
City of Jacksonville	FLS000012	Duval

6.2. Non Point Sources

Nonpoint source pollution generally involves a buildup of pollutants on the land surface that wash off during rain events and as such, represent contributions from diffuse sources, rather than from a defined outlet. Potential nonpoint sources are commonly identified, and their loads estimated, based on land cover data. Most methods calculate nonpoint source loadings as the product of the water quality concentration and runoff water volume associated with certain land use practices. The mean concentration of pollutants in the runoff from a storm event is known as the Event Mean Concentration, or EMC.

Table 4 and Table 5 provide the landuse distribution for the Julington and Big Davis Creek watershed which contains WBIDs: 2351 and 2356. The latest landuse coverages were obtained from the Florida Department of the Environment (FDEP) FTP site. The landuses are described using the Florida Landuse Classification Code (FLUCC) Level 1. The predominant landuse draining directly to Julington Creek and Big Davis Creek is urban and upland forest (50% and 44% respectively).

Table 4 Landuse Distribution in the Julington Creek

Land Use Name	Area (ac)	Portion of Watershed (%)
AGRICULTURE	83.1	0.64
BARREN LAND	116.6	0.89
RANGELAND	216.7	1.66
TRANSPORTATION, COMMUNICATION AND UTILITIES	663.3	5.09
UPLAND FORESTS	1529.4	11.73
URBAN AND BUILT-UP	6621.1	50.78
WATER	440.1	3.38
WETLANDS	3289.4	25.23
Totals	13040	100

Table 5 Landuse Distribution in the Big Davis Creek Watershed

Land Use Name	Area (ac)	Portion of Watershed (%)
AGRICULTURE	9.6	0.14
RANGELAND	101.9	1.51
TRANSPORTATION, COMMUNICATION AND UTILITIES	317	4.69
UPLAND FORESTS	2983.5	44.12
URBAN AND BUILT-UP	735.7	10.88
WATER	117.9	1.74
WETLANDS	2496.5	36.92
Totals	6762.1	100

Figure 15 illustrates the landuses in the Julington Creek and Big Davis Creek watershed.

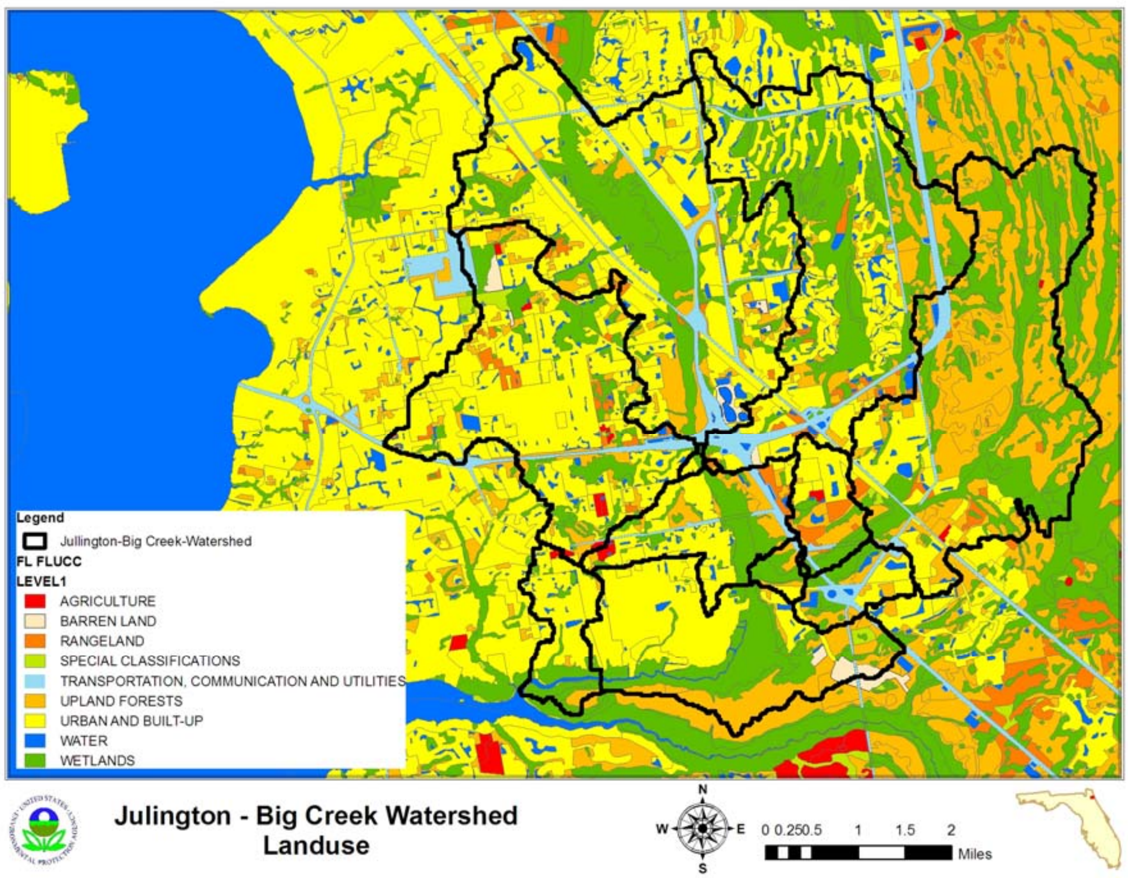

Figure 15 Julington Creek and Big Davis Creek Landuse Distribution

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 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

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" (Section 62-4-.432 (5)(c), F.A.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.

6.2.2. Agriculture

Agricultural lands include improved and unimproved pasture, row and field crops, citrus, and specialty farms. The highest total nitrogen and total phosphorus event mean concentrations are associated with agricultural land uses.

6.2.3. Rangeland

Rangeland includes herbaceous, scrub, disturbed scrub and coastal scrub areas. Event mean concentrations for rangeland are about average for total nitrogen and low for total phosphorus.

6.2.4. Upland Forests

Upland forests include flatwoods, oak, various types of hardwoods, conifers and tree plantations. Event mean concentrations for upland forests are low for both total nitrogen and total phosphorus.

6.2.5. Water and Wetlands

These occur throughout the watershed and have very low event mean concentrations down to zero.

6.2.6. Barren Land

Barren land includes beaches, borrow pits, disturbed lands and fill areas. Barren lands comprise only a small portion of the watershed. Event mean concentrations for barren lands tend to be higher in total nitrogen.

6.2.7. Transportation, Communications and Utilities

Transportation uses include airports, roads and railroads. Event mean concentrations for these types of uses are in the mid-range for total nitrogen and total phosphorus.

7. 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.

Two mechanistic models were used in the development of the TMDL for Julington Creek and Big Davis Creek TMDL. The first model is a dynamic watershed model that predicts the quantity of water and pollutants that are associated with runoff from rain events. The second model is a dynamic water quality model that is capable of integrating the loadings from the watershed model to predict the water quality in the receiving waterbody.

The period of simulation that was considered in the development of this TMDL is January 1, 2001 to January 1, 2008. The models were used to predict time series for total nitrogen, total phosphorus, BOD, dissolved oxygen, and chlorophyll a. The models were calibrated to current conditions and were then used to predict improvements in water quality as function of reductions in loadings.

More details on the model application in the development of the Julington Creek and Big Davis Creek TMDL are presented in Appendix A.

7.1. 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 EPA Region 3 (under contract with Tetra Tech) and has been widely used for TMDLs. In 2003, the U.S. Environmental Protection Agency (EPA) 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 EPA TMDL Modeling Toolbox.

LSPC will be used to simulate runoff (flow, total nitrogen, total phosphorus and BOD) from the land surface using a daily timestep for current and natural conditions of the Julington Creek and Big Davis Creek watershed. The predicted timeseries will be used as boundary conditions for the receiving waterbody model to predict in-stream and in-lake water quality.

7.2. Water Quality Analysis Simulation Program (WASP)

The Water Quality Analysis Simulation Program— (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 conventional pollutant model within the WASP framework is capable of predicting time varying concentrations for chlorophyll a, dissolved oxygen, nutrients (nitrogen, phosphorus) as function of loadings, flows, and environmental conditions.

WASP was calibrated to the current conditions of the Julington Creek and Big Davis Creek watershed using known meteorology, predicted loadings from the LSPC model and constrained by observed data in Julington Creek and Big Davis Creek. Furthermore, WASP was used in determining the load reductions that would be needed to achieve the water quality standards and nutrient targets for Julington Creek and Big Davis Creek.

7.3. Scenarios

Several modeling scenarios were developed and evaluated in this TMDL determination. A full description of each of these scenarios is presented in Appendix A.

7.3.1. Current Condition

The first scenario is to model the current conditions of the watershed. This included the development of a watershed and water quality model. The watershed model is parameterized using the current landuses and measured meteorological conditions to predict the current loadings of nitrogen, phosphorus and BOD. These predicted loadings and flow time series are passed on to the water quality model where the predicted algal, nitrogen, phosphorus, BOD and dissolved oxygen concentrations are predicted over time. The models (watershed and water quality) are calibrated to an eight year period of time to take into account varying environmental, meteorological or hydrological conditions on water quality.

Table 6 Comparison of Model Calibration vs. Observed Data

Big Davis CREEK	2002–2007 Data Average	2002-2007 Model Average
Total Nitrogen (mg/l)	0.81	0.88
Total Phosphorus (mg/l)	0.080	0.084
DO (mg/l)	4.3	4.9
Flow (cms)	0.28	0.25
Julington CREEK	**2002–2007 Data Average**	**2002-2007 Model Average**
DO (mg/l)	4.9	5.0

The current condition simulation will be used to determine the base loadings for the Julington Creek and Big Davis Creek. These base loadings compared with the TMDL scenario will be used to determine the percent reduction in nutrient loads that will be needed to achieve water quality standards.

7.3.2. Natural Condition

The natural condition scenario is developed to estimate what water quality conditions would exist if there were little to no impact from anthropogenic sources. There are point source dischargers in the Julington Creek and Big Davis Creek watershed that will be removed in the natural condition scenaris. Any landuse that is associated with man induced (urban, agriculture, transportation, barren lands and rangeland) activities is converted to upland forests for purpose of this analysis and the associated event mean concentration for nitrogen, phosphorus and BOD are used. These natural condition loadings from the watershed model are passed onto the water quality model where natural water quality conditions are predicted. The natural condition water quality predictions are presented in Table 7.

Table 7 Predicted Water Quality for Impervious Area Scenario

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	0.58
Total Nitrogen (mg/l)	0.03
Total Phosphorus (mg/l)	5.58
DO avg (mg/l)	7.6
DO minimum (mg/l)	5.7

The purpose of the natural conditions scenario is determine whether water quality standards can be achieved without abating the naturally occurring loads from the watershed.

7.3.3. Lower St. Johns River Nutrient TMDL

The Florida Department of Environmental Protect (FDEP) has promulgated a TMDL for the Lower St. John's River in 2008. This TMDL prescribed reductions in the total nitrogen loadings from the surrounding watersheds by 30%. This scenario investigates the possibility of the LSJR TMDL load reductions will achieve water quality standards in Julington and Big Davis Creek.

A modeling scenario was developed to predict the nutrient, chlorophyll a, and dissolved oxygen values for Julington Creek and Big Davis Creek reducing the total nitrogen load by 30%, and not adjusting the total phosphorus or BOD loadings. The results of the LSJR TMDL scenario are presented in Table 8.

Table 8 Predicted Water Quality Applying LSJR Nutrient TMDL

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	2.8
Total Nitrogen (mg/l)	0.73
Total Phosphorus (mg/l)	0.08
DO avg (mg/l)	5.9
DO minimum (mg/l)	2.5

While the application of the LSJR TMDL does improve the predicted water quality, it does not achieve water quality standards for dissolved oxygen. Thus it is necessary to consider further reductions.

7.3.4. 50 Percent Reduction Scenario

A fifty percent nutrient reduction scenario was evaluated including a corresponding reduction in sediment oxygen demand (SOD). Note no reductions were made that were less than the predicted natural conditions. Table 9 presents the predicted water quality under the 50% nutrient reduction scenario.

Table 9 Predicted Water Quality for 50% Nutrient Reduction

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	1.77
Total Nitrogen (mg/l)	0.52
Total Phosphorus (mg/l)	0.06
DO avg (mg/l)	6.5
DO minimum (mg/l)	3.7

7.3.5. Total Phosphorous 75 Percent Reduction Scenario

Seventy five percent total phosphorus (Natural condition) and fifty percent total nitrogen and BOD reduction scenario was evaluated including a corresponding reduction in sediment oxygen demand (SOD).

Table 10 presents the predicted water quality under the 75% TP and 50% TN reduction scenario.

Table 10 Predicted Water Quality for 75% TP Reduction and 50% TN

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	1.77
Total Nitrogen (mg/l)	0.52
Total Phosphorus (mg/l)	0.03
DO avg (mg/l)	6.9
DO minimum (mg/l)	5.0

7.3.6. Impervious Area Reduction Scenario

The large impervious area (assumed to be 33% of total urban area) causes higher rain event loadings and lower low flow conditions, both conditions which result in lower dissolved oxygen and higher nutrient loads. If storm water controls are put in to place that mitigates the impacts of the impervious area a lower percent reduction of nutrients is required to meet water quality standards. Table 11 gives the predicted concentrations for total nitrogen, total phosphorus and dissolved oxygen for the alternative of mitigating for impervious areas.

Table 11 Predicted Water Quality for Impervious Area Scenario

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	2.31
Total Nitrogen (mg/l)	0.83
Total Phosphorus (mg/l)	0.06
DO avg (mg/l)	6.8
DO minimum (mg/l)	4.5

7.3.7. TMDL

The TMDL scenario determines how much the current loadings would need to be reduced to achieve the applicable water quality standards (dissolved oxygen) and nutrient (nitrogen and phosphorus) interpretation of the narrative to protect against imbalance of flora and fauna. The predicted loading from the current conditions watershed model are incrementally reduced in the receiving waterbody model until the dissolved oxygen concentrations are above 5 mg/l or at natural background conditions. The TMDL modeling scenario assumes the implementation of the impervious area scenario and an additional 5% reduction in total nitrogen, total phosphorus and BOD as described in Appendix A.

Table 12 presents the average values for total nitrogen, total phosphorus, BOD, chlorophyll a, and dissolved oxygen for the TMDL scenario.

Table 12 TMDL Model Predictions

Julington and Big Davis Creeks	2001-2008 Model Prediction Annual Average
BOD (mg/l)	2.2
Total Nitrogen (mg/l)	0.80
Total Phosphorus (mg/l)	0.056
DO avg (mg/l)	6.9
DO minimum (mg/l)	5.0

8. TMDL Determination

A total maximum daily load (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:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

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 TMDL development, allowable loadings 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 mass loads, since the approach used to determine the TMDL targets relied on annual loadings. 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 loadings coming from the upstream watershed (Sweetwater Creek) and watershed that directly drains to Julington Creek and Big Davis

Creek. The allocations are given in Table 13. The MS4 service area is expected to reduce its loadings at the same percentage as the load allocation.

Table 13 TMDL Load Allocations for Julington Creek, Big Davis Creek and Sweetwater Creek (2351, 2356 and 2350)

		Current Condition		TMDL Condition		Percent
WBID	Constituent	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	Reduction
2351	Total Nitrogen	**	41810	**	21724	48%
	Total Phosphorus	**	6345	**	2598	59%
	BOD	**	185582	**	92014	50%
2356	Total Nitrogen	**	11440	**	8362	27%
	Total Phosphorus	**	1323	**	786	41%
	BOD	**	56773	**	41907	26%
2350	Total Nitrogen	**	12047	**	7172	40%
	Total Phosphorus	**	1643	**	741	55%
	BOD	**	54549	**	32050	41%

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 loadings and wet weather point source loadings 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 loading 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. Because of the eight year simulation period used in the model development, the model encompasses both critical and seasonal variations to determine the annual average allowable load.

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 a 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 margin of safety as TMDL targets for nutrients were set to natural background conditions for the individual watersheds.

8.3. Waste Load Allocations

Only MS4s and NPDES facilities discharging directly into lake segments (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. NPDES Dischargers

There are no point source continuous dischargers in the Julington Creek and Big Davis Creek watershed that are causing and contributing to the impairment.

8.3.2. Municipal Separate Storm 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 loadings coming exclusively from the MS4 areas. Although the aggregate wasteload 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 these TMDLs 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.

These TMDLs assume 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, these TMDLs assume 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.

The percent reduction calculated for nonpoint sources is assigned to the MS4 as loads from both sources typically occur in response to storm events. 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. Best management practices for the MS4 service should be developed to meet the percent reduction for both nitrogen and phosphorus as prescribed in Table 13.

8.4. Load Allocations

The load allocation for nonpoint sources was assigned a percent reduction from the current loadings coming into Julington Creek and Big Davis Creek and should be considered in the Basin Management Action Plan once the TMDL is implemented.

9. References

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

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

Harper, H. H. 1993. Stormwater loading rate parameters for Central and South Florida. Environmental Research & Design, Inc. Orlando, FL.

Keenan, L. W., E. F. Lowe, and D. R. Dobberfuhl. 2003. Pollutant load reduction goals for the Upper St. Johns River Basin. St. Johns River Water Management District, Division of Environmental Sciences, Palatka, FL.