PROPOSED
TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Dissolved Oxygen & Nutrients
In
Alafia River (North Prong) Upper Segment
(WBID 1621E)

And
Nutrients
In
Alafia River (South Prong)
(WBID 1653)

November 2012

United States Environmental Protection Agency

Region 4 serving the southeast

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY SHEET for WBID 1621E

Total Maximum Daily Load (TMDL)

2009 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
1621E	Alafia River (North Prong) Upper Segment	Class III Freshwater	Tampa Bay Tributaries	03100204	Polk-Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen & Nutrients

TMDL Technical Approach:

The TMDL allocations were determined by analyzing the effects of TN and TP concentrations and loadings on DO concentrations in the waterbody. A watershed model was used to predict delivery of pollutant loads to the waterbody and to evaluate the in-stream impacts of the pollutant loads. TN and TP geomean concentrations were evaluated against numeric nutrient criteria standards.

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	132,857	29,204	69,085	29,204	48%	0%	0%
Total Phosphorus	213,914	1,881	4,278	1,881	89%	0%	0%

Endangered Species Present (Yes or Blank): Yes

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:

Facility Number	Permittee(s)	Type
FL0000523	CF Industries, Inc. - Bartow Chemical Plant	Commercial
FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	Commercial
FL0000752	Mosaic Fertilizer, LLC - Green Bay Chemical Plant	Commercial
FL0002666	Exxon Mobil Refining & Supply Co. - Electrophos Site	Commercial

FL0020338	City of Mulberry	Domestic
FLS000006	Hillsborough County	Phase IC MS4
FLS000015	Polk County	Phase IC MS4
FLS000015	Polk County, City of Mulberry	Phase I MS4

SUMMARY SHEET for WBID 1653
Total Maximum Daily Load (TMDL)

2009 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	Class and Waterbody Type	Major River Basin	HUC	County	State
1653	Alafia River (South Prong)	Class III Freshwater	Tampa Bay Tributaries	03100204	Polk-Hillsborough	Florida

TMDL Endpoints/Targets:

Nutrients

TMDL Technical Approach:

The TMDL allocations were determined by analyzing the effects of TN and TP concentrations and loadings on DO concentrations in the waterbody. A watershed model was used to predict delivery of pollutant loads to the waterbody and to evaluate the in-stream impacts of the pollutant loads. TN and TP geomean concentrations were evaluated against numeric nutrient criteria standards.

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	71,298	102,316	71,298	102,316	0%	0%	0%
Total Phosphorus	80,128	12,250	38,461	12,250	52%	0%	0%

Endangered Species Present (Yes or Blank): Yes

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:

Facility Number	Facility Name	Type
FL0000256	Mosaic Phosphates Company - Kingsford Mine Complex	Commercial
FL0033332	Mosaic Phosphates Company - Lonesome Mine	Commercial
FL0132381	Cytec Industries, Inc. - Brewster Plant	Commercial
FLS000006	Hillsborough County	Phase IC MS4

FLS000015	Polk County	Phase IC 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.

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 (WBID) numbers are assigned to each water segment. This TMDL addresses both WBIDs 1621E and 1653, which are Group 2 waterbodies located in the Alafia River Planning Unit and is managed by the Southwest Florida Water Management District (SWFWMD). WBID 1621E and WBID 1653 are impaired for nutrients, and WBID 1653 is also impaired for dissolved oxygen.

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 2009 section 303(d) list identified numerous WBIDs in the Tampa Bay Tributaries Basin as not meeting water quality standards. After assessing all readily available water quality data, USEPA is responsible for developing a TMDL for WBIDs 1621E and 1653, depicted in Figure 2.1.

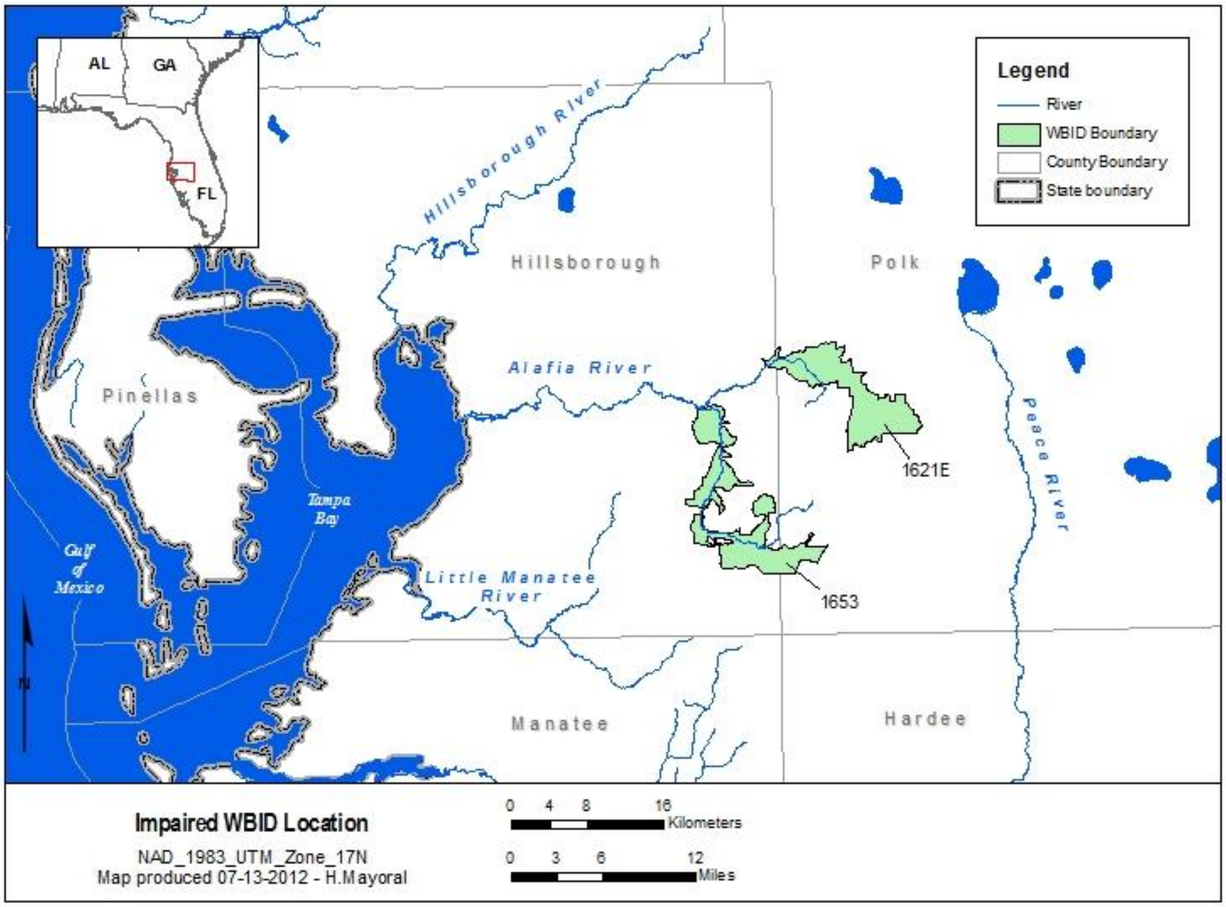

Figure 2.1 Location of impaired WBIDs 1621E and 1653in the Alafia River basin

3.0 WATERSHED DESCRIPTION

3.1 Hydrologic Description

The North Prong Alafia River (WBID 1621E) and the South Prong Alafia River (WBID 1653) join to form the Alafia River. The Alafia River flows through Alderman Ford Park, through the city of Riverview, and then through the city of Gibsonton where it drains into the Hillsborough Bay segment of the Tampa Bay estuary. Some water is diverted from the Alafia River into the C.W. Bill Young Regional Reservoir in Lithia, Florida for regional water supply.

The North Prong Alafia River upper segment (WBID 1621E) is located in the western part of Polk County, southwest of the City of Lakeland. The river channel is approximately 11.7 miles long and originates on mined lands southeast of the City of Mulberry and flows in a northwesterly direction to the confluence with English Creek and Thirtymile Creek. Tributaries to this upper segment of the North Prong include Skinned Sapling Creek, Bird Branch, and Poley Creek. The North Prong Alafia River (WBID 1621E) covers approximately 15,000 acres, of which the primary land uses are quarries/strip mines (8,332 acres), forested wetland (1,489 acres), and developed (1,192 acres medium intensity and 1,058 acres high intensity).

The predominant land use in the watershed is phosphate mine lands, which includes phosphate processing facilities, phosphogysum stacks (waste by-product), and cooling and settling ponds. The majority of the phosphate deposits have previously been mined and there are mine reclamation activities ongoing in the watershed. Along the mid to lower reaches of this river segment there are residential areas in and near the City of Mulberry. North Prong Alafia River is classified as a Class III waterbody, with designated uses of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife.

There are several NPDES-permitted outfalls discharging to the North Prong Alafia River (WBID 1621E). Most of these are industrial point sources operated by CF Industries and Mosaic Fertilizer and consist of stormwater, treated process water, and mine recirculation effluent.

The South Prong Alafia River (WBID 1653) is located in Hillsborough and Polk Counties. The South Prong of the Alafia River is approximately 17.5 miles long and generally flows in a northerly direction from the upper portion of the drainage in southwestern Polk County until it reaches the Alafia River in Hillsborough County. From there the Alafia River flows generally westward to Tampa Bay at Gibsonton, Florida. The South Prong of the Alafia River basin covers approximately 17,500 acres. Predominant land uses include: quarries/strip mines (6,130 acres), forested wetland (3,491 acres), and pasture (3,104 acres). The Alafia River State Park is within this basin, located on reclaimed land that was once a phosphate mining site.

3.2 Climate

The climate in Central Florida is sub-tropical. Rainfall over a 30-year period (1971 – 2000) from a station in Bartow, Florida averaged approximately 51 inches, (SERCC 2012). Average high temperatures in the summer are in the low-90s (°F), and average low temperatures in the winter are in the low-50s (°F).

3.3 Land Use

In WBID 1621E, strip mines and quarries make up the largest land use classification at 55 percent of the total land use (Figure 3.1 and Table 3.1). Combined developed land use, which accounts for 19 percent of the total land use, is located within and around the City of Mulberry. A majority of the developed land use is classified as medium-intensity and high intensity development, both of which combined represent approximately 15 percent of the total land use. Combined forested and non-forested wetlands account for an additional 15 percent, and are mainly located along the riparian corridor of the Alafia River. There is very little development in WBID 1653, most of which is classified as low-intensity development, which constitutes 6 percent of the total land use. Quarries and strip mines are located in the headwaters of the south prong of the Alafia River and account for 35 percent of the total land use in WBID 1653. Pastures and combined forested and non-forested wetlands account for an additional 18 percent and 21 percent, respectively. Small areas of forested land uses located in the Alafia River State Park within WBID 1653 account for an additional 12 percent of the total land use.

The drainage area for the Alafia River WBIDs varies from the actual WBID boundaries (Figure 3.2). The United States Geological Survey National Hydrography Dataset was used to delineate the contributing watershed areas. The subwatersheds that contribute to each of the WBIDs are listed on Table 3.2. The actual drainage area of the WBIDs was considerable larger (Table 3.3). The largest percent increase in acreage within WBID 1621E was in row crop land use, which increased from 42 acres to 810 acres. Over 14,500 acres of developed land use was located in the contributing watersheds to WBID 1621E, accounting for 34 percent of the total contributing land use. Combined wetlands doubled from approximately 2,200 acres in WBID 1653 to approximately 4,450 acres in the contributing watersheds to WBID 1653. The total acreage of land in quarries and strip mines in the contributing watersheds is more than double the acreage in WBID 1621E, and more than ten times the acreage in WBID 1653. Quarries and strip mines were the dominate land uses in the contributing subwatersheds, accounting for 40 percent of the total contributing area in WBID 1621E and 66 percent in WBID 1653.

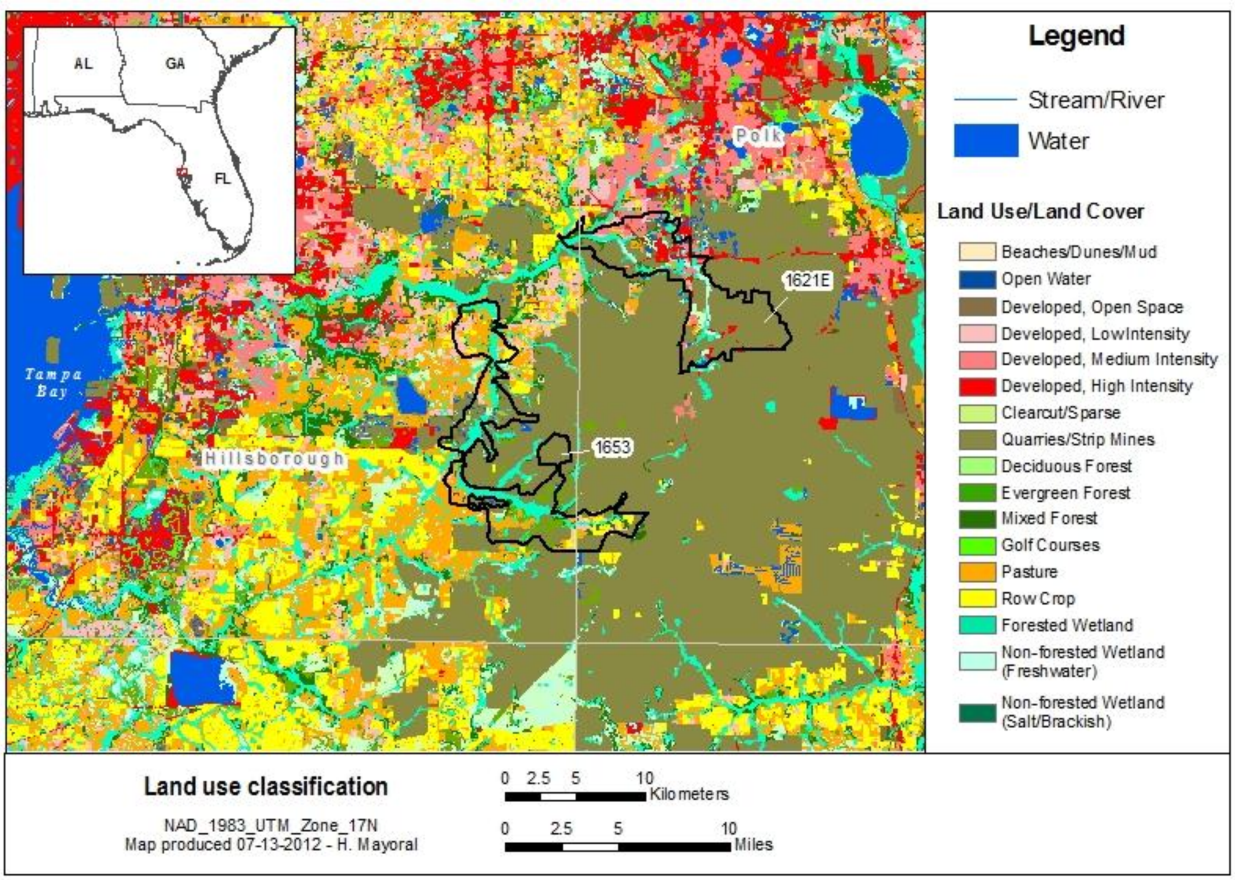

Figure 3.1 Land use for WBIDs 1621E and 1653 in the Alafia River basin

Table 3.1 Land use distribution for WBIDs 1621E and 1653 in the Alafia River basin

Land Use Classification	WBID 1621E		WBID 1653	
	Acres	%	Acres	%
Evergreen Forest	43	0%	1,243	7%
Deciduous Forest	6	0%	56	0%
Mixed Forest	482	3%	783	4%
Forested Wetland	1,489	10%	3,491	20%
Non-Forested Wetland (Freshwater)	735	5%	163	1%
Open Water	319	2%	189	1%
Pasture	464	3%	3,104	18%
Row Crop	42	0%	1,027	6%
Clear cut Sparse	367	2%	135	1%
Quarries Strip mines	8,332	55%	6,130	35%
Utility Swaths	0	0%	0	0%
Developed, Open Space	322	2%	128	1%
Developed, Low intensity	338	2%	985	6%
Developed, Medium intensity	1,192	8%	22	0%
Developed, High intensity	1,058	7%	39	0%
Beaches/Dunes/Mud	0	0%	0	0%
Golf Courses	5	0%	0	0%
Totals	15,194	100%	17,495	100%

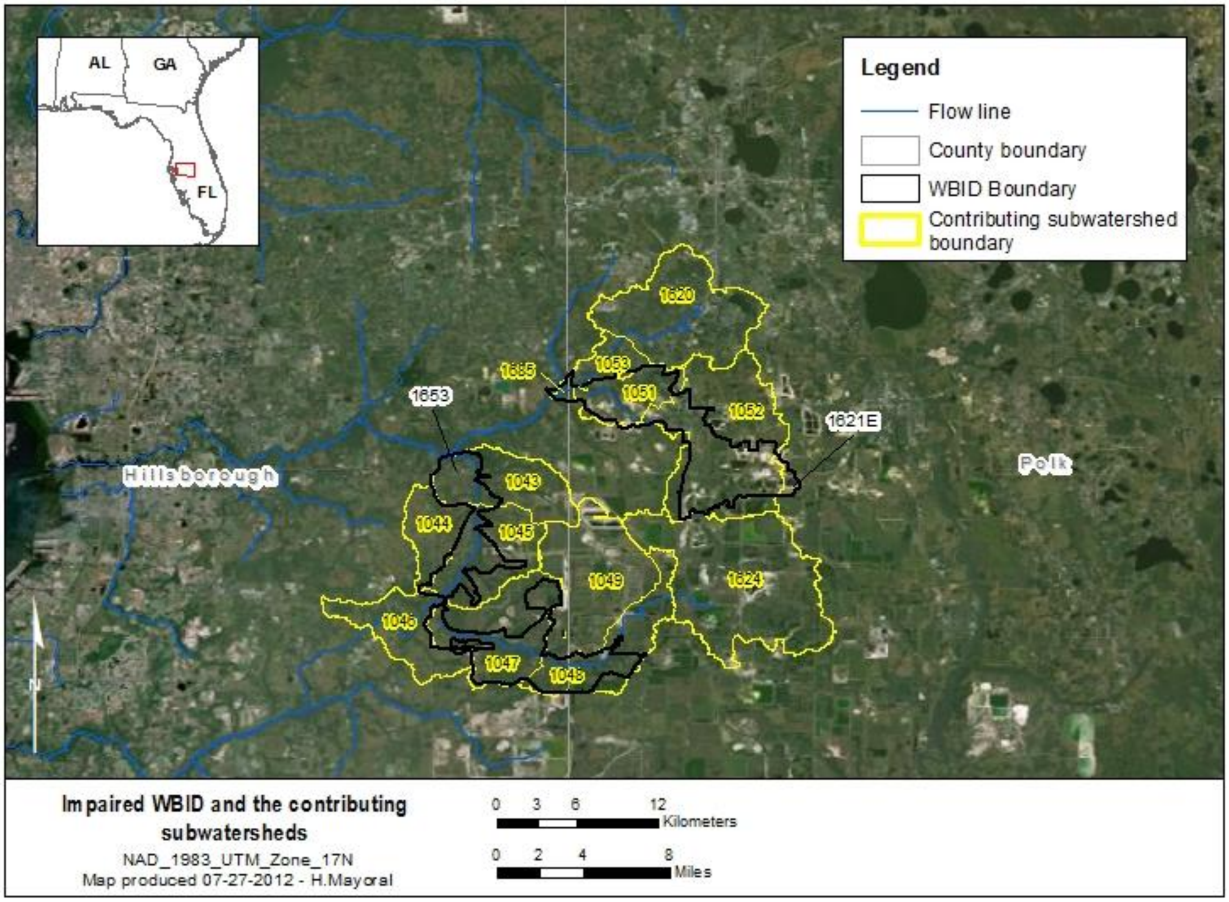

Figure 3.2 Aerial photograph illustrating contributing subwatersheds and impaired WBID boundaries

Table 3.2 Contributing subwatersheds to each WBID

1621E	1653
1051	1043
1052	1044
1053	1045
1620	1046
1685	1047
	1048
	1049
	1624

Table 3.3 Land use distribution for contributing subwatersheds in the Tampa Bay Tributaries basin

Land Use Classification	Contributing subwatersheds for WBID 1621E		Contributing subwatersheds for WBID 1653	
	Acres	%	Acres	%
Evergreen Forest	274	1%	2,391	3%
Deciduous Forest	214	0%	149	0%
Mixed Forest	987	2%	1,597	2%
Forested Wetland	3,232	7%	7,536	9%
Non-Forested Wetland (Freshwater)	1,224	3%	836	1%
Open Water	1,646	4%	511	1%
Pasture	1,842	4%	9,802	11%
Row Crop	810	2%	3,621	4%
Clear cut Sparse	596	1%	790	1%
Quarries Strip mines	17,400	40%	57,649	66%
Utility Swaths	0	0%	0	0%
Developed, Open Space	1,795	4%	127	0%
Developed, Low intensity	1,872	4%	2,439	3%
Developed, Medium intensity	6,880	16%	333	0%
Developed, High intensity	3,957	9%	128	0%
Beaches/Dunes/Mud	0	0%	0	0%
Golf Courses	383	1%	0	0%
Totals	43,113	100%	87,908	100%

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 the Alafia River or establish the TMDL to be consistent with a natural condition if the dissolved oxygen standard cannot be achieved.

The waterbodies in the Alafia River WBIDs 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 for many Class III waters in the state, including streams, which numerically interprets part of the state narrative criterion for nutrients. While those criteria have been submitted to EPA for review pursuant to section 303(c) of the CWA, EPA has not completed that review. Therefore, for streams in Florida, the applicable nutrient water quality standard for CWA purposes remains the Class III narrative criterion.

As set out more fully below, should any new or revised state criteria for nutrients in streams in Florida become applicable for CWA purposes before this proposed TMDL is established, EPA will consider the impact of such criteria on the target selected for this TMDL.

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 invalidated by the U.S. District Court for the Northern District of Florida and remanded back to EPA. Should a federally promulgated criterion become effective for CWA purposes before this proposed TMDL is established, EPA will consider the impact of such criteria on the target selected for this TMDL.

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 dissolved oxygen (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

Florida's recently adopted numeric nutrient criteria interprets the narrative water quality criterion for nutrients in paragraph 62-302.530(48)(b), F.A.C. See section 62-302.531(2). The Florida rule provides that the narrative water quality criteria for nutrients in paragraph 62-302.530(47)(a), F.A.C., continues to apply to all Class III waters. See section 62-302.531(1).

Florida's recently adopted rule applies to streams, including (WBID in TMDL). For streams that do not have a site specific criteria, Florida's rule provides for biological information to be considered together with nutrient thresholds to determine whether a waterbody is attaining 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 1 below are achieved. See section 62-302.531(2)(c).

Florida's rule provides that numeric nutrient criteria are 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.

Should FDEP's numeric nutrient criteria for streams become an applicable water quality standard for CWA purposes before this TMDL is established, EPA will consider the nutrient target necessary to attain section 62-302.531(2)(c), F.A.C. EPA will compare that target with the target necessary to attain paragraph 62-302.530(47)(a), F.A.C., to determine which target is more stringent.

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

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

The WBIDs addressed in this report are listed as not attaining their designated use on Florida's 2009 303(d) list for nutrients and/or dissolved oxygen. 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, 2010. 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 for each WBID are located in Table 5.1, and an analysis of water quality data is documented in Table 5.2. The locations of the water quality monitoring stations in the impaired WBIDs can be found in Figure 5.1 and Figure 5.2. Water quality data for the WBIDs can be found below in Figure 5.3 through Figure 5.12. Data for each water quality parameter from all stations located within are compiled within a figure.

5.1.1 Dissolved Oxygen

There are several factors that affect the concentration of dissolved oxygen (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. For WBID 1621E, the dissolved oxygen minimum concentration was 0.43 mg/L, the maximum concentration was 48.40 mg/L, and the mean concentration was 5.24 mg/L. For WBID 1653, the dissolved oxygen minimum concentration was 1.20 mg/L, the maximum concentration was 16.50 mg/L, and the mean concentration was 6.62 mg/L.

5.1.2 Biochemical Oxygen Demand

BOD 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. Carbonaceous BOD (CBOD) specifically measures the portion of decomposition that involves the conversion of biodegradable carbonaceous materials to carbon dioxide, while BOD5 measures both the nitrogenous and carbonaceous stages over a 5-day period. The mean CBOD concentration for WBID 1621E was 1.22 mg/L. The minimum and maximum CBOD concentrations for WBID 1621E were 0.53 mg/L and 4.60 mg/L, respectively. For WBID 1653, the minimum and maximum CBOD concentrations were 0.0 mg/L and 4.80 mg/L, respectively, and the mean CBOD concentration was 1.20 mg/L.

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. 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.

5.1.3.1 Total Nitrogen

Total Nitrogen (TN) is comprised of nitrate (NO3), nitrite (NO2), organic nitrogen and ammonia nitrogen (NH4). Though 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 occur from the decomposition of aquatic life or from sewage, while inorganic forms are generally from erosion and fertilizers. Nitrates are components of industrial fertilizers, yet can also be naturally present in soil, 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. For WBID 1621E, the total nitrogen minimum concentration was 0.87 mg/L, the maximum concentration was 92.7 mg/L, and the mean concentration was 9.13 mg/L. High total nitrogen values, including the maximum value, occurred in 2004 and 2005. For WBID 1653, the total nitrogen minimum concentration was 0.41 mg/L, the maximum concentration was 3.71 mg/L, and the mean concentration was 1.33 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 adsorbed, amorphous, and precipitated forms. Inorganic forms of phosphorus include orthophosphate and polyphosphates, though 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 uses up oxygen from the water. The mean total phosphorus concentration for WBID 1621E was 6.36 mg/L. The minimum and maximum total phosphorus concentrations for WBID 1621E were 1.50 mg/L and 29.0 mg/L, respectively. For WBID 1653, the minimum and maximum total phosphorus concentrations were 0.33 mg/L and 4.48 mg/L, respectively; and the mean total phosphorus concentration was 1.10 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. The corrected chlorophyll a maximum concentration for WBIDs 1621E and 1653 was 66.0 µg/L and 78.8 µg/L, respectively. The mean corrected chlorophyll a concentration was 2.88 µg/L for WBID 1621E, and 4.36 µg/L for WBID 1653.

Table 5.1 Water quality stations located in WBIDs 1621E and 1653

WBID	Station Number
1621E	21FLBRA 1621E-A
	21FLBRA 1621E-B
	21FLBRA 1621E-C
	21FLBRA 1621E-D
	21FLPOLKALAFIA1N
	21FLPOLKALAFIA2N
	21FLTPA 24020057
	21FLTPA 24020075
	21FLTPA 24020076
	21FLTPA 24020077
	21FLTPA 27505608157445
	21FLTPA 27532068158243
	21FLTPA 27532968200461
1653	112WRD 02301300
	21FLHILL116
	21FLHILL139
	21FLHILL548
	21FLIMCABETH-E
	21FLIMCABETH-W
	21FLIMCAJAMESON

WBID	Station Number
	21FLIMCALONESOME
	21FLIMCATHATCHER
	21FLKWATHIL-ALAFIA224-1
	21FLKWATHIL-ALAFIA224-2
	21FLKWATHIL-ALAFIA224-3
	21FLKWATHIL-ALIVER215-1
	21FLKWATHIL-ALIVER215-2
	21FLKWATHIL-ALIVER215-3
	21FLKWATHIL-ALIVER224-1
	21FLKWATHIL-ALIVER224-2
	21FLKWATHIL-ALIVER224-3
	21FLTPA 24020059
	21FLTPA 24020080
	21FLTPA 27433628201494
	21FLTPA 27474758207028

Table 5.2 Water quality data for WBIDs 1621E and 1653 in the Alafia River basin

Parameter	Stats	WBID	
		1621E	1653
BOD, 5 Day, 20°C (mg/L)	# of obs	16	221
	min	0.53	0.00
	max	4.60	4.80
	mean	1.22	1.20
	Geomean	1.04	0.91
DO, Analysis by Probe (mg/L)	# of obs	171	515
	min	0.43	1.20
	max	48.40	16.50
	mean	5.24	6.62
	Geomean	4.31	6.28
Nitrogen, Total (mg/L as N)	# of obs	146	530
	min	0.87	0.41
	max	92.70	3.71
	mean	9.13	1.33
	Geomean	3.80	1.26
Phosphorus, Total (mg/L as P)	# of obs	146	536
	min	1.50	0.33
	max	29.00	4.48
	mean	6.36	1.10
	Geomean	5.47	0.96
Chlorophyll-A-corrected (µg/L)	# of obs	146	201
	min	0.80	1.00
	max	66.00	78.80
	mean	2.88	4.36
	Geomean	1.81	1.98

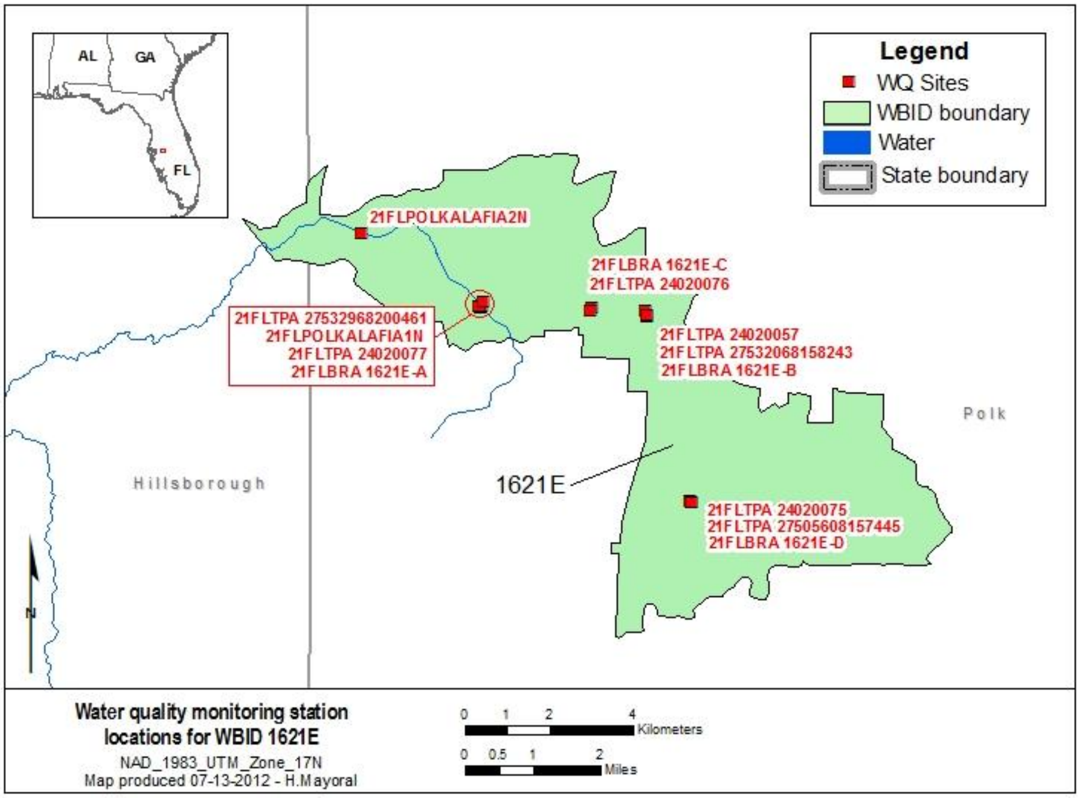

Figure 5.1 Water quality monitoring station locations for WBID 1621E in the Alafia River basin

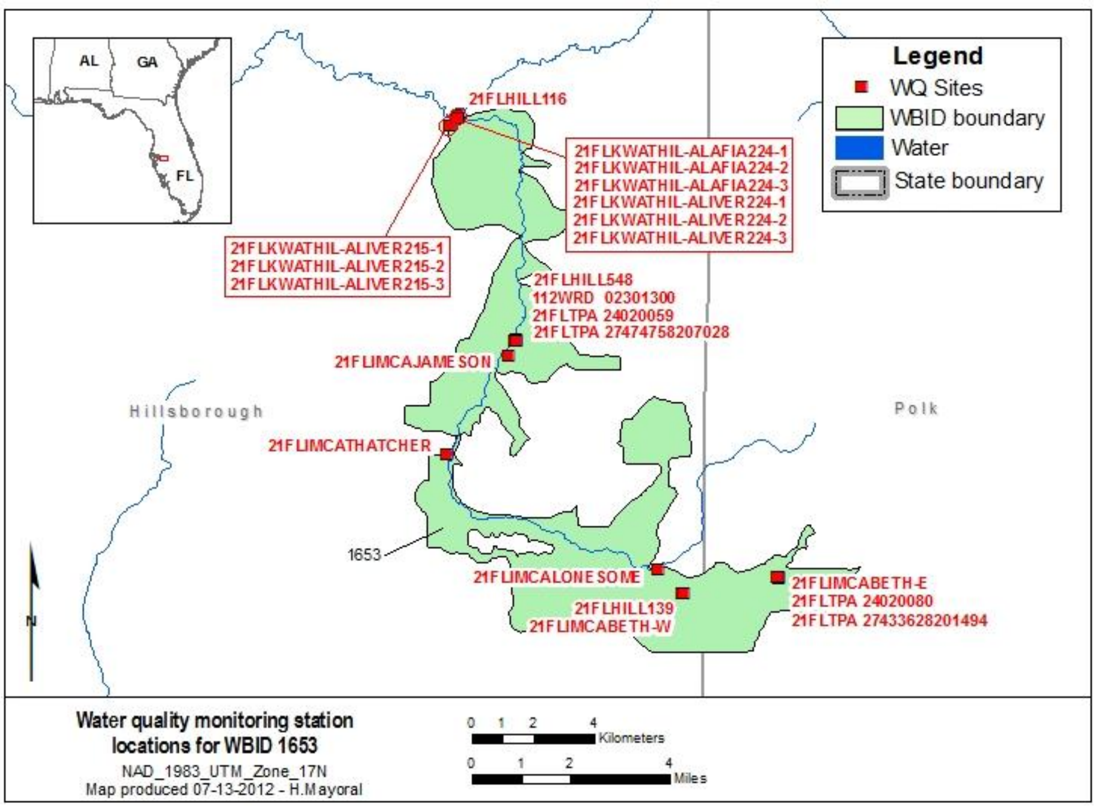

Figure 5.2 Water quality monitoring station locations for WBID 1653 in the Alafia River basin

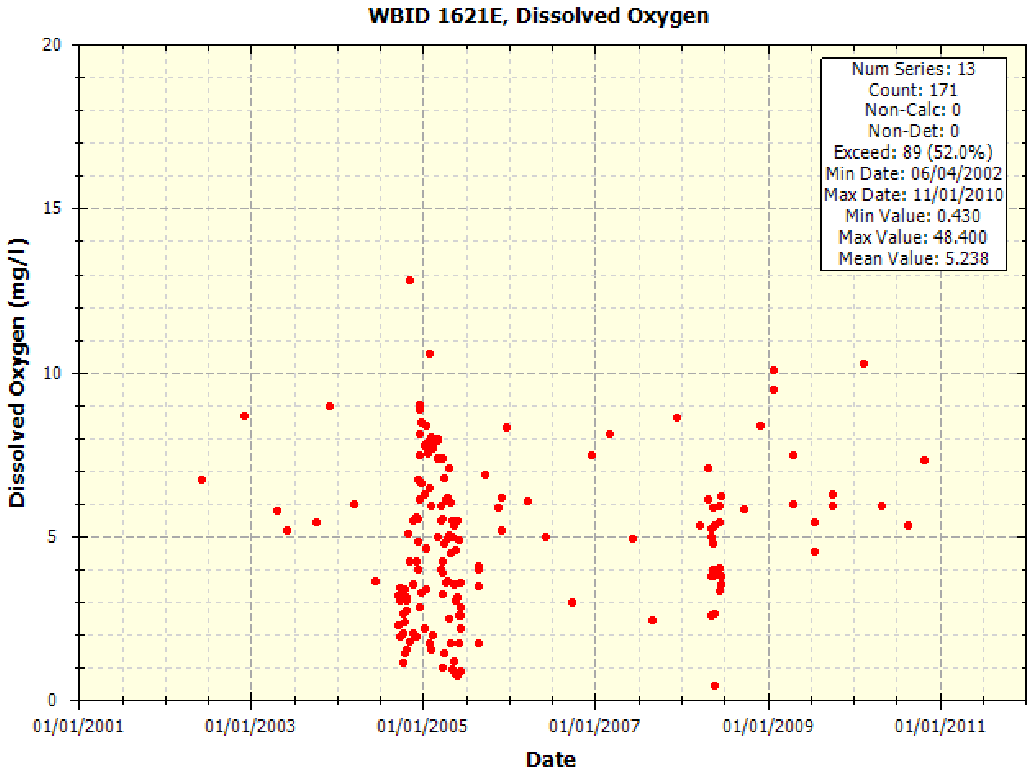

Figure 5.3 Dissolved oxygen concentrations for WBID 1621E

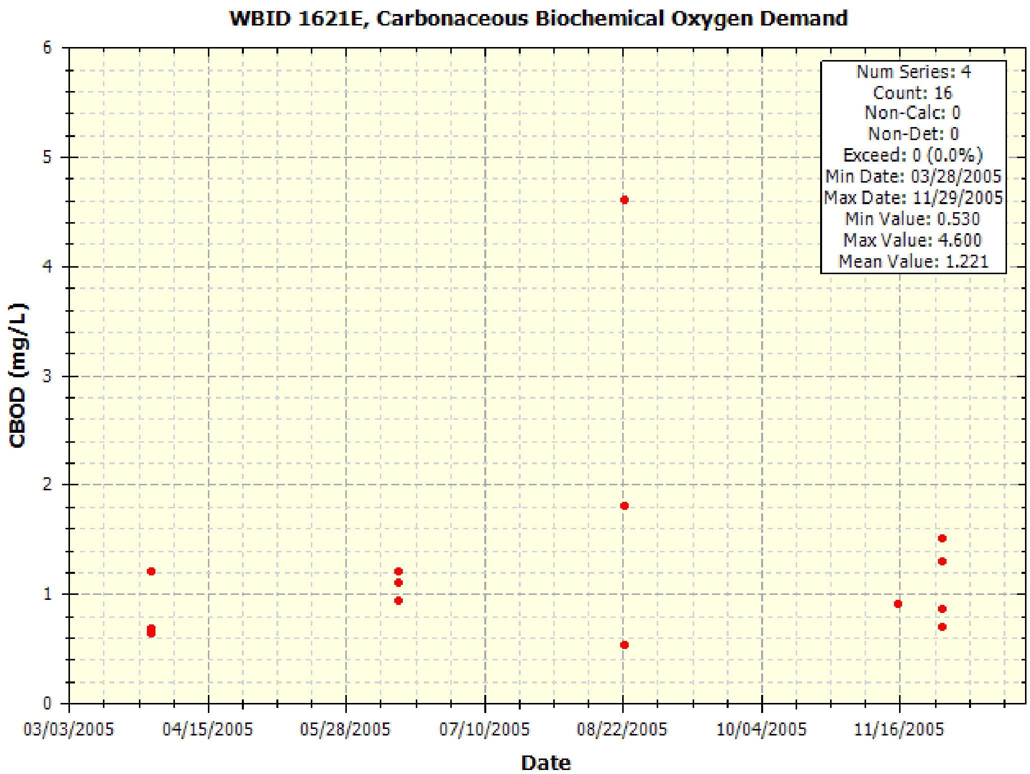

Figure 5.4 Carbonaceous biochemical oxygen demand concentrations for WBID 1621E

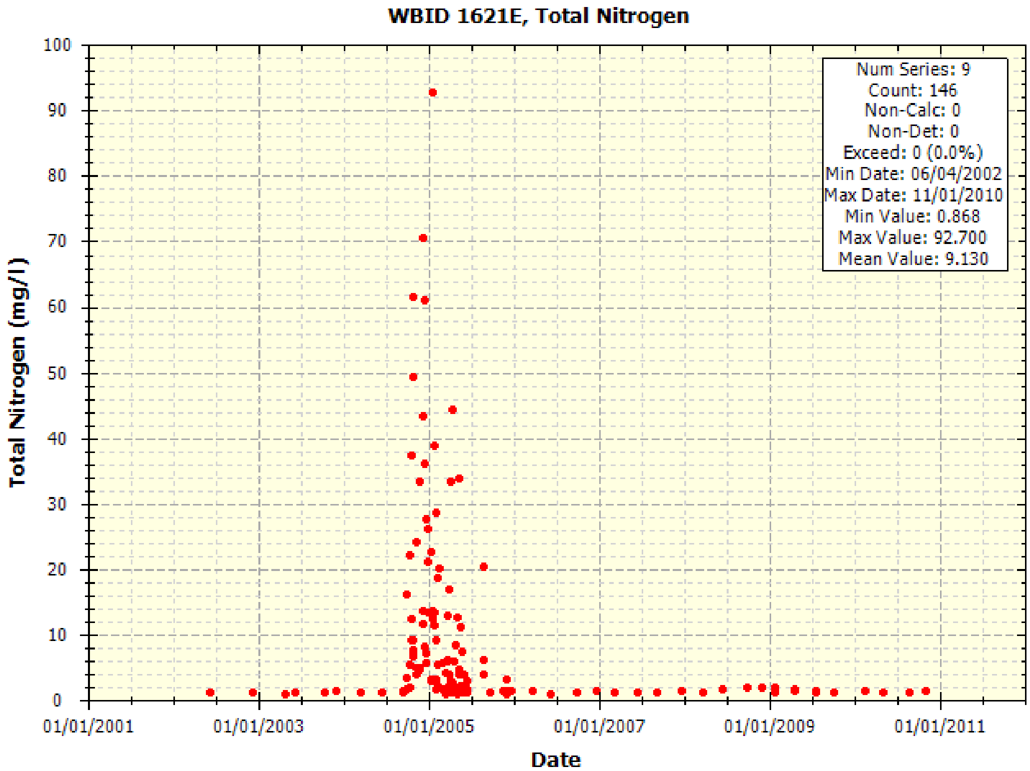

Figure 5.5 Total nitrogen concentrations for WBID 1621E

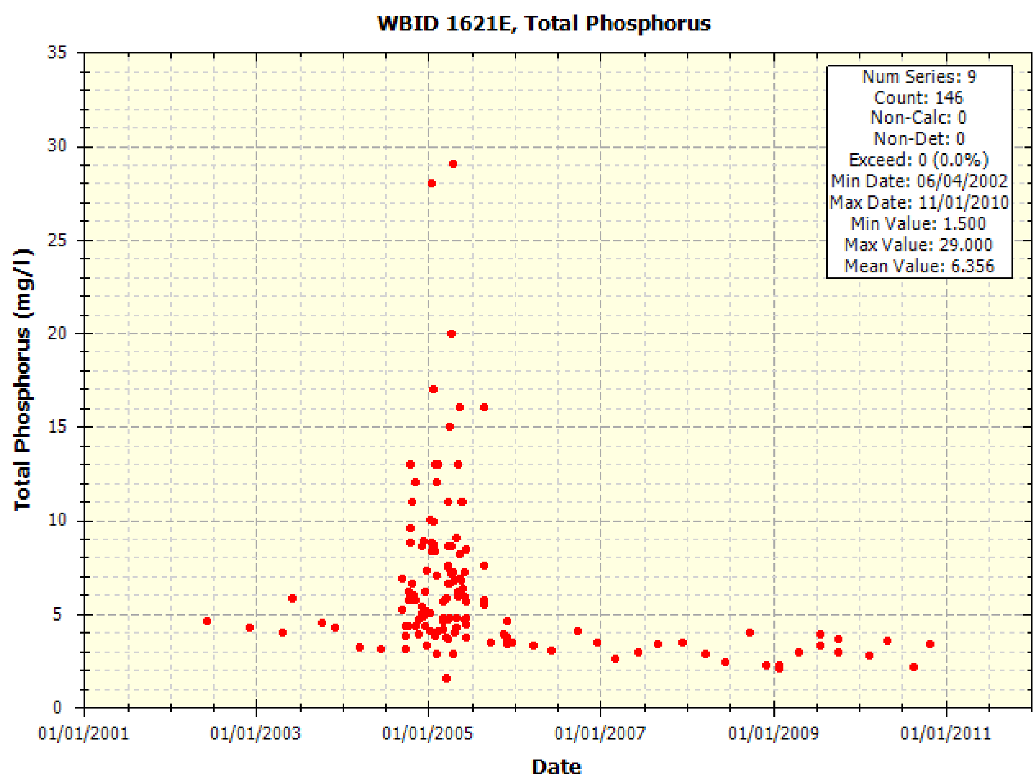

Figure 5.6 Total phosphorus concentrations for WBID 1621E

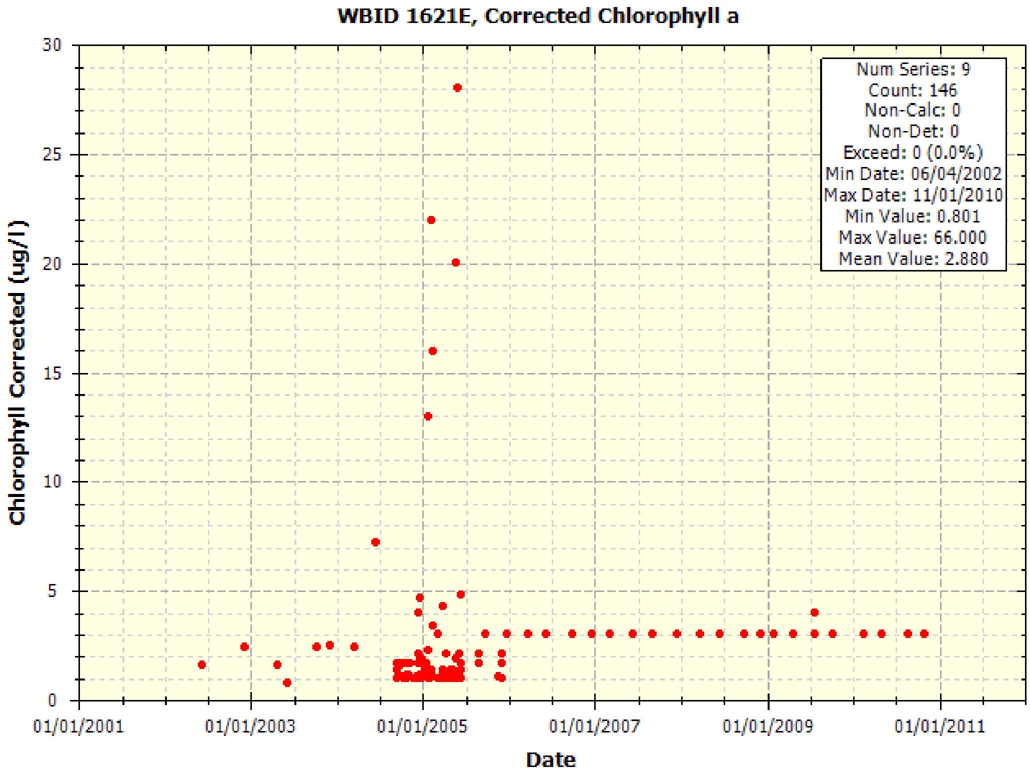

Figure 5.7 Corrected chlorophyll a concentrations for WBID 1621E

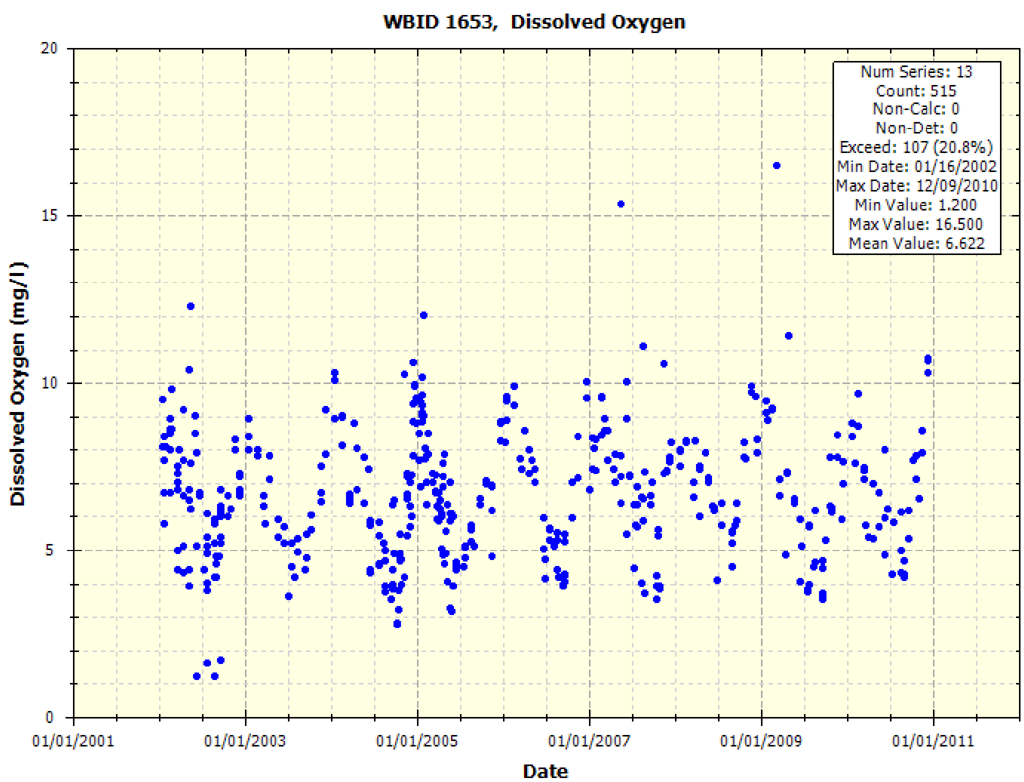

Figure 5.8 Dissolved oxygen concentrations for WBID 1621E

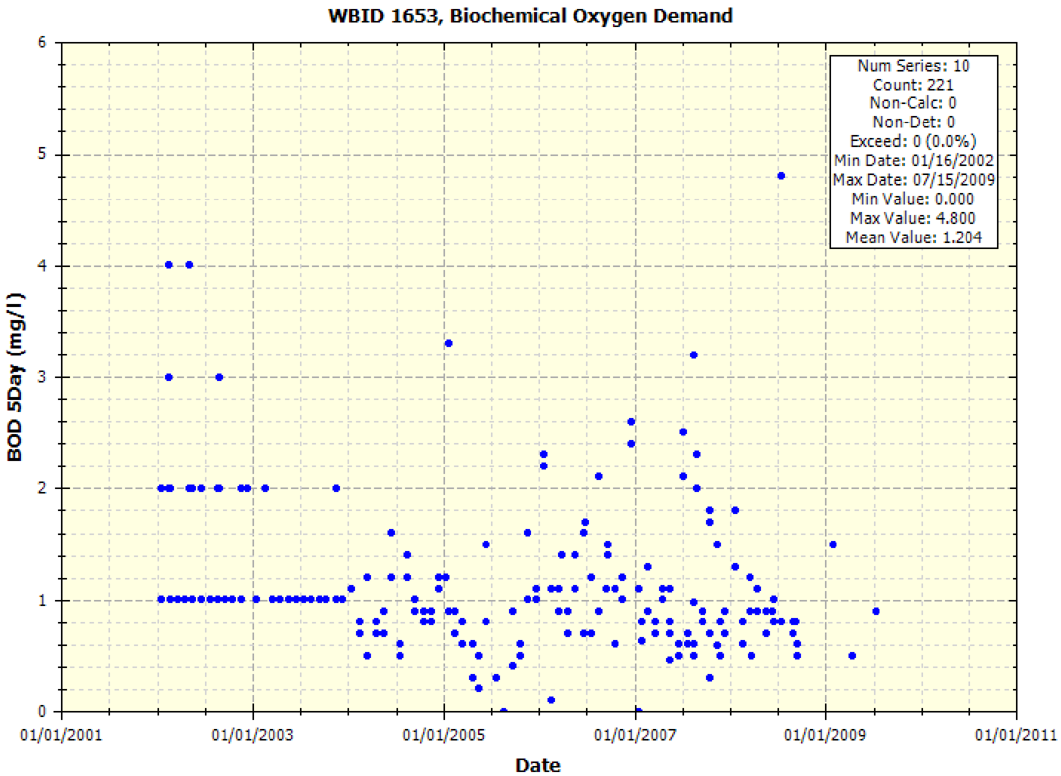

Figure 5.9 Biochemical oxygen demand concentrations for WBID 1653

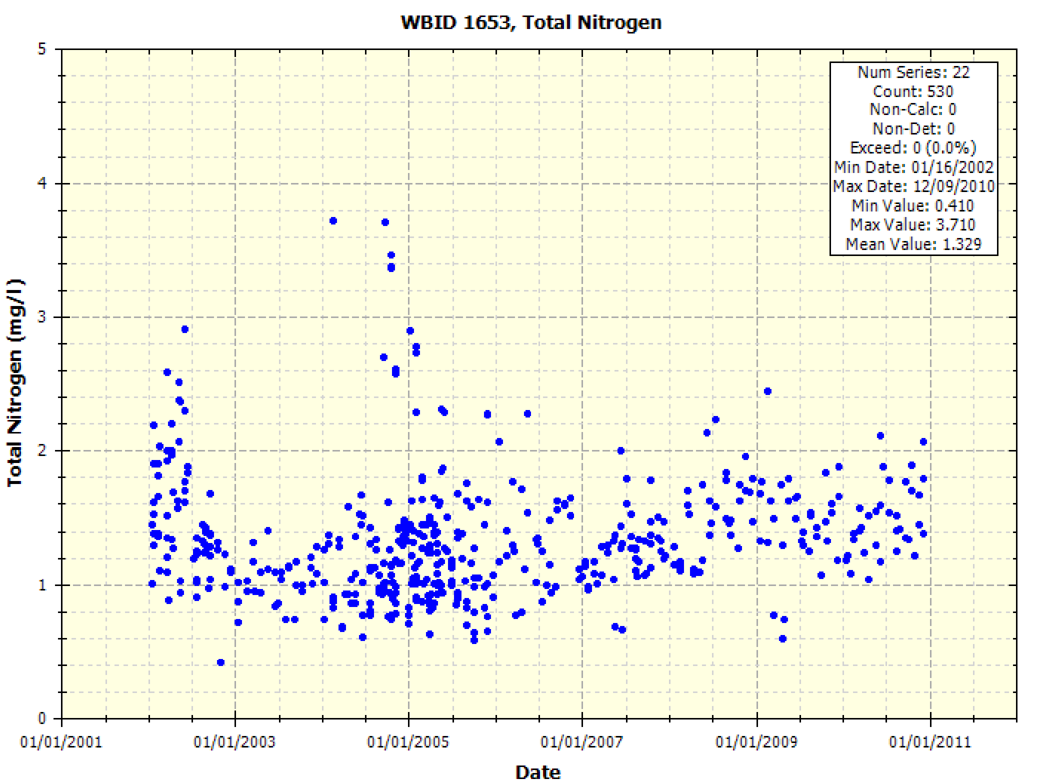

Figure 5.10 Total nitrogen concentrations for WBID 1653

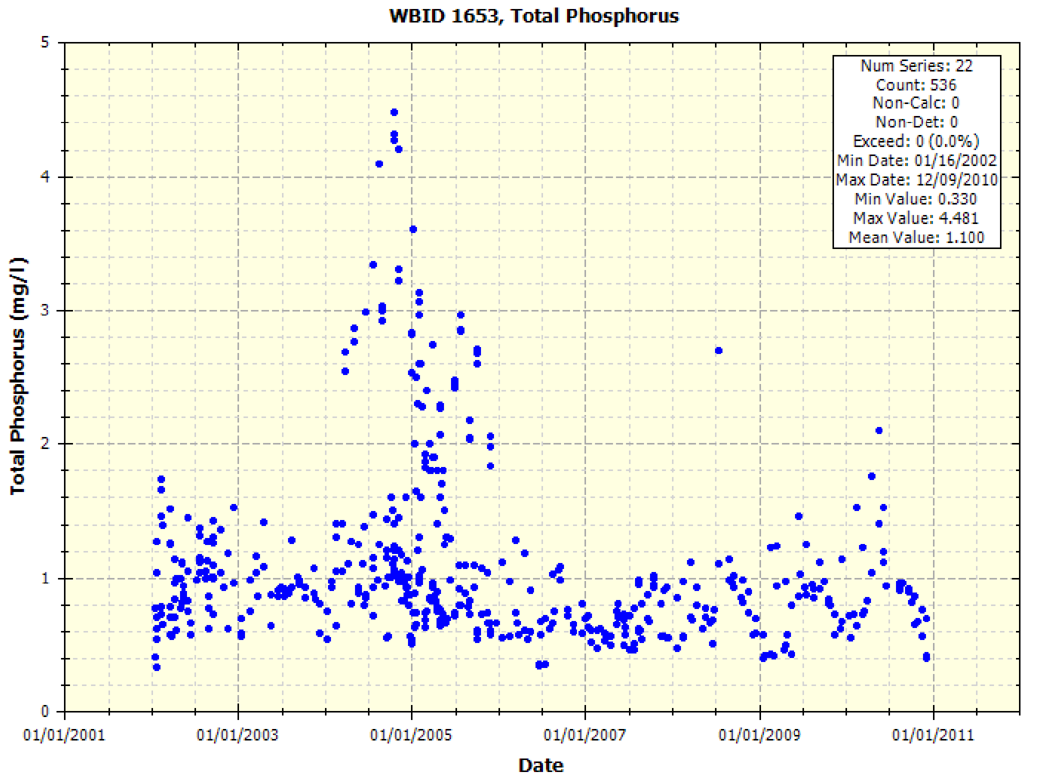

Figure 5.11 Total Phosphorus concentrations for WBID 1653

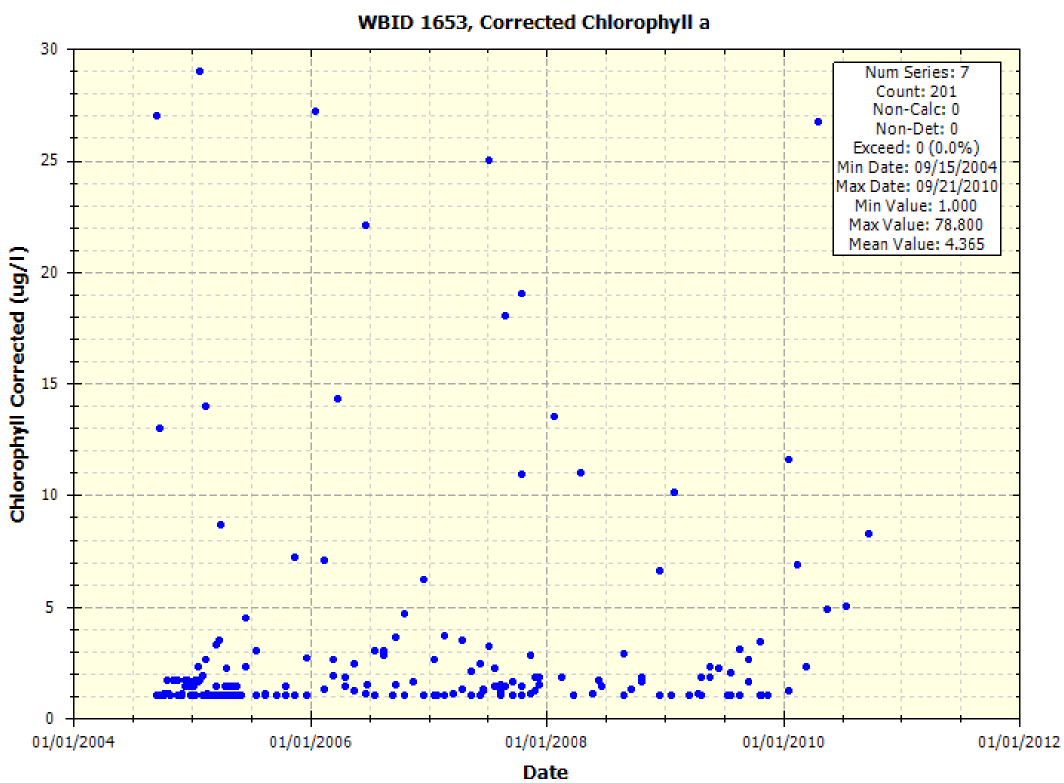

Figure 5.12 Corrected Chlorophyll a concentrations for WBID 1653

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 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 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. There are five NPDES-permitted facilities in WBID 1621E, and three permitted facilities in WBID 1653 (Table 6.1 and Figure 6.1). In some cases, permitted facilities have multiple outfalls.

Table 6.1 Permitted facilities in WBID 1621E and WBID 1653.

WBID	Facility Number	Facility Name	Type
1621E	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	Commercial
	FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	Commercial
	FL0000752	Mosaic Fertilizer, LLC - Green Bay Chemical Plant	Commercial
	FL0002666	Exxon Mobil Refining & Supply Co. - Electrophos Site	Commercial
	FL0020338	City of Mulberry	Domestic
1653	FL0000256	Mosaic Phosphates Company - Kingsford Mine Complex	Commercial
	FL0033332	Mosaic Phosphates Company - Lonesome Mine	Commercial
	FL0132381	Cytec Industries, Inc. - Brewster Plant	Commercial

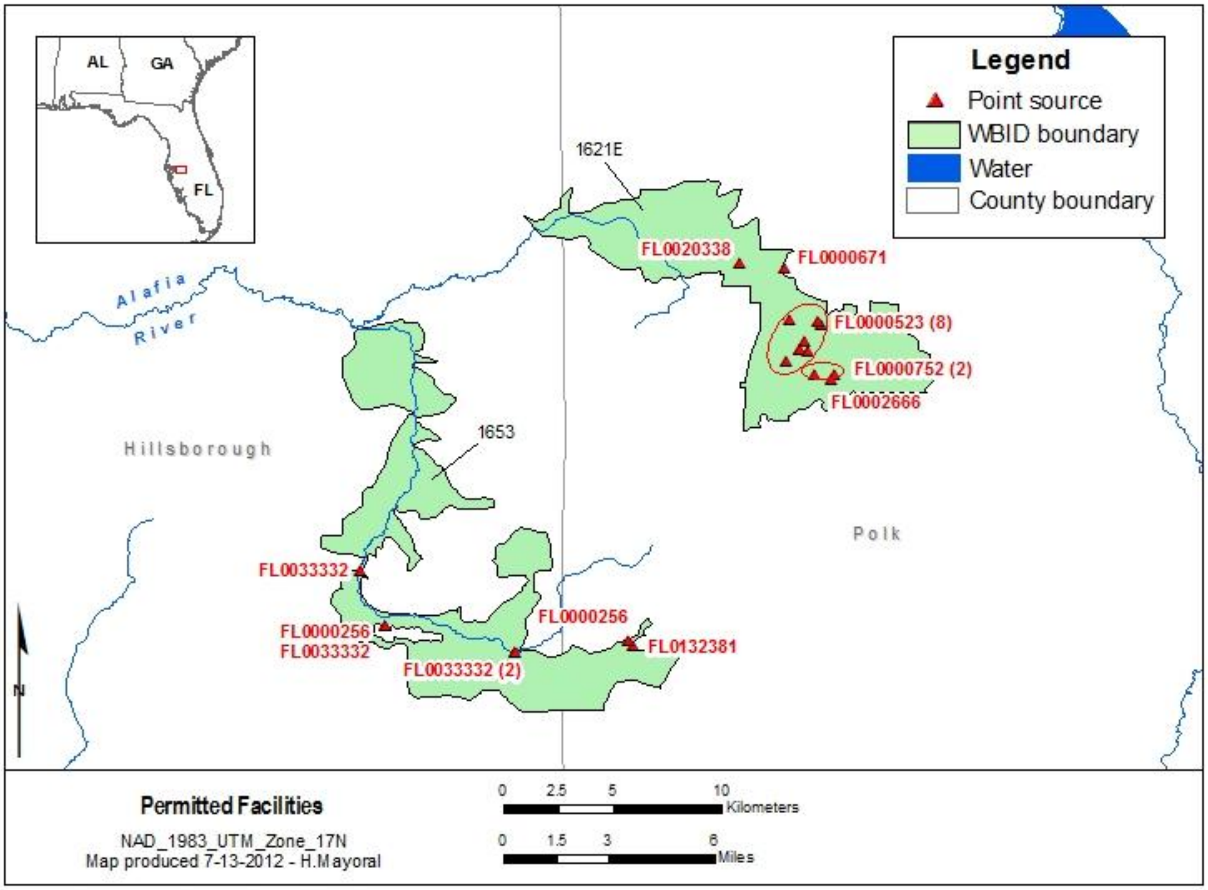

Figure 6.1 Permitted facilities in WBID 1621E and 1653

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. There is one Phase I MS4 and two Phase I C MS4s associated with impaired WBID 1621E (Table 6.2). The Phase I C MS4s are for Hillsborough (FLS000006) and Polk County (FLS000015). The Phase I MS4 is for the City of Mulberry, and is a co-permittee with Polk County (FLS000015). WBID 1653 also falls under the Hillsborough County and Polk County Phase I C MS4 permits. The Hillsborough County permit falls under Florida Department of Transportation (FDOT) District VII, while the Polk County permit falls under Florida Turnpike District I.

Table 6.2 MS4 Permits within WBID 1621E and 1653

WBID	Segment Name	Phase	Facility Number	Affiliate	Co-permittee
1621E	Alafia River (North Prong)	I C	FLS000006*	Hillsborough County	
		I C	FLS000015*	Polk County	
		I	FLS000015*	Polk County	City of Mulberry
1653	Alafia River (South Prong)	I C	FLS000006*	Hillsborough County	
		I C	FLS000015*	Polk County	

*FDOT

6.2 Nonpoint Sources

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 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. Figure 3.1 provides a map of the land use, while Table 3.1 lists the land use distribution in each 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 often a significant nonpoint source of nutrients and oxygen-demanding substances. In WBID 1621E, 34 percent of the contributing land use is developed, with a majority being medium- intensity developments. WBID 1653 has little development, with only 3 percent of the contributing land use consisting of low-intensity development. Urban land uses could potentially contribute towards the impairment within the WBIDs, particularly in WBID 1621E.

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 6.3 summarizes the cumulative 1number of septic systems installed in Hillsborough and Polk Counties 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 6.3 County estimates of Septic Tanks and Repair Permits

County	Number of Septic Tanks (1970-2008)	Number of Repair Permits Issued (2000-2010)
Hillsborough	107,198	15,437
Polk	118,392	20,510

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. Pastures account for 4 percent of the total land use contributing to WBID 1621E, and 11 percent if the total contributing land use to WBID 1653.

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 total phosphorus. Clear cut/sparse land uses contribute one percent of the total land use within each of the WBIDs.

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. Combined forested land use accounts for 3 percent of the contributing drainage area to WBID 1621E, and 5 percent to WBID 1653.

6.2.5 Water and Wetlands

Water and Wetlands often have very low nutrient loadings, although decaying organic matter in wetlands can contribute to high organic nutrient concentrations. Open water accounts for one percent of total land use contributing to WBID 1621E, while both forested and non-forested wetlands combined contribute 10 percent of the total contributing land use. Of the drainage area contributing to WBID 1653, one percent is classified as open water, and an additional 10 percent is classified as combined forested and non-forested wetlands.

6.2.6 Quarries/Strip mines

Land use classification includes quarries, strip mines, exposed rock and soil, fill areas, reclaimed lands, and holding ponds. Event mean concentrations for some barren lands tend to be higher in total nitrogen. Phosphorus mines can be very high in nutrients, specifically phosphorus. The basin has a large percentage of phosphate mines, and quarries and strip mines account for over 40 percent of the total land use that contributes to WBID 1621E, and over 65 percent contributing to WBID 1653. Phosphorus mines are likely the main source of nutrients because they are the dominating land use.

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 Alafia River TMDL 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 Alafia River watershed. The LSPC model utilized the data inputs, including land use and weather data, from the larger Tampa Bay Watershed model (USEPA 2012a and USEPA 2012b).

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 Tampa Bay 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 Alafia River Watershed model, once again using the NHD catchments as well as the USGS National Elevation Dataset Digital Elevation Model (Figure 7.1).

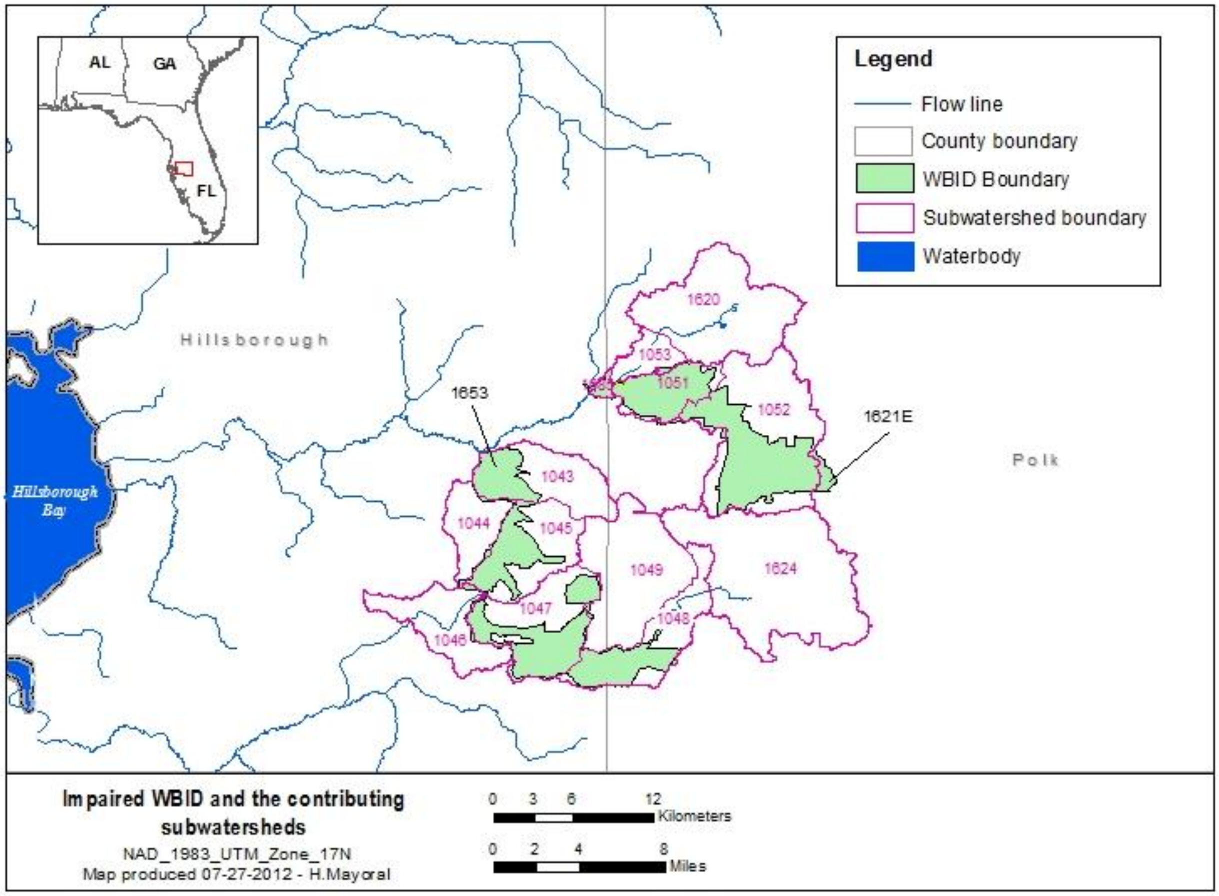

Figure 7.1 Location of Alafia River LSPC subwatersheds

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 Tampa Bay Watershed model was calibrated to non-tidally influenced USGS gages. The Alafia 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 Southwest Florida Water Management District (SWFMD) 2004 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 SWFWMD 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.

Facilities permitted under the National Pollutant Discharge Elimination System (NPDES) are, by definition, considered point sources. The NPDES geographic information system (GIS) coverages, provided by FDEP were adopted as the starting point for the evaluation of point sources for the Florida watershed models and reflected discharges as of December 2009. In areas where data was incomplete, data from EPA-PCS was used. Following data collection, any remaining gaps in the data that were three months or less were filled by averaging data from before and after gap months. If the gaps in the data were larger than three months the long term average was supplied. Point sources that were designated as reuse facilities were not input directly into the model, but were accounted for in the adjustment of the hydrologic calibration parameters.

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 Tampa Bay Watershed model weather stations contained data through 2009.

The hydrodynamic calibration parameters from the larger Tampa Bay Watershed model were used to populate the Alafia River watershed model. The Tampa Bay Watershed model was calibrated to continuous flow USGS gages. No continuous measured flow data was located in the Alafia River watershed, so no calibration updates were done for flow in Alafia River and the Tampa Bay Watershed model parameterization was used. Additionally, the water quality parameters from the larger Tampa Bay Watershed model were used to populate the Alafia River Watershed model. The Tampa Bay Watershed model was calibrated to several water quality stations whose data was taken from IWR38. The Alafia River watershed was calibrated to water quality data from IWR44. LSPC water quality calibration results are presented in Section 7.2.1, Current Condition.

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 concentrations in the natural condition scenario could meet the DO standard, 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 at the outlet of 1621E and 1653. The annual geometric mean concentrations for TN and TP in the Alafia River WBIDs are presented in Table 7.1. The current condition simulation was used to determine the base loadings for each of the WBIDs. 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 7.2 through Figure 7.11 provide the calibrated current condition modeled parameters for the Alafia River.

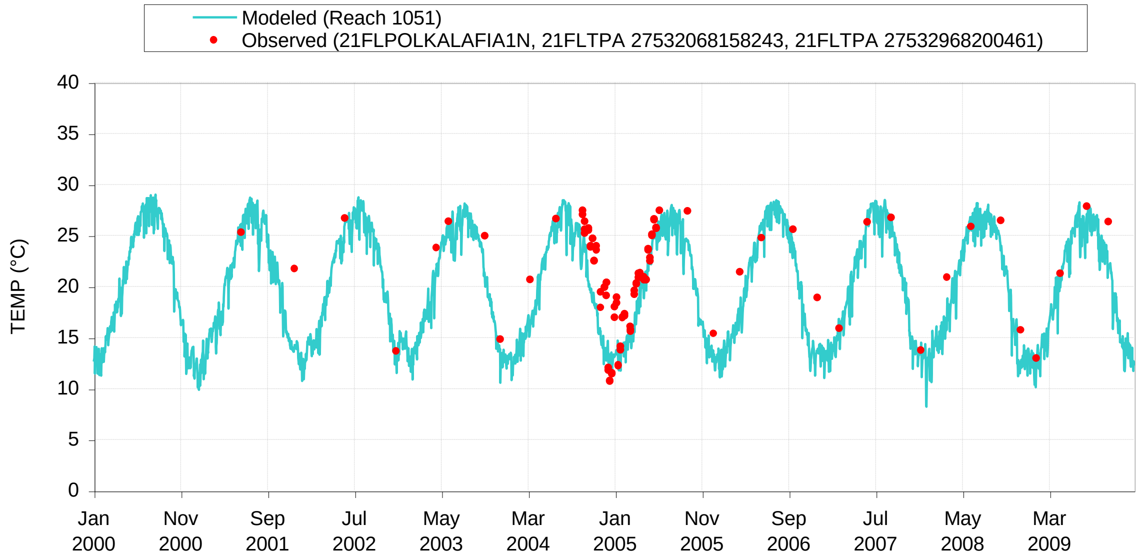

Figure 7.2 Modeled vs. Observed TEMP (°C) at 21FLPOLKALAFIA1N, 21FLTPA 27532068158243, and 21FLTPA 27532968200461 in WBID 1621E

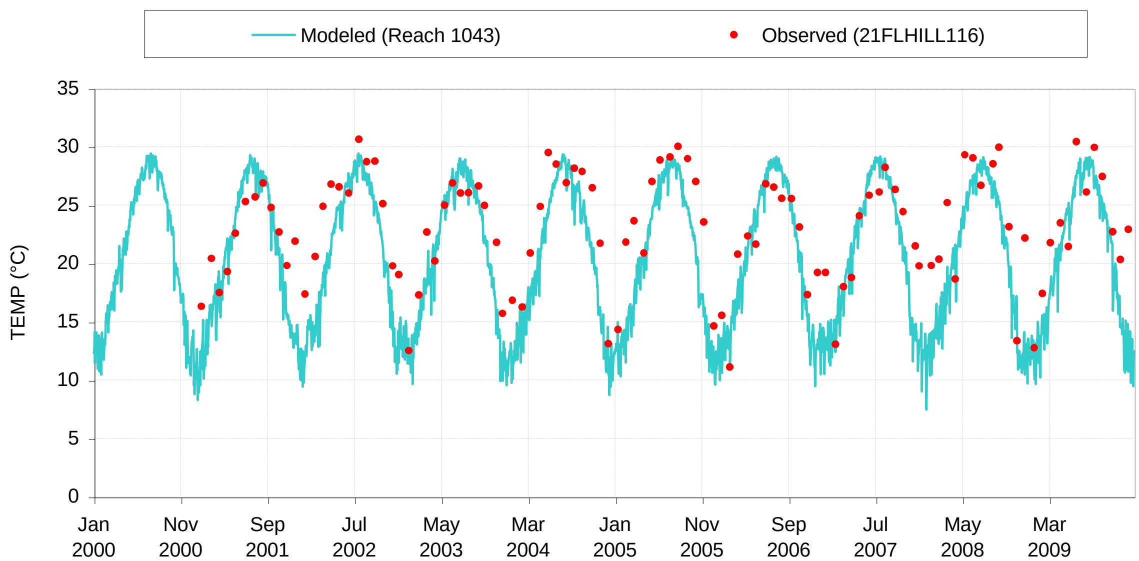

Figure 7.3 Modeled vs. Observed TEMP (°C) at 21FLHILL116 in WBID 1653

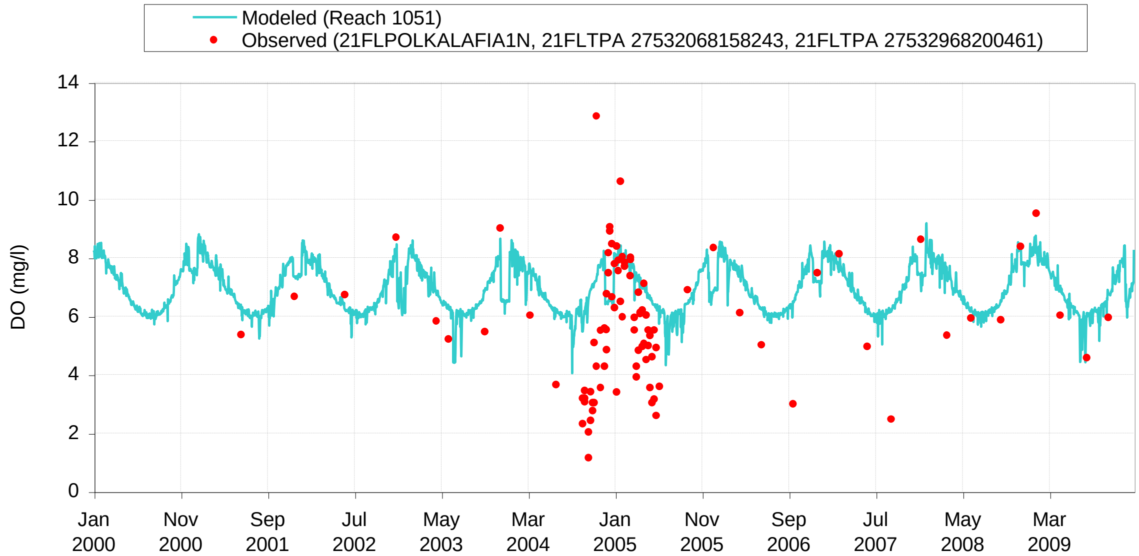

Figure 7.4 Modeled vs. Observed DO (mg/l) at 21FLPOLKALAFIA1N, 21FLTPA 27532068158243, and 21FLTPA 27532968200461 in WBID 1621E

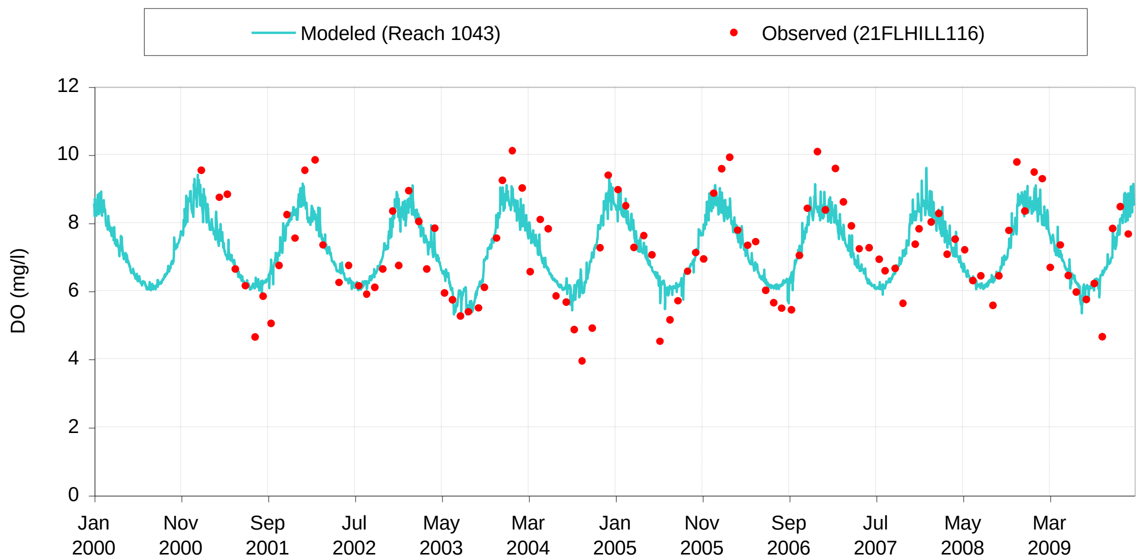

Figure 7.5 Modeled vs. Observed DO (mg/l) at 21FLHILL116 in WBID 1653

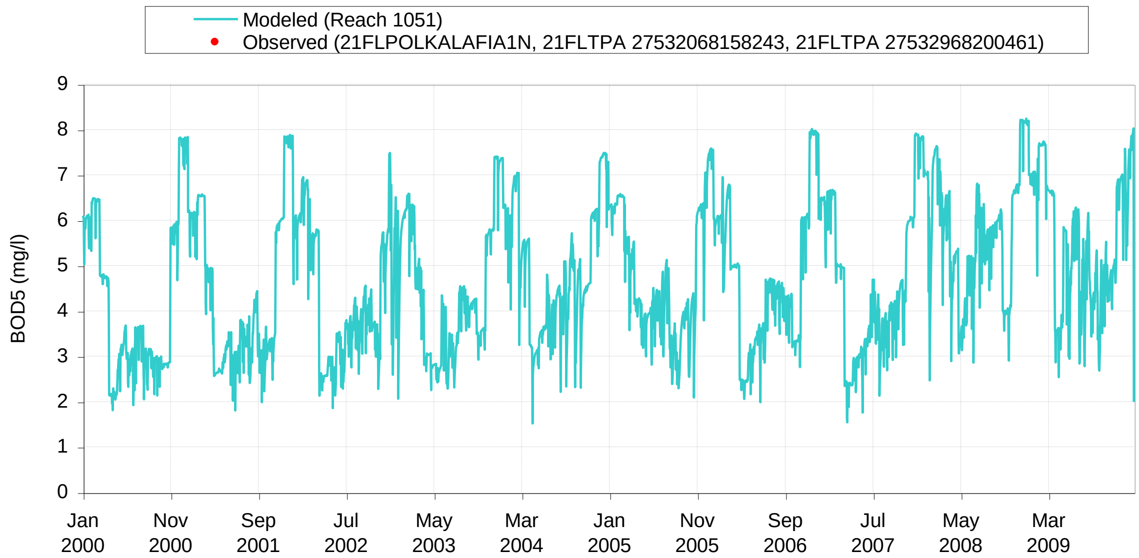

Figure 7.6 Modeled vs. Observed BOD5 (mg/l) at 21FLPOLKALAFIA1N, 21FLTPA 27532068158243, and 21FLTPA 27532968200461 in WBID 1621E

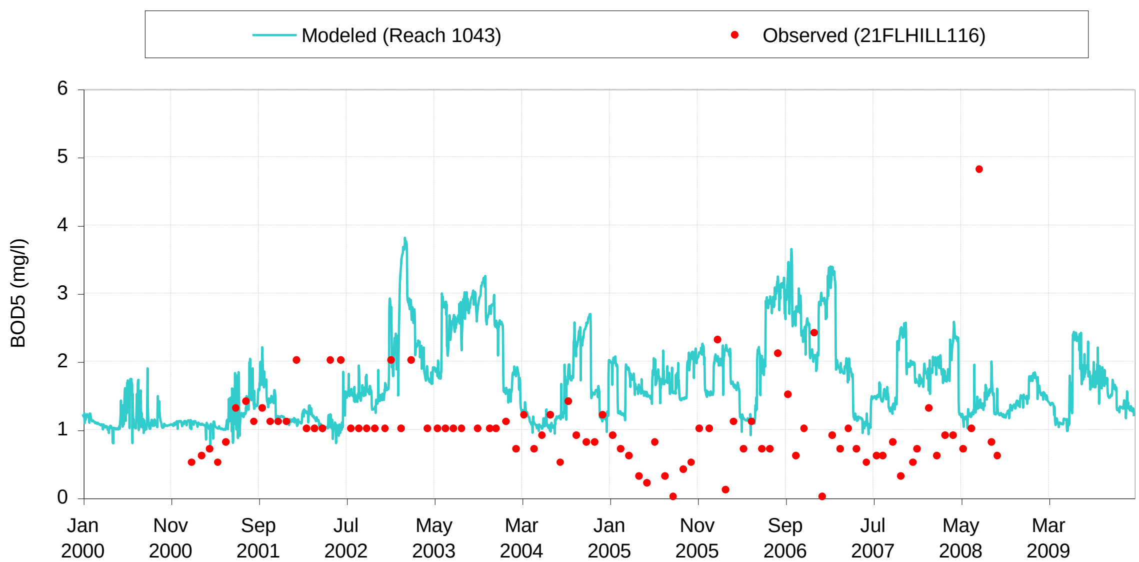

Figure 7.7 Modeled vs. Observed BOD5 (mg/l) at 21FLHILL116 in WBID 1653

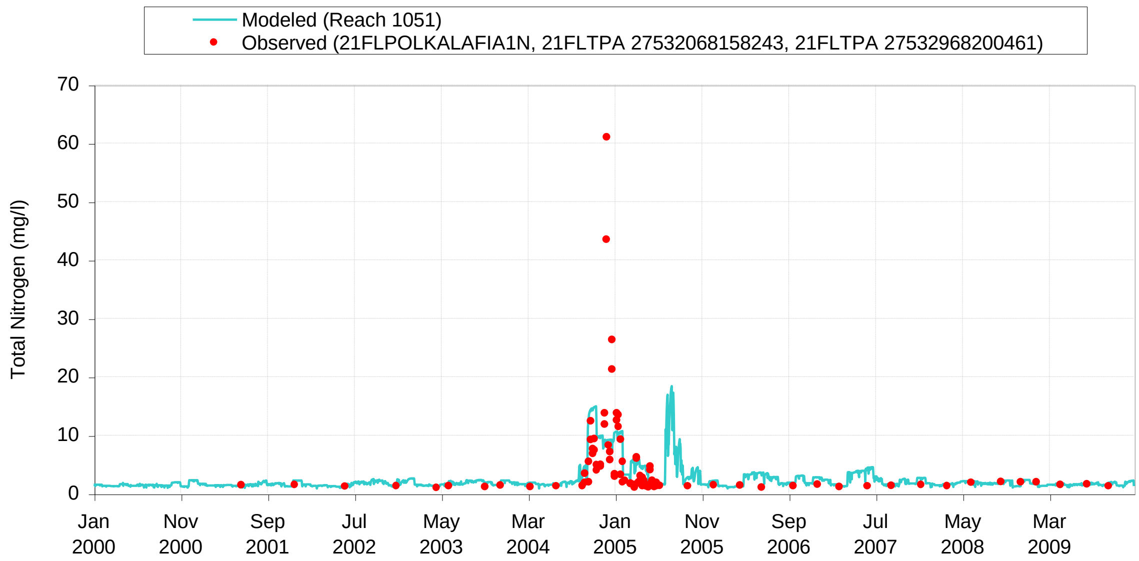

Figure 7.8 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLPOLKALAFIA1N, 21FLTPA 27532068158243, and 21FLTPA 27532968200461 in WBID 1621E

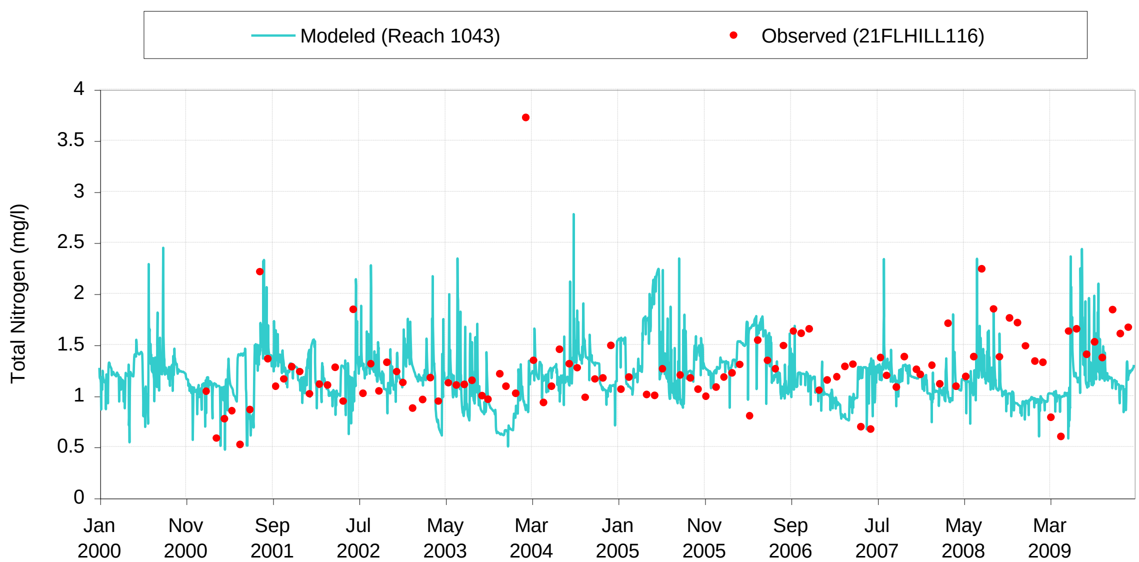

Figure 7.9 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLHILL116 in WBID 1653

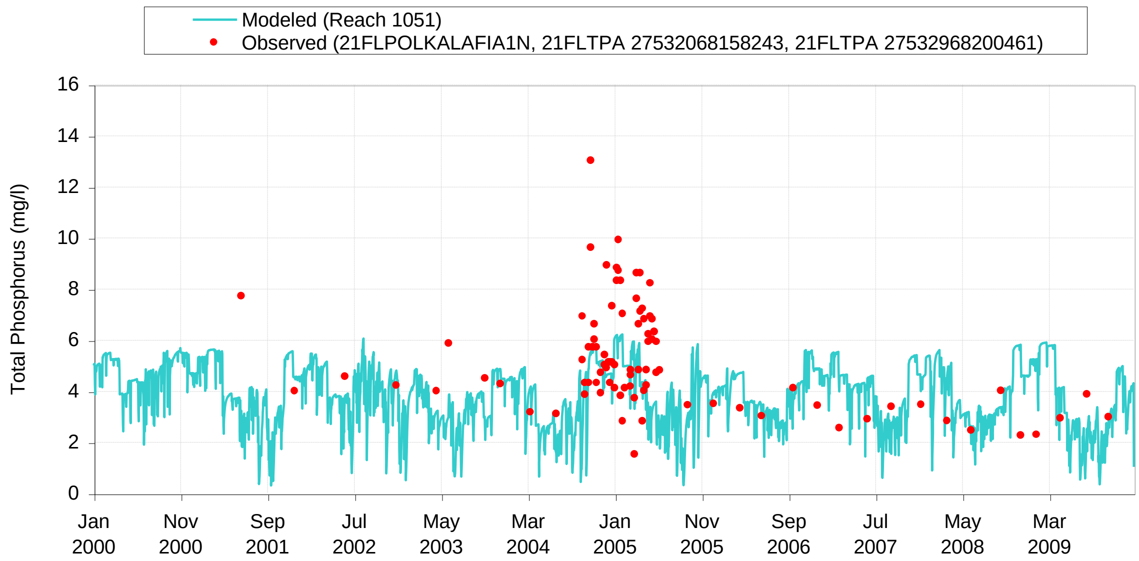

Figure 7.10 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLPOLKALAFIA1N, 21FLTPA 27532068158243, and 21FLTPA 27532968200461 in WBID 1621E

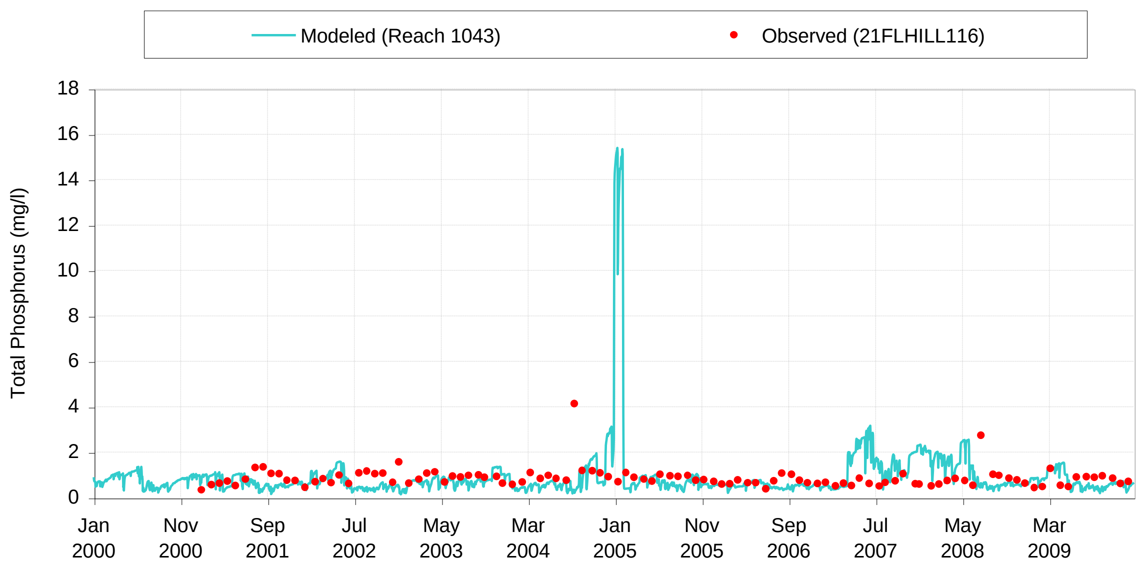

Figure 7.11 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLHILL116 in WBID 1653

Table 7.1 TN and TP geomean concentrations in WBID 1653 and WBID 1621E in the Alafia River basin

Year	WBID 1653	WBID 1621E

	TN geometric mean (mg/L)	TP geometric mean (mg/L)	TN geometric mean (mg/L)	TP geometric mean (mg/L)
2000	1.19	0.71	15.42	5.11
2001	1.18	0.62	15.21	4.19
2002	1.20	0.57	15.88	3.73
2003	0.99	0.73	9.67	5.43
2004	1.19	0.64	15.34	4.33
2005	1.34	0.80	21.84	6.28
2006	1.30	0.50	19.93	3.19
2007	1.11	1.20	12.79	15.85
2008	1.07	0.92	11.80	8.28
2009	1.13	0.64	13.38	4.39

Table 7.2 TN and TP loadings in WBID 1653 and WBID 1621E in the Alafia River basin

	WBID 1621E		WBID 1653	
Parameter	**WLA (kg/yr)**	**LA (kg/yr)**	**WLA (kg/yr)**	**LA (kg/yr)**
Total nitrogen (mg/L)	132,857	29,204	71,298	102,316
Total phosphorus (mg/L)	213,914	1881	80,128	12,250

7.2.2 Natural Condition

The natural condition scenario was developed to estimate water quality conditions if there was no impact from anthropogenic sources. The natural condition scenario was utilized to determine if the low DO in WBID 1621E was due to nutrient impairment or was a natural occurring phenomenon. For the natural condition run, the point sources located in the model were 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. In the natural condition modeling scenario, DO was lower than the standard in WBID 1621E, indicating that the DO standard is not achievable under natural conditions and that low DO is a naturally occurring phenomenon in WBID 1621E (Figure 7.12).

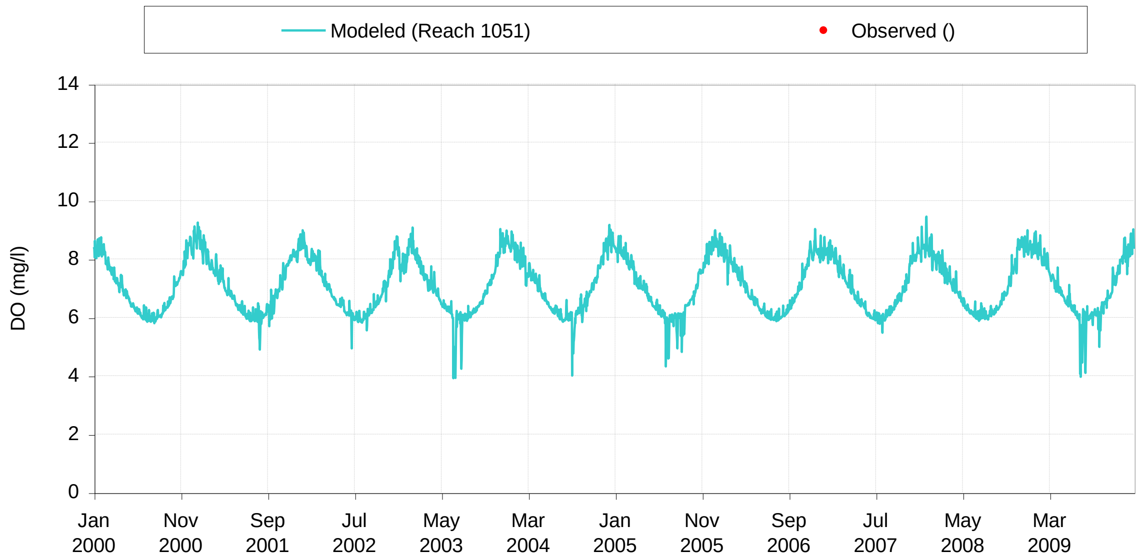

Figure 7.12 Modeled vs. Observed DO (mg/l) at Natural Condition

7.2.3 Point Source Removal

Both WBIDs 1621E and 1653 were listed as impaired for nutrients. Both WBIDs have multiple point sources with large discharges into the streams, both within the WBID and within the contributing subwatersheds (Table 7.3 and Figure 7.13). Water quality data from the point source effluent indicated that the effluent discharge had TN and TP concentrations greater than the inland numeric nutrient standards for the West Central region (0.49 mg/L for TP and 1.65 mg/L for TN). The standards are represented as geometric means and cannot be exceeded more than once every three years. For the point source removal scenario, no changes were made to the land use contributions and all point source contributions were removed from the model. In the scenario run, there were no violations of the nutrient standards (Table 7.4 and Figure 7.14 through Figure 7.17). The scenario indicates that point sources in WBID 1621E and 1653 were the cause of the nutrient impairment.

Table 7.3 Point sources included in the Alafia River Watershed model

WBID	Facility Number	Facility Name	Site name
1621E	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-001
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-003
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-004
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-005
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-006
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-007
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-007A

WBID	Facility Number	Facility Name	Site name
	FL0000523	CF Industries, Inc. - Bartow Chemical Plant	D-01B
	FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	D-001
	FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	D-002
	FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	D-01F
	FL0000671	Mosaic Fertilizer, LLC - Mulberry Chemical Plant	D-MSA
	FL0000752	Mosaic Fertilizer, LLC - Green Bay Plant	D-001
	FL0001589	Mosaic Fertilizer, LLC - Bartow Chemical Plant	D-001
	FL0002666	Exxon Mobil Refining & Supply Co. - Electrophos Site	D-001
	FL0039772	City of Lakeland - Glendale WRF	D-001
1653	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-001
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-002
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-003
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-004
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-005
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-006
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-007
	FL0000256	Mosaic Phosphates Co. - Kingsford Mine Complex	D-009
	FL0033332	Mosaic Phosphates Co. - Lonesome Mine	D-002
	FL0132381	Cytec Industries, Inc. - Brewster Plant	D-001

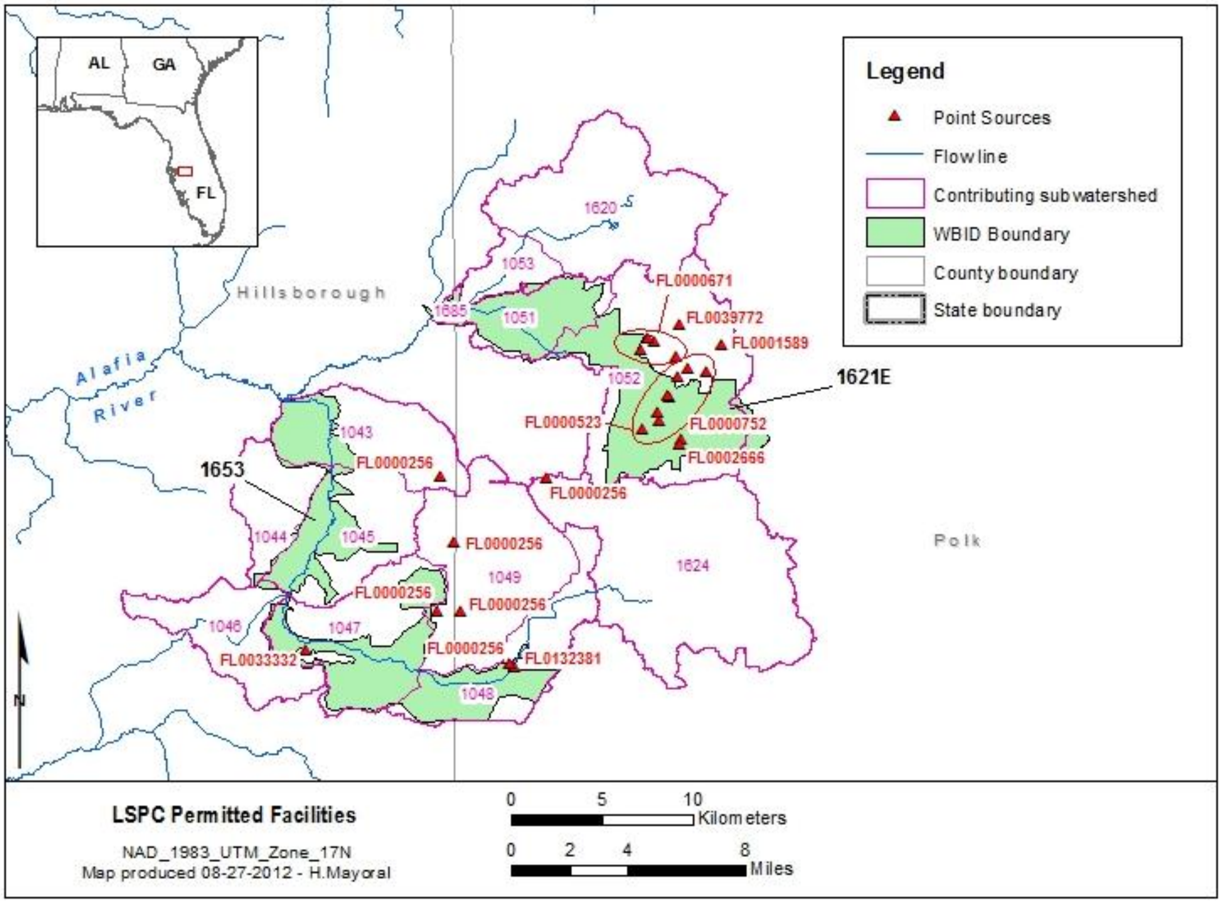

Figure 7.13 Permitted facilities included in the Alafia River Watershed model

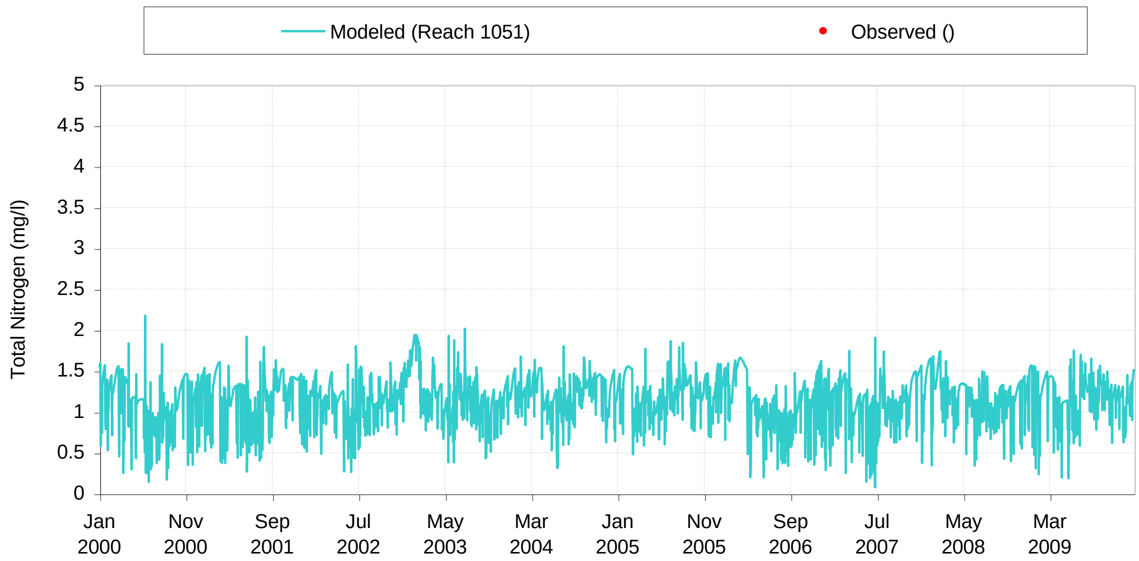

Figure 7.14 Modeled vs. Observed Total Nitrogen (mg/l) at No Point Sources

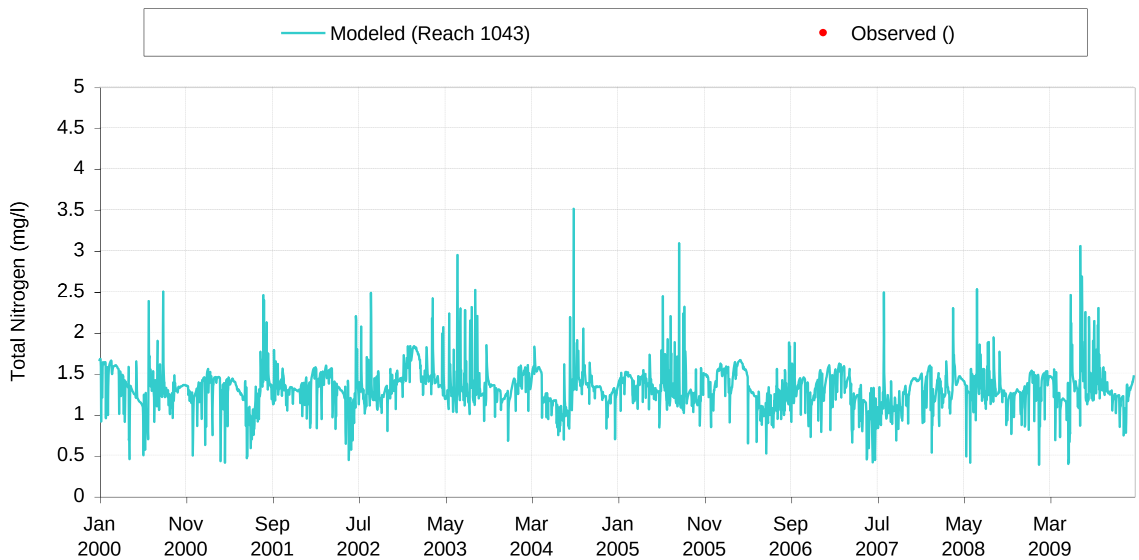

Figure 7.15 Modeled vs. Observed Total Nitrogen (mg/l) at No Point Sources

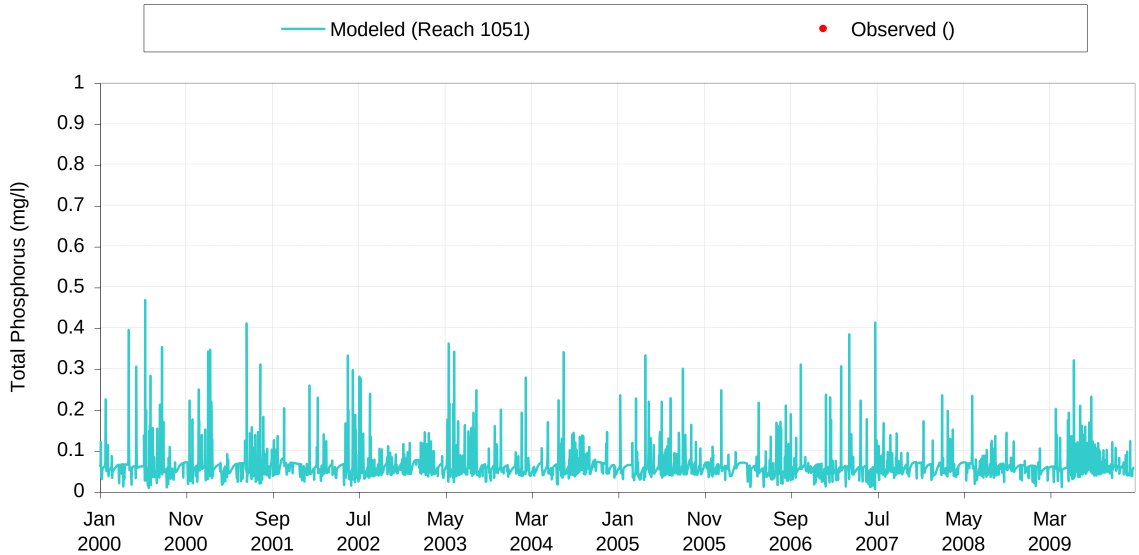

Figure 7.16 Modeled vs. Observed Total Phosphorus (mg/l) at No Point Sources

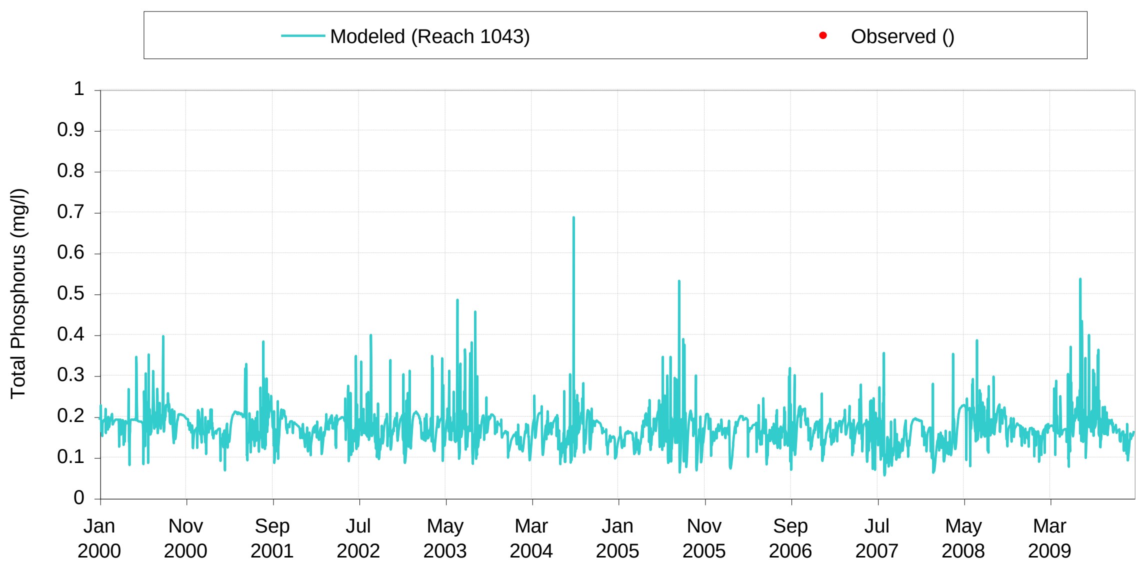

Figure 7.17 Modeled vs. Observed Total Phosphorus (mg/l) at No Point Sources

Table 7.4 TN and TP geomean concentrations in WBID 1653 and WBID 1621E in the Alafia River basin with point sources removed

	WBID 1653		WBID 1621E	
Year	**TN geometric mean (mg/L)**	**TP geometric mean (mg/L)**	**TN geometric mean (mg/L)**	**TP geometric mean (mg/L)**
2000	1.19	0.71	1.01	0.06
2001	1.18	0.62	1.10	0.06
2002	1.20	0.57	1.09	0.05
2003	0.99	0.73	1.15	0.06
2004	1.19	0.64	1.19	0.06
2005	1.34	0.80	1.18	0.06
2006	1.30	0.50	1.05	0.05
2007	1.11	1.20	1.05	0.05
2008	1.07	0.92	1.14	0.06
2009	1.13	0.64	1.14	0.06

7.2.4 Points Sources Reduction

To meet the nutrient water quality standards, nutrient loads from the point sources were reduced until the loadings at the WBID outfalls were able to meet the standards. No changes in land use loading rates were made in the model. To meet water quality standards, TP was reduced 52% in the point sources discharging to WBID 1653, and TN was reduced 48% and TP was reduced 89% in the point sources discharging to WBID 1621E. Results of the reductions are found in Figure 7.18 through Figure 7.21. The annual geometric means and average loading is presented in Table 7.5 and Table 7.6. In this scenario, the geometric mean violated once in the nine year modeled period.

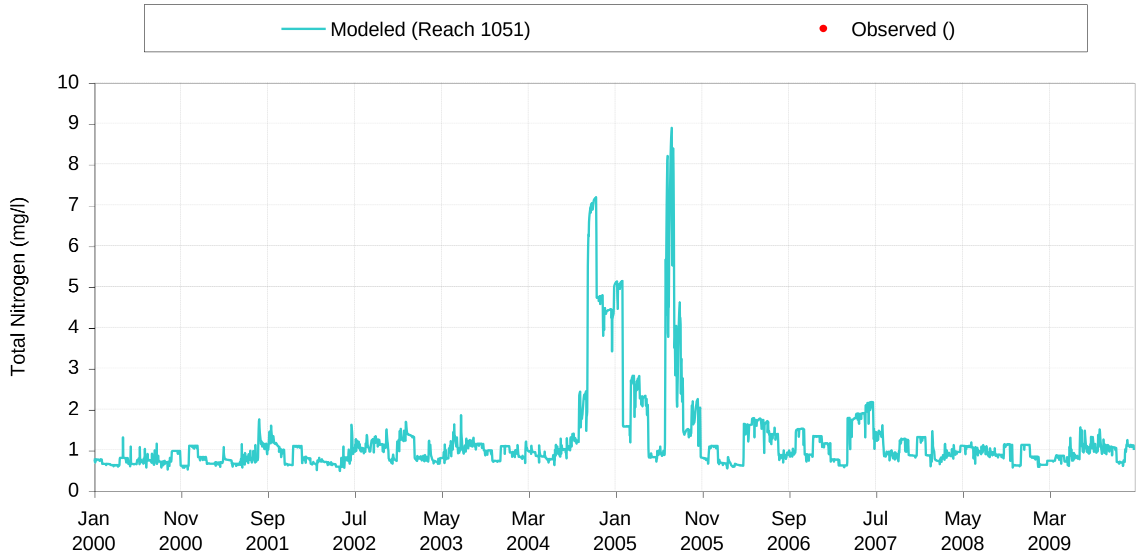

Figure 7.18 Modeled vs. Observed Total Nitrogen (mg/l) at reduction

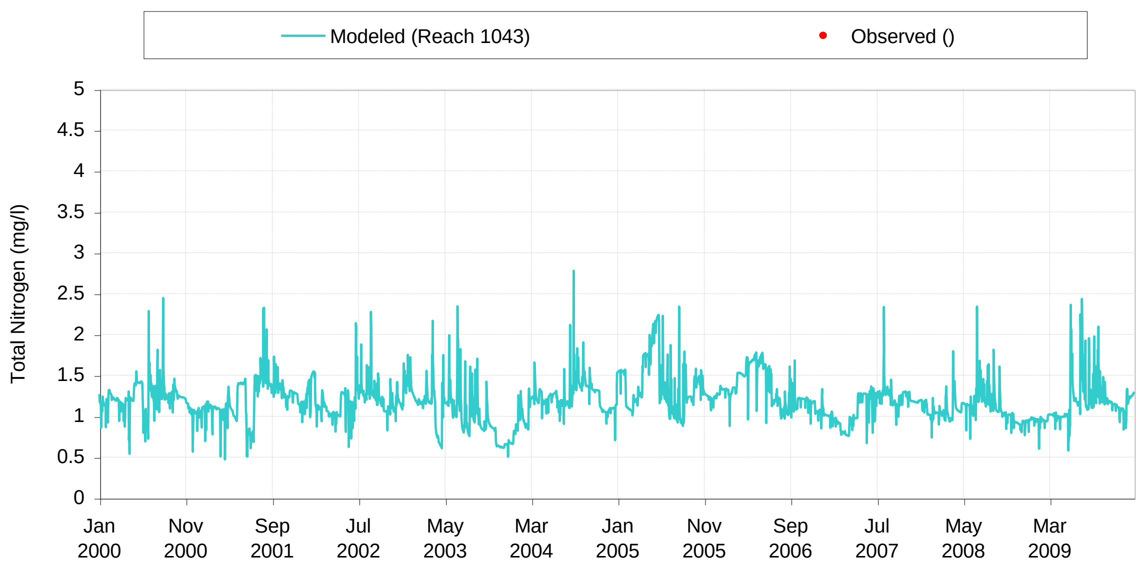

Figure 7.19 Modeled vs. Observed Total Nitrogen (mg/l) at reduction

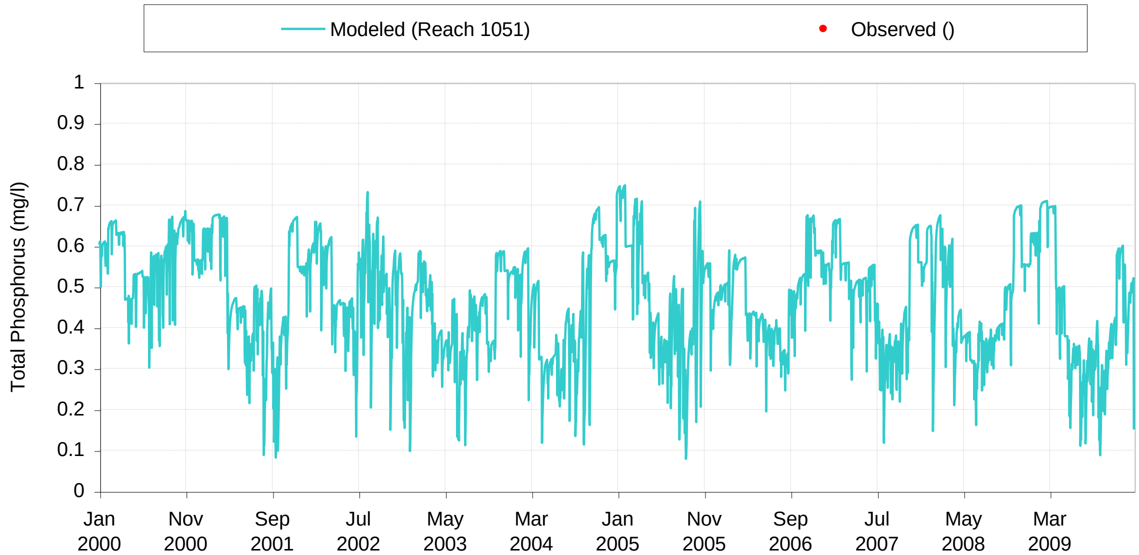

Figure 7.20 Modeled vs. Observed Total Phosphorus (mg/l) at reduction

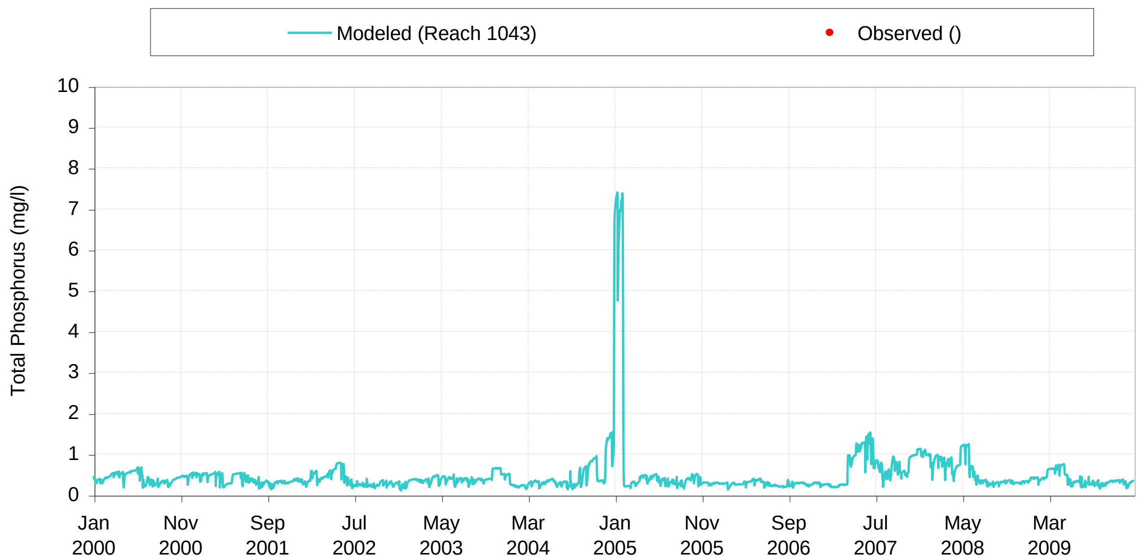

Figure 7.21 Modeled vs. Observed Total Phosphorus (mg/l) at reduction

Table 7.5 TN and TP geomean concentrations in WBID 1653 and WBID 1621E in the Alafia River basin with point sources redcued

Year	WBID 1653		WBID 1621E	
	TN geometric mean (mg/L)	TP geometric mean (mg/L)	TN geometric mean (mg/L)	TP geometric mean (mg/L)
2000	1.19	0.40	0.80	0.52
2001	1.18	0.35	0.89	0.41
2002	1.20	0.32	0.93	0.44
2003	0.99	0.38	1.02	0.37
2004	1.19	0.35	1.64	0.38
2005	1.34	0.42	2.00	0.41
2006	1.30	0.27	1.14	0.42
2007	1.11	0.60	1.22	0.43
2008	1.07	0.48	0.98	0.41
2009	1.13	0.36	0.93	0.37

Table 7.6 TN and TP loadings in WBID 1653 and WBID 1621E in the Alafia River basin with point sources reduced

Parameter	WBID 1621E		WBID 1653	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	69,085	29,204	71,298	102,316
Total phosphorus (mg/L)	4,278	1,881	38,461	12,250

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 at the outlet of each of the two WBIDs, and included all loadings from upstream sources and streams. During the development of this TMDL, it was determined that the point sources were the sources of the nutrient impairments in WBIDs 1621E and 1653. For this reason, the point source loads within the WBIDs and contributing sub-watersheds were reduced to meet the numeric nutrient criteria. The allocations for WBID 1621E and 1653 for total nitrogen and total phosphorus are presented in Table 8.1 and Table 8.2, respectively.

Table 8.1 TMDL Load Allocations for Alafia River, WBID 1621E

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	132,857	29,204	69,085	29,204	48%	0%	0%
Total Phosphorus	213,914	1,881	4,278	1,881	89%	0%	0%

Table 8.2 TMDL Load Allocations for Alafia River, WBID 1653

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	71,298	102,316	71,298	102,316	0%	0%	0%
Total Phosphorus	80,128	12,250	38,461	12,250	52%	0%	0%

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 waterbody 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 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 multiple NPDES-permitted point sources in both WBID 1621E and 1653. A WLA was calculated using the average discharge of all NPDES-permitted over the last nine years for each WBID.

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, Permits FLS000006 and FLS000015, 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 the WBIDs 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

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

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