Proposed

Total Maximum Daily Loads (TMDLs)

For

Dissolved Oxygen & Nutrients

In

Brushy Creek (WBID 1498),

Rocky Creek (1507),

Rocky Creek (Channel A) (1507A),

Double Branch (Freshwater) (1513E),

Double Branch (Estuarine) (1513F),

Sweetwater Creek (1516),

And Rocky Creek (Lower Segment) (1563)

March 2013

United States Environmental Protection Agency

Region 4 serving the southeast

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY SHEET for WBID 1498
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
1498	Brushy Creek	Class III Fresh	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	6,323	21,209	1,299	6,973	79%	67%	67%
Total Phosphorus	1,529	1,859	39	167	97%	91%	91%
Biochemical Oxygen Demand	5,701	32,583	3,749	17,454	34%	46%	46%

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:

Permit ID	Permittee	County	Permit Type
FL0036820	Hillsborough County Dale Mabry AWWTF (2)	Hillsborough	Domestic
FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

SUMMARY SHEET for WBID 1507

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
1507	Rocky Creek	Class III Fresh	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	19,076	49,768	4,718	15,534	75%	69%	69%
Total Phosphorus	3,421	5,517	149	403	96%	93%	93%
Biochemical Oxygen Demand	20,493	60,667	7,498	33,276	63%	45%	45%

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:

Permit ID	Permittee	County	Permit Type
FL0027821	Hillsborough County River Oaks AWWTF (2)	Hillsborough	Domestic
FL0041670	Hillsborough County Northwest Regional RMF (2)	Hillsborough	Domestic

FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

SUMMARY SHEET for WBID 1507A

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
1507A	Rocky Creek (Channel A)	Class II Marine	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	53,677	--	16,009	--	70%	70%
Total Phosphorus	--	6,585	--	423	--	94%	94%
Biochemical Oxygen Demand	--	57,949	--	34,298	--	41%	41%

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

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

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee	County	Permit Type
FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

SUMMARY SHEET for WBID 1513E

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
1513E	Double Branch (Freshwater)	Class III Fresh	Tampa Bay	03100206	Hillsborough-Pinellas	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	39,602	--	16,351	--	59%	59%
Total Phosphorus	--	3,588	--	371	--	90%	90%
Biochemical Oxygen Demand	--	41,171	--	26,525	--	36%	36%

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

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

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee	County	Permit Type
FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

FLS000005	Pinellas County, City of Oldsmar	Pinellas	Phase I C MS4

SUMMARY SHEET for WBID 1513F

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
1513F	Double Branch (Estuarine)	Class II Marine	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen and Nutrients

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	46,956	--	18,965	--	60%	60%
Total Phosphorus	--	4,410	--	470	--	89%	89%
Biochemical Oxygen Demand	--	47,479	--	29,791	--	37%	37%

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:

Permit ID	Permittee	County	Permit Type
FL0036820	Hillsborough County Dale Mabry AWWTF	Hillsborough	Domestic
FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

SUMMARY SHEET for WBID 1516
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
1516	Sweetwater Creek	Class III Fresh	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	29,457	--	8,294	--	72%	72%
Total Phosphorus	--	2,937	--	200	--	93%	93%
Biochemical Oxygen Demand	--	43,261	--	21,754	--	50%	50%

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

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

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee	County	Permit Type
FLS000006	Hillsborough County	Hillsborough	Phase I C MS4

SUMMARY SHEET for WBID 1563
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
1563	Rocky Creek (Lower Segment)	Class II Marine	Tampa Bay	03100206	Hillsborough	Florida

TMDL Endpoints/Targets:

Dissolved Oxygen

TMDL Technical Approach:

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

TMDL Waste Load and Load Allocation

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	47,871	--	10,338	--	78%	78%
Total Phosphorus	--	6,502	--	263	--	96%	96%
Biochemical Oxygen Demand	--	59,019	--	24,706	--	58%	58%

Endangered Species Present (Yes or Blank): Yes

USEPA Lead TMDL (USEPA or Blank): USEPA

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

Major NPDES Discharges to surface waters addressed in USEPA TMDL:

Permit ID	Permittee	County	Permit Type
FLS000006	Hillsborough County	Hillsborough	Phase I C 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 WBIDs 1498, 1507, 1507A, 1513E, 1513F, 1516, and 1563, all of which are Group 1 waterbodies located in the Coastal Old Tampa Bay Tributary Planning Unit and managed by the Southwest Florida Water Management District (SWFWMD). WBIDs 1507, 1507A, 1513E and 1513F are impaired for dissolved oxygen and nutrients, and WBIDs 1498, 1516, and 1563 are 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 Basin as not meeting water quality standards. After assessing all readily available water quality data, USEPA is responsible for developing a TMDL for WBIDs 1498, 1507, 1507A, 1513E, 1513F, 1516, and 1563, depicted in Figure 2.1. The parameters addressed for each WBID are listed in Table 2.1.

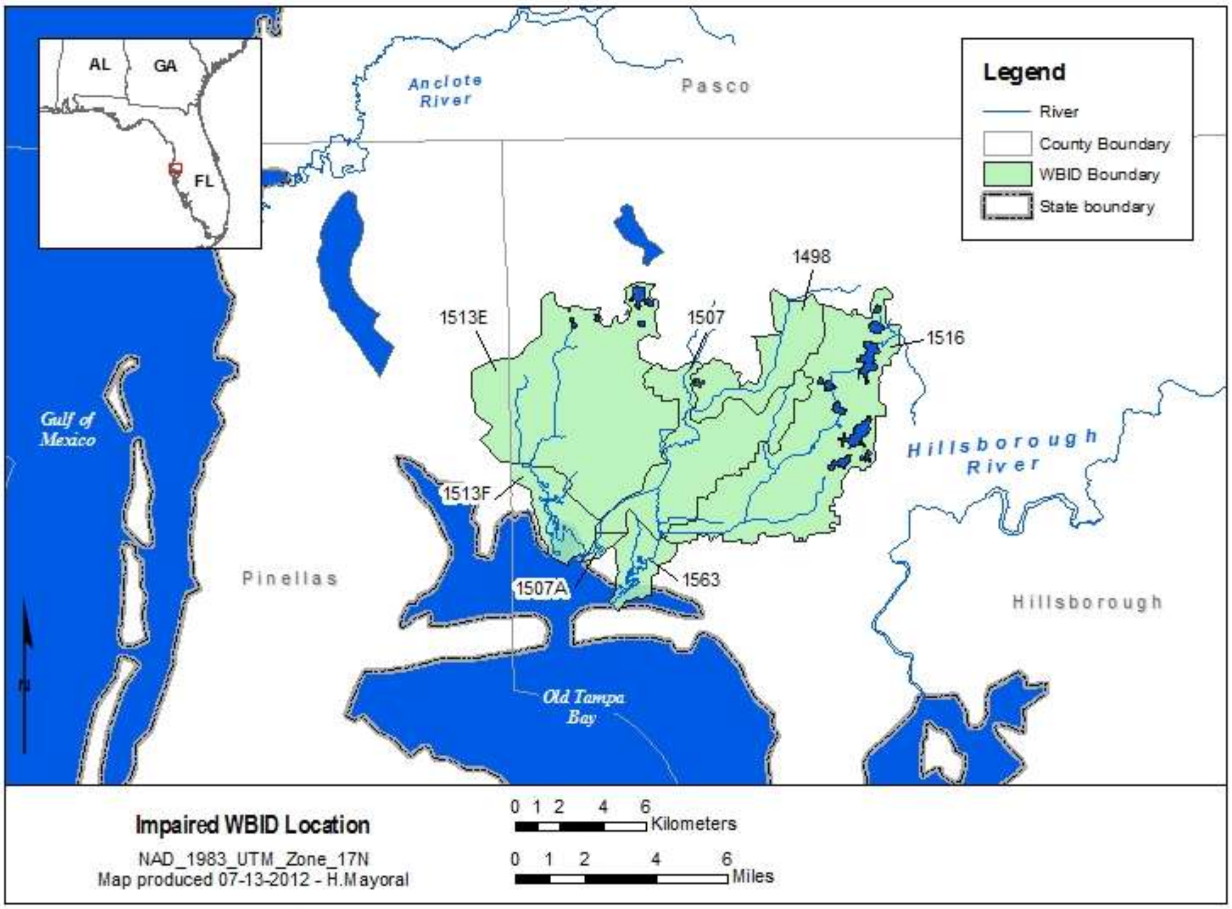

Figure 2.1 Location of the impaired WBIDs in the Tampa Bay basin

Table 2.1 Impaired WBIDs in the Tampa Bay basin.

WBID	Segment Name	Class	Parameters	Planning Unit
1498	Brushy Creek	3F	DO	Tampa Bay
1507	Rocky Creek	3F	DO & Nutrients	Tampa Bay
1507A	Rocky Creek (Channel A)	2	DO & Nutrients	Tampa Bay
1513E	Double Branch (Freshwater)	3F	DO & Nutrients	Tampa Bay
1513F	Double Branch (Estuarine)	2	DO & Nutrients	Tampa Bay
1516	Sweetwater Creek	3F	DO	Tampa Bay
1563	Rocky Creek (Lower Segment)	2	DO	Tampa Bay

3.0 WATERSHED DESCRIPTION

Tampa Bay is the largest open-water estuary in Florida, encompassing nearly 400 square miles and bordering three counties—Hillsborough, Manatee, and Pinellas. At 2,200 square miles, its watershed is more than five times larger than the bay itself (FDEP 2003). Tampa Bay proper, which includes Old, Middle, and Lower Tampa Bays and Hillsborough Bay, extends approximately 35 miles inland from the Gulf of Mexico and is 5 to 10 miles wide along most of its length. Four major causeways cross the bay. The bay averages only about 12 feet in depth, with the maximum natural depth of 89 feet found in a small area at its mouth in the Egmont Channel.

The Double Branch and Rocky Creek Basins described in this TMDL discharge to Old Tampa Bay east of Safety Harbor and south to State Highway 60, North Courtney Campbell Parkway. Located along the west coast of Florida in the Gulf Coastal Lowlands, the Double Branch and Rocky Creek Basins are located in northwest Hillsborough County, while a small portion of the Double Branch Basin is located in eastern Pinellas County. The City of Oldmar borders these Basins to the east and the city of Tampa in the south (FDEP 2003). The Rocky Creek Basin includes the drainage areas of Brushy Creek (WBID 1498), Sweetwater Creek (WBID 1516), and Rocky Creek (WBIDs 1507 and 1507A). The Double Branch Basin includes WBIDs 1513E and 1513F.

The Rocky Creek Basin is mostly residential with the largest portion of lakes in the Sweetwater Creek subbasin. Brushy Creek and Sweetwater Creek begin north of Northdale and share a subbasin boundary that flows along State Highway 597. Both Brushy Creek and Sweetwater Creek flow to the southwest where they confluence with Rocky Creek. Brushy Creek flows south through the Northdale Gulf and Tennis Club for approximately 5 miles to its confluence with Rocky Creek south of Citrus Park Drive near Veterans Parkway.

Before its confluence with Rocky Creek near Town 'N' Country, Sweetwater Creek is channelized and parallels a footpath. The confluence of the two is 600 feet upstream of a control structure on Rocky Creek. The portion of Rocky Creek (WBID 1563) that Sweetwater Creek intersects is not included in this TMDL. Several small lakes are located within the Sweetwater Creek subbasin and have their own individual WBID boundaries, which are not included in this TMDL.

The Rocky Creek WBIDs 1507 and 1507A included in this TMDL are north of the Sweetwater Creek subbasin. The upper most WBID, WBID 1507, begins in Citrus Park at County Road 582 near the confluence with Brushy Creek. From there, Rocky Creek flows south under West Linebaugh Avenue. There the creek is channelized, Channel A, and controlled by a structure. South of the control structure Rocky Creek parallels the Upper Tampa Bay Trial. Just downstream of a second structure and upstream of State Highway 580, the Lower Rocky Creek WBID 1507A begins. This reach flows through the Cabbagehead Bayou into Old Tampa Bay just south of Double Branch Bay.

The Double Branch Basin is approximately 25 square miles with 9.4 miles of stream from its headwaters to the confluence with Old Tampa Bay (FDEP 2009). The basin also includes a number of lakes that have individual WBIDs not included in this TMDL. A large portion of the basin is wetlands with mangroves downstream of State Highway 580 in Double Branch Bay at the confluence with Old Tampa Bay.

3.1 Climate

The Double Branch and Rocky Creek Basins are located just north of Tampa on the west coast of Florida. They experience a subtropical climate with hot, humid summers and mild, short winters. Average high temperatures in the summer are in the low-90s (°F), and average low temperatures in the winter are in the 50s (°F). The area receives an average of 47 inches of rain, of which a greater percentage falls during the wet season (June through September) (SERCC 2012).

3.2 Hydrologic Characteristics

The Double Branch and Rocky Creek Basins have relatively low topographic relief and portions of these creeks have been channelized. Brushy Creek, Sweetwater Creeks and the head waters of Rocky Branch are freshwater streams. Lower reaches of Double Branch and Rocky Creek are tidally influenced and include control structures to prevent saltwater intrusion and regulate freshwater flows (FDEP 2001). There are no springs in these Basins (FDEP 2003). The Floridan aquifer generally lies under the area around Tampa Bay but a surficial aquifer system exists in northern Hillsborough County. The flat Gulf Lowlands strongly influence the relationship between ground water and surface water. The rate of discharge from ground water to surface water in the area of Double Branch and Rocky Creek Basins is between 1 and 5 inches per year (Fernald and Purdum 1998).

3.3 Land Use

Table 3.1lists the acreage and percentage of various land use types in the impaired WBIDs. In WBIDs 1498, 1507, 1507A, and 1516, developed land use accounts for over 70 percent of the total land use, comprising mostly of high-intensity development. In WBIDs 1513E and 1563 developed land uses comprise 43 percent and 57 percent of the WBIDs, respectively. WBID 1513F is only 31 percent developed, and combined forested and non-forested wetlands accounting for 35 percent of the land use.

However, the largest acreage of wetlands are located in WBID 1513E, which is comparatively larger than most of the other WBIDs in terms of acreage. WBIDs 1513E and 1563 follow, having 25-26 percent of their total land use attributed to combined forested and non-forested wetlands. WBIDs 1498 and 1507 both attribute 13 percent of their total land use to combined forested and non-forested wetlands, while WBIDs 1507A and 1516 attribute 8-9 percent of their total land use to combined wetlands. There are very small percentages of pasture and row crop land use within most of the WBIDs, with the exception of WBID 1513E, which has pastures accounting for 9 percent of its total land use. WBID 1507 has 119 acres of pasture land use within its boundary, while WBID 1516 has 116 acres of row crops within its boundary. All other WBIDs have either no pasture or row crops, or minimal acreage (<60 acres). Combined forested land use ranges between 0 percent (WBID 1507A) and 11 percent (WBID 1513E) of the total land use in each of the WBIDs.

The actual drainage area for each of the WBIDs varies from their boundaries (Table 3.2), which alters the land uses that contribute to the WBIDs impairment (Figure 3.2 and Table 3.3). The United States Geological Survey National Hydrography Dataset was used to delineate the drainage area. Developed land use remains the largest land use classification type contributing to most of the WBIDs, ranging from 38 percent (WBID 1513E) to 77 percent (WBID 1516) of the total contributing area. Combined forested and non-forested wetlands were typically the second largest classification for all of the WBIDs, accounting for 15 to 25 percent of the total area contributing to each WBID. In WBID 1513E, nearly 15 percent of the total contributing land area is comprised of pasture land uses.

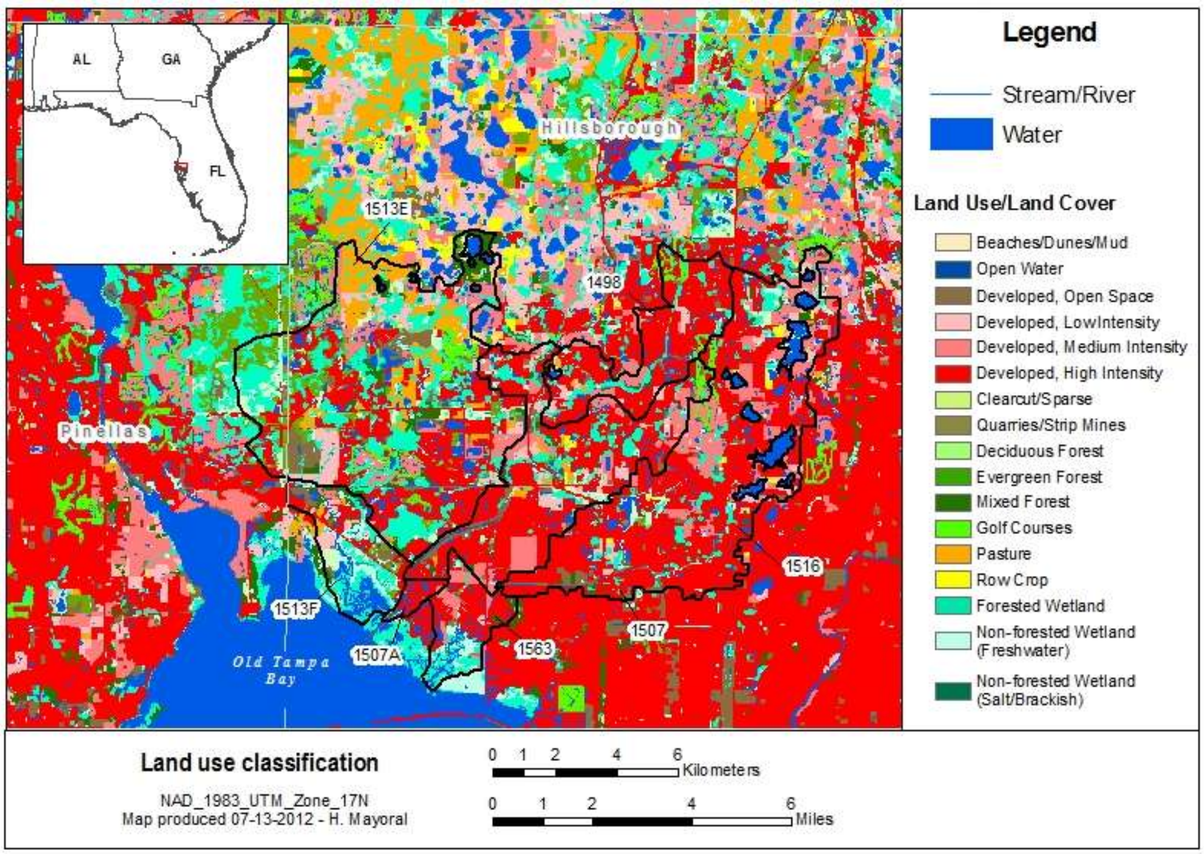

Figure 3.1 Land use for the impaired WBIDs in the Tampa Bay basin

Table 3.1 Land use distribution for the impaired WBIDs in the Tampa Bay basin

Land Use Classification	WBID 1498		WBID 1507		WBID 1507A		WBID 1513E		WBID 1513F		WBID 1516		WBID 1563	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Evergreen Forest	0	0%	17	0%	0	0%	940	6%	77	3%	18	0%	15	1%
Deciduous Forest	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Mixed Forest	24	1%	90	1%	0	0%	607	4%	122	5%	125	1%	40	2%
Forested Wetland	396	11%	769	11%	11	4%	3046	21%	460	19%	702	6%	246	15%
Non-Forested Wetland (Freshwater)	67	2%	149	2%	12	4%	659	5%	342	14%	291	3%	172	10%
Non-Forested Wetland (Salt/Brackish)	0	0%	0	0%	0	0%	0	0%	22	1%	0	0%	12	1%
Open Water	175	5%	351	5%	56	19%	924	6%	435	18%	800	7%	237	14%
Pasture	32	1%	119	2%	0	0%	1368	9%	57	2%	6	0%	0	0%
Row Crop	0	0%	36	1%	0	0%	30	0%	0	0%	116	1%	0	0%
Clear cut Sparse	4	0%	108	2%	0	0%	327	2%	104	4%	147	1%	0	0%
Quarries Strip mines	0	0%	0	0%	0	0%	46	0%	4	0%	10	0%	0	0%
Utility Swaths	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Developed, Open Space	133	4%	464	7%	10	3%	974	7%	162	7%	452	4%	30	2%
Developed, Low intensity	160	4%	449	6%	0	0%	768	5%	181	8%	363	3%	19	1%
Developed, medium intensity	184	5%	854	12%	5	2%	879	6%	40	2%	1682	15%	242	14%
Developed, High intensity	2375	65%	3592	51%	205	69%	3531	24%	361	15%	6340	57%	683	40%
Beaches/Dunes/Mud	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Golf Courses	118	3%	76	1%	0	0%	364	3%	0	0%	123	1%	0	0%
Totals	3668	100%	7074	100%	299	100%	14463	100%	2367	100%	11175	100%	1696	100%

Table 3.2 Contributing subwatersheds listed by WBID

	WBID 1498	WBID 1507	WBID 1507A	WBID 1513E	WBID 1513F	WBID 1516	WBID 1563
Contributing Subwatersheds	1026	1023 – 1026	1021	1017	1012 – 1020	1028 - 1030	1023 – 1031
	1651	1649		1018	1650		1649
		1651		1650			1651

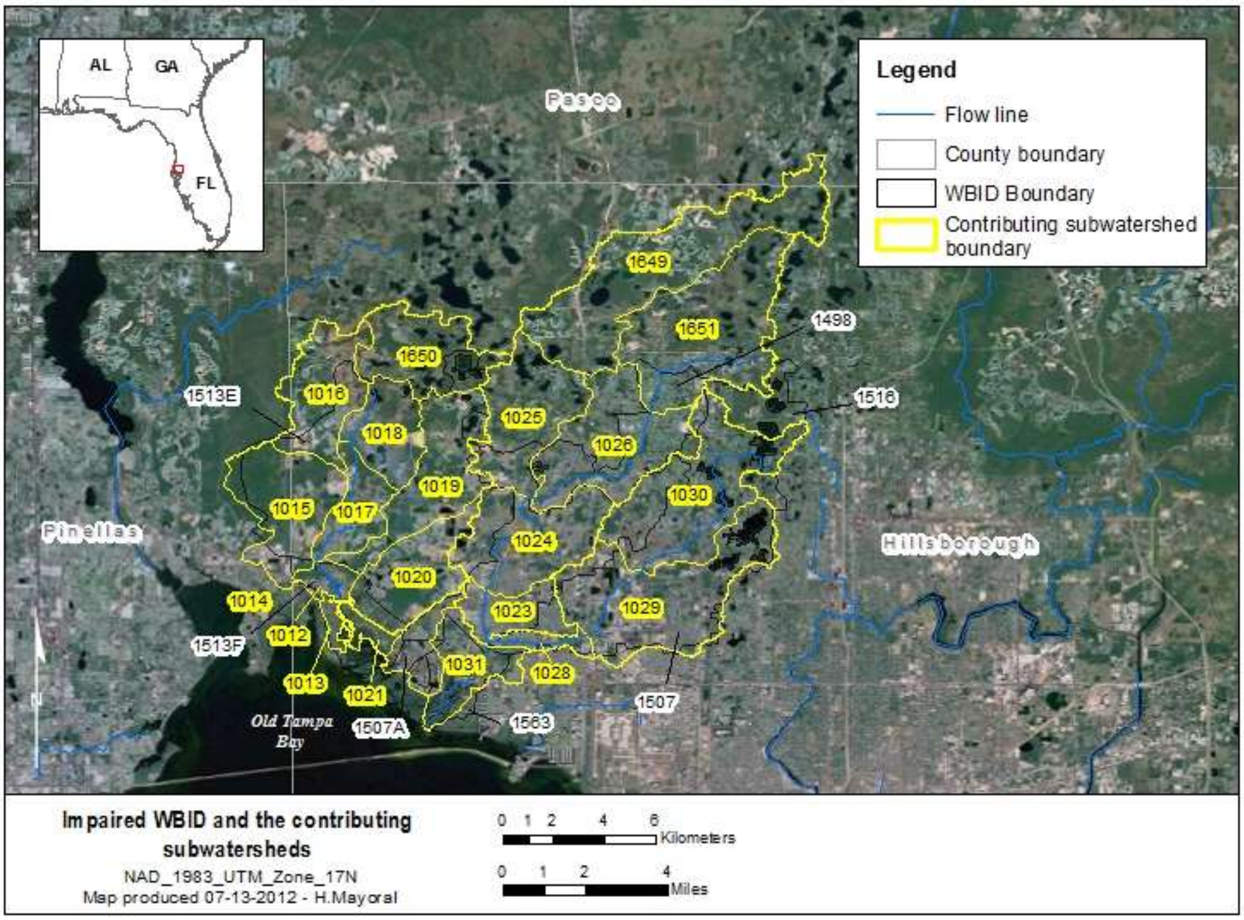

Figure 3.2 Aerial photograph illustrating contributing subwatershed and impaired WBID boundaries

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

Land Use Distribution for Contributing subwatersheds	WBID 1498		WBID 1507		WBID 1507A		WBID 1513E		WBID 1513F		WBID 1516		WBID 1563	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Evergreen Forest	167	2%	499	2%	8	1%	156	2%	1194	6%	20	0%	533	1%
Deciduous Forest	0	0%	7	0%	0	0%	0	0%	0	0%	0	0%	7	0%
Mixed Forest	104	1%	302	1%	16	1%	484	7%	870	4%	65	1%	452	1%
Forested Wetland	1433	14%	3920	15%	51	4%	1140	17%	3979	19%	775	7%	4882	12%
Non-Forested Wetland (Freshwater)	294	3%	745	3%	30	3%	242	4%	1147	6%	296	2%	1195	3%
Non-Forested Wetland (Salt/Brackish)	0	0%	0	0%	0	0%	0	0%	18	0%	0	0%	12	0%
Open Water	861	8%	2276	9%	198	17%	696	10%	1635	8%	1168	10%	3650	9%
Pasture	614	6%	1560	6%	9	1%	962	15%	2070	10%	2	0%	1563	4%
Row Crop	56	1%	277	1%	0	0%	264	4%	292	1%	85	1%	361	1%
Clear cut Sparse	212	2%	358	1%	8	1%	83	1%	455	2%	157	1%	514	1%
Quarries Strip mines	0	0%	0	0%	0	0%	11	0%	60	0%	10	0%	10	0%
Utility Swaths	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Developed, Open Space	415	4%	1211	5%	100	9%	529	8%	1533	7%	508	4%	1759	4%
Developed, Low intensity	626	6%	2534	10%	0	0%	967	15%	1487	7%	389	3%	2942	7%
Developed, medium intensity	1281	12%	3603	14%	32	3%	354	5%	1202	6%	1646	14%	5492	14%
Developed, High intensity	4263	40%	8628	33%	719	61%	702	11%	3857	19%	6573	55%	16085	40%
Beaches/Dunes/Mud	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Golf Courses	232	2%	530	2%	0	0%	41	1%	663	3%	153	1%	685	2%
Totals	10558	100%	26450	100%	1171	100%	6631	100%	20462	100%	11847	100%	40142	100%

4.0 WATER QUALITY STANDARDS/TMDL TARGETS

The waterbodies addressed in this report are either Class II (WBIDs 1507A, 1513F, 1563)or Class III waters (WBIDs 1498, 1507, 1513E, 1516). Class II waters have a designated use of Shellfish Propagation or Harvesting, while Class III waters have 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.

4.1 Nutrients Criteria

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

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

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

4.1.1 Narrative Nutrient Criteria

Florida's narrative nutrient criteria provide:

> The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter. Man induced nutrient enrichment (total nitrogen and total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242 F.A.C. See paragraph 62-302.530(47)(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. See paragraph 62-302.530(47)(b), F.A.C.

Chlorophyll and DO levels are often used to indicate whether nutrients are present in excessive amounts. The target for this TMDL is based on levels of nutrients necessary to prevent violations of Florida's DO criterion pursuant to paragraph 62-302.530(47)(a), F.A.C., as set out more fully below.

4.1.2 Development of Numeric Nutrient Criteria

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

Florida's interpretation of its narrative nutrient criteria applies to streams, including (WBIDs 1507A, 1513F, 1563, 1498, 1507, 1513E, 1516). For streams that do not have a site specific criteria, the interpretation provides for biological information to be considered together with nutrient thresholds to determine whether a waterbody is attaining See paragraph 62-302.531(2)(c), F.A.C. The rule provides that the nutrient criteria are attained in a stream segment where information on chlorophyll a levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora and either the average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or the nutrient thresholds set forth in Table 1 below are achieved. See paragraph 62-302.531(2)(c).

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

Table 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.

The water quality criterion for Class II freshwaters is as follows:

Shall not be less than 5.0 mg/L. Normal daily and seasonal fluctuations above these levels shall be maintained. [FAC 62-302.530 (30)]

The water quality criterion for Class III marine waters is as follows:

Shall not average less than 5.0 mg/L in a 24-hour period and shall never be less than 4.0 mg/L. Normal daily and seasonal fluctuations above these levels shall be maintained. [FAC 62-302.530 (30)]

4.3 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)]

4.4 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. [FAC 62-302.200(19)]

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. [FAC 62-302.300(15)]

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 dissolved oxygen and nutrients, or just 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 station locations within each of the impaired WBIDs is located in Table 5.1, and an analysis of water quality data is documented in Table 5.2. Figure 5.1 through Figure 5.3 show the locations of the water quality monitoring stations within each of the WBIDs. Water quality data for the WBIDs can be found below in Figure 5.4 through Figure 5.38, with the data from all water quality stations compiled in each figure.

5.1.1 Dissolved Oxygen

There are several factors that affect the concentration of dissolved oxygen (DO) in a waterbody, and natural DO levels are a function of water temperature, water depth and velocity, salinity and relative contributions from groundwater. Oxygen can be introduced by wind, diffusion, photosynthesis, and additions of higher DO water (e.g. from tributaries). DO concentrations can be lowered by processes that use up oxygen from the water, such as respiration and decomposition, and can be lowered through additions of water with lower DO (e.g. swamp or groundwater). Decomposition of organic matter, such as dead plants and animals, also consume DO. Minimum dissolved oxygen concentrations were less than 0.1 mg/L in all WBIDs, with the exception of WBIDs 1498 and 1513E, whose minimum dissolved oxygen concentrations were 1.56 mg/L and 0.63 mg/L, respectively. The highest mean dissolved oxygen concentration was 6.19 mg/L in WBID 1498, with the remaining WBID having means ranging between 2.9 mg/L and 4.81 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. The maximum BOD concentrations ranged between 2.2 mg/L (WBID 1498) and 10.6 mg/L (WBID 1507A). Mean BOD concentrations ranged between 1.0 mg/L and 1.6 mg/L, with the exception of WBID 1507A, whose mean BOD concentration measured 3.2 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 purpose of the nutrient assessment is to present the range, variability and average conditions within each of the WBIDs.

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. Usually, the eutrophication process is observed as a change in the structure of the algal community and includes severe algal blooms that may cover large areas for extended periods. Large algal blooms are generally followed by depletion in DO concentrations as a result of algal decomposition. Mean total nitrogen concentrations ranged between 0.97 mg/L and 1.27 mg/L. WBID 1507 had the highest maximum total nitrogen concentration at 8.44 mg/L, followed by WBID 1513E at 5.53 mg/L. The remaining WBIDs had maximum total nitrogen concentrations between 2.11 mg/L and 3.25 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 depletes oxygen in the water. Total phosphorus maximum concentrations measured between 0.27 mg/L and 0.61 mg/L, with the exception of WBID 1513E, which had a maximum concentration of 1.20 mg/L. Mean total phosphorus concentrations for all the WBIDs ranged between 0.09 mg/L (WBID 1516) and 0.17 mg/L (WBID 1507A).

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 concentrations within the WBIDs ranged between 25.0 µg/L and 364.0 µg/L. The highest maximum corrected chlorophyll-a concentrations were observed in WBID 1516, followed by WBID 1507 at 151.6 µg/L and WBID 1507A at 119.8 µg/L. The remaining WBIDs had maximum corrected chlorophyll-a concentrations which ranged between 25 µg/L and 65 µg/L. Mean corrected chlorophyll-a concentrations ranged between 2.84 µg/L and 7.2 µg/L, with the exception of WBID 1507A, whose mean concentrations were 16.84 µg/L.

Table 5.1 Water quality stations located in the impaired WBIDs

WBID	Station Number	WBID	Station Number
1498	112WRD 02306950	**1513F**	21FLHILL101
	21FLGW 22075		21FLKWATHIL-DBBRH-320-1
	21FLHILL161		21FLKWATHIL-DBBRH-320-2
	21FLKWATHIL-CREEK-305-1		21FLKWATHIL-DBBRH-320-3
	21FLKWATHIL-CREEK-305-2		21FLKWATHIL-DOUBLE BR-1
	21FLKWATHIL-CREEK-305-3		21FLKWATHIL-DOUBLE BR-2
	21FLTPA 24030151		21FLKWATHIL-DOUBLE BR-3
	21FLTPA 280503823129		21FLTPA 280131008237838
	21FLTPA 28353823320		21FLTPA 280147008238030
	21FLWQSPHIL545US	**1516**	21FLGW 22072
1507	112WRD 02306774		21FLGW 22088
	21FLHILL141		21FLGW 22094
	21FLHILL160		21FLHILL142
	21FLHILL170		21FLHILL162
	21FLKWATHIL-CREEK-302-1		21FLHILL171
	21FLKWATHIL-CREEK-302-2		21FLTPA 24040112
	21FLKWATHIL-CREEK-302-3		21FLTPA 280000308232320
	21FLTPA 280223708234300		21FLWQSPHIL553US
	21FLTPA 280305908233390	**1563**	21FLHILL103
	21FLTPA 280357008233568		21FLTPA 275949408235112
1507A	21FLHILL102		21FLTPA 280003308235097
	21FLTPA 280037208236293		
1513E	21FLHILL156		
	21FLHILL157		
	21FLHILL158		
	21FLHILL172		
	21FLHILL173		

Table 5.2 Water quality data for the impaired WBIDs

Parameter	Stats	WBID						
		1498	1507	1507A	1513E	1513F	1516	1563
BOD, 5 Day, 20°C (mg/L)	# of obs	45	178	103	131	103	136	103
	min	0.00	0.00	0.40	0.00	0.00	0.00	0.30
	max	2.20	8.60	10.60	5.80	6.70	6.70	6.00
	mean	1.07	1.50	3.20	1.42	1.45	1.38	1.59
	Geomean	0.75	1.04	2.66	0.91	1.05	0.85	1.36
DO, Analysis by Probe (mg/L)	# of obs	115	178	315	244	255	233	237
	min	1.56	0.01	0.00	0.63	0.00	0.09	0.01
	max	9.60	9.80	9.80	9.58	11.51	10.30	13.63
	mean	6.19	4.81	2.94	4.25	3.38	4.39	3.35
	Geomean	5.97	4.17	1.33	3.86	2.38	3.73	2.74
Nitrogen, Total (mg/L as N)	# of obs	101	341	130	202	149	199	130
	min	0.58	0.18	0.26	0.09	0.34	0.39	0.37
	max	2.20	8.44	2.21	5.53	2.35	3.25	2.11
	mean	1.13	1.27	0.97	1.21	0.95	0.88	1.06
	Geomean	1.10	1.12	0.93	1.12	0.90	0.84	1.02
Phosphorus, Total (mg/L as P)	# of obs	103	348	133	208	152	204	133
	min	0.02	0.00	0.08	0.00	0.01	0.01	0.06
	max	0.40	0.56	0.36	0.61	0.27	1.20	0.27
	mean	0.13	0.10	0.17	0.12	0.12	0.09	0.14
	Geomean	0.11	0.08	0.16	0.10	0.11	0.07	0.14
Chlorophyll-A-corrected (µg/L)	# of obs	84	195	85	178	84	146	81
	min	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	max	25.30	151.60	119.80	64.50	34.00	364.00	41.40
	mean	4.46	9.16	24.98	6.42	4.63	15.22	10.86
	Geomean	2.84	4.35	16.84	3.81	3.18	5.82	7.18

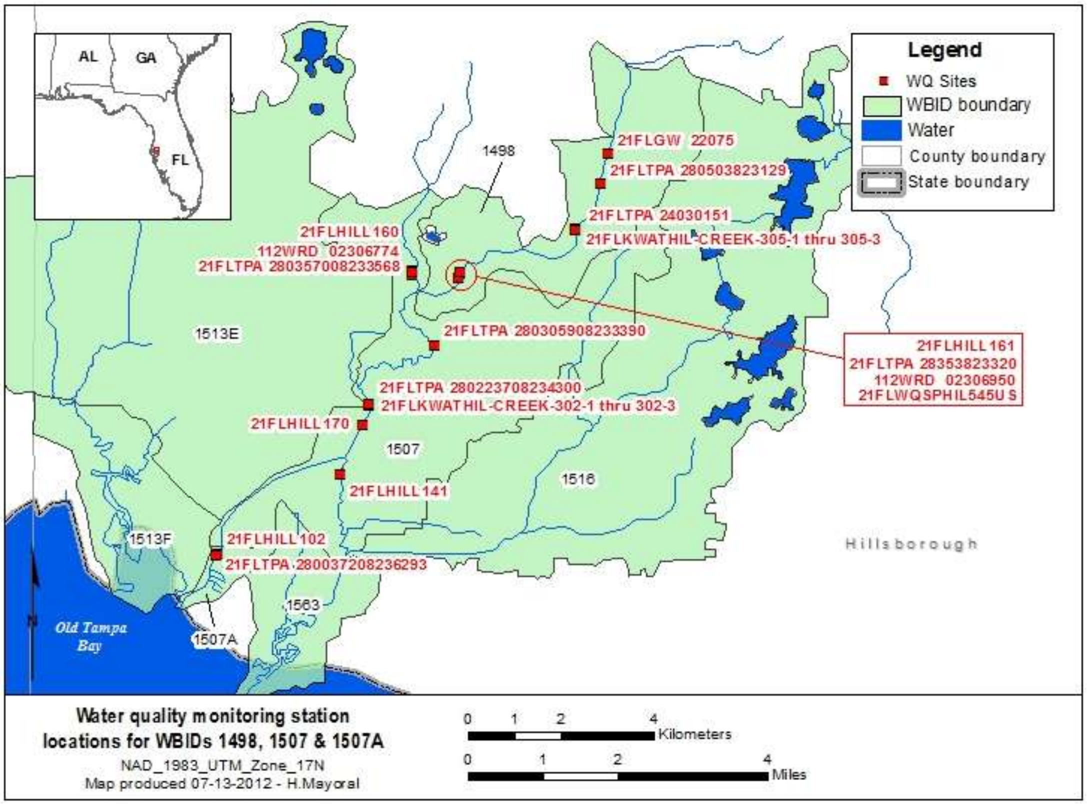

Figure 5.1 Water quality station locations for WBIDs 1498, 1507, and 1507A in the Tampa Bay basin

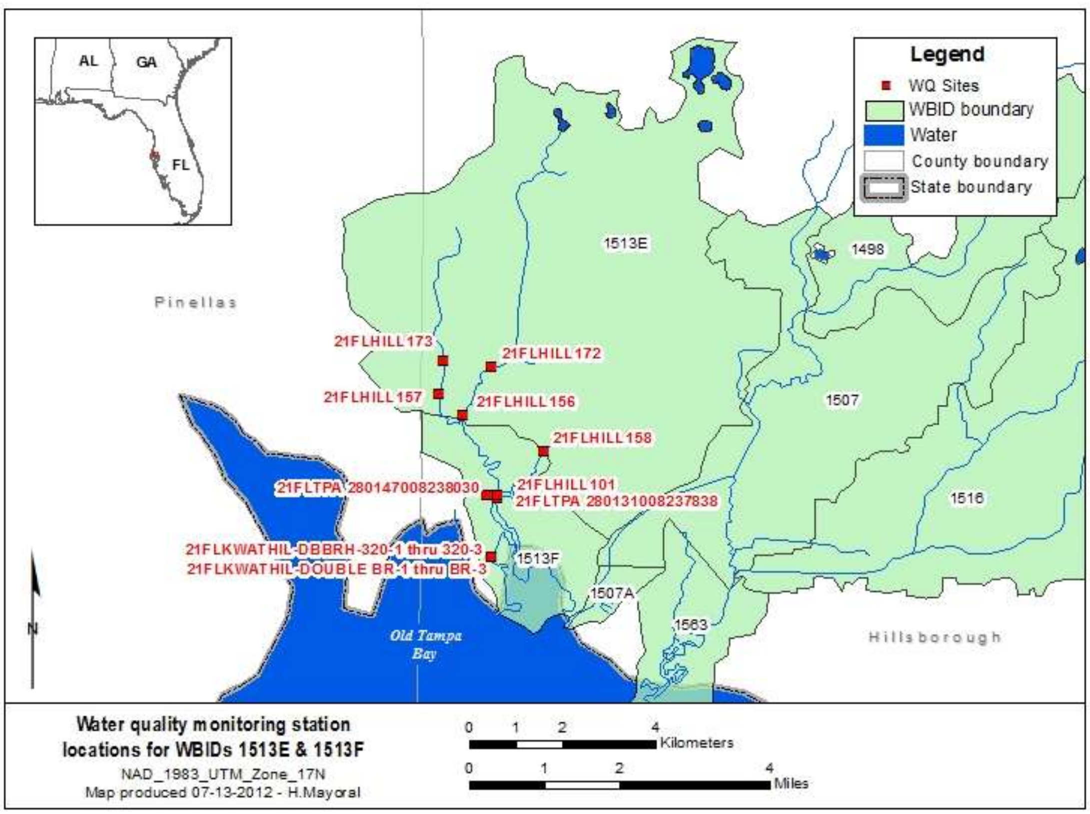

Figure 5.2 Water quality station locations for WBIDs 1513E and 1513F in the Tampa Bay basin

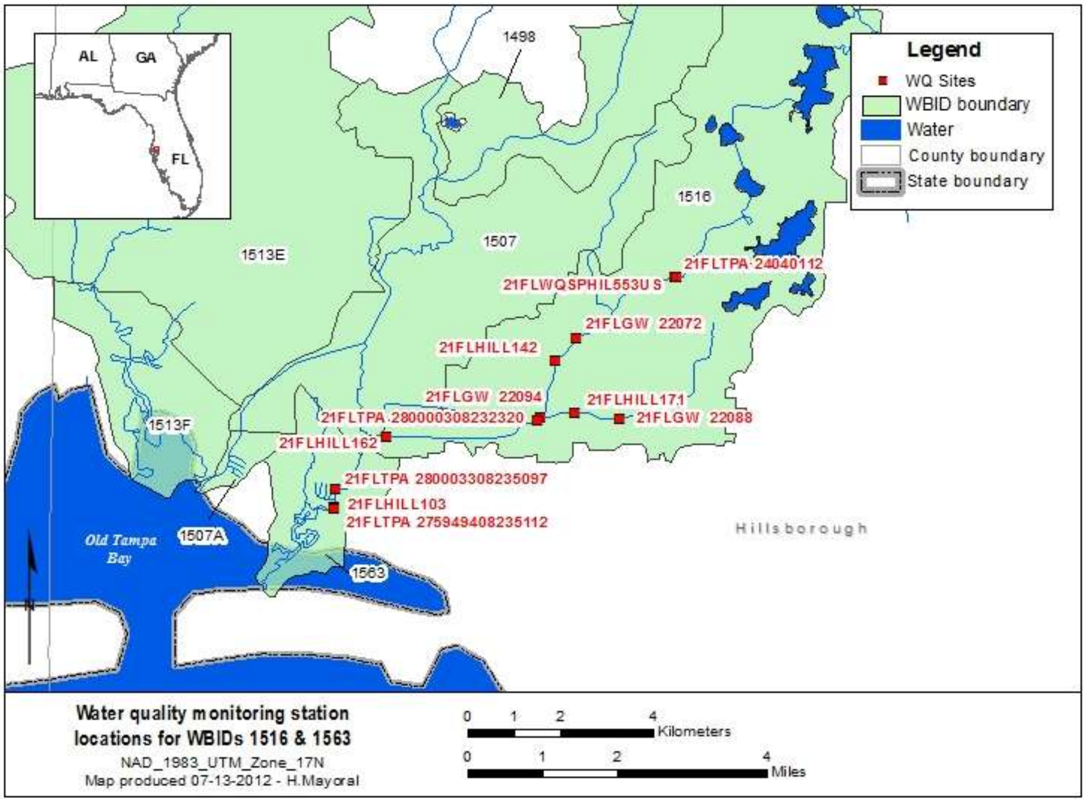

Figure 5.3 Water quality station locations for WBIDs 1516 and 1563 in the Tampa Bay basin

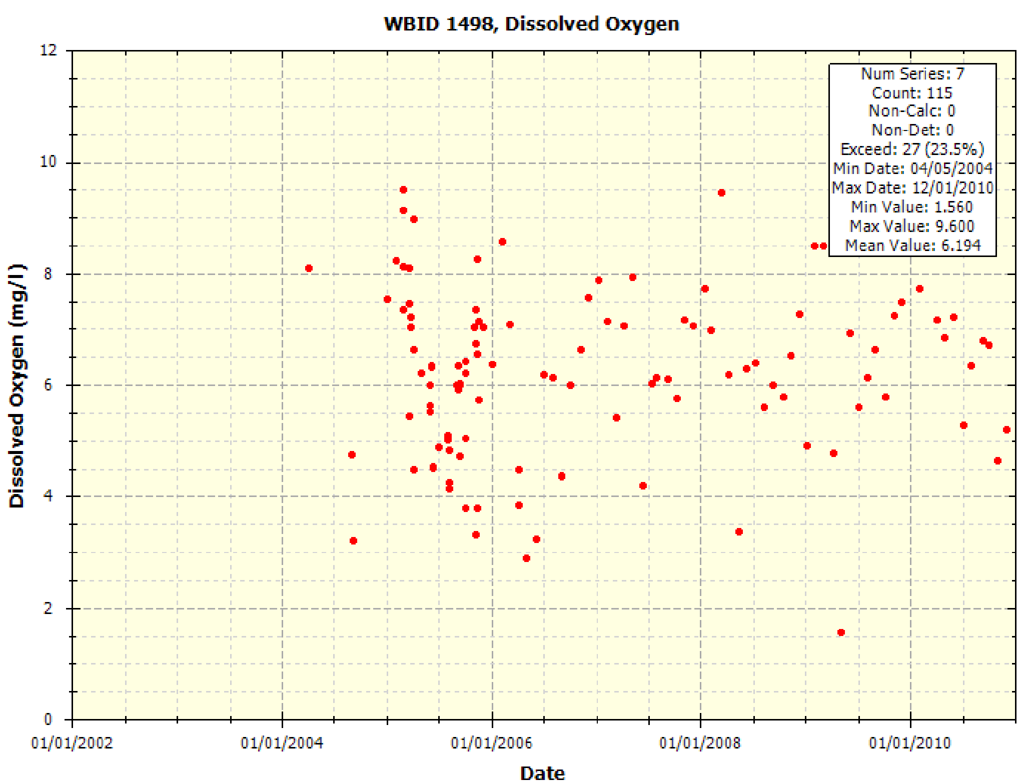

Figure 5.4 Dissolved oxygen concentrations for WBID 1498

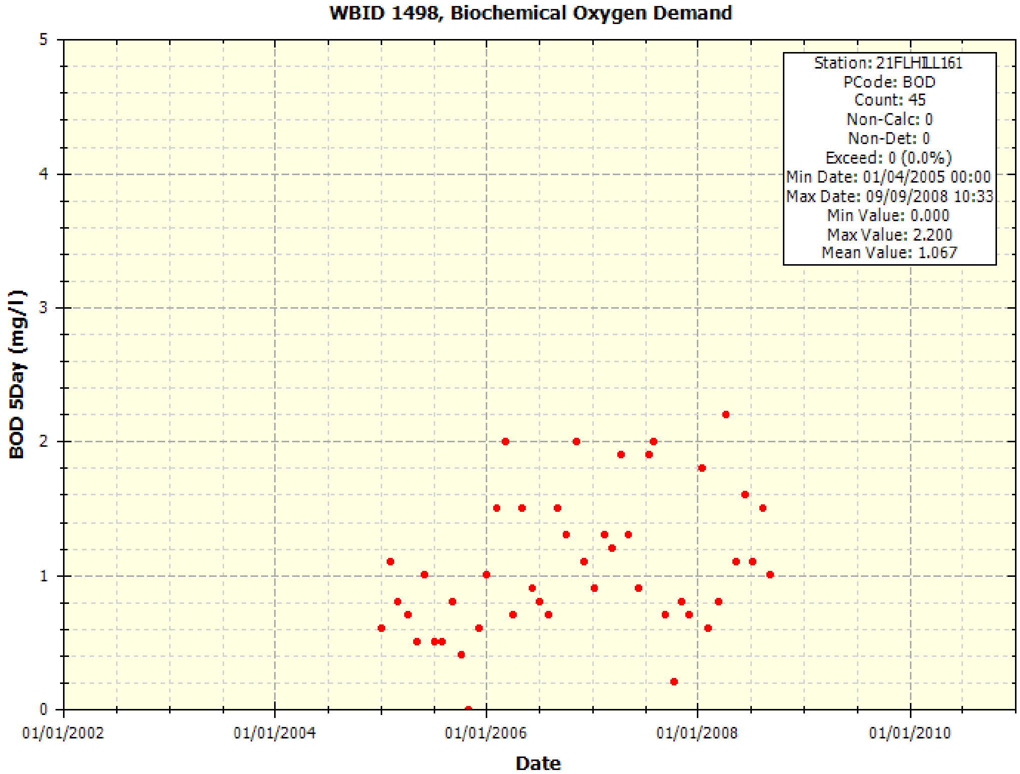

Figure 5.5 Biochemical oxygen demand concentrations for WBID 1498

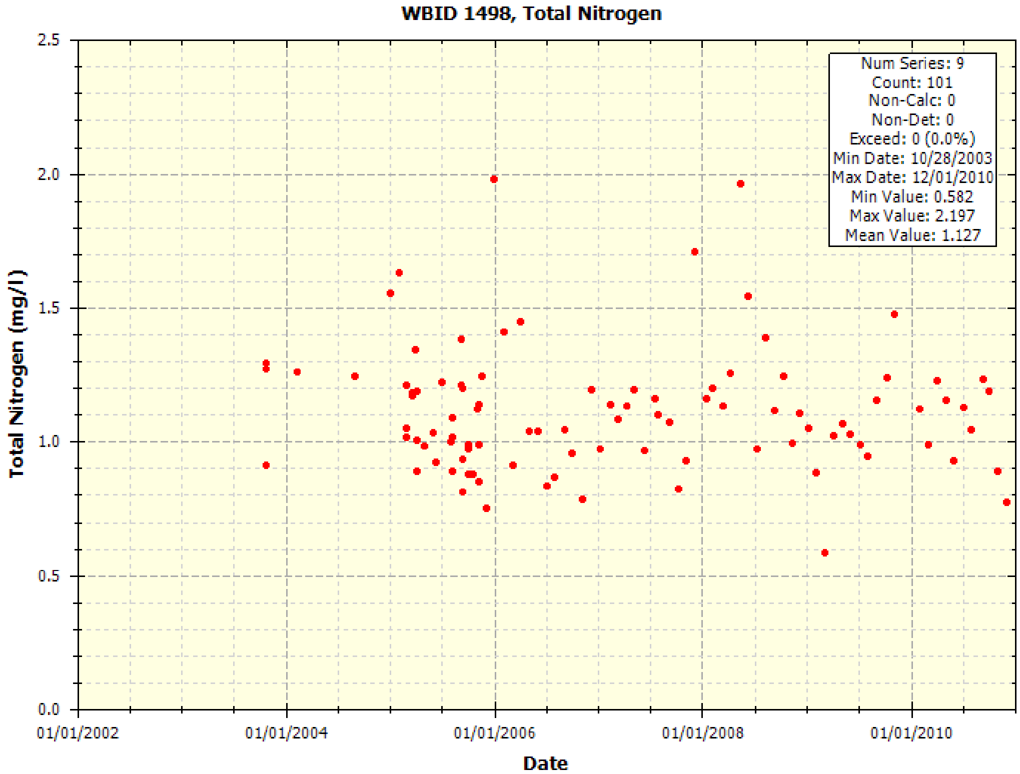

Figure 5.6 Total nitrogen concentrations for WBID 1498

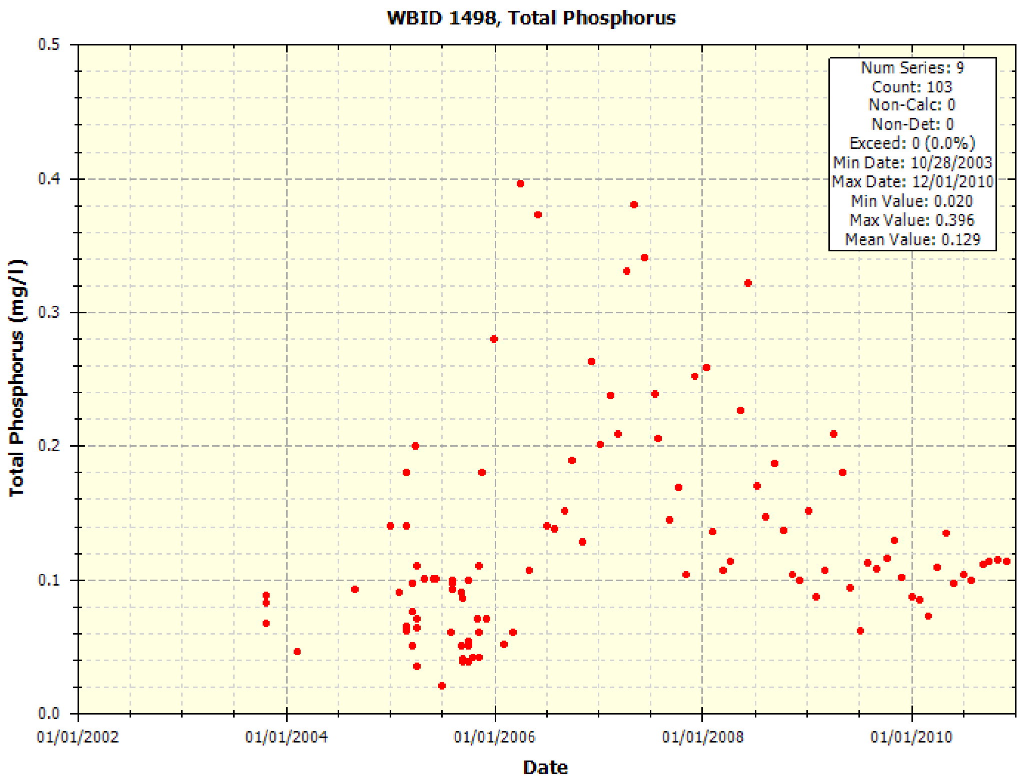

Figure 5.7 Total phosphorus concentrations for WBID 1498

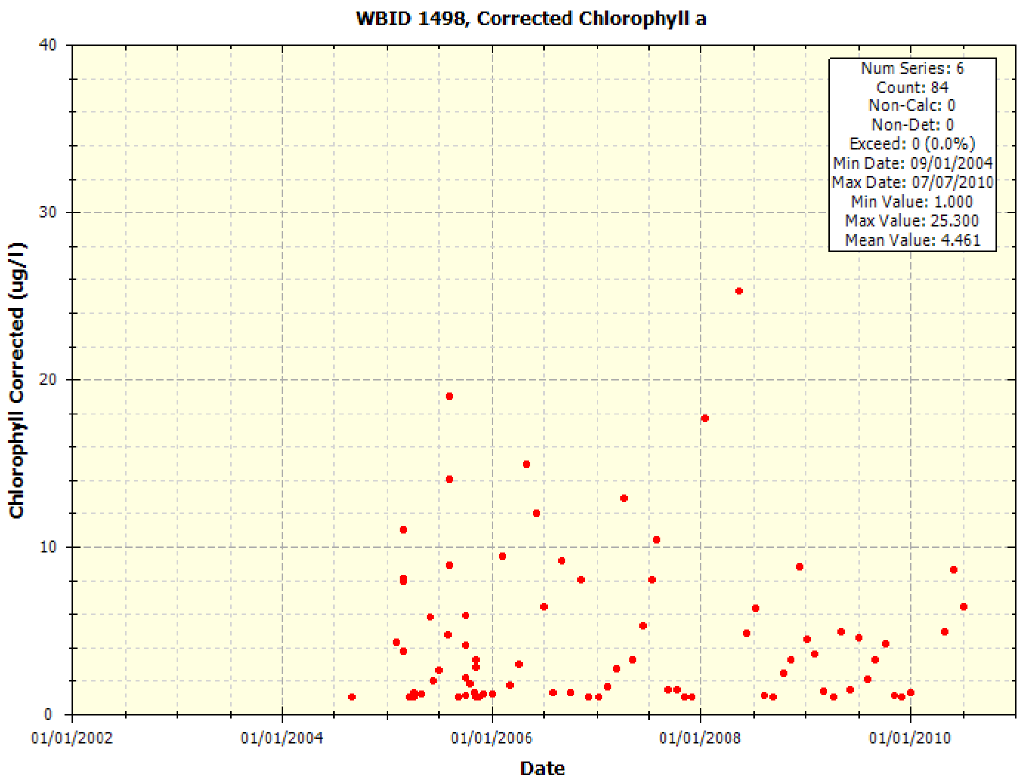

Figure 5.8 Corrected chlorophyll a concentrations for WBID 1498

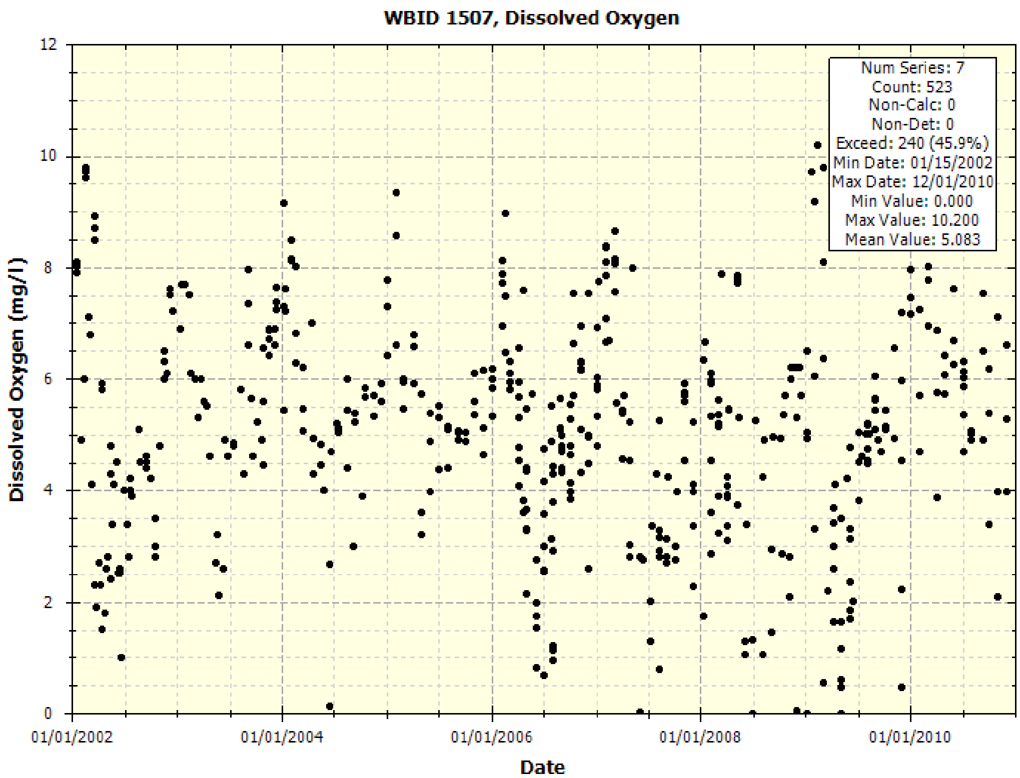

Figure 5.9 Dissolved oxygen concentrations for WBID 1507

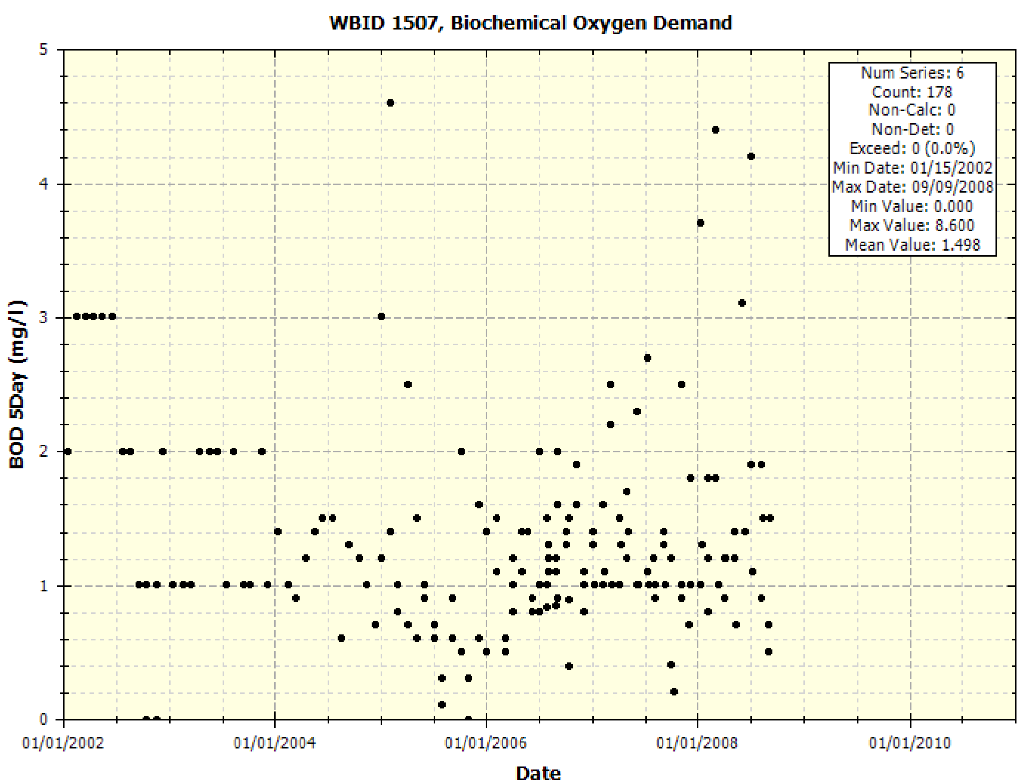

Figure 5.10 Biochemical oxygen demand concentrations for WBID 1507

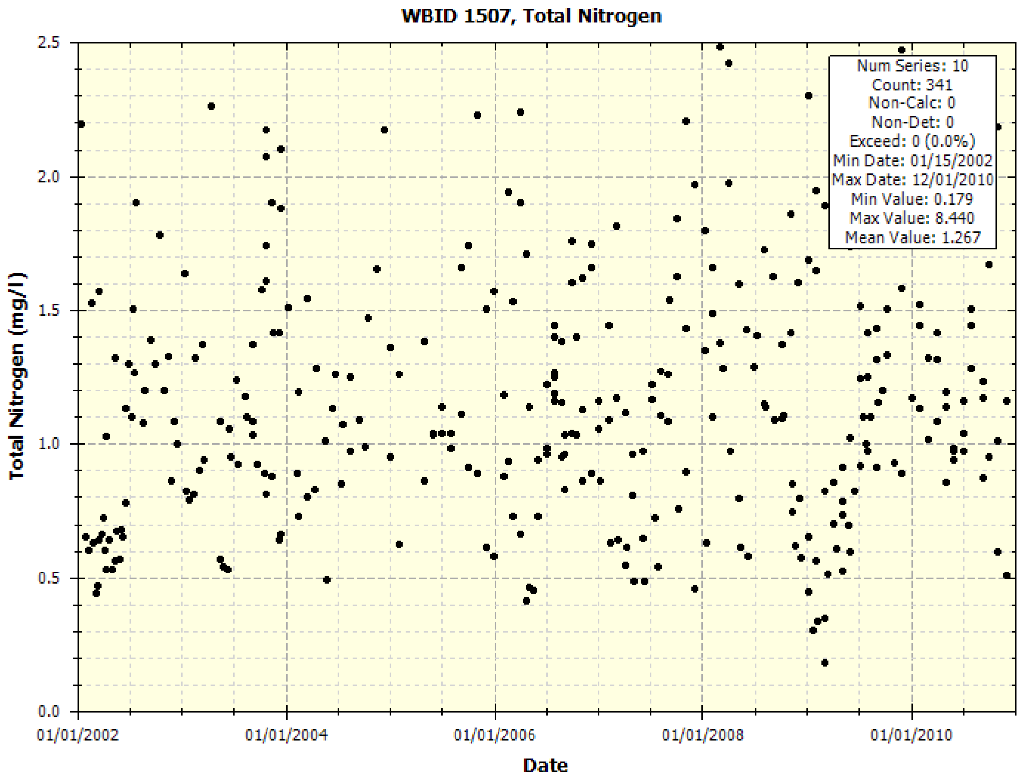

Figure 5.11 Total nitrogen concentrations for WBID 1507

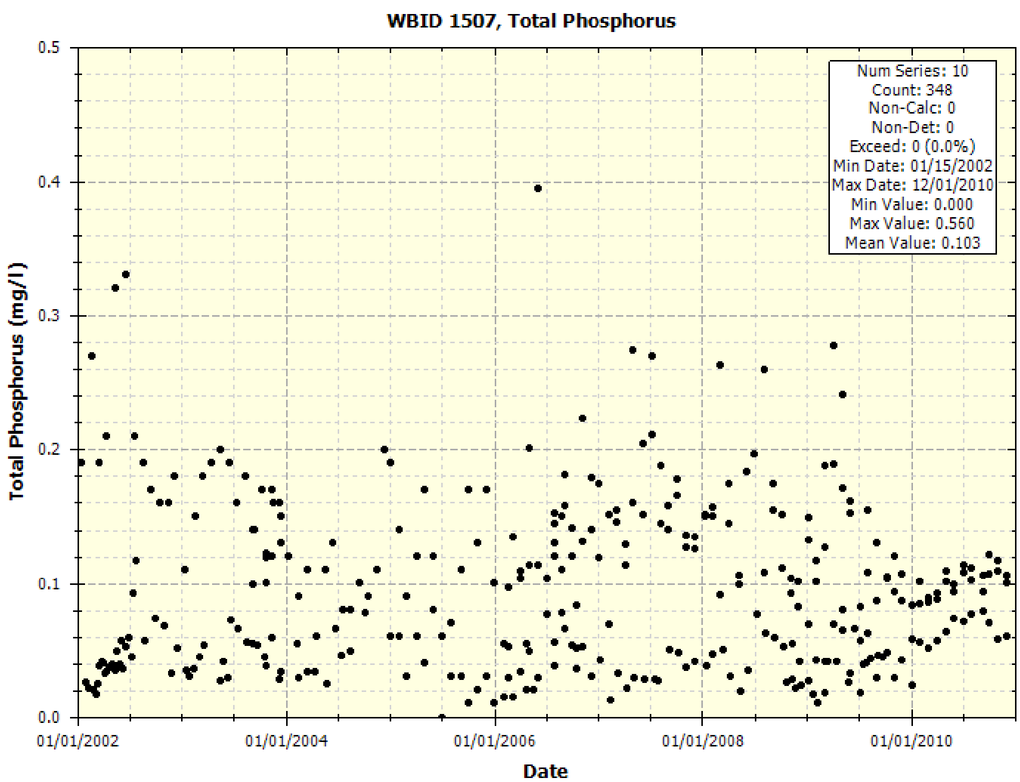

Figure 5.12 Total phosphorus concentrations for WBID 1507

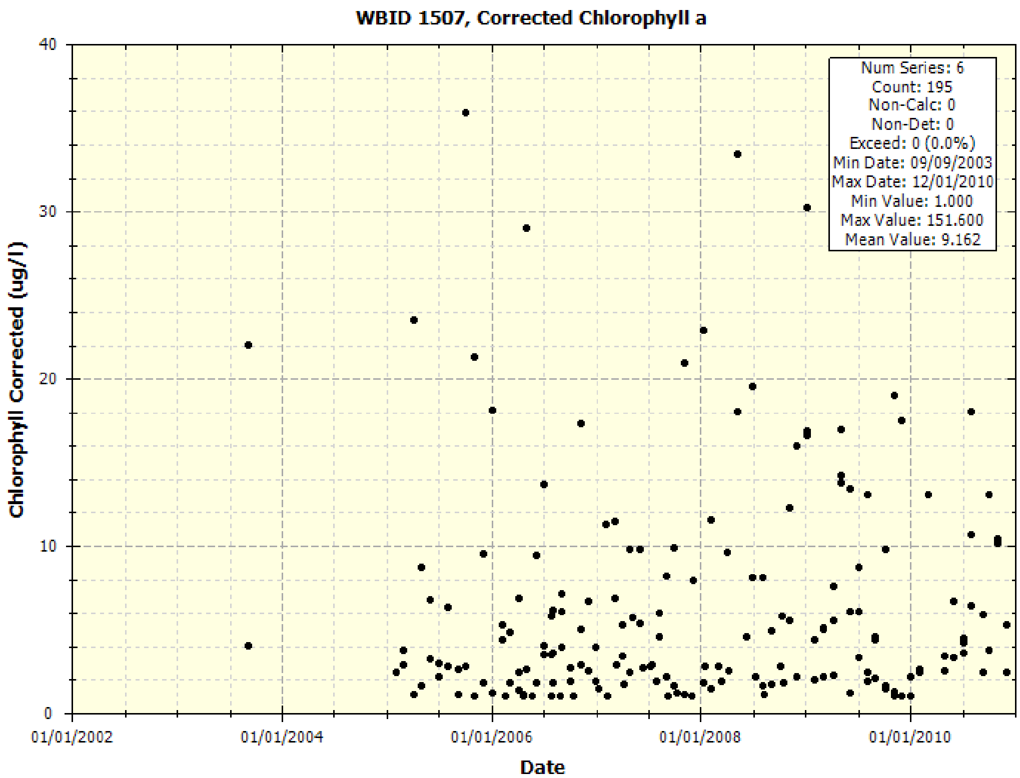

Figure 5.13 Corrected chlorophyll a concentrations for WBID 1507

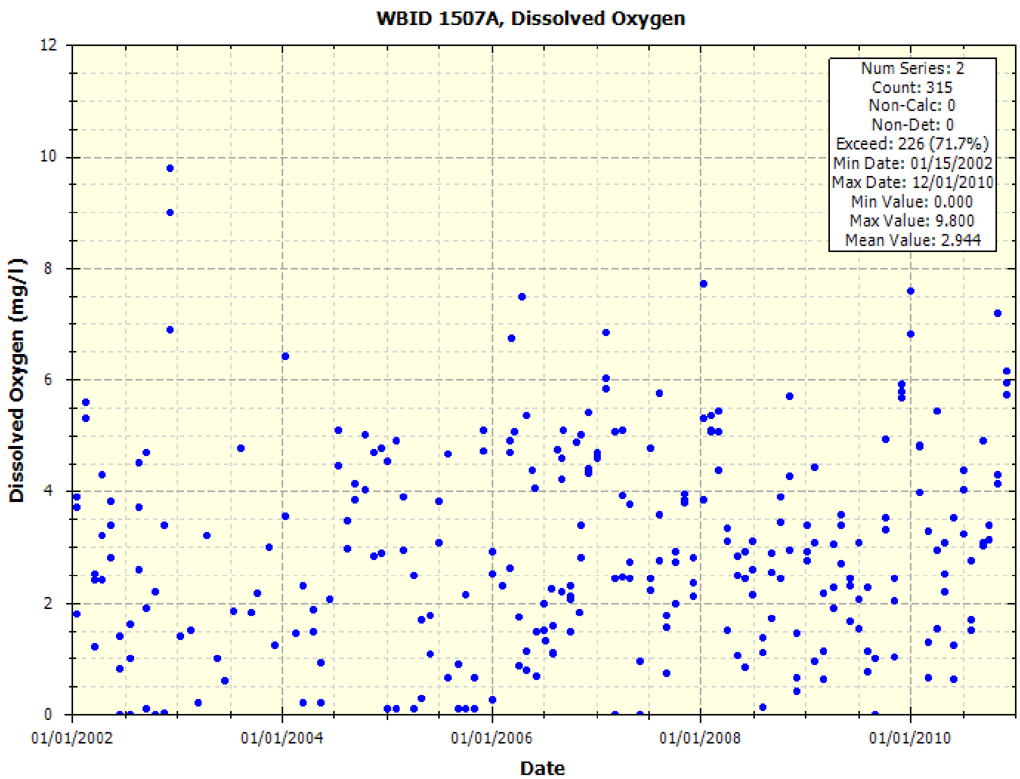

Figure 5.14 Dissolved oxygen concentrations for WBID 1507A

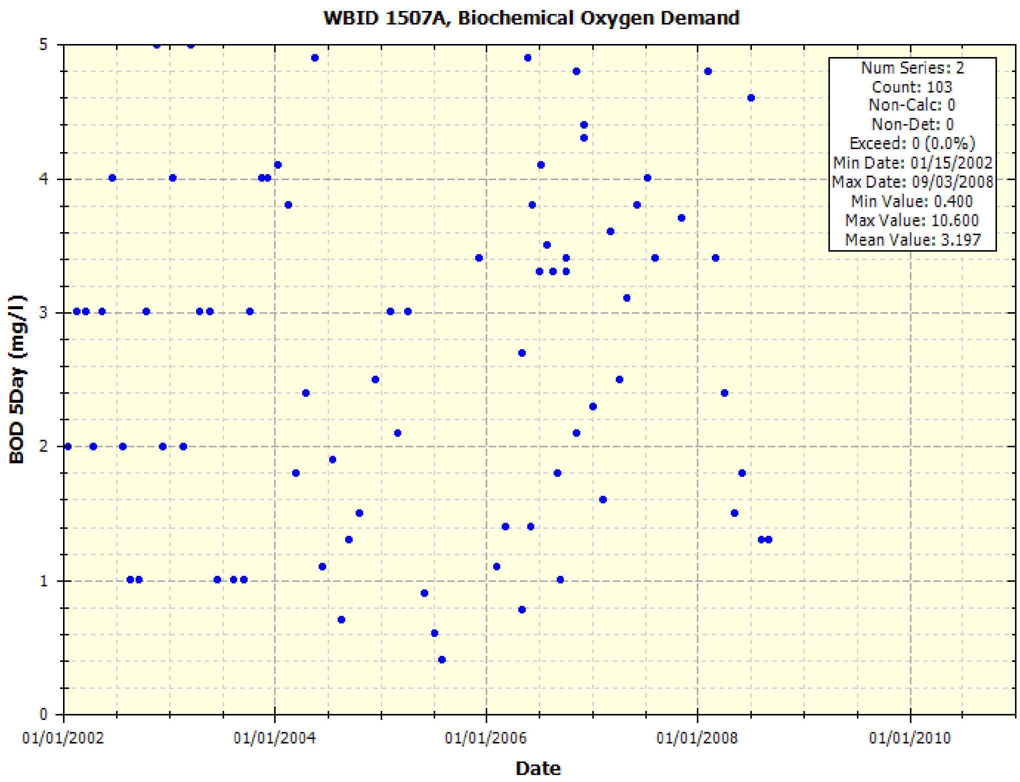

Figure 5.15 Biochemical oxygen demand concentrations for WBID 1507A

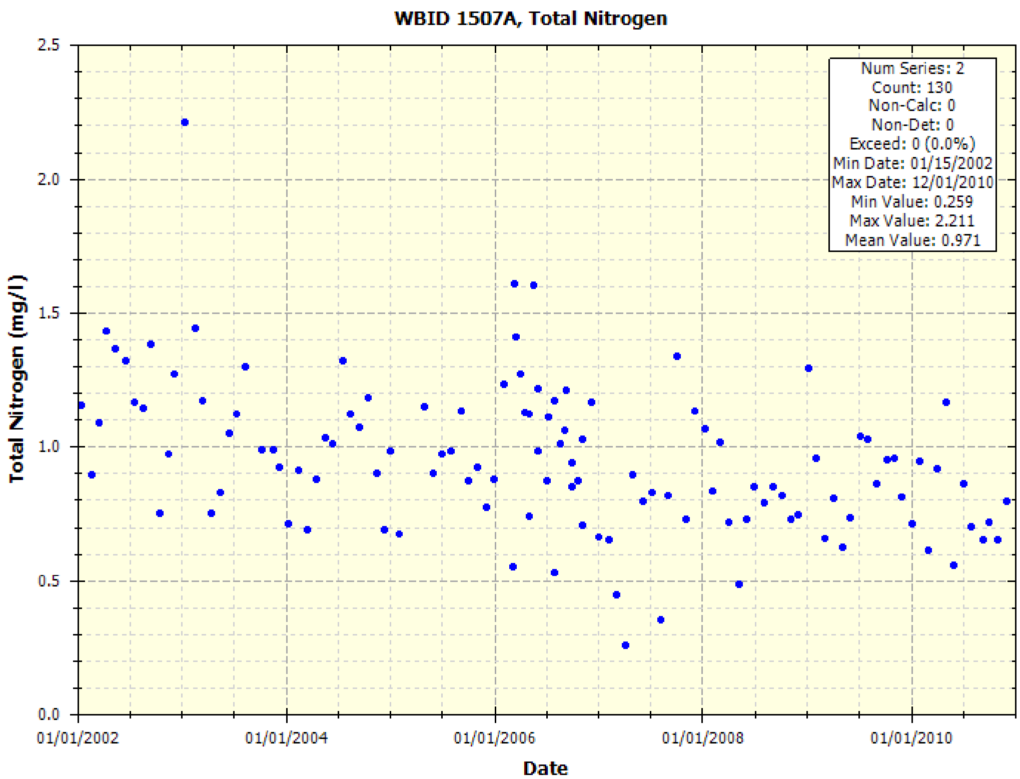

Figure 5.16 Total nitrogen concentrations for WBID 1507A

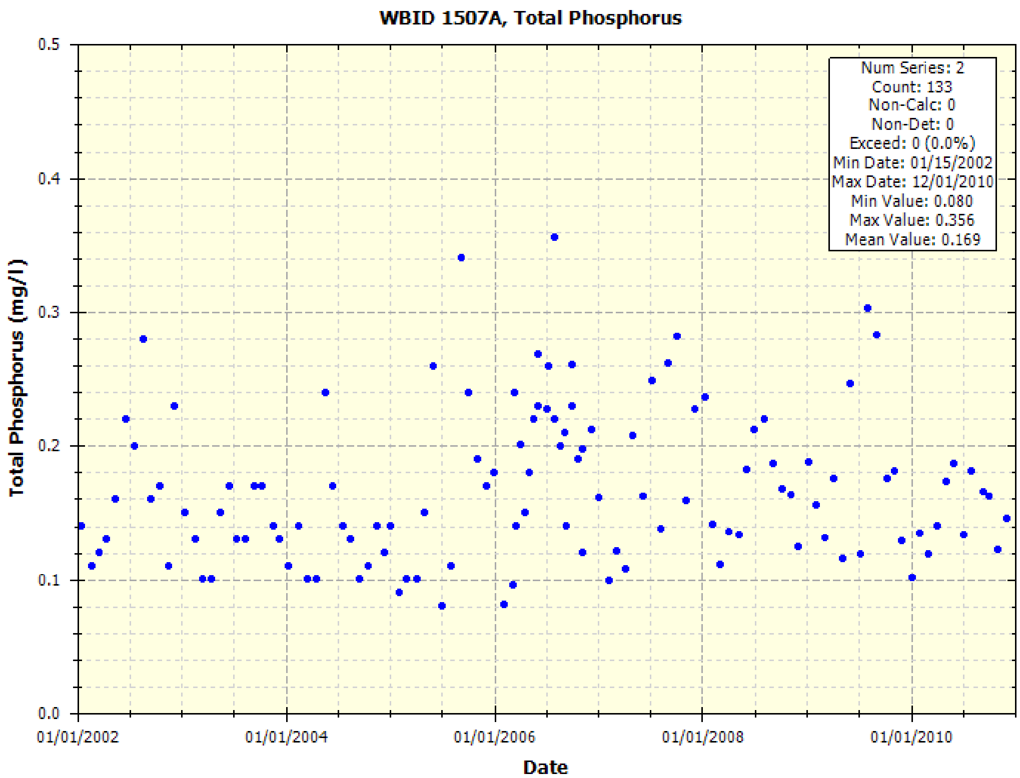

Figure 5.17 Total phosphorus concentrations for WBID 1507A

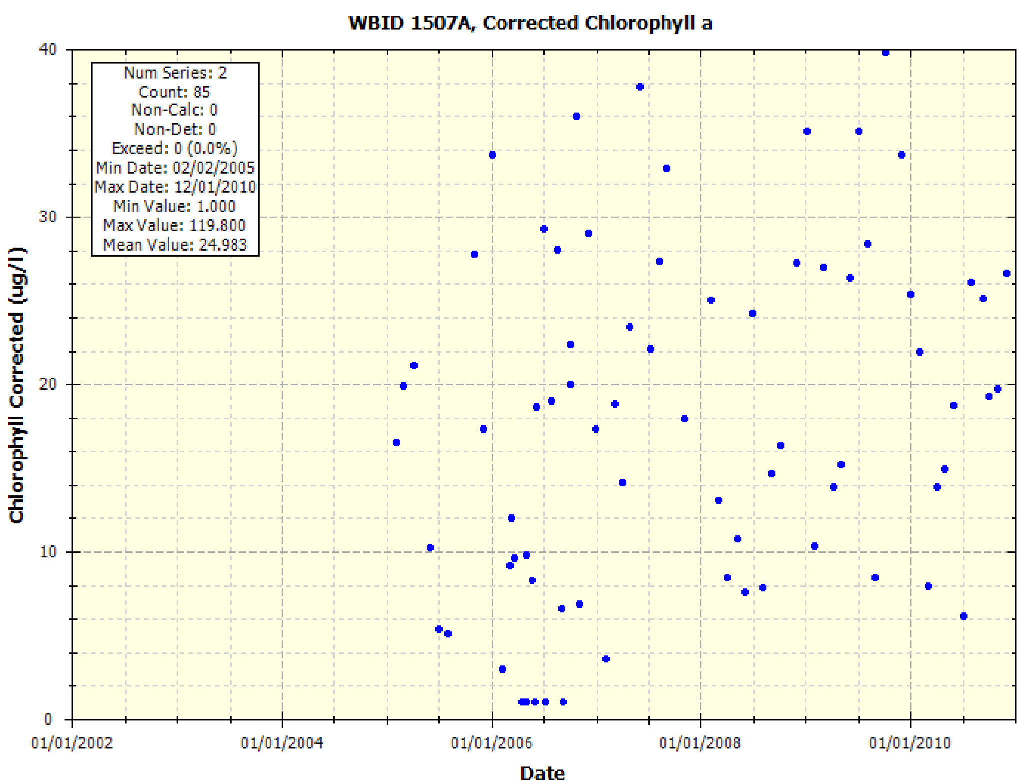

Figure 5.18 Corrected chlorophyll a concentrations for WBID 1507A

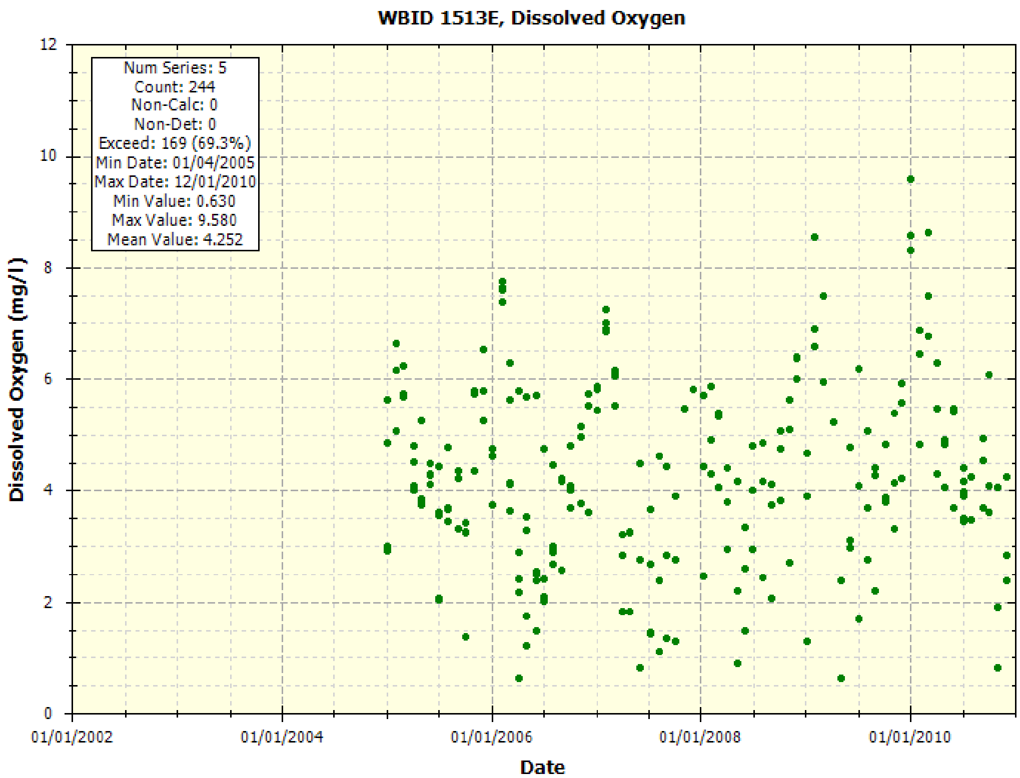

Figure 5.19 Dissolved oxygen concentrations for WBID 1513E

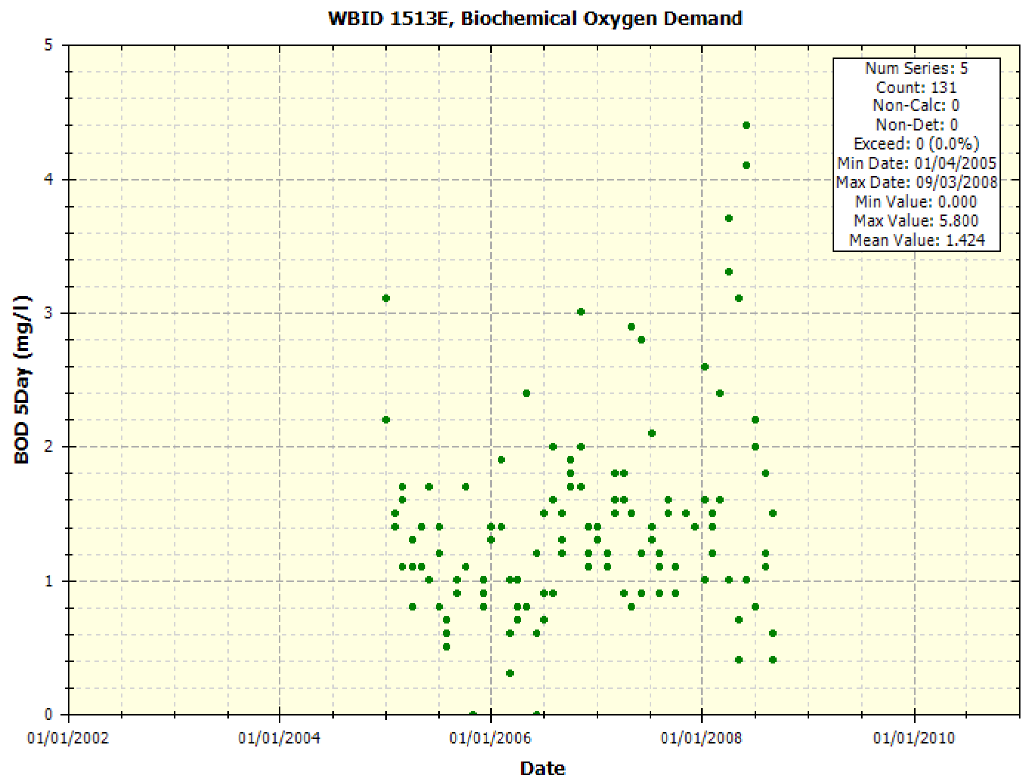

Figure 5.20 Biochemical oxygen demand concentrations for WBID 1513E

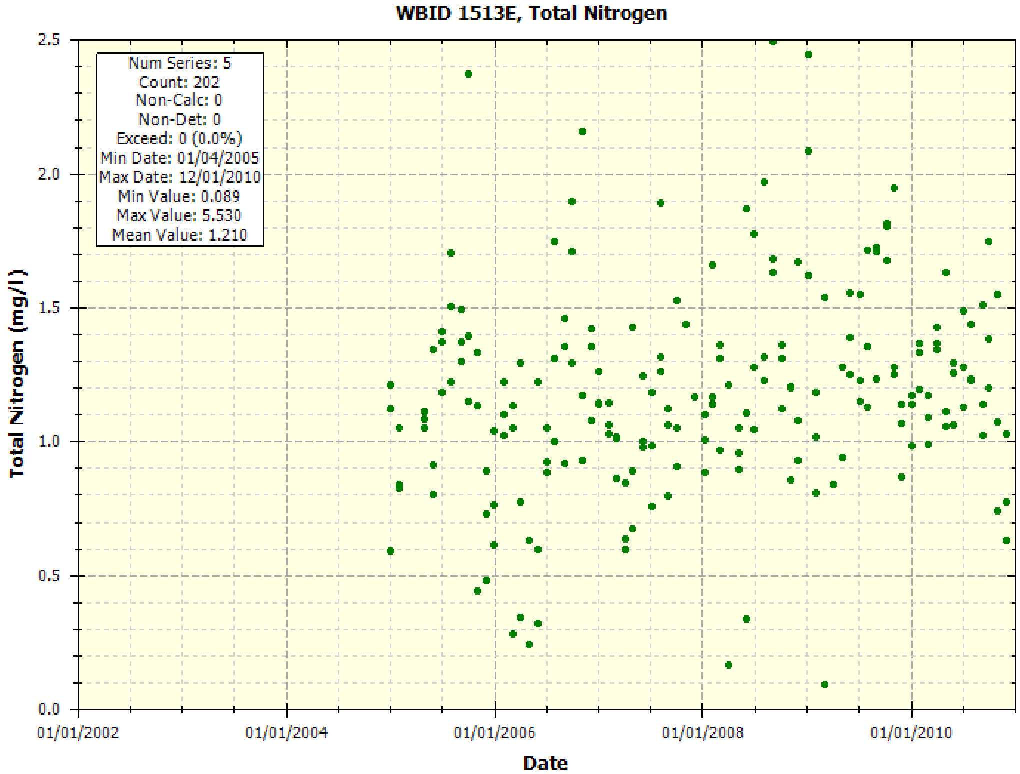

Figure 5.21 Total nitrogen concentrations for WBID 1513E

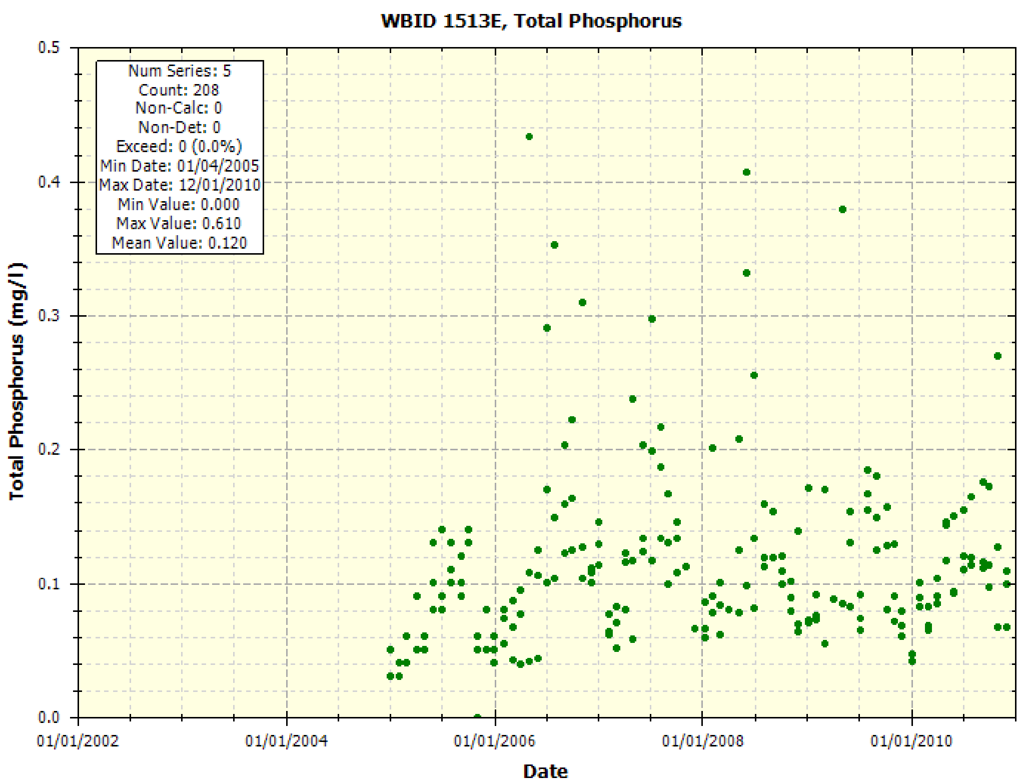

Figure 5.22 Total phosphorus concentrations for WBID 1513E

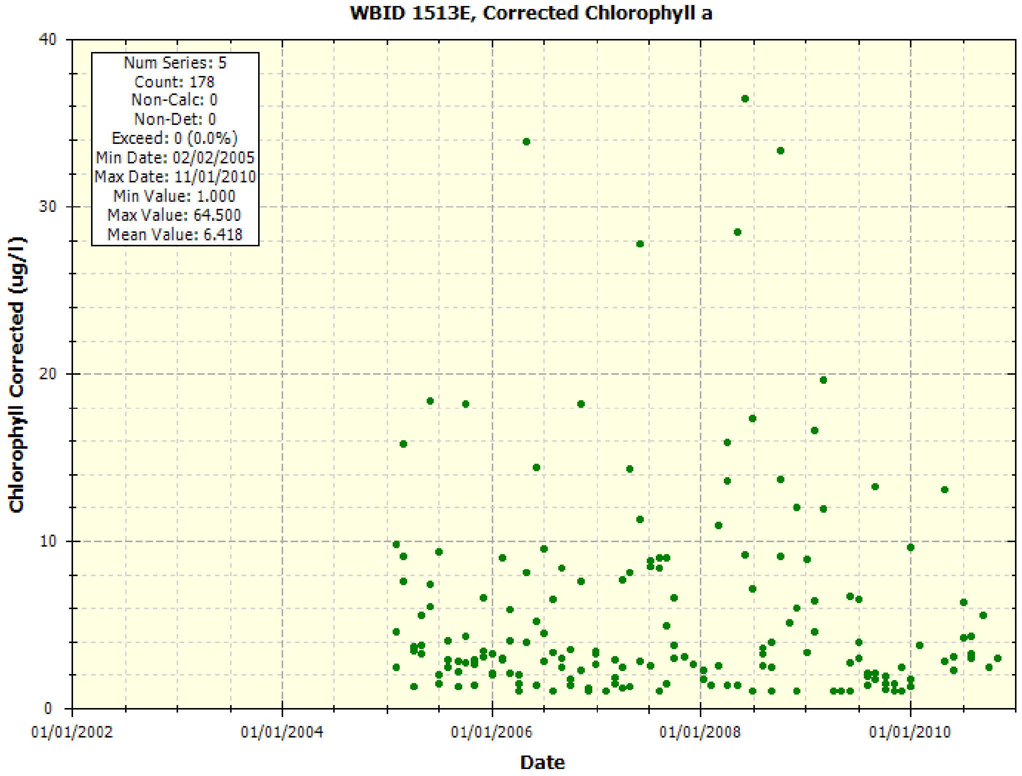

Figure 5.23 Corrected chlorophyll a concentrations for WBID 1513E

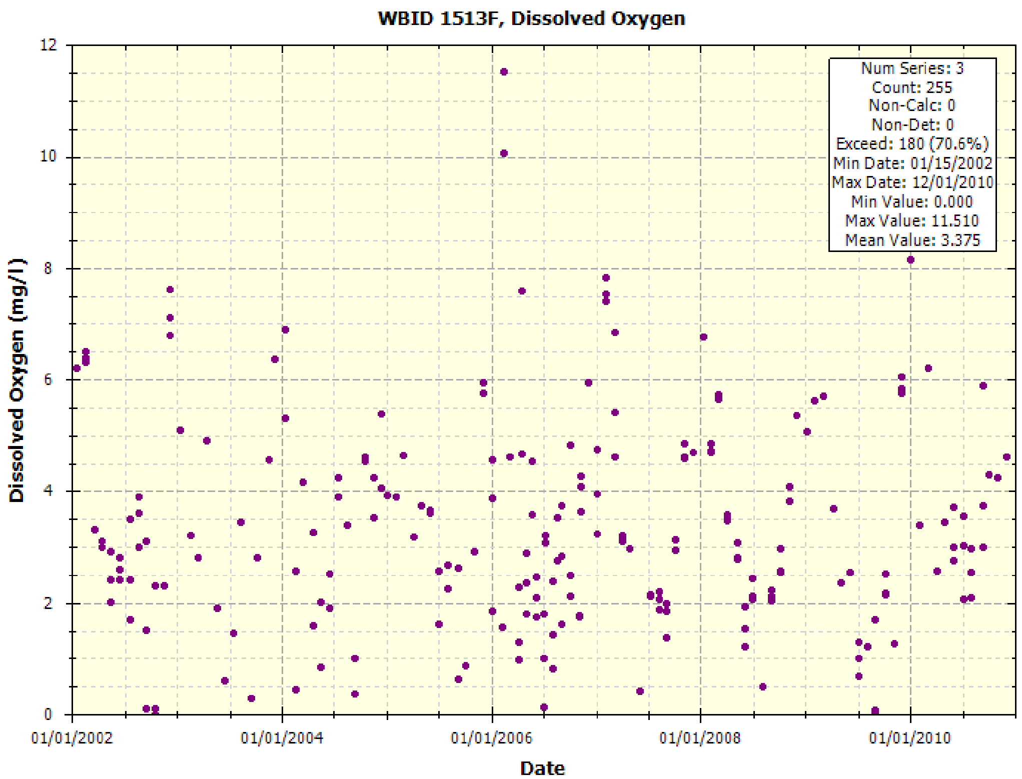

Figure 5.24 Dissolved oxygen concentrations for WBID 1513F

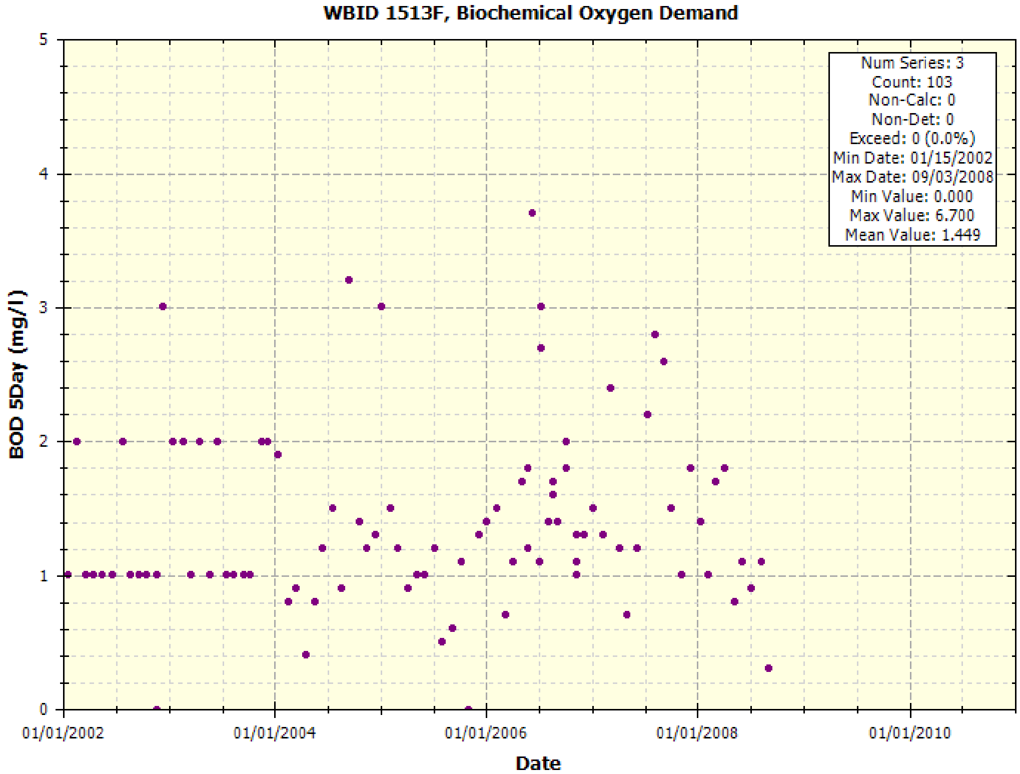

Figure 5.25 Biochemical oxygen demand concentrations for WBID 1513F

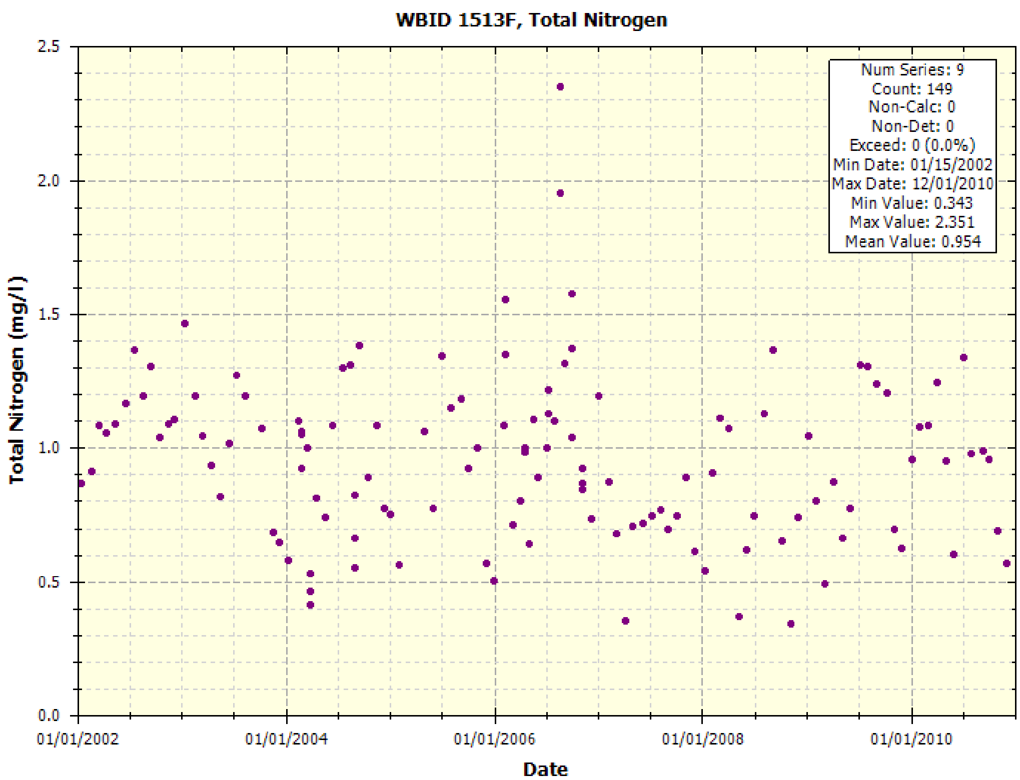

Figure 5.26 Total nitrogen concentrations for WBID 1513F

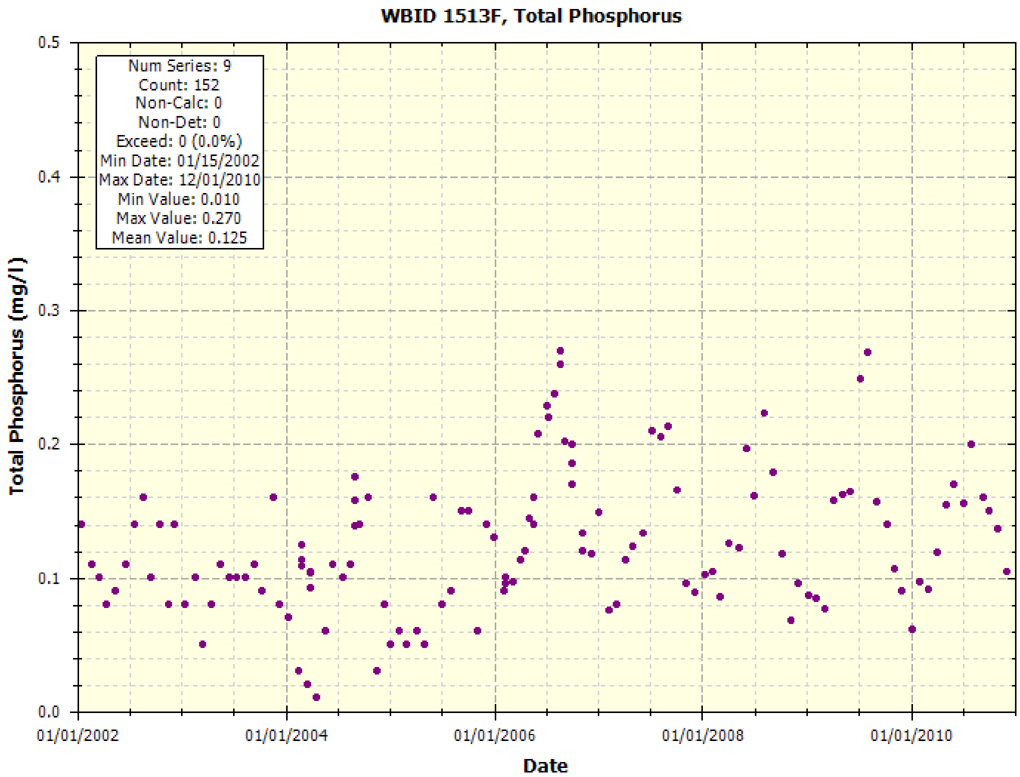

Figure 5.27 Total phosphorus concentrations for WBID 1513F

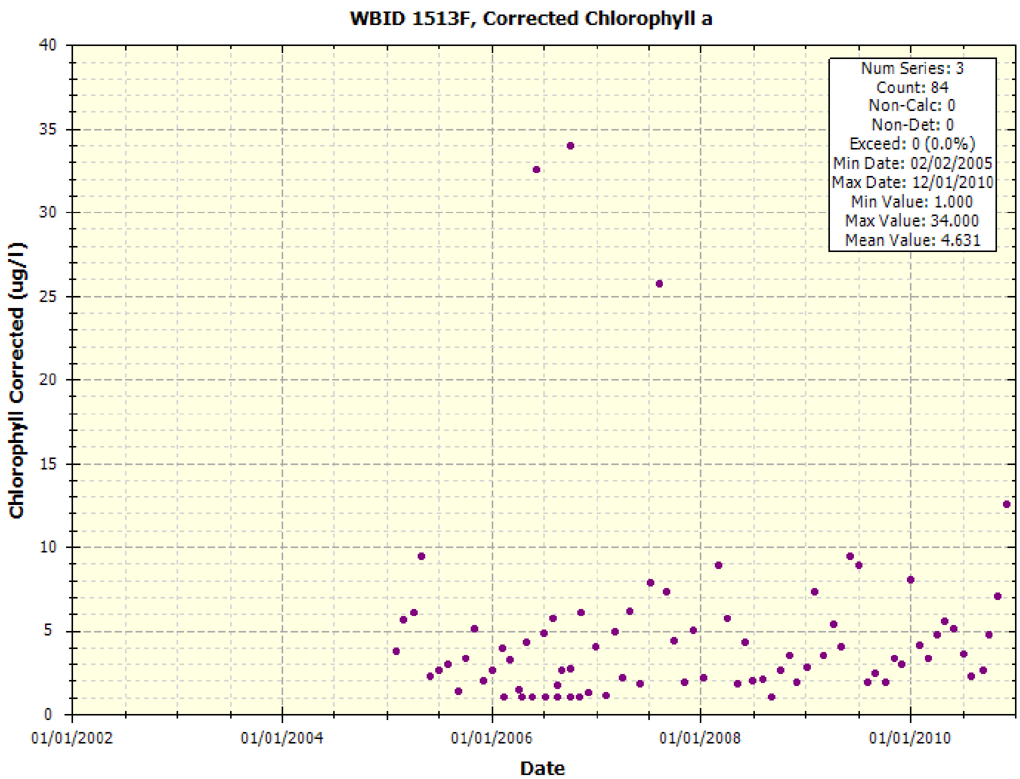

Figure 5.28 Corrected chlorophyll a concentrations for WBID 1513F

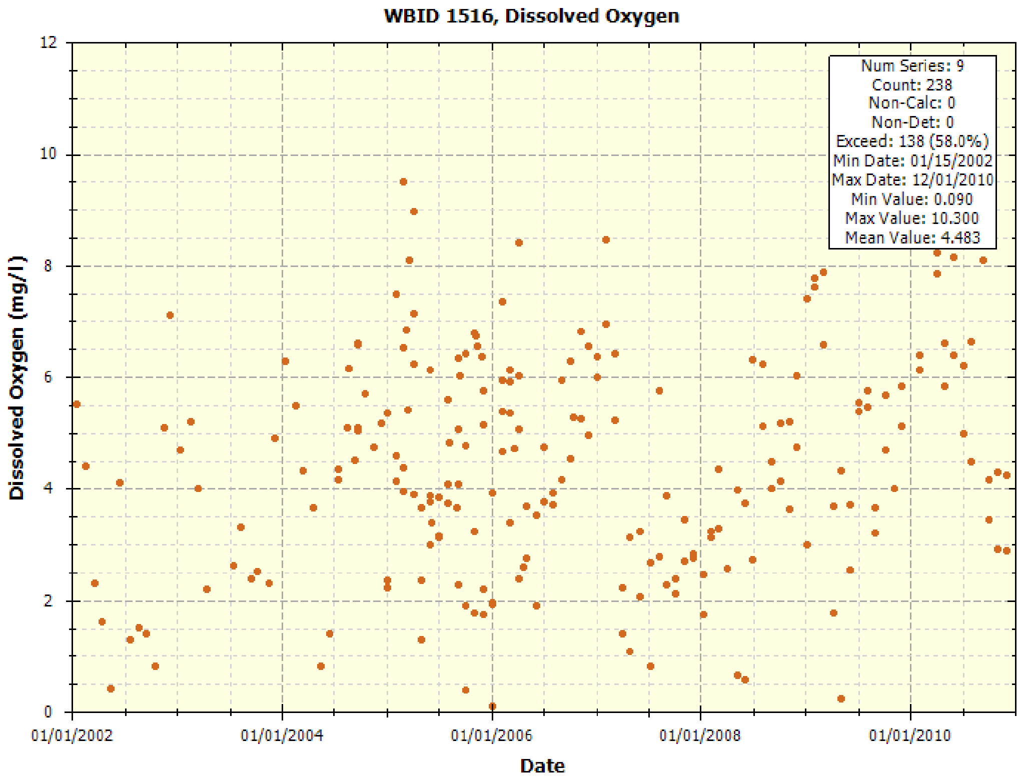

Figure 5.29 Dissolved oxygen concentrations for WBID 1516

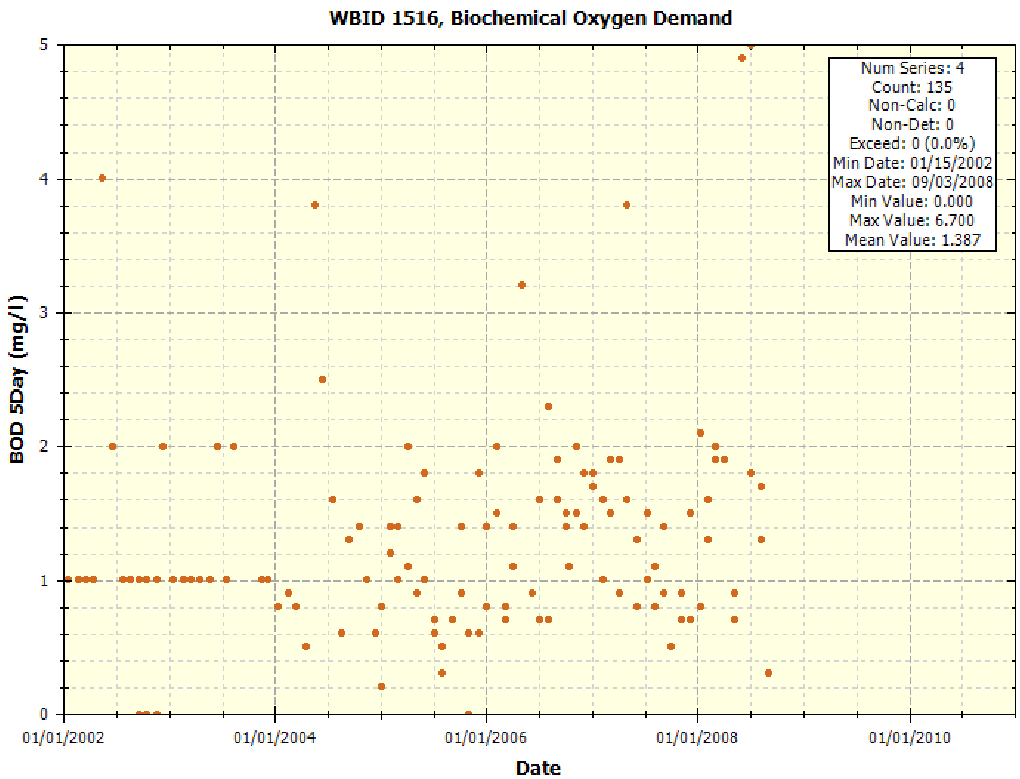

Figure 5.30 Biochemical oxygen demand concentrations for WBID 1516

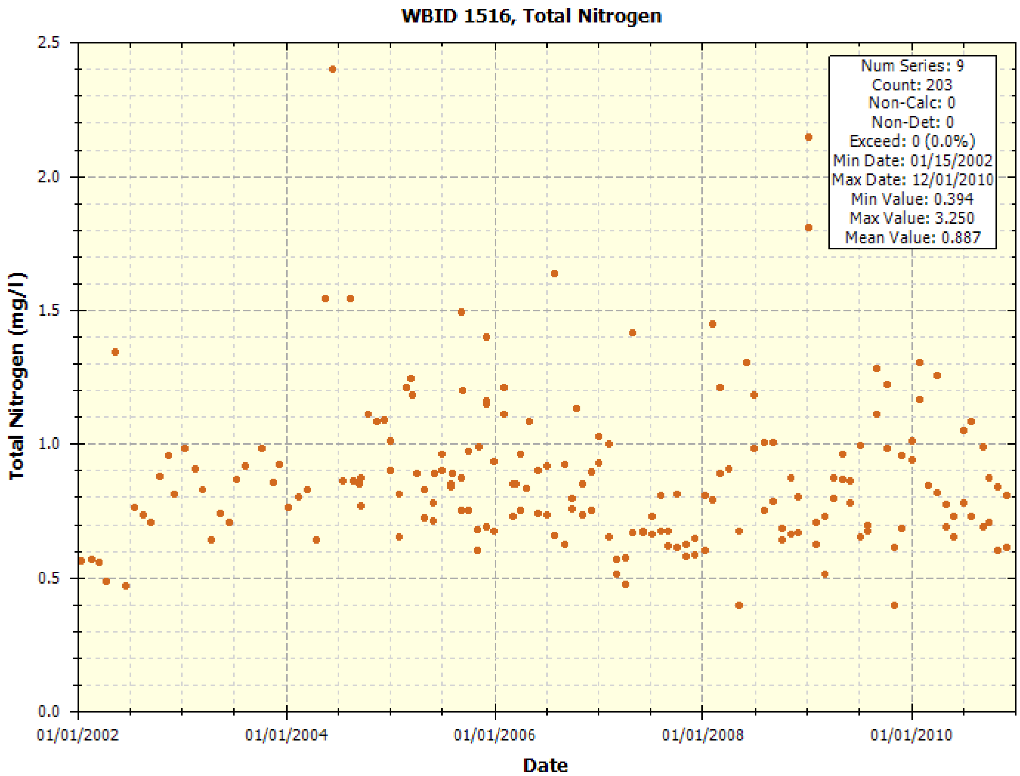

Figure 5.31 Total nitrogen concentrations for WBID 1516

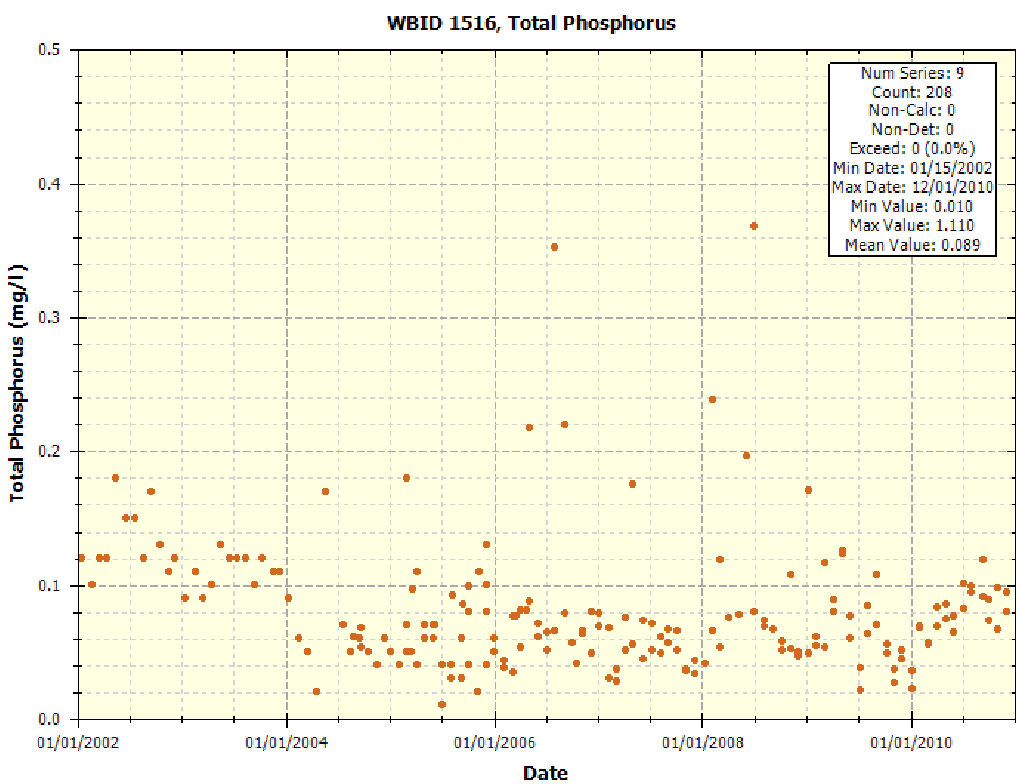

Figure 5.32 Total phosphorus concentrations for WBID 1516

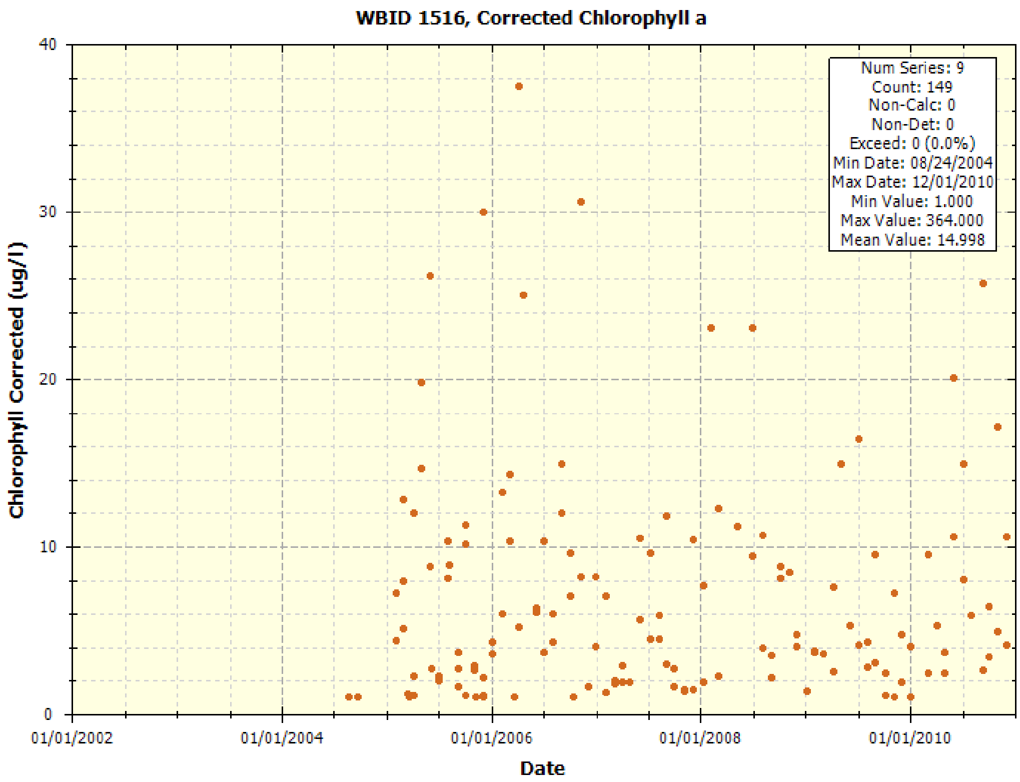

Figure 5.33 Corrected chlorophyll a concentrations for WBID 1516

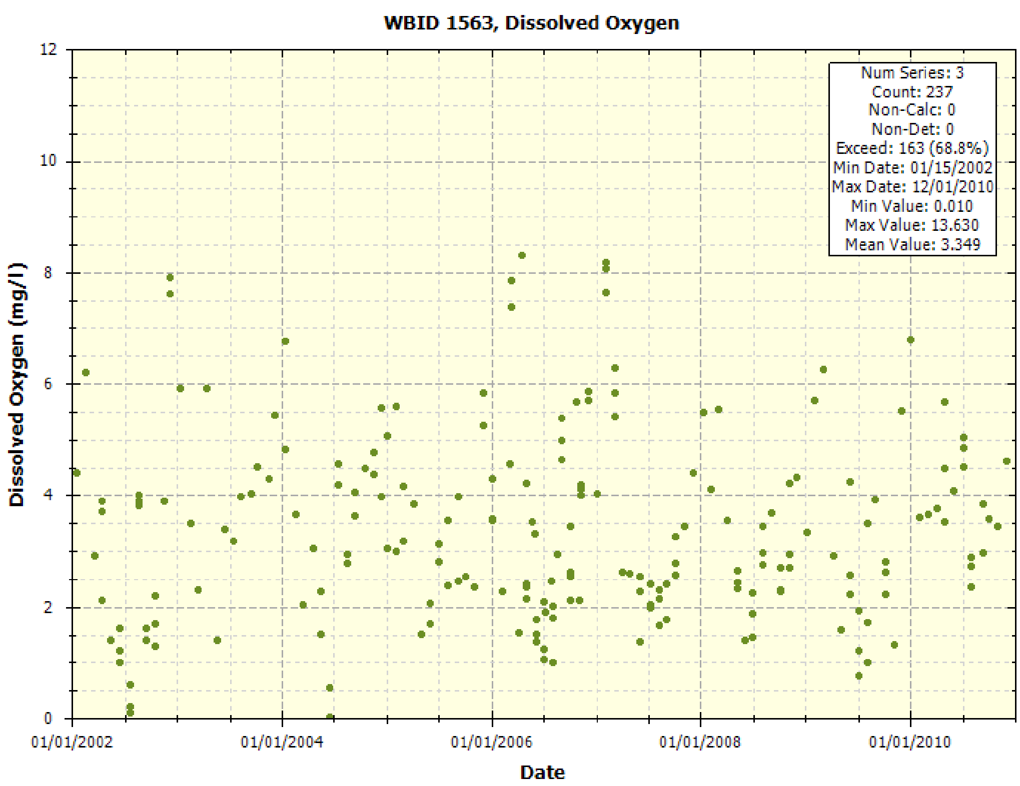

Figure 5.34 Dissolved oxygen concentrations for WBID 1563

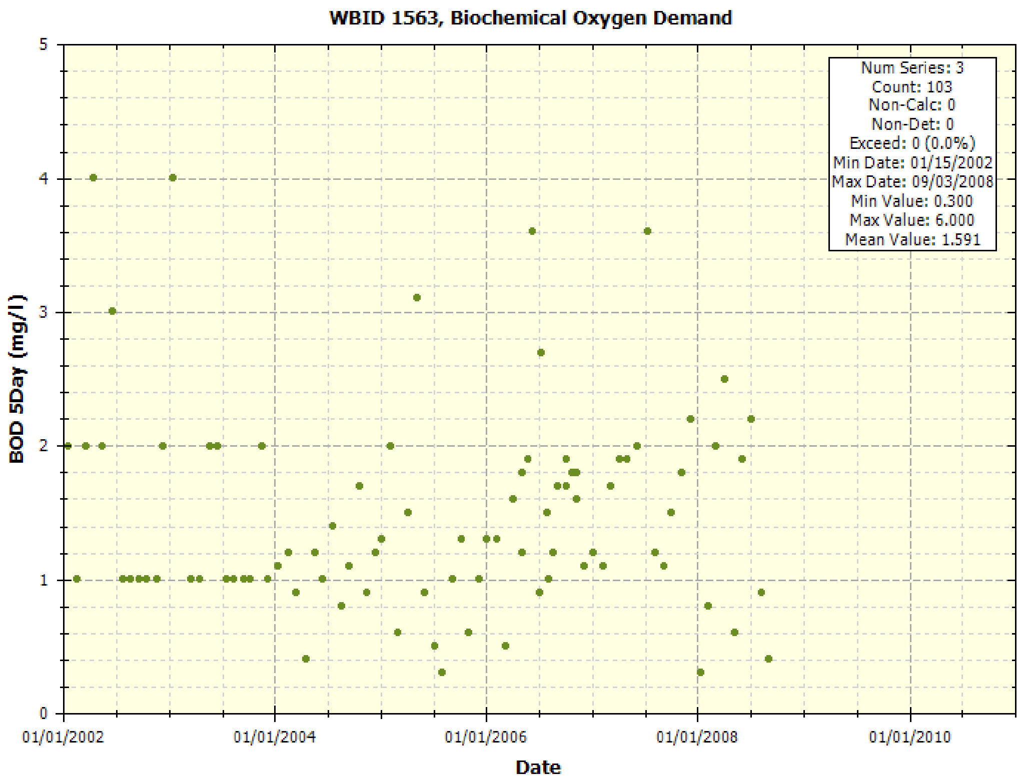

Figure 5.35 Biochemical oxygen demand concentrations for WBID 1563

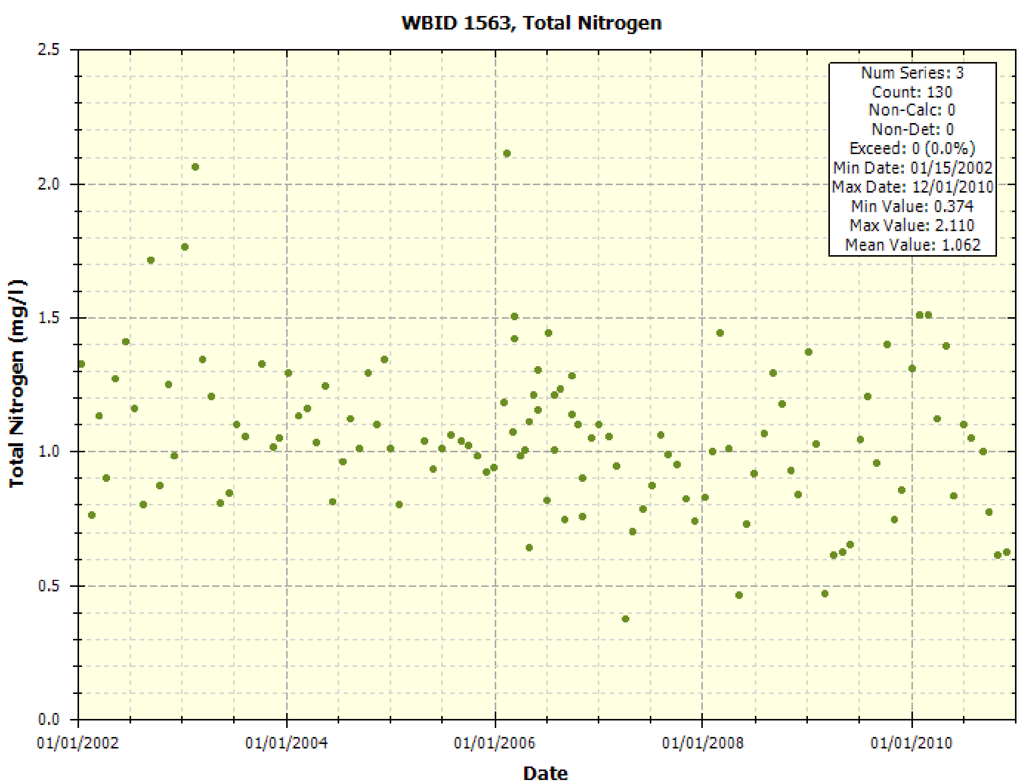

Figure 5.36 Total nitrogen concentrations for WBID 1563

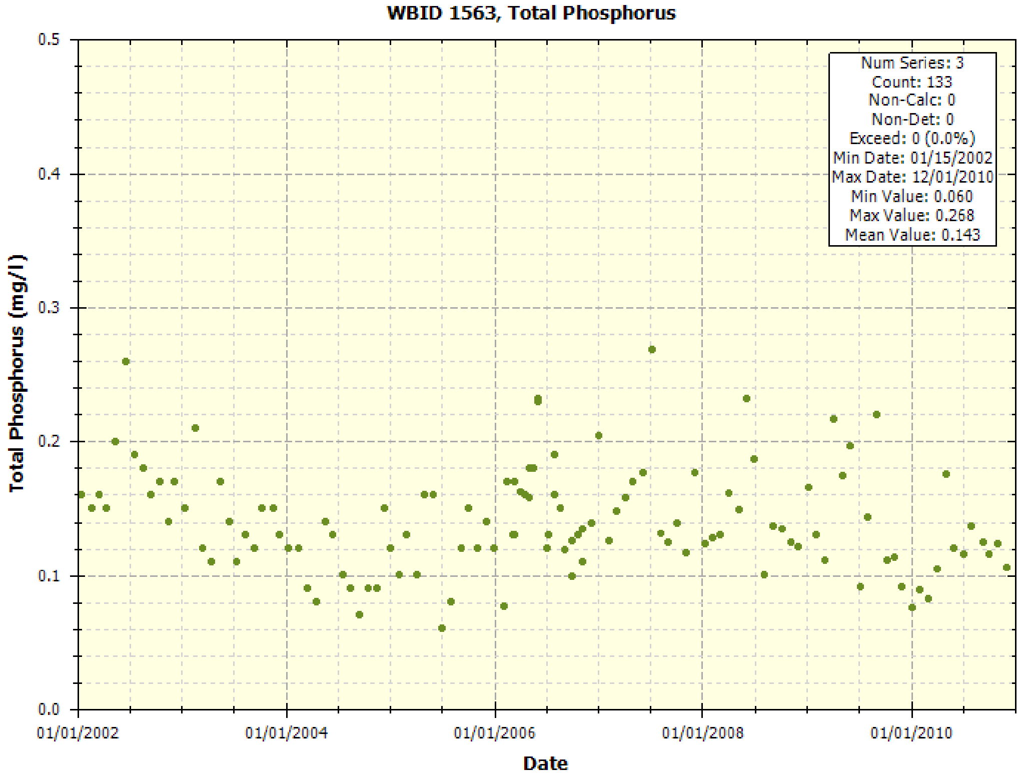

Figure 5.37 Total phosphorus concentrations for WBID 1563

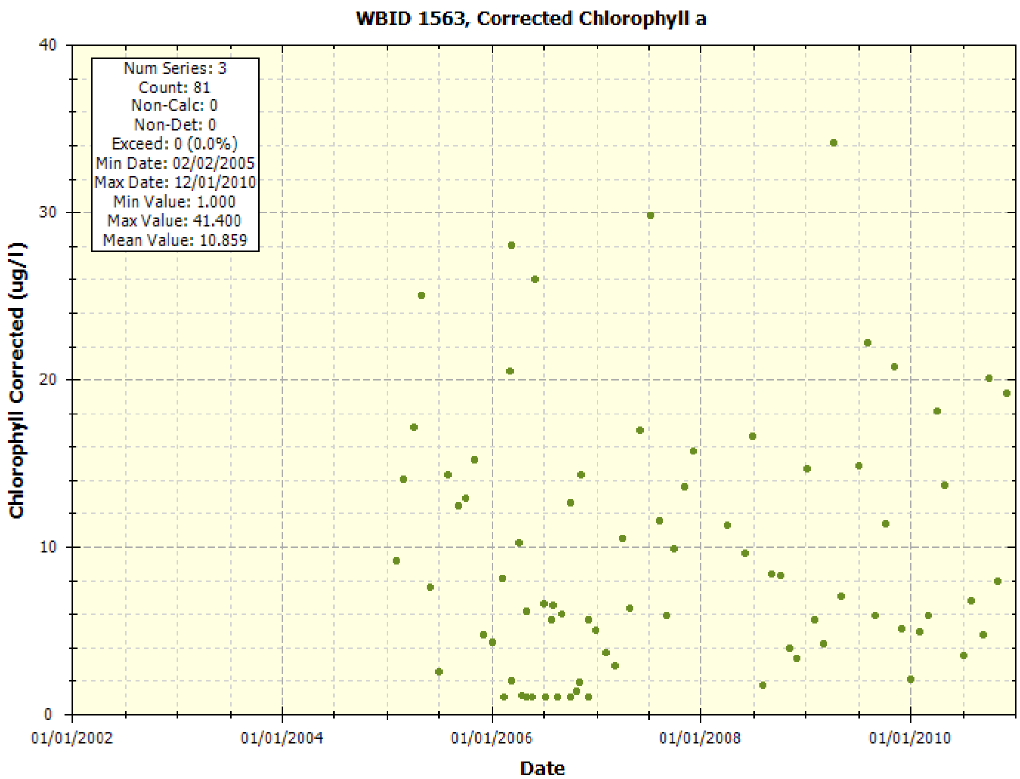

Figure 5.38 Corrected chlorophyll a concentrations for WBID 1563

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. Several NPDES-permitted point sources are located within the impaired WBIDs, and several have multiple outfall locations. The Hillsborough County Dale Mabry Advanced Wastewater Treatment Facility (FL0036820) is located in WBID 1498. Both the Hillsborough County Northwest Regional RMF (FL0041670) and the Hillsborough County River Oaks AWWTF (FL0027821) are located within WBID 1507. In WBID 1513E, FL00236820 is a Land Application System and does not directly discharge to the stream. Permitted facilities are listed by WBID in Table 6.1 and shown in Figure 6.1.

Table 6.1 Permitted Facilities by WBID

WBID	Facility Number	Facility Name	Type	Discharge
1498	FL0036820	Hillsborough County Dale Mabry AWWTF (2)	Domestic	Outfall
1507	FL0027821	Hillsborough County River Oaks AWWTF (2)	Domestic	Outfall
	FL0041670	Hillsborough County Northwest Regional RMF (2)	Domestic	Outfall
1513E	FL0036820	Hillsborough County Dale Mabry AWWTF	Domestic	LAS

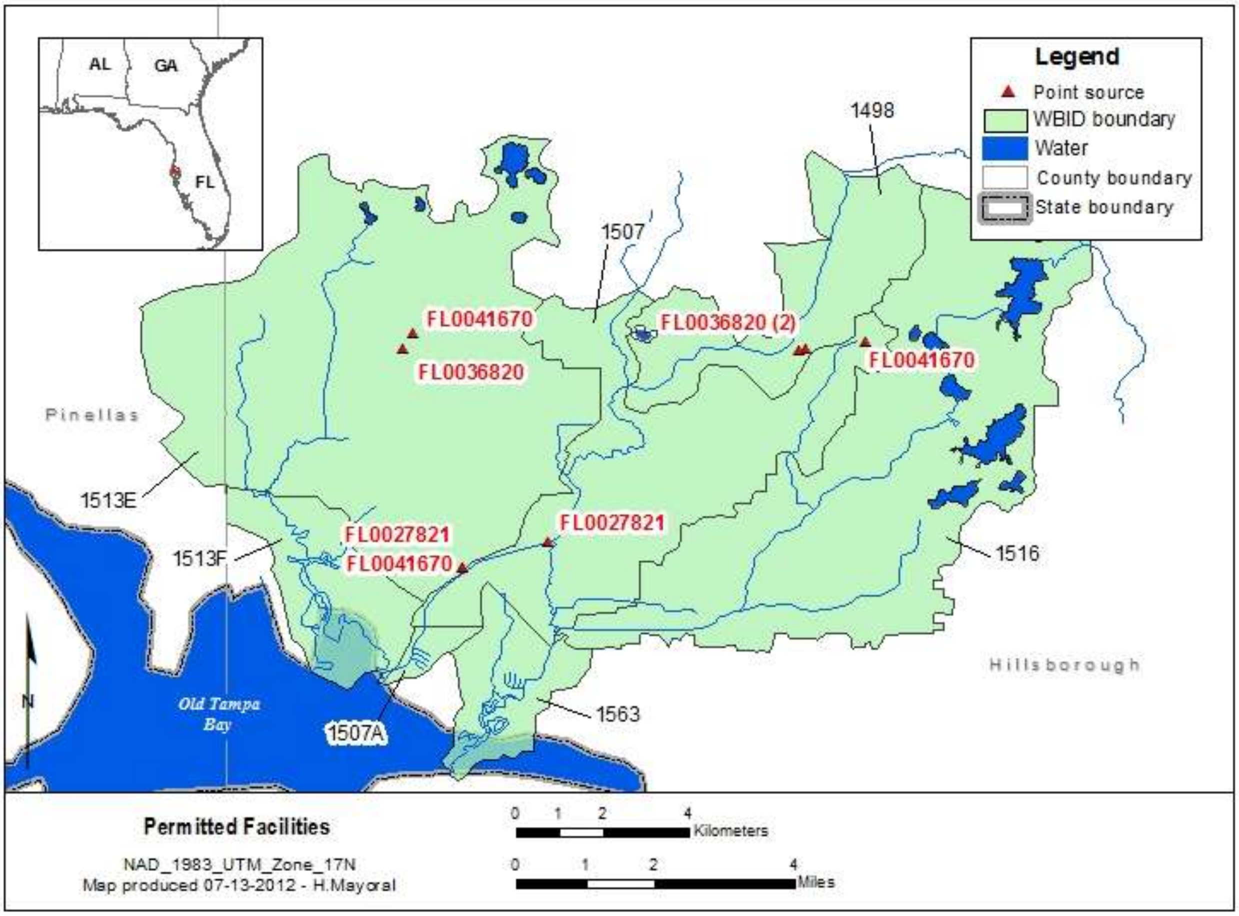

Figure 6.1 Permitted facilities in the impaired WBIDs

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. All WBIDs fall within the Phase I C MS4 permit for Hillsborough County (FLS000006). WBID 1513E also falls within the Pinellas County permit (FLS000005), with the City of Oldsmar (Phase I) as co-permittee (Table 6.2).

Table 6.2 MS4 Permits by WBID

WBID	Segment Name	Phase	Facility Number	Affiliate
1498	Brushy Creek	I C	FLS000006*	Hillsborough County
1507	Rocky Creek	I C	FLS000006*	Hillsborough County
1507A	Rocky Creek (Channel A)	I C	FLS000006*	Hillsborough County
1513E	Double Branch (Freshwater)	I	FLS000005*	Pinellas County, co-permittee City of Oldsmar
		I C	FLS000006*	Hillsborough County
1513F	Double Branch (Estuarine)	I C	FLS000006*	Hillsborough County
1516	Sweetwater Creek	I C	FLS000006*	Hillsborough County
1563	Rocky Creek (Lower Segment)	I C	FLS000006*	Hillsborough County

*FDOT, District VII

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 within 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. Developed land use accounts for over 60 percent of the total land use that contributes to each of the WBIDs, with the exception of WBID 1513E and WBID 1513F, where developed land accounts for approximately 40 percent of the contributing land use. In all WBIDs, the majority of the developed land is classified as high intensity development. Because of the high percentage of urban, residential, and commercial developments, they are likely the main cause of the impairments.

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 number of septic systems installed in Pinellas and Hillsborough 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)
Pinellas	23,869	3,015
Hillsborough	107,198	15,437

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 less than 6 percent of the total contributing land use for most WBIDs, with the exception of WBID 1513E and WBID 1513F, which have 15 percent and 10 percent of their total contributing land use consisting of pastures, respectively. In WBIDs 1507A and 1516, the total contributing land use attributed to pastures is less than one percent.

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. In all the WBIDs, clear cut/sparse land use accounts for less than one percent of the total contributing land use.

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. In WBIDs 1513E and 1513F, combined forest accounts for 10 percent of the contributing land use in each of the WBIDs. In all other WBIDs, less than 3 percent of the total contributing land use is attributed to combined forest land uses.

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 between accounts for 8 to 10 percent of the total contributing land use in all WBIDs except for WBID 1507A, which has nearly 17 percent of the contributing land use attributed to open water. Forested and non-forested wetlands contribute between 15 and 25 percent of the total land use to each of the WBIDs, with the exception of WBID 1507A and WBID 1516. Nine percent of the contributing land use to WBID 1516 is comprised of forested and non-forested wetlands, and only 7 percent of the contributing land use to WBID 1507A. Salt/Brackish non-forested wetlands were only located within the contributing area for WBID 1513F and WBID 1563.

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. There are no quarries or strip mines in the contributing subwatersheds to WBIDs 1498, 1507, and 1507A. Quarries and strip mines account for less than one percent of the total land use in all other WBIDs.

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 Rocky Creek 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 Rocky Creek 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 Rocky Creek Watershed model, once again using the NHD catchments as well as the USGS National Elevation Dataset Digital Elevation Model. The subwatershed delineation is located in Figure 3.2.

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 Rocky Creek 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 (SWFWMD) 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 Rocky Creek watershed model. The Tampa Bay Watershed model was calibrated to continuous flow USGS gages. Additionally, the water quality parameters from the larger Tampa Bay Watershed model were used to populate the Rocky Creek Watershed model. The Tampa Bay Watershed model was calibrated to several water quality stations whose data was taken from IWR38. The Rocky Creek watershed was calibrated to water quality data from IWR44, and water quality plots for stations located within the Rocky Creek watershed are presented in Figure 7.2 through Figure 7.21.

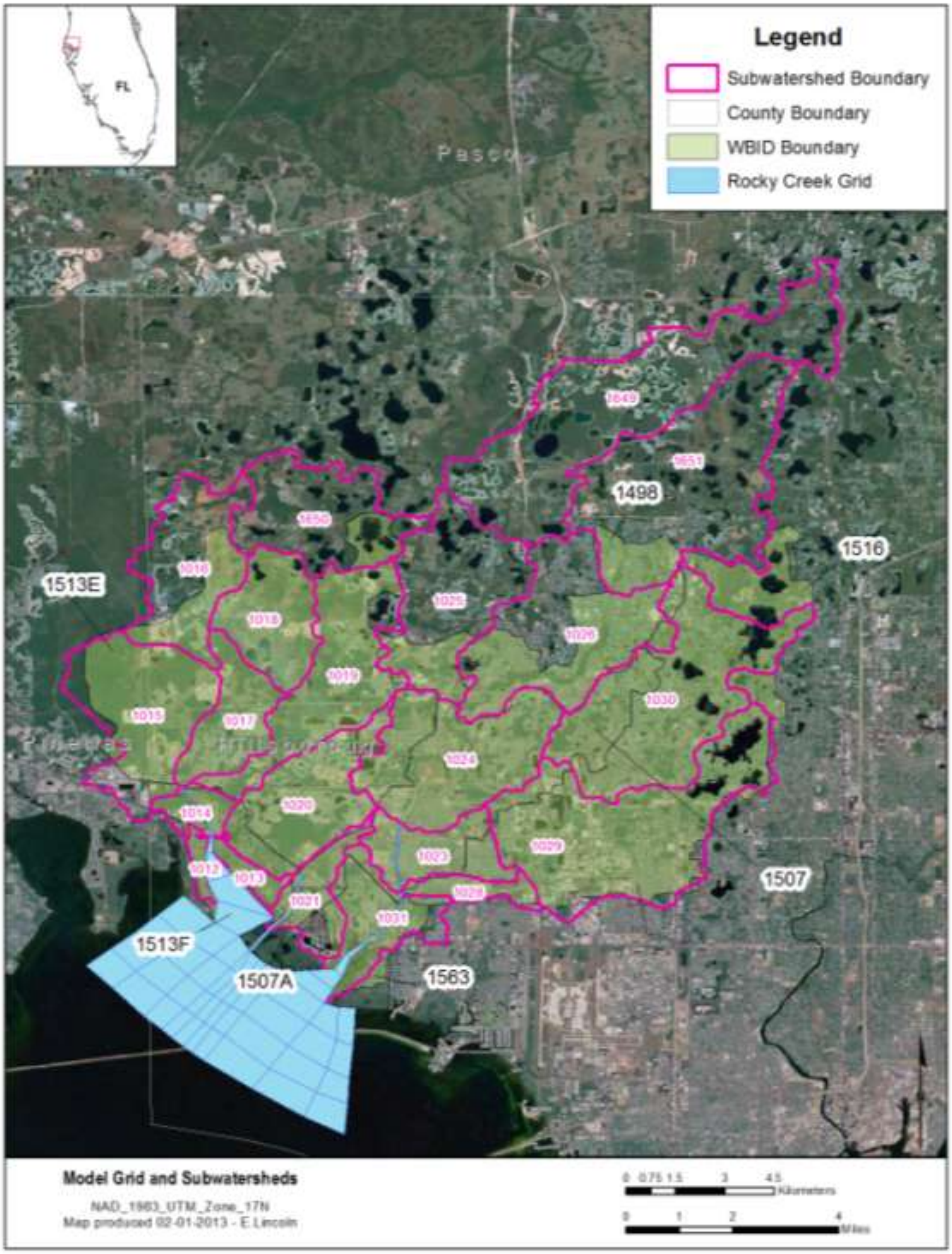

Figure 7.1 Subwatershed and WBID boundaries in the Rocky Creek model

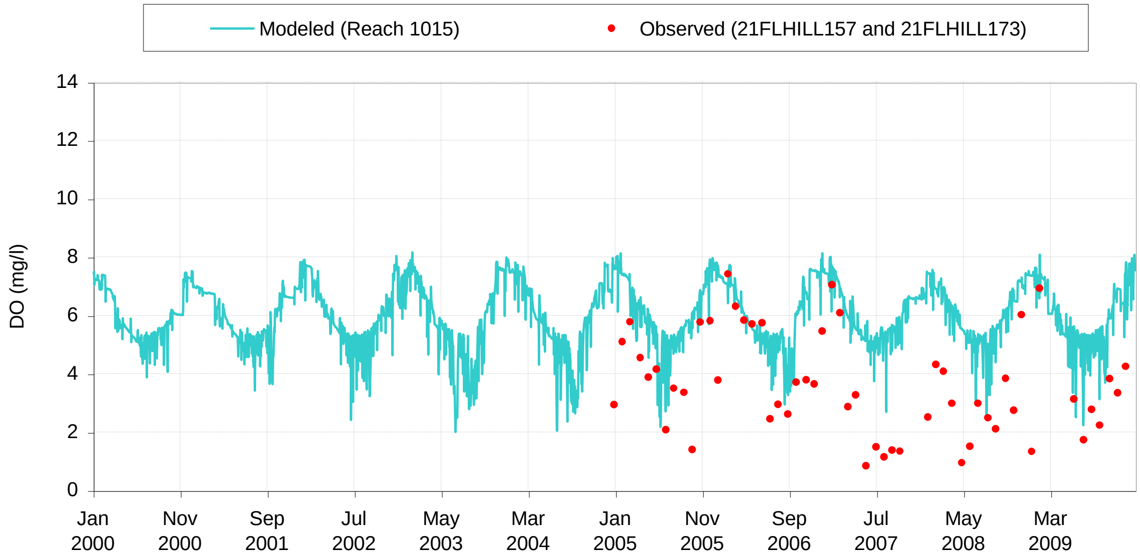

Figure 7.2 Modeled vs. Observed DO (mg/l) at 21FLHILL157 and 21FLHILL173 in WBID 1513E

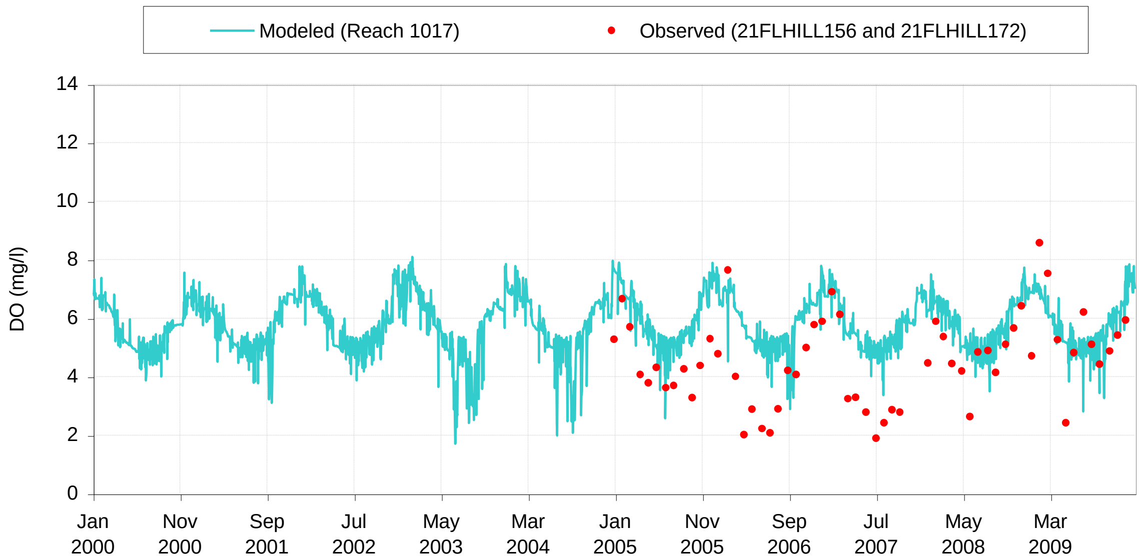

Figure 7.3 Modeled vs. Observed DO (mg/l) at 21FLHILL156 and 21FLHILL172 in WBID 1513E

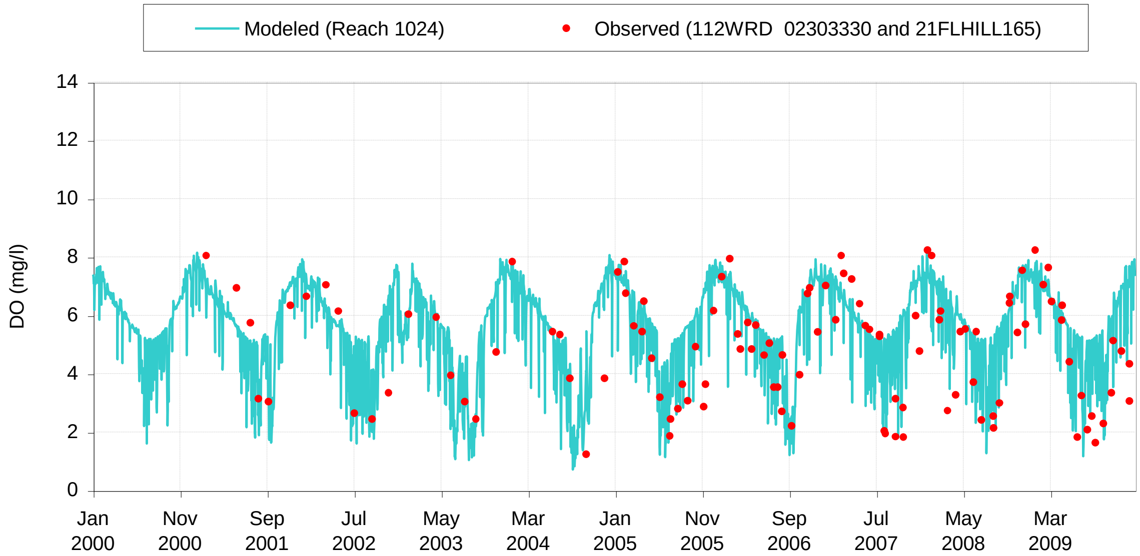

Figure 7.4 Modeled vs. Observed DO (mg/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

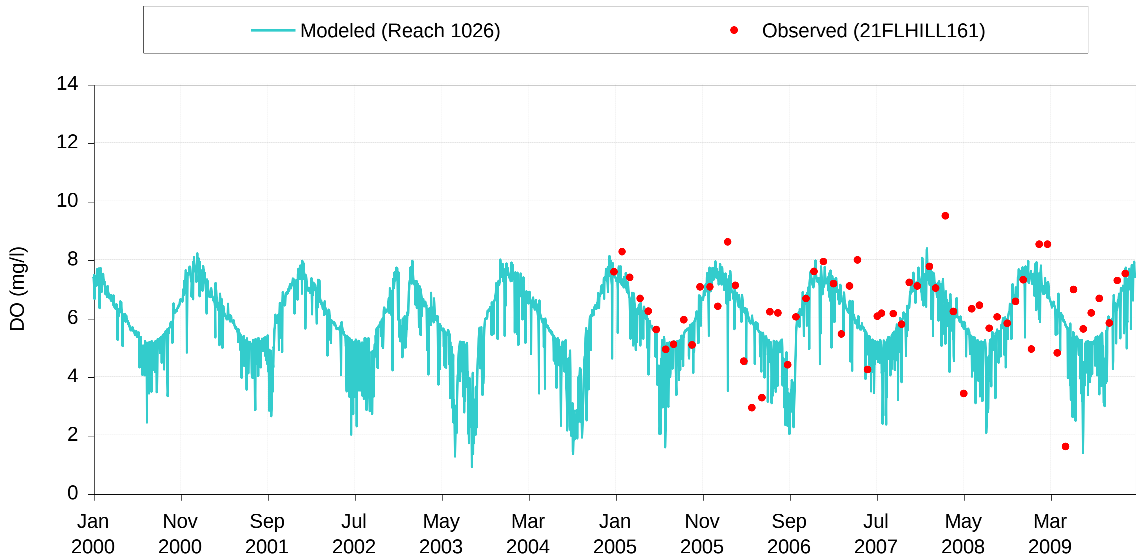

Figure 7.5 Modeled vs. Observed DO (mg/l) at 21FLHILL161 in WBID 1498

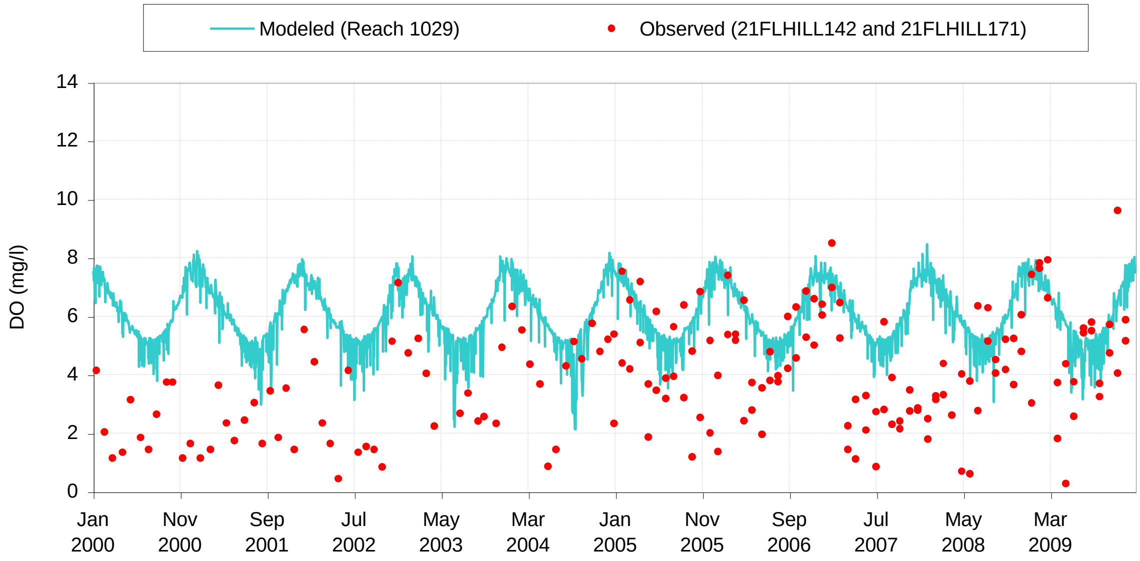

Figure 7.6 Modeled vs. Observed DO (mg/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

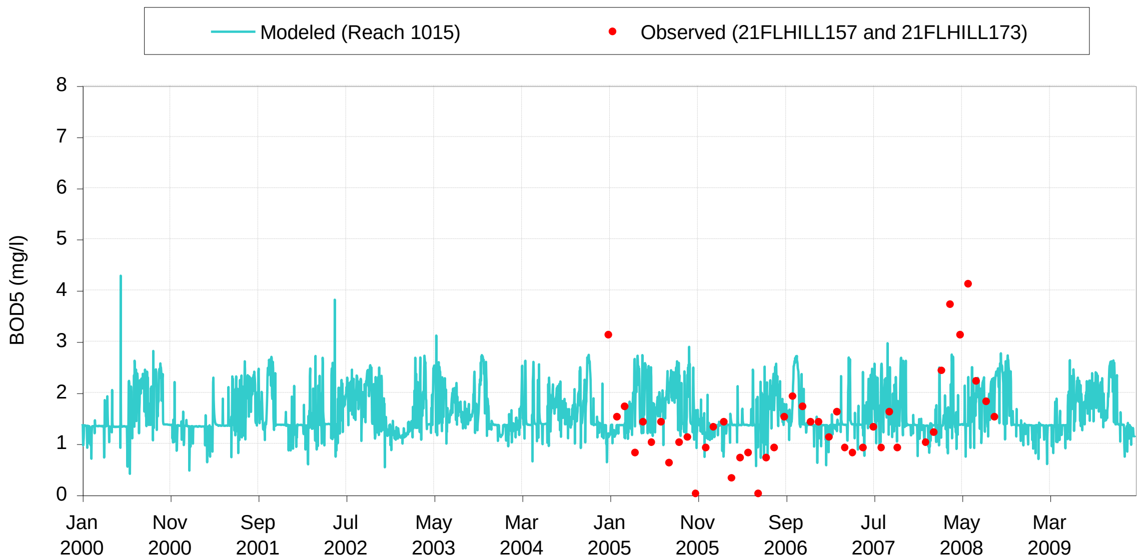

Figure 7.7 Modeled vs. Observed BOD5 (mg/l) at 21FLHILL157 and 21FLHILL173 in WBID 1513E

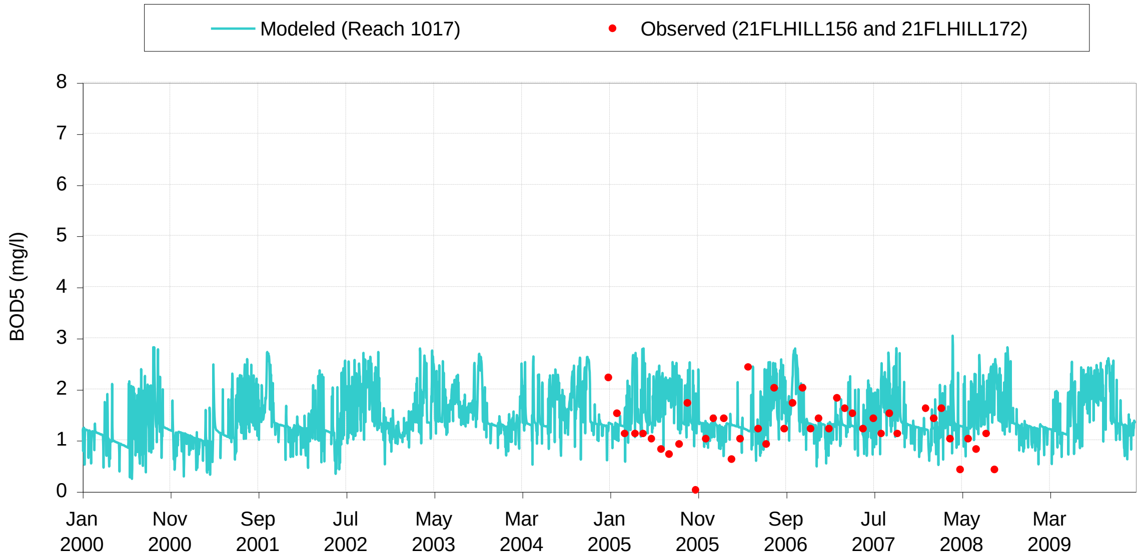

Figure 7.8 Modeled vs. Observed BOD5 (mg/l) at 21FLHILL156 and 21FLHILL172 in WBID 1513E

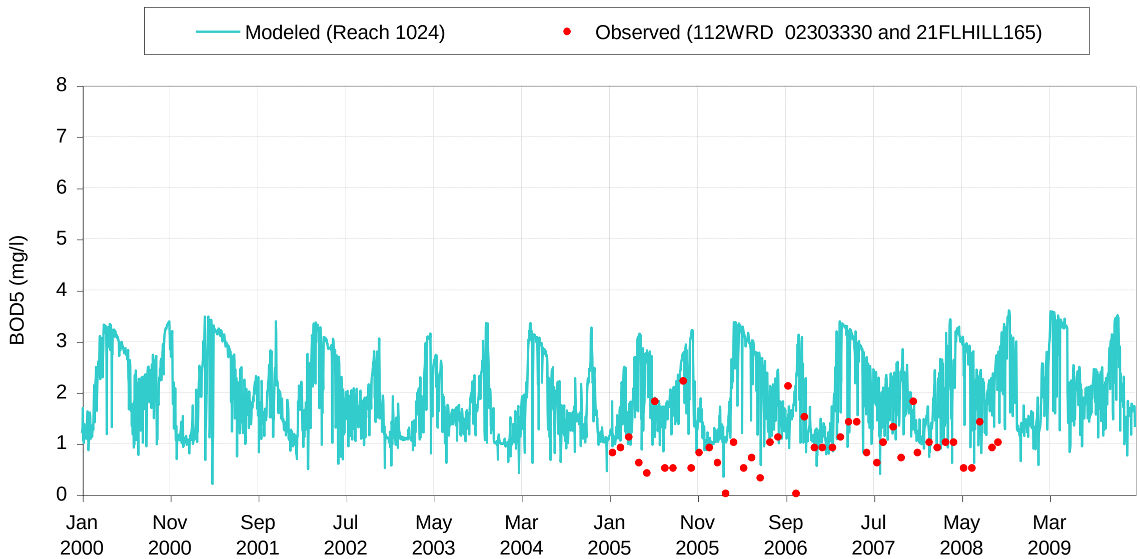

Figure 7.9 Modeled vs. Observed BOD5 (mg/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

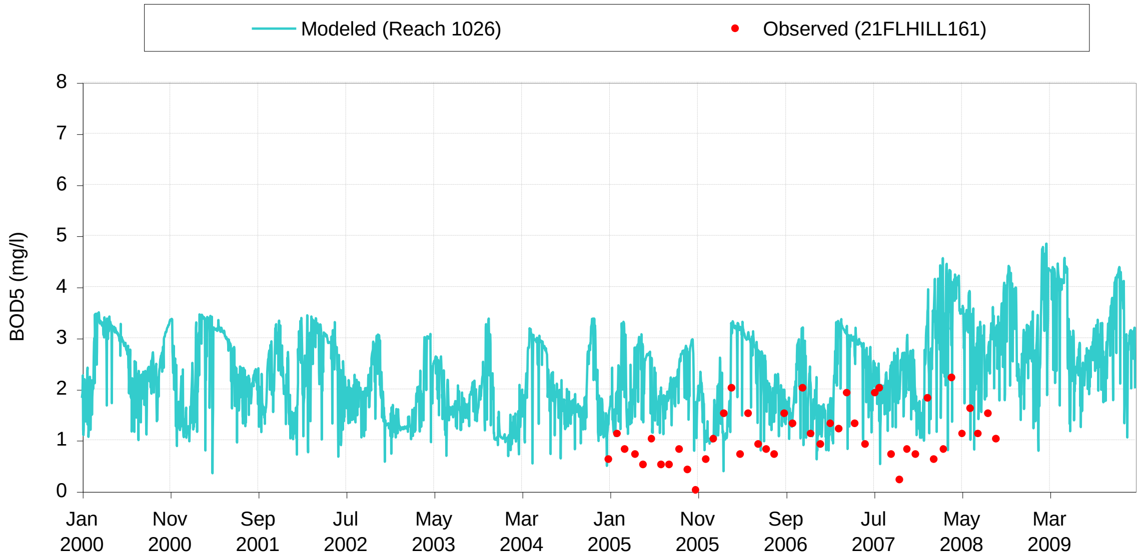

Figure 7.10 Modeled vs. Observed BOD5 (mg/l) at 21FLHILL161 in WBID 1498

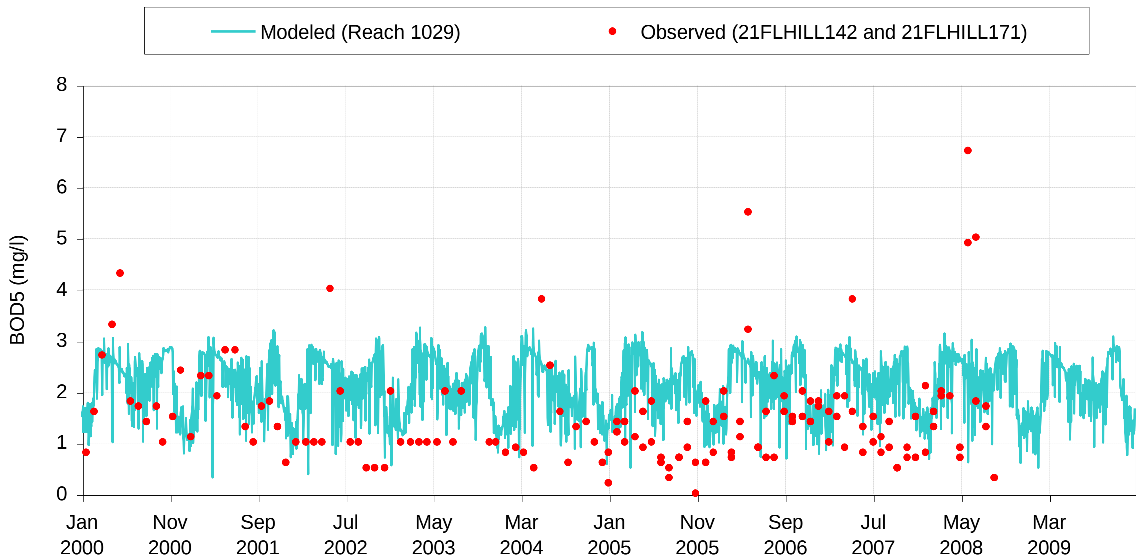

Figure 7.11 Modeled vs. Observed BOD5 (mg/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

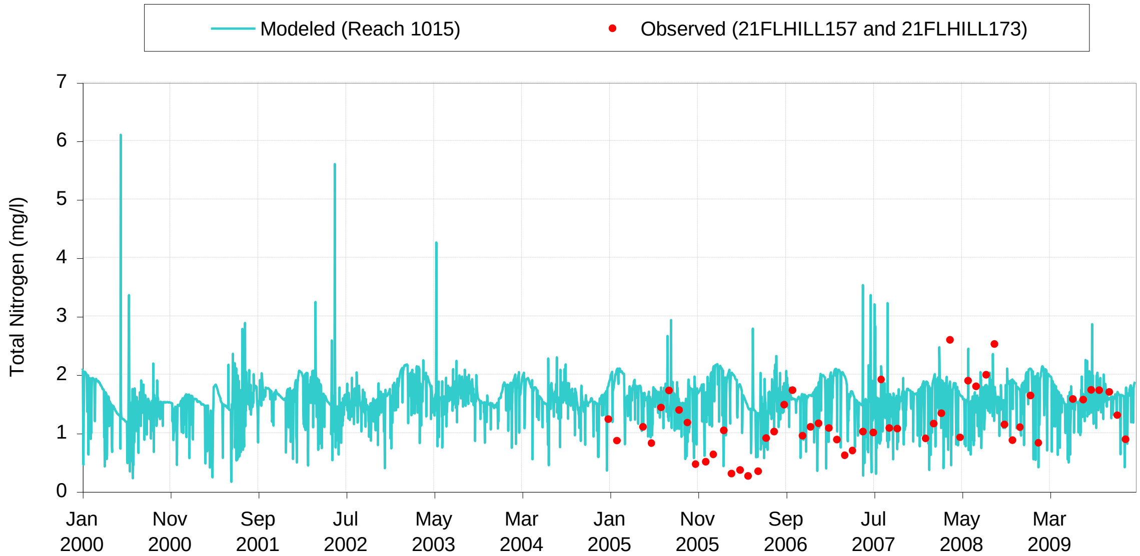

Figure 7.12 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLHILL157 and 21FLHILL173 in WBID1513E

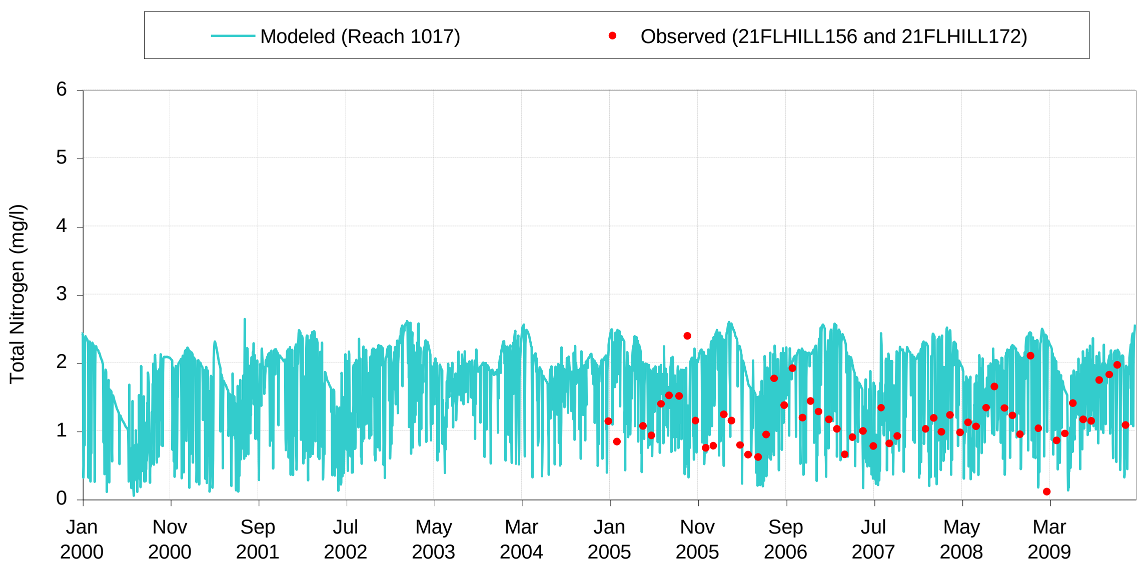

Figure 7.13 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLHILL156 and 21FLHILL172 in WBID1513E

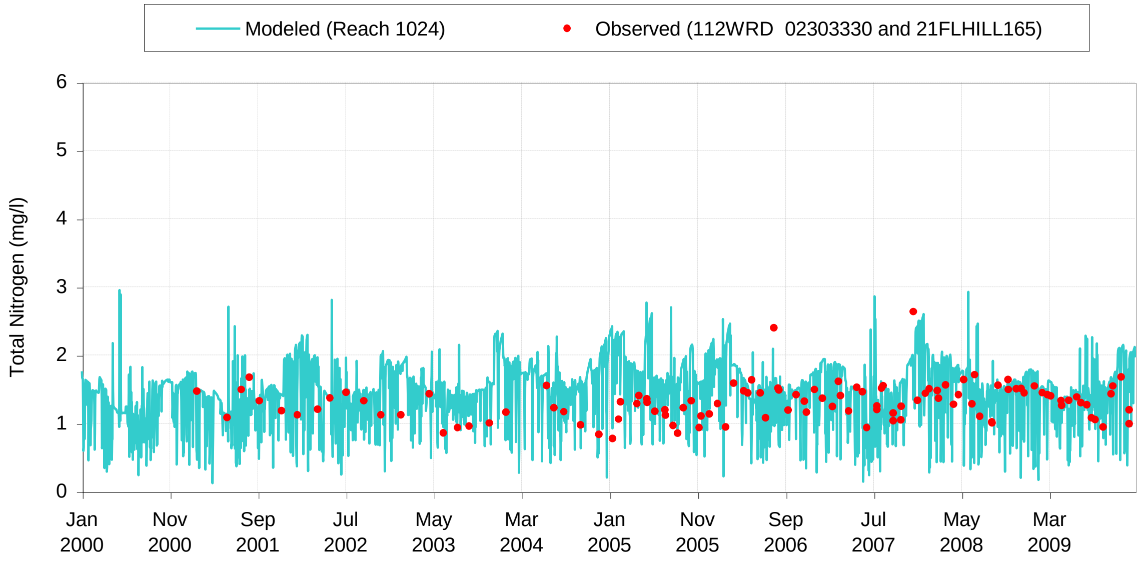

Figure 7.14 Modeled vs. Observed Total Nitrogen (mg/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

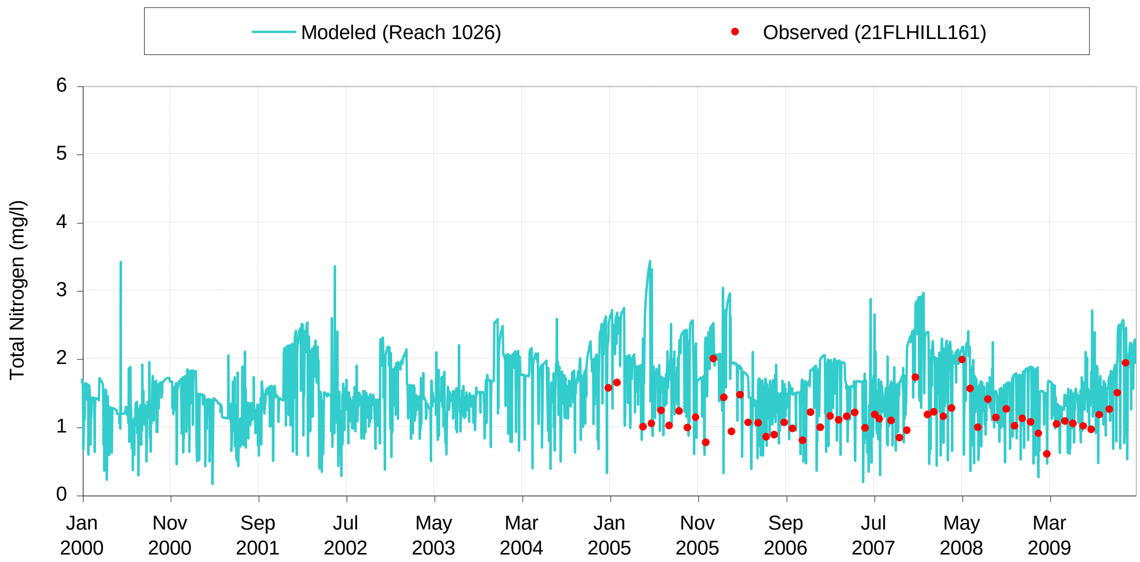

Figure 7.15 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLHILL161 in WBID 1498

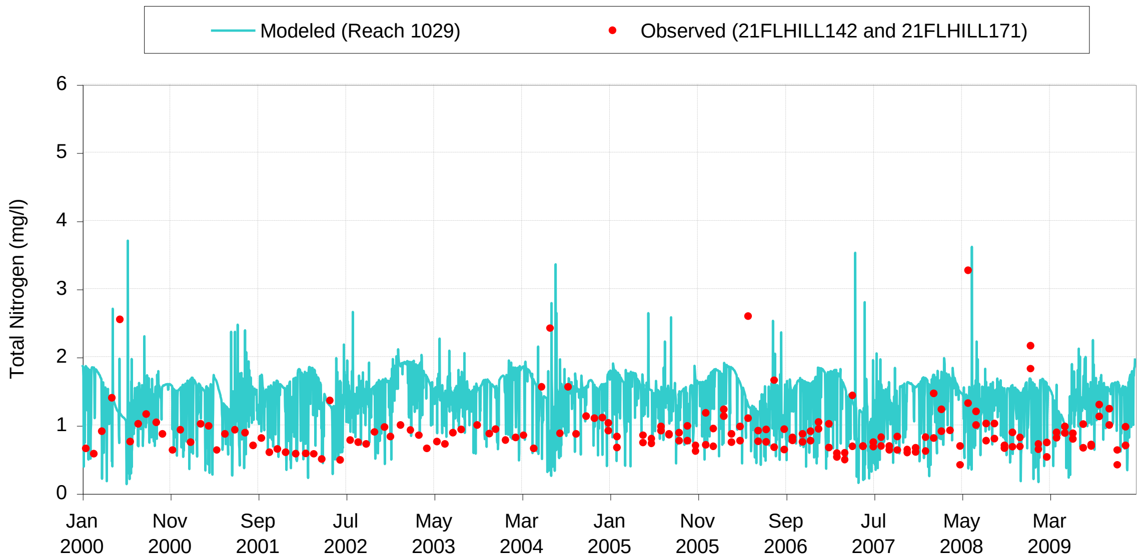

Figure 7.16 Modeled vs. Observed Total Nitrogen (mg/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

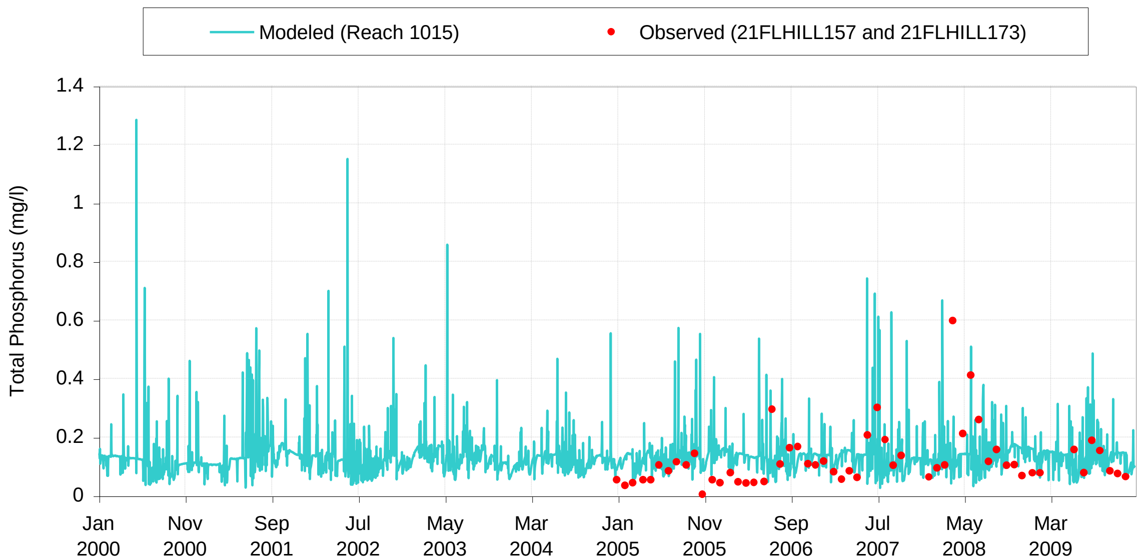

Figure 7.17 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLHILL157 and 21FLHILL173 in WBID1513E

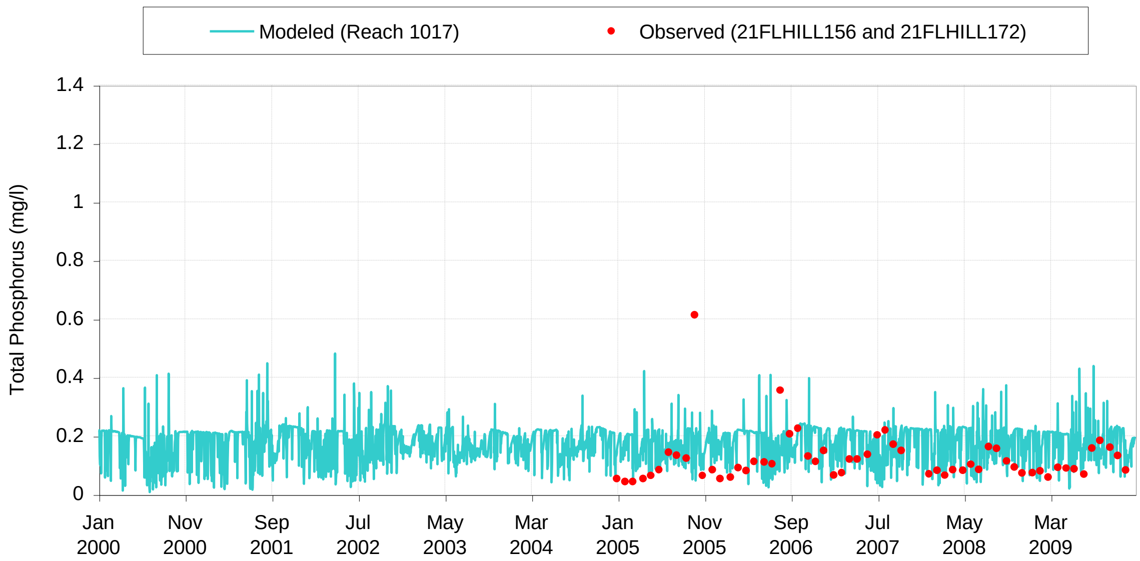

Figure 7.18 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLHILL156 and 21FLHILL172 in WBID1513E

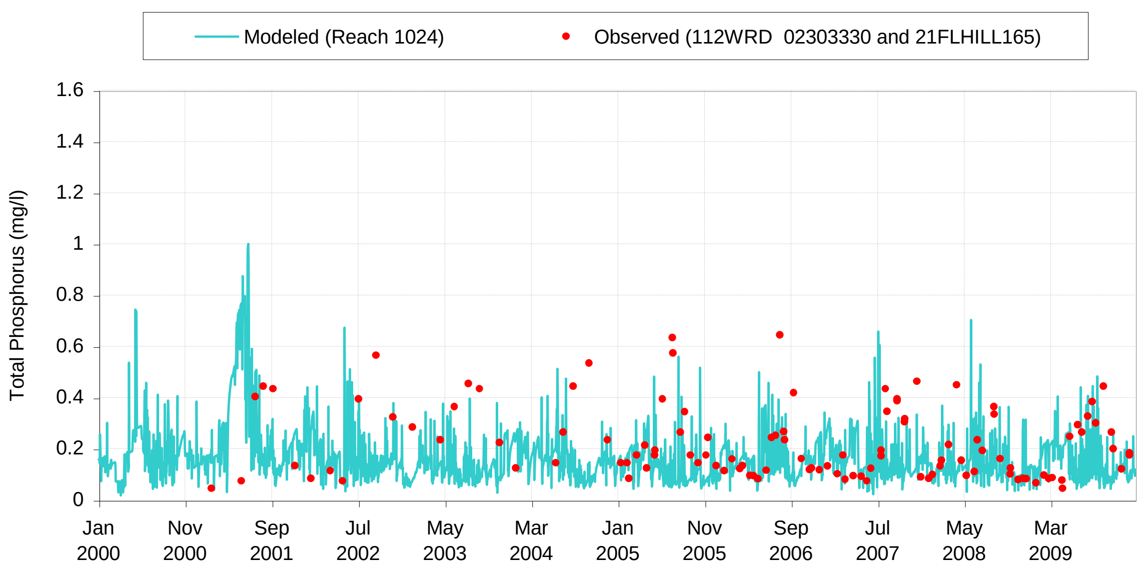

Figure 7.19 Modeled vs. Observed Total Phosphorus (mg/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

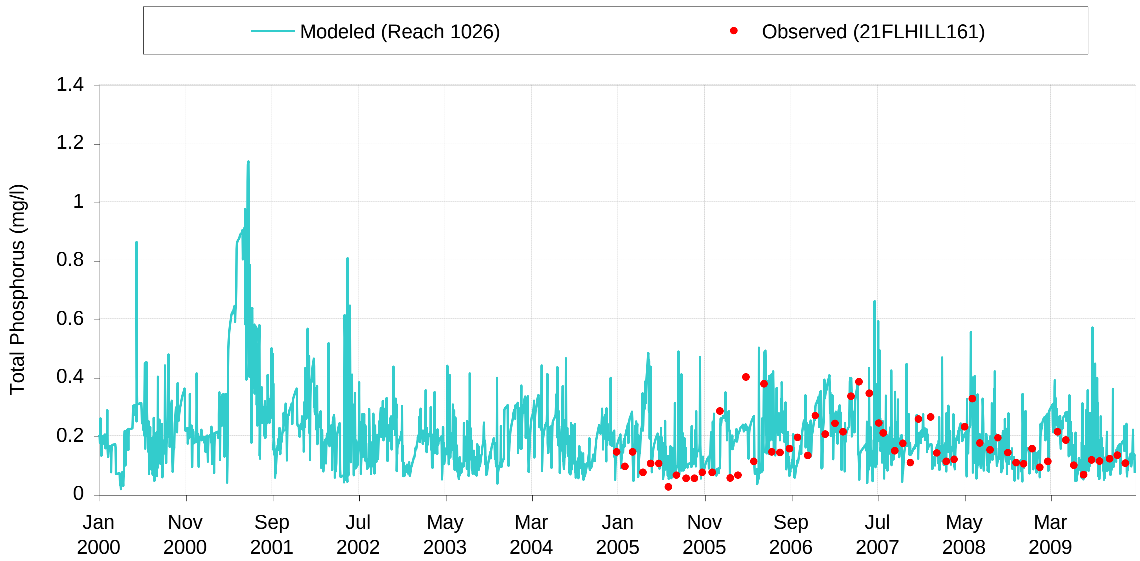

Figure 7.20 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLHILL161 in WBID 1498

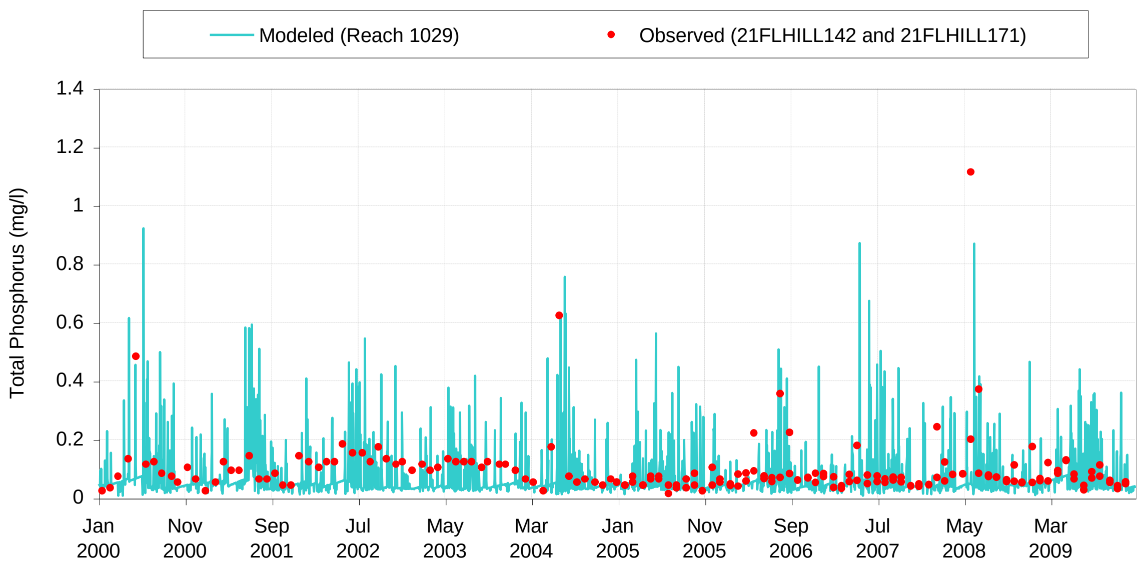

Figure 7.21 Modeled vs. Observed Total Phosphorus (mg/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

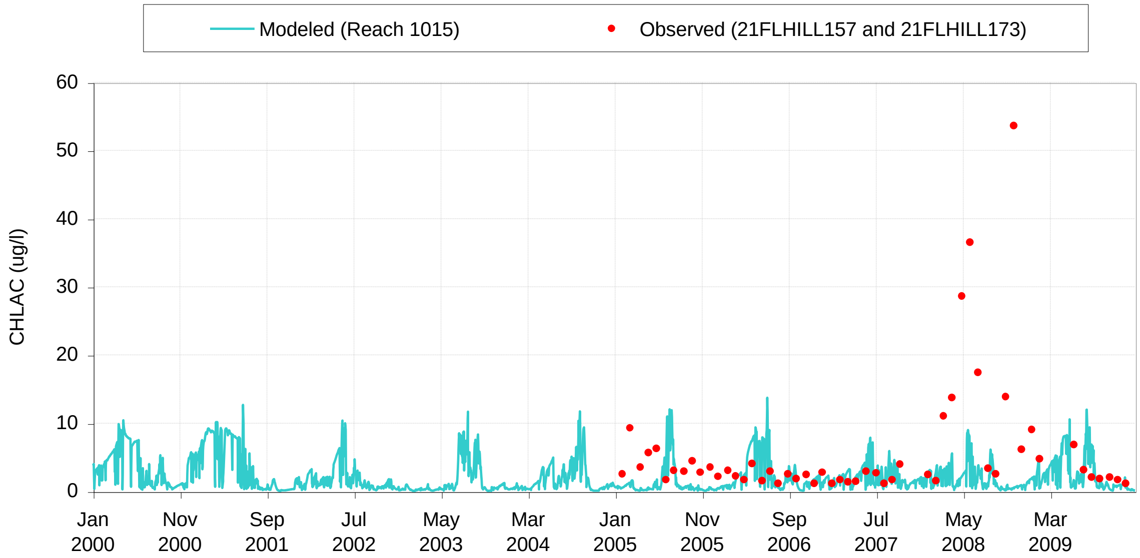

Figure 7.22 Modeled vs. Observed Chlorophyll a (ug/l) at 21FLHILL157 and 21FLHILL173 in WBID1513E

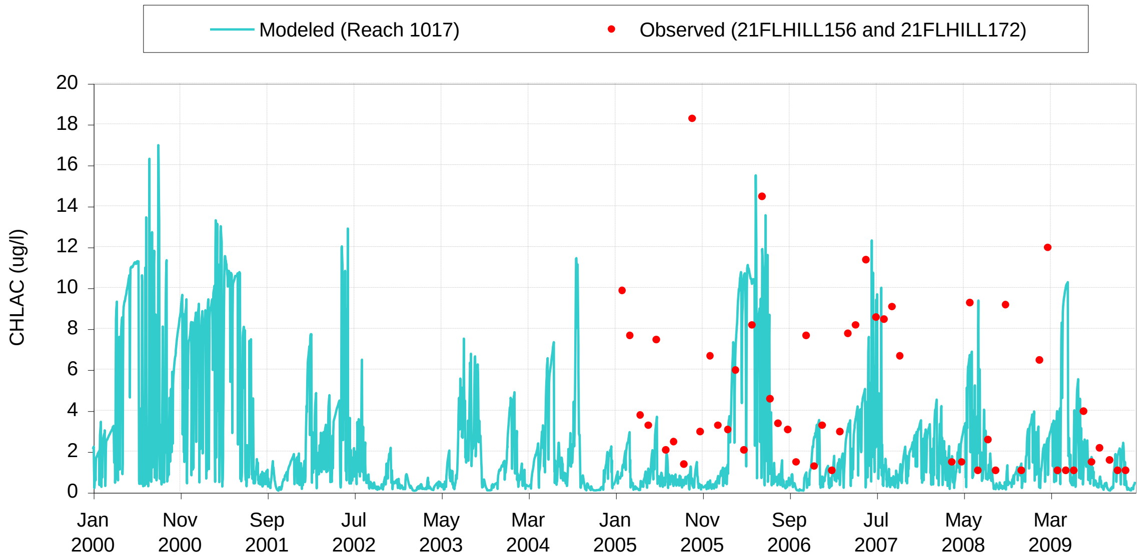

Figure 7.23 Modeled vs. Observed Chlorophyll a (ug/l) at 21FLHILL156 and 21FLHILL172 in WBID1513E

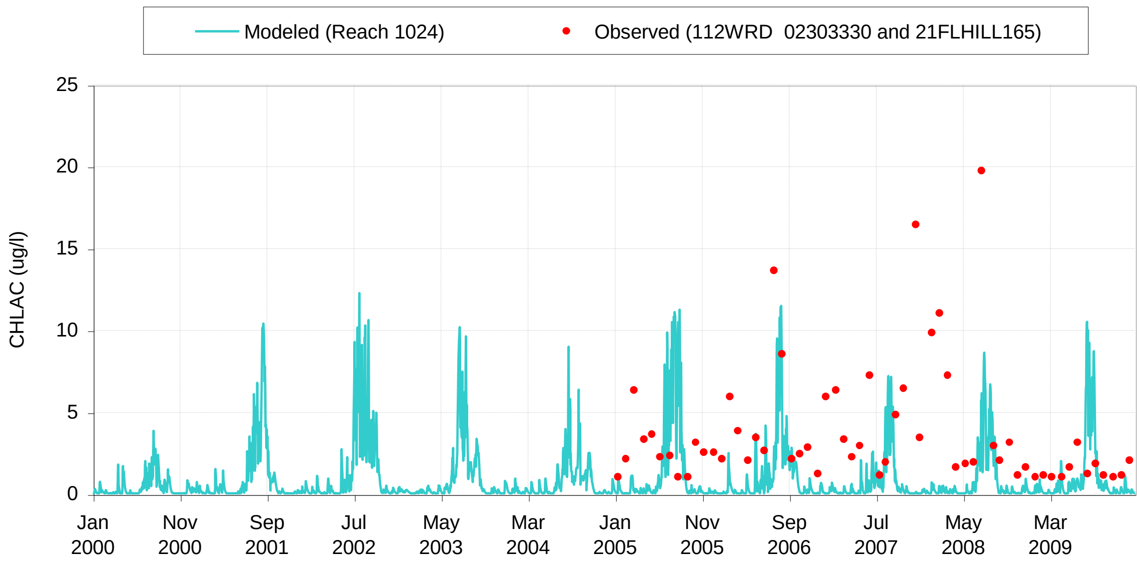

Figure 7.24 Modeled vs. Observed Chlorophyll a (ug/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

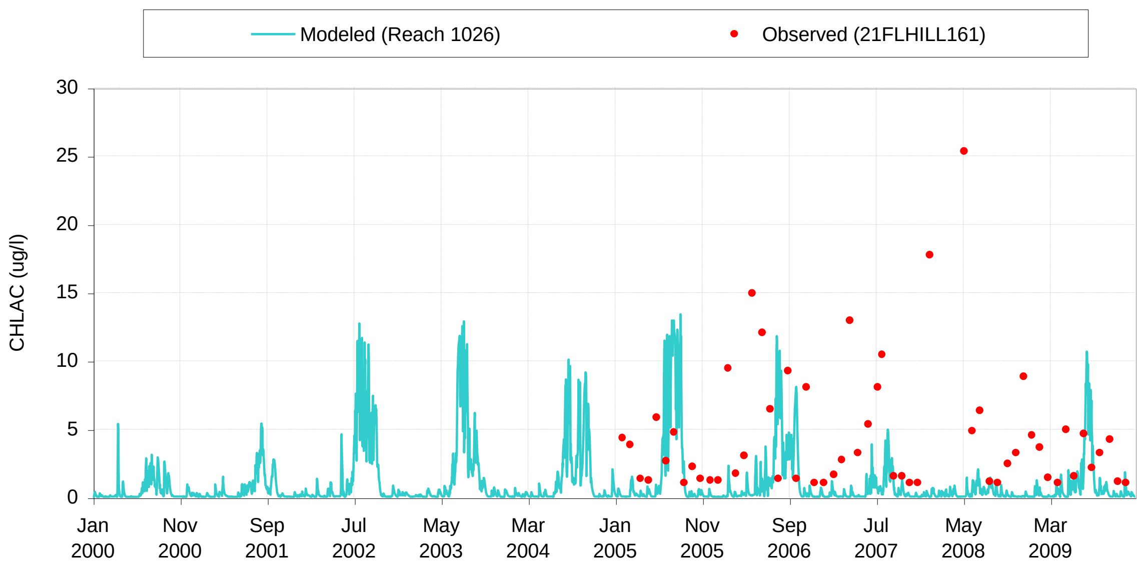

Figure 7.25 Modeled vs. Observed Chlorophyll a (ug/l) at 21FLHILL161 in WBID 1498

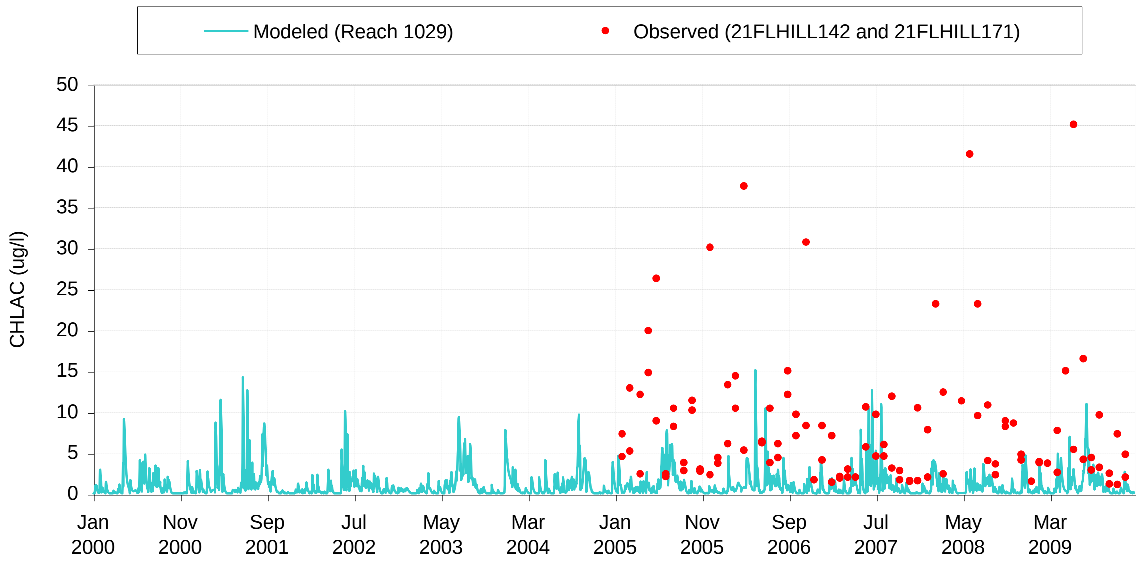

Figure 7.26 Modeled vs. Observed Chlorophyll a (ug/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

7.1.2 Environmental Fluids Dynamic Code (EFDC)

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

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

The EFDC model was utilized to simulate three-dimensional circulation dynamics of hydrodynamic state variables (water surface elevation, salinity, and temperature) in the Rocky Creek estuary. The Rocky Creek model utilized the Tampa Bay EFDC model that was created for the Florida Numeric Nutrient Criteria (NNC), which was resized to meet the modeling needs of Rocky Creek. The Tampa Bay EFDC model was created using NOAA bathymetric data.

The EFDC model predicts water surface elevation, salinity, and temperature, in response to a set of multiple factors: wind speed and direction, freshwater discharge, tidal water level fluctuation, rainfall, surface heat flux, and temperature and salinity associated with boundary fluxes. Hourly measurements of atmospheric pressure, dry and wet bulb atmospheric temperatures, rainfall rate, wind speed and direction, and fractional cloud cover were obtained from data collected at the Tamp WBAN station for 2002 through 2009. Solar short wave radiation was calculated using the CE-Qual-W2 method.

The Rocky Creek Estuary model used hourly water surface elevation time series data from the National Oceanic and Atmospheric Administration (NOAA) tidal stations to simulate tides at the open boundary. Observed temperature data at water quality stations were used to simulate the temperature at the open boundaries, and average salinity in the Tampa Bay Lagoon was used to simulate salinity. The Tampa Bay NNC Estuary was calibrated to measured NOAA tidal stations, and the Tampa Bay model was used to simulate the open boundary conditions in the Rocky Creek Estuary model. The upstream inland boundary grid cell received LSPC simulated watershed discharges.

The Rocky Creek EFDC grid consisted of 142 cells, specifically 71 cells in the horizontal direction and was two layers in the vertical direction (Figure 7.27). The grid was developed using bathymetry data from NOAA. Bathymetry was unavailable for the inland, tidally influenced streams, and channel slope from the USGS digital elevation model was used to estimate slope within the channel. The Rocky Creek grid extended from the Old Tampa Bay into Rocky Creek.

Because there were no NOAA tidal stations located within the Rocky Creek estuary, water surface elevation within the modeled cells could not be directly calibrated. Salinity measurements from IWR44 data were used to review the Rocky Creek estuary EFDC calibration. Following model review, the salinity and temperature parameters were adjusted accordingly.

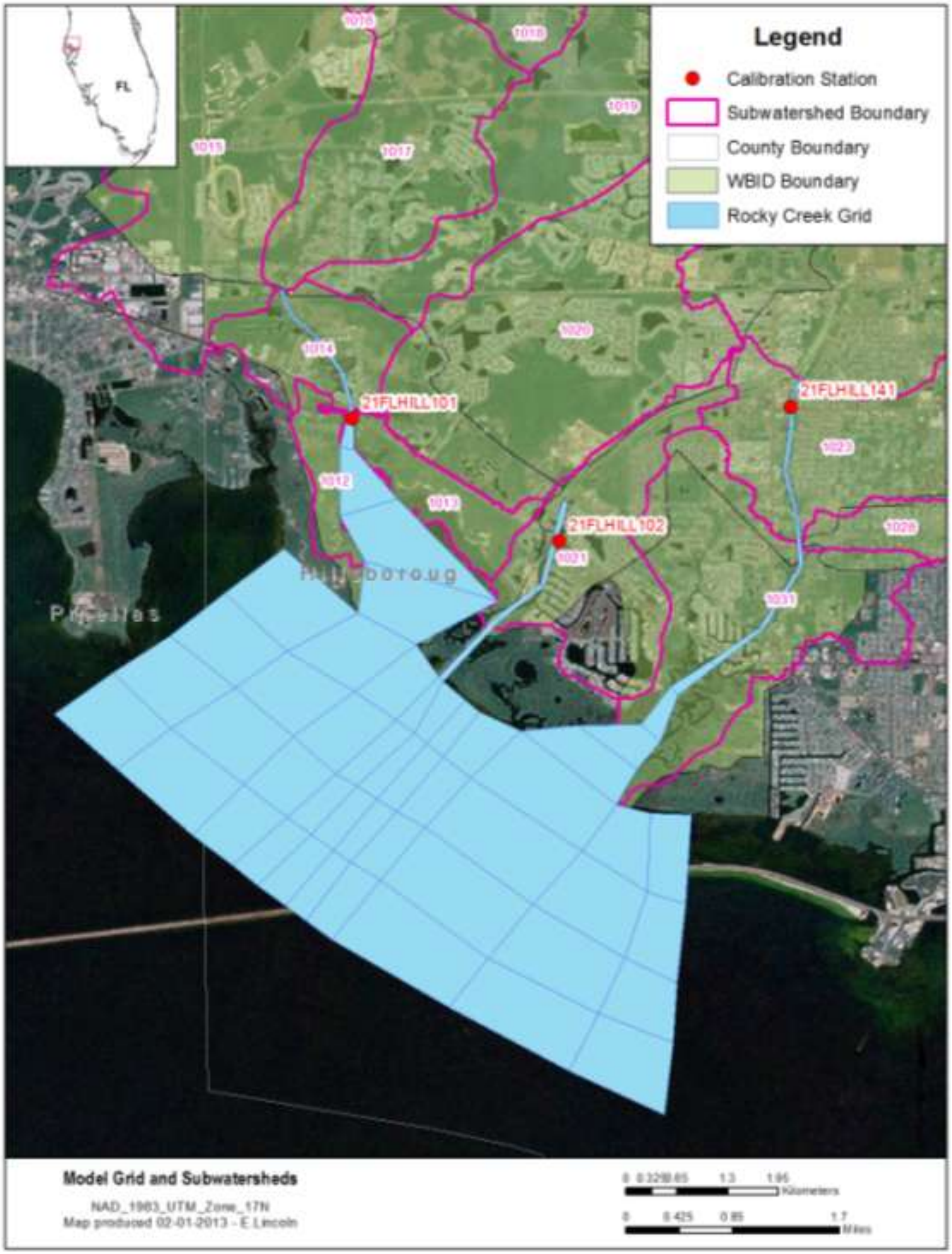

Figure 7.27 LSPC subwatershed boundaries and WASP model grid for the Tampa Bay basin

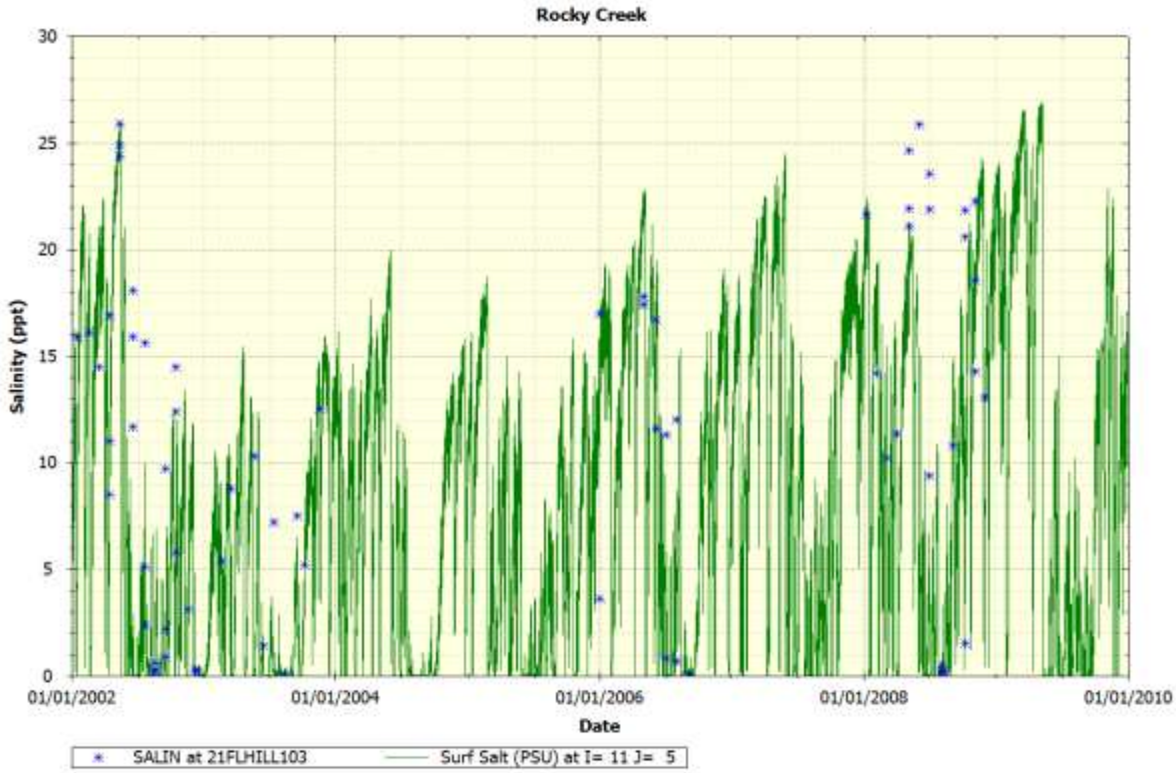

Figure 7.28 Simulated salinity verse measured salinity in Rocky Creek at station 21FLHILL103

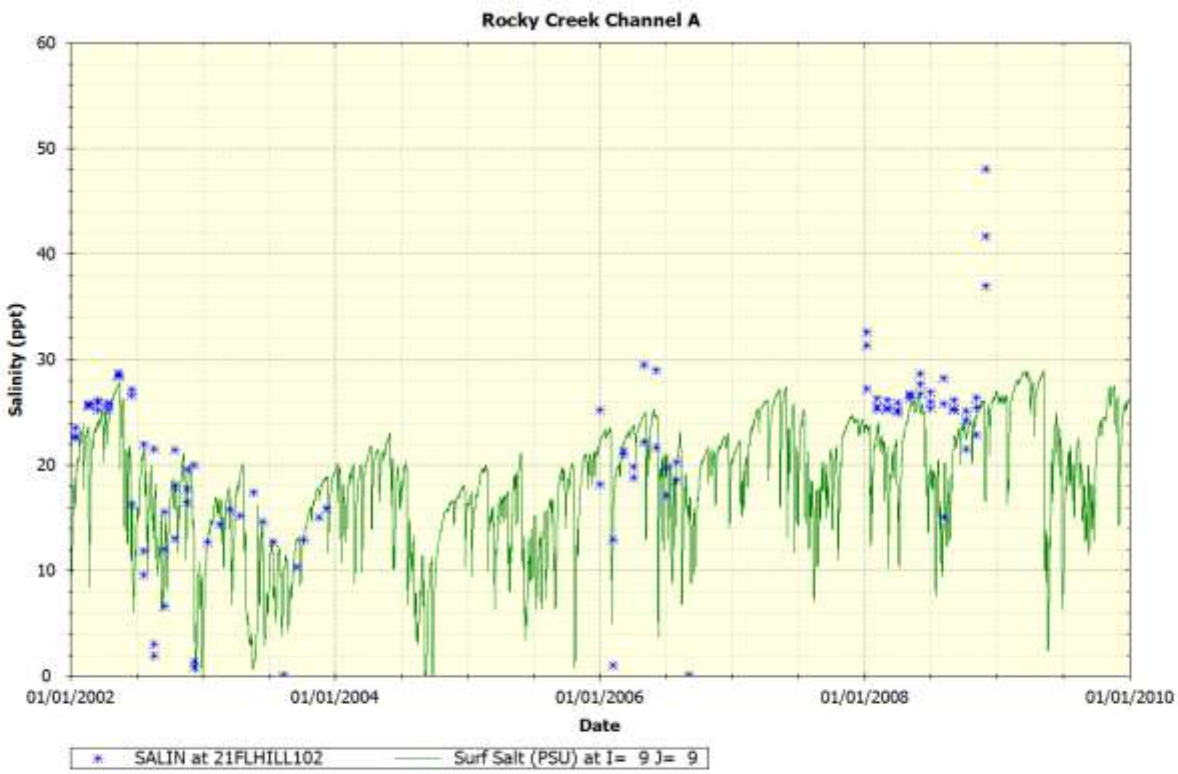

Figure 7.29 Simulated salinity verse measured salinity in Rocky Creek at station 21FLHILL102

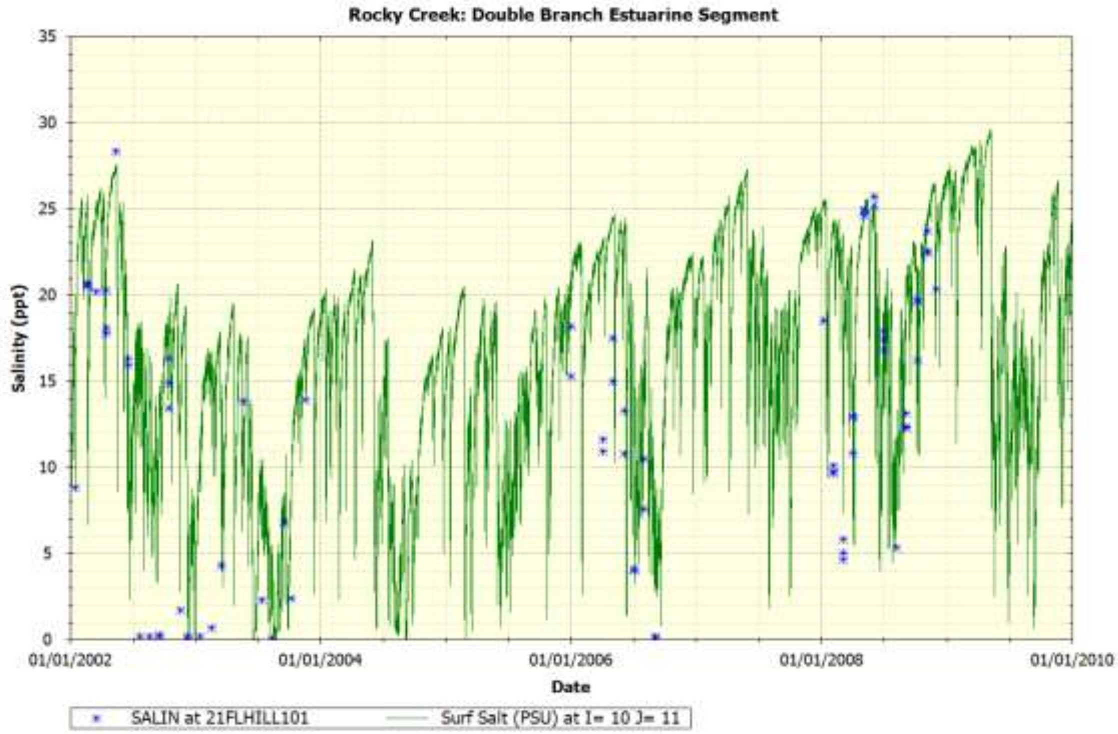

Figure 7.30 Simulated salinity verse measured salinity in Rocky Creek at station 21FLHILL101

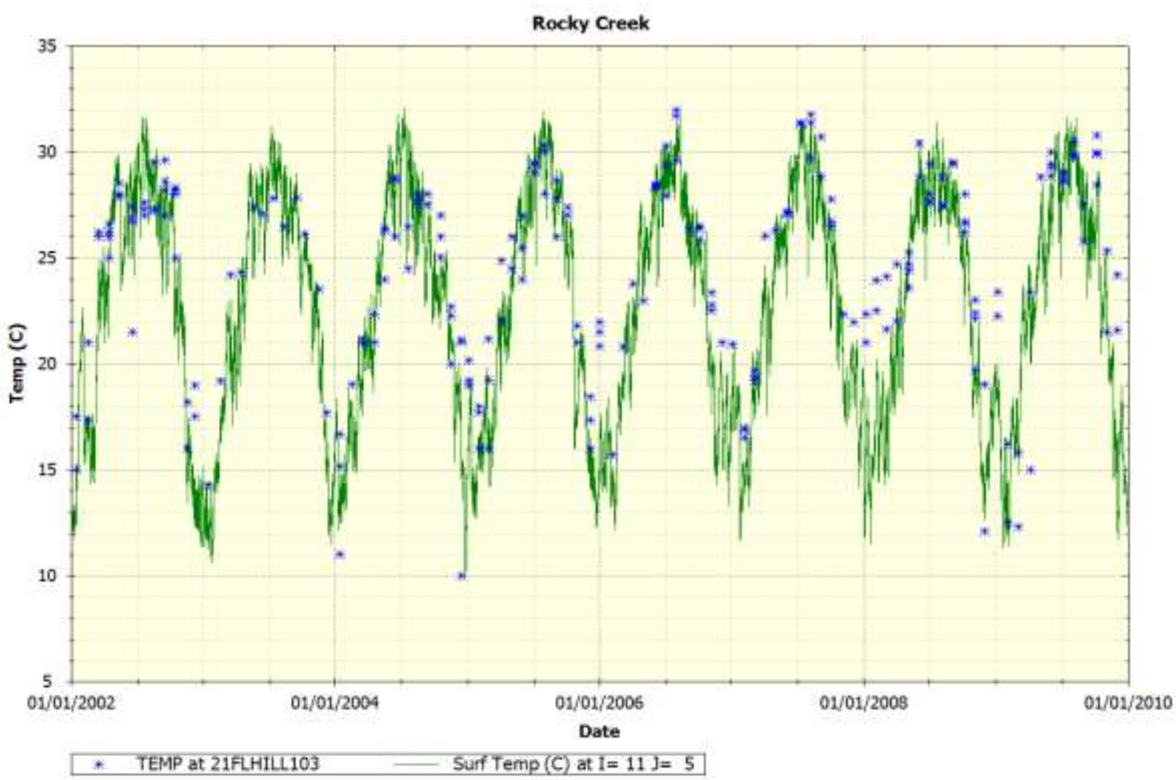

Figure 7.31 Simulated temperature verse measured temperature in Rocky Creek at station 21FLHILL103

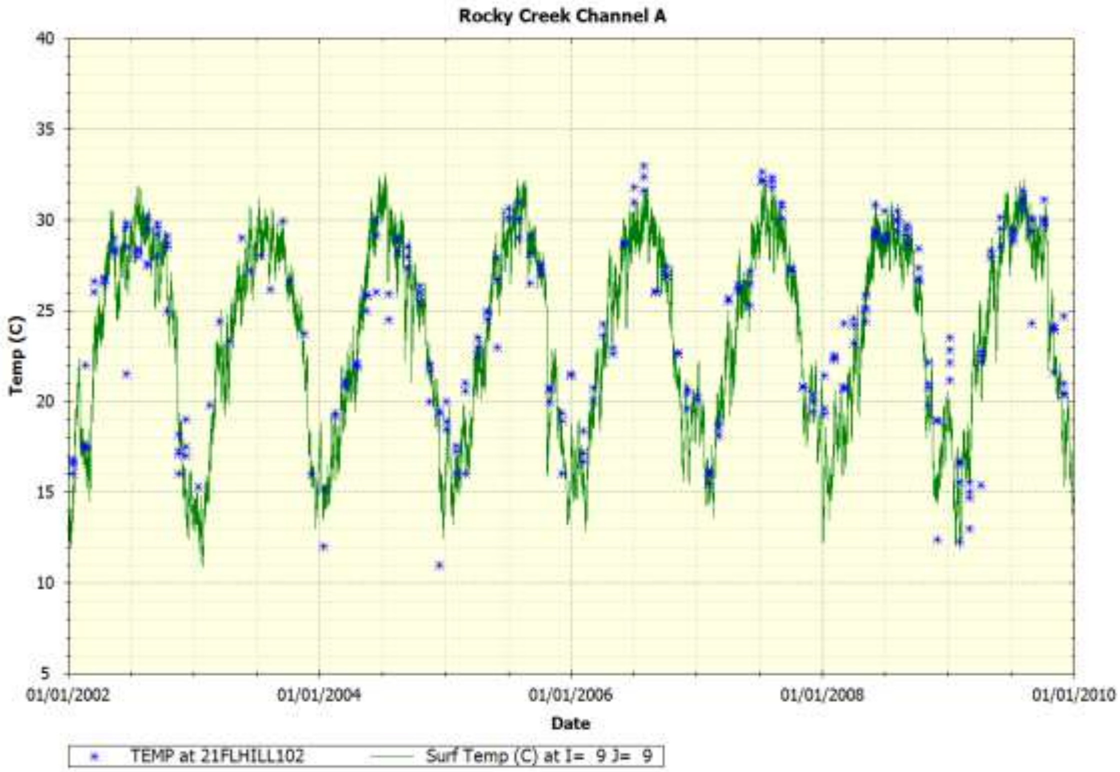

Figure 7.32 Simulated temperature verse measured temperature in Rocky Creek at station 21FLHILL102

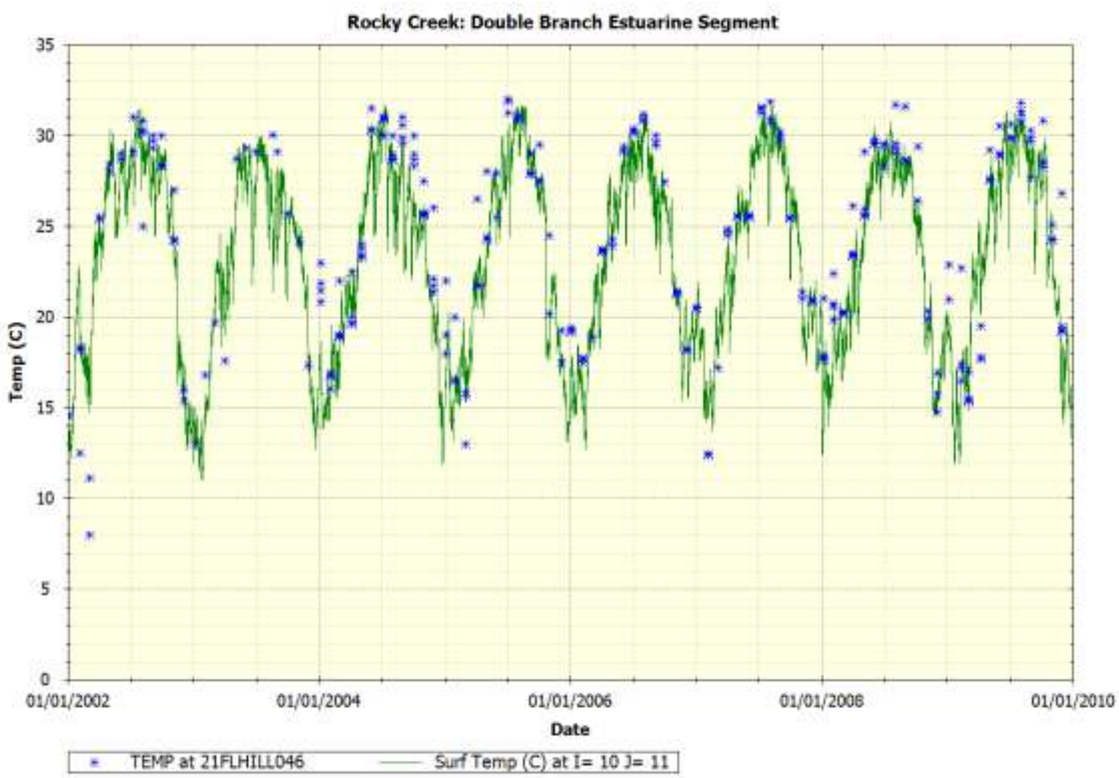

Figure 7.33 Simulated temperature verse measured temperature in Rocky Creek at station 21FLHILL101

7.1.3 Water Quality Analysis Simulation Program (WASP7)

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

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

The Rocky Creek WASP7 model utilized the same grid cells that were developed for the Rocky Creek EFDC model. The hydrodynamic simulation from the Rocky Creek EFDC model was input into the WASP7 model. Open boundary water quality conditions used measured water quality data from Tampa Bay. Water quality loading from the LSPC model was used to simulate loads coming from rivers and streams into the estuary.

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

Water quality parameters from the Tampa Bay NNC WASP model were used for initial parameter population for the Rocky Creek WASP7 model. The Rocky Creek estuary model calibration was reviewed against water quality data located in IWR44. Following review, the calibration was adjusted accordingly to provide the best existing scenario model calibration for the water quality parameters of concern. Results at select water quality stations are presented in Figure 7.34 through Figure 7.48.

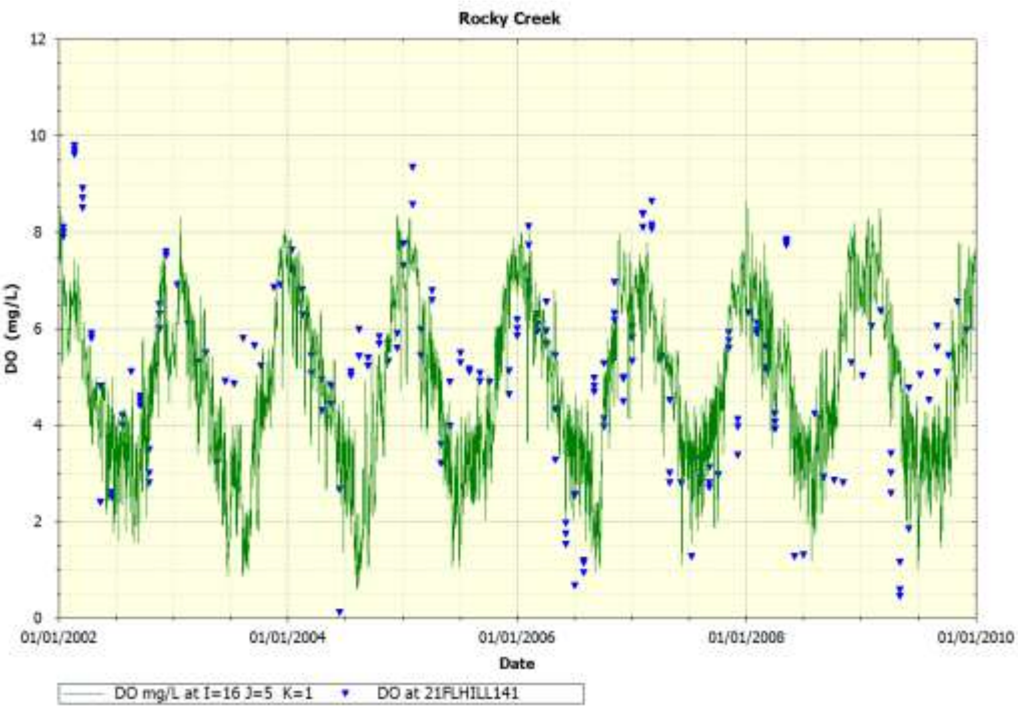

Figure 7.34 Simulated dissolved oxygen verse measured dissolved oxygen in Rocky Creek at station 21FLHILL141

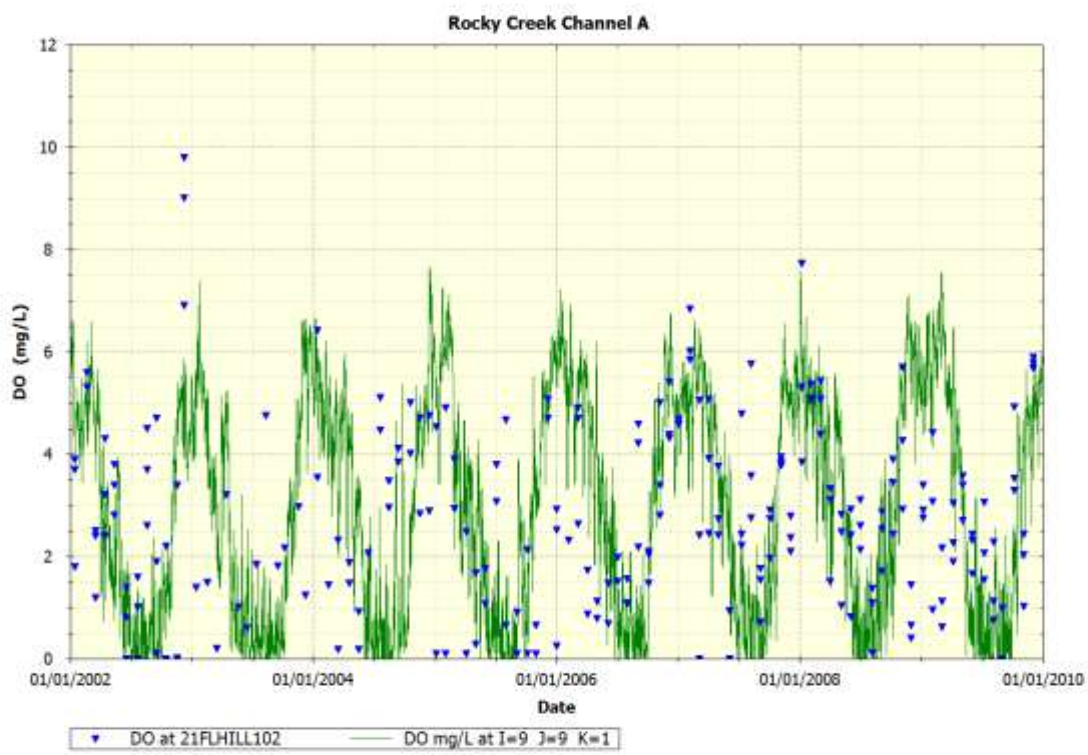

Figure 7.35 Simulated dissolved oxygen verse measured dissolved oxygen in Rocky Channel A at station 21FLHILL102

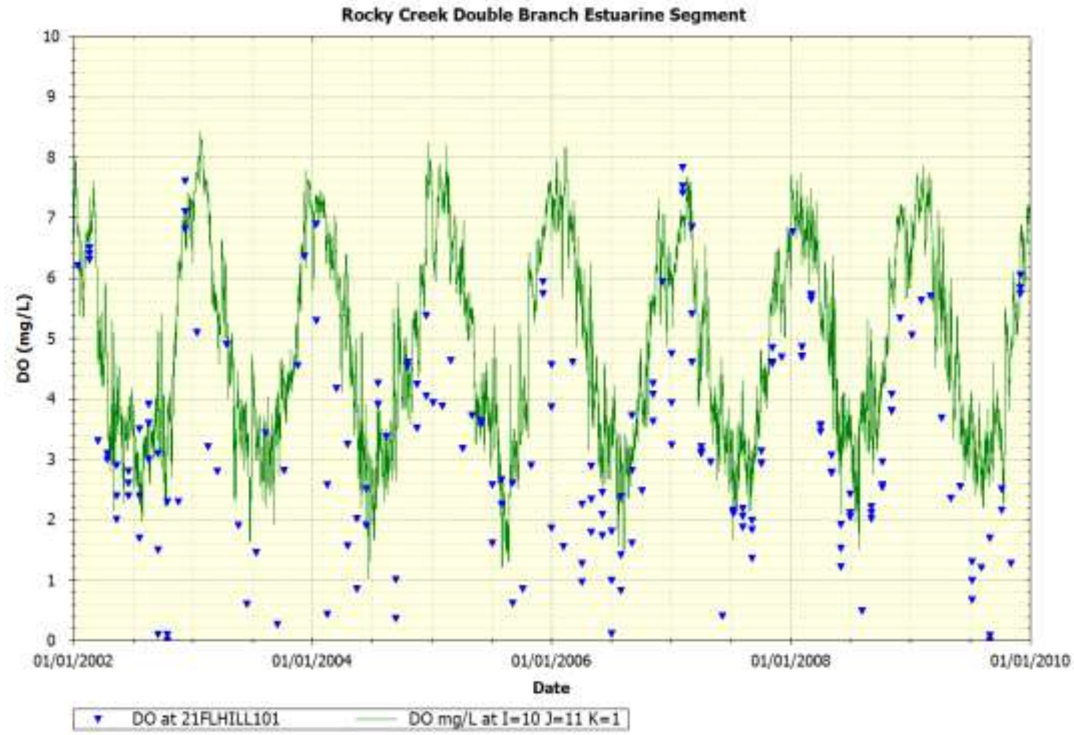

Figure 7.36 Simulated dissolved oxygen verse measured dissolved oxygen in Double Branch at station 21FLHILL101

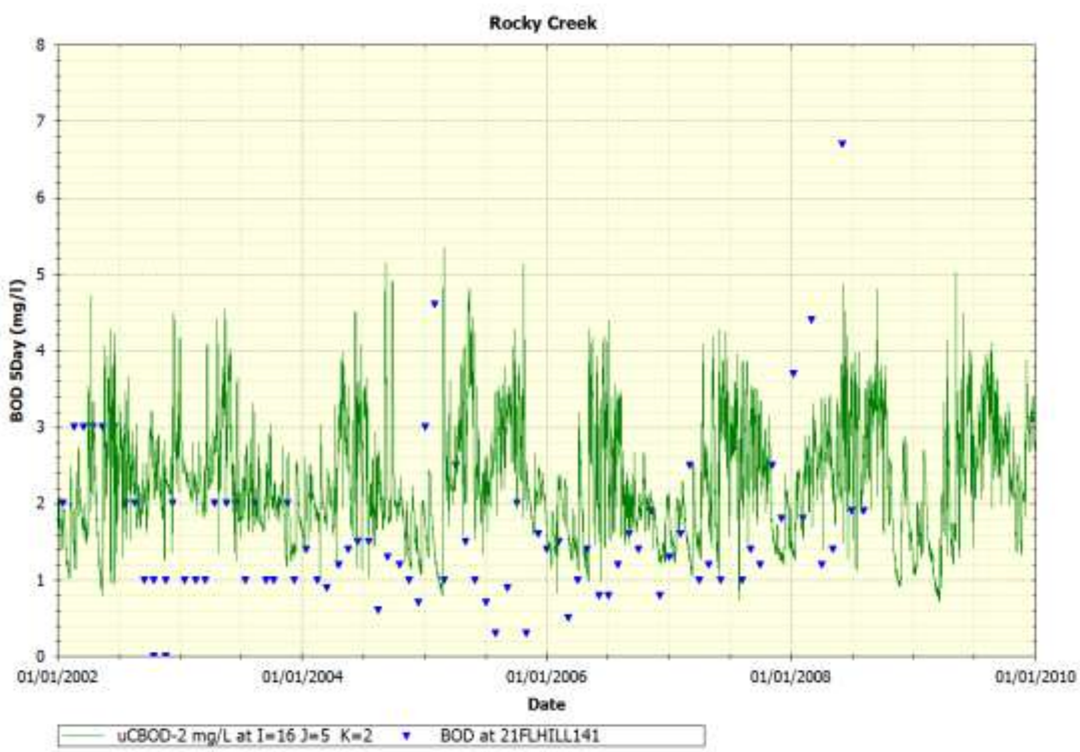

Figure 7.37 Simulated biochemical oxygen demand verse measured biochemical oxygen demand in Rocky Creek at station 21FLHILL141

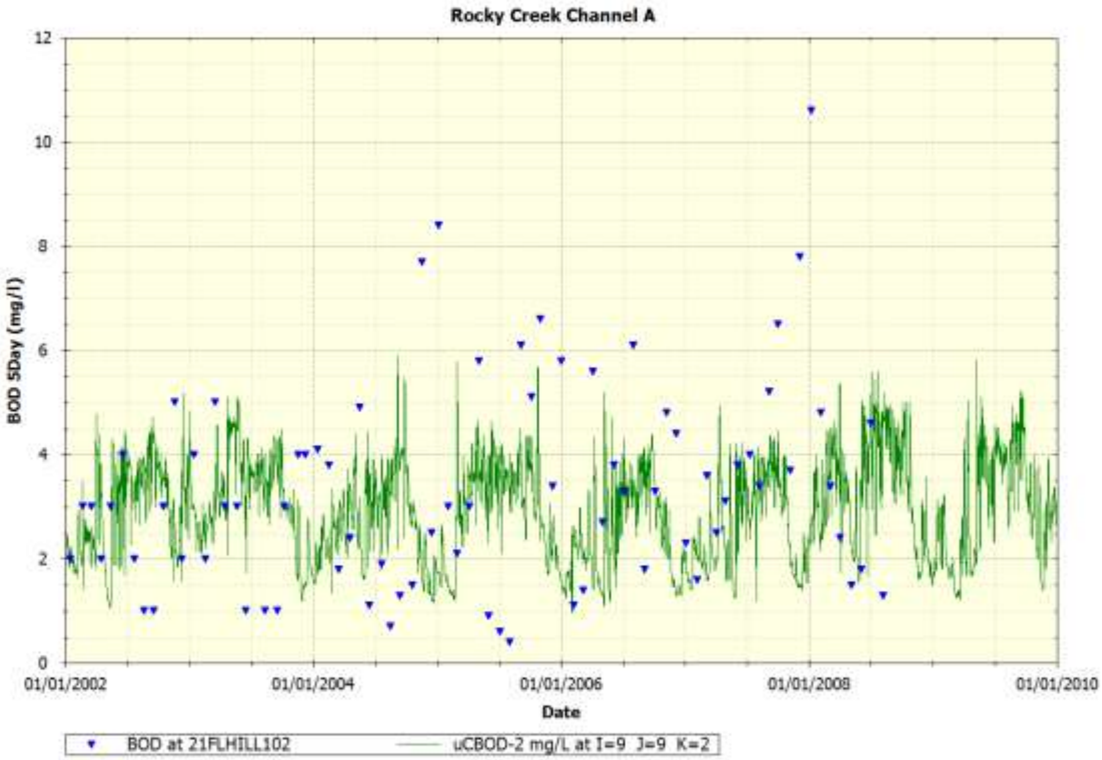

Figure 7.38 Simulated biochemical oxygen demand verse measured biochemical oxygen demand in Rocky Creek Channel A at station 21FLHILL102

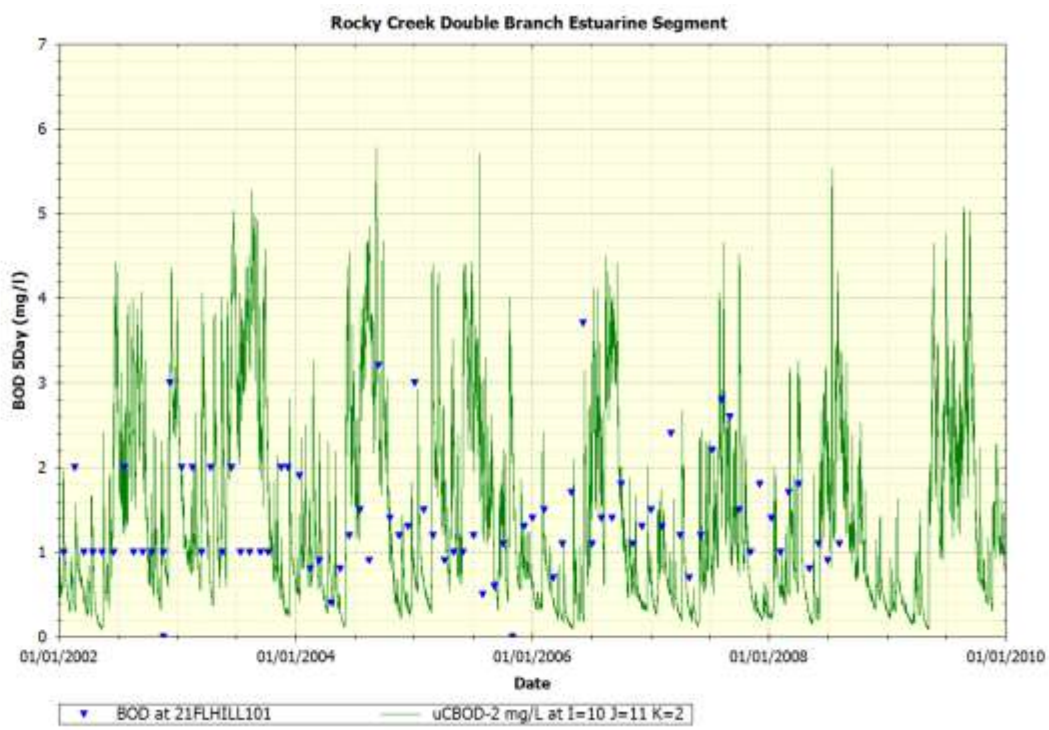

Figure 7.39 Simulated biochemical oxygen demand verse measured biochemical oxygen demand in Double Branch at station 21FLHILL101

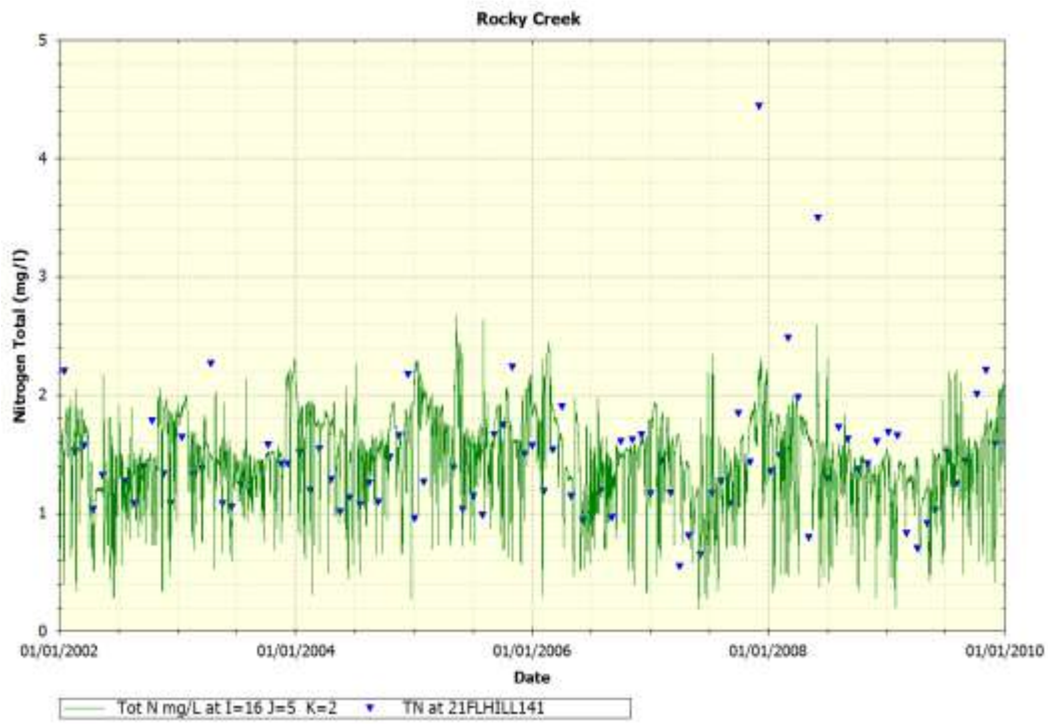

Figure 7.40 Simulated total nitrogen verse measured total nitrogen in Rocky Creek at station 21FLHILL141

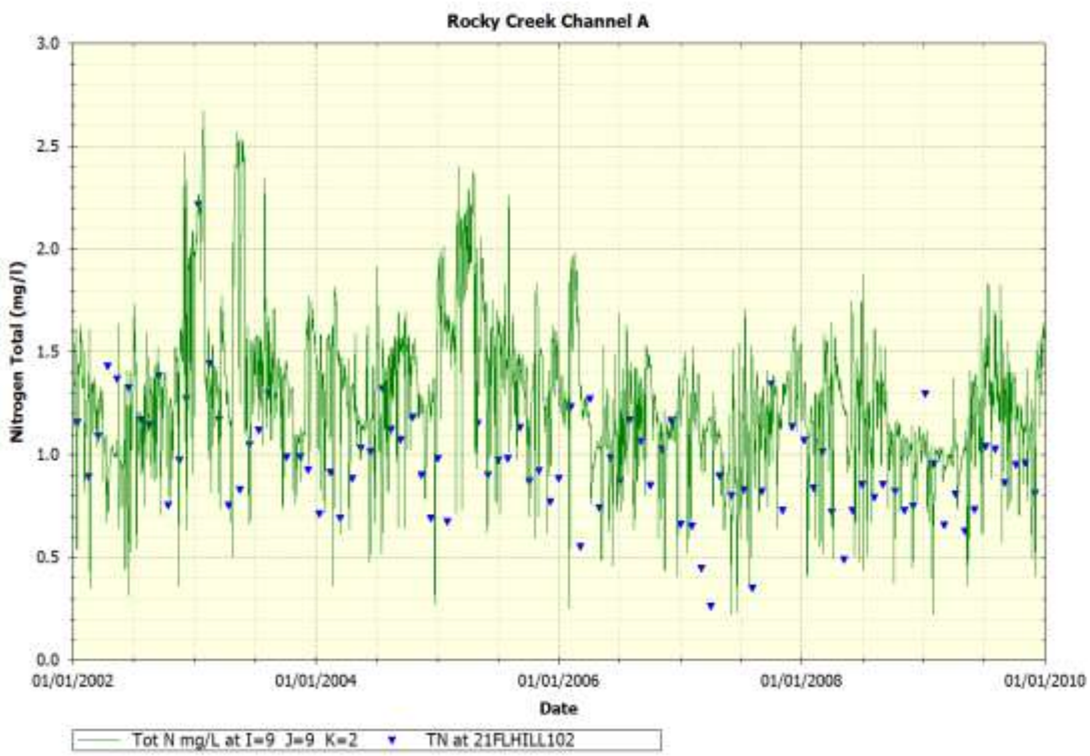

Figure 7.41 Simulated total nitrogen verse measured total nitrogen in Rocky Creek Channel A at station 21FLHILL102

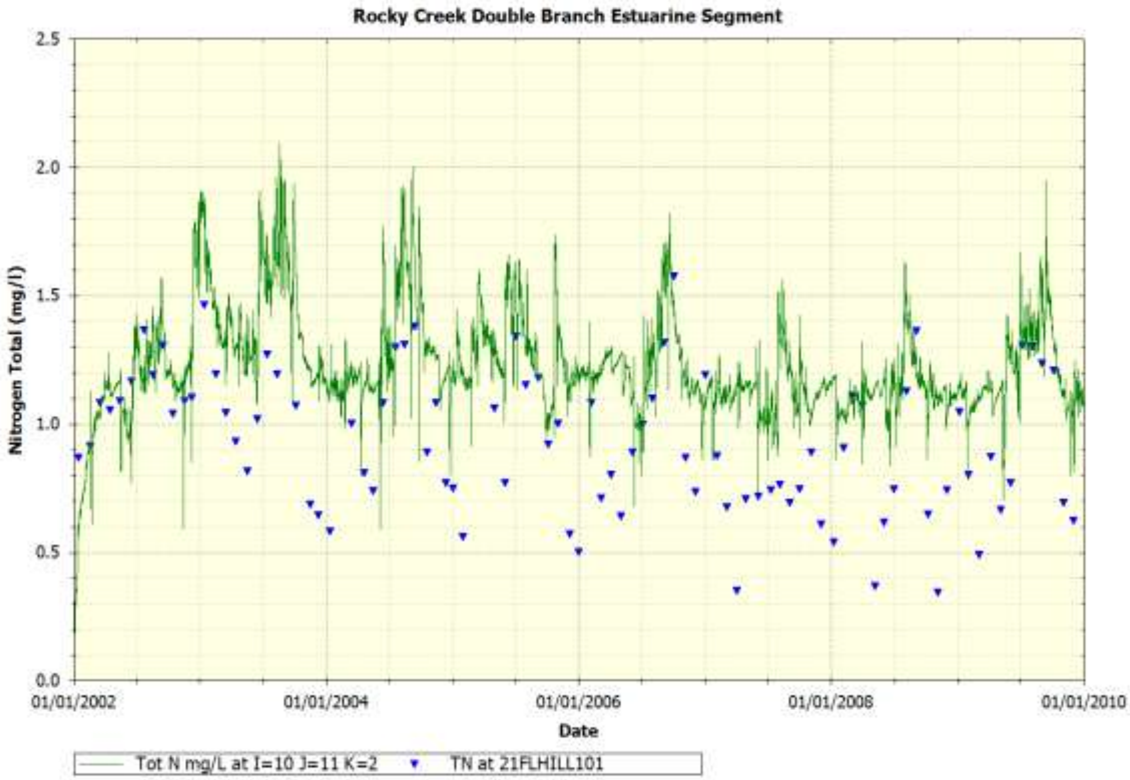

Figure 7.42 Simulated total nitrogen verse measured total nitrogen in Double Branch at station 21FLHILL101

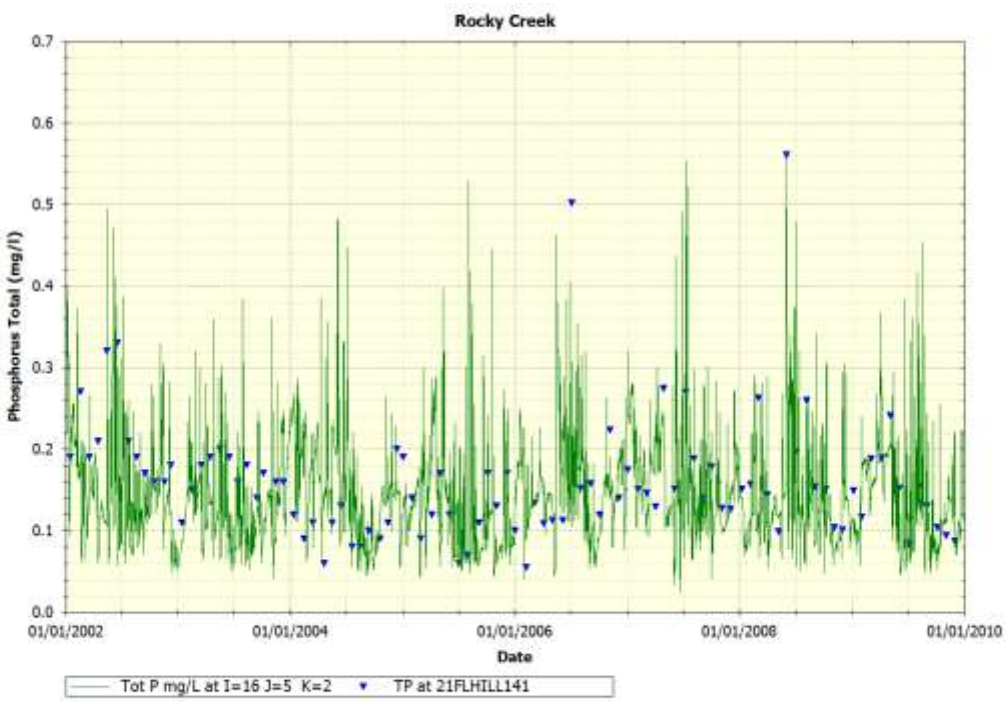

Figure 7.43 Simulated total phosphorus verse measured total phosphorus in Rocky Creek at station 21FLHILL141

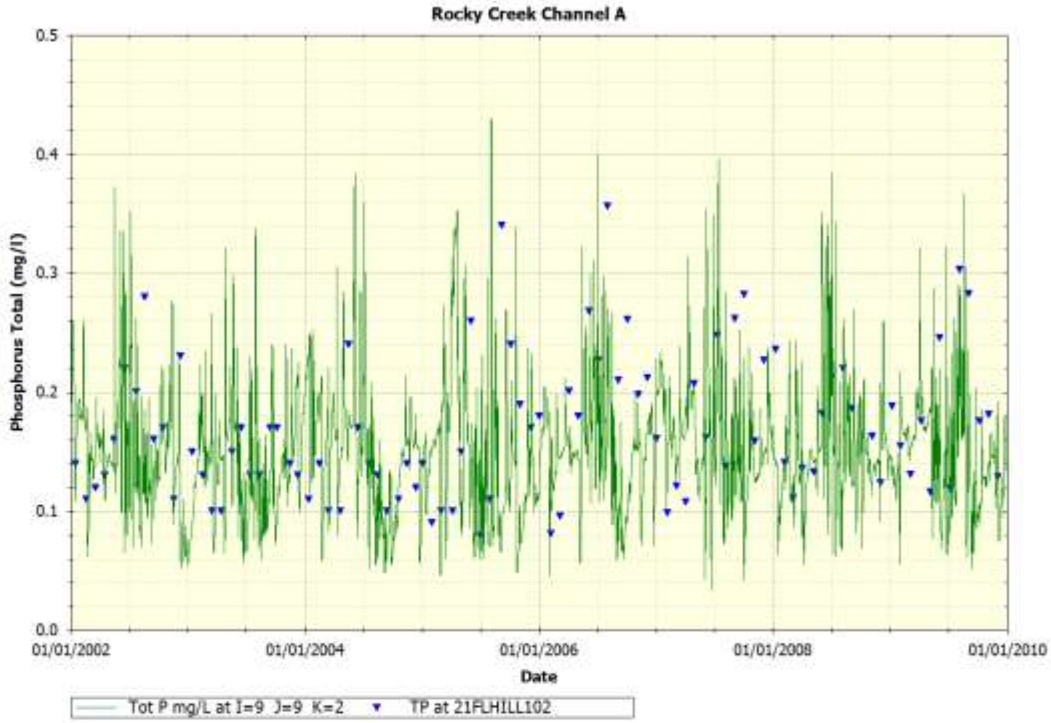

Figure 7.44 Simulated total phosphorus verse measured total phosphorus in Rocky Creek Channel A at station 21FLHILL102

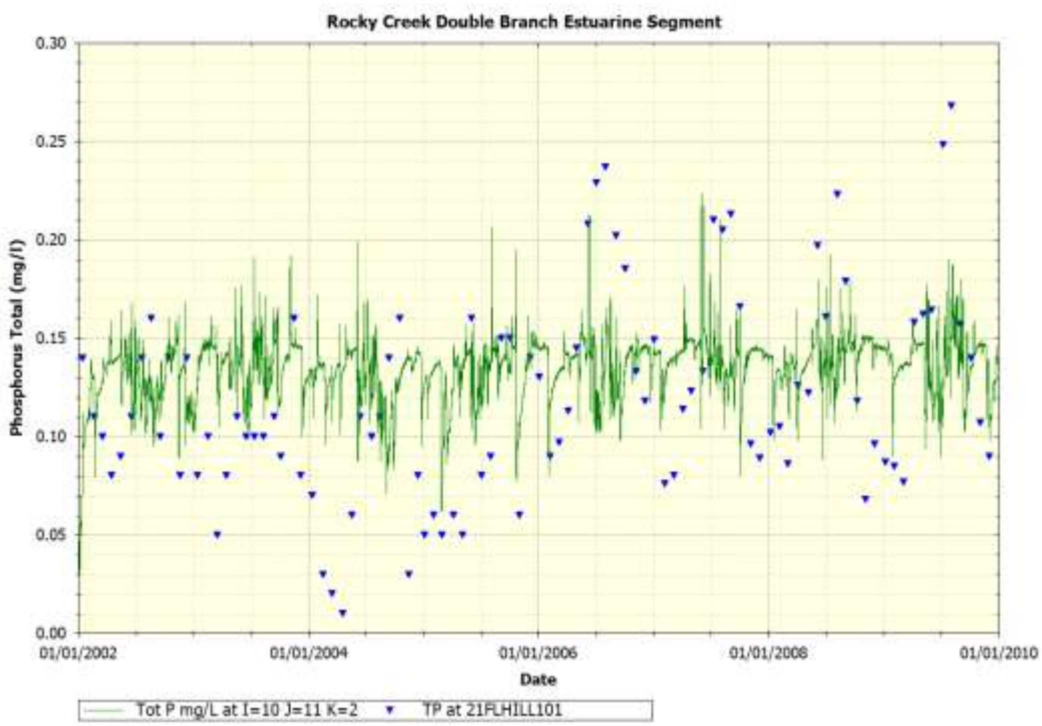

Figure 7.45 Simulated total phosphorus verse measured total phosphorus in Double Branch at station 21FLHILL101

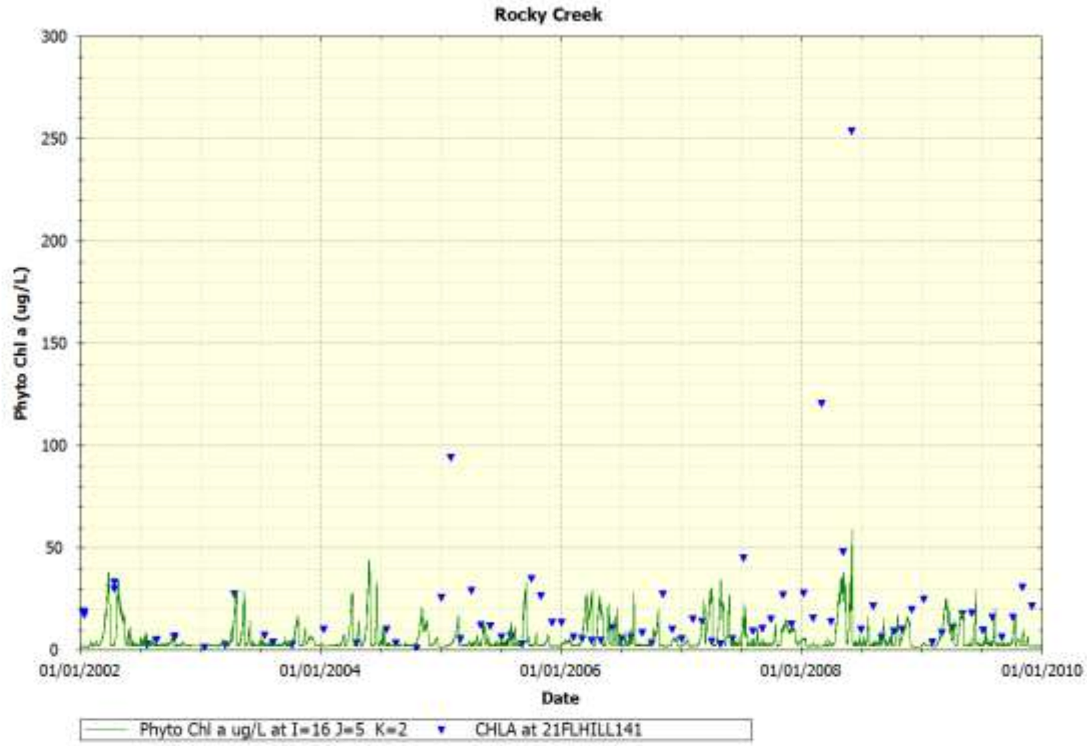

Figure 7.46 Simulated chlorophyll a verse measured chlorophyll a in Rocky Creek at station 21FLHILL141

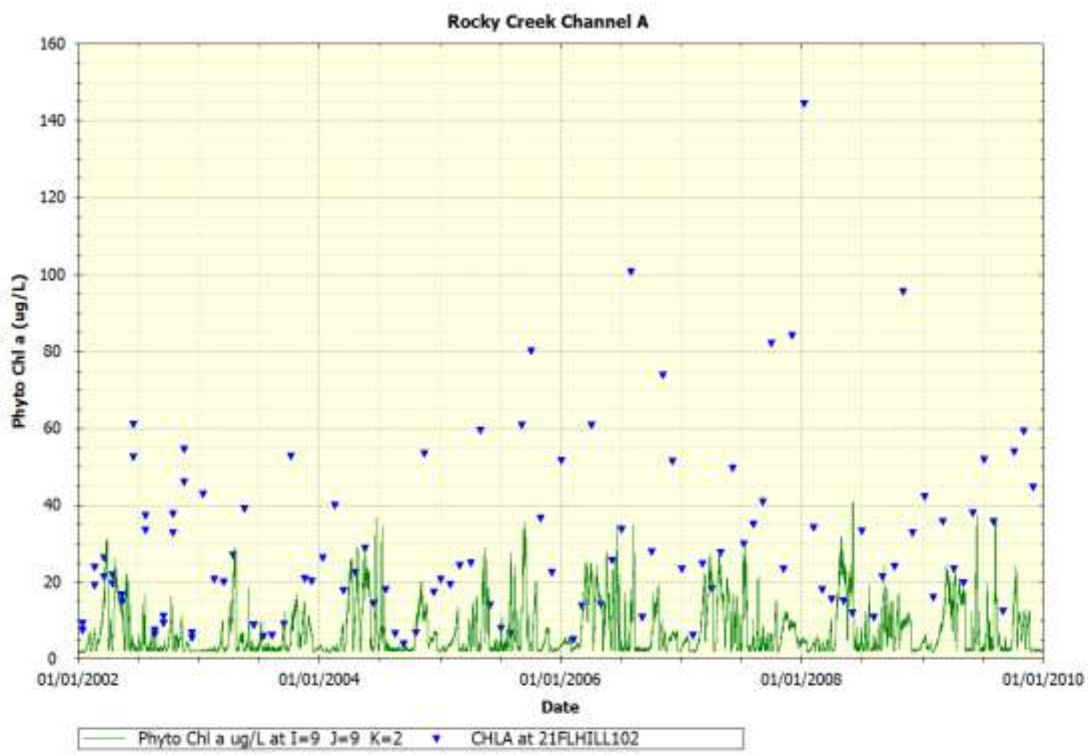

Figure 7.47 Simulated chlorophyll a verse measured chlorophyll a in Rocky Creek Channel A at station 21FLHILL102

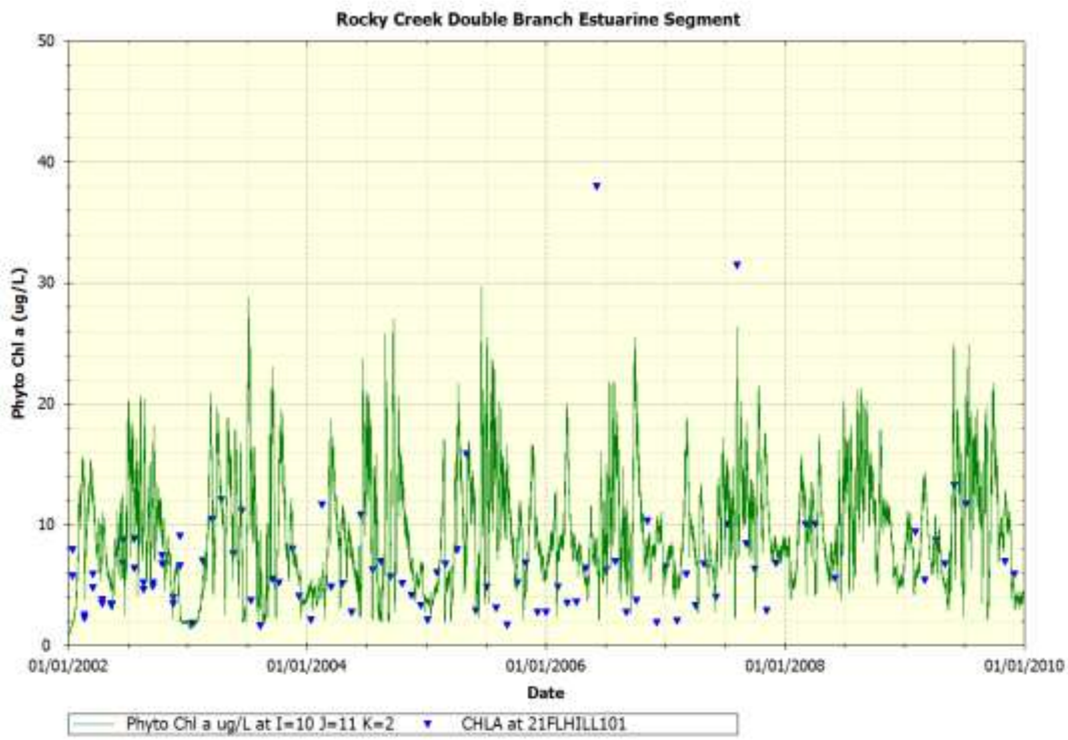

Figure 7.48 Simulated chlorophyll a verse measured chlorophyll a in Double Branch A at station 21FLHILL101

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 outlets of WBIDs 1498, 1507, 1507A, 1513E, 1513F, 1516, and 1563. The current condition annual average concentrations for each of the 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. Figures of the water quality calibration of each WBID can be found in Sections 7.1.1 and 7.1.3.

Table 7.1 Current condition concentrations in the impaired WBIDs

Parameter	WBID 1498	WBID 1507	WBID 1507A	WBID 1513E	WBID 1513F	WBID 1516	WBID 1563
Total nitrogen (mg/L)	1.59	1.48	1.26	1.65	1.23	1.36	1.43
Total phosphorus (mg/L)	0.21	0.23	0.15	0.17	0.13	0.07	0.14
BOD (mg/L)	2.31	2.40	2.81	1.46	1.42	2.26	2.17
DO (mg/L)	5.86	3.77	3.01	5.79	4.89	5.80	5.60

Table 7.2 Current condition loadings in the impaired WBIDs

Parameter	WBID 1498		WBID 1507		WBID 1507A		WBID 1513E	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	9,447	28,107	19,076	49,768	--	53,677	--	39,602
Total phosphorus (mg/L)	1,535	1,875	3,421	5,517	--	6,585	--	3,588
BOD (mg/L)	8,459	32,697	20,493	60,667	--	57,949	--	41,171

Parameter	WBID 1513F		WBID 1516		WBID 1563	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	46,956	--	29,457	--	47,871
Total phosphorus (mg/L)	--	4,410	--	2,937	--	6,502
BOD (mg/L)	--	47,479	--	43,261	--	59,019

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 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. Additionally, following the initial natural condition scenario run, sediment oxygen deman (SOD) was revised by using the following formula: $SOD_{revised} = (Avg\ Chla_{natural} / Avg\ Chla_{existing}) * SOD$. The lower, revised SOD represents the change expected in SOD following excessive nutrient removal from the system. The natural condition water quality predictions are presented in Table 7.3 and Table 7.4. Modeled natural condition dissolved oxygen is shown in Figure 7.49 through Figure 7.56.

The purpose of the natural conditions scenario was to determine whether water quality standards could be achieved without abating the naturally occurring loads from the watershed. The natural condition modeling scenario indicated that the DO standard is not achievable under natural conditions, indicating that low DO is a naturally occurring phenomenon in the Rocky Creek branches. Figure 7.57 through Figure 7.63 provide the cumulative distribution function of DO concentrations for both the modeled existing condition and natural condition results in the impaired WBIDs. The cumulative distribution curve shows there is an increase in DO concentrations in the natural condition scenario, specifically in DO concentration values less than 5 mg/L in the existing condition run.

Table 7.3 Natural condition concentrations in the impaired WBID

Parameter	WBID 1498	WBID 1507	WBID 1507A	WBID 1513E	WBID 1513F	WBID 1516	WBID 1563
Total nitrogen (mg/L)	0.46	0.45	0.77	0.48	0.83	0.45	0.71
Total phosphorus (mg/L)	0.01	0.01	0.14	0.01	0.09	0.01	0.03
BOD (mg/L)	2.22	2.09	0.74	1.41	0.54	2.17	1.81
DO (mg/L)	6.01	6.11	4.26	5.89	5.20	5.91	6.00

Table 7.4 Natural condition loadings in the impaired WBID

Parameter	WBID 1498		WBID 1507		WBID 1507A		WBID 1513E	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	1,790	11,194	4,718	15,534	--	16,009	--	16,351
Total phosphorus (mg/L)	39	194	149	403	--	423	--	371
BOD (mg/L)	6,305	19,398	7,498	33,276	--	34,298	--	26,525

Parameter	WBID 1513F		WBID 1516		WBID 1563	
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)
Total nitrogen (mg/L)	--	18,965	--	8,294	--	10,338
Total phosphorus (mg/L)	--	470	--	200	--	263
BOD (mg/L)	--	29,791	--	21,754	--	24,706

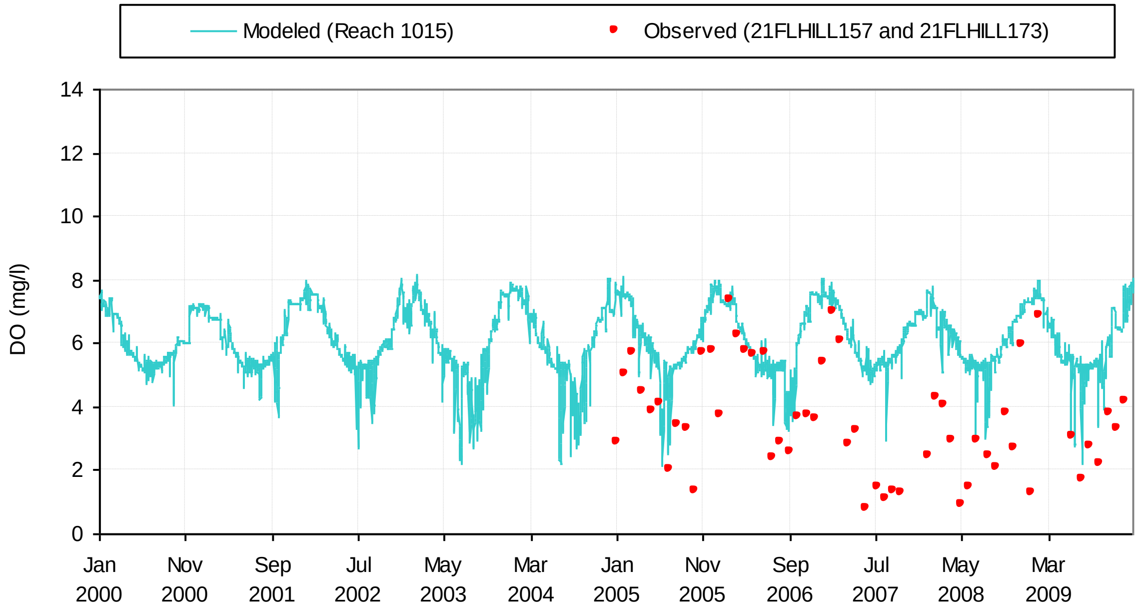

Figure 7.49 Modeled Natural Scenario DO (mg/l) at 21FLHILL157 and 21FLHILL173 in WBID 1513E

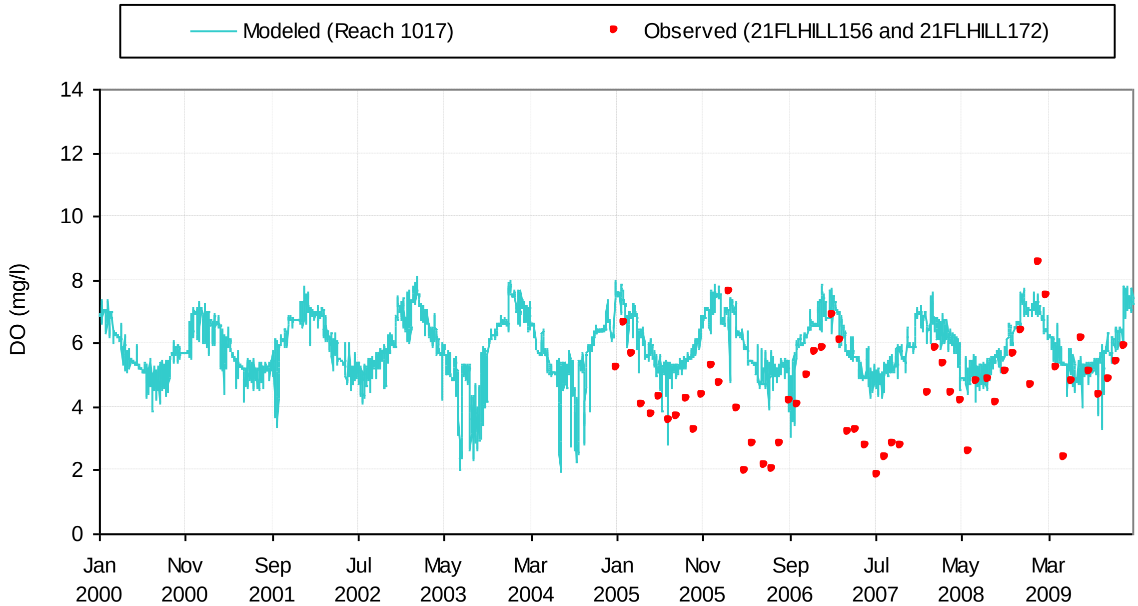

Figure 7.50 Modeled Natural Scenario DO (mg/l) at 21FLHILL156 and 21FLHILL172 in WBID 1513E

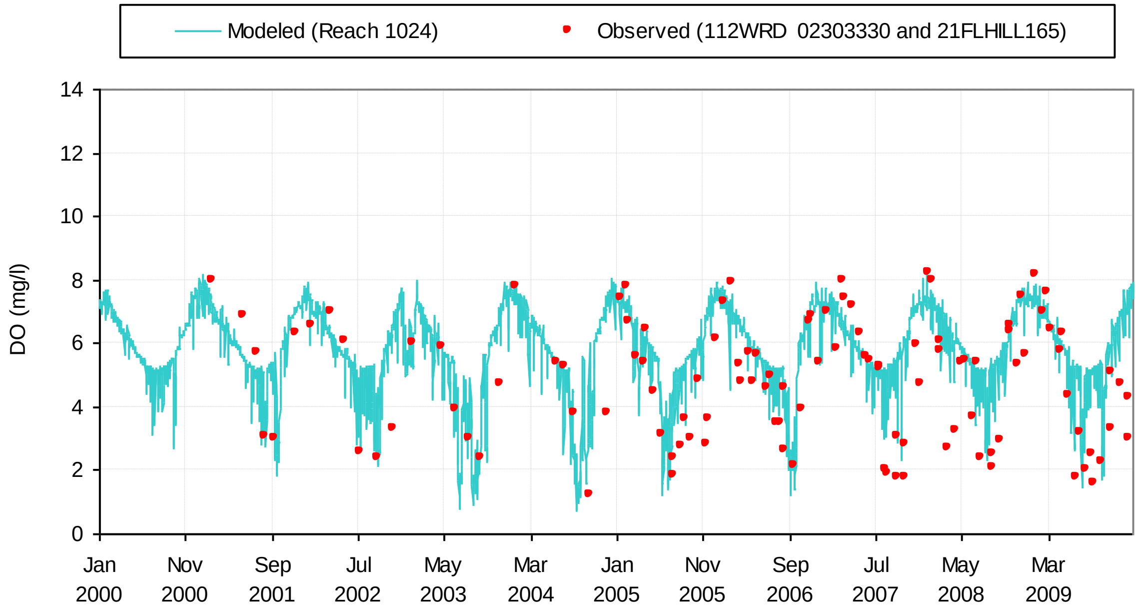

Figure 7.51 Modeled Natural Scenario DO (mg/l) at 112WRD 02303330 and 21FLHILL165 in WBID 1507

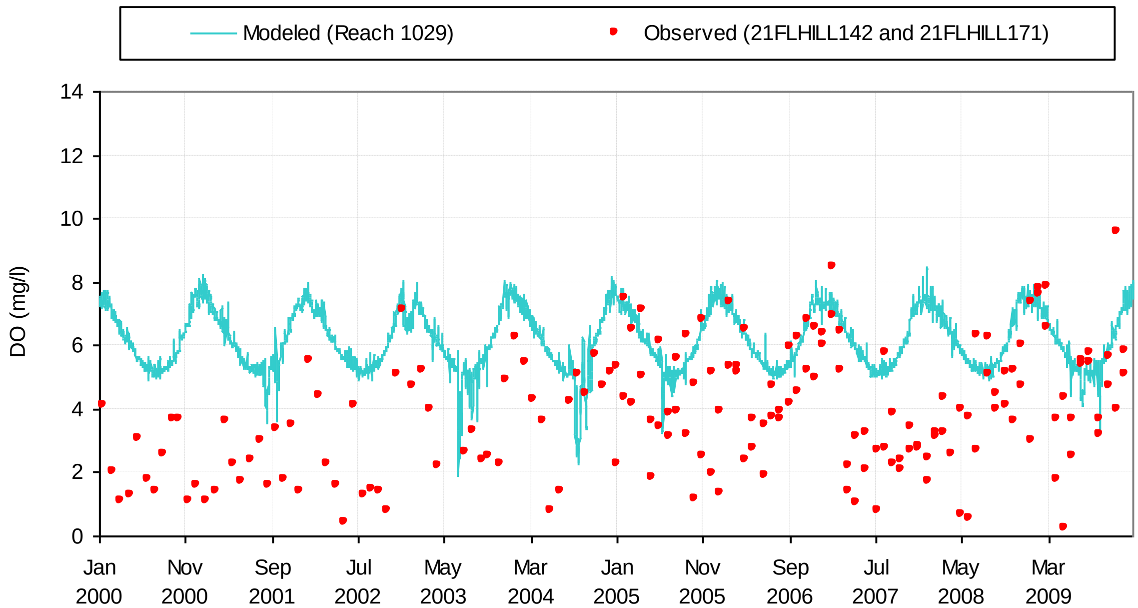

Figure 7.52 Modeled Natural Scenario DO (mg/l) at 21FLHILL142 and 21FLHILL171 in WBID 1516

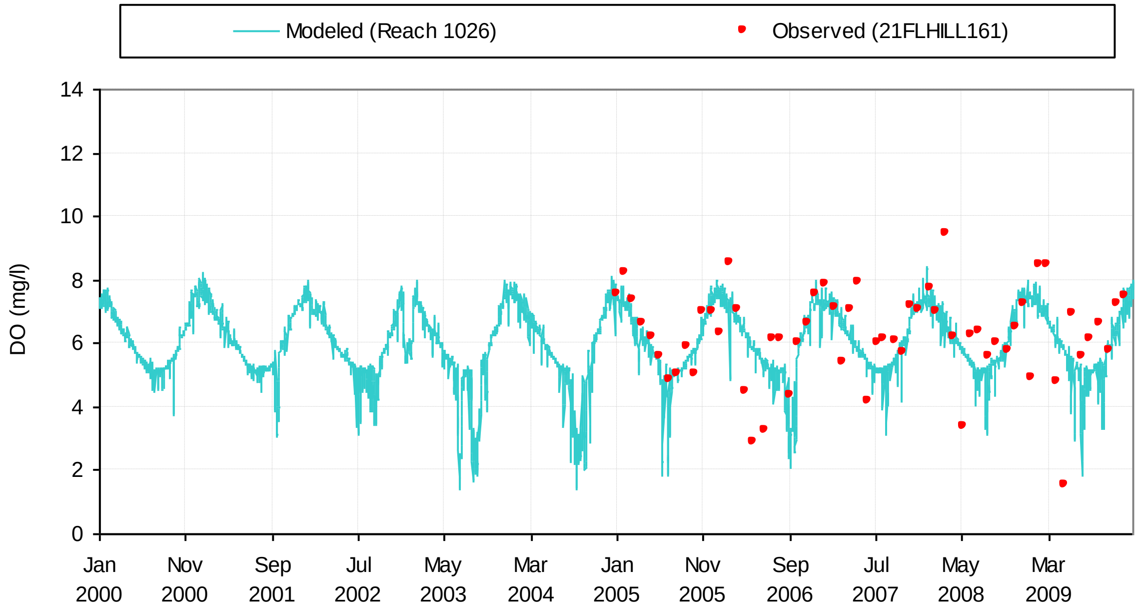

Figure 7.53 Modeled Natural Scenario DO (mg/l) at 21FLHILL161 in WBID 1498

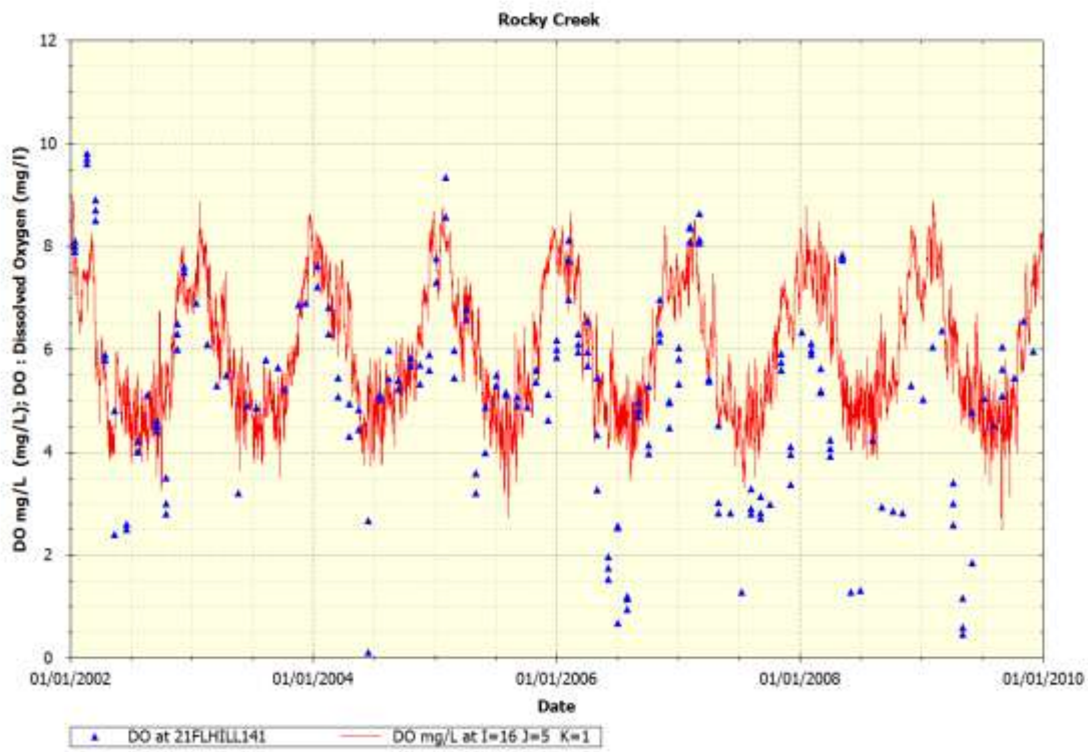

Figure 7.54 Modeled Natural Scenario DO (mg/l) in Rocky Creek at station 21FLHILL141

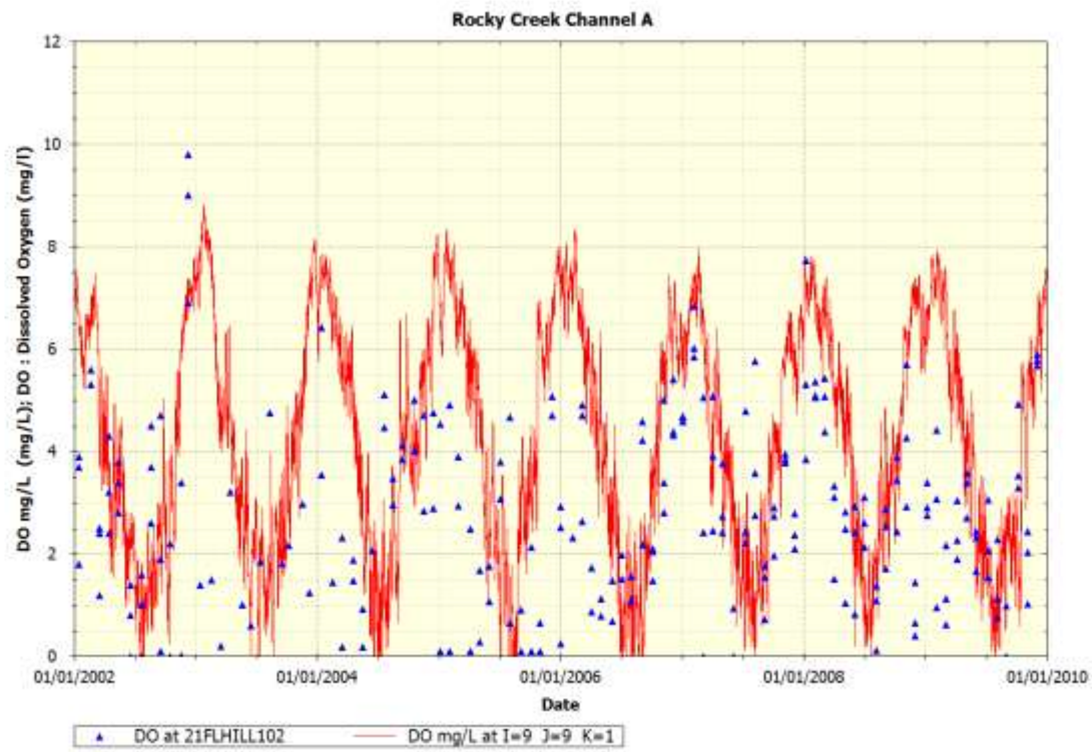

Figure 7.55 Modeled Natural Scenario DO in Rocky Channel A at station 21FLHILL102

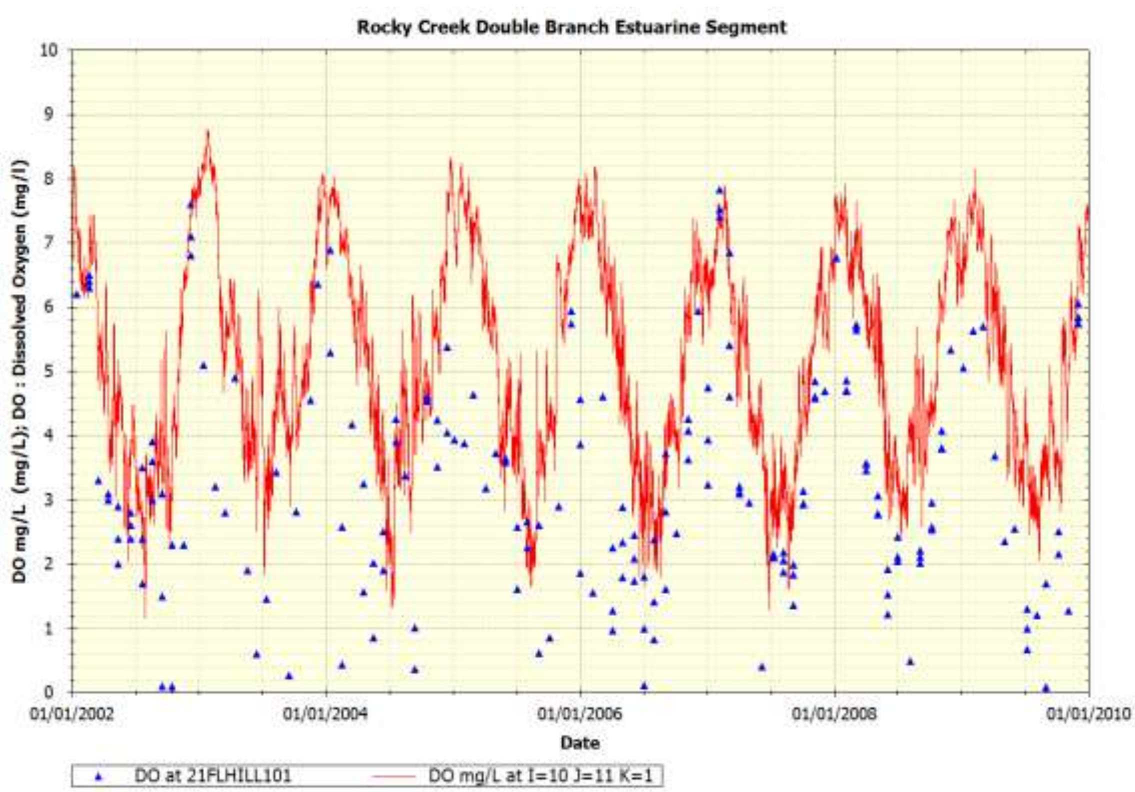

Figure 7.56 Modeled Natural Scenario DO (mg/L) in Double Branch at station 21FLHILL101

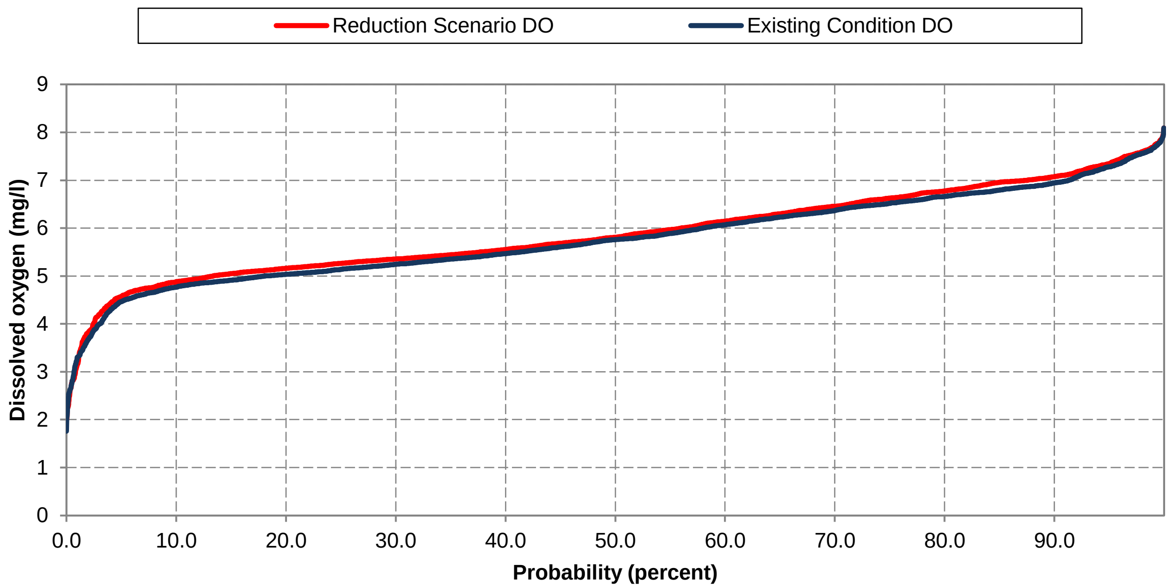

Figure 7.57 Dissolved oxygen concentration cumulative distribution function for WBID 1513E

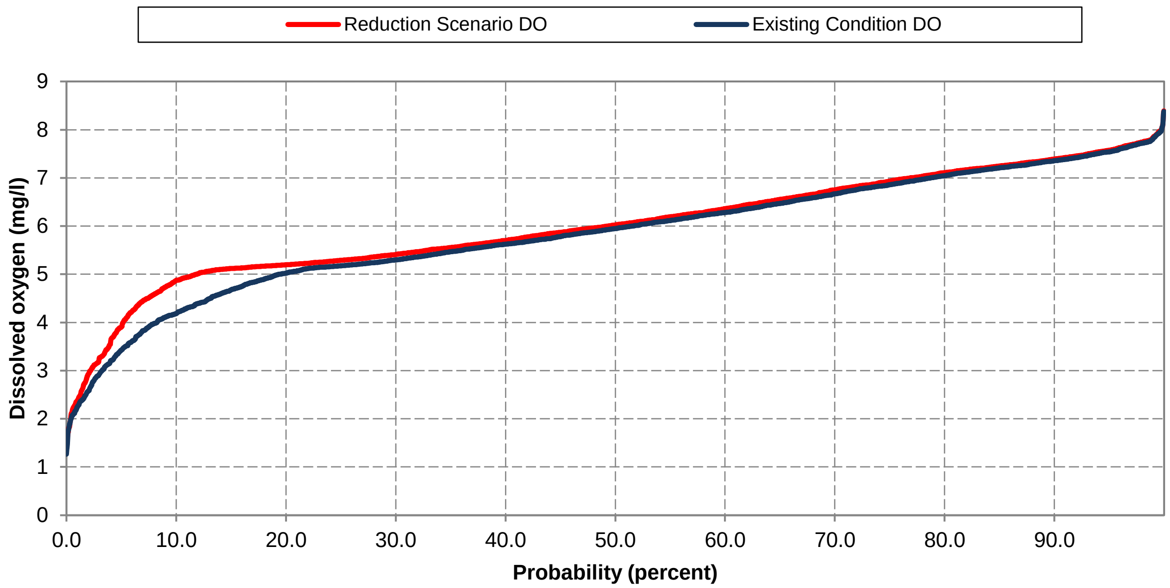

Figure 7.58 Dissolved oxygen concentration cumulative distribution function for WBID 1498

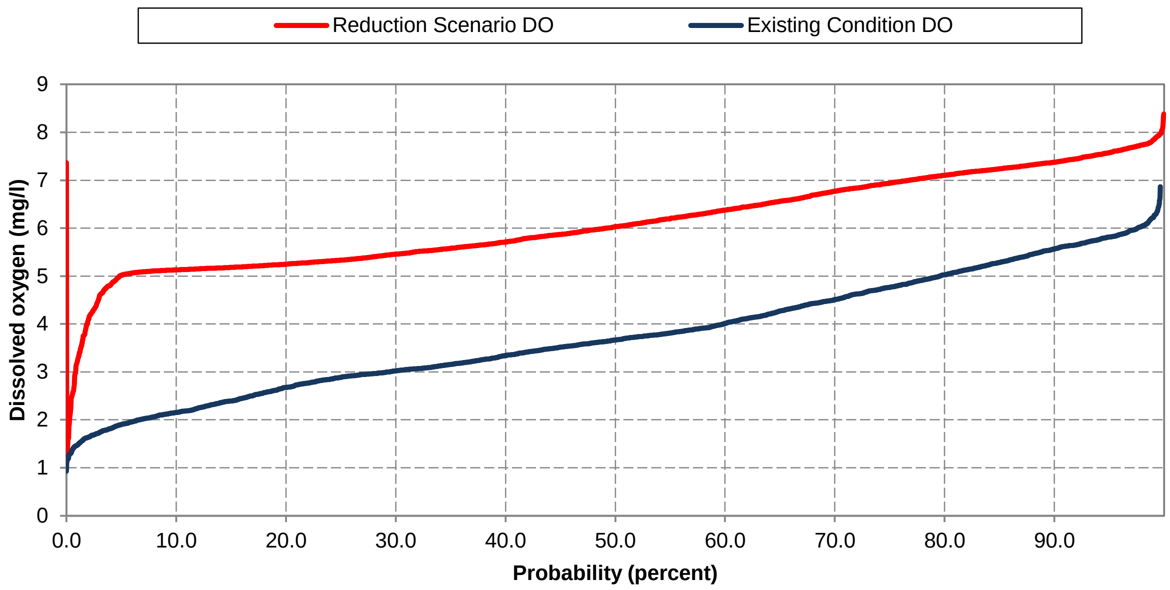

Figure 7.59 Dissolved oxygen concentration cumulative distribution function for WBID 1507

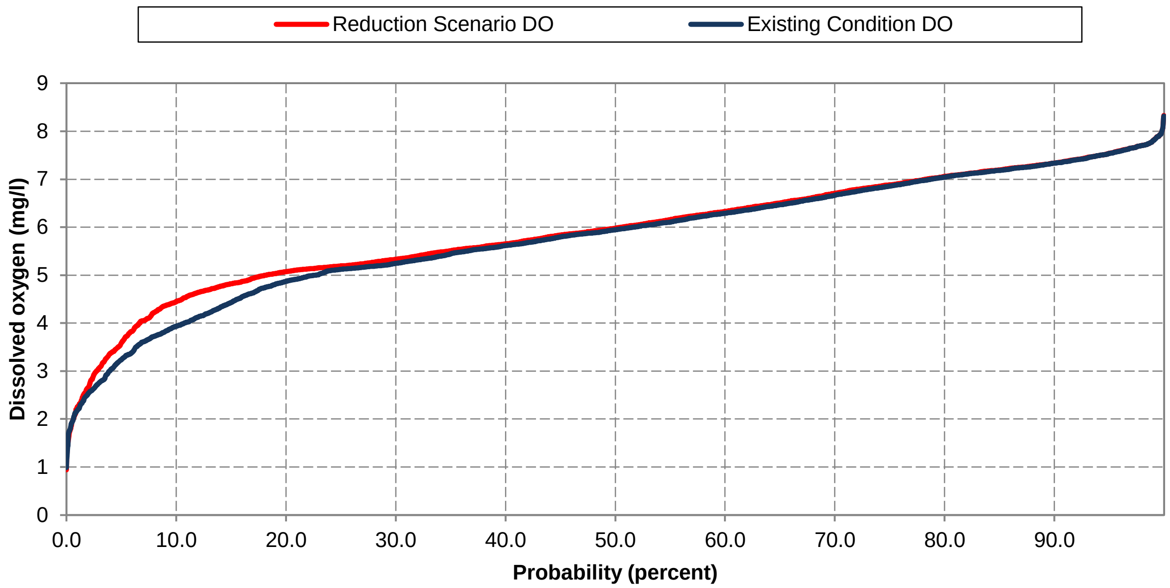

Figure 7.60 Dissolved oxygen concentration cumulative distribution function for WBID 1516

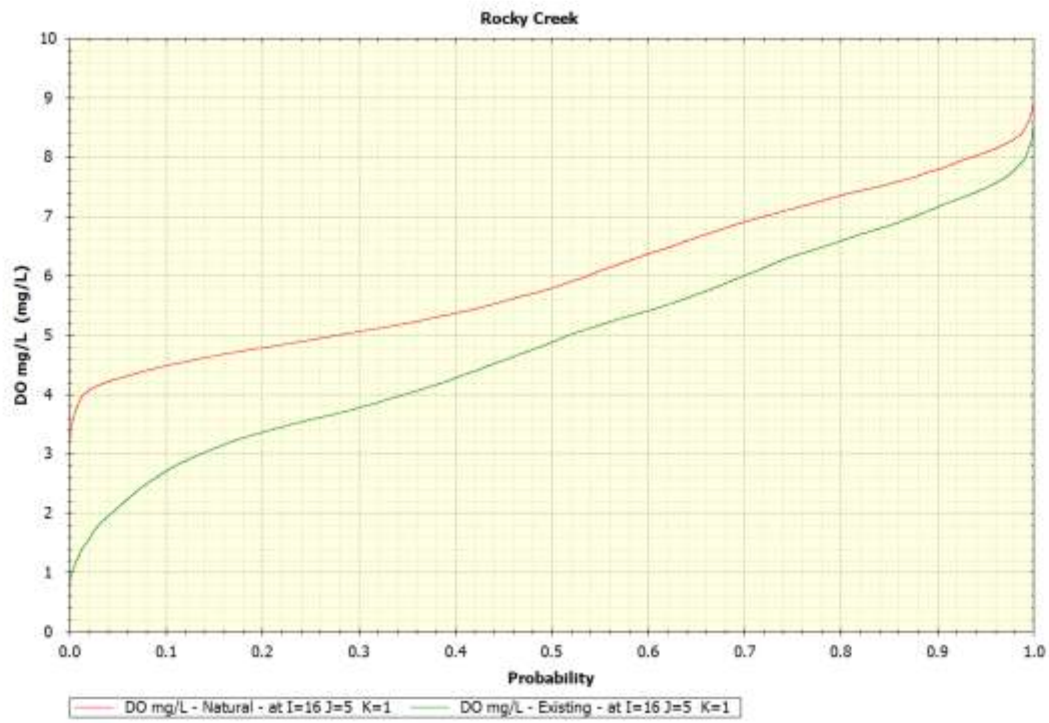

Figure 7.61 Dissolved oxygen concentration cumulative distribution function for WBID 1563

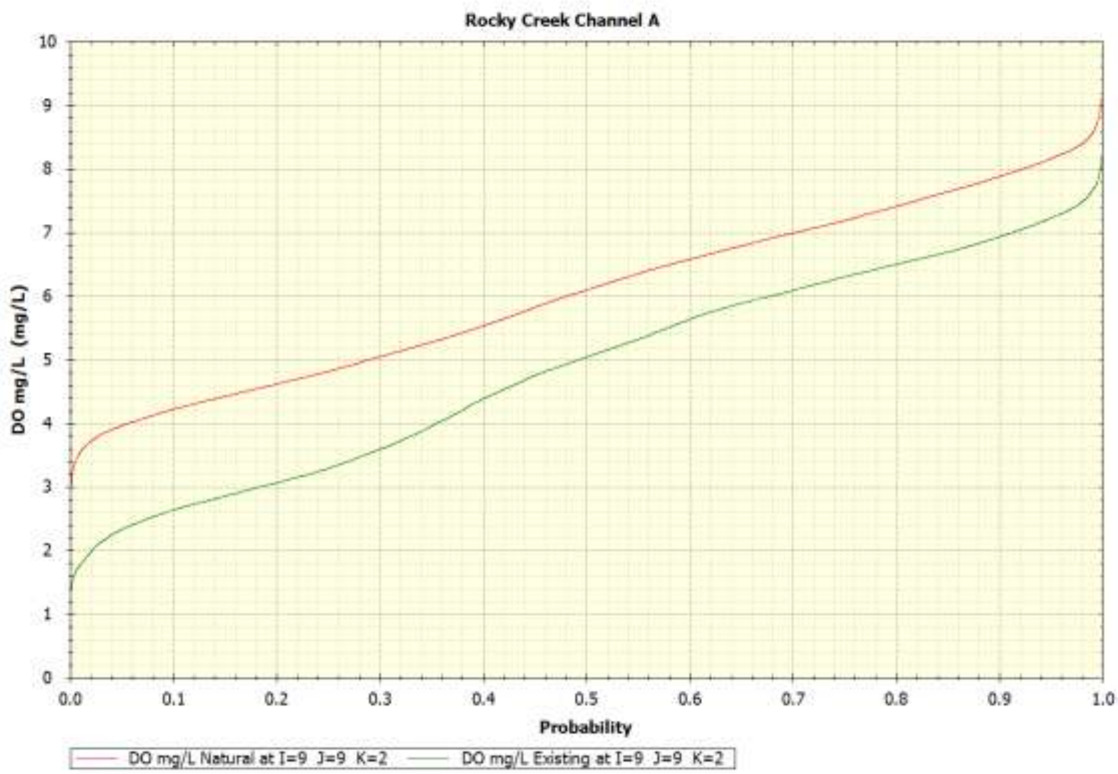

Figure 7.62 Dissolved oxygen concentration cumulative distribution function for WBID 1507A

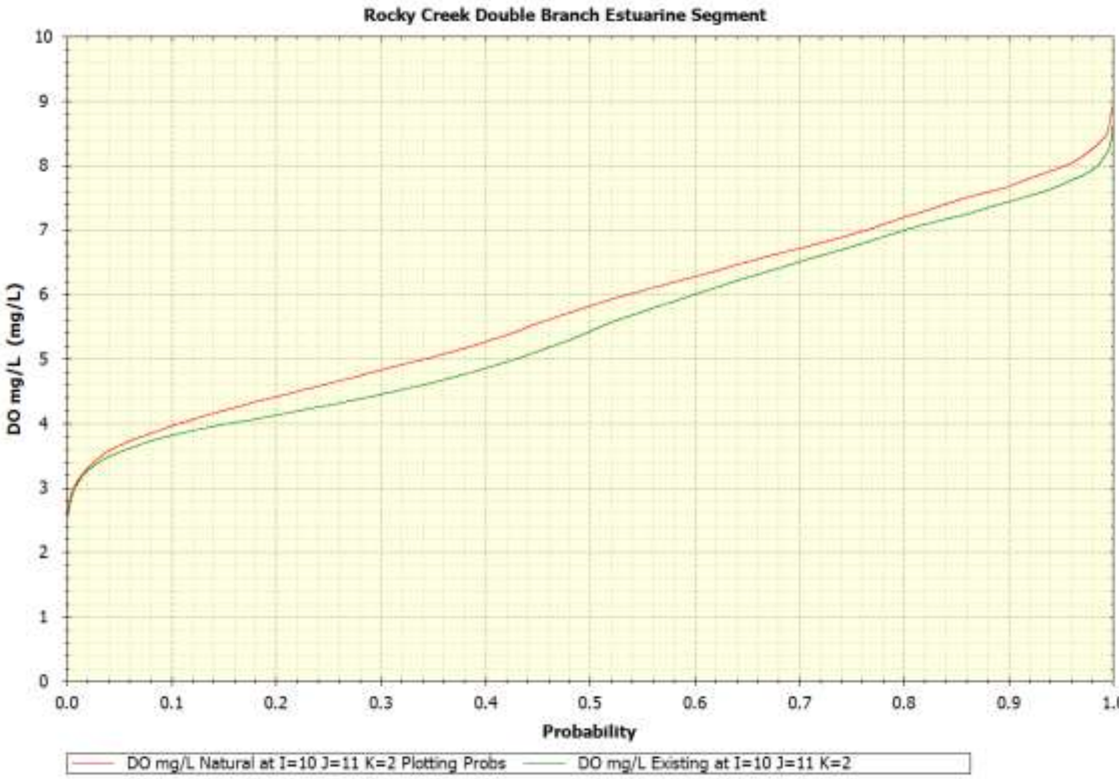

Figure 7.63 Dissolved oxygen concentration cumulative distribution function for WBID 1513F

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:

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

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 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 impaired WBIDs, and included all loadings from upstream sources and streams. During the development of this TMDL, it was determined that the natural condition scenario (removal of all anthropogenic sources and land uses) did not meet the Florida standards for DO. The DO was greater during the natural condition run, and nutrient loadings from the natural condition scenario were therefore used to determine the TMDL in accordance with the Natural Conditions narrative rule. By using the natural conditions nutrient loadings for the TMDL, the nutrient reductions also ensure protection of the downstream estuaries. The allocations for each of the impaired WBIDs for total nitrogen, total phosphorus, and biochemical oxygen demand are presented in Table 8.1 through Table 8.7.

Table 8.1 TMDL Load Allocations for WBID 1498 in the Tampa Bay Basin

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	9,447	28,107	1,790	11,194	81%	60%	60%
Total Phosphorus	1,535	1,875	39	194	97%	90%	90%
Biochemical Oxygen Demand	8,459	32,697	6,305	19,398	25%	41%	41%

Table 8.2 TMDL Load Allocations for WBID 1507 in the Tampa Bay Basin

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	19,076	49,768	4,718	15,534	75%	69%	69%
Total Phosphorus	3,421	5,517	149	403	96%	93%	93%
Biochemical Oxygen Demand	20,493	60,667	7,498	33,276	63%	45%	45%

Table 8.3 TMDL Load Allocations for WBID 1507A in the Tampa Bay Basin

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

Total Nitrogen	--	53,677	--	16,009	--	70%	70%
Total Phosphorus	--	6,585	--	423	--	94%	94%
Biochemical Oxygen Demand	--	57,949	--	34,298	--	41%	41%

Table 8.4 TMDL Load Allocations for WBID 1513E in the Tampa Bay Basin

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	39,602	--	16,351	--	59%	59%
Total Phosphorus	--	3,588	--	371	--	90%	90%
Biochemical Oxygen Demand	--	41,171	--	26,525	--	36%	36%

Table 8.5 TMDL Load Allocations for WBID 1513F in the Tampa Bay Basin

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	46,956	--	18,965	--	60%	60%
Total Phosphorus	--	4,410	--	470	--	89%	89%
Biochemical Oxygen Demand	--	47,479	--	29,791	--	37%	37%

Table 8.6 TMDL Load Allocations for WBID 1516 in the Tampa Bay Basin

Constituent	Current Condition	TMDL Condition	Percent Reduction

	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	29,457	--	8,294	--	72%	72%
Total Phosphorus	--	2,937	--	200	--	93%	93%
Biochemical Oxygen Demand	--	43,261	--	21,754	--	50%	50%

Table 8.7 TMDL Load Allocations for WBID 1563 in the Tampa Bay Basin

Constituent	Current Condition		TMDL Condition		Percent Reduction		
	WLA (kg/yr)	LA (kg/yr)	WLA (kg/yr)	LA (kg/yr)	WLA	LA	MS4
Total Nitrogen	--	47,871	--	10,338	--	78%	78%
Total Phosphorus	--	6,502	--	263	--	96%	96%
Biochemical Oxygen Demand	--	59,019	--	24,706	--	58%	58%

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 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 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. A WLA was calculated for the NPDES permitted point sources in WBIDs 1498, WBID 1507, and WBID 1507A.

8.3.2 Municipal Separate Storm Sewer System Permits

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

This TMDL assumes for the reasons stated above that it is infeasible to calculate numeric water quality-based effluent limitations for stormwater discharges. Therefore, in the absence of information presented to the permitting authority showing otherwise, this TMDL assumes that water quality-based effluent limitations for stormwater sources of nutrients derived from this TMDL can be expressed in narrative form (e.g., as best management practices), provided that:

(1) the permitting authority explains in the permit fact sheet the reasons it expects the chosen BMPs to achieve the aggregate wasteload allocation for these stormwater discharges; and (2) the state will perform ambient water quality monitoring for nutrients for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

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

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

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

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

Fernald, E. A., and E.D. Purdum. 1998. *Water Resources Atlas of Florida.* Institute of Science and Public Affairs, Florida State University.

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

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

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

Florida Department of Environmental Protection (FDEP). 2001. *Water Quality Status Report.* Florida Department of Environmental Protection. <http://waterwebprod.dep.state.fl.us/basin411/tampa/status/TAMPA_BAY.pdf>. Accessed July 2012.

Florida Department of Environmental Protection (FDEP). 2003. *Water Quality Assessment Report.* Florida Department of Environmental Protection. <http://waterwebprod.dep.state.fl.us/basin411/tampa/assessment/Tampa-Bay-WEBX.pdf>. Accessed July, 2012.

Florida Department of Environmental Protection (FDEP). 2009. *TMDL Report Dissolved Oxygen and Nutrient TMDL for Double Branch (1513).* Florida Department of Environmental Protection. Tallahassee, Florida.

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

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

Southeast Regional Climate Center (SERCC). 2012. Period of Record Monthly Climate Summary: Tampa WSCMO Airport, Florida (088788). Period of Record: March 25, 1900 to April 30, 2012. <http://www.sercc.com/climateinfo/historical/historical.html> Accessed July 2012.

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

United States Environmental Protection Agency (USEPA). 2012a. Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix C: Watershed Hydrology and Water Quality Modeling Report for 19 Florida Watersheds. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. July 2012.

United States Environmental Protection Agency (USEPA). 2012b. Technical Support Document for U.S. EPA's Proposed Rule for Numeric Nutrient Criteria for Florida's Estuaries, Coastal Waters, and Southern Inland Flowing Waters - Volume 1: Estuaries, Appendix C Attachment 16: The Tampa Watershed. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. July 2012.

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