Proposed

Total Maximum Daily Loads

for

Owens Branch (WBID 1675)

Nutrients

September, 2009

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SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. 303(d) Listed Waterbody Information

State: Florida

Major River Basins:

Tampa Bay Tributaries (Alafia River Basin)

1998 303(d) Listed Waterbodies for TMDLs addressed in this report:

WBID	Segment Name	County	Class and Waterbody Type	Constituent(s)
1675	Owens Branch	Hillsborough	III Freshwater	Nutrients

2. TMDL Endpoints (i.e., Targets)

The TMDLs are based upon an interpretation of narrative water quality standards which protect waters from anthropogenic nutrient enrichment and concentrations that cause an imbalance in natural populations of aquatic flora and fauna.

Segment Name	Total Nitrogen (kg/ac/yr)	Total Phosphorus (kg/ac/yr)	Total BOD (kg/ac/yr)
Owens Branch	0.99	0.98	5.50

Nutrient loads were estimated from a WASP7 model.

3. TMDL Approach

The TMDL was determined from a WASP model that simulated water quality, and a sediment oxygen demand (SOD) model was used to develop a relationship between SOD values and nutrient and biochemical oxygen demand (BOD) loading. The point and nonpoint load limits (kg/ac/yr) were then multiplied by the acreage of each segment to determine the average annual loads of total nitrogen, total phosphorus, and biochemical oxygen demand in units of kilograms/year (kg/yr). The Waste Load Allocations (WLAs) for each point source facility were developed considering their current permit limits, the quality and frequency of the actual discharge, and the assimilative capacity of the receiving watershed. Load Allocations (LAs) were determined as the difference between the total allowable load (TMDL) and the WLA.

4. TMDL Allocations for Owens Branch

WBID	Parameter[1]	TMDL (kg/day)[2]	TMDL (kg/year)[2]	WLA[3]		LA (kg/year)
				Facility (kg/year)	MS4 (%)[4]	
Owens Branch	TN	0.99	361	N/A	67%	361

	TP	0.98	358	N/A	67%	358
	BOD	5.50	2,008	N/A	67%	2,008

Notes for TMDL Allocations table:

1. TN = total nitrogen; TP = total phosphorus; BOD=Biochemical Oxygen Demand.
2. N/A=Not applicable.
3. This TMDL addresses 303(d) listings for nutrients. For convenience, the TMDL is provided in both units of kg/day and kg/year, but is intended to be implemented on an annual basis.
4. The WLA component includes individual allocations for NPDES facilities (e.g., WWTPs) and MS4s as contained in Table 1 of this report. Due to the infeasibility of separating the contributions from diffuse MS4 and non-MS4 sources, MS4s are incorporated into the Load Allocation, and are allocated the same percent reductions.
5. Percent reduction in current nonpoint source loading to achieve the Load Allocation for Owens Branch. The percent reductions are applied to nonpoint sources and MS4s.

5. Endangered Species (yes or blank): Yes

6. USEPA Lead on TMDL (USEPA or blank): USEPA

7. TMDL Considers Point Source, Nonpoint Source, or both: Both

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

Phase	Permit Name	Permit Number	County
II	Hillsborough County	FLS000006	Hillsborough

1. Introduction

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those waterbodies 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. This helps states establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework FDEP uses for implementing TMDLs. The state's 52 basins are divided into five groups. Water quality is assessed in each group on a rotating five-year cycle. Owens Branch is a group 2 basin. FDEP established five water management districts (WMD) responsible for managing ground and surface water supplies in the counties encompassing the districts. Owens Branch resides in the Southwest Water Management District (SWFWMD).

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 five square miles. Unique numbers or waterbody identification (WBIDs) numbers are assigned to each water segment.

2. Problem Definition

Florida's final 1998 Section 303(d) list identified Owens Branch as not supporting water quality standards (WQS). The TMDL addressed in this document is being established pursuant to USEPA commitments 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). After assessing all readily available water quality data, USEPA is responsible for developing a TMDL in WBID 1675 (Owens Branch) (Figure 1). The parameters addressed in this TMDL are total nitrogen, total phosphorus, and biochemical oxygen demand.

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

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

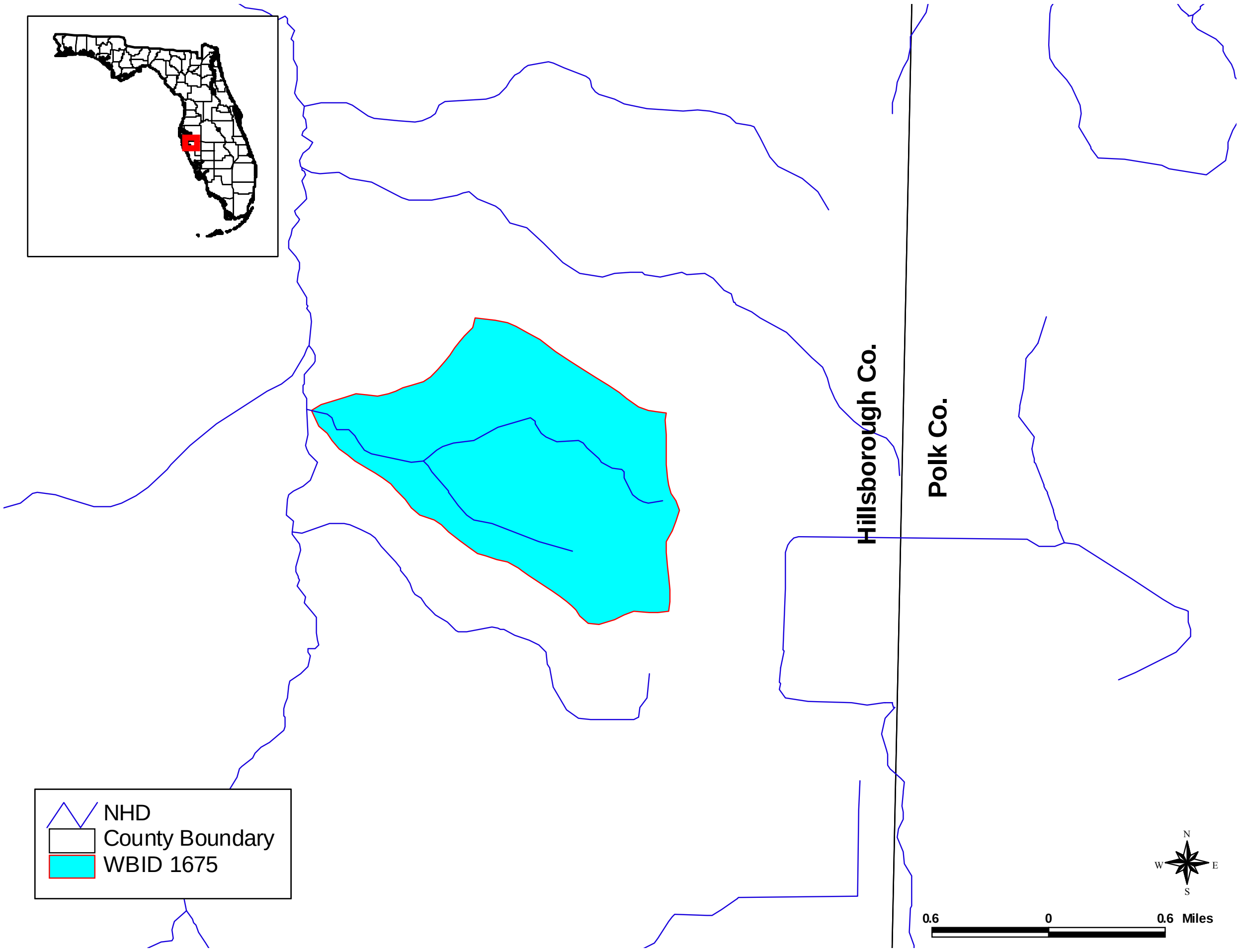

Figure 1. Impaired Waterbody Identification (WBID) addressed in this TMDL document.

3. Watershed Description

Owens Branch (WBID 1675) is a direct tributary to the South Prong of the Alafia River (Figure 1) near Tampa, FL. The stream and its tributaries drain approximately 6 km^2 (4 mi^2). The vast majority of the area is agricultural (41 percent) and urban residential (30 percent). The majority of the agricultural uses are crop and pastureland, and various tree crops. The urban residential land is made up almost exclusively of low density residential dwellings and extractive. Wetlands are the other major land use in the Owens Branch watershed (13 percent). There are no NPDES permitted dischargers in the watershed. The Owens Branch watershed lies within the Hillsborough County MS4 service area (FLS000006). The land use distribution for Owens Branch can be seen in Table 1.

Table 1. Land Use Breakdown for the Owens Branch Watershed.

Impaired Waterbody	WBID	Unit[22]	Urban, Residential & Built Up	Upland Nonforested	Agriculture	Forest	Water	Wetlands	Transportation & Utilities	Total
Owens Branch	1675	Km^2	1.9	2.6	0.4	0.6	0.0	0.8	0.0	6.2
		%	30.1	41.3	6.6	9.3	0.1	13.0	0.0	100.0

Notes:

1. Land use data are based on 2006 SWFWMD land cover features categorized according to the Florida Land Use and Cover Classification System (FLUCCS). The features were photo interpreted from 2006 one-foot color infrared digital aerial photographs at the 1:12,000 scale. Areas in the table represent the watershed draining to the impaired segment.
2. Km^2= square kilometers.
3. The urban/residential and built-up category includes commercial, industrial and extractive uses.
4. The upland nonforested category includes shrub and brushland.

4. Water Quality Standards

Owens Branch watershed is a Class III Freshwater with a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Designated use classifications are described in the Florida Administrative Code (F.A.C.), Section 62-302.400(1), and water quality criteria for protection of all classes of water are established in F.A.C. 62-302.530. Individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria is specified in F.A.C. Section 62-302.530. Several WBIDs were listed due to elevated concentrations of chlorophyll *a*.

4.1. Narrative Nutrients (Class III Fresh)

The State of Florida has a narrative water quality criterion for nutrients that applies to Class III Fresh states that:

> "In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." [Section 62.302.530 (48)(b) F.A.C.]

The state also has an additional narrative water quality criterion for nutrients that applies to all classes of water and states that:

> "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 or 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 Section 62.302.530 (48)(a) F.A.C.]

5. Linkage of Water Quality Standards to the Critical Resource

- While the Consent Decree identifies the WBID impaired for nutrients.

Essentially, the Tampa Bay Nitrogen Management Consortium Declaration goals are consistent with the concept established in the State of Florida Water Quality Standards for narrative nutrients (62-302.530 (48(b)) F.A.C.). Thus, a healthy macrophyte-based aquatic ecosystem within Owens Branch would be a direct indication of full support of aquatic flora and fauna. The first part of the Tampa Bay Nitrogen Management Consortium's Declaration reads:

> "From the uppermost reaches of Old Tampa Bay and Hillsborough Bay to the mouth of the bay at Egmont Key, the Tampa Bay estuary is made up of a variety of habitats where fish and other wildlife find shelter and food. They range from lush underwater beds of seagrasses, to tidal marshes and mangrove swamps. Abundant and healthy habitats are critical to the health of the bay. Without them, Tampa Bay would lack the diversity of

fish, birds and other wildlife that contribute to the natural wonder of the region and is essential to its economic vitality.

Submerged seagrass is among the most important habitats because it serves as shelter, nursery, and food source for a diverse variety of species and stabilizes the bay bottom. Restoration of seagrass habitat is the top priority goal of local government and agency partners of the Tampa Bay Estuary Program. The key to restoring seagrass is improving and then maintaining adequate water clarity that allows light to penetrate into the shallow waters of the bay where seagrasses grow. And the key to maintaining water clarity is preventing excessive nitrogen – a nutrient necessary for plant growth – from entering the bay and stimulating the growth of microscopic algae that cloud the water and prevents light from reaching the seagrasses." (Tampa, 6/23/2009).

6. Water Quality Assessment

A water quality assessment was conducted to review pertinent water quality data and information for Owens Branch. The primary constituents that were evaluated were: dissolved oxygen, chlorophyll *a*, nitrogen, phosphorus, and biochemical oxygen demand. Readily available water quality data were assessed using the Florida Department of Environmental Protection (FDEP) IWR database, version 35. The IWR database contains data from readily available sources within the State of Florida, including data from the Water Management Districts.

6.1. Water Quality Data

The water quality parameters and WBIDs are required to be included in the present TMDL because they were included on Florida's 1998 303(d) listing (see summary sheet). In addition, an independent assessment was made using the most recent data for WBID 1675 in order to determine present water quality conditions and confirm impairment. Data were compared to the State of Florida Water Quality Standards to determine potential for impairment for dissolved oxygen and nutrients. Nutrients were assessed based on a weight-of-evidence approach that takes into account nutrient concentrations, chlorophyll *a* levels, and dissolved oxygen concentrations. The State of Florida typically uses chlorophyll *a* as the primary indicator of nutrient enrichment, because its concentrations are a good measure of the biomass of phytoplankton, i.e. microscopic algae that drift in the water column.

7. 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 enter surface waters from both point and nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System

(NPDES) permits. NPDES permitted facilities, including certain urban stormwater discharges such as municipal separate stormwater systems (MS4 areas), certain industrial facilities, and construction sites over one acre, are stormwater driven sources considered "point sources" in this report.

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

7.1. Point Sources

7.1.1. Permitted Point Sources

A TMDL wasteload allocation (WLA) is given to NPDES permitted facilities discharging to surface waters within an impaired watershed. Facilities that dispose of wastewater by means other than a surface water discharge, such as spray irrigation or underground injection wells, typically treat wastewater to less stringent secondary standards. These facilities would be considered in the load allocation for nonpoint sources. There are currently no facilities permitted to discharge in Owens Branch (WBID 1675).

7.1.2. Municipal Separate Storm Sewer System Permits

Municipal Separate Stormwater Systems (MS4s) are point sources also regulated by the NPDES program. According to 40 CFR 122.26(b)(8), a municipal separate storm sewer system 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 stormwater;
>
> (iii) Which is not a combined sewer; and
>
> (iv) Which is not part of a Publicly Owned Treatment Works."

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

Owens Branch is within the Hillsborough Phase II MS4 permitted area (Table 2).

Table 2. MS4 permits potentially affected by the Owens Branch TMDL.

Phase	Permit Name	Permit Number	County
II	Hillsborough County	FLS000006	Hillsborough

7.2. Nonpoint Sources

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

Nonpoint sources account for a large amount of pollutants in Owens Branch. The land use distribution of the Owens Branch watershed provides insight into potential nonpoint sources of nutrients and biochemical oxygen demand. As can be seen in Figure 2, the majority of the land use in Owens Branch is agriculture.

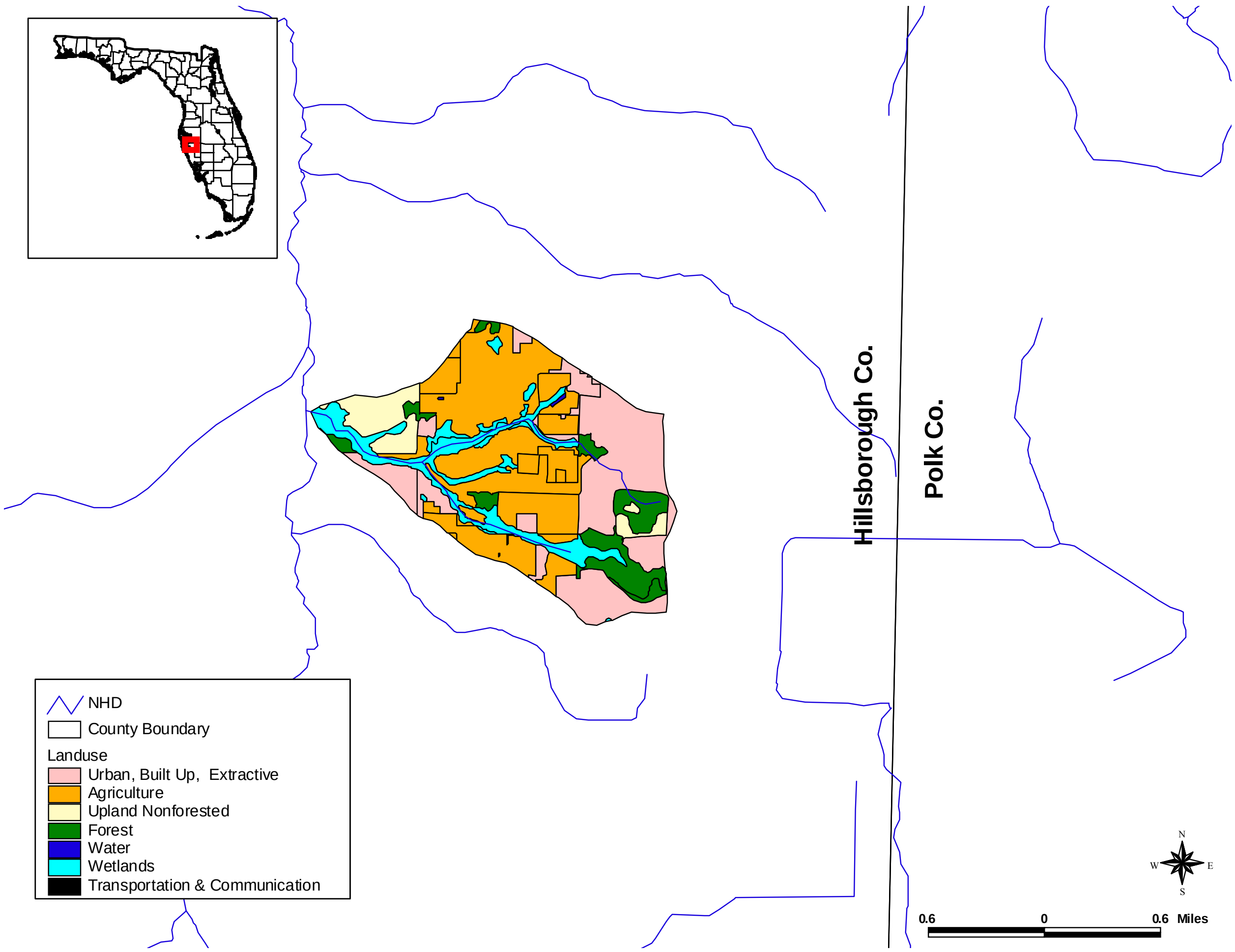

Figure 2. Land Uses within the Owens Branch watershed.

7.2.1. 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. Urban and other built-up land uses occur throughout the watershed in small numbers.

Nutrient and biochemical oxygen demand loading from MS4 and non-MS4 urban areas are attributable to multiple sources including stormwater runoff, leaks, and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as outlined in Chapter 403

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

Florida's stormwater program is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5)(c), F.A.C.).

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

7.2.2. Agriculture

Agricultural lands include improved and unimproved pasture, row and field crops, citrus, and specialty farms. The highest total nitrogen and total phosphorus event mean concentrations are associated with agricultural land uses. Within the Owens Branch watershed, the dominant land use is cropland and pastureland.

7.2.3. Upland Non-forested

Upland non-forested includes herbaceous, scrub, disturbed scrub, and coastal scrub areas. Rangeland occurs primarily in inland areas of IR14 and southward. Event mean concentrations for rangeland are about average for total nitrogen and low for total phosphorus.

7.2.4. Upland Forests

Upland forests include flatwoods, oak, various types of hardwoods, conifers and tree plantations. Within the Owens Branch watershed, forests make up roughly ten percent of the total area. Event mean concentrations for upland forests are low for both total nitrogen and total phosphorus.

7.2.5. Water and Wetlands

These occur throughout the watershed in the areas directly surrounding the stream, and have very low event mean concentrations down to zero. There is very little open water in Owens Branch watershed.

7.2.6. Transportation, Communications, and Utilities

Transportation uses include airports, roads, and railroads. Event mean concentrations for these types of uses are in the mid-range for total nitrogen and total phosphorus. There is a negligible amount of this land use in the Owens Branch watershed.

7.2.7. Groundwater and Atmospheric Sources

This source was considered to provide only a background level contribution and was not considered.

8. Analytical Approach

The Waste Load Allocations (WLAs) for each facility were developed considering their current permit limits, the quality and frequency of the actual discharge, and the assimilation capacity of the receiving watershed. Since TMDLs are the sum of the Load Allocation (LA) for nonpoint sources, the Waste Load Allocation for point sources, and the Margin of Safety (MOS), the LA was calculated as the difference:

$$\sum LA = \sum TMDL - \sum WLA - MOS$$

The modeling approach that was applied to simulate nutrient and biochemical oxygen demand fate and transport in the Owens Branch watershed is described further in Sections 8.1, 8.2, 8.3, and 8.4 and in Appendices A and B. The determination of the WLA is explained in Section 8.4. The causative pollutants targeted for these TMDLs are the nutrients total nitrogen (TN) and total phosphorus (TP).

8.1. WASP Model

The water quality simulation model WASP7 was used to analyze the Owens Branch watershed (WBID 1675). WASP7 was selected because it is part of EPA's tool box, can represent the basic processes determined to be important in this analysis, has a proven track record, and evaluates the effects of seasonality. The initial model setup was performed in a GIS platform. Existing data was used to develop boundary condition water quality constituent concentrations.

8.2. SOD Spreadsheet Model

In addition to WASP7, another model was used to establish a defensible link between instream loads versus SOD. An SOD model developed by Quantitative Environmental Analysis (QEA) and modified by Dr. James Martin at Mississippi State University (MSU) was implemented to determine the relative change in SOD by altering the watershed load of CBODu and nutrients. Hydraulic, nutrient and CBODu parameters were input to the model, and SOD was calibrated to the exiting WASP7 model.

8.3. Point Source Loads

There were no point sources considered in the Owens Branch TMDL. The MS4 contained within the watershed will have a reduction of a percentage to be determined by the TMDL reduction.

8.4. Results

8.4.1. Pollutant Loading Targets

BOD and nutrient targets were dependent on dissolved oxygen and chlorophyll. Currently the dissolved oxygen is in violation of the water quality standards, so BOD and nutrient loadings were reduced to meet the dissolved oxygen standard. A WASP7 model was calibrated to existing data for dissolved oxygen, BOD, nutrients, and chlorophyll *a*. The sediment oxygen demand (SOD) relationship to nutrient and BOD loading was handled externally with a SOD spreadsheet model. Reducing the SOD through reductions in BOD and nutrients to a point where dissolved oxygen no longer violated the standard was the approach used in developing the pollutant loading targets. Through the SOD spreadsheet model, reductions of BOD and nutrients were made at 10, 25, 50, 75, and 90 percent intervals in order to develop a curve in which we could determine what reductions needed to be made in order to meet our target SOD, and no longer violate the dissolved oxygen standard. The SOD spreadsheet model was run on WASP7 segment 6 since the lowest dissolved oxygen was found in this segment. It was verified that the reduction in SOD met in all other segments as well. Appendix B provides additional details on the SOD spreadsheet model.

8.4.2. Point Sources

There were no NPDES discharges to the Owens Branch Watershed. The MS4 permittee will be responsible for achieving the same reduction as the overall TMDL specifies.

9. TMDLs

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

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

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody and still achieve water quality standards and the waterbody's designated use. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the TMDL must be set and thereby provide the basis to establish water quality-based controls. These TMDLs are expressed as annual mass loads, since the approach used to determine the TMDL targets relied on annual loadings. The TMDLs targets were determined to be the conditions needed to restore and maintain healthy seagrass ecosystems. Trophic shifts and declines in seagrass communities are processes that tend to occur over longer periods. Furthermore, it is important to consider nutrient loading over time, since nutrients can accumulate in waterbodies.

The TMDL for Owens Branch is based upon the results of a WASP7 Model, as well as an SOD spreadsheet model. The TMDL and its components are presented for Owens Branch in Table 3. The TMDL is expressed as daily and annual loads of TN, TP, and BOD and are calculated to achieve the narrative nutrient criteria. The TMDL is intended to be implemented on an annual basis. Achieving the narrative nutrient and BOD criteria is expected to also result in achieving appropriate DO and chlorophyll regimes as these impairments are a direct result of symptoms associated with cultural eutrophication caused by nutrient and BOD enrichment. Load Allocations for the nonpoint sources in each segment, and Waste Load Allocations for individual NPDES-permitted facilities, are provided in their respective sections below.

Table 3. TMDL Allocations for Owens Branch.

WBID	Parameter[1]	TMDL (kg/day)[2]	TMDL (kg/year)[2]	WLA[3]		LA (kg/year)
				Facility (kg/year)	MS4 (%)[4]	
Owens Branch	TN	0.99	361	N/A	67%	361
	TP	0.98	358	N/A	67%	358
	BOD	5.50	2,008	N/A	67%	2,008

Notes:

1. TN = total nitrogen; TP = total phosphorus; BOD=Biochemical Oxygen Demand.
2. N/A=Not applicable.
3. This TMDL addresses 303(d) listings for nutrients and dissolved oxygen. For convenience, the TMDL is provided in both units of kg/day and kg/year, but is intended to be implemented on an annual basis.
4. The WLA component includes individual allocations for NPDES facilities (e.g., WWTPs) and MS4s as contained in Table 3 of this report. Due to the infeasibility of separating the contributions from diffuse MS4 and non-MS4 sources, MS4s are incorporated into the Load Allocation, and are allocated the same percent reductions. WLAs for facilities are the maximum annual loads.
5. Percent reduction in current nonpoint source loading to achieve the Load Allocation for that sub-lagoon. The percent reductions are applied to nonpoint sources and MS4s.

9.1. Critical Conditions and Seasonal Variation

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

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

Since nutrients can accumulate in waterbodies, it is important to consider their loading over longer time periods. For Owens Branch, critical conditions were selected based upon nutrient data only being collected during 2005. This necessitated the selection of the entire year of 2005. The WASP model that was used to determine nonpoint source contributions accounts for loading during both wet and dry conditions throughout the year was simulated.

9.2. Margin of Safety

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

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

The Owens Branch TMDL was developed using an implicit margin of safety. The targets for total nitrogen ,total phosphorus, and BOD are set to achieve a dissolved oxygen standard at all times.

9.3. Waste Load Allocations

Only MS4s and NPDES facilities discharging directly into Owens Branch are assigned a WLA. The WLA, if applicable, is 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. The only consideration will be the MS4 located within Owens Branch.

9.3.1. NPDES Dischargers

No waste NPDES dischargers were included in the WLA for Owens Branch.

9.3.2. Municipal Separate Storm System Permits

The WLA for MS4s are expressed in terms of percent reductions equivalent to the reductions required for nonpoint sources. Given the available data, it is not possible to estimate loadings coming exclusively from the MS4 areas. Although the aggregate wasteload allocations for stormwater discharges are expressed in numeric form, i.e. percent reduction, based on the information available today, it is infeasible to calculate numeric WLAs for individual stormwater outfalls because discharges from these sources can be highly intermittent, are usually characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. Water quality impacts 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.
>
> (2) The state will perform ambient water quality monitoring for nutrients for the purpose of determining whether the BMPs in fact are achieving such aggregate wasteload allocation.

The percent reduction calculated for nonpoint sources is assigned to the MS4 as loads from both sources typically occur in response to storm events. Permitted MS4s will be responsible for reducing only the loads associated with stormwater outfalls which it owns, manages, or otherwise has responsible control. MS4s are not responsible for reducing other nonpoint source loads within its jurisdiction. All future MS4s permitted in the area are automatically prescribed a WLA equivalent to the percent reduction assigned to the load allocations. Best management practices for the MS4 service should be developed to meet the percent reduction for both nitrogen and phosphorus as prescribed in Table 3.

9.4. Load Allocations

Load Allocations were determined by the difference between the TMDL and Waste Load Allocations for Owens Branch (Table 4):

$$\sum LAs = TMDL - \sum WLAs$$

Table 4. Load Allocations for Owens Branch.

Owens Branch			
	TN Load Allocation (kg/yr)[1]	TP Load Allocation (kg/yr)[1]	BOD Load Allocation (kg/yr)[1]
Total	361	358	2,008

Note: 1. To convert the units of the Load Allocations to kg/day, divide by 365 days.

References

Tampa Bay Nitrogen Management Consortium. 2009. Declaration of the Tampa Bay Nitrogen Management Consortium. Draft document dated 6/23/2009.

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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, DC. EPA-440/4-91-001, April 1991.

10. Appendix A- WASP Model Structure and Inputs.

10.1 WASP Model

Model inputs needed to be developed for the WASP7 model, namely the segmentation and boundary conditions. The segments were developed using the National Hydrography Dataset (NHD), National Elevation Dataset (NED), and watershed boundary. Flows were developed by obtaining flow data from a nearby USGS gage, and then area weighting the drainage area of each segment to determine a representative flow. Each segment contained the following information:

- Segment Name
- Segment Number
- Length (m)
- Width (m)
- Depth Multiplier
- Velocity Multiplier
- Slope (m/m)
- Mannings Roughness

There were a total of 6 segments for Owens Branch. A schematic of the WASP7 model network is shown in Figure 4.

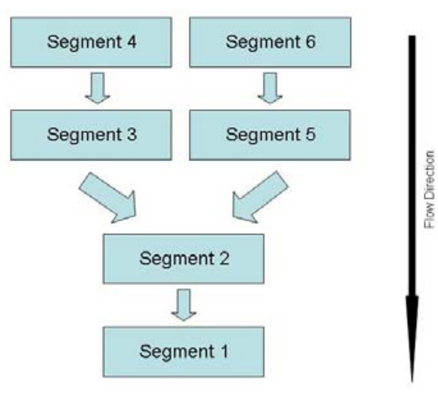

Figure 3. WASP7 Segmentation.

10.2 Event Mean Concentrations

Mean concentrations from measured data are multiplied by the annual average runoff volume to calculate an average annual total nitrogen or total phosphorus load for that parcel. The mean concentration reflects the average concentration of TP or TP expected in surface water running off from a parcel of land with a consistent land use. The sum of all loads within a drainage basin is calculated to develop a total annual load of total nitrogen and total phosphorus and an average annual load per acre for a watershed. Tables 5 through 11 displays the boundary concentrations used in WASP7.

Table 5. CBODu Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	12
2	552212	0.09	12
3	1564609	0.25	12
4	1753081	0.28	12
5	580075	0.09	12
6	1490959	0.24	12

Table 6. Chlorophyll a Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (ug/l)
1	293920	0.05	2
2	552212	0.09	2
3	1564609	0.25	4
4	1753081	0.28	5
5	580075	0.09	1
6	1490959	0.24	1

Table 7. Ammonia Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	0.047
2	552212	0.09	0.047
3	1564609	0.25	0.010
4	1753081	0.28	0.010
5	580075	0.09	0.054
6	1490959	0.24	0.054

Table 8. Nitrate Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	1.670
2	552212	0.09	1.670
3	1564609	0.25	0.017
4	1753081	0.28	0.017
5	580075	0.09	0.075
6	1490959	0.24	0.075

Table 9. Organic Nitrogen Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	0.848
2	552212	0.09	0.848
3	1564609	0.25	0.697
4	1753081	0.28	0.697
5	580075	0.09	1.707
6	1490959	0.24	1.707

Table 10. Orthophosphate Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	0.612
2	552212	0.09	0.612
3	1564609	0.25	0.651
4	1753081	0.28	0.651
5	580075	0.09	0.901
6	1490959	0.24	0.901

Table 11. Organic Phosphorus Concentrations for each WASP7 segment.

Segment	Segment Drainage Area (m^2)	Area Weight Factor	Concentration (mg/l)
1	293920	0.05	0.061
2	552212	0.09	0.061
3	1564609	0.25	0.122
4	1753081	0.28	0.122
5	580075	0.09	0.928
6	1490959	0.24	0.928

11. Appendix B – SOD Spreadsheet Model

11.1. SOD Spreadsheet Model

In addition to WASP7, another model was used to establish a defensible link between instream loads versus SOD. An SOD model developed by Quantitative Environmental Analysis (QEA) and modified by Dr. James Martin at Mississippi State University (MSU) was implemented to determine the relative change in SOD by altering the watershed load of CBODu and nutrients. Nutrient and CBODu parameters were input to the model, and SOD was calibrated to the exiting

The SOD spreadsheet model was run on segment 6. Table 12 and Figure 20 show results from the SOD spreadsheet model for CBOD5 and nutrient reductions of 10, 25, 50, 75 and 90 percent. Also shown is the SOD corrected to 20 deg-C.

Table 12. SOD Spreadsheet Model Results for Segment 6

		Existing Conditions		10% Reduction		25% Reduction		50% Reduction		75% Reduction		90% Reduction	
	Temp	SOD at Temp	SOD at 20degC	SOD at Temp	SOD at 20degC	SOD at Temp	SOD at 20degC	SOD at Temp	SOD at 20degC	SOD at Temp	SOD at 20degC	SOD at Temp	SOD at 20degC
1	18.86	1.90	2.07	1.82	1.99	1.69	1.84	1.39	1.52	0.88	0.96	0.37	0.41
30	18.40	2.27	2.57	2.16	2.44	1.97	2.23	1.57	1.77	0.95	1.07	0.40	0.45
60	18.73	1.99	2.20	1.91	2.11	1.77	1.95	1.44	1.59	0.90	0.99	0.38	0.42
90	19.82	1.48	1.51	1.44	1.46	1.35	1.37	1.16	1.17	0.80	0.81	0.37	0.38
120	21.39	2.57	2.31	2.44	2.19	2.20	1.98	1.71	1.54	0.98	0.89	0.40	0.36
150	23.01	2.06	1.64	1.97	1.56	1.82	1.44	1.47	1.17	0.93	0.73	0.40	0.32
180	24.24	1.31	0.94	1.27	0.91	1.20	0.86	1.03	0.75	0.75	0.54	0.38	0.27
210	24.75	1.41	0.98	1.37	0.95	1.31	0.91	1.14	0.79	0.79	0.55	0.36	0.25
240	24.39	2.57	1.83	2.44	1.74	2.21	1.58	1.71	1.22	0.97	0.69	0.39	0.28
270	23.27	2.27	1.77	2.17	1.68	1.98	1.54	1.58	1.23	0.95	0.74	0.39	0.31
300	21.70	2.02	1.77	1.93	1.70	1.79	1.57	1.46	1.28	0.90	0.79	0.38	0.33
330	20.09	2.14	2.13	2.04	2.03	1.88	1.86	1.51	1.50	0.92	0.92	0.39	0.39
360	18.86	1.90	2.07	1.82	1.99	1.69	1.84	1.39	1.52	0.88	0.96	0.37	0.41
390	18.40	2.27	2.57	2.16	2.44	1.97	2.23	1.57	1.77	0.95	1.07	0.40	0.45
420	18.73	1.99	2.20	1.91	2.11	1.77	1.95	1.44	1.59	0.90	0.99	0.38	0.42
450	19.82	1.48	1.51	1.44	1.46	1.35	1.37	1.16	1.17	0.80	0.81	0.37	0.38
480	21.39	2.57	2.31	2.44	2.19	2.20	1.98	1.71	1.54	0.98	0.89	0.40	0.36
510	23.01	2.06	1.64	1.97	1.56	1.82	1.44	1.47	1.17	0.93	0.73	0.40	0.32
540	24.24	1.31	0.94	1.27	0.91	1.20	0.86	1.03	0.75	0.75	0.54	0.38	0.27
570	24.75	1.41	0.98	1.37	0.95	1.31	0.91	1.14	0.79	0.79	0.55	0.36	0.25
600	24.39	2.57	1.83	2.44	1.74	2.21	1.58	1.71	1.22	0.97	0.69	0.39	0.28
630	23.27	2.27	1.77	2.17	1.68	1.98	1.54	1.58	1.23	0.95	0.74	0.39	0.31
660	21.70	2.02	1.77	1.93	1.70	1.79	1.57	1.46	1.28	0.90	0.79	0.38	0.33
700	20.09	2.02	2.00	1.93	1.92	1.79	1.78	1.46	1.45	0.90	0.90	0.38	0.38
	Average =	**2.00**	**1.80**	**1.91**	**1.73**	**1.76**	**1.59**	**1.43**	**1.29**	**0.89**	**0.81**	**0.39**	**0.35**

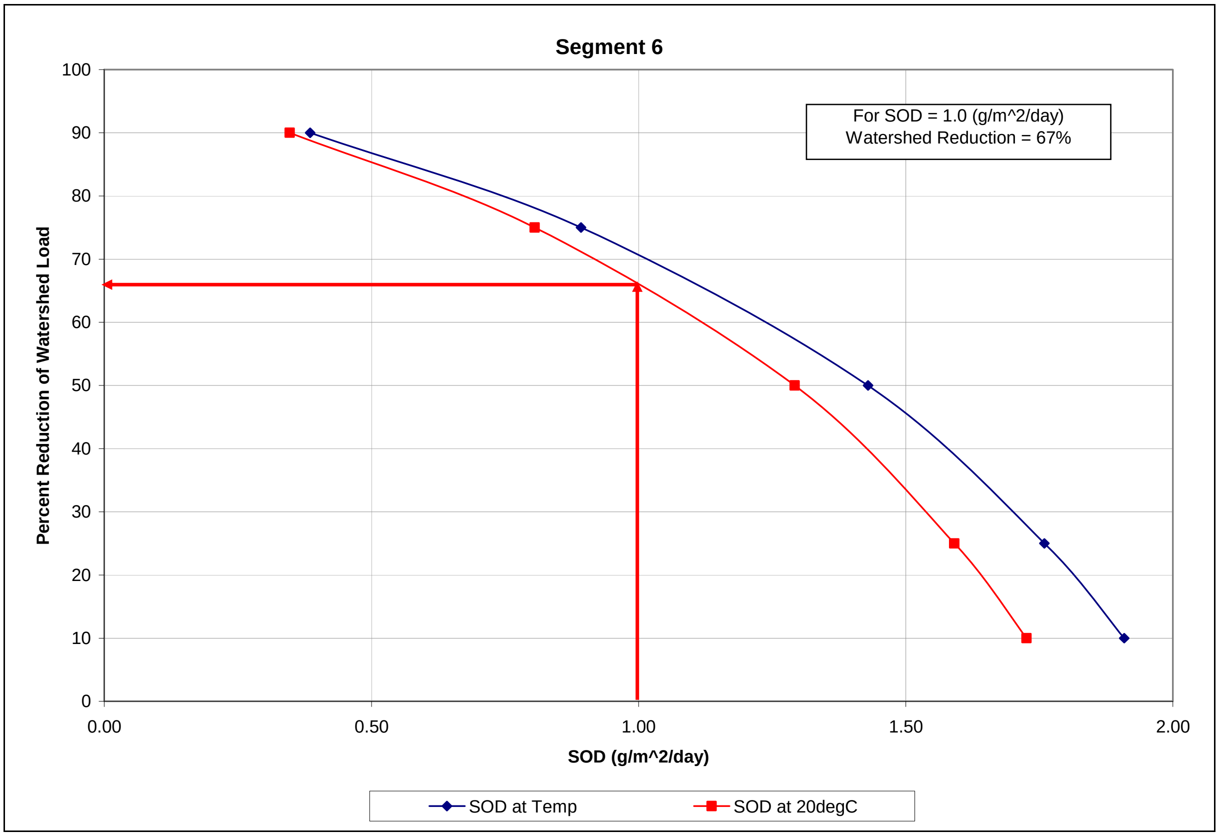

Figure 4. SOD Spreadsheet Model Results for Segment 6.