TOTAL MAXIMUM DAILY LOAD (TMDL)

For
Fecal Coliforms

In
Bell Creek (WBID 1660) and
Owens Branch (WBID 1675)

Prepared by:

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In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et. seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S. Environmental Protection Agency is hereby establishing the Total Maximum Daily Load (TMDL) for Fecal Coliforms in the Tampa Bay Basin (WBIDs 1660 & 1675 – Bell Creek and Owens Branch). Subsequent actions must be consistent with this TMDL.

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James D. Giattina, Director Date
Water Protection Division

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SUMMARY SHEET
Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   Major River Basin: Tampa Bay Tributaries

   Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name	River Basin	County	Constituent(s)
1660	Bell Creek	Tampa Bay	Hillsborough	Fecal Coliforms
1675	Owens Branch	Tampa Bay	Hillsborough	Fecal Coliforms

2. **TMDL Endpoints (i.e., Targets)**
   Fecal Coliforms, Class III Waters (fresh):
   Owens Branch – WBID 1675: Not to exceed 400 MPN/100ml in more than 10 percent of samples.
   Bell Creek – WBID 1660: Not to exceed 800 MPN/100ml in any one sample.

3. **Fecal Coliform Allocation:**

Waterbody	WBID	WLA[1]		LA (% Reduction)[2]	TMDL (% Reduction)[2]
		Facility (MPN/day)	MS4		
Bell Creek	1660	N/A	77%	77%	77%
Owens Branch	1675	N/A	83%	83%	83%

Notes:
1. The WLA is typically separated into the components originating from continuous NPDES facilities (e.g. WWTPs) and from Municipal Separate Storm Sewers (MS4). Facility WLAs are provided because there is currently an MS4 permit within the Bell Creek and Owens Branch watersheds.
2. Overall percent reduction required to achieve the targeted fecal coliform criterion. The Margin of Safety is implicit and does not take away from the TMDL value.
3. N/A = Not Applicable

4. **Endangered Species (yes or blank):** Yes

5. **EPA Lead on TMDL (EPA or blank):** EPA

6. **TMDL Considers Point Source, Nonpoint Source, or both:** Both

7. **Major NPDES Discharges to surface waters addressed in TMDL:** Yes.

Name	NPDES #	Discharge Type	Receiving Stream
Hillsborough Co. MS4	FLS000006	MS4	Bell Creek/Owens Branch

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 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, 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 approach to managing water resources on the basis of natural boundaries, such as river basins, rather than political boundaries. This watershed management approach is the framework FDEP uses for developing and implementing TMDLs. The state's 52 basins are divided into 5 groups. 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 their districts. Bell Creek and Owens Branch are Group 2 waterbodies (Figure 1) managed by the Southwest Florida Water Management District (SWFWMD).

For the purpose of planning and management, the WMDs divide their districts into planning units defined as either an individual primary tributary basin or a group of adjacent primary tributary basins with similar characteristics. Bell Creek and Owens Branch are located within the Alafia River Planning Unit, which covers the extents of the Alafia River watershed. Planning units contain smaller, hydrological based units called drainage basins, which are further divided into water segments. A water segment usually contains only one unique waterbody type (stream, lake, cannel, etc.) and is typically about five square miles in area. Unique waterbody identification (WBIDs) numbers are assigned to each water segment. The stream segments addressed in this TMDL report are designated WBID 1660 (Bell Creek) and WBID 1675 (Owens Branch). The locations of these WBIDs can be seen in Figure 2.

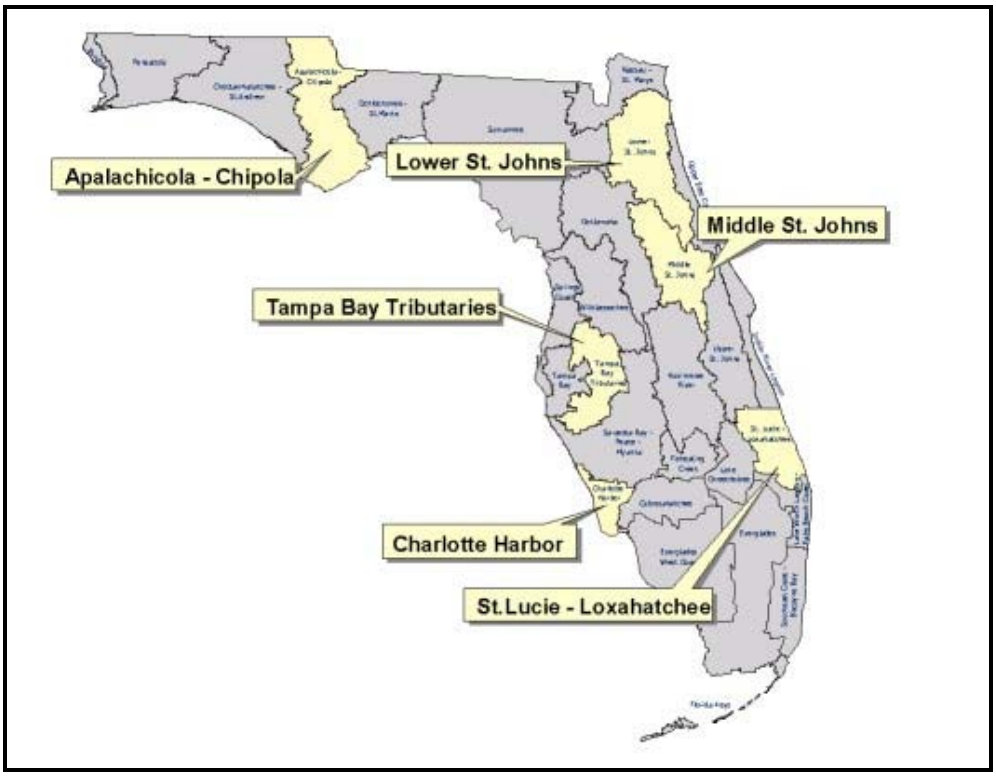

Figure 1. FDEP Group 2 River Basins

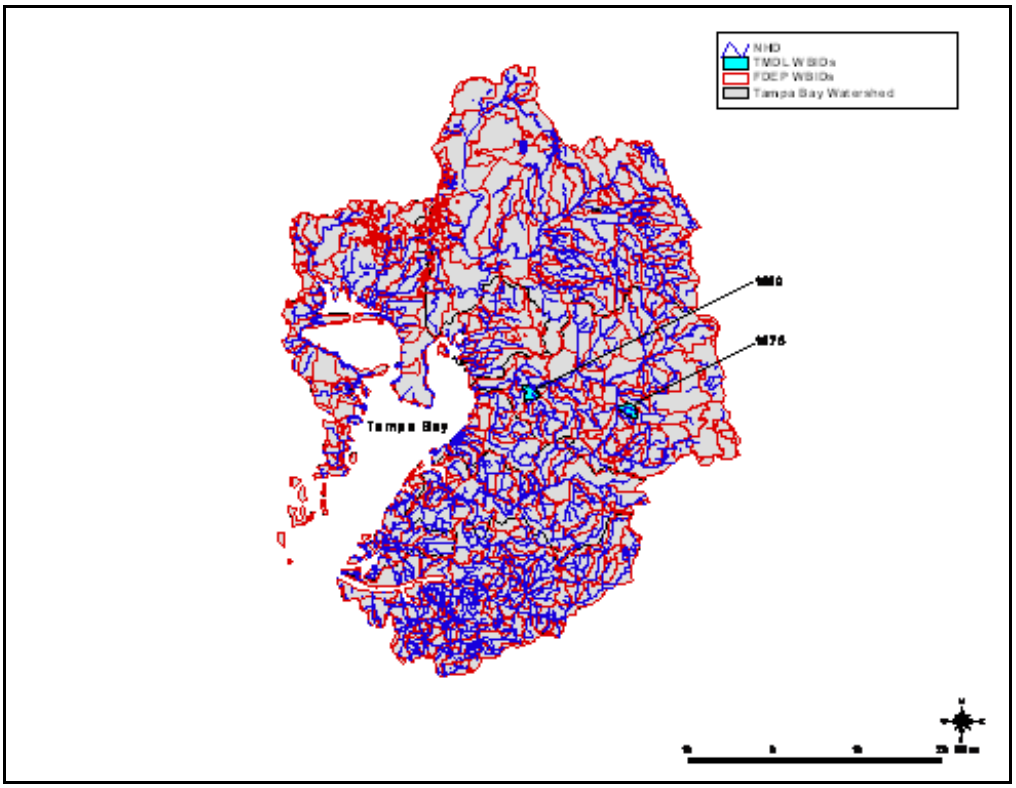

Figure 2. Tampa Bay Tributaries Basin

2.0 PROBLEM DEFINITION

To determine the status of surface water quality in the state of Florida; chemical data, biological data, and fish consumption advisories were evaluated for potential impairments. Florida's process for determining levels of water quality impairment is described in the Identification of Impaired Surface Waters Rule (IWR), in Section 62-303 of the Florida Administrative Code (FAC). The IWR defines threshold criteria for determining if a waterbody should be added to the state's planning list of potentially impaired waters. Once a waterbody is on the planning list, additional data and information are collected and assessed to determine if the water should be included on the state's verified list of water quality impairments.

Florida's final 1998 Section 303(d) list identified Bell Creek (WBID 1660) and Owens Branch (WBID 1675) as potentially not supporting water quality standards (WQS) due to elevated concentrations of fecal coliforms. Fecal coliform bacteria are present in large numbers in the intestinal tracts of humans and other warm-blooded animals. With the exception of Escherichia Coli, most fecal coliform bacteria do not cause disease by themselves. However, high numbers of them in a waterbody indicate the presence of fecal material, and therefore the likely presence of other bacteria that are pathogenic. A 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) established a schedule by which EPA is committed to developing TMDLs. These WBIDs have since been placed on the verified list.

The format of the remainder of this report is as follows: Section 3.0 is a general description of the impaired watersheds; Section 4.0 describes the water quality standards and target criteria; and Section 5.0 describes the data and source assessments, as well as the approach used to develop the TMDL.

3.0 WATERSHED DESCRIPTION

Bell Creek (WBID 1660) is a direct tributary to the Alafia River located in Florida's Hillsborough County (Figure 3). The stream and its tributaries drain approximately 55 km^2 (34 mi^2). The majority of the watershed (33 percent) consists of agricultural lands, almost all of which is cropland and pastureland (Table 1). The urban, residential, and extractive category, which accounts for 27 percent of the total area, is largely low and medium density residential land. Forest (23 percent) and Wetlands (13 percent) are the other major components of the Bell Creek watershed. There are no NPDES permitted dischargers in the watershed. The Bell Creek watershed lies within the Hillsborough County MS4 service areas (FL000006). The MS4 includes ditches, curbs, gutters, storm sewers, and similar means of collecting or conveying runoff that do not connect with a wastewater collection system or treatment plant.

Owens Branch (WBID 1675) is a direct tributary to the South Prong of the Alafia River (Figure 3). 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).

Table 1 NLCD Land Use Distribution for Bell Creek and Owens Branch

Impaired Waterbody	WBID(s)	Unit[2]	Urban Residential & Built-Up	Agriculture	Upland Nonforested	Forest	Water	Wetlands	Transportation & Utilities	Total
Bell Creek	1660, 1669, 1674, 1689	Km^2	14.7	18.0	1.0	12.6	0.9	7.1	0.4	54.5
		percent	26.9	33.0	1.8	23.1	1.6	13.0	0.7	100.0
Owens Branch	1675	Km^2	1.9	2.6	0.4	0.6	0.0	0.8	0.0	6.2
		percent	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.

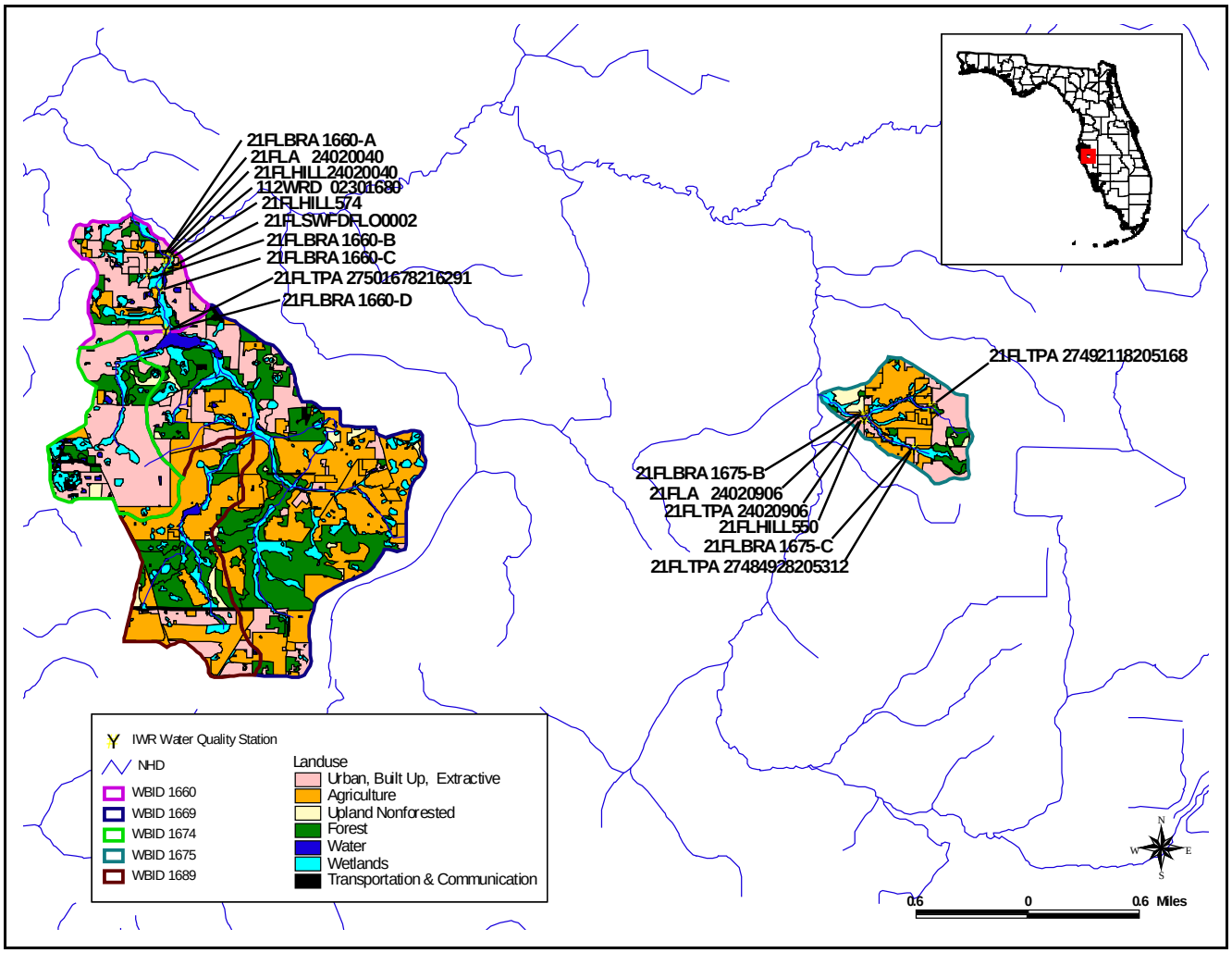

Figure 3 Land Use and location of sampling stations in WBIDs 1660 and 1675.

4.0 WATER QUALITY STANDARD AND TARGET IDENTIFICATION

Bell Creek (WBID 1660) and Owens Branch (WBID 1675) are Class III freshwater streams. The designated uses of Class III waters include recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (FAC), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards that apply to all waters, including Section 62-302.500 FAC [Surface Waters: Minimum Criteria, General Criteria], unless alternative or more stringent criteria are specified in FAC Section 62-302.530. 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 section.

Fecal Coliform Bacteria (Class III Waters- Fresh and Marine)

> The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period.

The geometric mean criteria reflect chronic or long-term water quality conditions, whereas the 400 and 800 values reflect acute or short-term conditions. To determine the impairment status of the streams, available data were assessed against both components of the acute criteria. It was not possible to assess against the geometric mean criteria in any WBID due to insufficient data. The 400 MPN/100 ml criterion was selected as the endpoint for the Owens Branch TMDL, while the 800 MPN/100 ml criterion was selected as the endpoint for the Bell Creek TMDL, since this resulted in more stringent reductions.

5.0 FECAL COLIFORM TMDL

This section of the report details the development of the fecal coliform TMDLs. Fecal coliform bacteria are frequently used as indicators of fecal contamination since they are abundant in the intestines and feces of animals and people.

5.1 Water Quality Assessment and Deviation from Target

FDEP maintains ambient monitoring stations throughout the basin and allows public access to the monitoring results via the internet in their IWR database. Data collected at monitoring stations within the impaired WBID and reported in IWR Run 35 were used in the analysis. Tables 2 and 4 provide a list of these monitoring stations. Monitoring results are tabulated in Appendix A. Results having laboratory data qualifiers were used in the TMDL analysis in accordance with Appendix A. A summary of fecal coliform monitoring data collected at each station for each WBID is provided in Tables 3 and 5. Most of the violations in WBID 1660 occur at Station 21FLBRA 1660-B, while most violations in WBID 1675 occur at stations 21FLBRA 1675-A and 21FLBRA 1675-B.

Table 2 Monitoring Stations in WBID 1660.

Station ID	Station Name	# of Observations	Start Date	End Date
21FLBRA 1660-A	1660 - Bell Creek - Bridge at Boyette Rd	6	4/22/2008	6/10/2008
21FLBRA 1660-B	1660 - Bell Creek - Crossing at Sedgebrook Rd	4	4/22/2008	5/23/2008
21FLBRA 1660-C	1660 - Bell Creek - Bridge in Boyette Springs Park-Sedgebroo	6	4/22/2008	6/17/2008
21FLBRA 1660-D	1660 - Bell Creek - at the end of shadow run road	6	5/8/2008	6/17/2008
21FLTPA 27501678216291	TP409-Bell Creek	10	3/28/2005	11/29/2009
21FLTPA 27511348216273	TP406-Bell Creek	10	3/28/2009	11/29/2009

Table 3 Summary of Fecal Coliform Monitoring Data in WBID 1660.

Station ID	% Samples >400 MPN/100ml	% Samples >800 MPN/100ml	Minimum Concentration	Maximum Concentration
21FLBRA 1660-A	33	0	110	540
21FLBRA 1660-B	75	75	300	3500
21FLBRA 1660-C	0	0	200	390
21FLBRA 1660-D	33	0	36	800
21FLTPA 27501678216291	10	0	1	430
21FLTPA 27511348216273	10	0	15	490

Table 4 Monitoring Stations in WBID 1675.

Station ID	Station Name	# of Observations	Start Date	End Date
21FLBRA 1675-A	1675 - Owens Branch - Small culvert on keysville	7	4/22/2008	6/17/2008
21FLBRA 1675-B	1675 - Owens Branch - Bridge at Walter Hunter Rd	5	4/22/2008	6/17/2008
21FLBRA 1675-C	1675 - Owens Branch - Crossing @ virgil Hall Rd	5	2/2/1998	10/17/2005
21FLTPA 24020906	TP13 - OWENS BRANCH	8	2/2/1998	10/18/2005
21FLTPA 27484928205312	TP410-Owens Branch	6	3/28/2005	10/18/2005
21FLTPA 27492118205168	TP411-Owens Branch	6	3/28/2005	10/17/2005

Table 5 Summary of Fecal Coliform Monitoring Data in WBID 1675.

Station ID	% Samples >400 MPN/100ml	% Samples >800 MPN/100ml	Minimum Concentration	Maximum Concentration
21FLBRA 1675-A	29	57	290	2800
21FLBRA 1675-B	80	80	150	3600
21FLBRA 1675-C	20	0	100	700
21FLTPA 24020906	38	0	80	620
21FLTPA 27484928205312	0	0	5	310
21FLTPA 27492118205168	17	0	1	460

Violations of the fecal coliform criteria often occur in response to rainfall events. Precipitation data collected at a nearby USGS Gage and plotted with the fecal coliform results to identify conditions when violations occurred (see Figures 4 and 5). In most instances, exceedances of the criteria occur in response to rain events while at other times exceedances occur during dry conditions. Implementation of this TMDL should address controlling nonpoint sources during both wet and dry weather conditions.

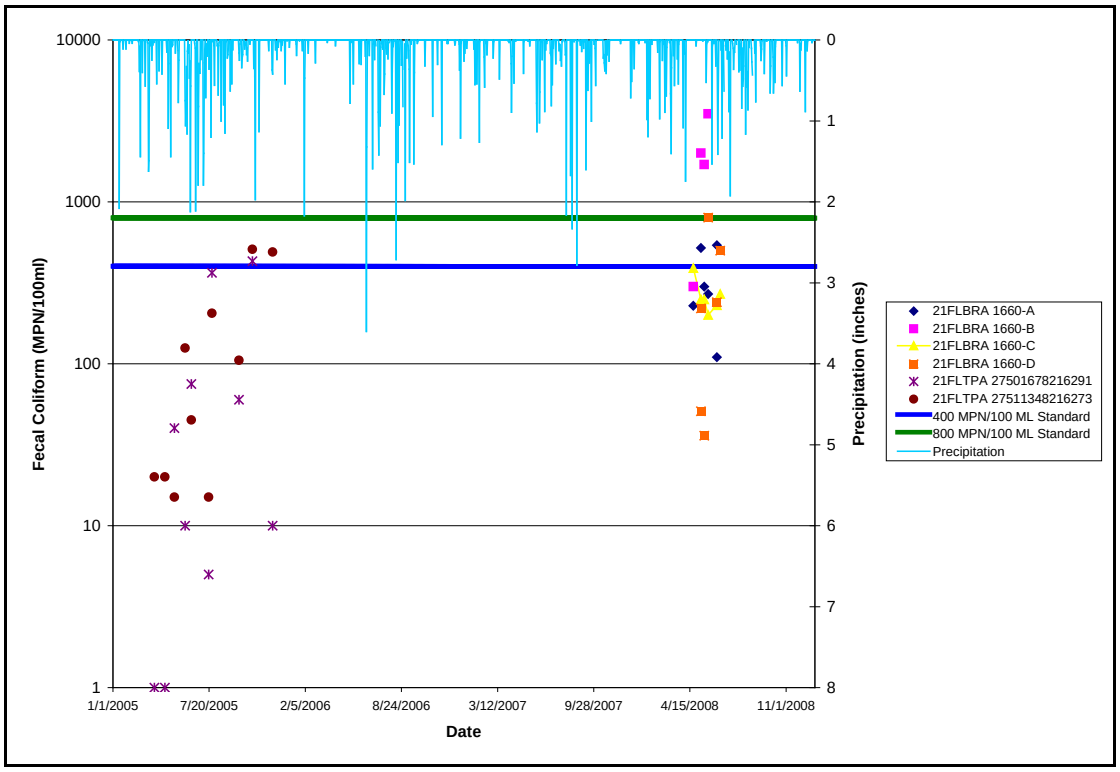

Figure 4 Comparison of Fecal Coliform Concentrations in Bell Creek and Rainfall at USGS02301500 – Alafia River at Lithia, FL

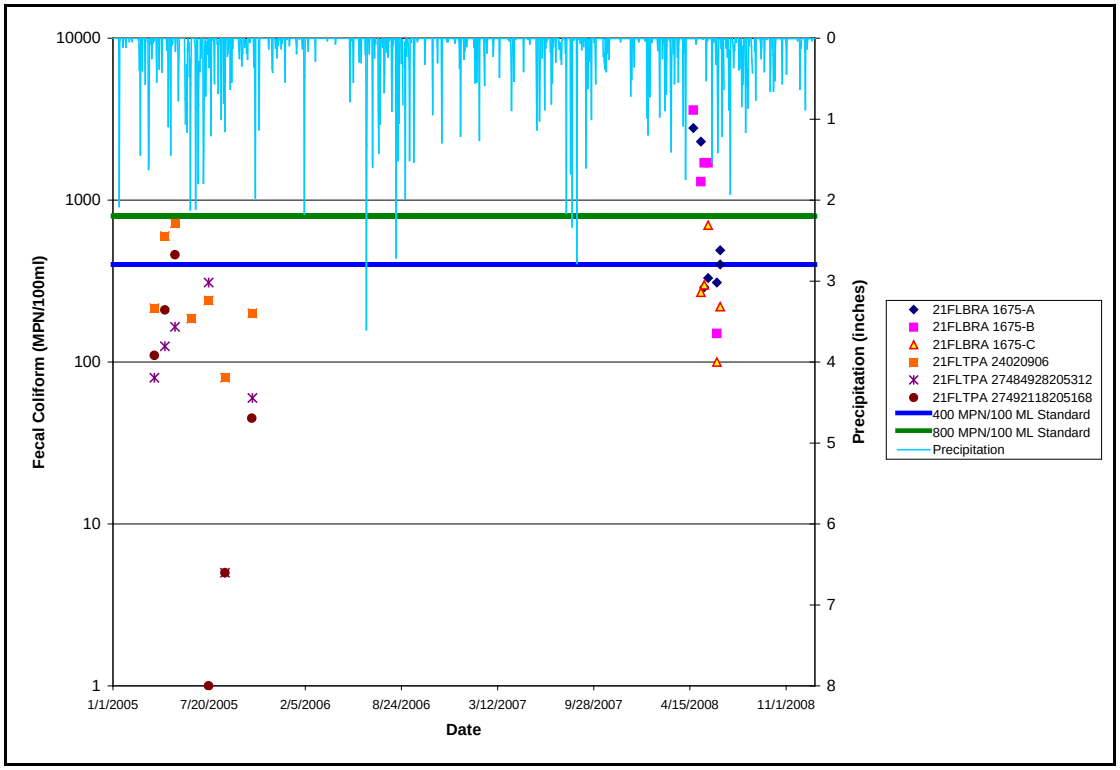

Figure 5 Comparison of Fecal Coliform Concentrations in Owens Branch and Rainfall at USGS02301500 – Alafia River at Lithia, FL

5.2 Source Assessment

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of coliform bacteria in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point sources or 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, as well as certain urban stormwater discharges such as Municipal Separate Storm Sewer Systems (MS4) areas, some industrial facilities, and construction sites over one acre, are considered primary point sources of coliform bacteria. Typically, excursions of fecal coliform bacteria that occur during periods of reduced rainfall result from a lack of dilution for point source discharges or other sources located close to the waterbody.

Nonpoint sources of coliform are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of bacteria on land surfaces and wash off as a result of storm events. Typical nonpoint sources of coliform bacteria include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 permitted areas)

5.2.1 Point Sources

5.2.1.1 Permitted Facilities

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 Bell Creek (WBID 1660) or Owens Branch (WBID 1675).

5.2.1.2 Municipal Separate Storm Sewer Systems Permits

The 1987 amendments to the Clean Water Act designated certain stormwater discharges as point sources requiring NPDES stormwater permits. The regulated activities involve Municipal Separate Storm Sewer Systems (MS4s), construction sites over one acre, and specific industrial operations. Although these types of stormwater discharges are now considered point sources with respect to permitting and TMDLs, they behave similarly to nonpoint sources in that they are

driven by rainfall-runoff processes leading to the intermittent discharge of pollutants from land use activities in response to storms.

According to 40 CFR 122.26(b)(8), an MS4 is defined as "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.

In 1990, EPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants washed into MS4s by stormwater runoff, or dumped directly into them, from being delivered to local waterbodies. Phase I of the program required operators of "medium" and "large" MS4s (generally serving populations of 100,000 or more) to implement a stormwater management program as a means of controlling polluted discharges. 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, and hazardous waste treatment, etc. Because the master drainage systems of most local governments in Florida are interconnected, EPA implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities, Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the 15 counties meeting the population criteria.

Phase II of the NPDES stormwater rule extended coverage to certain "small" MS4s and to construction sites between one and five acres. Small MS4s are defined as any municipal stormwater collection system that does not meet the criteria of a medium or large MS4 covered by Phase I. Only a select subset of small MS4s requires an NPDES stormwater permit. These "regulated small MS4s" include those located in "urbanized areas" as defined by the Bureau of Census, and other small MS4s designated by NPDES permitting authorities.

In October 2000, US EPA 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, 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.

Both Bell Creek (WBID 1660) and Owens Branch (WBID 1675) are affected by the Phase II MS4 permit for Hillsborough County (FLS000006).

5.2.2 Nonpoint Sources

5.2.2.1 Agriculture

Agriculture is a potential source of coliform delivery to streams, including runoff of manure from pastureland and cropland, and direct animal access to streams. Approximately 33 percent of the area draining to Bell Creek is classified as agriculture, 64 percent of it used for row crops and 15 percent is used for row crops (Table 1 and Figure 2). Over 40 percent of land use in Owens Branch is classified as agriculture. Crop and Pastureland make up 58 percent of the agriculture land, while the second biggest land use is for tree crops, which take up 23 percent of the agricultural land use.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA NASS, 2007). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. Livestock inventory from the 2007 Census of Agriculture report for Hillsborough County is listed in Table 6. Cattle and goats are the predominate livestock in the area of concern.

Table 6 Livestock Inventory by County (USDA NASS, 2007)

County	Cattle	Broiler Chickens	Goats	Hogs	Llamas	Sheep
Hillsborough	59,000	151	2,157	110	57	581

5.2.2.2 Wildlife

Wildlife deposit bacteria in their feces onto land surfaces where it can be transported during storm events to nearby streams, or they may deposit their feces directly into the waterbody or stream. Bacteria loads from wildlife is generally assumed background, since the contribution from this source is small relative to the load from urban and agricultural areas; however, due to the significant presence of forests and wetlands (39 percent for Bell Creek and 21 percent for

Owens Branch) and other prime habitat for wild animals in both WBIDs, it should be considered as a possibility for a greater loading than background.

5.2.2.3 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. 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 is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. Approximately 27 percent of Bell Creek's land use is Urban, with primarily being medium (57 percent) and low density residential (27 percent) development. Over 30 percent of Owens Branch is urban, with 81 percent of that being extractive, and nearly all the remaining urban land being low density residential development.

The State of Florida Department of Health publishes septic tanks data on a county by county basis (www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm). Table 7 summarizes the cumulative number of septic systems installed since the 1970 census. The data does not reflect septic tanks removed from service.

Table 7 County Estimates of Septic System Installations

County	Septic Systems (1970-2008)
Hillsborough	106,542

5.2.2.4 Urban Development

Urban land uses include residential, industrial, extractive and commercial categories. Fecal coliform loading from urban areas (whether within an MS4 jurisdiction or not) 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 of the Florida Statutes (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" (Section 62-40-.432 (5) (c), FAC).

In 1994, state legislation created the Environmental Resource Permitting program to consolidate stormwater quantity, stormwater quality, and wetlands protection into a single permit. Presently, the majority of environmental resource permits are issued by the state's water management districts, although DEP continues to issue permits for specific projects.

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

There are areas with low and medium density urban development and a separate MS4 within Bell Creek. There is a large area of extractive land in Owens Branch, as well as an MS4. It is possible that some of the fecal coliform bacteria are coming into the stream from MS4 runoff. This should be studied as a possible means for fecal coliform bacteria to enter the stream.

5.3 Analytical Approach

The approach for calculating coliform TMDLs depends on the number of water quality samples and the availability of flow data. When long-term records of water quality and flow data are not available, the TMDL is expressed as a percent reduction. Load duration curves are used to develop TMDLs when significant data are available to develop a relationship between flow and concentration. Flow measurements are not available for WBIDs 1660 or 1675, nor were sufficient information available to estimate flow. Complicating flow estimation matters more, there are large areas of wetlands in both WBIDs. Hydrologically speaking, wetland soils behave differently than other types of soils. Ultimately it was determined that the TMDLs should be expressed as a percent reduction.

5.3.1 Percent Reduction Approach for TMDL Development

The percent reduction required to meet the TMDL endpoint is based on the following equation:

$$\%\text{Reduction} = \left(\frac{[existing] - [criterion]}{[existing]} \right) \times 100$$

Where:
% Reduction = percent reduction
[*existing*] = existing concentration
[*criterion*] = criterion concentration (i.e. target)

Since the water quality standard for fecal coliform bacteria states that up to 10 percent of samples are allowed to exceed a concentration of 400 MPN/100 ml, the existing condition of the waterbody should be represented using a percentile slightly higher than the 90th, in order to ensure that less than 10 percent of the values exceed the criterion. A 90th percentile concentration implies that 90 percent of the measured values are lower than this concentration, and 10 percent are higher. For these TMDLs, the 95th percentile of fecal coliform measurements for each waterbody was calculated and compared against a target of 400 MPN/100 ml. This would meet the water quality standard and provide a margin of safety by ensuring that only 5 percent of the data exceed a concentration of 400 MPN/100ml. Percent reductions were also calculated using the maximum concentration measured in each WBID to represent the existing condition and the 800 MPN/100 ml criterion as the target. The larger of the two percent reduction values was selected as the TMDL. In the Bell Creek TMDL calculation, the existing conditions are represented by the 95th percentile fecal coliform concentration, and percent reductions are calculated to meet the 400 MPN/100 ml acute criterions, since that resulted in higher reduction. In Owens Branch, the 800 MPN/100 ml criterion was selected, since that resulted in the higher reduction. There are many formulas for calculating percentiles and these can be found in text books on statistics. The Hazen formula was used to calculate the 95th percentile, as it is recommended in Hunter's Applied Microbiology (2002) article on bacteria in water. Application of the Hazen formula to data collected at Bell Creek and Owens Branch is provided in Appendix A.

5.4 Development of Total Maximum Daily Loads

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be represented as the sum of all point source loads (WLA), nonpoint source loads (LA), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

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

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. The fecal coliform TMDLs for Bell Creek (WBID 1660) and Owens Branch (WBID 1675) are expressed as percent reductions.

5.4.1 Critical Conditions

The critical condition for nonpoint source coliform loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, coliforms build up on the land surface, and are washed off by rainfall. The critical condition for point source loading occurs during

periods of low stream flow when dilution is minimized. Water quality data have been collected during both high and low rainfall periods in Bell Creek and Owens Branch. Many coliform violations occur in response to rain events; however, in both Bell Creek and Owens Branch, the highest measured bacteria concentrations occurred during a dry period. Critical conditions are accounted for in the analyses by using the entire period of record of measured water quality data available for each WBID, and by using the largest percent reduction to represent the pollutant reduction required year-round, for the entire watershed. By achieving this reduction, water quality standards should be achieved during all other time periods.

5.4.2 Existing Conditions

Existing conditions represent the current water quality conditions of a waterbody. Existing conditions are being conservatively represented using the 95th percentile of measured concentrations. Fecal coliform samples collected in WBIDs 1660 and 1675, as well as the 95th percentiles and maximum, and percent reductions required to meet the TMDL target, are shown in Table 8 and Table 9, respectively.

Table 8 Fecal Coliform measurements in Bell Creek (WBID 1660)

WBID	Date	Time	Station	Fecal Coliform (MPN/100 ML)	Remark Code
1660	3/28/2005	10:45	21FLTPA 27511348216273	20	B
1660	3/28/2005	11:10	21FLTPA 27501678216291	1	K
1660	4/19/2005	12:35	21FLTPA 27511348216273	20	B
1660	4/19/2005	12:55	21FLTPA 27501678216291	1	K
1660	5/9/2005	8:50	21FLTPA 27511348216273	15	B
1660	5/9/2005	9:10	21FLTPA 27501678216291	40	B
1660	5/31/2005	13:00	21FLTPA 27511348216273	125	
1660	5/31/2005	13:20	21FLTPA 27501678216291	10	
1660	6/13/2005	9:00	21FLTPA 27501678216291	75	B
1660	6/13/2005	9:15	21FLTPA 27511348216273	45	B
1660	7/19/2005	9:00	21FLTPA 27511348216273	15	B
1660	7/19/2005	9:30	21FLTPA 27501678216291	5	B
1660	7/26/2005	8:30	21FLTPA 27501678216291	365	
1660	7/26/2005	8:55	21FLTPA 27511348216273	205	
1660	9/20/2005	9:10	21FLTPA 27501678216291	60	B
1660	9/20/2005	9:35	21FLTPA 27511348216273	105	
1660	10/18/2005	9:00	21FLTPA 27501678216291	430	
1660	10/18/2005	9:50	21FLTPA 27511348216273	510	
1660	11/29/2005	11:55	21FLTPA 27511348216273	490	
1660	11/29/2005	12:20	21FLTPA 27501678216291	10	
1660	4/22/2008	12:40	21FLBRA 1660-A	230	
1660	4/22/2008	13:05	21FLBRA 1660-B	300	
1660	4/22/2008	13:20	21FLBRA 1660-C	390	
1660	5/8/2008	11:30	21FLBRA 1660-A	520	
1660	5/8/2008	11:45	21FLBRA 1660-B	2000	
1660	5/8/2008	12:00	21FLBRA 1660-C	250	
1660	5/8/2008	12:25	21FLBRA 1660-D	51	
1660	5/8/2008	12:30	21FLBRA 1660-D	220	
1660	5/15/2008	13:10	21FLBRA 1660-C	250	
1660	5/15/2008	13:20	21FLBRA 1660-A	300	
1660	5/15/2008	13:34	21FLBRA 1660-B	1700	B
1660	5/15/2008	13:55	21FLBRA 1660-D	36	
1660	5/23/2008	11:30	21FLBRA 1660-C	200	
1660	5/23/2008	11:40	21FLBRA 1660-A	270	
1660	5/23/2008	11:50	21FLBRA 1660-B	3500	
1660	5/23/2008	12:10	21FLBRA 1660-D	800	B
1660	6/10/2008	11:00	21FLBRA 1660-C	230	
1660	6/10/2008	11:20	21FLBRA 1660-A	110	
1660	6/10/2008	11:21	21FLBRA 1660-A	540	
1660	6/10/2008	11:45	21FLBRA 1660-D	240	
1660	6/17/2008	10:10	21FLBRA 1660-C	270	
1660	6/17/2008	10:42	21FLBRA 1660-D	500	B
95th Percentile Fecal Coliform Concentration				1655	
Percent Reduction Needed to Meet 400 MPN/100 ML TMDL Target				76	
Maximum Measurement				3500	
Percent Reduction Needed to Meet 800 MPN/100 ML TMDL Target				77	

Notes: Remark Code B means t that the colony counts were made outside of the acceptable range. Remark Code K means the actual value is not known, but known to be less than the value reported. Remark Code Q means that the sample was held beyond the normal holding time. All data were included in the analysis as reported.

Table 9 Fecal Coliform Measurements in Owens Branch (WBID 1675)

WBID	Date	Time	Station	Fecal Coliform (MPN/100 ML)	Remark Code
1675	2/2/1998	10:55	21FLTPA 24020906	620	
1675	3/28/2005	9:25	21FLTPA 27492118205168	110	
1675	3/28/2005	9:40	21FLTPA 27484928205312	80	B
1675	3/28/2005	10:00	21FLTPA 24020906	215	
1675	4/19/2005	9:30	21FLTPA 27492118205168	210	
1675	4/19/2005	9:45	21FLTPA 27484928205312	125	
1675	4/19/2005	10:00	21FLTPA 24020906	600	
1675	5/10/2005	10:20	21FLTPA 27492118205168	460	
1675	5/10/2005	10:30	21FLTPA 27484928205312	165	
1675	5/10/2005	10:50	21FLTPA 24020906	720	B
1675	6/13/2005	9:55	21FLTPA 24020906	185	
1675	7/19/2005	10:30	21FLTPA 27492118205168	1	K
1675	7/19/2005	10:45	21FLTPA 27484928205312	310	
1675	7/19/2005	11:05	21FLTPA 24020906	240	K
1675	8/22/2005	9:10	21FLTPA 24020906	80	B
1675	8/22/2005	9:20	21FLTPA 27484928205312	5	B
1675	8/22/2005	9:40	21FLTPA 27492118205168	5	B
1675	10/17/2005	8:40	21FLTPA 27492118205168	45	B
1675	10/18/2005	8:45	21FLTPA 27484928205312	60	
1675	10/18/2005	12:05	21FLTPA 24020906	200	
1675	4/22/2008	11:00	21FLBRA 1675-A	2800	
1675	4/22/2008	11:30	21FLBRA 1675-B	3600	
1675	5/8/2008	10:20	21FLBRA 1675-A	2300	
1675	5/8/2008	10:35	21FLBRA 1675-C	270	
1675	5/8/2008	10:50	21FLBRA 1675-B	1300	B
1675	5/15/2008	12:20	21FLBRA 1675-A	290	
1675	5/15/2008	12:35	21FLBRA 1675-C	300	B
1675	5/15/2008	12:45	21FLBRA 1675-B	1700	B
1675	5/23/2008	10:45	21FLBRA 1675-A	330	
1675	5/23/2008	10:50	21FLBRA 1675-C	700	B
1675	5/23/2008	11:00	21FLBRA 1675-B	1700	B
1675	6/10/2008	10:05	21FLBRA 1675-A	310	
1675	6/10/2008	10:15	21FLBRA 1675-C	100	U
1675	6/10/2008	10:25	21FLBRA 1675-B	150	B
1675	6/17/2008	9:35	21FLBRA 1675-A	400	B
1675	6/17/2008	9:40	21FLBRA 1675-A	490	
1675	6/17/2008	9:55	21FLBRA 1675-C	220	B
95th Percentile Fecal Coliform Concentration				2400	
Percent Reduction Needed to Meet 400 MPN/100 ML TMDL Target				83	
Maximum Measurement				3600	
Percent Reduction Needed to Meet 800 MPN/100 ML TMDL Target				77	

Notes: Remark Code B means t that the colony counts were made outside of the acceptable range.
Remark Code K means the actual value is not known, but known to be less than the value reported.
Remark Code U means that the sample was at the detection limit. All data were included in the analysis as reported.

5.5 Margin of Safety

TMDLs shall include a margin of safety (MOS) that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. In this case the lack of knowledge concerns the data, and how well it represents the true water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative

assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In the Bell Creek and Owens Branch TMDL, an implicit MOS was used by targeting reductions that will result in no more than 5 percent of the samples exceeding a concentration of 400 MPN/100ml even though the standard requires less than 10 percent exceedance. Bell Creek was based on the 800 MPN/100 ML criterion. An implicit MOS is incorporated into the TMDL for Bell Creek by using the highest measured value to represent existing conditions, and applying the percent reduction to the entire watershed. It should be noted, that in the case of Bell Creek and Owens Branch, a very large portion of the reductions will need to come from non point sources.

5.6 TMDL Determination

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. The TMDLs were determined from the percent reductions required to meet the daily 800 MPN/100 ml WQS and the 400 MPN/100 ml WQS not to be exceeded in more than 10 percent of the samples for Class III waters. The TMDL reductions that are required to meet both components of the acute criteria for Bell Creek and Owens Branch are summarized in Table 10.

Table 10 TMDL Summary.

WBID	Parameter	WLA		Load Allocation (% Reduction)[2]	TMDL (% Reduction)[2]
		WWTP (MPN/Day)	MS4		
1660	Fecal Coliform	N/A	77%	77% Reduction	77% Reduction
1675	Fecal Coliform	N/A	83%	83% Reduction	83% Reduction

Notes:
1) The WLA is typically separated into the components originating from continuous NPDES facilities (e.g. WWTPs) and from Municipal Separate Storm Sewers (MS4). Facility WLAs are provided because there is currently an MS4 permit within the Bell Creek and Owens Branch watershed.
2) Overall percent reduction required to achieve the target fecal coliform criterion. The Margin of Safety is implicit and does not take away from the TMDL value.

5.6.1 Waste Load Allocation

Only NPDES-permitted facilities discharging directly into streams and MS4-permitted urban areas are assigned a WLA. WLAs are expressed separately for municipal and industrial facilities (e.g., WWTPs) and MS4 areas as the former discharge during all weather conditions whereas the latter discharge in response to storm events.

Neither WBID 1660 (Bell Creek), nor WBID 1675 (Owens Branch), are currently affected by any NPDES permits. Both WBIDs are affected by MS4 permits. All MS4s located within the boundaries of either watershed are going to be responsible for reducing their WLA by the percentage specified in the TMDL. MS4 permittees will only be responsible for reducing the loads associated with stormwater outfalls they own or otherwise have responsible control over.

5.6.2 Load Allocations

There are two modes of transport for nonpoint source coliform bacteria loading into the stream. First, fecal coliform loading from failing septic systems and animals in the stream are considered direct sources of coliform to the stream, since they are independent of precipitation. The second mode involves coliform loadings resulting from accumulation on land surfaces transported to streams during storm events. Thus, according to this data, the load allocation of 77 percent reduction for Bell Creek, and 83 percent reduction for Owens Branch should target both direct sources (i.e., failing septic tanks, domesticated animals and livestock in the stream) and rainfall-driven events, since the violations occur during both wet and dry periods.

5.6.3 Seasonal Variation

Seasonality was addressed by using all water quality data associated with the impaired WBID, which was collected during multiple seasons, and where possible over several years. Data for Bell Creek was collected throughout 2005 and 2008. Data for Owens Branch was collected throughout 2005 and 2008.

5.7 Recommendations

It is recommended that flow be measured at the time of sampling so that loads can be calculated. Determining the source of bacteria in waterbodies is the initial step to implementing a coliform TMDL. FDEP employs the Basin Management Action Plan (B-MAP) as the mechanism for developing strategies to accomplish the necessary 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

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APPENDIX A: WATER QUALITY DATA ANALYSIS

Table A-1 Guide to Water Quality Remark Codes (Rcode column in data tables)

Remark Code	Definition	Use in TMDL
A	Value reported is mean of two or more samples	Data included in analysis as reported
B	Result based on colony counts outside the acceptable range	Data included in analysis as reported
E	Extra sample taken in compositing process	Data included as average
I	The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.	Data included in analysis as reported
J	Estimated. Value shown is not a result of analytical measurement.	Data included in analysis as reported
K	Off-scale low. Actual value not known, but known to be less than value shown	Data included in analysis as reported
L	Off-scale high. Actual value not known, but known to be greater than value shown	Data included in analysis as reported
Q	Sample held beyond normal holding time	Data used in analysis – holding samples on ice slows the metabolism of the organisms resulting in no appreciable growth. Actual concentration is expected to be at least as high as the value reported.
T	Value reported is less than the criteria of detection	Data included in analysis if the reported value is below criteria; otherwise, reported value is not used in the analysis
U	Material was analyzed for but not detected. Value stored is the limit of detection.	Data not included in analysis
<	NAWQA – actual value is known to be less than the value shown	Data included in analysis
Z	Too many colonies were present to count (TNTC), the numeric value represents the filtration volume	Data not included in analysis

Table A-2 Fecal Coliform Data and Percentiles for WBID 1660

Date	Station	Result	Rcode	Rank	Percentile by Hazen Method
3/28/2005	21FLTPA 27501678216291	1	K	1	1
4/19/2005	21FLTPA 27501678216291	1	K	1	1
7/19/2005	21FLTPA 27501678216291	5	B	3	6
5/31/2005	21FLTPA 27501678216291	10		4	8
11/29/2005	21FLTPA 27501678216291	10		4	8
5/9/2005	21FLTPA 27511348216273	15	B	6	13
7/19/2005	21FLTPA 27511348216273	15	B	6	13
3/28/2005	21FLTPA 27511348216273	20	B	8	18
4/19/2005	21FLTPA 27511348216273	20	B	8	18
5/15/2008	21FLBRA 1660-D	36		10	23
5/9/2005	21FLTPA 27501678216291	40	B	11	25
6/13/2005	21FLTPA 27511348216273	45	B	12	27
5/8/2008	21FLBRA 1660-D	51		13	30
9/20/2005	21FLTPA 27501678216291	60	B	14	32
6/13/2005	21FLTPA 27501678216291	75	B	15	35
9/20/2005	21FLTPA 27511348216273	105		16	37
6/10/2008	21FLBRA 1660-A	110		17	39
5/31/2005	21FLTPA 27511348216273	125		18	42
5/23/2008	21FLBRA 1660-C	200		19	44
7/26/2005	21FLTPA 27511348216273	205		20	46
5/8/2008	21FLBRA 1660-D	220		21	49
4/22/2008	21FLBRA 1660-A	230		22	51
6/10/2008	21FLBRA 1660-C	230		22	51
6/10/2008	21FLBRA 1660-D	240		24	56
5/8/2008	21FLBRA 1660-C	250		25	58
5/15/2008	21FLBRA 1660-C	250		25	58
5/23/2008	21FLBRA 1660-A	270		27	63
6/17/2008	21FLBRA 1660-C	270		27	63
4/22/2008	21FLBRA 1660-B	300		29	68
5/15/2008	21FLBRA 1660-A	300		29	68
7/26/2005	21FLTPA 27501678216291	365		31	73
4/22/2008	21FLBRA 1660-C	390		32	75
10/18/2005	21FLTPA 27501678216291	430		33	77
11/29/2005	21FLTPA 27511348216273	490		34	80
6/17/2008	21FLBRA 1660-D	500	B	35	82
10/18/2005	21FLTPA 27511348216273	510		36	85
5/8/2008	21FLBRA 1660-A	520		37	87
6/10/2008	21FLBRA 1660-A	540		38	89
5/23/2008	21FLBRA 1660-D	800	B	39	92
5/15/2008	21FLBRA 1660-B	1700	B	40	94
5/8/2008	21FLBRA 1660-B	2000		41	96
5/23/2008	21FLBRA 1660-B	3500		42	99

Table A-3 Water Quality Data and Percentiles for WBID 1675

Date	Station	Result	Rcode	Rank	Percentile by Hazen Method
7/19/2005	21FLTPA 27492118205168	1	K	1	1
8/22/2005	21FLTPA 27484928205312	5	B	2	4
8/22/2005	21FLTPA 27492118205168	5	B	2	4
10/17/2005	21FLTPA 27492118205168	45	B	4	9
10/18/2005	21FLTPA 27484928205312	60		5	12
8/22/2005	21FLTPA 24020906	80	B	6	15
3/28/2005	21FLTPA 27484928205312	80	B	6	15
6/10/2008	21FLBRA 1675-C	100	U	8	20
3/28/2005	21FLTPA 27492118205168	110		9	23
4/19/2005	21FLTPA 27484928205312	125		10	26
6/10/2008	21FLBRA 1675-B	150	B	11	28
5/10/2005	21FLTPA 27484928205312	165		12	31
6/13/2005	21FLTPA 24020906	185		13	34
10/18/2005	21FLTPA 24020906	200		14	36
4/19/2005	21FLTPA 27492118205168	210		15	39
3/28/2005	21FLTPA 24020906	215		16	42
6/17/2008	21FLBRA 1675-C	220	B	17	45
7/19/2005	21FLTPA 24020906	240	K	18	47
5/8/2008	21FLBRA 1675-C	270		19	50
5/15/2008	21FLBRA 1675-A	290		20	53
5/15/2008	21FLBRA 1675-C	300	B	21	55
6/10/2008	21FLBRA 1675-A	310		22	58
7/19/2005	21FLTPA 27484928205312	310		22	58
5/23/2008	21FLBRA 1675-A	330		24	64
6/17/2008	21FLBRA 1675-A	400	B	25	66
5/10/2005	21FLTPA 27492118205168	460		26	69
6/17/2008	21FLBRA 1675-A	490		27	72
4/19/2005	21FLTPA 24020906	600		28	74
2/2/1998	21FLTPA 24020906	620		29	77
5/23/2008	21FLBRA 1675-C	700	B	30	80
5/10/2005	21FLTPA 24020906	720	B	31	82
5/8/2008	21FLBRA 1675-B	1300	B	32	85
5/15/2008	21FLBRA 1675-B	1700	B	33	88
5/23/2008	21FLBRA 1675-B	1700	B	33	88
5/8/2008	21FLBRA 1675-A	2300		35	93
4/22/2008	21FLBRA 1675-A	2800		36	96
4/22/2008	21FLBRA 1675-B	3600		37	99

In this TMDL the Hazen formula was used since it is recommended in Hunter's Applied Microbiology (2002) article concerning bacteria in water. To calculate the percentile associated with the sample concentrations the data are first sorted by concentration, lowest to highest. A ranking is assigned to each sample, with the lowest concentration having a rank of 1 and the highest concentration having a rank equivalent to the total number of samples collected. The percentile is calculated as follows:

Percentile = (Rank – 0.5)/ (total number of samples collected)

For example, for WBID 1675 on May 15, 2008 a fecal coliform concentration of 300 MPN/100ml was measured at station 21FLBRA 1675-C. This concentration ranks number 21 out of 37 samples collected in Owens Branch. The associated percentile is calculated as:

Percentile = (21-0.5)/37 = 0.55 = 55%

This implies that 55 percent of the time the instream concentration is less than 300 MPN/100ml.