FINAL

Threemile Creek
Total Maximum Daily Load (TMDL)
for Pathogens (*Enterococci)*

Assessment Unit IDs: AL03160204-0504-101, AL03160204-0504-102
Mobile County, Alabama

Alabama Department of Environmental Management
Water Division, Water Quality Branch
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ADEM
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Useful Acronyms & Abbreviations

A

A&I - Agriculture and Industry Use Classification
AAF - Average Annual Flow
ACES - Alabama Cooperative Extension Service
ADEM - Alabama Department of Environmental Management
ADPH - Alabama Department of Public Health
AEMC - Alabama Environmental Management Commission
AFO - Animal Feeding Operation
AL - Alabama; Aluminum (Metals)
AS - Arsenic
ASWCC - Alabama Soil & Water Conservation Committee
AWIC - Alabama Water Improvement Commission

B

BAT - Best Available Technology
BCT - Best Conventional Pollutant Control Technology
BMP - Best Management Practices
BOD - Biochemical Oxygen Demand
BPJ - Best Professional Judgment

C

CAFO - Confined Animal Feeding Operation
$CBOD_5$ - Five-Day Carbonaceous Biochemical Oxygen Demand
$CBOD_u$ - Ultimate Carbonaceous Biochemical Oxygen Demand
CFR - Code of Federal Regulations
CFS - Cubic Feet per Second
CMP - Coastal Monitoring Program
COD - Chemical Oxygen Demand
COE - Corps of Engineers (US Army)
CPP - Continuing Planning Process
CWA - Clean Water Act
CY - Calendar Year

D

DA - Drainage Area
DEM - Digital Elevation Model
DMR - Discharge Monitoring Report
DNCR - Department of Conservation & Natural Resources
DO - Dissolved Oxygen

E

E. coli - Escherichia Coliform Bacteria
EOP - End of Pipe

F

F&W - Fish and Wildlife Use Classification
FDA - Food and Drug Administration
Fe - Iron
FO - Field Operations
FS - Forestry Service (US)
FY - Fiscal Year

G

GIS - Geographic Information Systems
GOMA - Gulf of Mexico Alliance
GPS - Global Positioning System
GSA - Geological Survey of Alabama

H

HCR - Hydrographic Controlled Release
Hg - Mercury
HUC - Hydrologic Unit Code

I

IBI - Index of Biotic Integrity
IF - Incremental Flow
IWC - Instream Waste Concentration

L

LA - Load Allocation
Lat/Long- Latitude / Longitude
LDC - Load Duration Curve
LIDAR - Light Detection & Ranging
LWF - Limited Warmwater Fishery Use Classification

M

m^3/s - Cubic Meters per Second
MAF - Mean Annual Flow (MAF = AAF)
mg/l - Milligrams per Liter
MGD - Million Gallons per Day
mi - Miles
MOS - Margin of Safety
MS4s - Municipal Separate Storm Sewer Systems
MZ - Mixing Zone

N

N - Nitrogen
NA - Not Applicable
NASS - National Agricultural Statistics Service
$NBOD_x$ - Nitrogenous Biochemical Oxygen Demand
NED - National Elevation Database
NH_3-N - Ammonia Nitrogen
NHD - National Hydrography Database
NLCD - National Land Cover Dataset
NO_3+NO_2-N -Nitrate + Nitrite Nitrogen
NOAA - National Oceanic and Atmospheric Administration
NOV - Notice of Violation
NPDES - National Pollutant Discharge Elimination System
NPS - Non-Point Source
NRCS - National Resource Conservation Service
NTUs - Nephelometric Turbidity Units
NWS - National Weather Service

O

OAW – Outstanding Alabama Water Use Classification
OE - Organic Enrichment
ONRW - Outstanding National Resource Water Designation

P

P - Phosphorus
Pb - Lead
PCBs - Polychlorinated Biphenyl
pH - Concentration of Hydrogen Ions Scale
POTW - Publicly Owned Treatment Works
ppb - Parts per Billion
ppm - Parts per Million
ppt - Parts per Trillion
PS - Point Source
PWS - Public Water Supply Use Classification
PWSS - Public Water Supply System

Q

Q - Flow (MGD, m^3/s, cfs)
QA/QC - Quality Assurance / Quality Control
QAPP - Quality Assurance Project Plan

R

RRMP - River and Reservoirs Monitoring Program
RSMP - River and Streams Monitoring Program

S

S - Swimming and Other Whole Body Waters Contact Sports Use Classification
SH - Shellfish Harvesting Use Classification
SID - State Indirect Discharge
SMZ - Streamside Management Zone
SOD - Sediment Oxygen Demand
SOP - Standard Operating Procedure
SRF - State Revolving Fund
SSO - Sanitary Sewer Overflow
STP - Sewage Treatment Facility
SW - Surface Water
SWMP - Stormwater Management Plan
SWQM - Spreadsheet Water Quality Model (AL)
SWQMP - Surface Water Quality Monitoring Program

T

TBC - Technology-Based Controls
TBD - To be Determined
TDS - Total Dissolved Solids
TKN - Total Kjeldahl Nitrogen
TMDL - Total Maximum Daily Load
TON - Total Organic Nitrogen
TOT - Time of Travel
Total P - Total Phosphorus
TSS - Total Suspended Solids
TVA - Tennessee Valley Authority

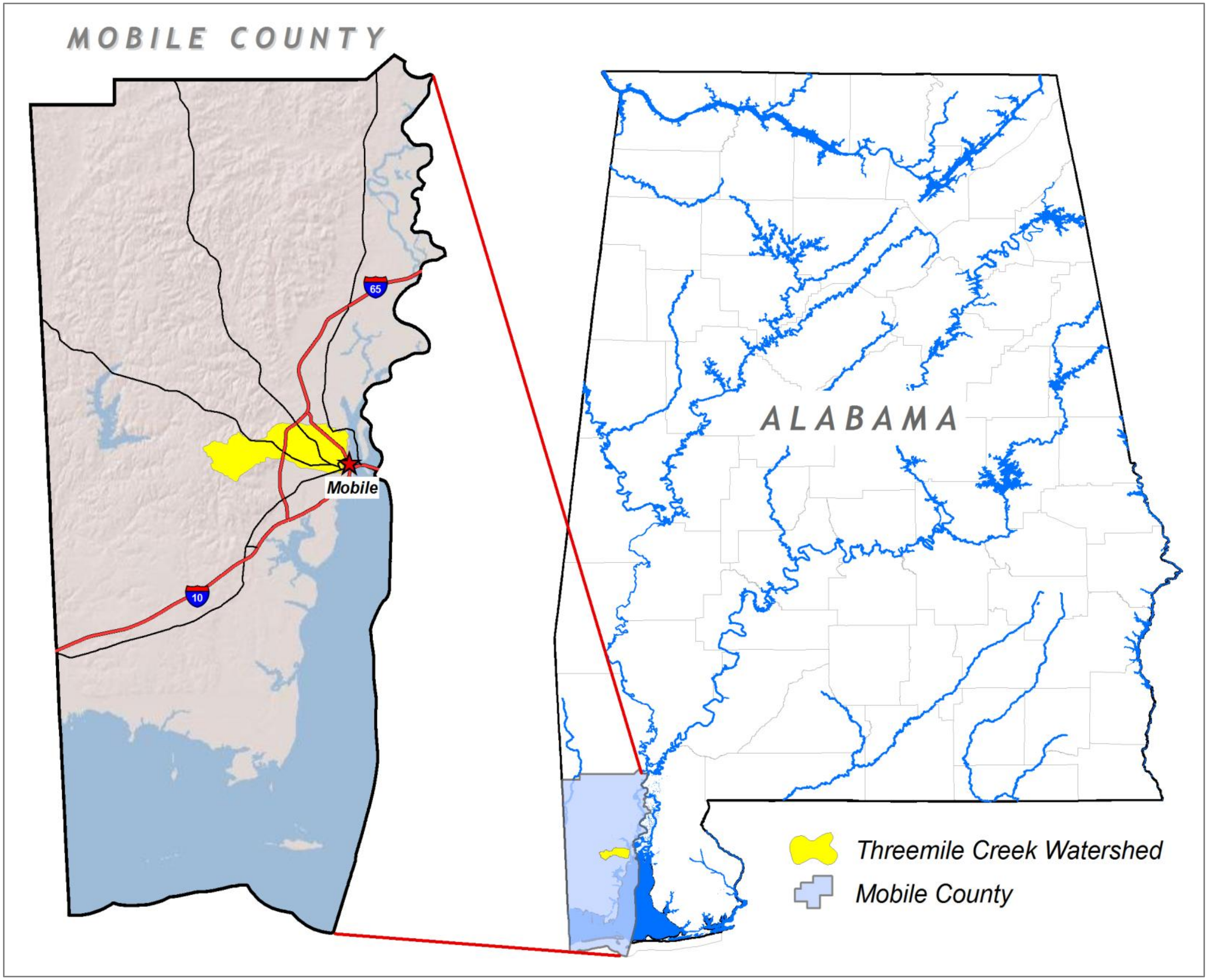
U

UAA - Use Attainability Analysis
UIC - Underground Injection Control
USDA - United Stated Department of Agriculture
USGS - United States Geological Survey
USEPA - United States Environmental Protection Agency
USFWS - United States Fish & Wildlife Services
UT - Unnamed Tributary
UV - Ultraviolet Radiation

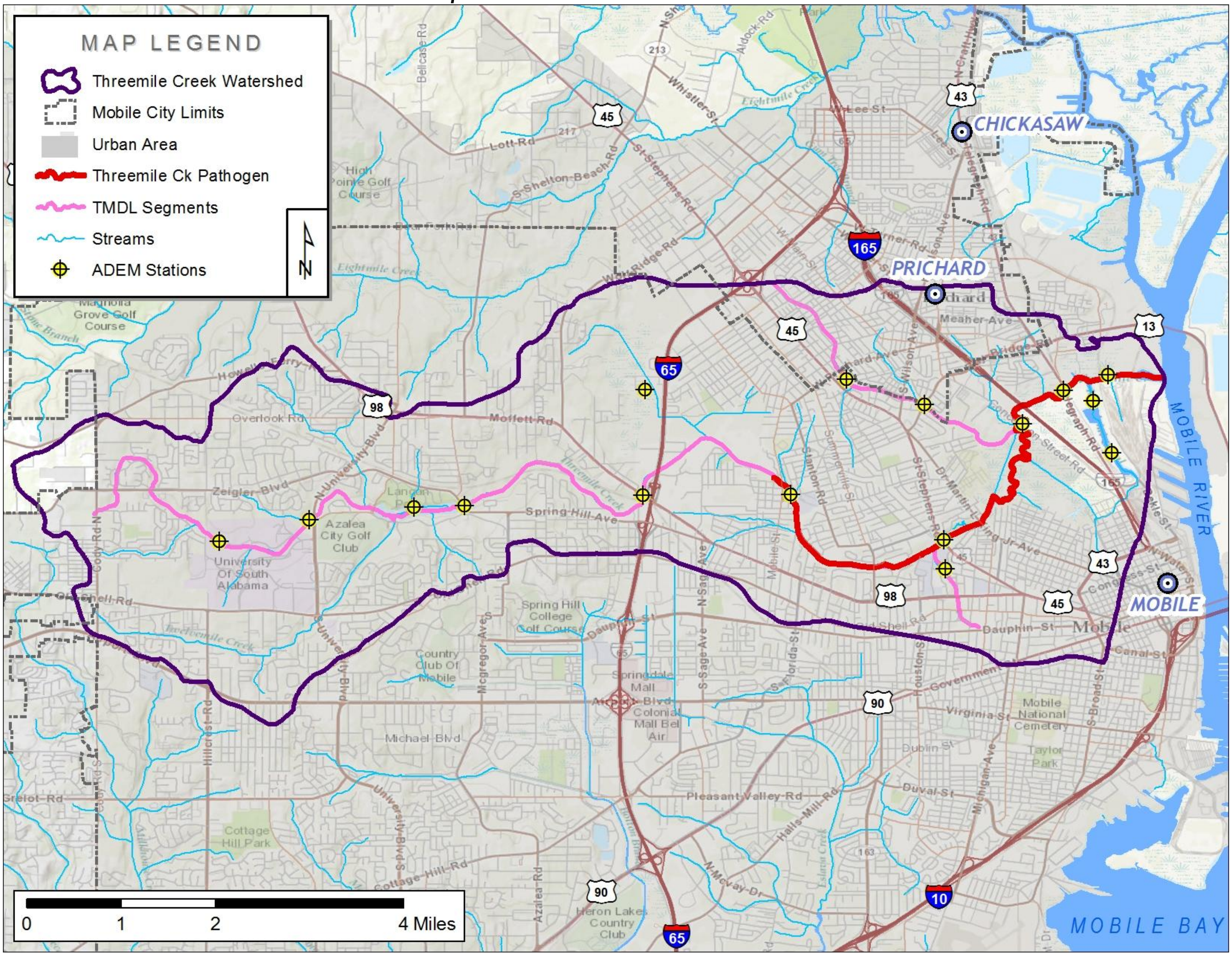
W

WCS - Watershed Characterization System
WET - Whole Effluent Toxicity
WLA - Wasteload Allocation
WMA - Wildlife Management Area
WPCP - Wastewater Pollution Control Plant
WQB - Water Quality Branch
WRDB - Water Resources Database
WTP - Water Treatment Plant
WWTF - Wastewater Treatment Facility
WWTP - Wastewater Treatment Plant
WY - Water Year

Map 1-1: General Location of the Threemile Creek Watershed



Map 1-2: Threemile Creek Watershed



Threemile Creek Pathogen TMDL (*Enterococci*)

1.0 EXECUTIVE SUMMARY

Embedded in an industrialized urban area, nearly all of Threemile Creek's (TMC) 30-square-mile drainage area is contained within the incorporated limits of the City of Mobile, with smaller portions located in the City of Prichard and unincorporated areas of west Mobile. It begins as a small freshwater creek and meanders eastward through nearly 15 miles of city landscape, ultimately transforming into a broad and deep tidally-influenced estuarine stream before flowing into the Mobile River. As a result of this watershed's abundance of high-use areas and growing population densities, as well as municipal and industrial infrastructure, TMC is very susceptible to water quality impairment from both point and nonpoint sources.

Pursuant to Section §303(d) of the Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (40 CFR Part 130), states are required to identify waterbodies which are not meeting their designated uses and then determine the Total Maximum Daily Load (TMDL) for pollutants causing the use impairment. A TMDL is the maximum amount of pollutant a waterbody can assimilate while meeting all applicable water quality standards. All TMDLs include a wasteload allocation (WLA) for all National Pollutant Discharge Elimination System (NPDES)-regulated discharges (point sources), a load allocation (LA) for all nonpoint sources, and an explicit and/or implicit margin of safety (MOS). TMDLs provide the framework that allows states to establish and implement pollution control and management plans with the ultimate goal indicated in §101(a)(2) of the CWA: "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable" (USEPA, 1991).

Several segments in the Threemile Creek watershed have been identified as impaired waters, some of which already have USEPA-approved TMDLs. Namely, TMC has an existing TMDL for organic enrichment/dissolved oxygen (OE/DO) that was completed in 2007, while Toulmins Spring Branch and an Unnamed Tributary of Threemile Creek both have pathogen TMDLs that were completed in 2009. This specific TMDL, however, explicitly addresses two segments on the lower mainstem of TMC that have been identified as impaired for pathogens (*Enterococci*). Map 1-1: General Location of the Threemile Creek Watershed and Map 1-2: Threemile Creek Watershed offer a general geographic representation of the watershed, while Table 1-1 on the following page presents an overview of the TMDL.

Table 1-1: TMDL Summary

Threemile Creek Pathogen TMDL Summary	
Impaired Waterbody	Threemile Creek
Use Classification	Agricultural & Industrial Water Supply (*A&I*)
River Basin	Mobile
County	Mobile (FIPS 097)
12-Digit HUC	031602040504
HUC-12 Name	Toulmins Spring Branch - Threemile Creek
Assessment Units	AL03160204-0504-101 (2.04 miles - lower) AL03160204-0504-102 (4.34 miles - upper) Total Length = 6.38 miles
Coordinates (at mouth)	(-88.043700°, 30.725966°)
Total Watershed Area	29.68 mi² / 18,993 acres
Year Listed	2004
Date of Data	2000-2001
Water Quality Impairment	Pathogens
Pathogen WQ Criteria (Coastal Waters)	Enterococci (colonies /100 ml) Single-sample Maximum ≤ 500
Major Sources	Collection system failure Municipal Infrastructure Urban runoff / storm sewers
Loading Capacity (TMDL - MOS)	2.68 E+12 colonies / day
Wasteload Allocation	3.19 E+11 colonies / day
Load Allocation	2.36 E+12 colonies / day
Margin of Safety	2.97 E+11 colonies / day
Percent Reduction	97%

1.1 §303(d) Listing of the Impairment

These two segments of Threemile Creek were originally placed on *Alabama's 2004 §303(d) List of Impaired Waterbodies* for pathogens based on data collected in 2000-2001 by the United States Geological Survey (USGS). In accordance with *Alabama's Water Quality Assessment and Listing Methodology*, an *Agricultural and Industrial*

Water Supply (A&I) waterbody can be placed in Category 5 (*303(d) listed* waterbodies that require a TMDL) for bacteriological impairment if more than 10% of single samples exceed the criteria. Of the samples collected by USGS, 43% exceeded the state's bacteriological criteria for fecal coliform. In January of 2010, Alabama adopted *Enterococci* as the indicator bacteria for coastal waters, thus the loadings in this TMDL are expressed accordingly. Subsequent sampling in the TMC watershed has continued to show impairment with respect to pathogens.

The lower listed segment of Threemile Creek (AL03160205-0504-101) spans 2.04 miles from its confluence with the Mobile River upstream to the mouth of Toulmins Spring Branch. The upper segment (AL03160205-0504-102) extends 4.34 miles farther upstream and ends at Mobile Street. The entire mainstem of TMC holds an *A&I* use classification. A detailed description of the TMC watershed can be found in section 3.0 Threemile Creek Watershed Description.

1.2 Data Capture and Results Summary

Following its listing in 2004, stations on the impaired portions of TMC were sampled by ADEM for both *Enterococci* and fecal coliform. Per ADEM TMDL development guidelines, only the *Enterococci* data collected in the previous 6 years was chosen to represent the "existing condition" considered in this TMDL. ADEM collected bacteriological data at 4 sampling locations, two on each listed segment. Over 90 individual samples were collected, including geometric means at 3 of the 4 stations. The *A&I* use classification only has a single-sample criteria for Enterococci. Full datasets listed by sampling station can be found in section 9.3 Water Quality Dataset of this report. Further review of the general water quality and intensive *Enterococci* study revealed that the segments of Threemile Creek listed for pathogens were still not meeting the water quality criterion applicable to the *A&I* use classification. Over the course of the intensive survey during the spring and summer of 2011, exceedances were observed at all 4 stations with an occurrence rate of around 30%. Therefore, a TMDL has been developed to bring the waterbody into compliance with water quality standards of the State of Alabama.

1.3 TMDL Calculation Summary

For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per unit volume (colonies/100 ml) or per unit time (colonies/day), in accordance with 40 CFR 130.2(i). In this instance, streamflow was taken into consideration, and loadings are expressed in the form of colonies/day (col/day). A percent reduction was calculated in order to quantify the necessary decrease in bacteria loading. The highest single-sample exceedance was selected as the existing condition, while the allowable condition was set to the pathogen criteria for a coastal *A&I* waterbody (*Enterococci*).

After calculating the percent reduction, a method similar to a mass balance was used for calculating the pathogen TMDL for Threemile Creek. Existing loads (in col/day) were calculated by multiplying the *Enterococci* concentrations (col/100 ml) by the instream flows at the time and location where the samples were collected. As mentioned previously, the existing condition was calculated using the highest single-sample exceedance event of 12,000 col/100 ml measured at station TMCM-5, which is located just downstream of the confluence of Threemile Creek and Toulmins Spring Branch. In the absence of measured streamflow for Threemile Creek, flow was estimated using real-time USGS data for nearby Chickasaw Creek and ratioed based on contributing drainage area.

Table 1-2 below summarizes the necessary load reductions for both point and nonpoint sources in the Threemile Creek watershed. Allowable loads were calculated using the same streamflow as above, the coastal water quality criteria for pathogens, and an explicit margin of safety of 10%. Existing point source loads were based on flow and bacteria data reported by the facilities at the time when the highest instream exceedance of water quality criteria occurred. Allowable loads for point sources were based on current permit requirements (currently in draft status). There are two major (greater than 1 million gallons per day (MGD)) wastewater treatment plants (WWTPs) in the watershed: Wright Smith Jr. WWTP and Carlos A. Morris WWTP. In light of the water quality issues in the TMC watershed, both discharges are scheduled to relocate their outfall locations to the Mobile River in the near future.

Table 1-2: Enterococci Load Reduction Requirements

Source	Existing Load [a] (colonies/day)	Allowable Load [b] (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load (LA)	7.13 E+13	2.36 E+12	6.89 E+13	97%
Point Source Load (WLA)	6.91 E+10	3.19 E+11	0	0%

a. Existing WLA loads were based on facility DMR data at the time the highest instream exceedance was observed.
b. Allowable WLA loads were based on design flow & NPDES-permitted limits for *Enterococci* (500 colonies /100 ml).

Table 1-3: Individual NPDES Point Source Reductions

Source	Existing Load [a] (colonies/day)	Allowable Load [b] (colonies/day)	Required Reduction (colonies/day)	% Reduction
Wright Smith WWTP (AL0023094)	1.50 E+10	2.42 E+11	0	0%
Carlos Morris WWTP (AL0023205)	5.40 E+10	7.72 E+10	0	0%
Total WWTPs (WLA)	6.91 E+10	3.19 E+11	0	0%

a. Existing WLA loads were based on facility DMR data at the time the highest instream exceedance was observed
b. Allowable WLA loads were based on design flow & NPDES-permitted limits for *Enterococci* (500 colonies /100 ml)

Table 1-4: Enterococci Pathogen TMDL Summary for Threemile Creek

TMDL [a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)			Load Allocation (LA)	
		WWTPs [b]	MS4s [c]	Leaking Collection Systems [d]		
(col/day)	(col/day)	(col/day)	Reduction	(col/day)	(col/day)	Reduction
2.97 E+12	2.97 E+11	3.19 E+11	97%	0	2.36 E+12	97%

a. TMDL was established using the single-sample *Enterococci* criterion for the *A&I* use classification (500 colonies/100 ml)
b. WLAs for WWTPs are expressed as a daily maximum. Any future WWTPs (and expansions of existing facilities) must meet the applicable instream water quality criteria for *Enterococci* at the point of discharge.
c. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The WLA target for leaking collection systems is zero. It is recognized, however, that a WLA of 0 col/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in *Enterococci* loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for *Enterococci*.

Compliance with the terms and conditions of existing and future NPDES permits will effectively implement the WLA and demonstrate consistency with this TMDL. The WLA reductions shown in the previous tables illustrate the difference between "existing conditions" and "allowable conditions." However, in lieu of a numeric percent reduction or loading reduction mandate on point sources, discharges must simply meet or exceed the *Enterococci* water quality criterion of 500 col/100 ml, end-of-pipe. This permitting strategy is protective of water quality and consistent with the requirements of this TMDL. Required load reductions in the LA portion of this TMDL can be implemented through citizen and stakeholder initiatives (such as the remediation of failing onsite waste treatment systems), education and outreach, and other measures which may be eligible for CWA §319 funding. In order to address future changes in the watershed and the relative uncertainties (e.g. source assessment), an adaptive management approach will be utilized.

2.0 INTRODUCTION TO TMDLS

Total Maximum Daily Loads (TMDLs) were created as a tool to improve water quality and provide a roadmap for sustainable, productive, and healthy water resources. The term TMDL was first introduced in the Clean Water Act and is a tool used extensively by the USEPA in collaboration with state environmental agencies such as ADEM. Each state has a TMDL program which submits TMDLs to the respective regional office of the USEPA for approval. The following contains information concerning Alabama's TMDL Program.

2.1 Alabama's TMDL Program Overview

2.1.1 What is a TMDL?

Water quality monitoring data is collected and compared with state water quality standards. If any standard is violated, the waterbody can be placed on the state's *§303(d) List of Impaired Waters*. *Alabama's Water Quality Assessment and Listing Methodology* outlines the decision making criteria for this process. Once a waterbody is placed on this list, additional water quality data is collected and analyzed. If the data shows there is an impairment of water quality, a TMDL is developed specific to the pollutant(s) of concern and the impaired waterbody. A TMDL determines the amount of the pollutant that the waterbody can assimilate while still meeting all applicable water quality standards. In essence, a TMDL establishes a "pollution budget" or allocation for each pollutant causing water quality impairment.

A single waterbody or stream/river segment may have several TMDLs developed if it is impaired by more than one pollutant. Likewise, a stream or watershed may have multiple segments or assessment units that are impaired. Typically, a TMDL will be developed to address pathogens, dissolved oxygen, nutrients, pH, metals, turbidity, or other impairments, separately and distinctly. The ultimate goal of a TMDL is to identify specific pollutants, link them to their sources, and set a numeric target in order to reduce pollution loadings and ensure the waterbody is meeting all water quality standards for its use classification. A TMDL addresses both point source discharges and nonpoint sources. Once developed, a TMDL is implemented through load reductions and watershed management practices that aim to improve and protect water quality throughout the watershed.

2.1.2 §303(d) List of Impaired Waters

As mentioned before, each state is tasked with developing a comprehensive list of impaired waterbodies. Moreover, the state also prioritizes these lists for

development of TMDLs which are then submitted to EPA for approval. This list is part of the *Integrated Water Quality Report to Congress*, a biennial review of water quality developed by each state and submitted to Congress (commonly referred to as the "305(b) report"). Alabama's §303(d) list and additional TMDL information can be found on ADEM's website:
http://www.adem.state.al.us/programs/water/waterquality.cnt.

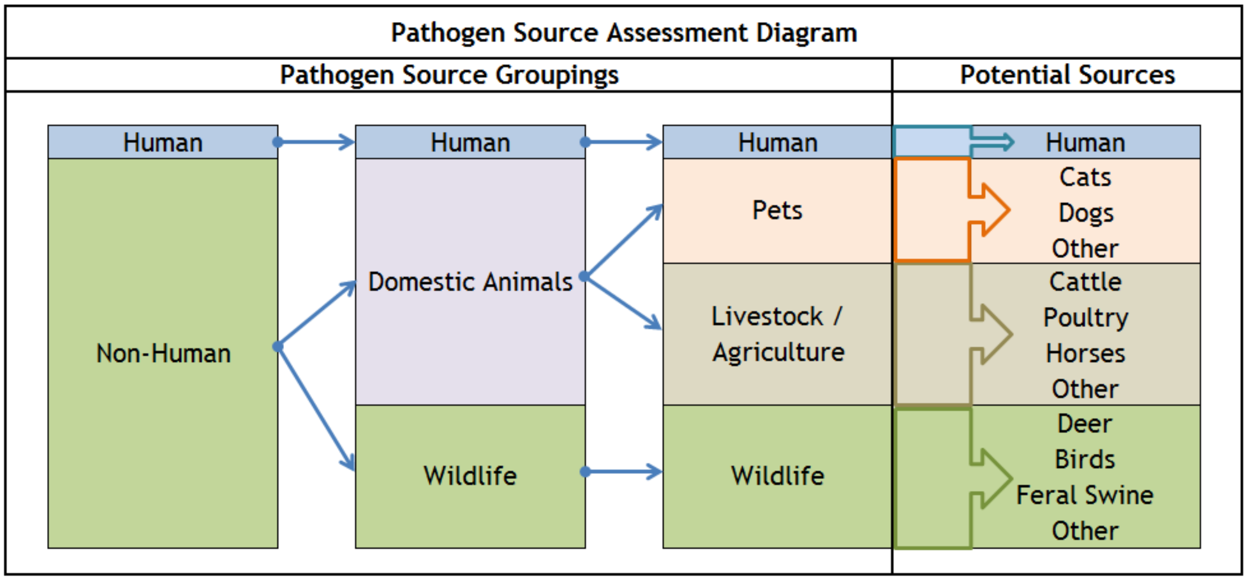
2.1.3 Causes of Impairment & Source Assessment Overview

Pollutants may enter waterbodies from municipal WWTPs, industrial or agricultural discharges, waste disposal operations, stormwater conveyance systems, or other defined sources. These types of sources are labeled point sources because the pollutants are discharged from a discrete end-of-pipe location. All point sources that discharge effluent to waters of the United States are required under the Clean Water Act to obtain a National Discharge Pollution Elimination System (NPDES) permit. ADEM administers these permits on a state level, effectively controlling what type and how much of each pollutant can be discharged based on applicable water quality standards for the receiving waterbody. As a result, point sources are tasked with treating effluent to a degree that is protective of these standards. These types of sources are addressed in the wasteload allocation (WLA) portion of the TMDL.

In addition to point sources, pollutants may also enter waterbodies from diffuse sources that are more difficult to distinguish. As overland flow moves over the Earth's surface following storm events, materials such as waste, excess nutrients, sediment, and other matter is transported and deposited into surface waters. This is called nonpoint source pollution which is address in the load allocation (LA) portion of the TMDL. In some instances, the distinction between point and nonpoint sources of pollution is unclear, such as failing onsite waste treatment systems or the concurrence of nonpoint sources with municipal separate stormwater sewer systems (MS4) sources.

Pathogen impairments can be effectively remediated if comprehensive source assessments are performed in order to pinpoint where problems lie. The most prominent sources of pathogen impairments are improperly or untreated human and animal wastes. Since there are many types of waterborne pathogens, indicator bacteria are often used to gauge the presence of potentially harmful (but naturally occurring) bacteria and other disease-causing organisms. Periods of low flow, high temperatures, and other variables create critical periods where risk of pathogen impairment is at its highest; thus, critical conditions are used for TMDL analysis and development. Figure 2-1 on the following page shows potential sources of pathogens.

Figure 2-1: Pathogen Source Assessment Diagram



2.1.4 TMDL Establishment & Implementation Overview

First, a water quality model of the waterbody is constructed. The model is used to predict how various pollutants affect water quality and also provides a maximum pollutant loading target in order for the waterbody to meet or exceed water quality standards applicable to their respective use classification(s). A TMDL has three basic components: a wasteload allocation (WLA) for point sources, a load allocation (LA) for nonpoint sources and natural background conditions, and an implicit or explicit margin of safety (MOS) (or both). A TMDL can be denoted by the following equation:

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

After a TMDL is developed and approved by USEPA, it is implemented through load reductions from point and nonpoint sources. This can be achieved through regulatory measures (such as NPDES permits), nonpoint source load reduction initiatives, and other watershed management practices. Each discharge considered a possible or contributing source is required to meet the reductions consistent with the TMDL. Additional water quality sampling is then conducted to track improvement and gather information for adaptive management purposes. Once sampling proves that the waterbody is meeting all applicable water quality standards, it can be placed in *Category 1* (waterbodies where all designated use classifications are fully supported).

3.0 THREEMILE CREEK WATERSHED DESCRIPTION

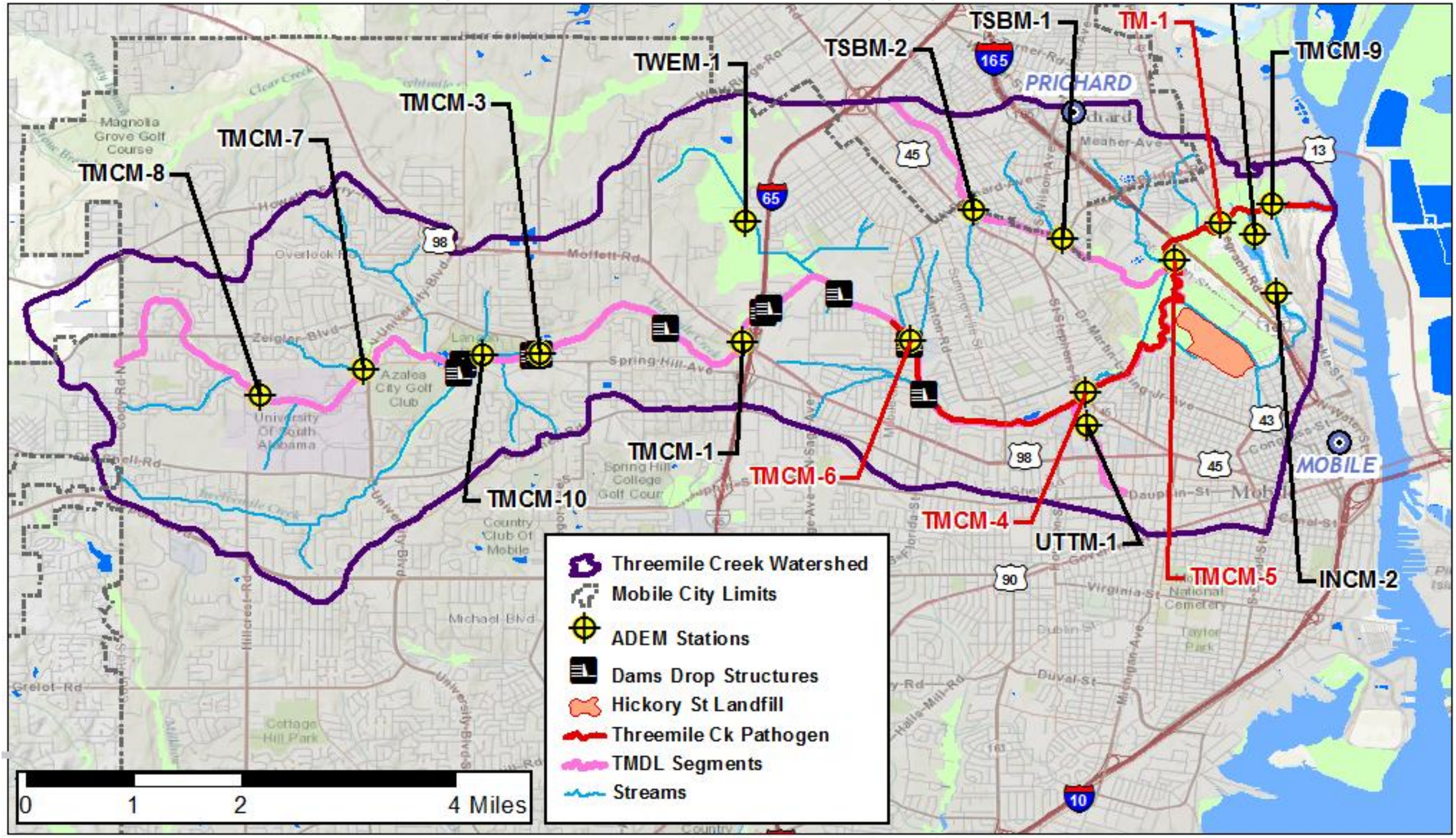
3.1 Watershed Geography

Map 3-1: The Mobile River Basin

The Threemile Creek watershed is located near Mobile, Alabama, a port city situated at the mouth of the Mobile River. This area represents the southernmost reaches of the Mobile River Basin, the sixth-largest primary drainage basin in the nation and the fourth-largest in terms of streamflow (USGS, 2013). The headwaters of TMC originate west of the City of Mobile and flow eastward through ≈14.9 miles of urban landscape before emptying into the Mobile River just miles upstream of Mobile Bay. Since it is part of a large estuary system located in an urbanized area, the 29.68 square-mile watershed has distinctive biology and hydrology, as well as a storied past. It was once known as "Portage on Bayou Chotage," which provided a valuable water supply and inland access to early European settlers of Mobile.

Map 1-1 and Map 1-2 offer a general overview of the watershed, while the following map depicts ADEM sampling stations and some hydrologic features located on Threemile Creek. Stations labeled in red were utilized in this pathogen TMDL development (TMCM-4, TMCM-5, TMCM-6, & TM-1).

Map 3-2: Threemile Creek Watershed & Sampling Stations

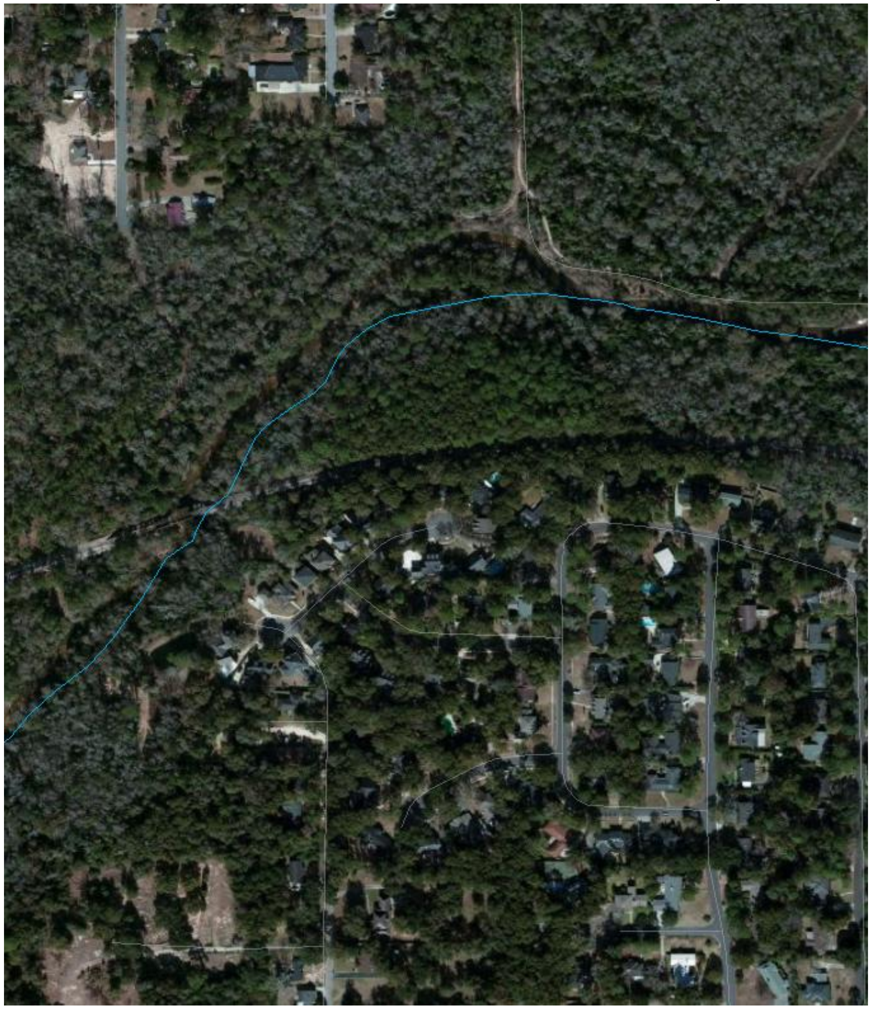


3.2 Hydrology

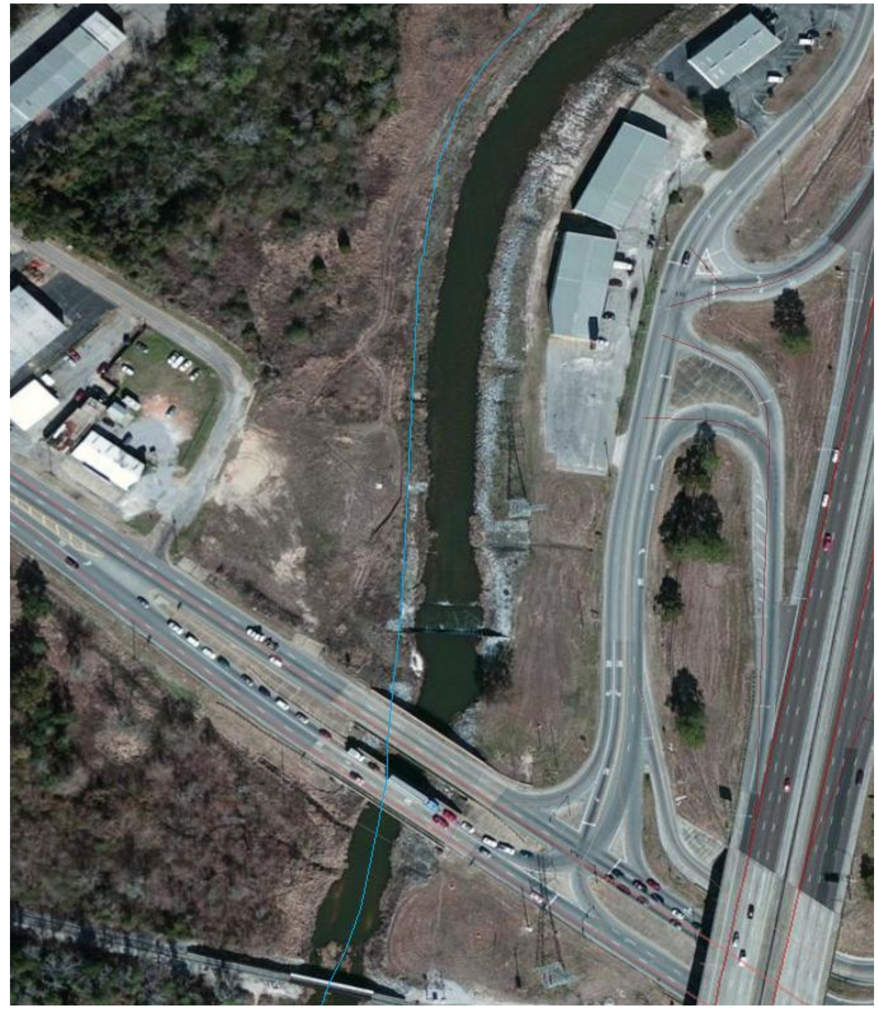
As mentioned previously, Threemile Creek possesses unique hydrology due to its geographic location and landforms. In addition, urbanization and manmade features within the watershed have also altered the behavior, distribution, and quality of surface water. A number of hydrodynamic restructuring projects were completed in order to alleviate the impacts of flooding in residential and commercial areas of Mobile. The headwaters of Threemile Creek originate just west of Cody Road and then flow into a series of artificial impoundments in Municipal (Langin) Park. Excess water from these lakes then flows over a spillway near Springhill Avenue. From this point, TMC flows eastward through intermittent residential and forested areas. There are a couple of small riprap stream crossings before reaching the first major drop structure just west of I-65. Up until this point, the streambanks are relatively stable with a somewhat intact riparian buffer. Downstream of this location, however, TMC is much more channelized and lined periodically with riprap and tiered gabion baskets (see Picture 3-2 and Picture 3-3 on the following page). After another 3 drop structures spaced evenly over the 2 miles following the I-65 crossing, TMC becomes a free-flowing waterbody until it reaches the Mobile River. As it nears Downtown Mobile, a straight, one-mile-long canal connects two locations on the original mainstem of the creek. The original streambed meanders alongside this canal through low wetland areas surrounding the abandoned Hickory Street Landfill. The waterbody begins to widen as it nears its confluence with the Mobile River, the area around which is highly industrialized. Finally, Threemile Creek flows into the Mobile River just 4 miles upstream of where Mobile River enters Mobile Bay.

Picture 3-1: Drops Structures on Threemile Creek near Fillingim Street

Picture 3-2: Threemile Creek below Municipal Park



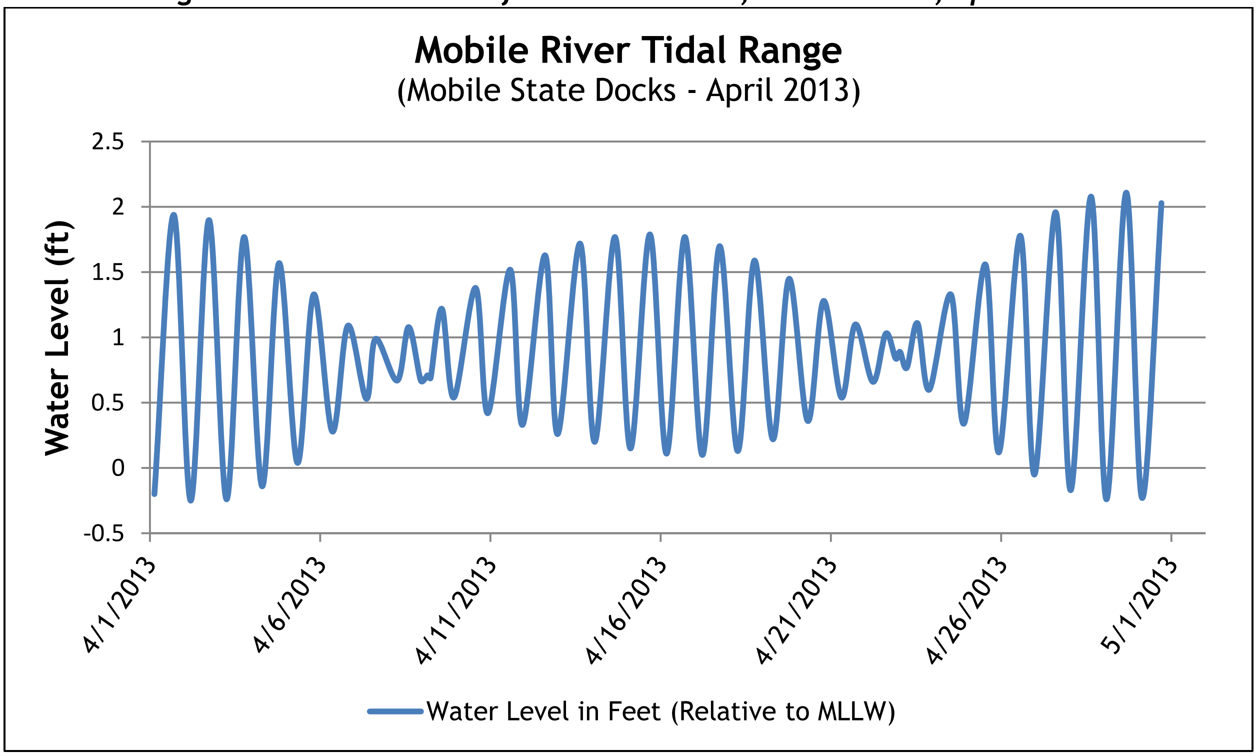
Picture 3-3: Threemile Creek at I-65



The aerial image on the left shows a representative segment of Threemile Creek between Municipal Park and the first drop structure located about 0.5 miles upstream of I-65. In contrast, the picture on the right shows the second series of drop structures and banks stabilized with gabion baskets near the I-65 crossing. Reduction in riparian buffers reduces the natural filtering capacity of land adjacent to waterbodies which can exacerbate impairments and aid in transport of pollutants.

With respect to tidal influence, approximately the lower third of the watershed is impacted, while the areas above the last drop structure are not. The last drop structured is about 5.6 miles upstream from the mouth between stations TMCM-4 and TMCM-6 (see Map 3-2). The areas below this point down to the low-lying areas near the confluence with the Mobile River have normal diurnal tidal fluctuations as much as two feet during spring tide events and almost no change during a neap tide. Figure 3-1 is an example of monthly tidal oscillations of the Mobile River near the mouth of TMC (NOAA Data, 2013).

Figure 3-1: Illustration of Tidal Variation, Mobile River, April 2013

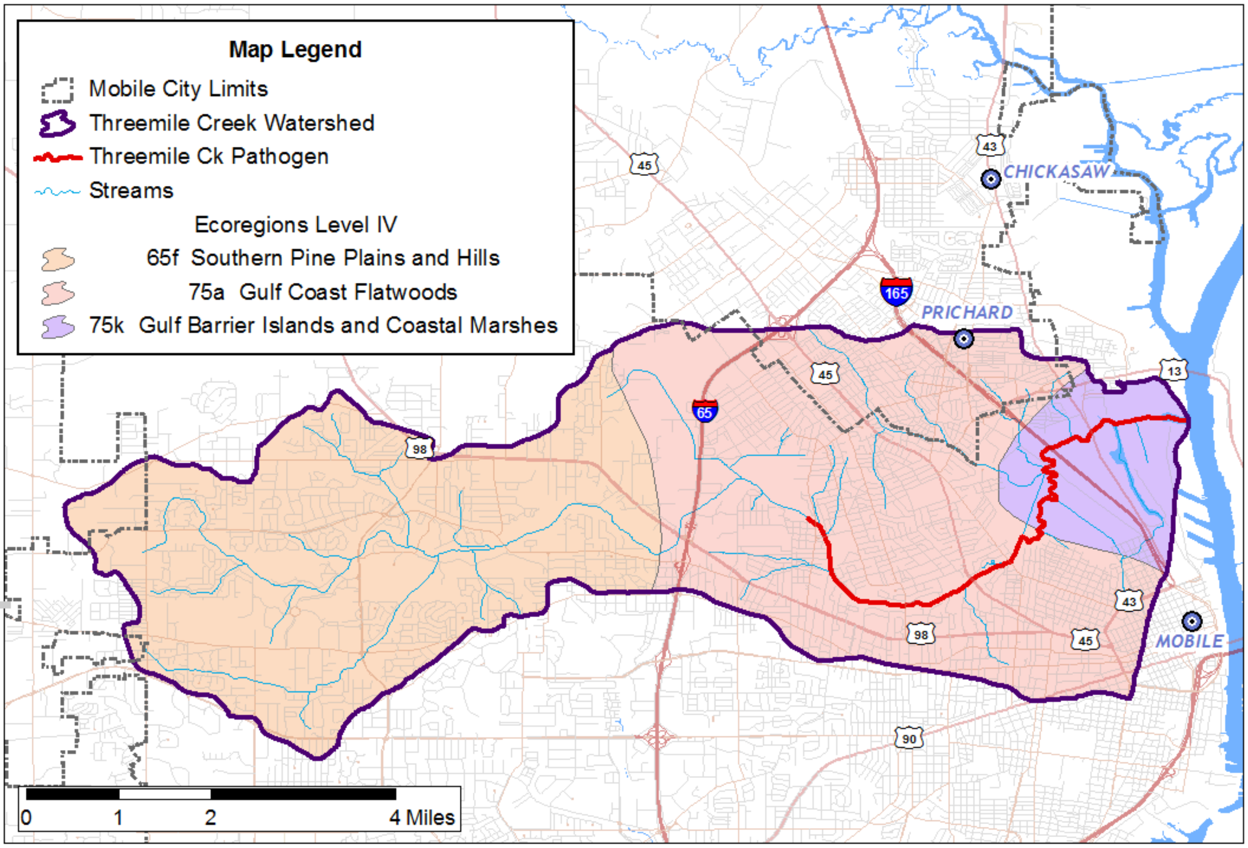


3.3 Ecoregions in the Threemile Creek Watershed

An ecoregion (short for ecological region) is a geographical area defined by unique physical characteristics and environmental conditions. This includes a wide range of physiographic elements such as geology, hydrology, soil characteristics, climate, native vegetation, and so on. Recognizing how these characteristics are spatially correlated help us to better understand ecological impacts and aid in managing natural resources.

The TMC watershed is located in the southernmost portion of the *East Gulf Coastal Plain* physiographical region. This area includes *Southeastern Plains Ecoregion (65)* and the *Southern Coastal Plain Ecoregion (75)*. These two level III ecoregions can be further broken down into three level IV ecoregions, which are displayed in Map 3-3: Threemile Creek Level IV Ecoregions. This illustration is followed by brief descriptions of each ecoregion (listed in order of proportion of the total watershed area, largest to smallest).

Map 3-3: Threemile Creek Level IV Ecoregions



- In Alabama, the ***Gulf Coast Flatwoods (75a) Ecoregion*** occupies a narrow strip along the coastal areas surrounding Mobile Bay and adjacent estuaries. This region is characterized by wet, sandy flats and broad (sometimes swampy) depressions that are typically covered with Southern mixed forests. Streams are low-gradient with sandy and silty substrates. (14.07 mi^2 of watershed)
- The ***Southern Pine Plains and Hills (65f)*** are dominated by southern yellow pine and mixed forests spread over southward-sloping dissected irregular plains, low hills, and slightly steeper slopes near drains. Streams in this area tend to display low- to moderate-gradients, higher acidity, stained or tannic color, with sandy or clay bottoms. (12.95 mi^2 of watershed)
- The ***Gulf Barrier Islands and Coastal Marshes (75k) Ecoregion*** is an even more narrow sliver of land consisting of river delta, intertidal salt/brackish marshes, barrier islands, beaches, and mixed pine and hardwood scrub/shrub stretched along the shorelines of Alabama and Mississippi. (2.67 mi^2 of watershed) (Griffith et al, 2001)

It should be noted that though these are the naturally occurring landscapes of the region, some of which are still present, much of the watershed has been transformed by development and urbanization. More information concerning changes in land cover and impervious surfaces are discussed in more detail in Section 5.2.3.

3.4 Soil Characteristics

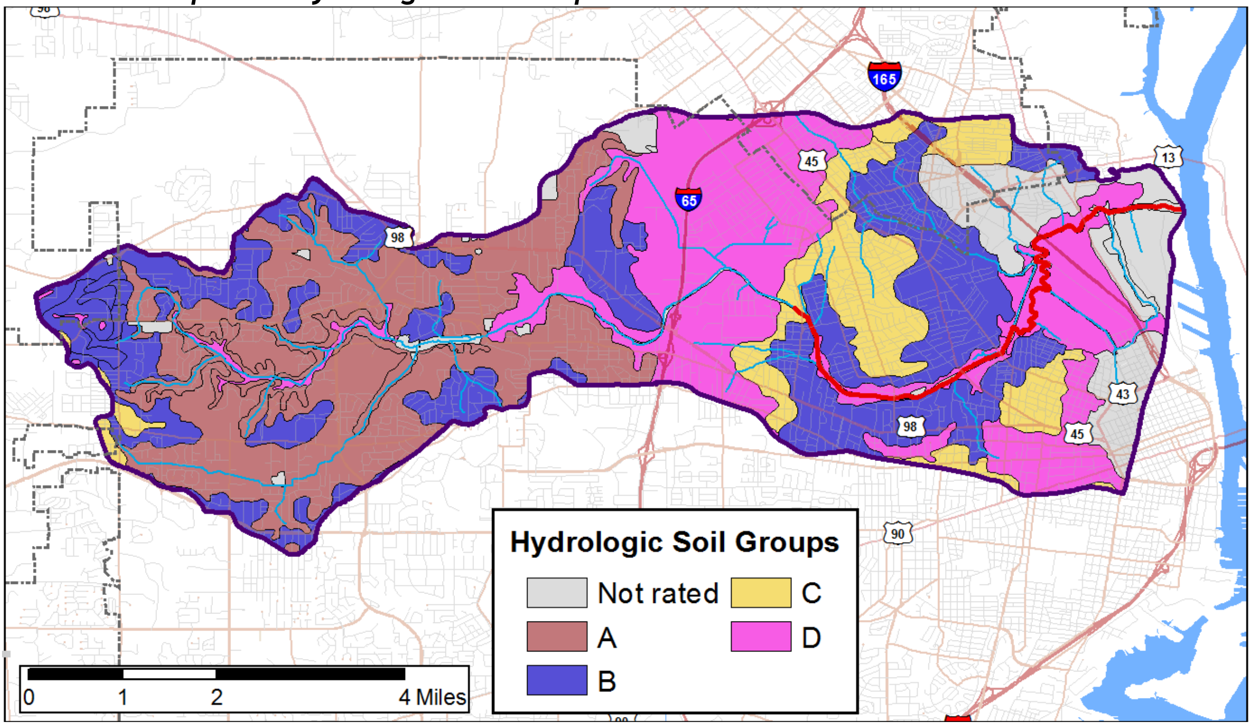
Soil types and their physical characteristics can have a large impact on water quality. Much like the taxonomic system used in naming plants or animals, a similar convention exists for soils. Out of the 12 soil orders, two are present in the Threemile Creek watershed. Soils in the TMC watershed are primarily Ultisols, which are also referred to as red clay soils. A small portion near the mouth is classified as Histosols, which are organic soils common in swampy or marshy areas.

The Threemile Creek watershed is comprised of mostly loamy sands and sandy loams in all four hydrologic soil groups. The following excerpt from the Natural Resource Conservation Service (NRCS) *Soil Data Viewer Extension for ArcMap 10* describes each soil group (NRCS, 2012):

- ***Group A:*** *Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.*
- ***Group B:*** *Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.*
- ***Group C:*** *Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.*
- ***Group D:*** *Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.*
- *If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only soils that are rated D in their natural condition are assigned to dual classes.*

The distribution of the soil types are shown in Map 3-4.

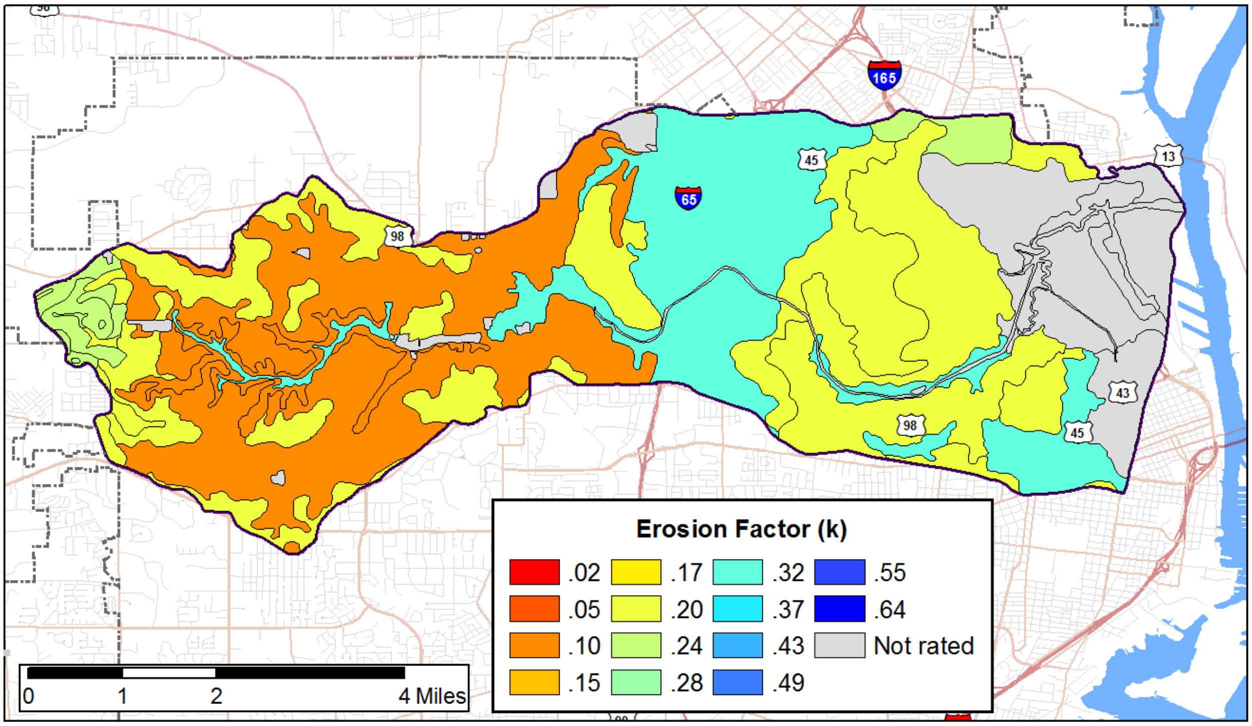
Map 3-4: Hydrologic Soil Groups in the Threemile Creek Watershed



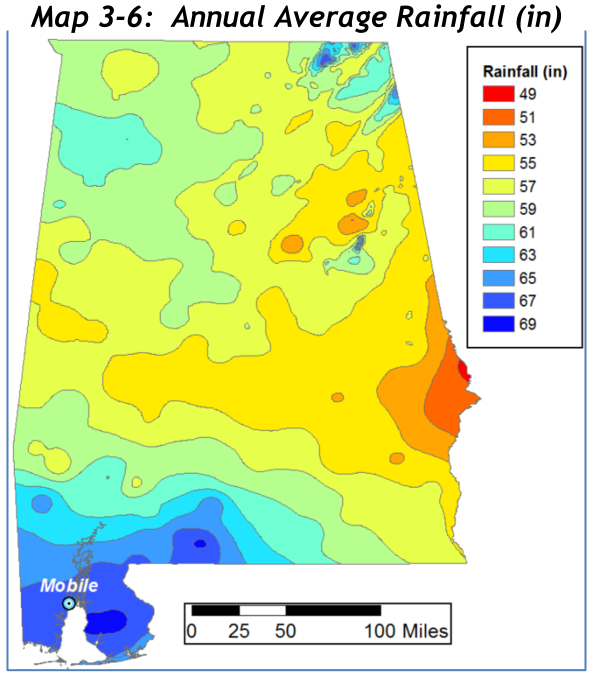
3.5 Slope & Erosion Potential

In the previous section, soil characteristics were discussed. The type of soil and topography of the landscape plays a large role in how susceptible watersheds are to sheet and rill erosion by surface runoff. Almost the entire TMC watershed has a representative slope of less than 5% and a moderate erodibility factor (0.1 < *k* < 0.4). Higher *k*-values represent increased vulnerability to erosion. The fate and transport of pathogens is correlated to erosion and the resulting sediment transport. As seen in Map 3-5, the areas with a higher potential for erosion are located near the pathogen impairment.

Map 3-5: Erosion Potential in the TMC Watershed



Map 3-6: Annual Average Rainfall (in)

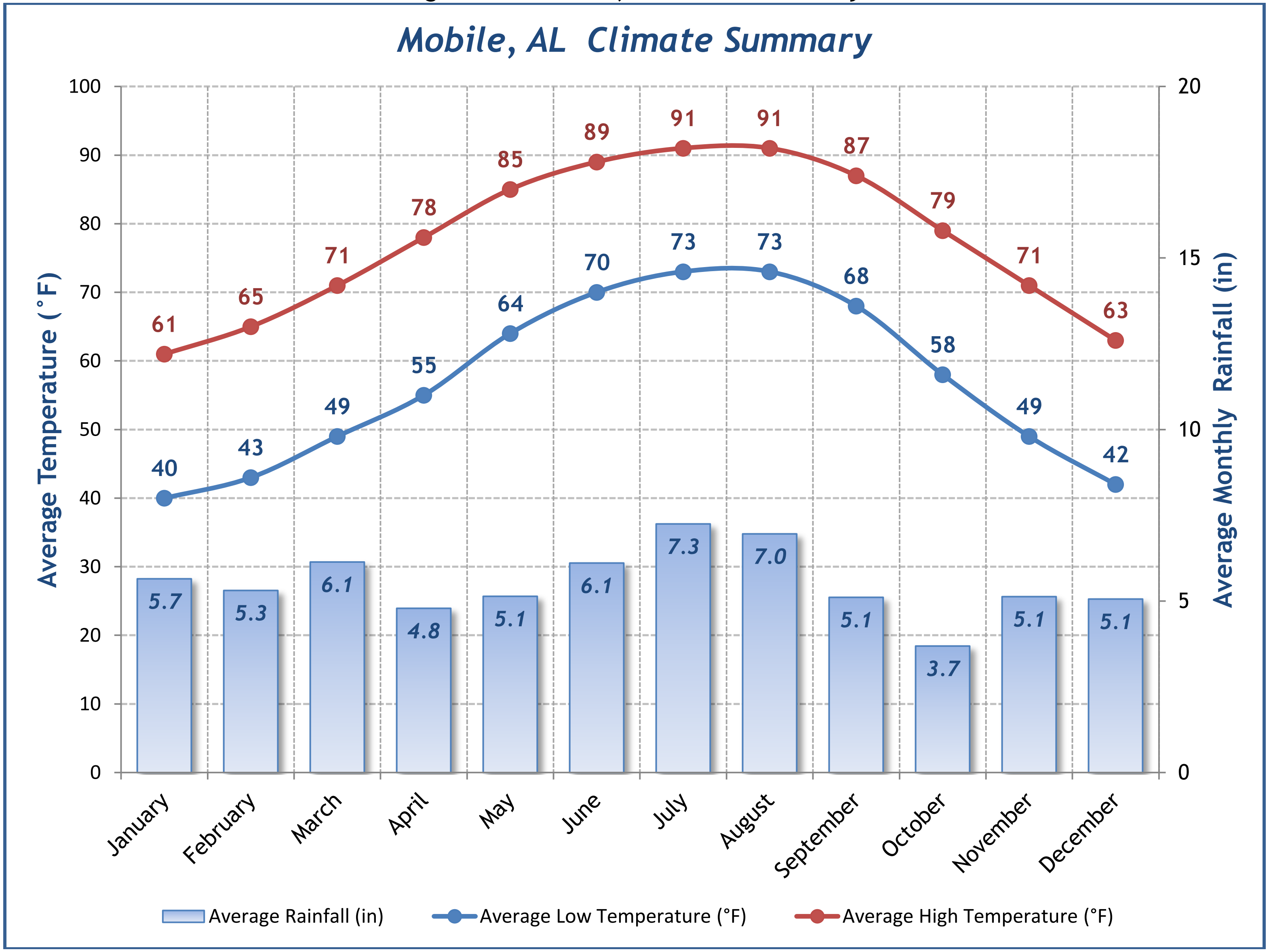


3.6 Climate & Rainfall

The humid subtropical climate of Mobile, AL is typical of the southern temperate rainforests, which are characterized by long growing seasons, periods of intense rainfall, and generally mild temperatures. According to a study completed in 2007 by Weatherbill, Inc., Mobile, AL receives an average of 66+ inches of rainfall per year, officially making it the wettest US city by volume. It also ranks second in most rainy days per year with 59.3 (days with 0.25" or more). A summary of the climate of Mobile, AL is displayed in Figure 3-2.

In addition to localized coastal weather phenomena, the area is also affected by global weather patterns such as El Niño, La Niña, and the warm Gulf Stream current which loops through the Gulf of Mexico before flowing northward up the Atlantic Seaboard.

Figure 3-2: Mobile, AL Climate Summary



3.7 Land Use Assessment

The following illustrations represent land uses in the Threemile Creek watershed. First, land cover types are displayed ungrouped, and then they are categorized by general type (natural, developed, and other). About 78% of the watershed is considered developed land. These statistics were derived from geospatial land cover data from the National Land Cover Dataset (*NLCD, 2006*).

Figure 3-3 Threemile Creek Land Cover (Ungrouped)

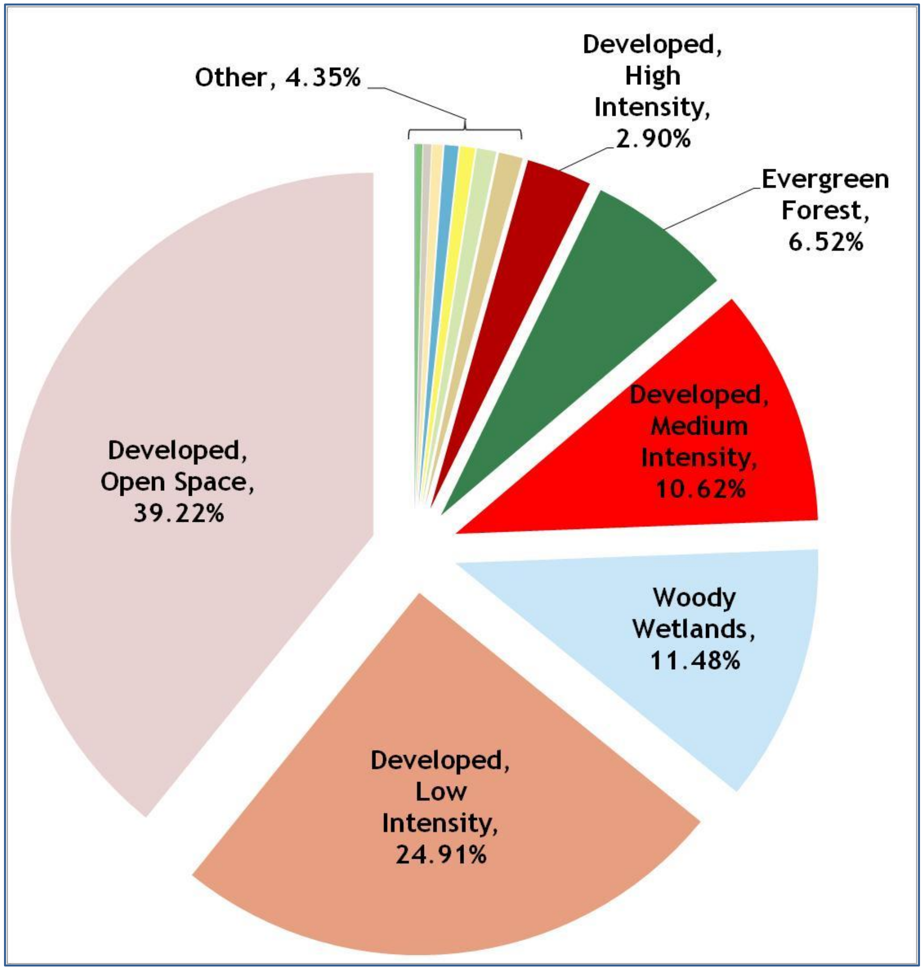


Table 3-1: Ungrouped Land Cover Statistics

Class Description	mi²	Acres	Percent
Deciduous Forest	0.01	6.22	0.03%
Barren Land	0.09	56.90	0.30%
Open Water	0.10	66.90	0.35%
Grassland / Herbaceous	0.14	87.79	0.46%
Emergent Herbaceous Wetlands	0.18	116.68	0.61%
Hay/Pasture	0.20	124.90	0.66%
Mixed Forest	0.26	164.24	0.86%
Shrub/Scrub	0.32	202.47	1.07%
Developed, High Intensity	0.86	551.62	2.90%
Evergreen Forest	1.93	1238.15	6.52%
Developed, Medium Intensity	3.15	2017.14	10.62%
Woody Wetlands	3.41	2180.71	11.48%
Developed, Low Intensity	7.39	4730.80	24.91%
Developed, Open Space	11.64	7448.03	39.22%
TOTALS →	**29.68**	**18992.56**	**100.00%**

Figure 3-4: Threemile Creek Land Cover (Grouped)

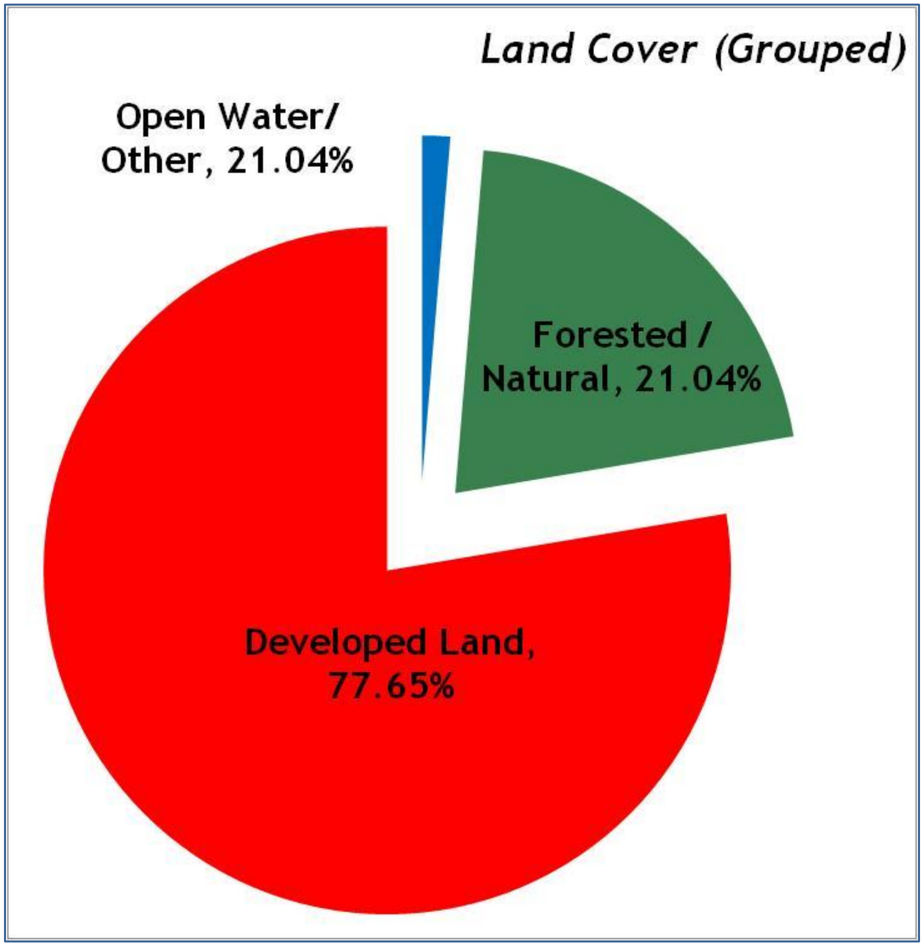
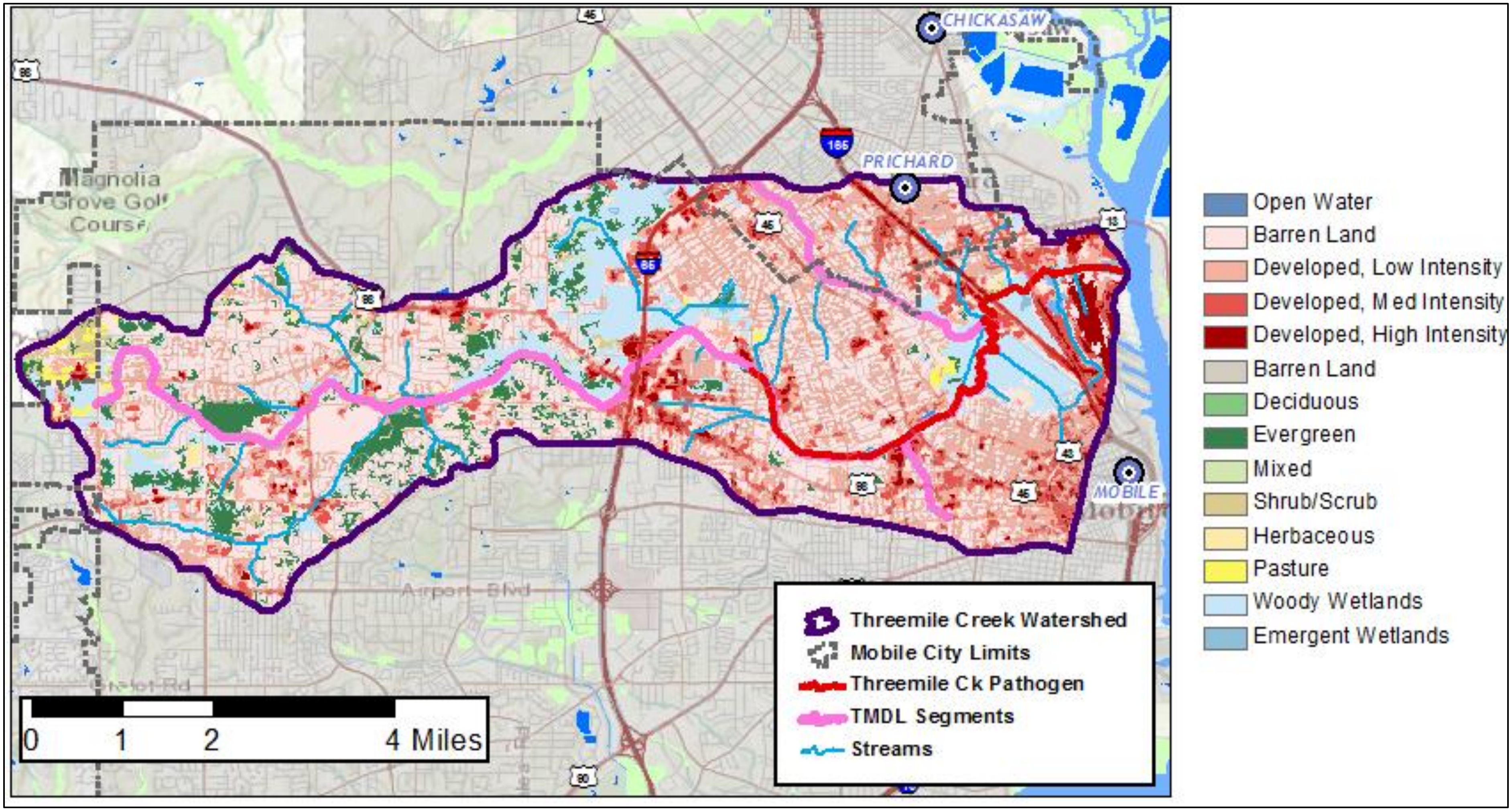


Table 3-2: Grouped Land Cover Statistics

Class Description	mi²	Acres	Percent
Open Water / Other	0.39	248.70	1.31%
Forested / Natural	6.24	3996.27	21.04%
Developed Land (Grouped)	23.04	14747.59	77.65%
TOTALS →	**29.68**	**18992.56**	**100.00%**

Map 3-7: Threemile Creek Land Cover (NLCD, 2006)



3.8 Special Conditions

As a coastal city on the northern Gulf of Mexico, Mobile is subject to powerful tropical storm systems including hurricanes. In addition to damaging winds and large amounts of precipitation, there are often storm surges associated with these systems. This rise in water level can result in widespread inland flooding which can leads to disruption in normal hydrological and ecological function.

3.9 Threatened or Endangered Species

There are three species in the Threemile Creek watershed that have been designated as threatened or endangered: the alligator snapping turtle (*Macroclemys temminckii*), the Alabama red-belly turtle (*Pseudemys alabamensis*), and the gulf sturgeon (*Acipenser Oxyrinchus Desotoi*). The alligator snapping turtle has been identified by the Alabama National Heritage Program as fair to good established variability with no signs of decline. The red-bellied turtle is primarily threatened by loss of habitat and nesting area, which has led to an apparent decrease in recruitment. Their range is limited to the Mobile-Tensaw River Delta in Mobile and Baldwin Counties of Alabama (ADEM, 2006). Finally, the gulf sturgeon was listed as a threatened species by the US Fish and Wildlife Service in 1991. The gulf sturgeon is anadromous, living in salt water yet spawning in fresh water and is also threatened by habitat destruction and degradation (Mettee et al, 1996).

Picture 3-4: Threatened and Endangered Species in the Threemile Creek Watershed

4.0 PROBLEM STATEMENT

4.1 Original Listing Information

Two segments on the lower portion of Threemile Creek were originally placed on Alabama's *2004 §303(d) List of Impaired Waterbodies* for pathogens (fecal coliform) based on data collected in 2000-2001 by the United States Geological Survey (USGS). In accordance with *Alabama's Water Quality Assessment and Listing Methodology*, an *A&I* waterbody can be placed in Category 5 for bacteriological impairment if more than 10% of single samples exceed the criteria. Of the samples collected by USGS, three of seven, or 43%, exceeded the state's bacteria criteria. In January of 2010, Alabama adopted *Enterococci* as the indicator bacteria for coastal waters, thus the loadings in this TMDL are expressed accordingly. Subsequent sampling in the TMC watershed has continued to show impairment with respect to pathogens (*Enterococci*). Pathogen data collected by both ADEM and USGS can be found in the Water Quality Dataset section.

4.2 Water Quality Standards & Criteria Exceeded

Table 4-1: Alabama Bacteriological Criteria for A&I Waterbodies

Use Classification	Non-Coastal Waters	Coastal Waters
Agricultural and Industrial Water Supply (*A&I*)	*E. Coli (colonies/100 ml)* • Geometric Mean ≤ 700 • Single Sample Max ≤ 3200	*Enterococci (colonies/100 ml)* • Single Sample Max ≤ 500

The following excerpt from *ADEM's Administrative Code, Chapter 335-6-10-.09* outlines the specific water quality criteria for the *A&I* use classification:

(7) **AGRICULTURAL AND INDUSTRIAL WATER SUPPLY**

(a) Best usage of waters: agricultural irrigation, livestock watering, industrial cooling and process water supplies, and any other usage, except fishing, bathing, recreational activities, including water-contact sports, or as a source of water supply for drinking or food-processing purposes.

(b) Conditions related to best usage:

(i) The waters, except for natural impurities which may be present therein, will be suitable for agricultural irrigation, livestock watering, industrial cooling waters, and fish survival. The waters will be usable after special treatment, as may be needed under each particular circumstance, for industrial process water supplies. The waters will also be suitable for other uses for which waters of lower quality will be satisfactory.

(ii) This category includes watercourses in which natural flow is intermittent and non-existent during droughts and which may, of necessity, receive treated wastes from existing municipalities and industries, both now and in the future. In such instances, recognition must be given to the lack of opportunity for mixture of the treated wastes with the receiving stream for purposes of compliance. It is also understood in considering waters for this classification that urban runoff or natural conditions may impact any waters so classified.

(c) Specific criteria:

1. Sewage, industrial wastes, or other wastes: none which are not effectively treated or controlled in accordance with rule 335-6-10-.08.

2. pH: sewage, industrial wastes or other wastes shall not cause the pH to deviate more than one unit from the normal or natural pH, nor be less than 6.0, nor greater than 8.5. For salt waters and estuarine waters to which this classification is assigned, wastes as herein described shall not cause the pH to deviate more than one unit from the normal or natural pH, nor be less than 6.5, nor greater than 8.5.

3. Temperature: the maximum temperature rise above natural temperatures due to the addition of artificial heat shall not exceed 5°F in streams, lakes, and reservoirs, nor shall the maximum water temperature exceed 90°F.

4. Dissolved oxygen: sewage, industrial wastes, or other wastes shall not cause the dissolved oxygen to be less than 3.0 mg/l. In the application of dissolved oxygen criteria referred to above, dissolved oxygen shall be measured at a depth of 5 feet in waters 10 feet or greater in depth; and for those waters less than 10 feet in depth, dissolved oxygen criteria will be applied at middepth.

5. Color, odor, and taste-producing substances, toxic substances, and other deleterious substances, including chemical compounds attributable to sewage, industrial wastes, and other wastes: only such amounts as will not render the waters unsuitable for agricultural irrigation, livestock watering, industrial cooling, industrial process water supply purposes, and fish survival, nor interfere with downstream water uses. For the purpose of establishing effluent limitations pursuant to chapter 335-6-6 of the Department's regulations, the minimum 7-day low flow that occurs once in 10 years ($7Q_{10}$) shall be the basis for applying the acute aquatic life criteria. The use of the $7Q_{10}$ low flow for application of acute criteria is appropriate based on the historical uses and/or flow characteristics of streams to be considered for this classification.

6. Bacteria: In non-coastal waters, bacteria of the E. coli group shall not exceed a geometric mean of 700 colonies/100 ml; nor exceed a maximum of 3,200 colonies/100 ml in any sample. In coastal waters, bacteria of the *Enterococci* group shall not exceed a maximum of 500 colonies/100 ml in any sample. The geometric mean shall be calculated from no less than five samples collected at a given station over a 30-day period at intervals not less than 24 hours.

7. Radioactivity: the concentrations of radioactive materials present shall not exceed the requirements of the State Department of Public Health.

8. Turbidity: there shall be no turbidity of other than natural origin that will cause substantial visible contrast with the natural appearance of waters or interfere with any beneficial uses which they serve. Furthermore, in no case shall turbidity exceed 50 Nephelometric units above background. Background will be interpreted as the natural condition of the receiving waters without the influence of man-made or man-induced causes. Turbidity levels caused by natural runoff will be included in establishing background levels.

5.0 TECHNICAL BASIS FOR TMDL DEVELOPMENT

5.1 Water Quality Target Identification

For this TMDL analysis, the numeric water quality target is set to ≤ 500 colonies / 100ml, the instream single-sample bacteria criteria for the *A&I* use classification. This target, in conjunction with a target of zero for leaking collection systems and illicit discharges, is the basis for the TMDL and load allocations, and is protective of water quality standards applicable to the *A&I* use classification.

5.2 Pollutant Source Assessment

5.2.1 Point Source Discharges

A point source is defined as any discernable, confined, and discrete conveyance (such as a pipe, ditch, channel, or various other structures) from which pollutants are, or may be discharged. These effluent and stormwater outlets include municipal wastewater treatment plants (WWTPs), municipal separate storm sewer systems (MS4s), industrial facilities, mining operations, confined animal feeding operations (CAFOs), and certain stormwater and construction discharges. They are regulated through the National Pollutant Discharge Elimination System (NPDES) to ensure pollutant loadings are protective of applicable water quality standards of the State of Alabama. ADEM administers the NPDES permits on behalf of EPA based on the nature of discharge listed above and has separate program sections to address each type. The types of point sources most commonly associated with pathogen impairments are municipal WWTPs, MS4s, CAFOs, and a few specific industrial processes.

5.2.1.1 *Municipal Wastewater Treatment Plants*

In urban settings such as this, sewer lines typically run parallel to streams in the floodplain. Thus, if failing sanitary sewer infrastructure is present, substantial loads of pathogens can flow into adjacent surface waters or even leach into the groundwater. Similarly, upset operating conditions, improper treatment, bypasses, and other illicit discharges from sewage treatment facilities can also have severe negative impacts on water quality with respect to pathogens. Numeric limits on the amount of pathogens a WWTP can legally discharge are included in their NPDES permit and are expressed in the form of an indicator species of bacteria. Other NPDES permits in the watershed, including industrial and construction stormwater, were not included in the narrative since they are not believed to be a contributing source.

There are two major (> 1.0 million gallons per day (MGD)) WWTPs located in the TMC watershed: Mobile's Wright Smith WWTP (AL 0023094) and the City of Prichard's Carlos Morris WWTP (AL0023205), both of which are currently operated by Mobile Area Water and Sewer System (MAWSS). Both of these discharges are located near station TMCM-5 where the highest exceedance was observed.

Wright Smith WWTP discharges to the mainstem of TMC near the confluence of TMC with Toulmins Spring Branch with a current permitted design flow of 12.8 MGD. This plant provides service to approximately 28,000 people and has 355 miles of gravity mains, 12 miles of force mains, 8,185 manholes, and 35 lift stations in its footprint. Carlos Morris WWTP, which was only recently acquired by MAWSS as part of ongoing litigation, also discharges to TMC just downstream of Wright Smith's outfall with a design flow of 4.08 MGD. It has a service population of about 7,000 people and has around 48 miles of gravity mains, 1+ miles of force mains, 1,060 manholes, and 8 lift stations within its service area (MAWSS, 2013).

Table 5-1: Major Municipal WWTPs in the Threemile Creek Watershed

NPDES Permit ID	Facility Name	Receiving Waterbody	Design Flow (MGD)	Enterococci Limit [a]
AL0023034	Wright Smith Jr. WWTP	Threemile Creek	12.8	500 col/100 ml
AL0023205	Carlos A. Morris WWTP	Threemile Creek	4.08	500 col/100 ml

a. Pending NPDES permit limits are applied as a daily maximum reported monthly.

As a result of load reductions required by the 2006 Threemile Creek Organic Enrichment / Dissolved Oxygen TMDL and consent decrees due to degraded water quality in the watershed, both facilities are transitioning to outfall locations located on the Mobile River which would allow for greater assimilative capacity of pollutants. Thus, for Wright Smith WWTP, a tiered NPDES permit for both outfall locations is currently under development. The relocation is on schedule for completion by the end of 2013. As for Carlos A. Morris WWTP, the future is uncertain at this time, though it is certain the discharge location in Threemile Creek will be abandoned.

In addition to the permitted continuous discharge of treated effluent (i.e. end-of-pipe), sanitary sewer overflows (SSOs) caused by excessive stormwater, power failure, blockage, or other upset condition can also contribute to pathogen loadings. The vast amount of infrastructure mentioned above requires constant maintenance and upgrades over time. SSOs are required to be reported to ADEM and are fairly common during rain events. Typically, overflows are detected and addressed quickly in order to minimize pathogen exposure to the public. ADEM maintains a database of SSOs that includes the time, date, location, and duration of the event. Failure to remediate ongoing issues can result in penalties and other enforcement action. SSOs have been reported at both plants. According to their respective *Municipal Water Pollution Prevention* (MWPP) annual reports, Wright Smith had over 90 SSOs and Carlos A. Morris had 12 SSOs. Both facilities are under a court-ordered mandate called a consent decree, which is a binding agreement between ADEM and the permittee aimed at remediating issues which are causing environmental harm. These orders impose penalties for illicit discharges, require maintenance and/or upgrades to failing infrastructure, and also call for updates on progress. A consent decree was issued by ADEM in 1996 to the Prichard Water Works and Sewer board, which operated Carlos A. Morris at the time. MAWSS, which now operates both facilities, was subsequently served a separate consent decree in 2002. In addition to permitted limits, compliance with this TMDL begins with the requirements set forth in these agreements, including reducing SSOs and repairing failing infrastructure.

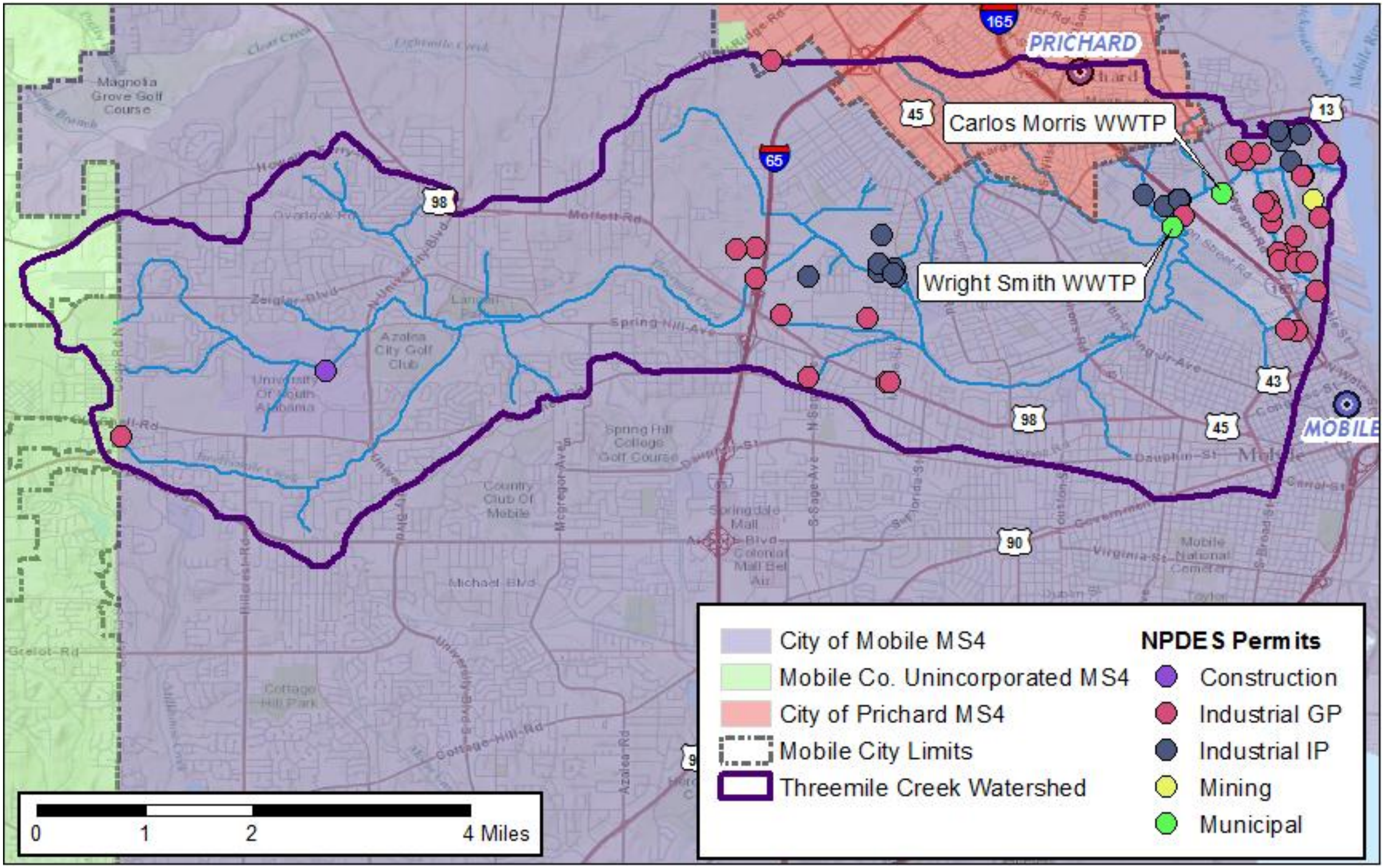
5.2.1.2 *Municipal Separate Storm Sewer Systems (MS4s)*

Stormwater runoff containing pollutants is commonly transported through Municipal Separate Storm Sewer Systems (MS4s), from which it is often discharged untreated into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a NPDES permit and develop a stormwater management program. Phase I MS4 permits, first issued in 1990, requires *medium* and *large* cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. Generally, Phase I MS4s are covered by individual permits and Phase II MS4s are covered by a general permit. Each regulated MS4 is required to develop and implement a stormwater management program (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges. An MS4 is a conveyance or system of conveyances that is:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the U.S.;
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.);
- Not a combined sewer; and
- Not part of a Publicly Owned Treatment Works (POTW)

The entirety of the TMC watershed falls within the Phase I permit area for the Greater Mobile Area MS4 ALS000002. Since source assessment between nonpoint sources and MS4 municipal stormwater is virtually impossible, both nonpoint sources and MS4 sources will be treated equally in this TMDL, both requiring a 97% reduction.

Map 5-1: NPDES & MS4 Entities in the Threemile Creek Watershed



Note: The MS4 permit for the greater Mobile area (ALS000002) includes the entities of the City of Prichard and unincorporated Mobile County. Thought they are covered under the same permit, each entity is responsible for stormwater management within their respective boundaries.

5.2.2 Nonpoint Source Assessment

5.2.2.1 *Wildlife*

Wildlife can also contribute to pathogen impairments, especially where it is plentiful and widespread. The State of Alabama boasts a very diverse river and stream network that also provides plenty of habitats for all kinds of wildlife. Waste from these animals can contribute to pathogen impairment. These are generally considered as natural background conditions and do not require a load reduction.

5.2.2.2 *Agricultural Activities & Domesticated Animals (AFOs, CAFOs, etc.)*

This is not a significant source of pathogens in the TMC watershed.

5.2.2.3 *Failing Onsite Wastewater Disposal Systems*

Onsite wastewater disposal systems can pose a serious threat to water quality if not maintained properly. The Alabama Department of Public Health (ADPH) estimates that about 25% of septic systems in Alabama could be failing. The Mobile County Health Department requires initial site suitability tests for new installations as well as inspections for existing systems. More information can be found on their website at:
http://www.mobilecountyhealth.org/

5.2.2.4 *Domestic Pets*

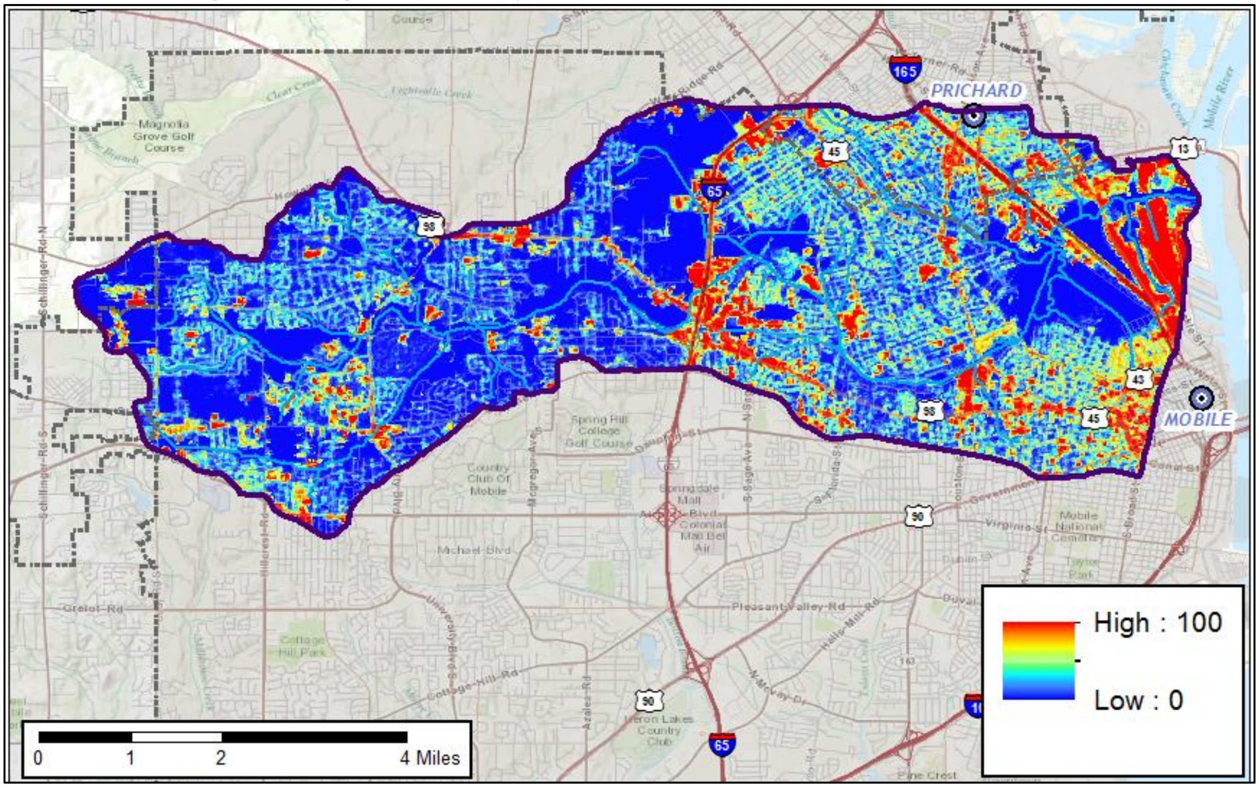
Domestic pets, such as dogs, cats, and so forth, can also be contributors to pathogen impairment. If the waste of these animals is not properly disposed of, it eventually washes into the streams through storm sewers and overland flow. Since a majority of the watershed is considered developed, it can be safely assumed that pet waste is a contributing factor to pathogen impairment.

5.2.3 Impervious Surfaces Assessment

Impervious surfaces have become a key indicator of the impact of developed lands on water quality. These surfaces increase runoff velocity and restrict stormwater from permeating the natural soil. The runoff is typically gathered in to storm sewer systems which discharge into lakes and streams, carrying with it any pollutants that are present. From the land use assessment above, the TMC Creek watershed is predominantly developed land (approximately 78%). Though not all of developed land is impervious, a large portion of it is.

Map 5-2 depicts impervious surfaces (dark red) versus non-impervious surfaces (blue). The darker the color red, the higher degree and density of impervious surfaces exists. Potential adverse water quality impacts can be reduced through engineering design of stormwater systems, best management practices, urban forestry and landscaping, and other initiatives.

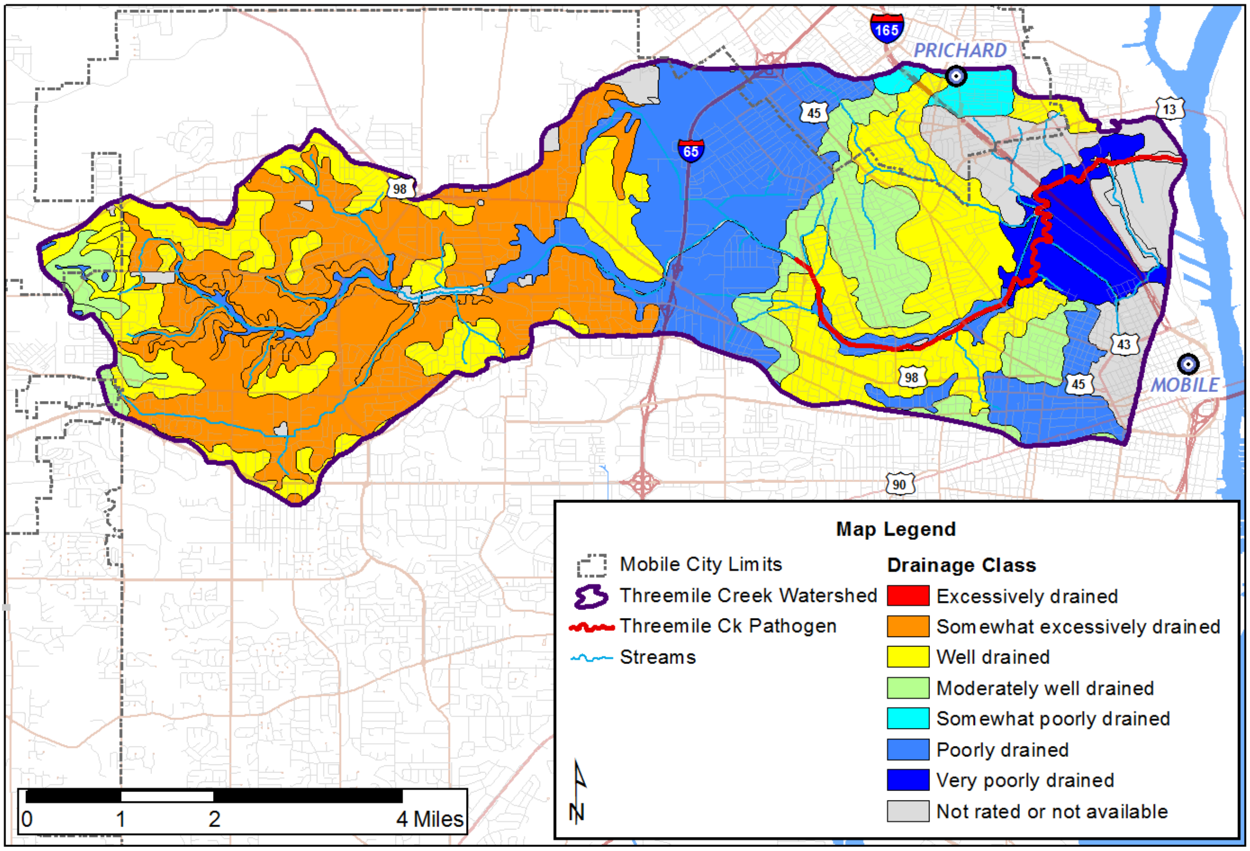
Map 5-2: Impervious Surfaces in the Threemile Creek Watershed



5.2.4 Drainage Assessment

Based on SSURGO (Soil Survey Geographic Database) data produced and distributed by the Natural Resources Conservation Service (NRCS), soil drainage properties can be spatially analyzed to identify areas where poorly drained soils may add to land use and impervious surface issues. Increased runoff due to low infiltration rates can increase transport of contaminants such as pathogens during storm events. The natural filtering process as water is absorbed into the soil is reduced where poor drainage exists. Much of the area in the lower part of the Threemile Creek watershed is considered “poorly drained” or “very poorly drained.” Some of the heavily urbanized areas in downtown Mobile were not rated due to the lack of availability of soil samples (all impervious). Aside from stormwater infrastructure, it is safe to assume that these areas are also considered “very poorly drained.”

Map 5-3: Drainage Characteristics of the Threemile Creek Watershed



5.3 Linkage between Numeric Targets & Sources

5.3.1 Nonpoint Loading Information

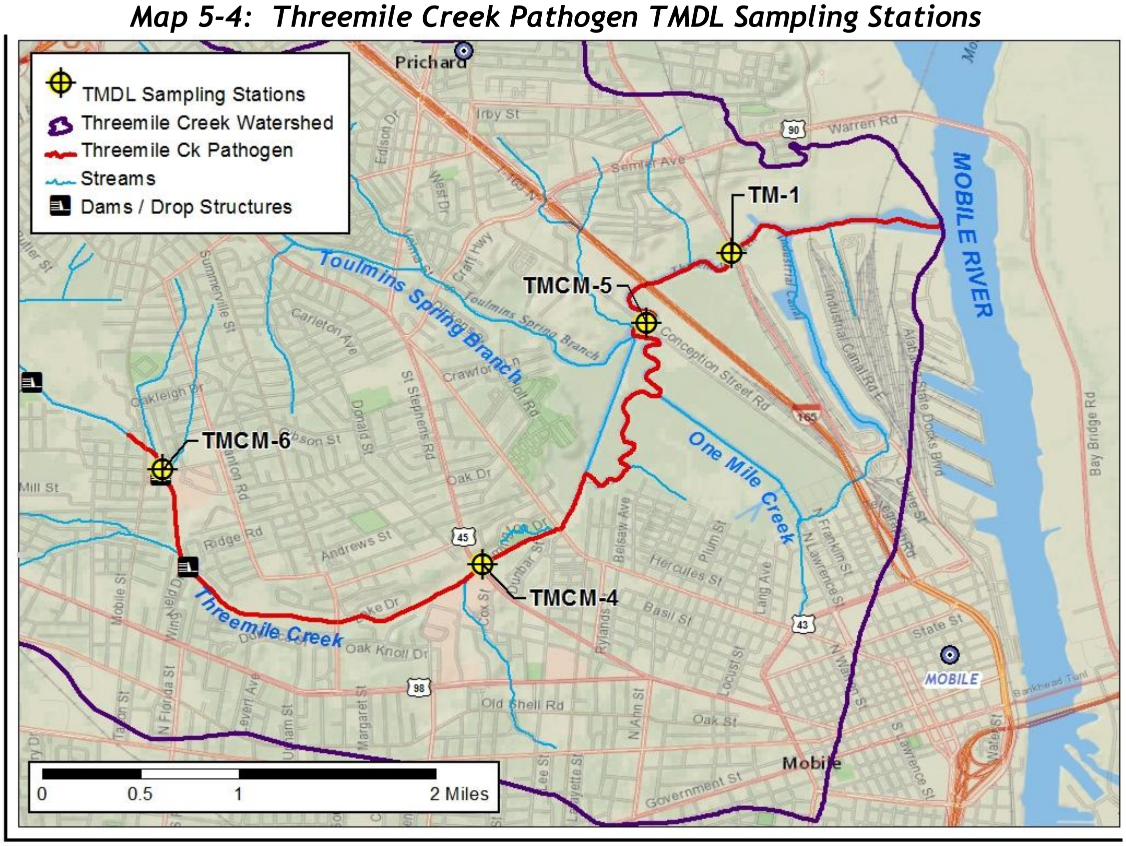
The Threemile Creek watershed has three main land cover types: urbanized developed areas, forests, and all others. Pollutant loadings from forested areas tend to be low due to their filtering capabilities and will be considered as background conditions. The most likely sources of pathogen loadings from nonpoint sources in the TMC watershed are urban runoff, failing septic systems, and illicit discharges. It is not considered a logical approach to calculate individual components for nonpoint source loadings. Hence, there will not be individual loads or reductions calculated for the various nonpoint sources. The loadings and reductions will only be calculated as a single total nonpoint source load and reduction.

5.4 Data Availability & Analysis

5.4.1 Data Acquisition and Results

Following its listing in 2004, a §303(d) sampling study was performed by ADEM on the listed segments of TMC for additional water quality assessment. ADEM collected samples from several different surface water quality stations, including stations along the entire length of the impaired segments. It should be noted that this segment was originally listed while fecal coliform was the indicator bacteria used for Alabama's listing methodology. In January 2010, Alabama adopted *Enterococci* as the pathogen indicator for coastal waterbodies. Consequently, the load reductions within this TMDL are entirely based on the *Enterococci* criteria and data, though the fecal coliform data was also scrutinized in order to formulate the most practical and effective way to implement the TMDL. Further review of the general water quality and intensive *Enterococci* study revealed that the listed segments of TMC were still not meeting the pathogen criterion applicable to its use classification (*A&I*). Each station was carefully examined and the data compiled to identify specific areas of impairment and possible sources. All stations had multiple single-sample exceedances. Therefore, a TMDL has been developed for the listed segment of TMC specific to the data collected.

Map 5-4: Threemile Creek Pathogen TMDL Sampling Stations



Station TMCM-6, located near the beginning of the upper listed segment, exhibited exceedances of the criteria on about 40% of the station visits. The highest exceedance of 2900 col/100 ml was observed on June 22, 2011. This coincided with exceedances collected the same day at the other stations. Station TMCM-4, just downstream of TMCM-6 on the upper segment also had an exceedance rate of about 40%, the highest being on the same date and of the same magnitude as TMCM-6 (06-22-2011, 2,900 col/100 ml).

Station TMCM-5 is located just downstream of the confluence of Threemile Creek with Toulmins Springs Branch near the outfalls of the two major municipal sources. The highest observed single-sample exceedance of 12,000 col/100 ml, 24 times the acceptable water quality criteria, was collected on 03-10-2011. As an implicit margin of safety, this value was selected to represent the existing condition. Finally, Station TM-1, a trend monitoring station with a large amount of data, showed 8 exceedances in the past 6 years. This station is sampled monthly for a host of water quality parameters. Please see the Water Quality Dataset section of this report for complete datasets.

5.5 Critical Conditions

For the Southeast, the most critical time periods with respect to water quality and stream health occur during the hot, dry months of the summer (June through September). During these months, flow dissipates due to lack of precipitation and increase in temperature. This, in turn, results in a reduction in assimilative capacity of waterbodies. Moreover, water quality parameters such as dissolved oxygen are much more susceptible to reaching dangerous levels during these critical periods.

5.5.1 Low Flow Estimates

Based on USGS daily average streamflow data, statistical low-flow estimates were developed using Water Resources Database 5.0 (WRDB 5.0). While there are USGS stations on Threemile Creek, data from USGS Gage #02471001 (*Chickasaw Creek near Kushla, AL)* was ultimately used for these estimates. This gage exhibited a continuous dataset with a long period of record while the gages located on TMC were more limited. Both watersheds possess similar characteristics with respect to geographic location, average annual precipitation, and streamflow recession index. Thus, low-flow estimates for stations on TMC were found via the ratio method using low-flow analyses performed for USGS Gage 02471001. This method estimates flows at an ungaged station of a known drainage area based on the drainage area and flows at a hydrologically similar location. These estimates are available in Section 9.3.2. Low-flow estimates are often used in permit development and other water quality calculations as a representation of critical conditions. In this case, however, the instantaneous streamflow measurement at the Kushla, AL gage was ratioed based on drainage area in order to find the streamflow for Threemile Creek at the actual time the sample was collected. Low-flow estimates were still included as a point of reference and an illustration on the magnitude of flow during critical periods.

5.6 Margin of Safety

There are two methods for incorporating a Margin of Safety (MOS) during a TMDL analysis: implicitly incorporate the MOS using conservative model assumptions to develop allocations, or 2) by explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

Both an explicit and implicit MOS were incorporated into this TMDL. The MOS accounts for the uncertainty associated with pathogen loadings. An explicit MOS of 10% was applied to the TMDL. An implicit MOS was also incorporated in the TMDL by basing the existing condition on the highest measured *Enterococci* organism count that was collected during critical conditions.

6.0 TMDL DEVELOPMENT

6.1 TMDL Definition & Equations

A total maximum daily load (TMDL) is the sum of individual wasteload allocations for point sources (WLAs), load allocations (LAs) for nonpoint sources including natural background levels, and a margin of safety (MOS). As mentioned in the previous section, the margin of safety can be included either explicitly or implicitly and accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. A TMDL can be denoted by the equation:

$$\textbf{TMDL} = \Sigma\ \textbf{WLAs} + \Sigma\ \textbf{LAs} + \textbf{MOS}$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while achieving water quality standards under critical conditions. For some pollutants, TMDLs are expressed on a mass loading basis (e.g. pounds per day). However, for pathogens, TMDL loads are typically expressed in terms of organism counts per day (colonies/day) or by volume (colonies/100 ml), in accordance with 40 CFR 130.2(i).

6.2 Load Calculations

A method similar to a mass balance approach was used to calculate the *Enterococci* pathogen TMDL for Threemile Creek. This approach utilizes the conservation of mass principle (or organism loadings in this case). Total loads can be calculated by multiplying the *Enterococci* concentrations by streamflow, yielding a daily organism count. The existing condition was calculated for the exceedance at station TMCM-5, which resulted in the highest percent reduction. In the same manner, the allowable load was calculated by multiplying the single-sample bacteria criterion for coastal waters by the same flow used in calculating the existing condition.

6.2.1 Allowable Loading

The allowable load of pathogens in the watershed was calculated under the same physical conditions as discussed in the *Existing Conditions* section. This was done by taking the streamflow and multiplying it by the single-sample *Enterococci* criterion for the *A&I* use classification (see *Calculation B* in Figure 6-2: Pathogen Loading Worksheet). *Calculation C* in the same figure shows how the explicit MOS was calculated. Finally, the allowable loading, including the explicit MOS, is shown in *Calculation D*.

In addition to the overall allowable loadings discussed above, allowable loadings were also calculated for individual point sources based on their design flow and pending permit limits (which is also the single-sample *Enterococci* criterion for the *A&I* use classification). These calculations are shown below:

Figure 6-1: Allowable WLA Loadings

Allowable Wasteload Allocation (Point Source Discharges)						
Wright Smith WWTP (AL0023094) (Permitted Daily Maximum - *Enterococci*)	12.8	~~*MGD*~~	X $\frac{500}{100}$ $\frac{col}{\text{~~ml~~}}$	X 24465755	X 100 $\frac{\text{~~ml~~} * s}{\text{~~ft}^3\text{~~} * day}$	X 1.547 $\frac{\text{~~cfs~~}}{\text{~~MGD~~}}$
	=	***2.42231E+11***	***col / day***			
Carlos Morris WWTP (AL0023205) (Permitted Daily Maximum - *Enterococci*)	4.08	~~*MGD*~~	X $\frac{500}{100}$ $\frac{col}{\text{~~ml~~}}$	X 24465755	X 100 $\frac{\text{~~ml~~} * s}{\text{~~ft}^3\text{~~} * day}$	X 1.547 $\frac{\text{~~cfs~~}}{\text{~~MGD~~}}$
	=	***7.72E+10***	***col / day***			
Total Wasteload Allocation (WWTPs)*	=	**3.19E+11**	***col / day***			

*Allowable WLA loading based on pending permit requirements

Figure 6-2: Pathogen Loading Worksheet

Pathogen Loading Calculations Worksheet

Station TMCM-5 (Representing Lower Segment AL03160204-0504-101)

Threemile Creek *Enterococci* Criteria (*A&I*):	Single-sample:	≤	500	colonies / 100 ml	
	Geomean:		No Criteria		
Highest Single-Sample Exceedance:	12,000	col / 100 ml		Date:	3/10/2011
				Time:	8:15 AM
Chickasaw Creek Streamflow* (gaged):	1225	cfs	Drainage Area:	125.0	mi^2
Threemile Creek Streamflow (ratioed):	243.04	cfs	Drainage Area:	24.8	mi^2

	Streamflow (Q)		*Enterococci*	Conversion Factors				
Exisiting Condition *(Based on Highest SS Exceedance)*	243.04 $\frac{ft^3}{s}$	X	$\frac{12{,}000\ col}{100\ ml}$	X 24465755	X 100	$\frac{ml * s}{ft^3 *day}$	=	7.14E+13 $\frac{col}{day}$ A
Allowable Loading *(Without MOS)*	243.04 $\frac{ft^3}{s}$	X	$\frac{500\ col}{100\ ml}$	X 24465755	X 100	$\frac{ml * s}{ft^3 *day}$	=	2.97E+12 $\frac{col}{day}$ B
Margin of Safety (MOS) *(Explicit MOS set to 10%)*	243.04 $\frac{ft^3}{s}$	X	$\frac{50\ col}{100\ ml}$	X 24465755	X 100	$\frac{ml * s}{ft^3 *day}$	=	2.97E+11 $\frac{col}{day}$ C
Allowable Loading *(Including MOS)*	Total Allowable	-	MOS	= 2.97E+12	- 2.97E+11		=	2.68E+12 $\frac{col}{day}$ D

*Instantaneous USGS flow at time bacteriological sample was collected (average of 8:00 AM & 8:30 AM measurements)

6.2.2 Existing Conditions

The existing pathogen loading conditions were calculated by multiplying the *Enterococci* single-sample exceedance concentration of 12,000 col/100 ml by the instantaneous streamflow of 243.04 cfs. The product of these two values multiplied by a conversion factor yields the total loading (col/day) of *Enterococci (Calculation A* in Figure 6-2: Pathogen Loading Worksheet). Existing LA loading was found by subtracting the existing WLA loading from the total existing loading.

Figure 6-3: Existing Point Source Loading Calculations

Existing Wasteload Allocation (Point Source Discharges)							
Wright Smith WWTP (AL0023094) (DMR Daily Maximum - Fecal Coliform)	12.80	~~MGD~~	X 31.00 / 100	col / ~~ml~~	X 24465755	X 100 (~~ml~~ * s) / (~~ft^3~~ *day)	X 1.547 ~~cfs~~ / ~~MGD~~
	=	**1.50E+10**	***col / day***				
Carlos Morris WWTP (AL0023205) (DMR Data Daily Maximum - *Enterococci*)	4.08	~~MGD~~	X 350.00 / 100	col / ~~ml~~	X 24465755	X 100 (~~ml~~ * s) / (~~ft^3~~ *day)	X 1.547 ~~cfs~~ / ~~MGD~~
	=	**5.40E+10**	***col / day***				
Total Existing Load (WWTPs)*	=	**6.91E+10**	***col / day***				

Figure 6-4: Existing Nonpoint Source Loading Calculations

Existing Nonpoint Source Loading								
Existing LA Loading	=	Total Existing Loading	-	Existing WLA Loading				
	=	7.14E+13	-	6.91E+10	=	7.13E+13		
LA Reduction	=	(Existing LA - Allowable LA) / Existing LA			=	**%-Reduction**		**Reduction (col/day)**
	=	(7.13E+13 - 2.36E+12) / 7.13E+13			=	**96.7%**	**or**	**6.89E+13**

6.2.3 Required Load Reductions

The difference in the pathogen loading between the existing condition (exceedance event) and the allowable condition (water quality criteria) represents the total load reduction required and amounts to a 97% reduction. The following tables show the result of the *Enterococci* TMDL for Threemile Creek.

Table 6-1: Enterococci Load Reduction Requirements

Source	Existing Load [a] (colonies/day)	Allowable Load [b] (colonies/day)	Required Reduction (colonies/day)	% Reduction
Nonpoint Source Load (LA)	7.13 E+13	2.36 E+12	6.89 E+13	97%
Point Source Load (WLA)	6.91 E+10	3.19 E+11	0	0%

a. Existing WLA loads were based on facility DMR data at the time the highest instream exceedance was observed.
b. Allowable WLA loads were based on design flow & NPDES-permitted limits for *Enterococci* (500 colonies /100 ml).

Table 6-2: Individual NPDES Point Source Reductions

Source	Existing Load [a] (colonies/day)	Allowable Load [b] (colonies/day)	Required Reduction (colonies/day)	% Reduction
Wright Smith WWTP (AL0023094)	1.50 E+10	2.42 E+11	0	0%
Carlos Morris WWTP (AL0023205)	5.40 E+10	7.72 E+10	0	0%
Total WWTPs (WLA)	6.91 E+10	3.19 E+11	0	0%

a. Existing WLA loads were based on facility DMR data at the time the highest instream exceedance was observed
b. Allowable WLA loads were based on design flow & NPDES-permitted limits for *Enterococci* (500 colonies /100 ml)

Table 6-3: Enterococci Pathogen TMDL Summary for Threemile Creek

TMDL [a]	Margin of Safety (MOS)	Waste Load Allocation (WLA)			Load Allocation (LA)	
		WWTPs [b]	MS4s [c]	Leaking Collection Systems [d]		
(col/day)	(col/day)	(col/day)	Reduction	(col/day)	(col/day)	Reduction
2.97 E+12	2.97 E+11	3.19 E+11	97%	0	2.36 E+12	97%

a. TMDL was established using the single-sample *Enterococci* criterion for the *A&I* use classification (500 colonies/100 ml)
b. WLAs for WWTPs are expressed as a daily maximum. Any future WWTPs (and expansions of existing facilities) must meet the applicable instream water quality criteria for *Enterococci* at the point of discharge.
c. Future MS4 areas would be required to demonstrate consistency with the assumptions and requirements of this TMDL.
d. The WLA target for leaking collection systems is zero. It is recognized, however, that a WLA of 0 col/day may not be practical. For these sources, the WLA is interpreted to mean a reduction in *Enterococci* loading to the maximum extent practicable, consistent with the requirement that these sources not contribute to a violation of the water quality criteria for *Enterococci*.

Compliance with the terms and conditions of existing and future NPDES permits will effectively implement the WLA and demonstrate consistency with the assumptions and requirements of the TMDL. Required load reductions in the LA portion of this

TMDL can be implemented through voluntary measures and may be eligible for CWA §319 grants.

The Department recognizes that adaptive implementation of this TMDL will be needed to achieve applicable water quality criteria and we are committed towards targeting the load reductions to improve water quality in the Threemile Creek watershed. As additional data and/or information become available, it may become necessary to revise and/or modify the TMDL accordingly.

7.0 FOLLOW-UP MONITORING

ADEM has adopted a basin approach to water quality management which divides Alabama's fourteen major river basins into five groups. Each year, ADEM's water quality resources are concentrated in one of the five basin groups. One goal is to continue to monitor impaired waterbodies. Monitoring will help further characterize water quality conditions resulting from the implementation of best management practices and load reductions in the watershed. This monitoring will occur in each basin according the schedule shown in the table below:

Table 7-1: Surface Water Quality Monitoring Schedule

River Basin Group	Year to be Monitored
Tennessee	2013
Chattahoochee / Chipola / Choctawhatchee / Perdido-Escambia	2014
Alabama / Coosa / Tallapoosa	2015
Escatawpa / Upper Tombigbee / Lower Tombigbee / Mobile	2016
Black Warrior / Cahaba	2017

8.0 PUBLIC PARTICIPATION

As part of the public participation process, this TMDL was placed on public notice and made available for review and comment. The public notice was prepared and published in the four major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject TMDL was made available on ADEM's Website: www.adem.state.al.us. The public can also request paper or electronic copies of the TMDL by contacting Mr. Chris Johnson at 334-271-7827 or cljohnson@adem.state.al.us. The public was given an opportunity to review the TMDL and submit comments to the Department in writing. At the end of the public review period, all written comments received during the public notice period became part of the administrative record. ADEM considered all comments received by the public prior to finalization of this TMDL and subsequent submission to EPA Region 4 for final review and approval.

9.0 APPENDICES

9.1 References

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9.2 Listing Methodology Criteria

Table 9-1: 303(d) Listing Requirements

Minimum Number of Samples Exceeding the Numeric Criterion Necessary for Listing*

Sample Size	Number of Exceedances	Sample Size	Number of Exceedances
8 thru 11	2	97 thru 104	14
12 thru 18	3	105 thru 113	15
19 thru 25	4	114 thru 121	16
26 thru 32	5	122 thru 130	17
33 thru 40	6	131 thru 138	18
41 thru 47	7	139 thru 147	19
48 thru 55	8	148 thru 156	20
56 thru 63	9	157 thru 164	21
64 thru 71	10	165 thru 173	22
72 thru 79	11	174 thru 182	23
80 thru 88	12	183 thru 191	24
89 thru 96	13	192 thru 199	25

* - For conventional parameters, including bacteria, at the 90 percent confidence level

Table 9-2: 303(d) Delisting Requirements

Maximum Number of Samples Exceeding the Numeric Criterion Necessary for Delisting*

Sample Size	Number of Exceedances	Sample Size	Number of Exceedances
8 thru 21	0	104 thru 115	7
22 thru 37	1	116 thru 127	8
38 thru 51	2	128 thru 139	9
52 thru 64	3	140 thru 151	10
65 thru 77	4	152 thru 163	11
78 thru 90	5	164 thru 174	12
91 thru 103	6	175 thru 186	13

* - For conventional parameters, including bacteria, at the 90 percent confidence level

9.3 Water Quality Dataset

9.3.1 303(d) sampling Results (Intensive Survey)

Table 9-3: TMCM-5 ADEM Enterococci Data (Lower Segment)

Station ID	Visit Date	Enterococcus Col / 100ml	Geomean (Col / 100ml)
TMCM-5	3/10/2011	12000	
TMCM-5	4/4/2011	50	
TMCM-5	5/11/2011	82	
TMCM-5	6/21/2011	570	477
TMCM-5	6/22/2011	3000	
TMCM-5	6/23/2011	96	
TMCM-5	6/27/2011	250	
TMCM-5	7/12/2011	600	
TMCM-5	8/23/2011	900	220
TMCM-5	8/24/2011	590	
TMCM-5	8/29/2011	44	
TMCM-5	8/30/2011	200	
TMCM-5	9/13/2011	110	
TMCM-5	10/12/2011	42	
	N:	14	
	Minimum:	42	
	Maximum:	12000	
	Median:	225	
	Mean:	1323.86	
	Exceedance Rate:	43%	

Table 9-4: TM-1 ADEM Enterococci Data (Lower Segment)

Station ID	Visit Date	Enterococcus Col / 100ml	Geomean (Col / 100ml)
TM-1	2/7/2007	2	
TM-1	3/22/2007	6	
TM-1	4/12/2007	120	
TM-1	5/29/2007	88	
TM-1	6/18/2007	8	

TM-1	7/5/2007	600	
TM-1	8/6/2007	230	
TM-1	8/14/2007	50	
TM-1	8/21/2007	490	
TM-1	8/29/2007	390	
TM-1	9/4/2007	360	
TM-1	10/15/2007	120	
TM-1	11/19/2007	2	
TM-1	12/11/2007	4	
TM-1	1/9/2008	4	
TM-1	2/19/2008	600	
TM-1	3/25/2008	2	
TM-1	4/15/2008	40	
TM-1	5/6/2008	30	
TM-1	6/12/2008	38	
TM-1	7/2/2008	2	
TM-1	8/4/2008	2	
TM-1	9/9/2008	48	
TM-1	10/16/2008	240	
TM-1	12/3/2008	2	
TM-1	1/8/2009	570	
TM-1	2/26/2009	40	
TM-1	3/17/2009	600	
TM-1	4/16/2009	18	
TM-1	5/11/2009	8	
TM-1	6/15/2009	2	
TM-1	7/13/2009	10	
TM-1	8/18/2009	600	
TM-1	9/23/2009	48	
TM-1	10/19/2009	6	
TM-1	11/12/2009	300	
TM-1	12/9/2009	10	
TM-1	1/25/2010	2300	
TM-1	2/18/2010	2	

TM-1	5/12/2010	40	
TM-1	7/27/2010	2	
TM-1	9/13/2010	82	
TM-1	5/24/2011	68	
TM-1	7/26/2011	1200	
TM-1	9/27/2011	2	
TM-1	8/16/2012	6	
TM-1	9/6/2012	580	
TM-1	10/17/2012	470	
	N:	48	
	Minimum:	2	
	Maximum:	2300	
	Median:	40	
	Mean:	217.54	
	Exceedance Rate:	17%	

Table 9-5: TMCM-4 ADEM Enterococci Data (Upper Segment)

Station ID	Visit Date	Enterococcus Col / 100ml	Geomean (Col / 100ml)
TMCM-4	3/10/2011	1300	
TMCM-4	4/4/2011	50	
TMCM-4	5/11/2011	84	
TMCM-4	6/20/2011	20	140
TMCM-4	6/21/2011	20	
TMCM-4	6/22/2011	2900	
TMCM-4	6/23/2011	76	
TMCM-4	7/12/2011	600	
TMCM-4	8/23/2011	600	71
TMCM-4	8/24/2011	1100	
TMCM-4	8/29/2011	2	
TMCM-4	8/31/2011	32	
TMCM-4	9/13/2011	44	
TMCM-4	10/12/2011	8	
	N:	14	
	Minimum:	2	

Maximum:	2900
Median:	63
Mean:	488.29
Exceedance Rate:	36%

Table 9-6: TMCM-6 ADEM Enterococci Data (Upper Segment))

Station ID	Visit Date	Enterococcus Col / 100ml	Geomean (Col / 100ml)
TMCM-6	3/10/2011	700	
TMCM-6	4/5/2011	1300	
TMCM-6	5/11/2011	14	
TMCM-6	6/21/2011	20	155
TMCM-6	6/22/2011	2900	
TMCM-6	6/23/2011	76	
TMCM-6	6/27/2011	34	
TMCM-6	7/12/2011	600	
TMCM-6	8/23/2011	1600	17
TMCM-6	8/24/2011	2	
TMCM-6	8/29/2011	10	
TMCM-6	8/30/2011	20	
TMCM-6	9/13/2011	2	
TMCM-6	10/12/2011	4	
N:		14	
Minimum:		2	
Maximum:		2900	
Median:		27	
Mean:		520.14	
Exceedance Rate:		36%	

Table 9-7: USGS Pathogen Indicator Data (2000-2003) (USGS, 2004)

Site label (fig. 1)	Enterococci (col/100 mL)			*Escherichia coli* (col/100 mL)			Fecal coliform (col/100 mL)		
	Minimum	Median	Maximum	Minimum	Median	Maximum	Minimum	Median	Maximum
TM-1	11	48	6,000	20	71	2,400	25	100	2,400
TM-3	10	1,200	31,000	14	1,500	29,000	44	300	12,000
TM-4	10	76	47,000	47	290	21,000	83	285	17,000
CEN	110	1,300	14,000	120	2,850	26,000	38	7,000	30,000
TSB	330	2,650	93,000	20	1,060	31,000	< 10	2,550	16,000
TM-5	9	225	22,000	30	470	20,000	20	540	15,000

9.3.2 Low-flow Estimates

Figure 9-1: Low-flow Estimate for TMCM-5

Flow Estimate Summary Report

Notes: Flows for Threemile Creek near Mobile, Alabama based on USGS flow data from nearby gage on Chickasaw Creek. Watersheds similar in geographic location, average annual precipitation, and streamflow recession index.

Project:	*Threemile Creek Pathogen TMDL*
Date:	*5/20/2013*
Performed By:	*Jason Wilkins, ADEM WQ*
Gaging Site:	*USGS 02471001 (Chickasaw Creek near Kushla, AL)*
Ratioed Site:	*TMCM-5 (Threemile Creek @ Conception St)*
Flow Data Type:	*Average Daily Flow, cfs*
Start Date:	*10/1/1951*
End Date:	*5/19/2013*
# of Records:	*22,512*
Years	*61**
Calculation:	*WRDB 5.0 Low-Flow Analysis*

Gaging Site Data Results		USGS 02471001
$7Q_{10}$:	*31.82*	*cfs*
$7Q_2$:	*57.11*	*cfs*
$1Q_{10}$:	*29.04*	*cfs*
Mean Annual Flow:	*271.32*	*cfs*
Drainage Area:	*125.00*	*mi^2*
Lat / Long:	*30.802780°*	*-88.143330°*

Ratioed Site Results		TMCM-5
$7Q_{10}$:	*6.31*	*cfs*
$7Q_2$:	*11.33*	*cfs*
$1Q_{10}$:	*5.76*	*cfs*
Mean Annual Flow:	*53.83*	*cfs*
Drainage Area:	*24.80*	*mi^2*
Lat / Long:	*30.718830°*	*-88.065400°*

*Only full climatic years used in statistical analysis

Figure 9-2: Low-flow Estimate for TMCM-4

Flow Estimate Summary Report

Notes: Flows for Threemile Creek near Mobile, Alabama based on USGS flow data from nearby gage on Chickasaw Creek. Watersheds similar in geographic location, average annual precipitation, and streamflow recession index.

Project:	*Threemile Creek Pathogen TMDL*
Date:	*5/20/2013*
Performed By:	*Jason Wilkins, ADEM WQ*
Gaging Site:	*USGS 02471001 (Chickasaw Creek near Kushla, AL)*
Ratioed Site:	*TMCM-4 (Threemile Creek @ St. Stephens Rd)*
Flow Data Type:	*Average Daily Flow, cfs*
Start Date:	*10/1/1951*
End Date:	*5/19/2013*
# of Records:	*22,512*
Years	*61**
Calculation:	*WRDB 5.0 Low-Flow Analysis*

Gaging Site Data Results		USGS 02471001
$7Q_{10}$:	*31.82*	*cfs*
$7Q_2$:	*57.11*	*cfs*
$1Q_{10}$:	*29.04*	*cfs*
Mean Annual Flow:	*271.32*	*cfs*
Drainage Area:	*125.00*	*mi^2*
Lat / Long:	*30.802780°*	*-88.143330°*

Ratioed Site Results		TMCM-4
$7Q_{10}$:	*5.18*	*cfs*
$7Q_2$:	*9.30*	*cfs*
$1Q_{10}$:	*4.73*	*cfs*
Mean Annual Flow:	*44.17*	*cfs*
Drainage Area:	*20.35*	*mi^2*
Lat / Long:	*30.701530°*	*-88.077460°*

*Only full climatic years used in statistical analysis

Figure 9-3: 7Q10 Analysis Graph

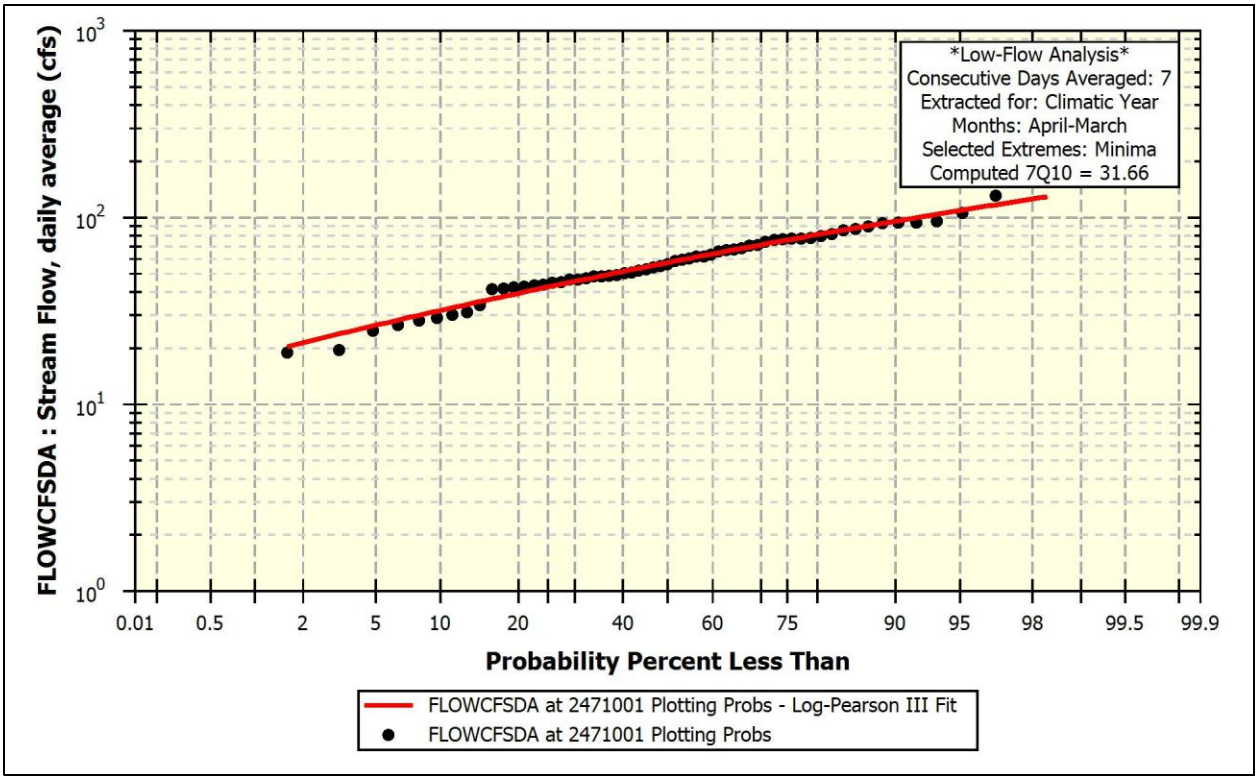
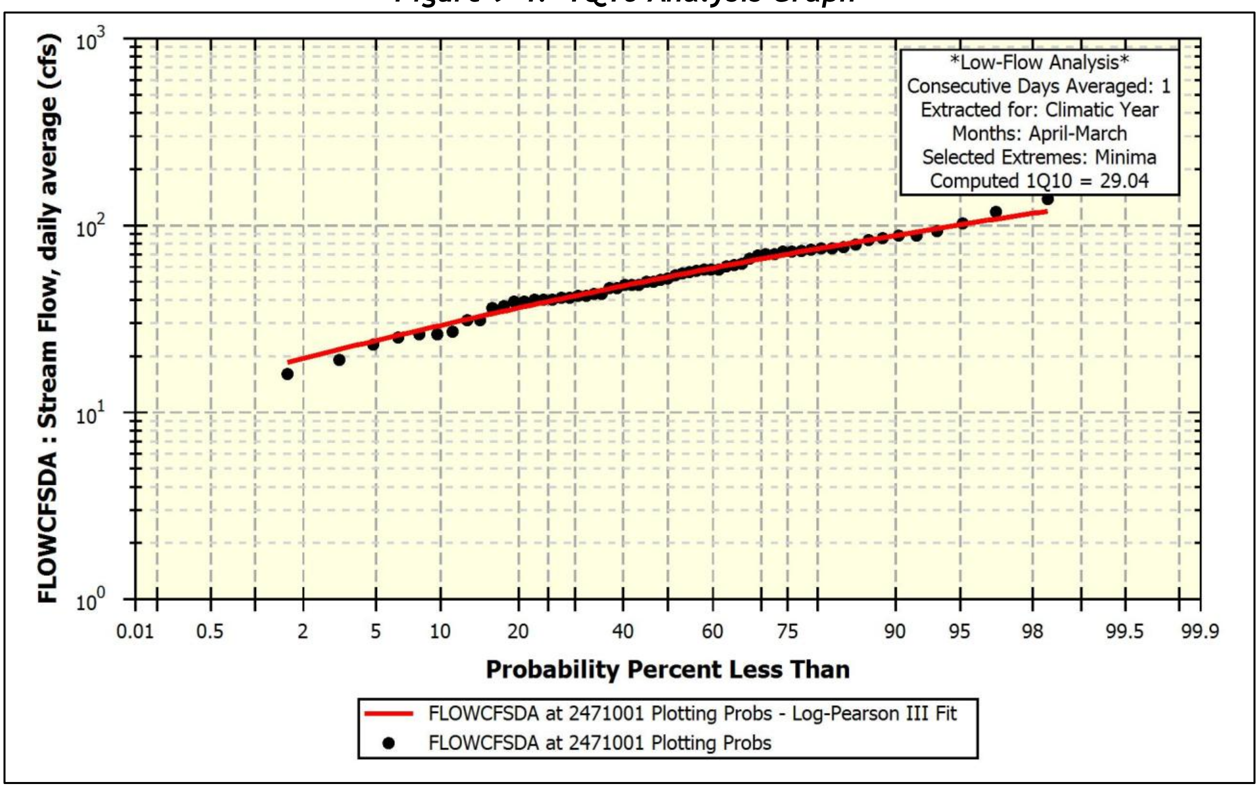


Figure 9-4: 1Q10 Analysis Graph



9.4 DMR Data

Table 9-8: Wright Smith WWTP DMR Data

Wright Smith AL0023094 DMR Data (2007-2013)				
Reporting Period	Fecal Coliform (col/100ml)*		Flow (MGD)	
	Monthly Avg	Daily Max	Monthly Avg	Daily Max
January-07	5	200	9.57	18.28
February-07	3	10	8.01	13.07
March-07	3	8	7.57	10.47
April-07	3	23	7.81	11.62
May-07	26	81	7.74	18.52
June-07	45	200	8.04	12.11
July-07	48	276	10.23	16.53
August-07	69	282	10.13	14.56
September-07	30	109	9.51	14.27
October-07	20	159	9.26	21.74
November-07	9	65	7.4	14.22
December-07	3	15	8.83	21.41
January-08	1	3	10.1	16.41
February-08	8	100	10.66	20.32
March-08	6	93	8.81	17.74
April-08	3	8	10.43	27.55
May-08	20	160	9.14	14
June-08	46	400	9.34	12.85
July-08	40	400	9.28	12.3
August-08	36	200	10.68	24.28
September-08	37	400	11.39	24.31
October-08	19	200	8.19	11.14
November-08	6	26	7.79	11.13
December-08	2	9	9.1	20.25
January-09	1	6	8.45	12.53
February-09	12	200	8.04	15.12
March-09	4	18	11.58	24.98
April-09	6	24	9.85	21.75
May-09	57	1011	8.96	18.74
June-09	12	39	8.5	13.2
July-09	12	32	8.31	14.69

August-09	14	40	10.08	15.78
September-09	5	32	11.4	20.91
October-09	19	200	9.06	14.84
November-09	9	80	8.9	25.81
December-09	8	78	14.81	29.98
January-10	3	35	13.45	28.95
February-10	1	2	14.68	27.46
March-10	11	200	12.26	23.83
April-10	1	3	10.27	13.24
May-10	6	23	12.26	23.83
June-10	11	57	9.52	17.05
July-10	20	200	8.26	9.58
August-10	17	200	10.01	16.24
September-10	29	200	8.26	12.03
October-10	25	200	7.15	9.26
November-10	206	2300	8.51	16.69
December-10	11	200	9.24	12.93
January-11	1	1	8.09	13.38
February-11	1	2	8.67	14.53
March-11	3	31	9.11	17.47
April-11	2	10	7.61	8.24
May-11	14	105	7.35	8.16
June-11	21	128	7.89	10.09
July-11	22	215	10.1	20.99
August-11	41	200	9.74	20.25
September-11	29	200	10.97	25.23
October-11	23	99	7.23	7.85
November-11	5	35	6.96	9.99
December-11	10	191	6.67	8.07
January-12	1	1	6.92	10.67
February-12	1	6	9.18	18.96
March-12	1	12	9.99	18.56
April-12	24	400	7.99	11.08
May-12	47	400	9.55	27.69
June-12	38	229	13.02	29.11
July-12	16	63	10.53	14.89
August-12	30	150	11.66	14.09
September-12	13	67	11.88	28.2

October-12	8	63	8.41	21.36
November-12	2	6	7.25	8.1
December-12	3	28	7.48	10.63
January-13	6	35	8.21	16.5
February-13	1	4	13.59	23.3
March-13	13	244	8.5	27.09
	Fecal Coliform (col/100ml)*		**Flow (MGD)**	
	Monthly Avg	**Daily Max**	**Monthly Avg**	**Daily Max**
90th %-ile:	40.60	279.60	11.79	26.58
Min:	1.00	1.00	6.67	7.85
Max:	206.00	2300.00	14.81	29.98
Mean:	18.19	156.43	9.40	17.11
Median:	11.00	80.00	9.11	16.24
N:	75.00	75.00	75.00	75.00

*Fecal Coliform used in absence of *Enterococci* data

Table 9-9: Carlos A Morris WWTP DMR Data

Carlos Morris AL0023205 DMR Data (2007-2013)				
Reporting Period	**Enterococci (col/100ml)**		**Flow (MGD)**	
	Monthly Avg	**Daily Max**	**Monthly Avg**	**Daily Max**
January-07	102	2420	2.64	3.74
February-07	781	2420	1.74	2.56
March-07	186	2460	1.62	2.07
April-07	86	2420	1.87	2.13
May-07	No Data			
June-07	3	18	2.1	4.6
July-07	12	3000	2.898	3.657
August-07	7.3	4900	2.485	12.8
September-07	12	2800	2.16	4.97
October-07	4	154	2.367	9.35
November-07	3	2700	1.669	3.37
December-07	5	80000	2.765	8.79
January-08	3	17	3.865	5.074
February-08	7	490	3.888	8.21
March-08	2	2	2.596	6.9
April-08	2	6	2.842	11.15

May-08	2	13	2.257	5.394
June-08	3	20	2.039	4.235
July-08	3	12	2.04	5.038
August-08	3	15	2.217	7.113
September-08	3	210	3.002	11.39
October-08	3	13	1.378	3.893
December-08	No Data			
January-09	3	70	2.348	5.842
February-09	2	2	2.155	6.45
March-09	3	25	3.524	11.424
May-09	4	210	2.356	11.207
June-09	2	2	1.935	6.29
July-09	6	380	1.858	5.011
August-09	3	64	5.066	12.764
September-09	2	4	4.526	10.551
October-09	5	126	3.178	6.816
November-09	113	5600	2.669	7.144
December-09	4	72	5.732	12.864
January-10	4	1070	4.422	10.155
February-10	0.1	0.1	4.381	7.305
March-10	2	40	2.874	6.36
April-10	2	2	1.721	2.857
May-10	5	5300	2.855	10.276
June-10	4	310	2.517	6.519
July-10	2	10	1.673	3.72
August-10	2	2	3.199	8.206
September-10	2	12	1.659	4.888
October-10	2	8	1.297	3.255
November-10	3	84	2.77	11.932
December-10	2	35	3.034	9.161
January-11	3	74	3.166	6.501
February-11	6	460	4.003	15.4
March-11	10	350	2.799	11.602
April-11	6	8000	1.447	2.222
May-11	2	13	1.252	1.556
June-11	2	2	1.293	1.982
July-11	2	2	3.46	18.596
August-11	2	12	1.424	3.49

September-11	2	2	3.624	21.308
October-11	2	2	1.043	1.4
November-11	2	2	1.504	4.841
December-11	2	2	1.951	4.139
January-12	2	2	1.914	7.103
February-12	3	13	3.896	17.938
March-12	3	34	3.633	18.962
April-12	2	6	1.654	4.001
May-12	2	5	2.242	12.979
June-12	3	100	3.512	12.799
July-12	2	2	1.71	5.857
August-12	2	5	3.665	21.921
September-12	2	2	3.728	16.572
October-12	2	3	1.624	6.94
November-12	3	22	1.618	2.432
December-12	4	52	2.197	4.137
January-13	3	72	2.572	5.662
February-13	3	16	5.658	8.838
March-13	3	10	2.866	5.08

	Enterococci (col/100ml)		Flow (MGD)	
	Monthly Avg	Daily Max	Monthly Avg	Daily Max
90th %-ile:	10.00	2700.00	3.90	12.98
Min:	0.10	0.10	1.04	1.40
Max:	781.00	80000.00	5.73	21.92
Mean:	20.98	1785.68	2.64	7.77
Median:	3.00	20.00	2.49	6.50
N:	71.00	71.00	71.00	71.00

9.5 Facility DMR Data (March 2011)

Figure 9-5: Wright Smith WWTP DMR Form (March 2011)

Alabama Department of Environmental Management Discharge Monitoring Report *(DMR)*

PERMITTEE NAME: Mobile Bd Of Water And Sewer
MAILING ADDRESS: P O Box 2368 , Mobile, AL 36652
FACILITY: Mobile Wright Smith Wwtp
LOCATION: 1879 Conception Street Road , Mobile, AL 36652

PERMIT NUMBER: AL0023094
MONITORING POINT: 0011

MONITORING PERIOD:	
YY | MM | DD	YY | MM | DD
From: 11 03 01	To: 11 03 31

MAJOR
COUNTY: Mobile
PROGRAM: Municipal
***** NO DISCHARGE [ ] *****
NOTE: Read instructions before completing this form.

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
		Average	Maximum		Minimum	Average	Maximum				
FLOW, IN CONDUIT OR THRU TREATMENT PL	Sample Measurement	9.11	17.47	03 MGD	*****	*****	*****	*****	0	Daily	Continuous
Parameter Code: 50050 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	report monthly average	report maximum daily		*****	*****	*****			Daily	Continuous
CHLORINE, TOTAL RESIDUAL	Sample Measurement	*****	*****	*****	*****	*****	0	19 mg/l	0	Week Days	Grab
Parameter Code: 50060 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	*****	*****		*****	*****	0.01 maximum daily			Week Days	Grab
COLIFORM, FECAL GENERAL	Sample Measurement	*****	*****	*****	*****	3	31	13 col/100mL	0	Week Days	Grab
Parameter Code: 74055 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	*****	*****		*****	1000 max monthly geometric	4000 maximum daily			Week Days	Grab
BOD, 5-DAY PERCENT REMOVAL	Sample Measurement			*****	92			23 %	0	Week Days	Grab
Parameter Code: 81010 Stage Code: K PERCENTREMOVAL	Permit Requirement				85.0 monthly average					Week Days	Grab
SOLIDS, SUSPENDED PERCENT REMOVAL	Sample Measurement			*****	93			23 %	0	Monthly	Calculated
Parameter Code: 81011 Stage Code: K PERCENTREMOVAL	Permit Requirement				65.0 monthly average					Monthly	Calculated
	Sample Measurement										
	Permit Requirement										
	Sample Measurement										
	Permit Requirement										

Figure 9-6: Carlos A. Morris WWTP (March 2011)

Alabama Department of Environmental Management Discharge Monitoring Report *(DMR)*

PERMITTEE NAME: Prichard Water Works & Sewer Board
MAILING ADDRESS: 1252 East Clark Avenue Prichard, AL 36610
FACILITY: Prichard Wwsb C A Morris Pt
LOCATION: 54 Grover St Prichard, AL 36610

PERMIT NUMBER: AL0023205
MONITORING POINT: 0012
MONITORING PERIOD:
YY | MM | DD — YY | MM | DD
From: 11 03 01 **To:** 11 03 31

MAJOR
COUNTY: Mobile
PROGRAM: Municipal
***** NO DISCHARGE [ ] *****
NOTE: Read instructions before completing this form.

Parameter		Quantity or Loading		Units	Quality or Concentration			Units	No. Ex.	Frequency of Analysis	Sample Type
		Average	Maximum		Minimum	Average	Maximum				
OXYGEN, DISSOLVED (DO)	Sample Measurement	*****	*****	*****	8.1	*****	*****	19 mg/l	0	3/7	GR
Parameter Code: 00300 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	*****	*****		5.0 minimum daily	*****	*****			3X Weekly test	Grab
BOD, 5-DAY (20 DEG. C)	Sample Measurement	2000	2549	26 lbs/day	*****	101	121	19 mg/l	0	3/7	CP-24
Parameter Code: 00310 Stage Code: G RAW SEW/INFLUENT	Permit Requirement	report monthly average	report weekly average		*****	report monthly average	report weekly average			3X Weekly test	24-Hr Composite
BOD, 5-DAY (20 DEG. C)	Sample Measurement	117	466	26 lbs/day	*****	5.0	10.5	19 mg/l	0	3/7	CP-24
Parameter Code: 00310 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	500 monthly average	750 weekly average		*****	15.0 monthly average	22.5 weekly average			3X Weekly test	24-Hr Composite
PH	Sample Measurement	*****	*****	*****	6.3	*****	7.1	12 S.U.	0	3/7	GR
Parameter Code: 00400 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	*****	*****		6.0 minimum daily	*****	9.0 maximum daily			3X Weekly test	Grab
SOLIDS, TOTAL SUSPENDED	Sample Measurement	2833	3681	26 lbs/day	*****	142	183	19 mg/l	0	3/7	CP-24
Parameter Code: 00530 Stage Code: G RAW SEW/INFLUENT	Permit Requirement	report monthly average	report weekly average		*****	report monthly average	report weekly average			3X Weekly test	24-Hr Composite
SOLIDS, TOTAL SUSPENDED	Sample Measurement	317	1475	26 lbs/day	*****	13.6	33.3	19 mg/l	0	3/7	CP-24
Parameter Code: 00530 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	1000 monthly average	1501 weekly average		*****	30.0 monthly average	45.0 weekly average			3X Weekly test	24-Hr Composite
NITROGEN, AMMONIA TOTAL (AS N)	Sample Measurement	14	50	26 lbs/day	*****	0.6	2.2	19 mg/l	0	3/7	CP-24
Parameter Code: 00610 Stage Code: 1 EFFLUENT GROSS VALUE	Permit Requirement	166 monthly average	250 weekly average		*****	5.0 monthly average	7.5 weekly average			3X Weekly test	24-Hr Composite

9.6 Supporting Photographs

Picture 9-1: Threemile Creek @ I-65 (Upstream View) – 1/29/2013

Picture 9-2: Threemile Creek @ I-65 (Downstream View) – 1/29/2013

Picture 9-3: Threemile Creek @ Fillingim Street (Upstream View) – 1/29/2013

Picture 9-4: Threemile Creek @ Fillingim Street (Downstream View) – 1/29/2013

Picture 9-5: Threemile Creek @ Confluence w/ TMC UT (Upstream View) – 1/29/2013

Picture 9-6: Threemile Creek @ Confluence w/ TMC UT (Upstream View) – 1/29/2013