UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

MAR 0 8 2013

Ms. Kelly Jean Heffner
Deputy Secretary for Water Management
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
P.O. Box 2063
Harrisburg, Pennsylvania 17105

Dear ~~Ms.~~ Kelly Heffner:

The U.S. Environmental Protection Agency (EPA), Region III, is establishing Total Maximum Daily Loads (TMDLs) to address fecal coliform bacteria recreational use impairments associated with unknown causes in the Pine Creek Watershed in southwestern Pennsylvania. These TMDLs were established in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified on Pennsylvania's Section 303(d) lists. This TMDL covers all the streams in the Pine Creek watershed. These segments were first listed in 2008 for their failure to attain the recreational designated use.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to nonpoint sources can be reasonably met. The TMDLs for the Pine Creek Watershed satisfies each of these requirements. A copy of EPA's TMDL report is enclosed with this letter.

Following the establishment of these TMDLs, Pennsylvania is required to incorporate these TMDLs into Pennsylvania's Water Quality Management Plan pursuant to 40 CFR §130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact Ms. Elizabeth Gaige at 215-814-5676.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosures

Bacteria TMDLs to Address the Recreation Use Impairment in the Pine Creek Watershed Allegheny County, Pennsylvania

Established by the United States Environmental Protection Agency, Region III

March 8, 2013

Jon M. Capacasa **Date**
Director,
Water Protection Division

Bacteria TMDLs for the Pine Creek Watershed
Allegheny County, Pennsylvania

February 2013

Prepared for
U.S. Environmental Protection Agency Region 3

Prepared by
Tetra Tech, Inc.

In fulfillment of the requirements for completing Task Order 29,
Contract EP-C-08-004

Acknowledgments

This study was developed and prepared by Tetra Tech, Inc. (Tetra Tech) in Fairfax, Virginia, for the U.S. Environmental Protection Agency Region 3. Completion of this study depended on generous informational and data support from various groups, particularly the Pine Creek Watershed Coalition and 3Rivers Wet Weather Demonstration. Special acknowledgment is made to the following groups who provided critical support and guidance at various phases throughout the project:

Pine Creek Watershed Coalition
3Rivers Wet Weather Demonstration Program
Municipalities of the Pine Creek Watershed
Pennsylvania Department of Environmental Protection
ALCOSAN
Allegheny County Health Department

A special thanks goes to the citizen volunteers of the Pine Creek Watershed Coalition, which generously contributed time and expertise to carefully collect more than 1,000 water quality samples throughout the Pine Creek watershed, without which this study would not have been possible.

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) is establishing a total maximum daily load (TMDL) for the Pine Creek watershed, in Allegheny County in southwestern Pennsylvania. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* Part 130) require states to develop TMDLs for impaired water bodies. A TMDL establishes the amount of a pollutant that a water body can assimilate without exceeding its water quality standard for that pollutant. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources.

Pine Creek flows approximately 23 miles through the North Hills area of Allegheny County, encompassing 67 square miles and portions of 14 municipalities. The lower half of the watershed is largely composed of residential development, but the headwaters and upstream portions primarily consist of forested and agricultural areas. Although these areas are not as urbanized as downstream portions of the watershed, rapid development is occurring. The stream flows from the north toward Pittsburgh to the south, where it discharges to the Allegheny River, among highly urbanized lands. The Pine Creek watershed is contained in one U.S. Geological Survey 8-digit hydrologic cataloging unit (05010009) and includes 128 stream miles. Major tributaries to Pine Creek are Little Pine Creek, Course Run, Gourdhead Run, McCaslin Run, Willow Run, Montour Run, Rinaman Run, Wexford Run, and Fish Run. Pine Creek and several of its tributaries are regularly stocked trout streams.

WATER QUALITY DATA AND APPLICABLE WATER QUALITY STANDARDS

Stream reaches in the Pine Creek watershed are included on the Commonwealth's 2008 and 2010 Section 303(d) lists because of recreational use impairments. Data used to make use attainment determinations were collected by citizen volunteers of the Pine Creek Watershed Coalition with monitoring frequency designed to support collection of adequate samples to meet not only the quantitative requirements for comparison to standards, but also to meet the additional objectives of supporting pollutant source identification, model development, and TMDL development. Monitoring was conducted weekly at each location from November 2006 through October 2007.

Monitoring data for attainment use determination and TMDL target concentrations were based on the established recreational water quality standard in the Pennsylvania Code, Title 25, Environmental Protection, Department of Environmental Protection, Chapter 93. The bacteria standard is excerpted below, in part, from Table 3 in Section 93.7 of the Pennsylvania Code (PADEP 1998):

> During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.

TMDL ALLOCATIONS

A TMDL for a pollutant and water body is composed of the sum of individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include an implicit or explicit Margin of Safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. The TMDL components are illustrated using the following equation:

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

TMDLs for the Pine Creek watershed were developed to address bacteria impairments associated with unknown sources of pathogens in the watershed using the Loading Simulation Program in C++ (LSPC). LSPC is a modeling system capable of representing loads from nonpoint and point sources in the watershed and simulating in-stream processes. Both point and nonpoint sources contribute to the fecal coliform bacteria impairments in the watershed. Failing onsite septic systems and direct discharges of untreated sewage often result in exceedances of recreational criteria. Precipitation runoff that is collected through a municipal separate storm sewer system (MS4) that is subject to NPDES permit requirements is a discharge through a point source, though runoff outside the regulated MS4 boundaries is a nonpoint source of fecal coliform bacteria. Agricultural sources of fecal coliform bacteria are present, but less significant in the Pine Creek watershed. Other point sources of fecal coliform bacteria include the effluents of sewage treatment facilities and publicly owned treatment works (POTWs) and combined sewer overflows (CSOs). Modeled subwatershed loadings were iteratively reduced to estimate the load reductions required to meet in-stream concentration targets for fecal coliform bacteria.

The Pine Creek watershed was subdivided into 57 modeled subwatersheds and aggregated into 17 Allocation Groups for the purpose of presenting TMDLs. Section 6.4 of this report contains the TMDLs for each of 17 Allocation Groups representing separate hydrologic units of the Pine Creek watershed. WLAs were assigned to permitted facilities including POTWs, CSOs and MS4s that discharge in the watershed. The LAs include nonpoint sources, non-MS4 land cover loads, sanitary sewer overflows, septic systems and unknown sources of bacteria in the watershed.

TMDLS FOR EACH OF THE ALLOCATION GROUPS SUMMARIZED FROM SECTION 6.4

Table ES-1. TMDL bacteria load summary

ALLOCATED	Allocation Group:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)
Nonpoint Sources	Landuse	1.04E+09				1.76E+10	5.39E+09	4.00E+08	2.73E+09	1.21E+11			1.00E+09					
	Septics	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Source X										0.00E+00							0.00E+00
	wildlife, direct discharge	7.31E+07									6.41E+09	1.36E+09						3.73E+09
Sum LA:		1.11E+09	0.00E+00	0.00E+00	0.00E+00	1.76E+10	5.39E+09	4.00E+08	2.73E+09	1.21E+11	6.41E+09	1.36E+09	1.00E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E+09
MS4	BRADFORD WOODS																	
	ETNA																	
	FOX CHAPEL																	
	FRANKLIN PARK																	
	HAMPTON																	
	INDIANA																	
	MARSHALL																	
	MCCANDLESS																	
	OHARA																	
	PINE																	
	RICHLAND																	
	ROSS																	
	SHALER																	
	SHARPSBURG																	
Sum MS4:		7.05E+09	2.20E+10	2.17E+10	5.95E+09	1.40E+10	3.64E+09	1.25E+10	2.06E+10	3.13E+10	3.21E+10	3.62E+10	4.18E+10	7.90E+09	6.42E+09	4.70E+10	1.39E+11	8.07E+10
CSO	CSO1															1.24E+09		
	CSO1A															2.71E+08		
	CSO2															1.42E+05		
	CSO3															5.30E+07		
	CSO4															4.50E+08		
	CSO5															1.06E+08		
	CSO7										6.44E+07							
	SSO22										0.00E+00							
Permitted Point Sources	PA0216143								1.89E+07									
	PA0205141					1.89E+07												
	PA0027669																	2.49E+11
	PA0028177														1.66E+10			
	PA0043729																1.33E+11	
	PA0000515				3.77E+07													
	PA0025992										7.89E+10							
	PA0003425																2.19E+08	
Sum WLA:		7.05E+09	2.20E+10	2.17E+10	5.99E+09	1.40E+10	3.64E+09	1.25E+10	2.06E+10	3.13E+10	1.11E+11	3.62E+10	4.18E+10	7.90E+09	2.30E+10	4.91E+10	2.72E+11	3.30E+11
TMDL:		8.16E+09	2.20E+10	2.17E+10	5.99E+09	3.16E+10	9.03E+09	1.29E+10	2.33E+10	1.52E+11	1.18E+11	3.76E+10	4.28E+10	7.90E+09	2.30E+10	4.91E+10	2.72E+11	3.34E+11

[1] MS4 Allocations are inclusive of transportation permittees: Pennsylvania Department of Transportation and Pennsylvania Turnpike Commission. These entities are not provided discrete allocations, but are discussed further in Section 3.1

CONSIDERATION OF CRITICAL CONDITIONS AND SEASONAL VARIATION

The critical condition is the set of environmental conditions, which, if met, will ensure attainment of objectives for all other conditions. This is typically the period in which the impaired water body exhibits the most vulnerability. Nonpoint source loading is typically precipitation-driven; thus, in-stream impacts tend to occur during wet weather in which storm events cause surface runoff to carry pollutants to water bodies. Under low-flow conditions, non-precipitation-driven point sources dominate bacteria loading with their more constant flow and pollutant loading. These TMDLs are presented as average daily counts that were developed to meet the identified TMDL endpoints under a range of conditions observed throughout the year. The LSPC model simulates seasonal precipitation variability throughout the watershed as represented by the hourly weather time-series used to drive the model covering a range of hydrologic conditions, including the critical condition(s). Seasonal variation is also captured in the time variable simulation, which represents seasonal precipitation on a year-to-year basis.

PUBLIC PARTICIPATION

EPA welcomed public comments on the draft Pine Creek Bacteria TMDL from August 31, 2011, through November 15, 2011. EPA also held a public meeting to present the details and answer questions regarding the proposed Pine Creek Watershed Bacteria TMDL on September 28, 2011, from 5:00 to 7:00 p.m. at the Shaler Township Municipal Building, 300 Wetzel Road, Glenshaw, Pennsylvania. Stakeholders attending the meeting included the Allegheny County Health Department, Pine Creek Watershed Coalition, Pennsylvania Environmental Council, ALCOSAN, and many of the municipalities in the watershed. EPA received requests from a number of stakeholders for an extension to the public comment period. In response to requests for more time to gather available data and provide meaningful comments on the draft TMDL, EPA extended the public comment period twice providing a 75-day public comment period that closed on November 15, 2011. EPA publicized the draft TMDL by placing notice in local newspapers, including the *Pittsburgh Post-Gazette*, *Greensburg Tribune-Review* and *Pine Creek Journal*. The notices included information about the public meeting and instructions to the public on how to access and submit comments on the draft TMDL. EPA also published this information on its website. Appendix H of this document contains all the comments received and EPA's responses to each comment.

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1. Introduction and Background

1.1. Watershed Description

Pine Creek flows approximately 23 miles through the North Hills area of Allegheny County, in southwestern Pennsylvania (Figure 1-1). Encompassing 67 square miles, the Pine Creek watershed is one of the largest in north-central Allegheny County, and it includes portions of 14 municipalities. The lower half of the watershed is largely composed of residential development, but the headwaters and upstream portions primarily consist of forested and agricultural areas. Although these areas are not as urbanized as downstream portions of the watershed, rapid development is occurring.

The stream flows from the north toward Pittsburgh to the south, where it discharges to the Allegheny River, among highly urbanized lands. The Pine Creek watershed is within one U.S. Geological Survey (USGS) 8-digit hydrologic cataloging unit (05010009) and includes 128 stream miles. Major tributaries to Pine Creek are Little Pine Creek, Course Run, Gourdhead Run, McCaslin Run, Willow Run, Montour Run, Rinaman Run, Wexford Run, and Fish Run. Pine Creek and several of its tributaries are regularly stocked trout streams.

1.2. Impaired Water Bodies

Many communities throughout Pennsylvania operate aging sewer systems that include separate sanitary sewer systems, combined sewer systems, or a combination of the two. These sewer systems undergo chronic, and sometimes severe, sewage overflows during wet weather. Data indicate that waters receiving these discharges can be significantly affected by bacteria from sewage overflows and other pollutant sources that include exfiltration, failing septic systems, and nonpoint sources. These issues apply to the Pine Creek watershed.

The Pennsylvania Department of Environmental Protection (PADEP) included 118 stream miles in the Pine Creek watershed on the state's 2008 303(d) list as impaired for recreational uses. The listing was based on weekly monitoring data collected at 25 locations in the watershed from November 2006 through October 2007. Only the Willow Run watershed was found to be unimpaired; however, because sources in the Willow Run (PADEP stream ID 42168) watershed contribute to downstream impairments, they were given allocations in this the total maximum daily load (TMDL). Figure 1-2 shows the water bodies impaired for recreational uses in the Pine Creek Watershed, and Table 1-1 provides the listings.

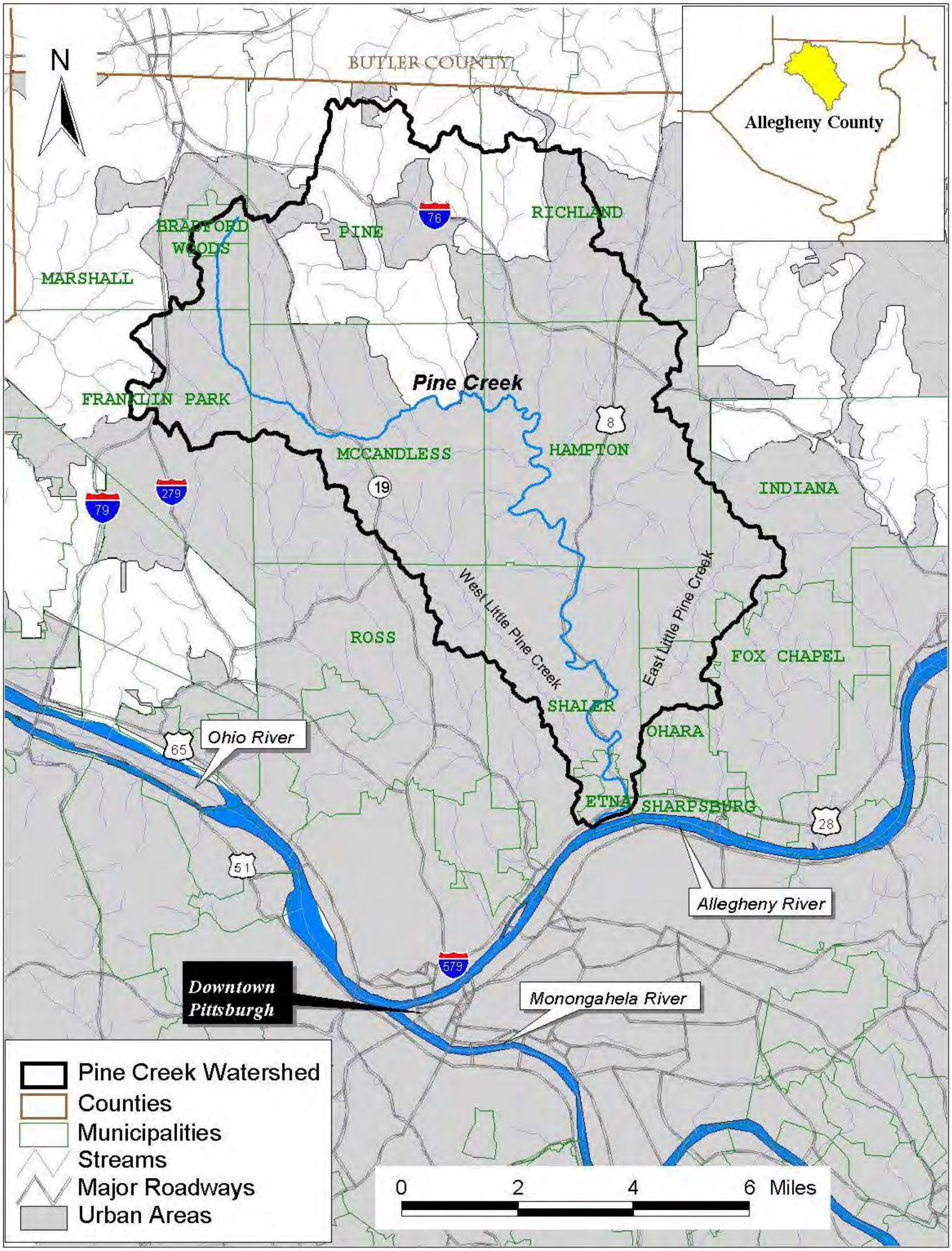


Figure 1-1. Pine Creek watershed.

Table 1-1. 2010 Recreational use impairments identified in Category 5 of the *2010 Pennsylvania Integrated Water Quality Monitoring and Assessment Report* addressed by the Pine Creek Bacteria TMDL, HUC 05010009

Stream name	Listing	Source
Crouse Run	Recreational (14249) - 4.21 miles	Source Unknown Pathogens
Crouse Run Unnamed Of (ID:123972143)	Recreational (14249) - 0.89 miles	Source Unknown Pathogens
Crouse Run Unnamed To (ID:123972135)	Recreational (14249) - 0.51 miles	Source Unknown Pathogens
Crouse Run Unnamed To (ID:123972140)	Recreational (14249) - 0.81 miles	Source Unknown Pathogens
Crouse Run Unnamed To (ID:123972141)	Recreational (14249) - 1.32 miles	Source Unknown Pathogens
Fish Run	Recreational (14249) - 2.47 miles	Source Unknown Pathogens
Fish Run Unnamed To (ID:123971472)	Recreational (14249) - 0.77 miles	Source Unknown Pathogens
Fish Run Unnamed To (ID:123971512)	Recreational (14249) - 1.18 miles	Source Unknown Pathogens
Gourdhead Run	Recreational (14249) - 2.93 miles	Source Unknown Pathogens
Gourdhead Run Unnamed Of (ID:123972097)	Recreational (14249) - 0.18 miles	Source Unknown Pathogens
Gourdhead Run Unnamed Of (ID:123972202)	Recreational (14249) - 0.41 miles	Source Unknown Pathogens
Gourdhead Run Unnamed To (ID:123972098)	Recreational (14249) - 1.43 miles	Source Unknown Pathogens
Gourdhead Run Unnamed To (ID:123972110)	Recreational (14249) - 0.55 miles	Source Unknown Pathogens
Little Pine Creek	Recreational (14249) - 12.83 miles	Source Unknown Pathogens
Little Pine Creek Unnamed Of (ID:123972089)	Recreational (14249) - 0.61 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123971455)	Recreational (14249) - 0.43 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123971457)	Recreational (14249) - 0.77 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123971504)	Recreational (14249) - 1.22 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123971516)	Recreational (14249) - 0.5 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972070)	Recreational (14249) - 1.02 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972075)	Recreational (14249) - 1.07 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972078)	Recreational (14249) - 0.61 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972079)	Recreational (14249) - 1.06 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972081)	Recreational (14249) - 0.98 miles	Source Unknown Pathogens
Little Pine Creek Unnamed To (ID:123972084)	Recreational (14249) - 1.4 miles	Source Unknown Pathogens
McCaskin Run	Recreational (14249) - 1.95 miles	Source Unknown Pathogens
Montour Run	Recreational (14249) - 4.99 miles	Source Unknown Pathogens
Montour Run Unnamed Of (ID:123973355)	Recreational (14249) - 0.63 miles	Source Unknown Pathogens
Montour Run Unnamed Of (ID:123973375)	Recreational (14249) - 0.29 miles	Source Unknown Pathogens
Montour Run Unnamed Of (ID:123973377)	Recreational (14249) - 0.7 miles	Source Unknown Pathogens
Montour Run Unnamed Of (ID:123973400)	Recreational (14249) - 0.82 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123972151)	Recreational (14249) - 1.06 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123972170)	Recreational (14249) - 0.51 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973364)	Recreational (14249) - 0.32 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973373)	Recreational (14249) - 0.31 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973397)	Recreational (14249) - 2.09 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973406)	Recreational (14249) - 0.41 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973411)	Recreational (14249) - 0.52 miles	Source Unknown Pathogens
Montour Run Unnamed To (ID:123973429)	Recreational (14249) - 0.33 miles	Source Unknown Pathogens
North Fork Pine Creek	Recreational (14249) - 5.04 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed Of (ID:123973022)	Recreational (14249) - 0.57 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed Of (ID:123973024)	Recreational (14249) - 0.25 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed Of (ID:123973032)	Recreational (14249) - 0.25 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed Of (ID:123973033)	Recreational (14249) - 1.3 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123971489)	Recreational (14249) - 0.34 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123971495)	Recreational (14249) - 0.69 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123971497)	Recreational (14249) - 1.02 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123973019)	Recreational (14249) - 1.64 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123973030)	Recreational (14249) - 2.01 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123973035)	Recreational (14249) - 2.45 miles	Source Unknown Pathogens
North Fork Pine Creek Unnamed To (ID:123973047)	Recreational (14249) - 0.28 miles	Source Unknown Pathogens
Pine Creek	Recreational (14249) - 26.48 miles	Source Unknown Pathogens
Pine Creek Unnamed Of (ID:123972086)	Recreational (14249) - 0.5 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123971460)	Recreational (14249) - 0.85 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123971462)	Recreational (14249) - 0.71 miles	Source Unknown Pathogens

Stream name	Listing	Source
Pine Creek Unnamed To (ID:123971466)	Recreational (14249) - 0.63 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123971470)	Recreational (14249) - 0.83 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123971484)	Recreational (14249) - 1.04 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123971509)	Recreational (14249) - 1.84 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972096)	Recreational (14249) - 0.57 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972100)	Recreational (14249) - 1.28 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972113)	Recreational (14249) - 2.06 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972126)	Recreational (14249) - 0.82 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972138)	Recreational (14249) - 2.51 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972249)	Recreational (14249) - 1.39 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972250)	Recreational (14249) - 0.9 miles	Source Unknown Pathogens
Pine Creek Unnamed To (ID:123972253)	Recreational (14249) - 1.1 miles	Source Unknown Pathogens
Rinaman Run	Recreational (14249) - 2.63 miles	Source Unknown Pathogens
Rinaman Run Unnamed To (ID:134880725)	Recreational (14249) - 0.77 miles	Source Unknown Pathogens
Wexford Run	Recreational (14249) - 2.8 miles	Source Unknown Pathogens
Wexford Run Unnamed To (ID:123971500)	Recreational (14249) - 0.82 miles	Source Unknown Pathogens

***Listed length is inaccurate, should be 2.52 miles
****Listed length is inaccurate, should be 0.95 miles

1.3. Water Quality Criteria

Pine Creek is subject to water quality standards found in the *Pennsylvania Code*, Title 25, Environmental Protection, Department of Environmental Protection, Chapter 93. The bacteria standard is excerpted below, in part, from Table 3 in Section 93.7 of the Pennsylvania Code (PADEP 1998):

> During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.

In waters designated for potable water supply:

> Maximum of 5,000/100 mL as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000/100 mL in more than 5% of the samples.

These criteria are presented in Table 1-2; note that for contact recreation, the swimming season is defined as May 1 through September 30.

Table 1-2. Pennsylvania bacteria criteria

Parameter (colony forming units [CFU] #/100 mL)	Pennsylvania code		
	Warm water fish (WWF), cold water fish (CWF), and trout stocking (TSF)	Potable water supply (PWS)	Water contact
Fecal Coliform Geometric Mean[a]	200		200
Fecal Coliform 10% not to exceed[a]	--	--	400
Fecal Coliform maximum average, and no more than 20 samples in 1 month to exceed[a]	--	5,000	--
Fecal Coliform 5% not to exceed[a]	--	20,000	--

[a] Source: PADEP 1998

Figure 1-2 shows the water bodies impaired for recreational uses in the Pine Creek watershed.

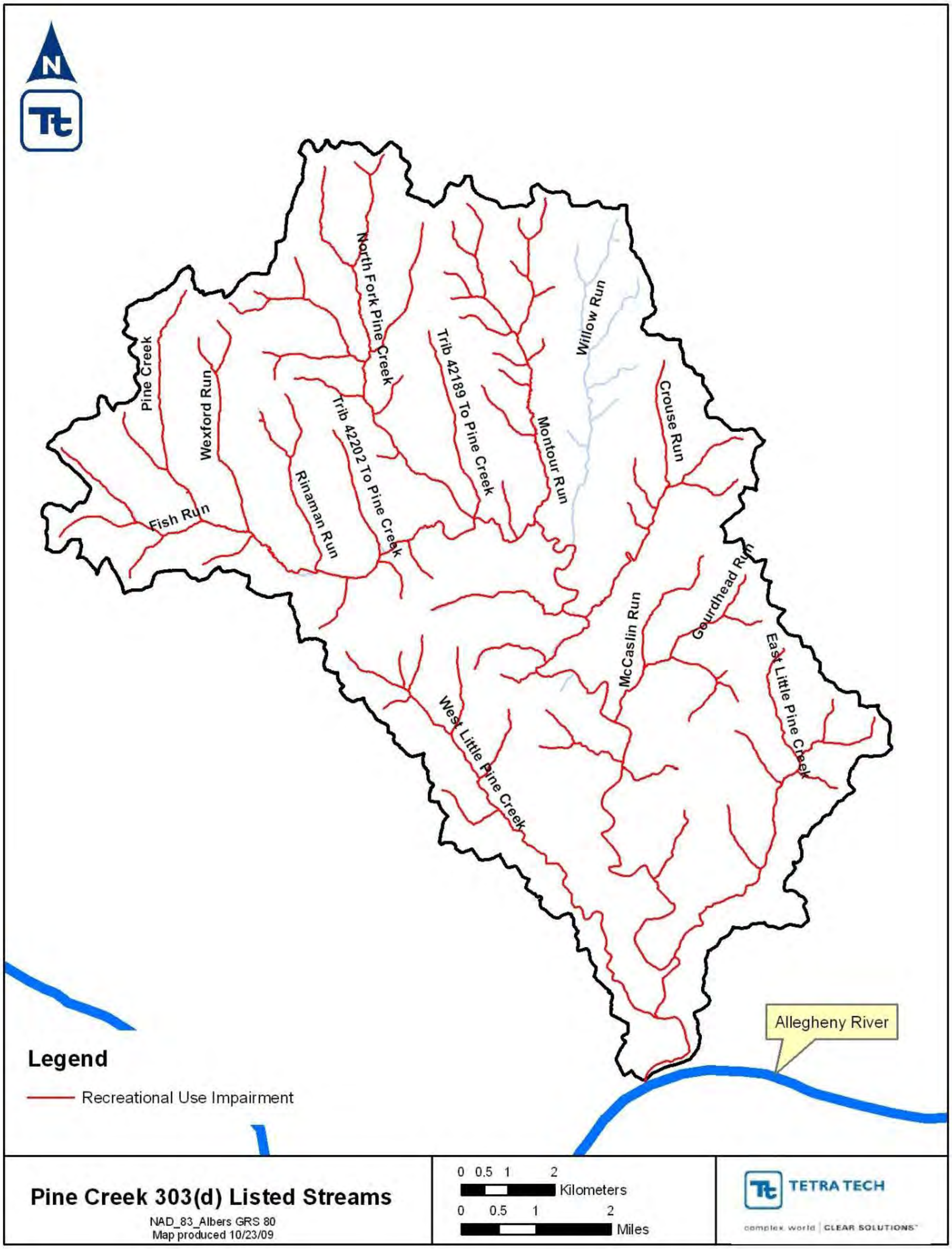


Figure 1-2. PADEP 303(d) listed streams for recreational use impairment.

Table 1-3 lists the beneficial use designations for the Pine Creek watershed.

Table 1-3. Beneficial uses designated for the Pine Creek watershed

Symbol	Water use
Aquatic Life	
WWF	Warm Water Fishes
TSF	Trout Stocking
CWF	Cold Water Fishes
Water Supply	
PWS	Potable Water Supply
IWS	Industrial Water Supply
LWS	Livestock Water Supply
AWS	Wildlife Water Supply
IRS	Irrigation Water Supply
Recreation	
B	Boating
F	Fishing
WC	Water Contact Sports
E	Esthetics

Source: PADEP 1998

1.4. TMDL Targets

When calculating TMDLs, numeric in-stream water quality target concentrations are established to ensure attainment of water quality criteria and protection of beneficial uses. The numeric water quality criteria applicable to fecal coliform in Pennsylvania were used as the basis for the TMDL endpoint.

2. Available Data and Analysis

This section discusses data available to characterize water quality in the Pine Creek watershed and to support model and TMDL development. Additionally, this section discusses results of specific analyses related to bacteria monitoring data collected to support development of this TMDL.

2.1. Data Inventory

2.1.1. Hydrology

The USGS National Water Information System online database lists two flow gauges with current and historic flow data in the Pine Creek watershed. USGS 03049800 is on Little Pine Creek near Etna, Pennsylvania, and USGS 03049807 is on Pine Creek at Grant Avenue at Etna. Data from these gauges were analyzed to obtain a general understanding of flow in the area. Additional flow measurements were obtained by PADEP to support TMDL development. PADEP monitored four locations between March and October 2007 using pressure transducers and established stage-discharge relationships. The stations are listed in Table 2-1.

Table 2-1. USGS stream gauge attributes

Station ID	Gauge name	Drainage area (square miles)	Period of record	
			Start date	End date
Pine North Park_SD	Pine Creek at Outlet of North Park Lake	23.11	3/2007	10/2007
Mouth	Pine Creek at Mouth	65.42	3/2007	10/2007
West	West Branch Little Pine Creek	6.62	3/2007	10/2007
MCD	Pine Creek at McDonalds	51.54	3/2007	10/2007
USGS 03049800	Little Pine Creek near Etna, PA	5.78	1962	present
USGS 03049807	Pine Creek at Grant Avenue at Etna, PA	57.3	6/2006	present

2.1.2. Weather

The climate in western Pennsylvania is generally mild throughout the year, with cooler winters. Winters are not usually extreme, with temperatures staying a few degrees above freezing. Warm temperatures occur in spring, and summers are hot and sunny, with fairly low humidity. The Pittsburgh area receives an average of 37 inches of precipitation per year. Exceptions include the very wet years of 2003 and 2004 and the drought years of 2001 and 2002. Meteorological data are available from the National Climatic Data Center (NCDC). The weather data include temperature, precipitation, and snow measurements, and other surface airways information (e.g., pressure and wind speed measurements). The weather station nearest the watershed is at the Pittsburgh International Airport (ID: PA6993), which is approximately 10 miles west of the Pine Creek watershed, southwest of the Ohio River (Table 2-2). Figure 2-1 shows the locations of the USGS gauges and the NCDC weather station.

Table 2-2. NCDC weather station attributes

Station ID	Gauge name	Period of record	
		Start date	End date
PA6993	Pittsburgh International Airport	1952	present

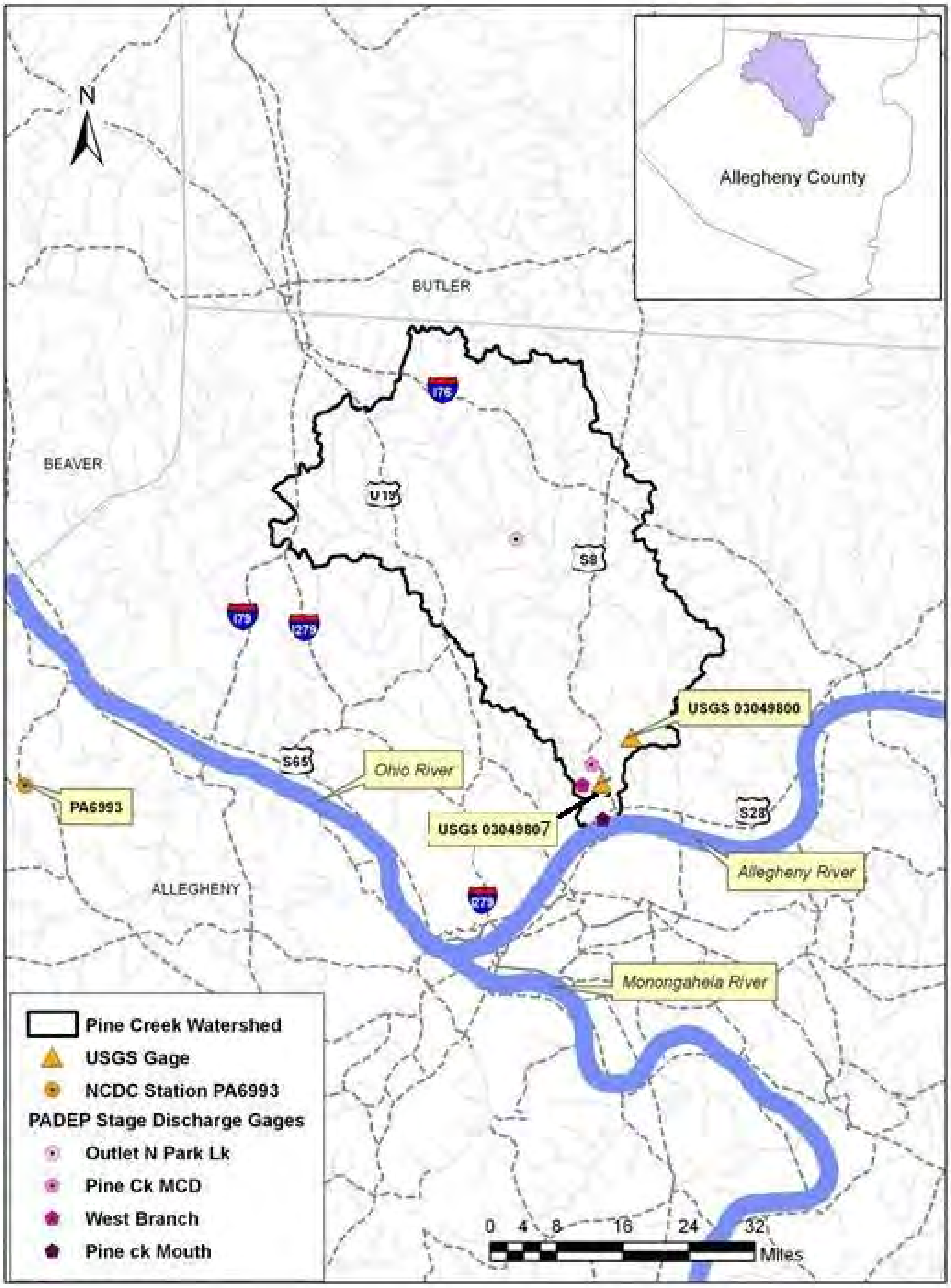


Figure 2-1. Locations of NCDC climate station and PADEP and USGS flow monitoring.

In addition to weather data available from the NCDC, the Three Rivers Wet Weather (3RWW) Demonstration Program operates an extensive system of 33 rain gauges throughout Allegheny County that collect rainfall data during wet-weather events (3RWW also provided additional data for the watershed [see Table 3-5] to support the modeling and TMDL development process). The data gathered by these gauges are supplemented with National Weather Service NEXRAD radar data collected during the same period for every square kilometer in the county. EPA used this additional wet-weather information to confirm, validate, and patch if necessary, the hourly rainfall data available from NCDC stations. These data were used in the modeling effort described in Section 5.

2.1.3. Land Use Data

General land use and land cover data for the Pine Creek watershed were extracted from the Multi-Resolution Land Use Characteristics Consortium's (MRLC's) satellite image-derived 2001 Land Use and Land Cover (LULC) data set (Homer et al. 2004). This data set includes 29 categories, 14 of which are in the Pine Creek watershed. Table 2-3 summarizes land cover in this watershed, and the LULC coverage for the Pine Creek watershed is shown on Figure 2-2.

Forest is the single dominant land use/land cover, at just over 40 percent of the watershed, followed by low-intensity developed and developed open space, which together compose approximately 50 percent of the total land cover in the watershed. The lower half of the watershed is more urbanized than the upstream areas, which are where more forest and agricultural lands are. Etna Borough is in the highly urbanized area (UA) near the mouth of the stream, where it discharges to the Allegheny River just north of downtown Pittsburgh.

Table 2-3. LULC in the Pine Creek watershed

Land use	Area (acres)	Area (square miles)	% of total
Open Water	94	0.2	0.22%
Developed, Open Space	13,081	20.3	30.42%
Developed, Low Intensity	8,532	13.3	19.84%
Developed, Medium Intensity	1,764	2.8	4.10%
Developed, High Intensity	733	1.1	1.70%
Barren Land (Rock/Sand/Clay)	4	0.0	0.01%
Deciduous Forest	17,144	26.8	39.87%
Evergreen Forest	164	0.3	0.38%
Mixed Forest	96	0.1	0.22%
Grassland/Herbaceous	226	0.4	0.53%
Pasture/Hay	677	1.1	1.57%
Cultivated Crops	472	0.7	1.10%
Woody Wetlands	12	0.0	0.03%
Emergent Herbaceous Wetlands	6	0.0	0.01%
TOTALS:	43,006	67.1	100%

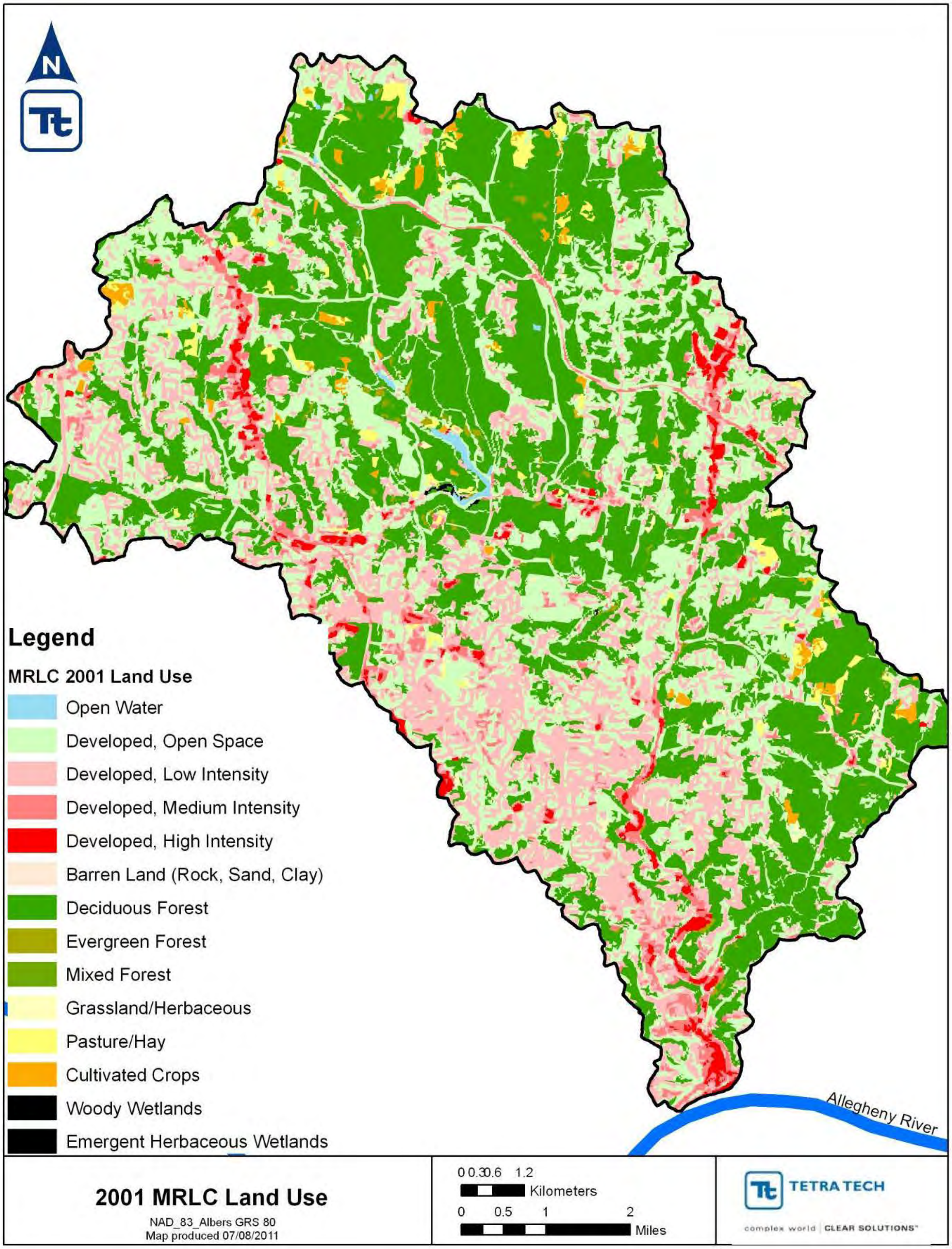


Figure 2-2. Land use distribution in the Pine Creek watershed.

2.1.4. Water Quality Data

Various efforts at data collection have occurred to support different water quality management efforts in the Pine Creek watershed. A review of these is available in a report developed during previous phases of this project (Tetra Tech 2006a).

From November 2006 to October 2007, weekly bacteria data (fecal coliform and *Escherichia coli*) were collected at 25 locations in the Pine Creek watershed to support determination of recreational use attainment status in the watershed (Tetra Tech 2006b) and eventual TMDL development. The fecal coliform data were compared to numeric water quality criteria applicable to Pennsylvania waters and these criteria were used as TMDL endpoints. Fecal coliform data were used to calibrate a water quality model used to develop the TMDLs provided in this report. Figure 2-3 shows locations of sampling stations in conjunction with other relevant sources and monitoring locations such as National Pollutant Discharge Elimination System (NPDES)-permitted discharges, combined sewer overflows (CSO)/sanitary sewer overflows (SSO) discharges, and the USGS gauges.

Table 2-4 summarizes the fecal coliform data collected and used in the TMDL, including the number of samples taken at each station and the minimum, average, and maximum counts for each sampled parameter.

Table 2-4. Summary of water quality station data

Station ID	Count	Fecal coliform (#/100 mL)		
		Min	Avg	Max
1	36	86	7,996	104,000
2	35	32	9,088	102,000
3	34	65	5,160	33,000
4	35	89	1,611	12,300
5	35	155	1,997	14,250
6	35	210	2,119	16,050
7	35	97	1,537	10,800
8	35	338	8,738	135,000
9	35	39	2,197	44,000
10	35	75	986	5,100
11	35	165	4,020	21,100
12	35	250	2,938	20,000
13	35	26	1,130	20,000
14	35	68	1,296	13,600
15	35	64	785	5,800
16	35	6	851	11,636
17	35	26	775	7,200
18	35	5	1,102	15,200
19	35	135	1,737	11,400
20	35	6	1,316	8,300
21	35	5	1,420	15,050
22	35	1	412	4,900
23	35	13	1,035	9,750
24	35	45	23,968	720,000
25	35	58	1,340	11,545

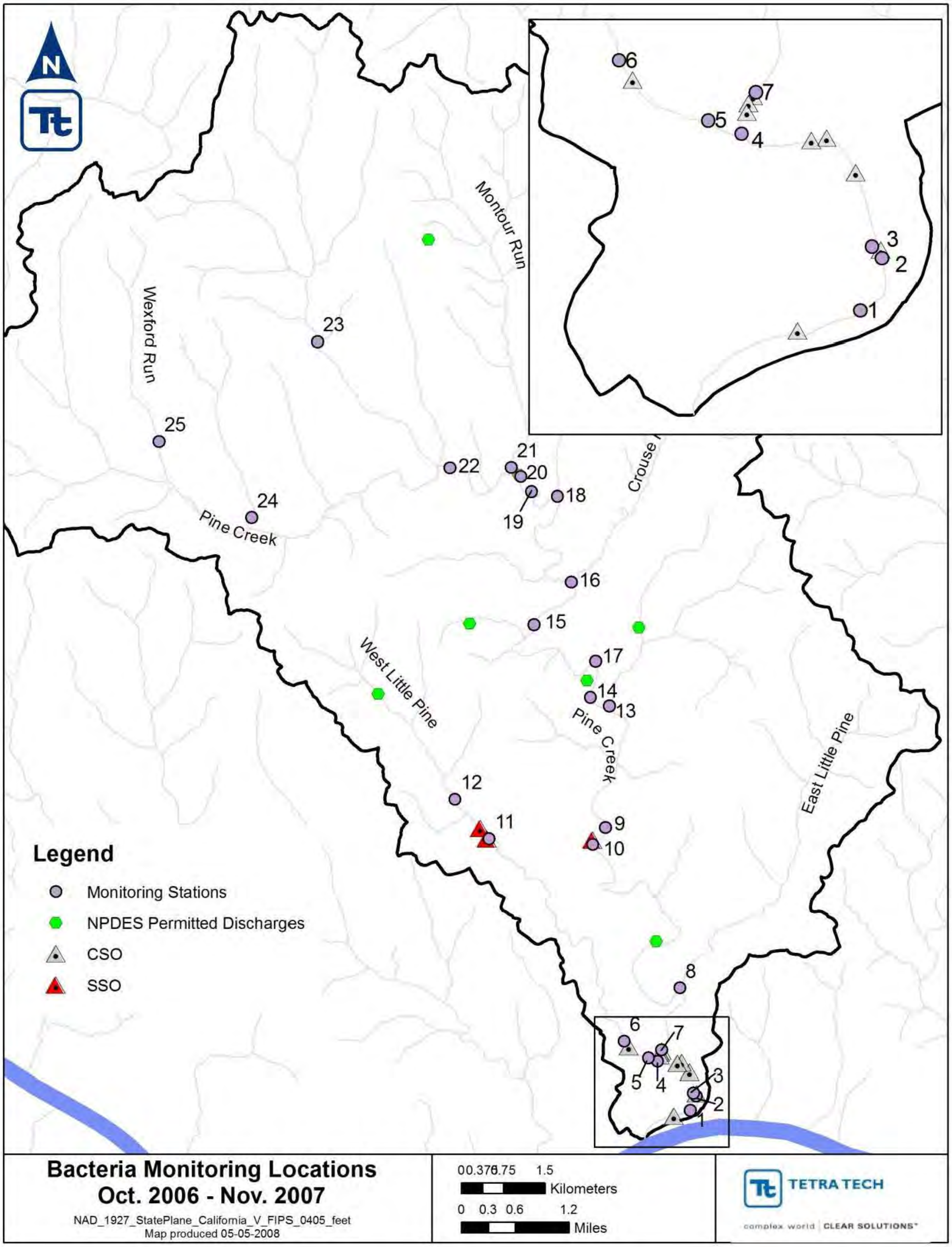


Figure 2-3. Sites monitored during the 2006–2007 monitoring effort, and permitted discharges.

2.2. Data Analysis

2.2.1. Stream Sampling

A more detailed review of the assessment/pre-TMDL sampling results is available in the supporting document, *Bacteria Data Analysis to Support Bacteria Modeling and TMDL Development for the Pine Creek Watershed, Pittsburgh, Pennsylvania* (Tetra Tech 2009).

Figure 2-4, Figure 2-5 and Figure 2-6 illustrate, respectively, the range of maximum, average, and minimum counts at each of the stations. As one might expect, given the presence of CSO/SSO discharges in the lower portion of the watershed, these figures illustrate that generally, the highest bacteria levels occur in this part of the watershed. Maximum bacteria levels at stations 1 and 2 on the mainstem reflect CSO discharges, and reached levels of more than 100,000 fecal coliform counts, while neighboring stations routinely have levels in the tens of thousands. However, elevated levels are also seen at stations in other parts of the watershed (station 8 – maximum fecal coliform of 135,000; station 9 – maximum fecal coliform of 44,000; station 24 – maximum fecal coliform of 720,000). These levels are likely due to septic contributions at station 8, and other sources that are not immediately obvious at the other locations (e.g., possible leaking sewer lines). Figure 2-4 graphically illustrates the maximum fecal coliform data shown in Table 2-4. Larger circles indicate stations where the data indicate the highest levels of bacteria. From this graphic, one is able to visualize where the extreme values occur, predominantly in the lower portion of the watershed.

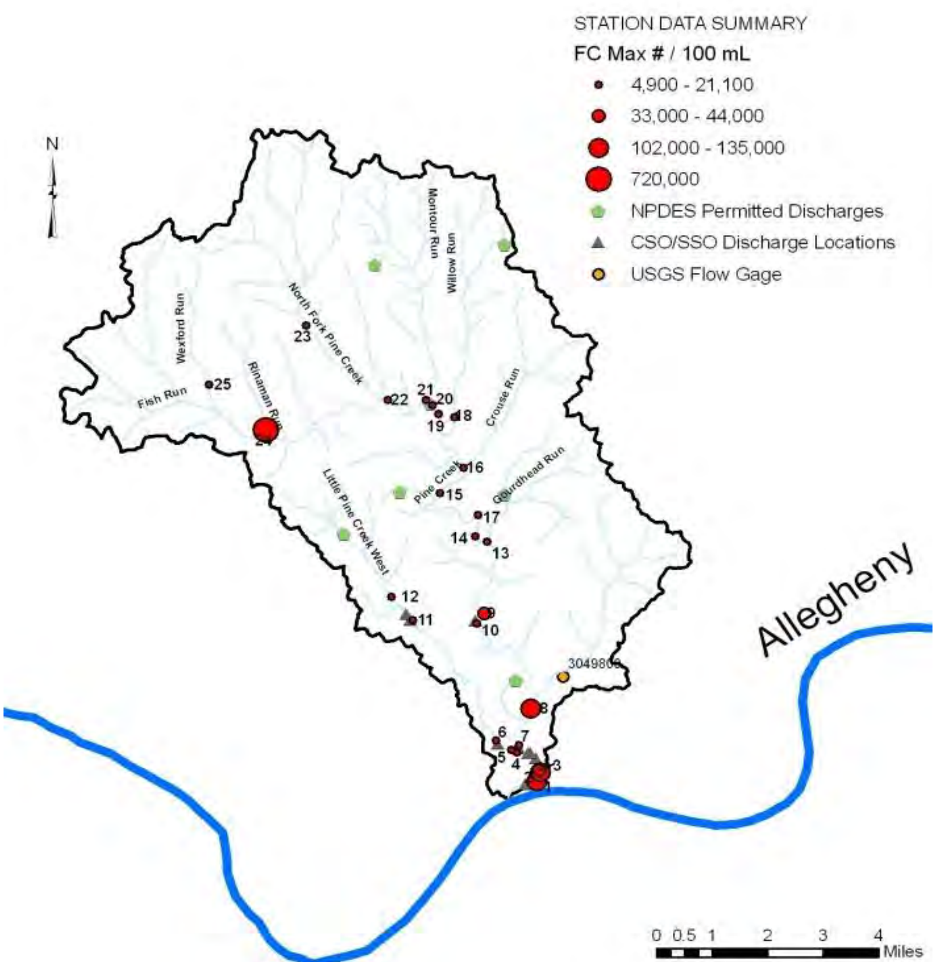


Figure 2-4. Range of maximum FC bacteria levels at stations in the Pine Creek watershed.

Figure 2-5 shows that stations with the higher averages correspond with stations that also see highest maximums. Station minimums are shown on Figure 2-6.

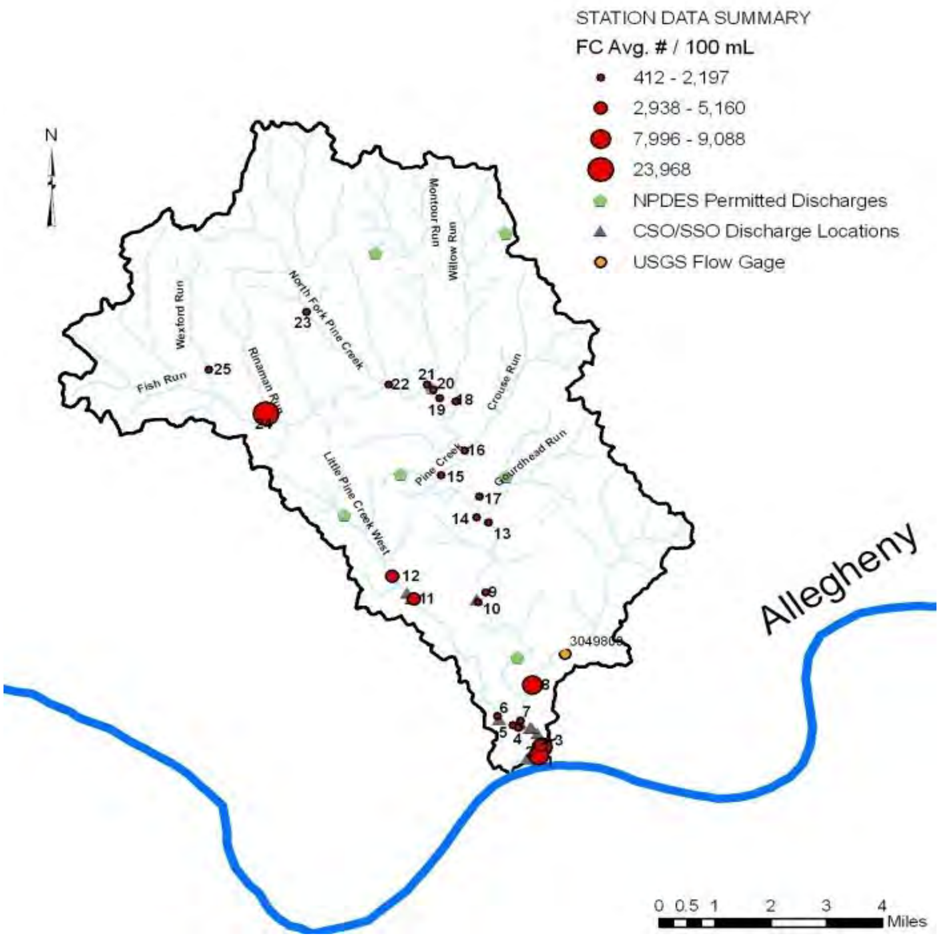


Figure 2-5. Range of average FC bacteria levels at stations in the Pine Creek watershed.

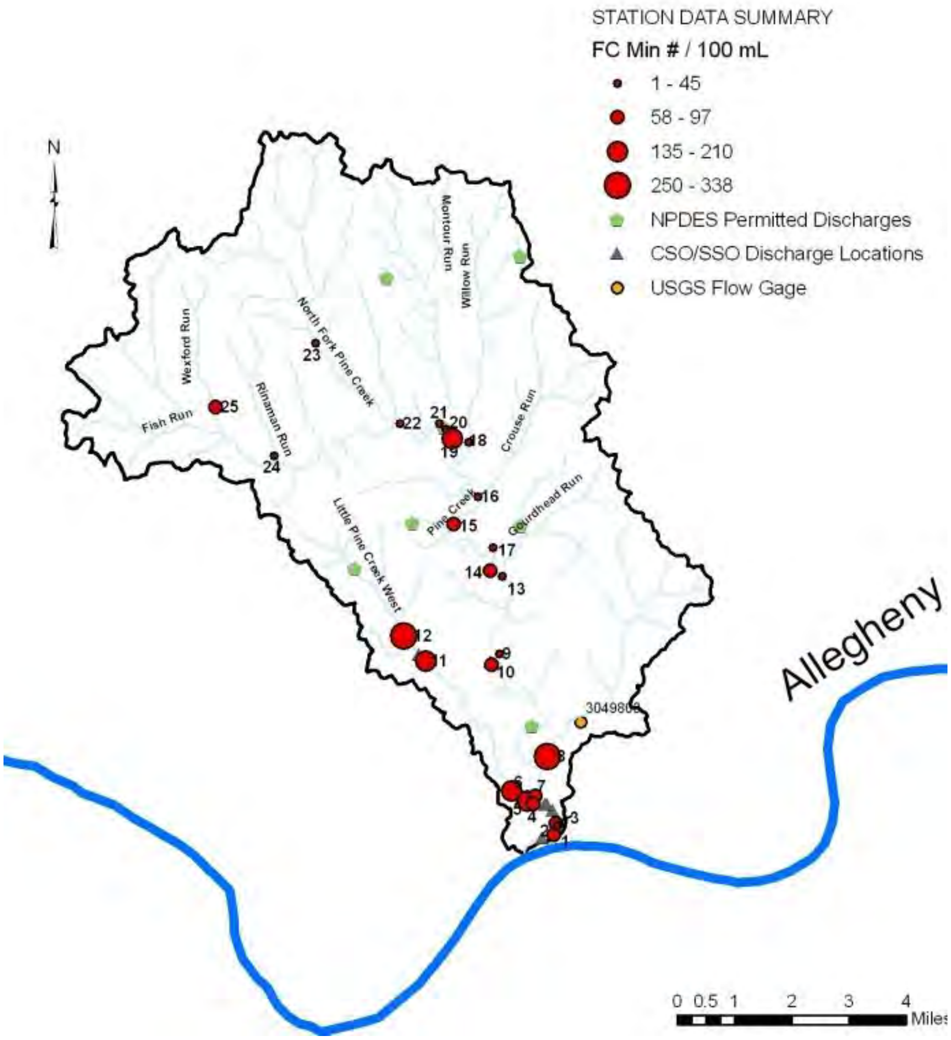


Figure 2-6. Range of minimum FC bacteria levels at stations in the Pine Creek watershed.

The monitoring data reveal that bacteria levels are highest in the summer months at all stations. Analysis of the fecal coliform sampling results show that all stations exceeded geometric mean criteria and not-to-exceed (NTE) criteria during the recreational season.[1] Two stations, 8 and 11, show impairment during the non-recreational season as well. All stations also fail to meet the fecal coliform NTE criteria.

2.2.2. Flow Loading Analysis

To develop a better understanding of the conditions under which bacteria are entering streams in the Pine Creek watershed, a flow-weighted concentration analysis and a seasonal concentration analysis were performed. The goal of flow-weighted concentration analysis is to help identify trends in concentration levels that can be associated with low-flow conditions, high-flow conditions, mixed low-flow/high-flow

[1] PADEP placed 118 stream miles in the Pine Creek watershed on its 2008 303(d) list as impaired for recreational uses on the basis of these monitoring data; however, PADEP did not include the Willow Run watershed, draining to station 18, as impaired (or in category 5), but it is addressed by this TMDL.

conditions, or non-flow-related conditions. The goal of the seasonal/monthly analysis is to help determine whether upstream land management activities and practices might be affecting water quality.

Example results of these analyses for station 25 appear on Figure 2-7. The first (flow-weighted analysis) examines the potential relationship between bacteria criteria violations and flow levels by presenting the flow-weighted average fecal coliform concentrations. Available water quality observation data are paired with the USGS hydrograph flow estimates for gauge 3049800 for the same date. Flow values are ranked from highest to lowest and divided into percentiles. For each percentile range, average flow is shown in blue, and the minimum and maximum flow range for that percentile. Concentration data are presented in bar graph format for each percentile range. The data table above the graph provides additional summary statistics for flows and concentrations. The mean concentration listed in the data table represents the flow-weighted average concentration. For example, for the flows and concentrations in the 0–10 percentile range, bacteria are calculated and summed, flows are summed, and the total bacteria count is divided by the total flow to derive the flow-weighted average concentration.

In cases where bacteria counts are highest during low-flow conditions (e.g., point source-dominated) the first graph would show an inverse relationship between the flow percentiles and corresponding concentrations (i.e., as flows increase, concentrations would decrease). This result could reflect a leaking sewer line, failing septic systems, or discharges from a point source. These types of inputs would dominate in-stream concentrations under low-flow conditions; under high-flow conditions, assuming no significant high-flow condition-related sources, these inputs would be diluted, and the graph would show low concentrations during high flows. For a strictly high-flow loading condition, the graph would show high concentrations occurring with increasing flows. One would expect to see highest concentrations with the highest flow percentiles and the lowest concentrations occurring in conjunction with the lowest flow percentiles. When no relationship between flow levels and concentrations is discernible, one might infer a mixed loading scenario or a scenario unrelated to flows.

The second graph for each water quality station presents the monthly analysis of water quality observations and shows seasonal patterns. Observations are grouped according to the month in which they were recorded. Corresponding flow values are averaged and plotted with the monthly mean concentration. The first graph shows an increasing trend in concentrations with increasing flow percentiles at this station; however, the highest concentrations occurred during the 60–80th flow percentile ranges. From the seasonal analysis, one sees that the highest stream flows occurred during August, May, and June (in that order), while the lowest occurred during October, September, and July. From this it could be inferred that sources of bacteria in this watershed are likely predominantly precipitation driven or high-flow-related, or both. From the seasonal analysis, it is apparent that counts are highest during the warm-weather months. This could be attributed to multiple factors including more active sources during this period, better survival of bacteria in the environment, or higher relative contributions from land-based runoff.

Data from all stations were evaluated. The graphical results of this analysis are presented in their entirety in Appendix A. Given the presumed sources of bacteria in this watershed, one would expect to see various patterns depending on the location of the station and proximity to different sources (NPDES discharges, CSO/SSO discharges, leaking sewer laterals, land uses, or known problem areas for septic system failures). Stations 3, 8, 12, 19, and 20 exhibit patterns that do not appear related to flow level; counts are relatively constant regardless of flow percentile. Of these, stations 12, 19, and 20 are downstream of NPDES permitted sources, station 3 is downstream of a CSO discharge, and station 8 is located on East Little Pine Creek, which is discussed further in Section 3.2.1 and, according to ACHD, is likely influenced by septic inputs. Except for the CSO discharges, these sources would be associated with high bacteria levels under low-flow conditions, with dilution (and lower counts) occurring under high-flow conditions. Because these stations do not record significant dilution during high-flow conditions, precipitation-related sources are also suggested. Station 24 shows a trend of decreasing bacteria levels with increasing flows, indicating the possibility of a constant source of bacteria in this subwatershed. Note the high maximum of 720,000 counts / 100 milliliter (mL) measured on May 30, 2007. If this maximum is an outlier, the relationship between flows and concentrations at this location might be more mixed. Another possible source of bacteria at these locations might be leaking sewer laterals.

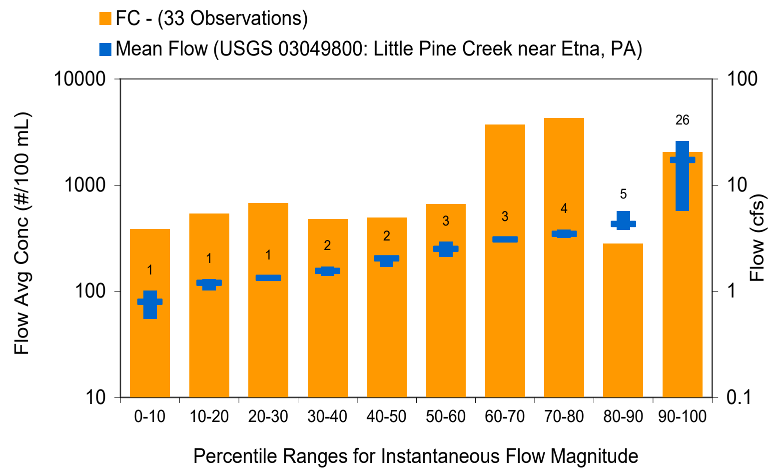
The remaining stations do show some relationship between higher flows and higher concentrations, indicating sources that predominate during high-flow conditions; however, the relationship is not always strong, and in most cases, the flow-bacteria relationship is somewhat mixed, indicating the presence of both low-flow dominating sources and high-flow dominating sources. Stations where the highest measured concentration occurred during the highest percentile flow range are stations 1, 2, 8, 9, 14, 15, 16, 17, and 22. The majority of stations' highest concentrations occurred in conjunction with flows in the 60-70th percentile range: stations 3, 4, 5, 6, 7, 10, 11, 12, 13, 18, 19, 21, and 23.

Location: Site 25
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.793	0.550	1.000	383.94	288.00	530.00
10-20	3	1.200	1.100	1.300	539.44	100.00	960.00
20-30	3	1.333	1.300	1.400	678.20	410.00	1167.00
30-40	4	1.550	1.400	1.700	474.77	125.00	811.00
40-50	3	2.033	1.900	2.100	494.67	145.00	820.00
50-60	3	2.500	2.100	2.900	659.92	545.00	806.00
60-70	3	3.067	3.000	3.200	3726.63	155.00	10150.00
70-80	3	3.467	3.200	3.800	4279.98	626.00	11545.00
80-90	3	4.300	3.800	5.200	281.37	81.00	675.00
90-100	4	17.200	5.800	26.000	2045.61	71.00	5400.00

Location: Site 25
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	80.33	71.00	155.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	3464.88	165.00	5400.00
June	4	3.625	1.700	5.800	1950.60	675.00	3700.00
July	4	1.523	0.790	3.000	5366.29	530.00	10150.00
August	5	5.990	0.550	22.000	2628.68	430.00	11545.00
September	4	1.508	0.830	2.500	632.87	330.00	1167.00
October	3	1.267	1.000	1.400	287.63	125.00	450.00
November	3	2.667	1.300	3.800	605.77	100.00	806.00
December	2	2.100	2.100	2.100	347.50	145.00	550.00



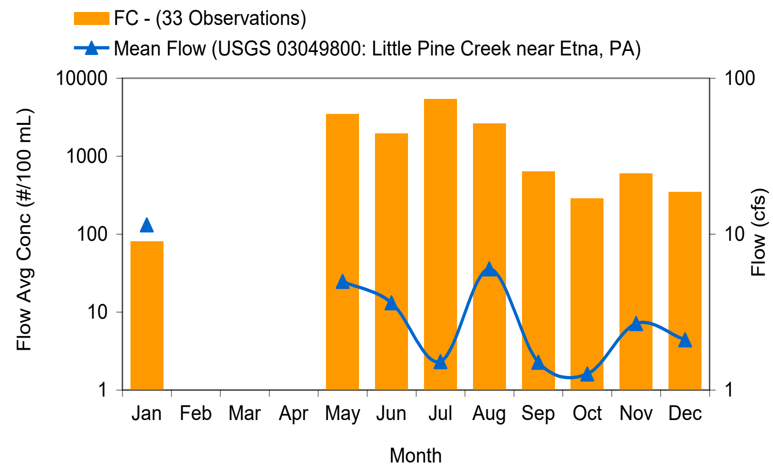


Figure 2-7. Station 25 flow-bacteria analysis.

3. Source Assessment

Several possible sources of bacterial contamination exist in the Pine Creek watershed. Sources can be divided into two categories: point sources and nonpoint sources. This section describes the possible sources of pollution in the pilot watershed, which also might exist in other watersheds throughout the Pittsburgh region and Pennsylvania.

3.1. Point Sources

A point source, according to 40 *Code of Federal Regulations* (CFR) 122.3, is any discernible, confined, and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or might be discharged. The NPDES program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

3.1.1. Industrial and Public/Private Sewerage Discharges

Eight NPDES permitted facilities are authorized to discharge bacteria in the Pine Creek watershed. These are listed in Table 3-1 and shown on Figure 3-1.

Table 3-1. Industrial and public/private sewerage NPDES permits in the Pine Creek watershed

NPDES ID	SIC code	SIC name	Name[a]
PA0216143[b]	8811	Private Household	
PA0205141[b]	4952	Sewerage Systems	
PA0027669	4952	Sewerage Systems	MCCANDLESS TWP SAN AUTH-PINE C
PA0028177	4952	Sewerage Systems	MCCANDLESS TWP SAN AUTH-A & B
PA0043729	4952	Sewerage Systems	HAMPTON TWP - ALLISON PARK WPCP
PA0000515	3498	Fabricated Pipe and Pipe Fittings	ANVIL PRDTS PITTSBURG DIV
PA0025992	4952	Sewerage Systems	MCCANDLESS TWP SAN AUTH-LONGVU
PA0003425[b]	2843	Surface Active Agents, Finishing Agents, Sulfonated Oils, and Assistants	BALL CHEMICAL CO-GLENSHAW

Source: EPA ICIS Database

[a] Some names have been withheld, because they refer to individual citizens.

[b] Permits expired. They were included in the TMDL because expired permits do not necessarily indicate discharge is stopped. All listed permits were active during the modeled period so it was necessary to represent them for calibration purposes.

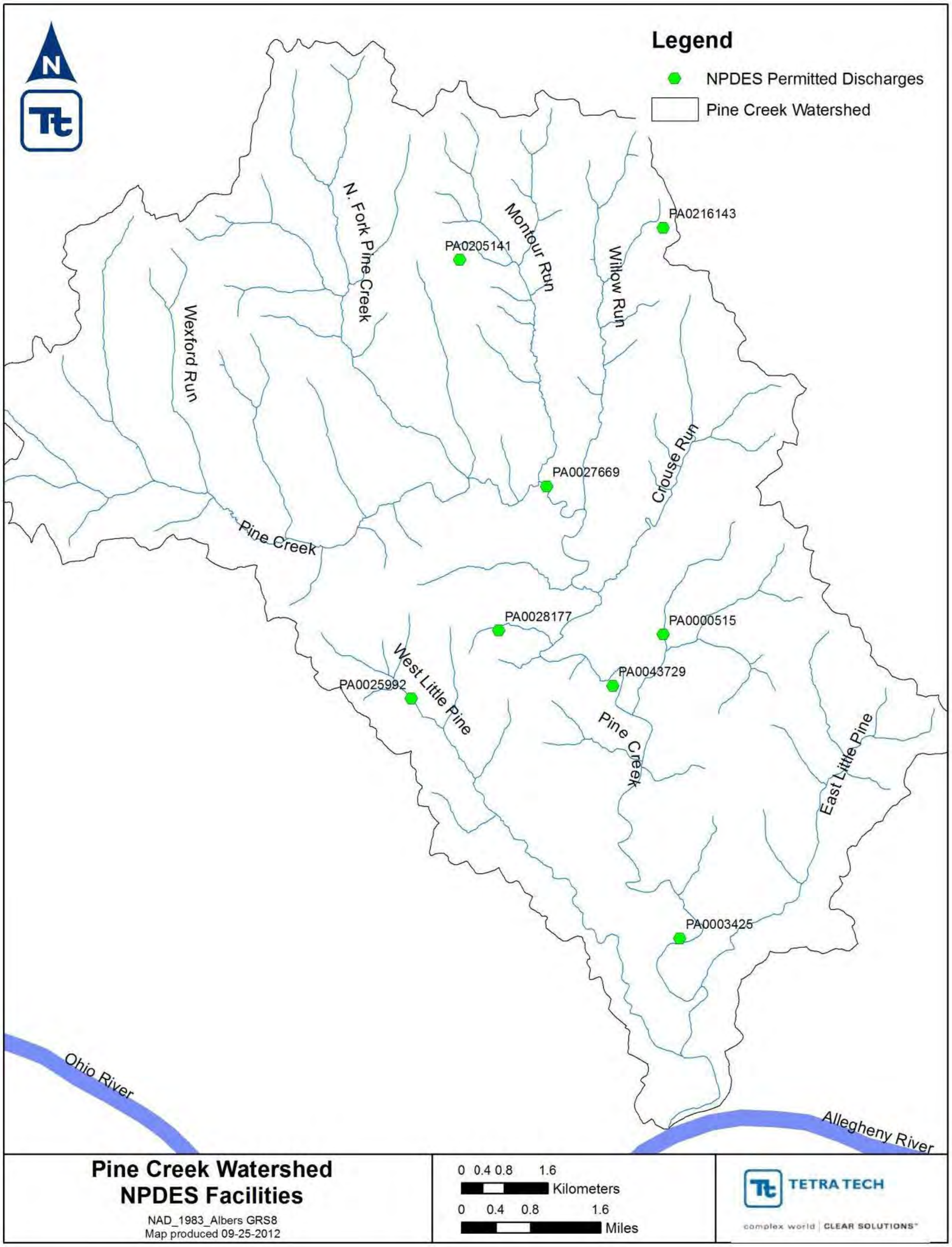


Figure 3-1. Industrial and public/private sewerage NPDES permitted facilities in the Pine Creek watershed.

Table 3-2 lists summary data characterizing these facility discharges on the basis of discharge monitoring report (DMR) data and permit limits.

Table 3-2. Industrial and public/private sewerage NPDES discharger characteristics

NPDES ID	Name	Flow limit (mgd)	Average DMR flow (mgd)	Average DMR fecal coliform (CFU/100 mL)
PA0216143	*	0.0004	0.0004	1
PA0205141	*	0.0004	--	--
PA0027669	MCCANDLESS TWP SAN AUTH-PINE C	6	3.4875	2,580
PA0028177	MCCANDLESS TWP SAN AUTH-A & B	0.4	0.1205	155
PA0043729	HAMPTON TWP - ALLISON PARK WPCP	3.2	2.0500	121
PA0000515	ANVIL PRDTS PITTSBURG DIV	0.0008	0.0005	3,675
PA0025992	MCCANDLESS TWP SAN AUTH-LONGVU	1.9	1.0446	144
PA0003425	BALL CHEMICAL CO-GLENSHAW	0.0072	--	--

mgd = million gallons per day
* Some names have been withheld, because they refer to individual citizens.
Period of record: February 2001–June 2006

3.1.2. CSO/SSO Discharges

Allegheny County Sanitary Authority (ALCOSAN) has been a major provider of wastewater conveyance and treatment to Pittsburgh area member communities since late 1940s. Service is now extended to 83 communities including Pittsburgh. Partner communities own/operate their own collection systems and range in size from 400,000 to fewer than 500 people.

ALCOSAN's system was designed to convey dry-weather flow from partner communities to the ALCOSAN treatment plant on the Ohio River. The interceptor system was designed to include over 300 overflow points (throughout Allegheny County). Therefore, during wet-weather conditions, carrying capacity is exceeded and a mixture of stormwater, groundwater, and sanitary sewage can be discharged into streams and rivers.

A significant area of Etna Borough is within the A-68 interceptor service area, which largely mimics the boundary of the borough. Stormwater loads for Etna Borough in this service area are conveyed to the ALCOSAN treatment plant. The drainage area for Interceptor A-68 was provided by Etna, and EPA used this information to identify areas in the watershed that drain to POTW facilities and do not contribute loads to surface waters in the Pine Creek watershed.

ALCOSAN'S A-68 interceptor includes both CSOs and SSOs in the lower half of the Pine Creek watershed. Etna and Shaler Township are both ALCOSAN partner communities. Etna contains eight CSO discharges and one SSO discharge; Shaler Township has three SSOs. Communities with CSOs are required to develop long-term control plans (LTCPs), while SSOs are considered unpermitted, illegal, and must be eliminated.

Data were provided by Etna and Shaler regarding the CSO and SSO outfalls in each municipality. Data included location information, and flow data for monitored outfalls. No water quality data were available for any of the outfalls. The method used to estimate water quality of the discharges is described in Section 5.2.5.

Shaler Outfalls

No CSO outfalls exist in Shaler. Flow data for all three SSO outfalls were obtained for the Shaler sites. On the basis of the data, no observed or predicted overflows occur at SSO MH-145 or SSO MH-75s; therefore, they were not represented in the model as sources of flow or bacteria.

Etna Outfalls

For seven of the eight CSO outfalls in Etna, flow data were available. Because no data were available for CSO8, it was not represented in the TMDL modeling as a source of flow or bacteria. Although a single SSO outfall (A6800-OSS-L-36) is shown in Etna, no data were available for this location; therefore, this outfall was assumed not to overflow, and it was not represented in the model as a source of flow or bacteria.

Table 3-3 lists each outfall by name (if available), associated township, and whether it was explicitly modeled for the TMDL. Figure 3-2 shows locations of these outfalls.

Table 3-3. CSO/SSOs in the Pine Creek watershed

Outfall	Name of outfall	Borough/township	Modeled
CSO8	Poplar Street and Railroad Bridge	Etna	No
CSO1	Bridge Street	Etna	Yes
CSO1A	Etna Towne Center	Etna	Yes
CSO2	Ganster Street	Etna	Yes
CSO3	Butler Street	Etna	Yes
CSO5	Dewey and Cresent	Etna	Yes
CSO4	Grant Avenue and RR Bridge	Etna	Yes
SSO		Etna	No
CSO7		Etna	Yes
SSO Overflow MH-145		Shaler	No
SSO Overflow MH-75	Lower	Shaler	Yes
SSO Overflow MH-78	Upper	Shaler	No

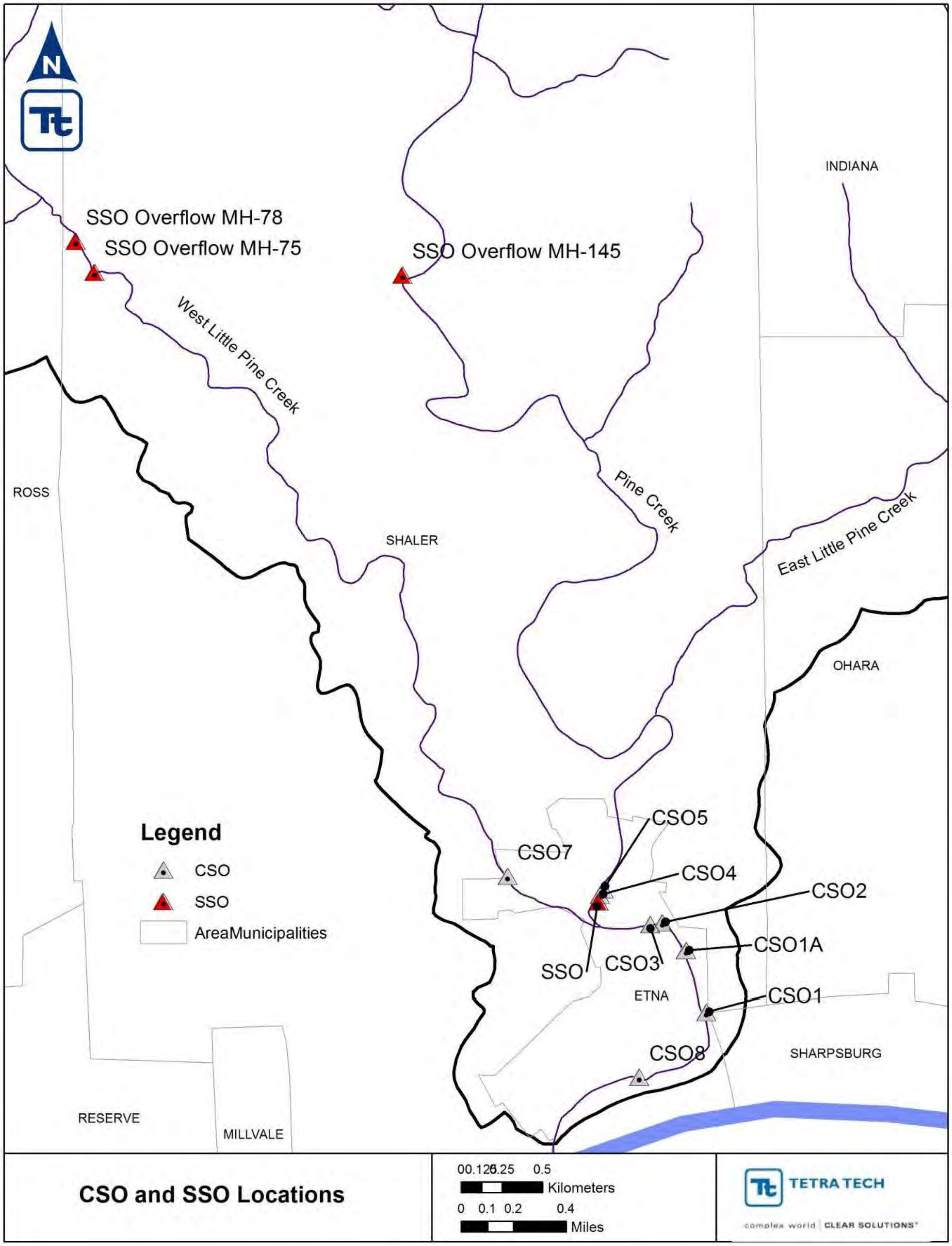


Figure 3-2. CSO and SSO locations in the Pine Creek watershed.

3.1.3. *Municipal Separate Stormwater Sewer Systems (MS4)*

Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants that can eventually enter nearby water bodies. MS4 discharges are considered point sources and require coverage by an NPDES MS4 permit as described below.

Under the NPDES stormwater program, operators of large, medium, and regulated small MS4s must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population in the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population between 100,000 and 249,999; a large MS4 has a population of 250,000 or more. Phase II of the rule extends coverage of the NPDES Storm Water Program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program. Only a select subset of small MS4s, referred to as regulated small MS4s, require an NPDES stormwater permit. Regulated small MS4s are defined as (1) all small MS4s in *urbanized areas* (UAs) as defined by the Bureau of the Census, and (2) those small MS4s outside a UA that are designated by NPDES permitting authorities.

Portions of 14 small MS4 communities as well as 2 transportation MS4s are in the boundaries of the Pine Creek watershed. A geographic information system (GIS) shapefile of Pennsylvania municipalities was used to establish the boundaries of the MS4 communities. Unregulated areas have been identified as non-UAs on the basis of the U.S. Census Bureau's UA determination for 2000, available at http://www.census.gov/geo/www/ua/uaucbndy.html. Figure 3-3 shows the Pine Creek watershed with MS4 and unregulated areas superimposed. Table 3-4 lists the permitted municipalities in the watershed. Sharpsburg has been exempted by PADEP and represents an insignificant amount of area in the watershed.

Table 3-4. MS4s Permittees in the Pine Creek watershed

MS4 community	NPDES ID
Etna Borough	PAG136269
Sharpsburg	Exempt/Waiver
O'Hara	PAI136128
Fox Chapel	PAI136102
Ross	PAG136221
Shaler	PAG136146
Indiana	PAI136101
Hampton	PAG136281
McCandless	PAG136140
Franklin Park	PAG136175
Marshall	PAG136306
Bradford Woods	PAG136263
Pine	PAG136152
Richland	PAG136309
Pennsylvania Department of Transportation	PAI-1315-00-05-0002
Pennsylvania Turnpike Commission	PAI-1315-00-06-0001

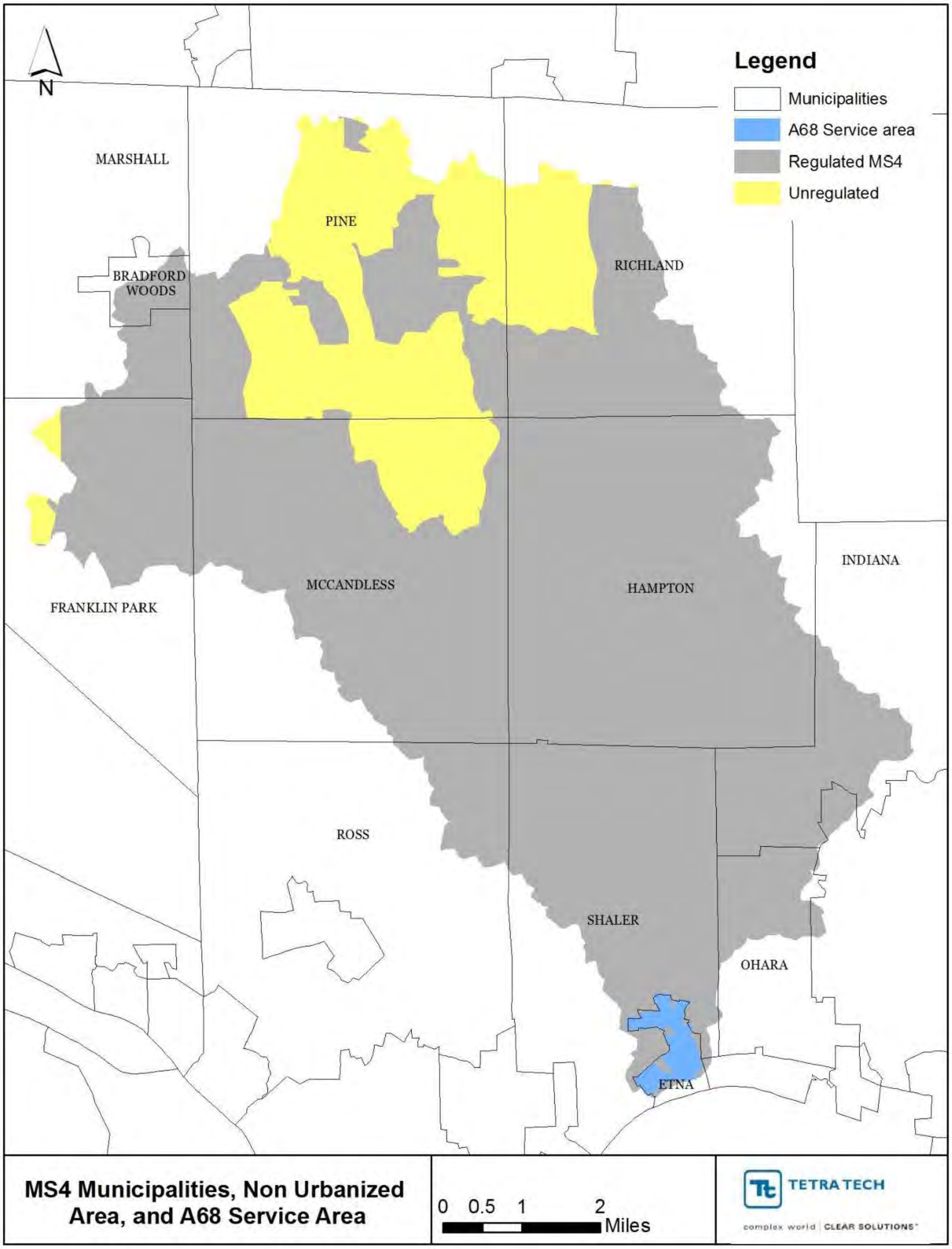


Figure 3-3. MS4 municipalities, non-UAs, and A68 service area in the Pine Creek watershed.

3.2. Nonpoint Sources

Nonpoint source pollutants are generally defined as those pollutants that result from common, widespread activities in both urban and rural areas—for example, activities that would lead to urban runoff or agricultural runoff. Several possible nonpoint sources of bacteria exist in the Pine Creek watershed: failing/leaking sewage systems, agricultural runoff, septic systems, and urban influences.

Urban and suburban areas in watersheds are potential sources of bacteria to streams. Contaminants can build up on impervious surfaces and wash off to streams when rain occurs. Some sources associated with urban areas include failing/leaking sewage systems, failing septic systems, industrial wastes, and wildlife and domestic pet wastes.

In rural areas, agricultural land uses also can be a significant source of pollutants in terms of runoff or direct contributions of contaminants to streams. The runoff from areas of animal production can contribute bacteria to water resources, although no known Concentrated Animal Feeding Operations are in the Pine Creek watershed. Other possible sources of contamination are septic systems and runoff from impervious surfaces.

3.2.1. Septic Systems

Septic systems can be a source of contamination because bacteria from the systems (if not properly sited and maintained) can reach the surface water through groundwater. It is important to maintain septic systems to prevent leakage and ensure proper waste treatment.

Sewage disposal within the Pine Creek watershed consists of a mix of septic systems and sewers. Some areas in the watershed are subject to malfunctioning septic systems, although specific on-site system failure rates are not available. The Allegheny County Health Department (N. Ruffing, March 3, 2006, personal communication) has indicated the presence of areawide disposal problems across the watershed. Specifically, the eastern portion of the watershed, including East Little Pine Creek, lacks sewers, and is susceptible to leaking septic systems. This area includes portions of Indiana, O'Hara, and Shaler Townships. Most of the West Pine Creek watershed includes sewered areas, and the headwater areas to the north include a mixture of sewer-serviced areas and septic systems. It has been noted that this area also suffers from malfunctioning septic systems.

Estimates of septic systems were developed using several geospatial data sets received in various formats obtained from the communities of McCandless, Hampton, Indiana, and Richland, and from 3RWW. 3RWW also provided precipitation data as discussed in Section 2.1.2. Spatial data obtained from 3RWW and the municipalities included:

- building locations with attribute data for sewer status
- manholes
- lateral lines
- main sewer lines
- and property boundaries

However, the same level of information was not available for all communities in the watershed, and available data varied by municipality. Data layers that were available for a municipality sometimes overlapped slightly with an adjacent municipality or might not have covered the entire municipality. Therefore, an estimate of septic systems affecting the reaches in the Pine Creek watershed was developed by creating a composite layer using the best geospatial data available for each municipality. Table 3-5 summarizes the available data for each municipality and the data set or sets that were used to estimate the septic systems in that township. Several municipalities (McCandless, Indiana, and Hampton) provided data that extended into other townships, hence the differentiation of *Area of Coverage* and *Spatial Data Type and Source* in Table 3-5. For example, the spatial data received from McCandless identifying buildings by type extended into Hampton, Pine, Franklin Park, Marshall, and Bradford Woods.

Table 3-5. Available data types and source by municipality

Area of coverage	Spatial data type and source			
	Buildings-system type	Buildings- attached/not attached	Sewer lines	Property boundaries
Shaler		**3RWW**	3RWW	NHCOG
Etna	**Etna**	3RWW	3RWW	NHCOG
O'Hara		**3RWW**	3RWW	NHCOG
Indiana		**3RWW**	Indiana, 3RWW	NHCOG
Fox Chapel		**3RWW**	3RWW	NHCOG
Hampton	**McCandless**	**3RWW**	**Hampton**	**NHCOG**
McCandless	**McCandless**		**Hampton**	**NHCOG**
Pine	**McCandless**		**Hampton**	**NHCOG**
Richland			**Richland, Hampton**	**NHCOG**
Franklin Park Borough	**McCandless**			NHCOG
Marshall	**McCandless**			NHCOG
Bradford Woods	**McCandless**			NHCOG
Ross		**3RWW**	3RWW	NHCOG

3RWW = 3 Rivers Wet weather; NHCOG = North Hills Council of Governments; bold text = data source that was used; grey text = data available but not used because other, more robust data were available

Figure 3-4 shows the estimated locations of the septic structures and identifies the data set used to estimate these locations. These structures were summed by subwatershed and the resulting load was applied to the watershed model as described in Section 5.2.5, and tabulated in Table 5-7.

3 Rivers Wet Weather Data

The data set from 3RWW was created in 1998 by ALCOSAN and the Allegheny County Health Department (ACHD) to help ALCOSAN municipalities address the region's sewage overflow problem that EPA had cited in 1997. The data set was obtained from 3RWW and used to estimate septic structure locations in portions of six municipalities in the Pine Creek watershed (Ross, Shaler, Indiana, O'Hara, Fox Chapel, and Hampton) (see Table 3-5). The data set used to develop the septic structure locations was a shapefile providing the locations of all structures in the jurisdiction shown in Figure 3-4. These spatial data also provided attributes that identify each structure as *attached* or *not attached.* The structures identified as not attached were assumed to be unsewered structures and on septic systems, and potentially contributing a bacteria load.

McCandless Township Data

Spatial data were obtained from McCandless Township and used to estimate septic structure locations in portions of six municipalities in the Pine Creek watershed (Hampton, McCandless, Franklin Park, Marshall, Bradford Woods, and Pine). McCandless provided a spatial data set indicating the locations of all structures on septic systems in the jurisdiction shown in Figure 3-4. These spatial data were used to identify unsewered structures on septic systems, and potentially contributing a bacteria load.

Hampton Township Data
Spatial data were obtained from Hampton Township and used to estimate septic structure locations in portions of four municipalities in the Pine Creek watershed (Hampton, Richland, McCandless, and Pine). Hampton provided sewer line data (see Table 3-5), which was used in tandem with parcel data obtained for the entire watershed. The locations of structures served by septic systems (shown in Figure 3-4) were estimated using an overlay of the parcel and sewer line data. Parcels not adjacent to a sewer line were identified as structures likely to be on septic systems, and potentially contributing a bacteria load.

Richland Township Data
Spatial data were obtained from Richland Township and used to estimate septic structure locations in a portion of Richland Township. Richland provided sewer line data (see Table 3-5), which was used in tandem with parcel data obtained for the entire watershed. The locations of structures served by septic systems (shown in Figure 3-4) were estimated using an overlay of the parcel and sewer line data. Parcels not adjacent to a sewer line were identified as structures likely to be on septic systems, and potentially contributing a bacteria load.

Etna Borough Data
Spatial data were obtained from Etna Borough regarding septic structure locations (see Table 3-5). Etna provided a spatial data set providing the locations of all structures on septic systems in the jurisdiction shown in Figure 3-4. These spatial data were used to identify unsewered structures on septic systems, and potentially contributing a bacteria load.

Indiana Township Data
Spatial data were obtained from Indiana Township (see Table 3-5). Indiana provided a spatial data set providing the locations of manholes and sewer. These spatial data were not useable to estimate the locations of structures served by septic systems. Data from other sources (3RWW) were used to estimate the locations of structures in Indiana Township.

North Hills Council of Governments Data (NHCOG)
Spatial data were obtained from the NHCOG (see Table 3-5). Relating to septic structure locations, NHCOG transmitted the Etna data described above and provided land parcel data in spatial format. The parcel data were used in tandem with sewer line data (if available) for municipalities where better data were not available. The parcel and sewer line method was used in portions of, or all, the municipalities of Hampton, McCandless, Pine, and Richland.

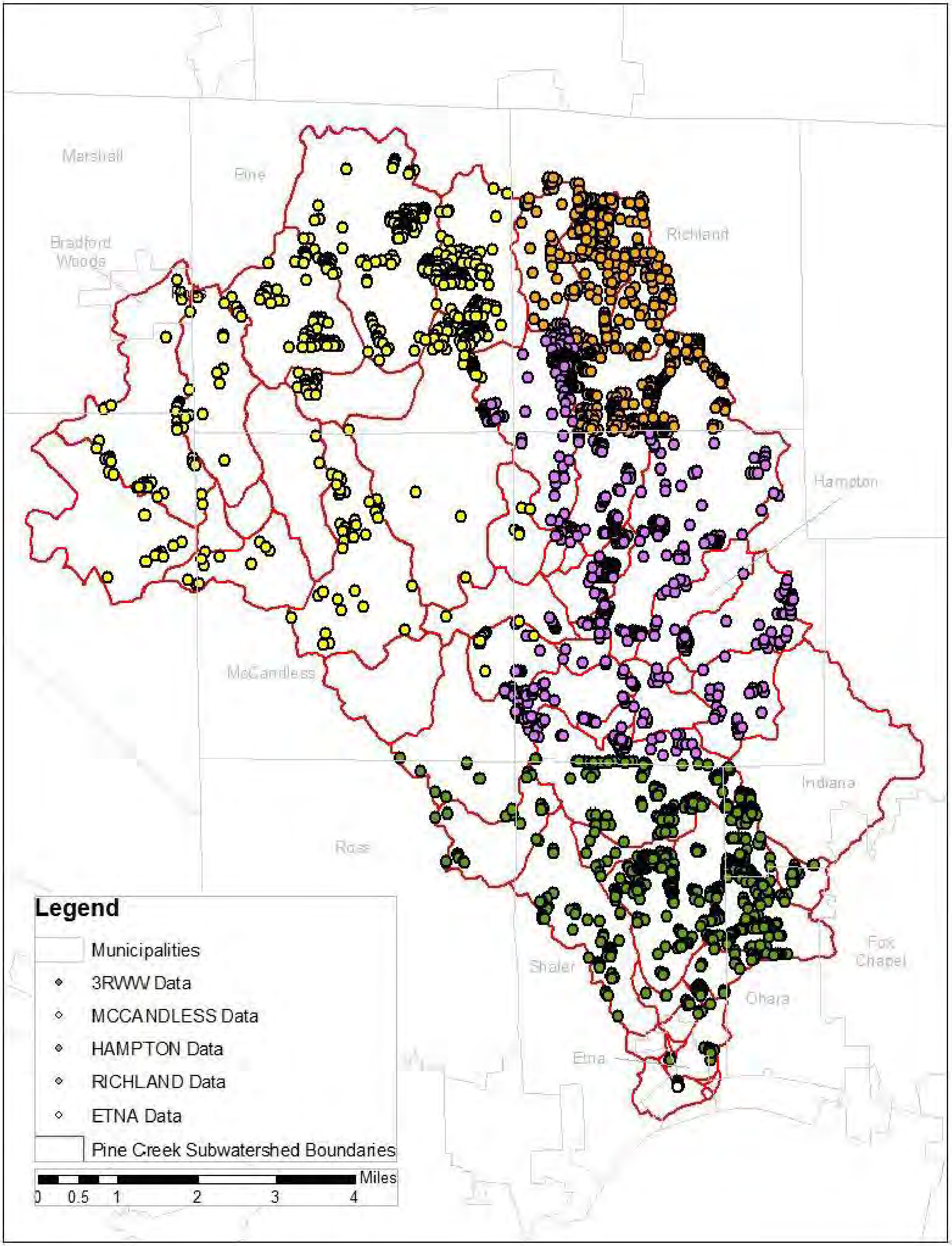


Figure 3-4. Estimated septic system locations in the Pine Creek watershed.

3.2.2. Agriculture

The upstream portions of the Pine Creek watershed include limited amounts of agricultural areas that may impact water quality in downstream areas. Information such as animal counts, access to streams, and percent time animals spend grazing versus in confinement is needed for determining the bacteria-loading potential from livestock and other farm animals. Animals can contribute pollutants directly to the streams, or animal wastes can wash off the land during storm events. Additionally, details regarding land practices, such as fertilizer and manure application practices on croplands and other agricultural lands, are needed for determining possible contamination to streams during rain events. County-level farm and livestock estimates were obtained from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) database and are shown in Table 3-6. These values help to identify the types of animals present in Allegheny County and were used in developing estimates of animal densities for modeling.

Table 3-6. 2007 Agricultural Census data for Allegheny County

Item	Value
Farms (number)	534
Land in farms (acres)	38,023
Land in farms – Average size of farm (acres)	71
Land in farms – Median size of farm (acres)	40
Total cropland (acres)	18,397
Pastureland, all types (acres)	9,213
Cattle and calves inventory (number)	2,021
Cattle and calves inventory – Beef cows (number)	1,096
Cattle and calves inventory – Milk cows (number)	122
Hogs and pigs inventory (number)	133
Sheep and lambs inventory (number)	603
Layers (hens) 20 weeks old and older inventory (number)	2,467
Horses and ponies inventory (number)	1,206

Source: USDA NASS 2007

3.2.3. Wildlife Estimates

Wildlife, such as deer, raccoon, opossum, bats, and waterfowl can contribute pollutants directly to streams, or animal wastes can wash off the land during storm events. Upstream portions of the watershed, where forests and parks are abundant, have a fair amount of wildlife that can contribute bacteria to the water resources. Specific estimates from wildlife surveys or observations and identification of potential problem areas can be useful in watershed source assessments. For this study, a number of data sources were used to estimate populations of deer, turkey, geese, duck, raccoon, and beaver in the Pine Creek watershed. Appendix C describes model representation of wildlife, and Appendix F presents a description of the multiple references and data sources that were compiled for purposes of estimating wildlife and waterfowl for this TMDL, and assumptions used in model representation.

Other large mammal species also contribute bacteria in the Pine Creek watershed, including beaver and raccoons. Although the Pennsylvania Game Commission provides forecasts by Wildlife Management Unit (WMU), quantitative numbers are not available at the level of detail of the deer estimates.

4. TMDL Technical Approach

Establishing the relationship between the in-stream water quality targets and source loadings is a critical component of TMDL development. It allows evaluation of management options that will achieve the desired source bacteria reductions necessary to meet water quality standards. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain water body responses with conditions. This section presents the approach taken to develop the linkage between sources and in-stream response for TMDL development in the Pine Creek watershed.

A watershed model is a useful tool for providing a quantitative linkage between sources and in-stream response. It is essentially a series of algorithms applied to watershed characteristics and meteorological data to simulate naturally occurring, land-based processes over an extended period, including hydrology and pollutant transport. Many watershed models are also capable of simulating in-stream processes using the land-based and subsurface calculations as input. Once a model has been adequately set up and calibrated for a watershed, it can be used to quantify the existing loading of pollutants from subwatersheds or from land use categories, and it can be used to assess the impacts of a variety of management scenarios.

Modeling Framework

The following technical factors were critical to selecting the Loading Simulation Program in C++ (LSPC) watershed model to support development of the Pine Creek bacteria TMDLs; they are outlined in further detail in the report, *Review of Water Quality Modeling Applications to Support Bacteria Modeling in Southwestern Pennsylvania* (Tetra Tech 2006c):

- The model should be able to address a variety of pollutants, including the pollutant of concern (e.g., bacteria).
- The model should be able to address a watershed with mixed land uses.
- To provide accurate representation of rainfall events and resulting peak runoff, the model should provide adequate time-step estimation of flow and should not oversimplify storm events.
- The model should be able to represent reservoir features.
- The model should be capable of simulating various pollutant transport mechanisms (e.g., groundwater contributions, sheet flow).

Using the above considerations, the LSPC was selected for modeling. LSPC was developed by Tetra Tech specifically to support TMDL studies. It consists of a re-coded C++ version of the Hydrologic Simulation Program FORTRAN (HSPF) model. Although LSPC and HSPF are similar models fundamentally, LSPC offers the following of advantages over HSPF and other available platforms for running HSPF:

- Provides storage of all geographic, modeling, and point source permit data in a Microsoft Access database and text file format, making data manipulation efficient and straightforward
- Presents no inherent limitations regarding the size and number of subwatersheds and streams that can be modeled
- Provides the ability to specify and develop queries to generate unique reports of model results
- Provides post-processing and analytical tools designed specifically to support TMDL development and reporting requirements (including a TMDL calculator).

A subset of LSPC's algorithms are identical to those in the HSPF model. A brief overview of the HSPF model and LSPC-related model routines are provided below. A detailed discussion of HSPF-simulated processes and model parameters is available in the HSPF user's manual (Bicknell et al. 1996).

HSPF is a comprehensive watershed and receiving water quality modeling framework that was originally developed in the mid-1970s. During the past several years, it has been used to develop hundreds of EPA-approved TMDLs, and it is generally considered the most advanced hydrologic and watershed loading model available. The hydrologic portion of HSPF is based on the Stanford Watershed Model (Crawford and Linsley 1966), which was one of the pioneering watershed models developed in the 1960s. The HSPF framework was developed in a modular fashion with many different components that can be assembled in different ways, depending on the objectives of the individual project. The model has three major modules:

- PERLND for simulating watershed processes on pervious land areas
- IMPLND for simulating processes on impervious land areas
- RCHRES for simulating processes in streams and vertically mixed lakes.

All three modules include many subroutines that calculate the various hydrologic and water quality processes in the watershed. Many options are available for both simplified and complex process formulations. Table 4-1 lists the modules from HSPF that are used in LSPC.

Table 4-1. HSPF modules included in LSPC

RCHRES Modules	HYDR	Simulates in-stream hydraulic behavior
	ADCALC	Simulates in-stream advection of dissolved or entrained constituents
	CONS	Simulates in-stream conservative constituents
	HTRCH	Simulates in-stream heat exchange
	SEDTRN	Simulates in-stream behavior of inorganic sediment
	GQUAL	Simulates in-stream behavior of a generalized quality constituent
PERLND/ IMPLND Modules	SNOW	Simulates snowfall, snow accumulation, and melting
	PWATER/IWATER	Simulates water budget for a pervious/impervious land segment
	SEDMNT/SOLIDS	Simulates production/removal of sediment for a pervious/impervious land segment
	PSTEMP	Simulates soil layer temperatures
	PWTGAS/IWTGAS	Estimates water temperature and dissolved gas concentrations in the outflows from pervious/impervious land segments
	PQUAL/IQUAL	Simulates water quality in the outflows from pervious/impervious land segments

Spatially, LSPC allows a watershed to be divided into a series of subwatersheds representing the drainage areas that contribute to each of the stream reaches. These subwatersheds are then further subdivided into segments representing different land uses. For the developed areas, the land use segments are further divided into the pervious (PERLND) and impervious (IMPLND) fractions. The stream network (RCHRES) links the surface runoff and groundwater flow contributions from each of the land segments and subwatersheds, and routes them through the water bodies using storage routing techniques. The stream model includes precipitation and evaporation from the water surfaces, flow contributions from the watershed, tributaries, and upstream stream reaches. Flow withdrawals and diversions can also be represented.

Important routines for water quality simulation include the QUAL module, which has PERLND/IMPLND and RCHRES components that define the upland and in-stream characteristics of each. This routine provides the basic framework for simulating pollutant loading and transport in a watershed.

QUAL simulates the behavior of a generalized water quality constituent by linking land use surface runoff, associated pollutant loadings, and in-stream conditions. It allows for a constituent to be present or in a sediment-associated state, and in its simplest configuration, it represents all transformations and removal processes using simple, first-order decay approaches. The framework is flexible and allows modeling of different combinations of constituents depending on data availability and the objectives of the study.

Note that the water quality monitoring plan developed to support this effort was developed to complement and support LSPC in several ways. Multiple monitoring locations were designed to facilitate parameterizing the watersheds with diverse loading and source characteristics. Frequent sampling was done to facilitate direct comparison of water quality data with standards and to take advantage of LSPC's ability to run on short time steps.

5. Model Development

A LSPC model was configured for the areas contributing to impaired streams in the Pine Creek watershed as a series of hydrologically connected subwatersheds. Configuring the model involved subdividing the watersheds into modeling units, followed by continuous simulation of flow and water quality for these units using meteorological, land use, soils, stream, and fecal coliform data. Development and application of the watershed model to address the project objectives involved the following major steps:

1. Watershed delineation
2. Configuration of key model components
3. Hydrology calibration and validation
4. Water quality calibration and validation

5.1. Watershed Delineation

Watershed delineation refers to subdividing the entire watershed into smaller, discrete subwatersheds for modeling and analysis. LSPC calculates watershed processes using user-defined, hydrologically connected subwatersheds. To facilitate model calibration, this subdivision was primarily based on stream networks and topographic variability and secondarily on the locations of flow and water quality monitoring stations. Using this method, 68 subwatersheds were defined for the Pine Creek watershed, as shown in Figure 5-1.

5.2. Configuring Critical Model Components

Configuration of the watershed model involved considering the following six major components:

- Water body representation
- Land use representation
- Meteorological data
- Hydrologic representation
- Pollutant (fecal coliform) representation

These components provided the basis for LSPC's ability to estimate flow and pollutant loadings, and to translate those inputs into in-stream bacteria levels. Detailed discussions about developing each component are provided in the following subsections.

5.2.1. Water Body Representation

Water body representation refers to the modules, or algorithms, in LSPC used to simulate flow and pollutant transport through streams, rivers, and lakes. Each delineated subwatershed is represented with a single stream or lake feature. Streams are assumed completely mixed, one-dimensional segments with a constant trapezoidal cross section. To route flow and pollutants, LSPC automatically generates curves for each stream using Manning's equation and representative physical data. Required stream data include slope, Manning's roughness coefficient, and stream dimensions, including mean depths and channel widths. The USGS National Hydrography Dataset (NHD) stream reach network was used to determine the representative stream length for each subwatershed. The stream lengths were used along with the 10-meter National Elevation Dataset to calculate reach slope. The National Elevation Dataset is a GIS grid coverage of land surface elevation at a resolution of 10 meters; it was developed by the USGS. An estimated Manning's roughness coefficient of 0.02 was applied to each representative stream reach. Assuming representative trapezoidal geometry for all streams, mean stream depth and channel width were estimated using regression curves that related upstream drainage area to stream dimensions (Rosgen 1996).

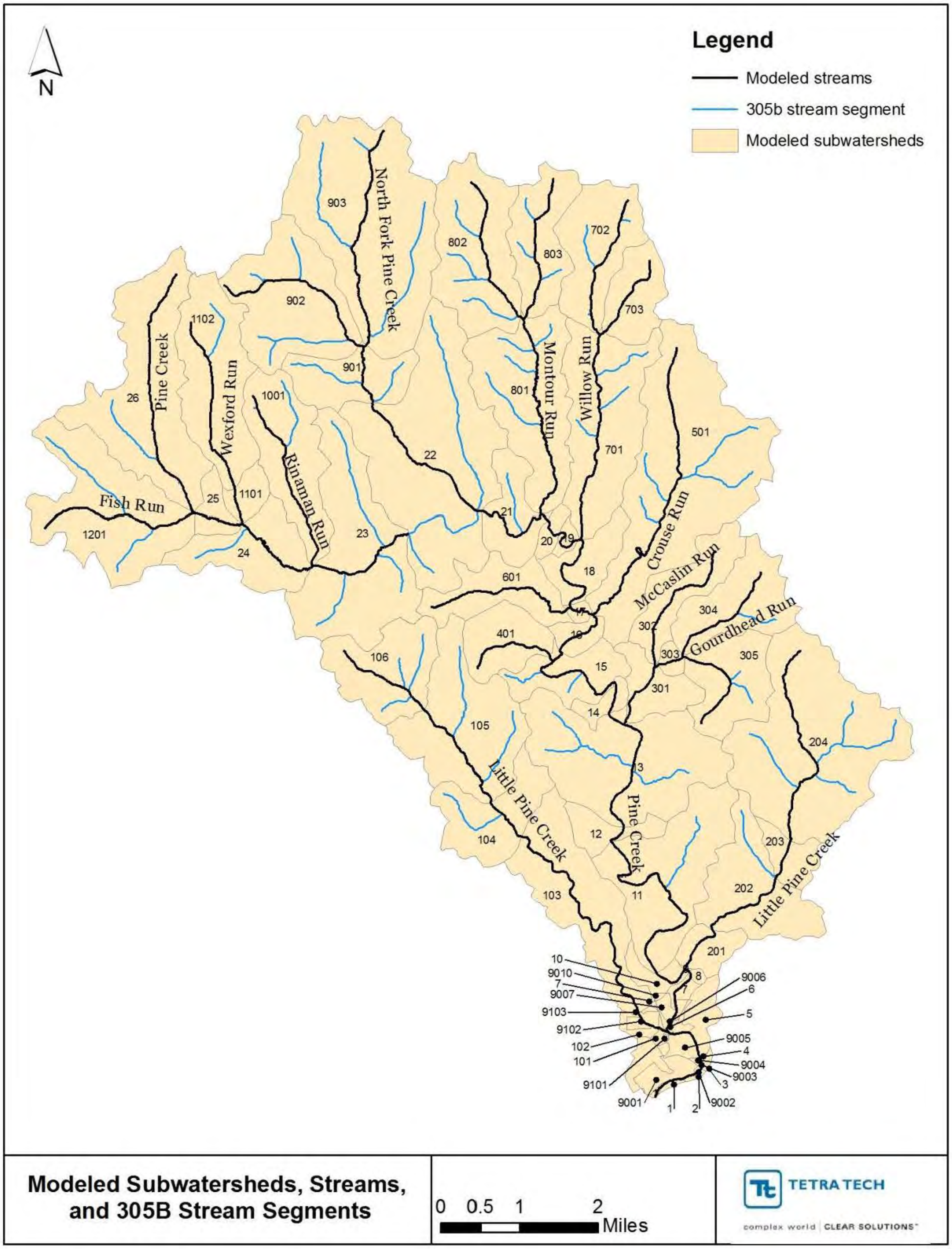


Figure 5-1. Modeled subwatersheds in the Pine Creek study area.

In addition to the streams, an impoundment is centrally located in the Pine Creek watershed. The North Park Lake reservoir was incorporated into the model setup to represent the impact on stream hydraulics and associated water quality. The Pine Creek dam creates a partial barrier to pollutant transport. Therefore, it must be taken into consideration when simulating watershed conditions in the TMDL study area. To represent the reservoirs in the watershed model, storage and spillway dimensions were estimated from available data.

For every model stream reach, LSPC requires a rating curve or function table (FTABLE) that defines the representative depth-outflow-volume-surface area relationship of the reach. As described above, LSPC automatically generates stream FTABLEs. When a stream reach is represented as a reservoir, however, the FTABLE must be edited to reflect the associated bathymetry. No bathymetric data were available for the model-represented reservoirs. To estimate the FTABLE of each, critical characteristics were estimated from available GIS shapefiles and data provided in *Draft Detailed Project Report and Integrated Environmental Assessment* developed by the U.S. Army Corps of Engineers (USACE 2006).

North Park Lake was represented as a trapezoidal feature in the modeling environment. The storage and surface area at maximum stage of the reservoir were obtained from the *Draft Detailed Project Report and Integrated Environmental Assessment* (USACE 2006). Dam discharge was then estimated using a simplified weir representation of spillway geometry provided in the 2006 report. Characteristics of North Park Lake and how it is represented in the LSPC model are presented in Table 5-1.

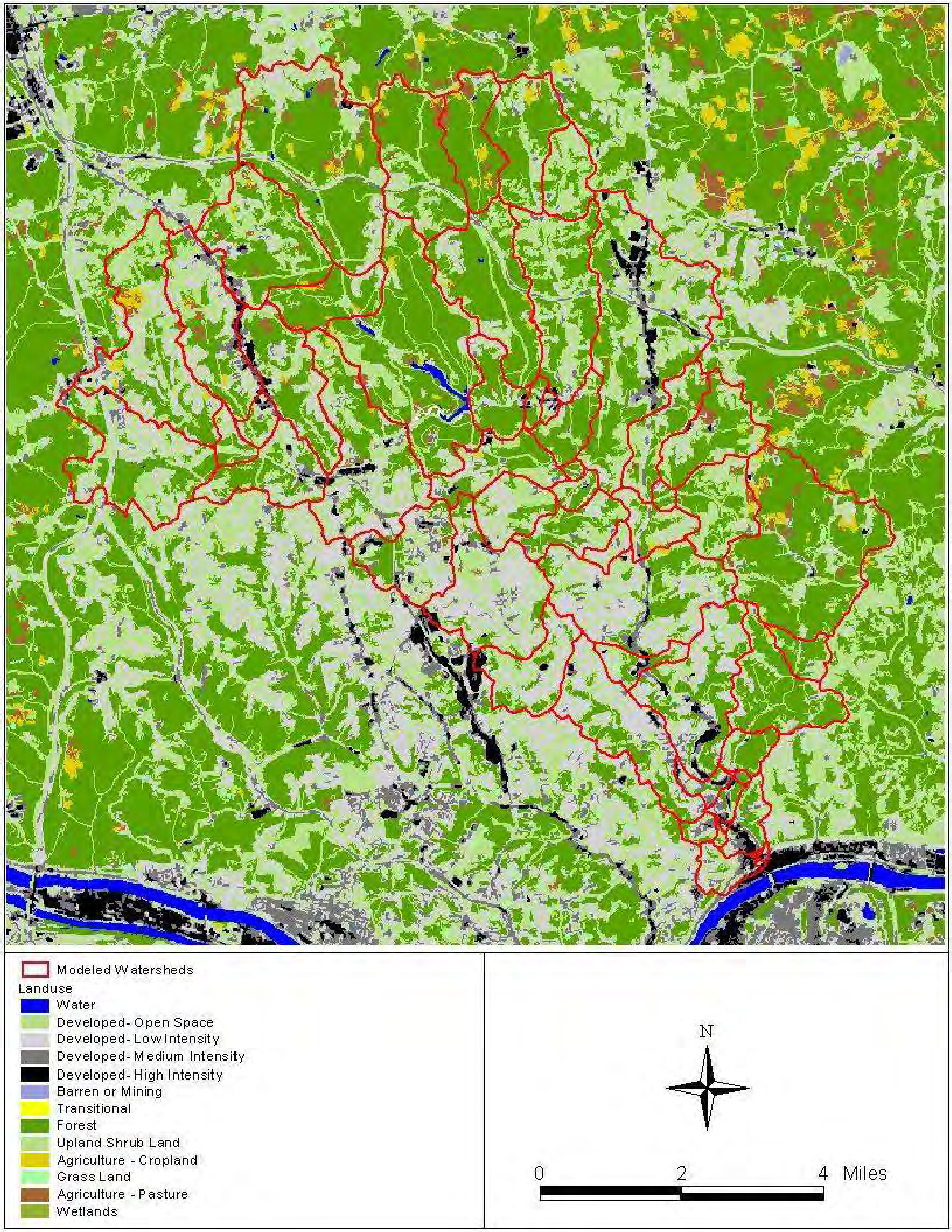
Table 5-1. Model-represented reservoir data

Dam	Storage (acre-feet)	Surface area (acres)	Width (feet)	Average depth (feet)	Length (feet)	Weir width (feet)
North Park Lake	297	63	1,657	4.71	1,657	5

5.2.2. Land Use Representation

The LSPC watershed model requires a basis for distributing hydrologic and pollutant loading parameters. Hydrologic variability in a watershed is influenced by land surface and subsurface characteristics. Variability in pollutant loading is highly correlated to land use practices. Land use representation provides the basis for distributing soils and pollutant loading characteristics throughout the watershed.

To explicitly model nonpoint sources in the impaired Pine Creek watershed, the existing 2001 NLCD land use categories were consolidated to create the model land use groupings shown in Table 5-2. The land use coverage provided the basis for estimating and distributing bacteria associated with land-based, precipitation-driven sources. LSPC algorithms require that land use categories be divided into separate pervious and impervious land units for modeling. This division was made for the appropriate land uses (urban) to represent impervious and pervious areas separately. It was based on typical impervious percentages, as summarized in Table 5-2, and the resulting overall watershed imperviousness is 8.3 percent, which agrees with the estimated percent of overall watershed imperviousness used in the *2009 Pine Creek Watershed Implementation Plan* (PEC 2009). The land use distribution is tabulated by modeled watershed in Appendix B.



Source: Homer et al. 2004

Figure 5-2. MRLC land use distribution in the Pine Creek watershed.

Table 5-2. Consolidation of 2001 NLCD land uses for the Pine Creek LSPC model

Model category	2001 NLCD code and category	% Impervious
Water	11 Open water	0%
Wetland	90 Woody wetlands	0%
	95 Emergent herbaceous wetlands	0%
Forest	41 Deciduous forest	0%
	42 Evergreen forest	0%
	43 Mixed forest	0%
Cropland	82 Cultivated crops	0%
Pasture	31 Barren Land	0%
	71 Grassland/herbaceous	0%
	81 Pasture/hay	0%
LIR	22 Developed, low-intensity residential	20%
MIR	23 Developed, medium-intensity residential	35%
HIR	24 Developed, high-intensity residential	80%
Open Space	21 Developed, open space	5%

5.2.3. Meteorological Representation

Hydrologic processes depend on changes in environmental conditions, particularly weather. As a result, meteorological data are a critical component of the watershed model. These data drive LSPC and LSPC algorithms that simulate watershed hydrology and water quality; therefore, accurately representing climatic conditions is required to develop a valid modeling system.

The climate data requirements of the model vary depending on whether processes related to snowfall are represented. If snowfall is omitted from the simulation, precipitation (rainfall) and evapotranspiration are the only data needed. When snow is included, dry bulb air temperature, wind speed and direction, solar radiation, dew point temperature, and cloud cover data are also required. Snowfall was included in the TMDL model setup because it is a significant component of the precipitation totals in the study area. Seasonal snowfall, snow accumulation, and snowmelt affect the timing and magnitude of watershed stream flows.

Precipitation data were accessed from the 3RWW Demonstration Program online precipitation database to develop a representative data set for the study area covering the modeling period. 3RWW stores and distributes observed precipitation data gathered by 33 rain gauges in Allegheny County. These stations are used to convert NEXRAD radar data from Moon Township into a grid-based estimate of rainfall across the county. Hourly data were obtained from 3RWW for each of the grids that intersect the Pine Creek watershed.

Most of the modeled subwatersheds contain portions of several precipitation grid cells (Figure 5-3). To assign precipitation data to each subwatershed, the grid cells in the 3RWW precipitation array were overlayed with the modeled subwatersheds in a GIS. The portion of a given precipitation cell was then converted to a fraction of the total subwatershed area. The fractions of all precipitation cells that fall within a given subwatershed should equal 1. The fractions were then multiplied by the hourly precipitation data provided by 3RWW for each of the precipitation grids in a subwatershed. The hourly data for all precipitation cells were then summed and assigned to the modeled subwatershed as a new hourly data set. As a result, each modeled subwatershed was assigned its own unique weather file.

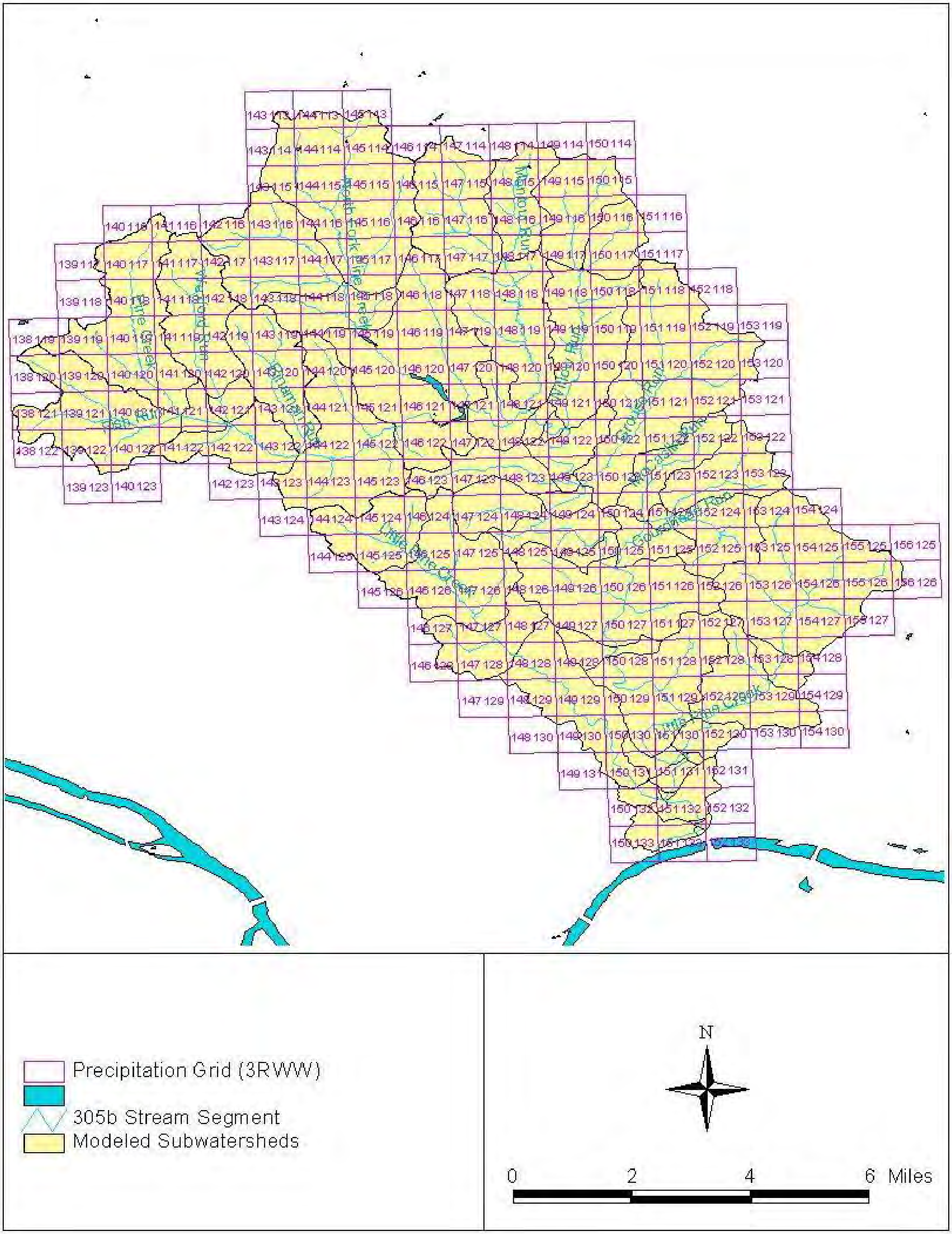


Figure 5-3. Precipitation grid and cell IDs used in the Pine Creek watershed modeling process.

Meteorological data other than precipitation are taken directly from NCDC station records. Required climatic data not included in the NCDC records—evapotranspiration and solar radiation—were calculated from the available data using literature methodologies (Hamon 1961). All meteorological data were subsequently formatted for use as hourly time series. An hourly time step is required to properly reflect diurnal temperature changes and provide adequate resolution for rainfall/runoff intensity to drive water quality processes during storms or snowmelt events.

Identifying the most representative climate data for the model was based on several factors, including geographic coverage, data record, and data completeness. The Pittsburgh International Airport station was chosen to provide the parameters necessary for modeling snowfall, mainly on the basis of geographic proximity. Table 5-3 lists the portion of the model time series for which the station data were incorporated and the completeness of the record expressed as the percentage of the data set not missing, as reported by NCDC.

Table 5-3. WBAN climate station characteristics

WBAN ID	Station name	Elevation (feet)	Parameter	Model range	Percent complete
94823	Pittsburgh International Airport	1,150	Dry-bulb temp	01/01/2006–06/33/2008	100%
			Wind speed	01/01/2006–06/33/2008	99%
			Dew point temp	01/01/2006–06/33/2008	100%
			Cloud cover	01/01/2006–06/33/2008	97%

5.2.4. Hydrologic Representation

Hydrologic representation refers to the LSPC modules or algorithms used to simulate hydrologic processes (e.g., surface runoff, evapotranspiration, and infiltration). The LSPC PWATER (water budget simulation for pervious land segments) and IWATER (water budget simulation for impervious land segments) modules, which are identical to those in HSPF, were used to represent hydrology for all pervious and impervious land units (Bicknell et al. 1996).

To account for the potential variability of hydrology characteristics throughout the watershed associated with different soil types or topography, the hydrologic soil groups were reviewed. The hydrologic soil group classification is a means for grouping soils by similar infiltration and runoff characteristics during periods of prolonged wetting. The Natural Resources Conservation Service (NRCS) has defined four hydrologic soil groups, providing a means for grouping soils by similar infiltration and runoff characteristics (Table 5-4). Typically, clay soils that are poorly drained have the worst infiltration rates (D soils), whereas sandy soils that are well drained have the best infiltration rates (A soils). Data for the watershed were obtained from BASINS, which contains information from the State Soil Geographic Database (STATSGO), and are presented in Figure 5-4. The data were summarized using the major hydrologic group in the surface layers of the map unit. Soil group C is the dominant group for both Map Unit ID (MUID) soil mapping units in the watershed. MUID units identify discrete areas characterized by combinations of soil characteristics in the STATSGO database. This hydrologic group served as a starting point for designating infiltration and groundwater flow parameters during the LSPC setup.

Table 5-4. NRCS hydrologic soil groups

Hydrologic soil group	Description
A	Soils with high infiltration rates. Usually deep, well-drained sands or gravels. Little runoff.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well-drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff.

5.2.5. Pollutant Representation

An analysis of the water quality data and a review of previous studies indicate possible nonpoint sources of bacteria. Point sources also contribute bacteria in the watershed. The pollutants represented in the watershed model include fecal coliform bacteria.

Bacteria are simulated as being subject to a first-order decay rate. The decay rate is calculated on a daily basis in the LSPC model, and is conceptualized as a fraction per day of bacteria that survive. Fate of fecal coliform on pervious and impervious land segments is simulated using the PQUAL (PERLND module) and IQUAL (IMPLND module) sub-modules, respectively. Fate of fecal coliform in stream water is simulated using the general constituent pollutant (GQUAL) sub-module within RCHRES module. Fecal coliform bacteria are simulated as dissolved pollutants in the GQUAL submodule. Complete documentation of these modules are given in the HSPF Version 11 User's Manual (Bicknell et al. 1996).

Point Source Representation

Point source contributions of bacteria were incorporated into the model to represent the sources described in Section 3.

Industrial and Public/Private Sewerage Permitted Facilities

For permitted dischargers, flow and pollutant concentrations obtained from DMRs were used where available. Monthly DMR data are available for some facilities. However, an hourly time step was used to run the LSPC model, and observed values were applied to all days in a given month if the actual data were used. For months in which no data were collected, monthly average values for that month (from other years) were applied. Flow and water quality limits, or water quality endpoints, were used when DMR information was not available.

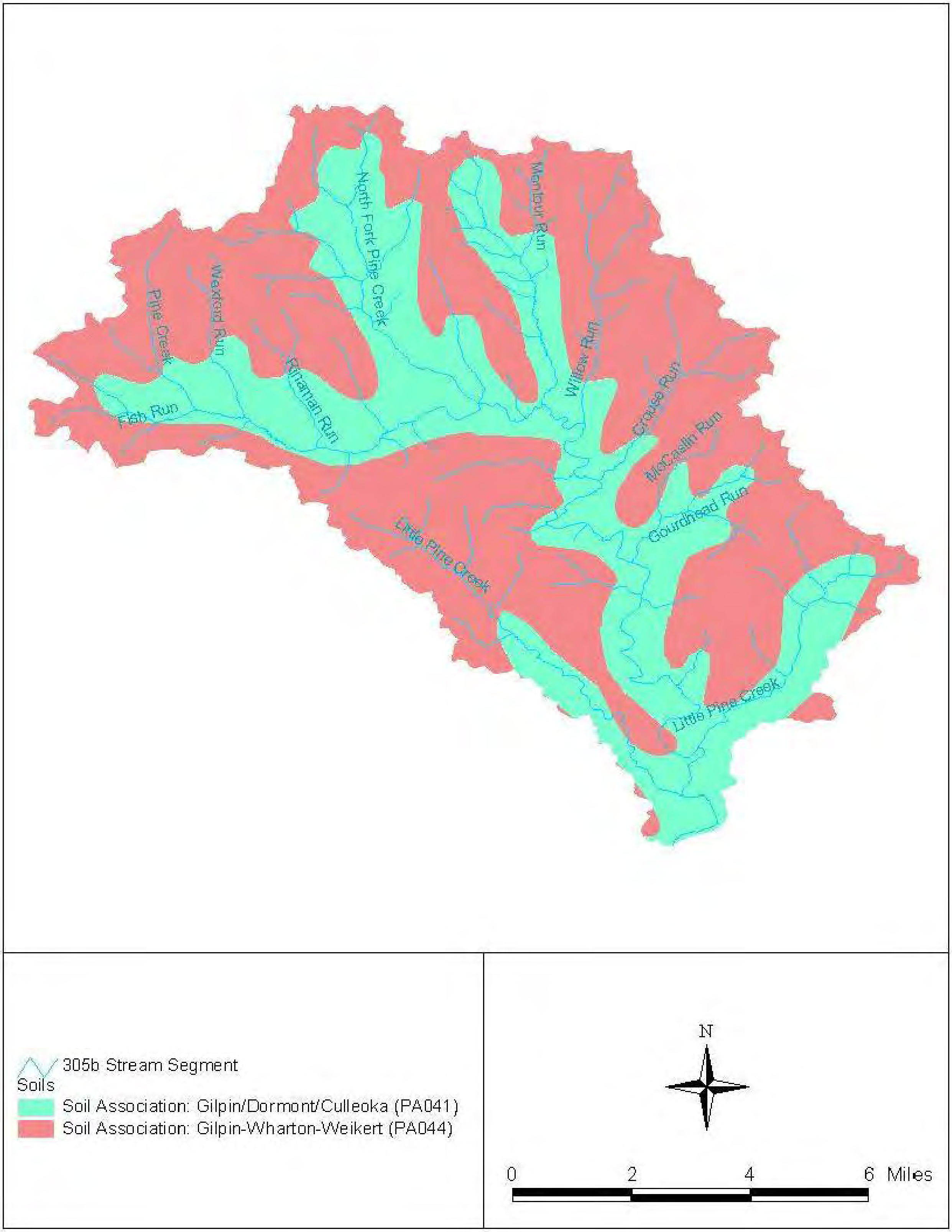


Figure 5-4. STATSGO soil MUID groups in the Pine Creek watershed.

CSOs/SSOs

CSO overflows are a source of bacteria due to stormwater and raw sewage mixing, and subsequent discharge to surface waters. Overflow events were identified on the basis of monitoring data (pressure transducer) and overflow structure height information, and by pressure transducer maintenance records. These records helped to verify the water level at which an overflow, and subsequent bacteria loading, were occurring. Outfalls (both CSO and SSO) with no available flow data of any kind were not assumed to discharge and were therefore not modeled. Time series were developed for seven discharging CSOs and one SSO according to the available monitoring data and were used in developing the TMDL.

For the purposes of modeling the CSOs for a longer calibration period, time series discharges outside the monitored period had to be estimated. To do this, a relationship between precipitation and the magnitude of estimated CSO flows was developed so that rainfall could be used to estimate CSO flow volume. Precipitation estimates developed by the 3RWW are available in grid-based format and provide coverage for the Pine Creek watershed. These data were used to derive the overflows and subsequently allow for estimation outside the CSO monitoring period.

Once overflow events were estimated, bacteria concentrations were applied to the flows based on typical literature raw sewage concentrations, or from values measured in the region. A value of 10^6 colony forming units (CFU) of fecal coliforms per 100 mL is a common literature value used for TMDL purposes to characterize raw sewage (Horsley and Witten 1996). This value was multiplied by the overflow volume only to calculate the bacteria from a given CSO. If the water level in the CSO was less than the overflow, no raw sewage discharge was assumed.

Bacteria from CSOs in the Pine Creek watershed were estimated on the basis of observed flow monitoring data and a bacteria concentration of 10^6 CFU/100 mL for the raw sewage component. Once overflow occurs, a fraction of the CSO volume is stormwater; therefore, a partitioning estimate was applied to estimate bacteria contributions. Fifty percent of the excess measured volume (volume exceeding the overflow volume) was modeled as raw sewage, and the bacteria was subsequently calculated relative to the overflow magnitude as shown in Figure 5-5. The overflow volume was estimated using observed stage-discharge relationships established for a CSO. Once the time series of bacteria were estimated for a CSO, the time-series data were applied conceptually as a point source at the outfall location in the model.

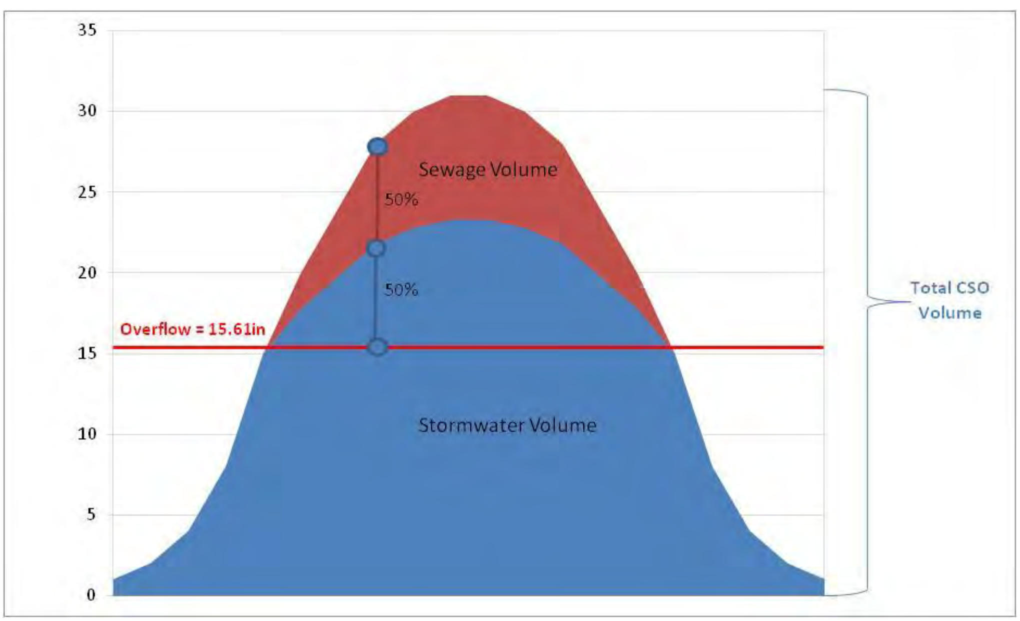


Figure 5-5. Example characterization of CSO overflows.

Land Use/Land Cover Loading Representation

Loading processes for bacteria were represented for each land unit using the LSPC PQUAL (simulation of quality constituents for pervious land segments) and IQUAL (simulation of quality constituents for impervious land segments) modules, which are identical to those in HSPF. These modules allow for the simulation of pollutant loading as sediment-associated, as a buildup-washoff relationship, as an event mean concentration in land segment outflow, or a combination of the three.

In the case of the Pine Creek watershed, the buildup-washoff relationship was used. Bacteria were modeled as a pollutant which builds up or accumulates, and then washes off based on rainfall. Accumulation rates were assigned to model land uses to simulate buildup of bacteria on the land surface and removal during overland flow, which is simulated as being removed at a rate related to the volume of water flowing over the land surface. Accumulation rates were estimated on the basis of typical fecal coliform production rates for animal species associated with different land use types. These values served as starting points for water quality calibration. The appropriateness of the values to the Pine Creek watershed was validated through comparison to local water quality data during the calibration process (described in Section 5.3).

Agriculture

Agricultural land can be a source of fecal coliform bacteria to waterways. The upstream portions of the Pine Creek watershed include limited amounts of agricultural areas that may impact water quality in downstream areas. Information such as animal counts, access to streams, and percent time animals spend grazing versus in confinement is needed for determining the bacteria-loading potential from livestock and other farm animals. Runoff from pastures and animal operations, improper land application of animal wastes, and animals with access to water bodies are all sources of fecal coliform bacteria. Agricultural best management practices (BMPs) such as buffer strips, alternative watering sources, limiting livestock access to creeks, and proper land application of animal wastes reduce fecal coliform loading to water bodies.

County-level farm and livestock estimates were obtained from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) database and are shown in Table 3-6. These values help to identify the types of animals present in Allegheny County and were used in developing estimates of animal densities for modeling. Agricultural animal populations in the watershed were estimated using 2007 Agricultural Census data for Allegheny County, and EPA's Fecal Coliform Load Estimation Spreadsheet (FCLES) tool was used to develop initial estimates of accumulation rates of fecal coliform bacteria on the land surface (USEPA 2000). The FCLES tool quantifies the fecal coliform bacteria component of waste generated by warm-blooded animals and distributes these quantities to streams and to the land surface on the basis of land use type and waste management practices. Estimates derived from the FCLES tool were used as inputs to the watershed loading model. These initial estimates were fine-tuned during the model testing (calibration) process to more closely match available monitoring data. See Appendix C for further details regarding the FCLES tool and the bacteria loading estimations derived for the Pine Creek watershed.

A countywide ratio of livestock type to farmland acres was developed and applied to the Pine Creek watershed pasture land (as indicated by the MRLC land cover data set). Table 5-5 lists fecal coliform production rates for various animals used to calculate loadings from each livestock category. Livestock, except for dairy cattle, are not usually confined and are typically grazing in pastures. Census data show a predominance of beef cattle in the county; therefore, all cattle in the watershed were assumed to be beef cattle. It was assumed that cattle manure is applied to cropland and deposited on pasture, and hog, sheep, and chicken manure affects pasture only. It was also assumed that no manure is imported into the watershed.

Wildlife

Fecal coliform bacteria also originate in forested and other areas from wildlife sources such as deer, raccoons, and wild turkeys. Although beaver are thought to inhabit lodges in water bodies, they might still have access to surrounding forested land. As with pasture lands, the FCLES tool was used to estimate bacteria loadings for forest and other land uses inhabited by wildlife and domestic pets. In the Pine Creek watershed, deer and domestic pets are prevalent. In addition, large numbers of geese are known to inhabit areas around North Park Lake. To represent this issue in the modeling, the distribution of wildlife was assigned differently in the North Park boundary, as shown in Table 5-5.
Table 5-5 identifies the animals that were assumed to affect various land use types, typical literature-based daily bacteria production rates for each animal, and the land use loading rate that was used to simulate the animal contributions. Deer were assumed to reside primarily on all lands except for high-intensity residential areas. Wild turkey were simulated on pasture, open space, and forested lands. Beaver were simulated on forested and wetlands areas; raccoons were simulated on all lands except residential and croplands. Similarly, domestic dogs and outside cats were simulated on residential lands. Ducks and geese were assumed to reside in wetlands buffer areas. The accumulation rates for wetlands are high because of an estimated population of 800 geese in the watershed (http://www.pittsburghlive.com/x/pittsburghtrib/s_508469.html), which were assigned to wetland areas that largely correspond to the location of North Park Lake. A very small wetland area is also identified in the MRLC 2001 land use data set downstream of North Park Lake. Appendix F provides further description of the various data sources used to develop animal population estimates for the watershed.

Table 5-5. Fecal coliform production rates for various animal types and associated land uses

Animal	Pasture	cropland	forest	wetland	open space	LIR	MIR	HIR	Water- NPL	Pasture- NPL	cropland- NPL	forest- NPL	wetland- NPL	open space- NPL	LIR- NPL	MIR- NPL	HIR- NPL	Fecal Coliform loading rate applied per acre (#/ac/day) [to each assigned LU]
Beef cow	x									x								1.26E+10
Hog	x									x								1.79E+08
Sheep	x									x								7.95E+08
Horse	x									x								5.47E+06
Deer	x	x	x	x	x	x	x			x	x	x	x	x	x	x		3.59E+07
Chicken	x									x								4.09E+07
Turkey	x		x		x					x		x		x				2.29E+06
Duck (in streams)[a]																		
Goose				x														3.45E+08
Goose (NPL)										x	x	x	x	x	x	x	x	9.58E+09
Beaver			x	x								x	x					1.95E+06
Raccoon	x		x	x	x					x		x	x	x				1.95E+06
Domestic Pets (Dogs, cats)						x	x	x							x	x	x	2.56E+09
Area (ac):	818	438	15758	1	12434	8426	1722	712	79	91	34	1653	16	653	111	44	20	

HIR = High Intensity Residential; LIR = Low Intensity Residential; MIR = Medium Intensity Residential; NPL = North Park Lake areas

[a] Duck contributions w ere added directly to modeled stream segments at a loading rate of 2.43E+09 #/day instead of to the land surface.

For more information, see Appendix C.

Land Use/MS4s

The watershed model distributes hydrologic and pollutant loading parameters on the basis of land use type to appropriately represent hydrologic variability throughout the basin. This variability can be influenced by land use-specific surface (land cover) and subsurface characteristics (soils). It is also necessary to represent variability in pollutant loading, which is highly correlated to land practices. As discussed in Sections 2.1.4 and 5.2.2, a customized land use data set based on MRLC's 2001 NLCD land use coverage was used to configure the model. LSPC model algorithms that simulate hydrologic and pollutant loading processes for pervious and impervious lands were then applied to the corresponding land units. Land use-specific modeled loading rates listed in Table 5-6 represent the sum of all animals, by land use, identified in Table 5-5.

Table 5-6. Modeled land use-specific accumulation rate of fecal coliform based on animal-specific loading rates

Land use	Daily production rate (#/day/acre)
Open Space	4.02E+07
Low Intensity Residential	2.60E+09
Medium Intensity Residential	2.60E+09
High Intensity Residential	2.56E+09
Forest	4.21E+07
Pasture	1.37E+10
Cropland	3.59E+07
Wetland	3.84E+08
NPL-Open Space	9.63E+09
NPL-Low Intensity Residential	1.22E+10
NPL-Medium Intensity Residential	1.22E+10
NPL-High Intensity Residential	1.21E+10
NPL-Forest	9.63E+09
NPL-Pasture	2.33E+10
NPL-Cropland	9.62E+09
NPL-Wetland	9.62E+09

Note: NPL = North Park Lake

As discussed in Section 3.1.2, areas in the A-68 service area boundary do not contribute to bacteria loads in the surface waters of Pine Creek. Flow volumes and bacteria loads were calculated on the basis of the land use distribution in this area, but they were not assigned to a receiving stream in the modeling environment.

Septic Failures

As discussed previously in Section 3, septic systems can be a source of contamination because bacteria from the systems (if not properly sited and maintained) can reach the surface water through groundwater. For the modeling, an effort to identify more influential septic systems was conducted. Septic systems were generally considered to have a greater effect on in-stream water quality if they were closer to surface waters.

The geospatial data for septic systems identified in Section 3 were overlayed with a stream buffer layer based on PADEP's 305(b) water bodies. A buffer of 1,000 feet from the nearest 305(b) stream was created in a GIS, and the structures on septic systems in the buffer were selected for each subwatershed (Table 5-7, Figure 5-6,). On the basis of numbers provided by PADEP related to the percentage of new permits issued to repair existing systems, 25 percent of structures in the buffer were assumed to be using failing septic systems (Rick Shertzer, May 6, 2010, email communication). This percentage was used as a calibration parameter for the modeling and is based on observed in-stream bacteria data collected in 2007. Bacteria loads were derived on the basis of a variety of spatial data sets provided by the municipalities in the Pine Creek watershed. These data sets are identified in Table 5-7, along with derived estimates of unsewered buildings by modeled subwatershed.

Once the number of structures was identified in each subwatershed, the number of occupants was derived using 2000 census tract data. The average number of occupants per structure is identified by tract, and the tract data set was overlayed with the modeled subwatershed layer to derive an area-weighted number of occupants per structure. This number was then multiplied by the number of unsewered buildings to estimate the unsewered population. The population was then multiplied by the Horsley and Witten (1996) estimate of 70 gallons per person per day contributed to a septic system. The Horsley and Witten (1996) reference of 1E+05 CFU/100 mL was then used to estimate fecal coliform concentrations in failed septic systems and, thus, loading to surface waters.

Table 5-7. Septic structure estimates within 1,000 feet of surface water

Subwatershed	Data source	Unsewered buildings	Unsewered buildings within 1,000 feet of surface water
1	Etna[e]	5	1
2	Etna[e]	0	0
3	3RWW[a]	0	0
4	3RWW[a]	0	0
5	3RWW[a]	9	8
6	3RWW[a]	0	0
7	3RWW[a]	7	7
8	3RWW[a]	26	26
9	3RWW[a]	10	10
10	3RWW[a]	6	5
11	3RWW[a]	213	118
12	3RWW[a]	24	2
13	3RWW[a]	138	84
13	Hampton[c]	42	20
14	Hampton[c]	17	7
15	Hampton[c]	44	31
16	Hampton[c]	6	5
17	Hampton[c]	5	5
18	Hampton[c]	76	15
19	Hampton[c]	1	1
20	Hampton[c]	11	6
21	McCandless[b]	5	5
21	Hampton[c]	0	0
22	McCandless[b]	40	17
23	McCandless[b]	33	15
24	McCandless[b]	11	10
25	McCandless[b]	0	0
26	McCandless[b]	38	11

Subwatershed	Data source	Unsewered buildings	Unsewered buildings within 1,000 feet of surface water
101	3RWW[a]	4	4
102	3RWW[a]	0	0
103	3RWW[a]	57	37
104	3RWW[a]	20	3
105	3RWW[a]	8	3
106	3RWW[a]	0	0
201	3RWW[a]	57	45
202	3RWW[a]	231	145
203	3RWW[a]	23	23
204	3RWW[a]	18	0
301	Hampton[c]	6	6
302	Hampton[c]	12	5
303	Hampton[c]	1	1
304	Hampton[c]	42	13
305	Hampton[c]	24	16
401	Hampton[c]	7	5
401	McCandless[b]	9	1
501	Hampton[c]	112	56
501	Richland[d]	92	13
601	Hampton[c]	6	0
601	McCandless[b]	1	1
701	Hampton[c]	66	22
701	Richland[d]	140	64
702	Richland[d]	196	102
703	Richland[d]	62	38
801	Hampton[c]	93	54
801	McCandless[b]	9	0
802	McCandless[b]	135	93
803	Richland[d]	54	31
901	McCandless[b]	15	14
902	McCandless[b]	61	47
903	McCandless[b]	137	46
1001	McCandless[b]	2	0
1101	McCandless[b]	0	0
1102	McCandless[b]	12	8
1201	McCandless[b]	13	7
Sum		2,492	1,312

[a] 3RWW GIS Data: 3RWW: "Buildingslinked_3rww050224_pl_p_alb.shp shapefile" field Lateralsta = "bldgnotattached"

[b] McCandless GIS Data: "PCsys_Septic_MTSA.shp" EG received directly from MTSA on 3/30/12, EG sent to Tt 4/5/12. MTSA made edits to original data to develop "PCsys_Septic_MTSA.shp" system field = NA or blank

[c] Hampton GIS Data: "New_Hampton.shp" developed based on parcels.shp and sewer line data received from Hampton (PIPES.shp) and Richland (7871 - RT Sewerlines - 3-12-12 - revised.shp).

[d] Richland GIS Data: developed from parcels.shp and Richland sewer line data (7871 - RT Sewerlines - 3-12-12 - revised.shp). and Sewered_lots.shp.

[e] Etna GIS Data: "Etna_UnSewer_BldgFtpt.shp" received from NHCOG 1/31/12.

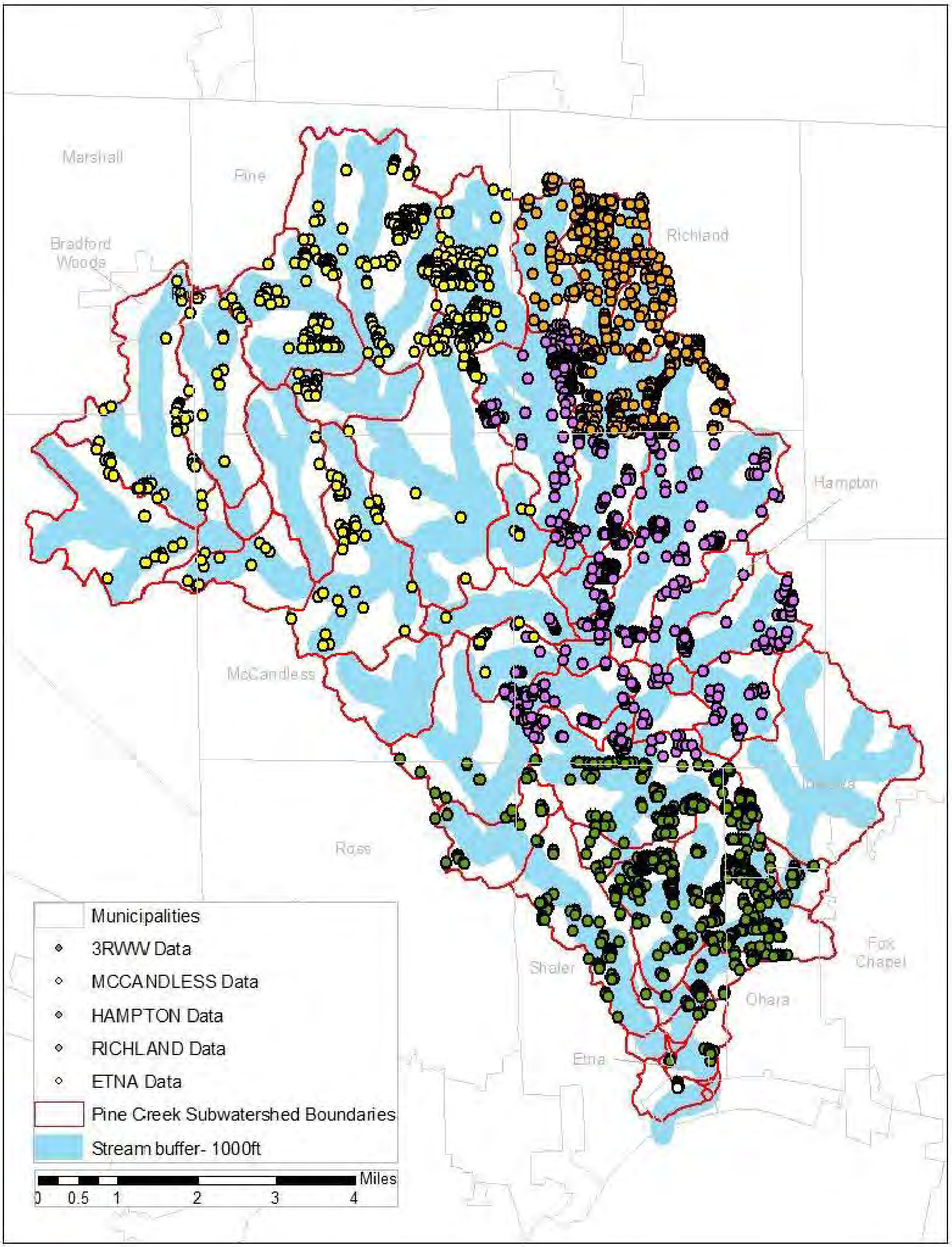


Figure 5-6. Stream buffer overlayed on unsewered structures in the Pine Creek watershed.

5.3. Watershed Model Calibration and Validation

After initially configuring the watershed model, model calibration and validation for hydrology and water quality were performed. Calibration is an iterative procedure of parameter evaluation and refinement as a result of comparing simulated and observed values of interest. It is required for parameters that cannot be deterministically and uniquely evaluated from topographic, climatic, physical, and chemical characteristics of the watershed and compounds of interest. Calibration is based on several years of simulation to evaluate parameters under a variety of climatic conditions. The calibration procedure results in parameter values that produce the best overall agreement between simulated and observed flow and water quality throughout the calibration period.

5.3.1. Flow Calibration

Hydrologic calibration was performed after the initial model setup. The period of November 1, 2006, to October 31, 2007, was used to calibrate the model, and five flow stations (four PADEP stations and two USGS stations) were selected as assessment points. Primary calibration was performed at USGS gauge 03049800, on East Little Pine Creek, because this was the only USGS gauge in the Pine Creek watershed with a complete set of daily records. The calibration period also includes a much shorter monitoring effort (March 2007 through May 2008) conducted at the PADEP stations. Data collected at these stations supplemented the calibration effort by providing calibration guidance for additional locations in the watershed, including the mainstem of Pine Creek and West Little Pine Creek (see Figure 2-1). The period also encompasses an intensive water quality monitoring effort.

Designation of key hydrologic parameters in the PWATER and IWATER modules of LSPC was required. These parameters are associated with infiltration, groundwater flow, and overland flow. During calibration, parameters influencing the simulation of runoff, infiltration, and evapotranspiration were adjusted on the basis of land use and soil type. Modeling parameters were varied to mirror observed temporal trends and soil and land use characteristics. The hydrologic model was calibrated by first adjusting the model parameters until the simulated and observed annual and seasonal water budgets matched. Then the intensity and arrival time of individual events were calibrated. This iterative process was repeated until the simulated results closely represented the system and reproduced observed flow patterns and magnitudes. Initial modeling parameters were assigned based on guidelines in BASINS Technical Note 6 (USEPA 2000).

Key considerations in the hydrology calibration included the overall water balance, high-flow and low-flow distribution, storm flow volumes and timing, and seasonal variation. At least three criteria for goodness of fit were used for calibration: volumetric comparison, graphical comparison, and the relative error method. Calculating runoff volumes at various time scales (e.g., daily, monthly) provides an assessment of the model’s ability to accurately simulate the water budget. The model calibration was performed using the guidance of error statistics criteria specified in HSPEXP (Lumb et al. 1994). An example calibration plot is shown in Figure 5-7, and a water budget analysis is shown in Table 5-8; the complete hydrology calibration results are in Appendix D.

Overall, the calibrated model predicted the watershed water budget well. All calibration and validation locations showed the modeled water budget to be within 9 percent of observed conditions. Predicted seasonal volumes were also within recommended ranges at every location. Predicted storm volumes and storm peaks also closely matched observed data, particularly at validation gauges. Because the runoff and resulting stream flow are highly dependent on rainfall, occasional storms were over-predicted or under-predicted depending on the spatial variability of the meteorologic and gauge stations.

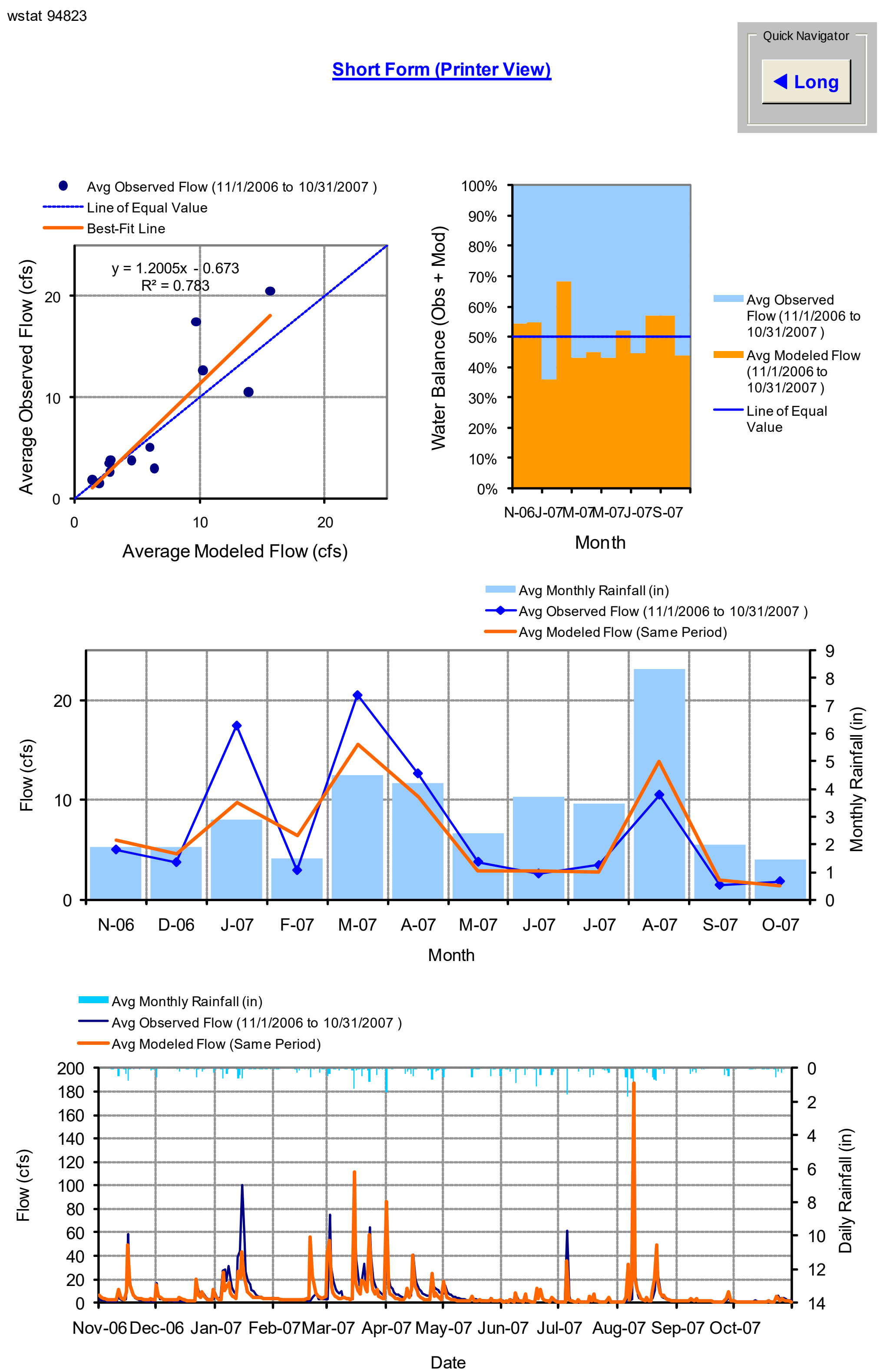


Figure 5-7. LSPC hydrology calibration 2006–2007 at USGS 03049800: East Little Pine Creek.

Table 5-8. Water budget statistical comparison 2006–2007 at USGS 03049800: East Little Pine Creek

Simulated versus observed flow	Percent error	Recommended criterion[a]
Error in total volume	-9.37%	10%
Error in 50% lowest flows	8.25%	10%
Error in 10% highest flows	-11.52%	15%
Seasonal volume error – summer	20.55%	30%
Seasonal volume error – fall	13.04%	30%
Seasonal volume error – winter	-23.41%	30%
Seasonal volume error – spring	-16.12%	30%
Error in storm volumes	14.01%	20%
Error in summer storm volumes	23.07%	50%

[a] Recommended criterion: HSPEXP

Significant amounts of monitoring data were used to calibrate the model for bacteria. Available monitoring data in the watershed were identified and assessed for application to calibration. From November 2006 to October 2007, weekly bacteria data were collected at 25 locations in the Pine Creek watershed to support determination of recreational use attainment status in the watershed (see Section 2.1.4) and eventual TMDL development. These data provided the most recent water quality data and good spatial coverage. The period selected for water quality calibration—November 1, 2006, through October 31, 2007—was the same period used in the hydrology calibration.

5.3.2. Water Quality Calibration

Bacteria loads are delivered to the tributaries with surface runoff, subsurface flows, and direct point sources. LSPC provides mechanisms for representing all these various pathways of pollutant delivery. A detailed water quality analysis was performed with observed flow and in-stream monitoring data. The confidence in the calibration process increases with the quantity and quality of the monitoring data. The 2007 bacteria data provide very good spatial and temporal coverage of water quality in the Pine Creek watershed.

During calibration, parameters influencing the simulation of pollutant washoff, and watershed-specific septic failure rates, were adjusted. Permitted discharges were not changed on the basis of a relatively good inventory of data to characterize these sources. Septic system failure rates were calculated according to the method described in Section 5.2.6, and were characterized using local data. Because site-specific data did not exist, assigning a 25 percent rate in septic systems within the stream buffer was used as a starting point (PADEP, May 6, 2010, Richard Shertzer, personal communication) but was ultimately used as one of the calibration parameters. The number of failing septic systems was originally calculated (as discussed previously) by selecting all septic systems within a 1,000-foot buffer of a stream, and estimating a 25 percent failure rate. The calibration used the same buffers, but the failure rate was adjusted as a calibration variable. The rates were generally reduced (to a 1.5 to 8 percent failure).

Once the septic failure rates were adjusted and the calibration was nearly completed, two spatially distinct locations in modeled subwatersheds 20, 21, and 105 appeared to have significant sources of bacteria that had not been represented, because of an under-prediction of in-stream bacteria concentration at these locations. As a result of these large, obviously overlooked sources of bacteria, *Source X* was modeled in two ways to better estimate the nature of the bacteria source. Typically, unknown sources are represented by adjusting bacteria concentrations in groundwater and interflow components of the hydrology model. However, this method was not suitable because of a significant spike in bacteria concentrations near the McCandless Township Sanitary Authority's Pine Creek Sewage Treatment Plant (NPDES #PA0027669). Therefore, Source X was applied as a direct point source to the stream to match observed bacteria concentrations. Source X represents a flow of 0.16 cubic foot per second and a load of 1.68E+10

CFU/hour. Source X is the equivalent of 140 failing septic systems (189 failing septics are represented within 1,000 feet of a stream in the Pine Creek watershed modeling effort), and is distributed in three modeled watersheds (modeled watersheds 105 [West Little Pine Creek], 20, and 21 [both on the Pine Creek mainstem]) containing and adjacent to the PA0027669 and PA0025992 facilities. PA0027669 is in modeled subwatershed 21, which is upstream of subwatershed 20. Combined, the Source X component in subwatersheds 20 and 21 is the equivalent of 110 failed septic systems. PA0025992 is at the boundary of modeled subwatersheds 105 and 106, where 106 is the upstream watershed. Source X was estimated to be the equivalent of 30 failed septic systems when modeled as a source in subwatershed 105 and compared to calibration data at the pour point of watershed 105. Permitted wastewater from PA0027669 and PA0025992 is represented explicitly using DMR data for flows and bacteria, suggesting that the outfalls are not the sources of the Source X load. Instead, source X could be due to failed or improper infrastructure in the vicinity of these two facilities. Such spatially distinct, high-frequency bacteria sampling data allows the modeler to identify unknown sources and improve the calibration by including loadings associated with Source X in the modeling.

During the calibration process described above, predicted pollutant concentrations were graphically compared to observed values. After calibrating the model for selected locations, modelers obtained a calibrated data set containing parameter values for each modeled land use and soil type. Water quality calibration results at station 8 (Mouth of East Little Pine Creek), which is near the USGS 03049800 flow calibration gauge, are shown on Figure 5-8, and the full water quality calibration results for the simulation are presented in Appendix E.

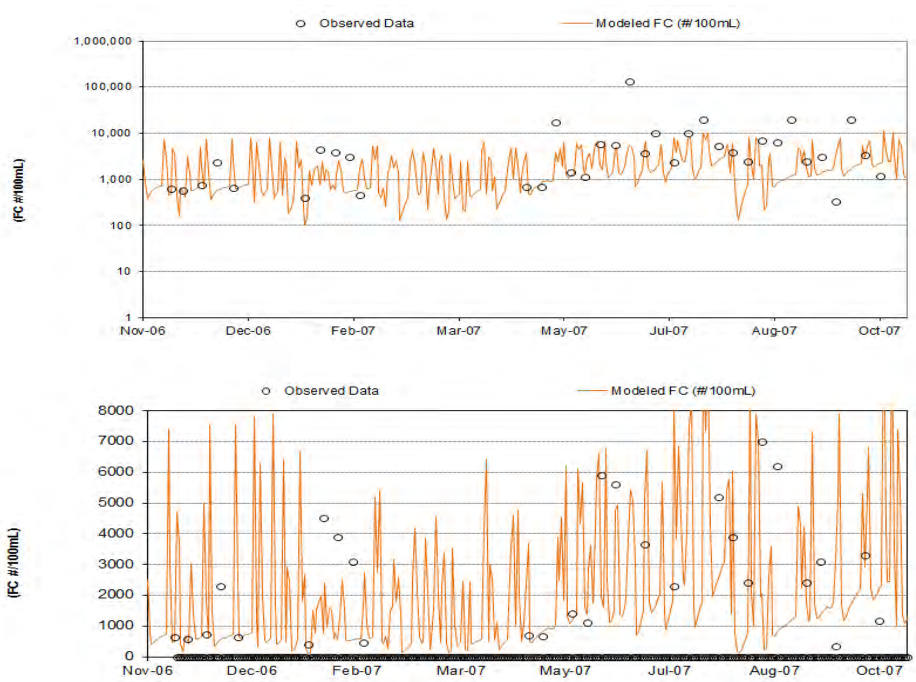


Figure 5-8. LSPC bacteria calibration station 8: Mouth of East Little Pine Creek, showing a plot of log bacteria concentrations, and a high-resolution display of the calibration < 8,000 CFU/100 mL.

In preparation of the allocation effort, the calibrated watershed model was delineated into 17 *Allocation Groups*. Figure 5-9 shows the allocations groupings, and the calibrated model results showing the relative bacteria source contributions by allocation group are shown in Figure 5-10. The source contributions are shown for the allocation *baseline* scenario, where permitted facilities are discharging at permitted limits.

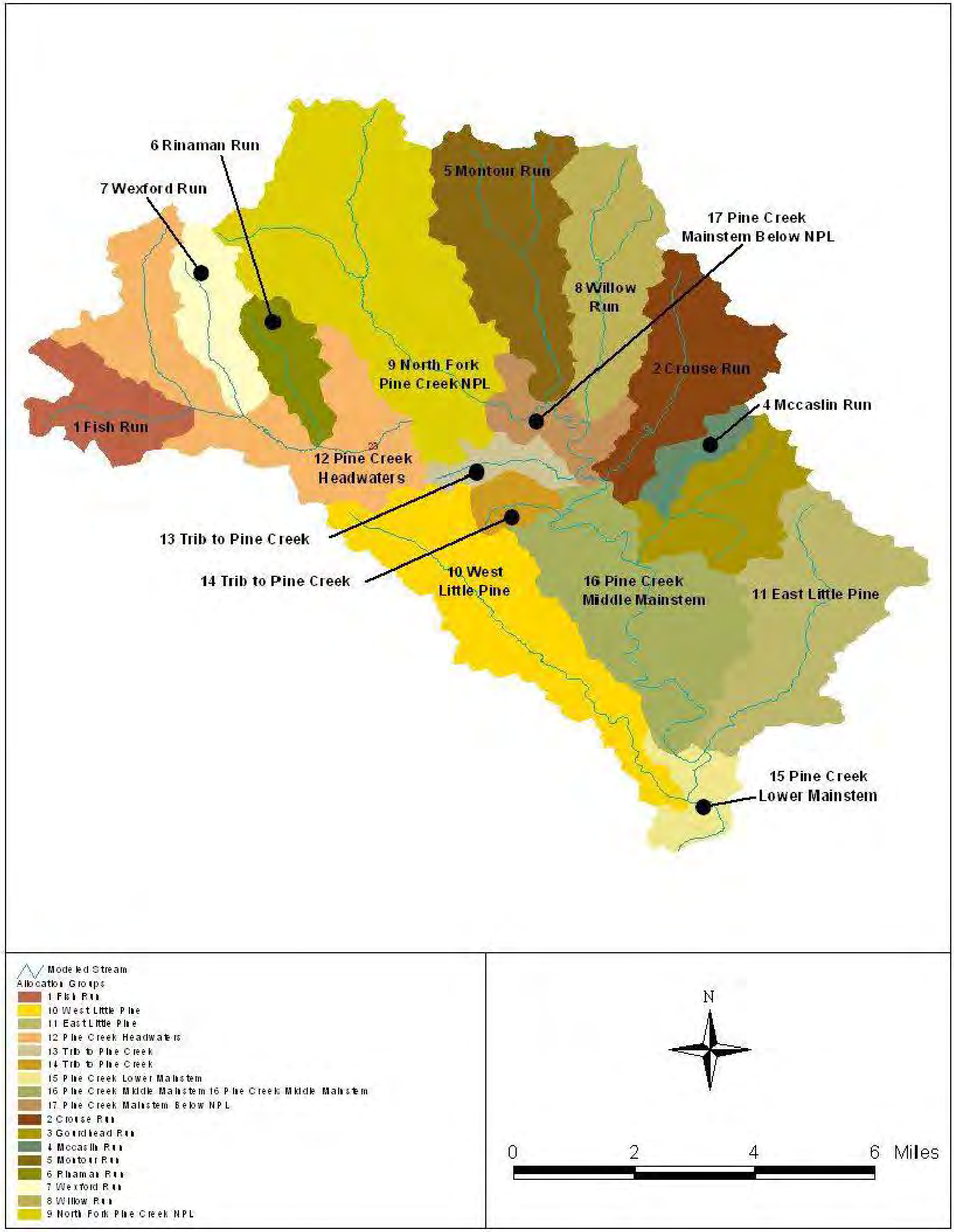


Figure 5-9. Allocation groups in the Pine Creek watershed.

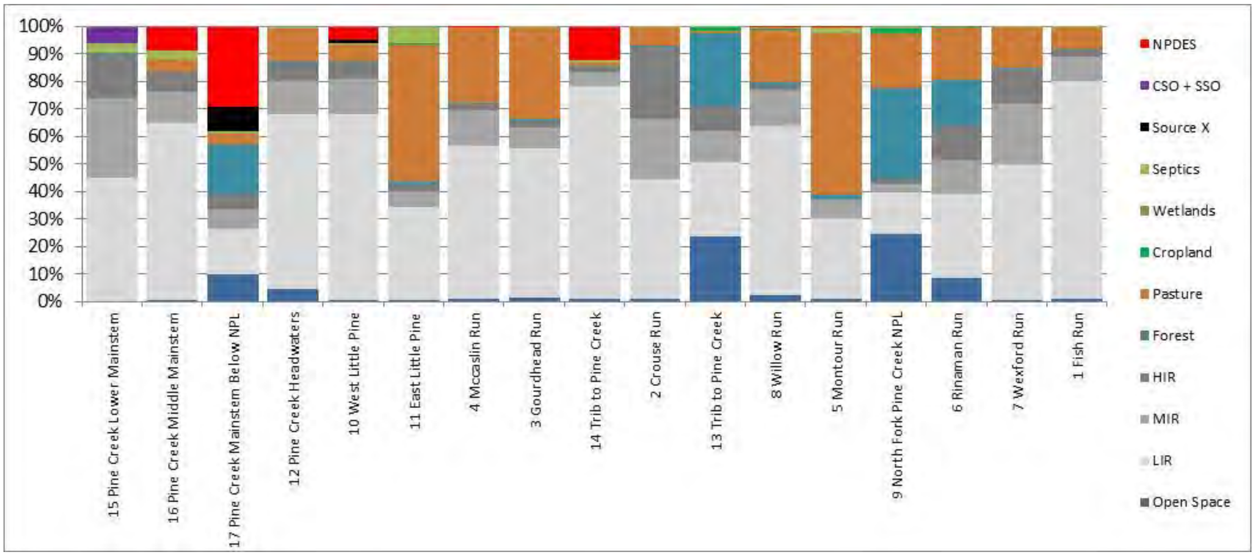


Figure 5-10. Bacteria contributions by source and allocation group representing existing conditions with existing sources discharging at current/existing limits (baseline scenario).

5.3.3. LSPC Model Assumptions and Limitations

The major underlying assumptions associated with the Pine Creek watershed model development are as follows:

- The effect of high-flow events on channel geometry is not significant.
- No significant vertical stratification is assumed in the stream reaches.
- Each LSPC reach is assumed to be completely mixed for water quality parameters.
- LSPC is a spatially lumped model and does not represent the spatial orientation of individual land uses in a subwatershed.
- Land uses and stream channel cross sections are fixed and constant throughout the modeling period.
- Stratification effects cannot be simulated because of representation as a completely mixed system. Lateral spatial gradients in the main channel or in tributaries cannot be represented.
- Regeneration of fecal coliform bacteria is not a significant source.
- The average rate of decay for fecal coliform bacteria (0.7 ^{1}/day) does not vary seasonally or by meteorological conditions.
- Streams are assumed to be completely mixed, one-dimensional segments with a constant trapezoidal cross-section.

6. ALLOCATION ANALYSIS AND TMDLS

A TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards or goals. It is composed of the sum of individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the following equation:

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

In TMDL development, allowable loadings from each pollutant source are summed to a cumulative TMDL threshold, thus providing a quantitative basis for establishing water quality-based controls. TMDLs can be expressed as a mass loading over time (e.g., grams of pollutant per day) or as a concentration in accordance with 40 CFR 130.2(l). PADEP reserves the right to revise these allocations, with approval from EPA, if the revised allocations are consistent with the achievement of water quality standards.

6.1. TMDL Endpoints

Endpoints for fecal coliform bacteria were selected on the basis of the existing criterion discussed in Section 1.3. The bacteria standard is excerpted below, in part, from Table 3 in Section 93.7 of the Pennsylvania Code (PADEP 1998):

> During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.

In waters designated for potable water supply:

> Maximum of 5,000/100 ml as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000/100 ml in more than 5% of the samples.

On the basis of the standards described above and in Section 1.3, the TMDL targets for Pine Creek change seasonally (Table 6-1). In the summer months (May 1 through September 30), the dual TMDL target is a maximum 30-day geometric mean of 200 CFU/100 mL and a maximum instantaneous concentration of 400 CFU/100 mL. The instantaneous maximum of 400 CFU/100 mL cannot be exceeded in more than 10 percent of samples. Because the model produces daily results, no more than 10 percent of the daily model results were to exceed 400 CFU/100 mL. The geometric mean of daily modeled values was calculated as a 30-day geometric mean because the standard requires that in-stream water quality satisfy both criteria. Modeling was performed to satisfy both of these endpoints. During the non-summer months (October 1 through April 30), the TMDL target is a maximum geometric mean concentration of 2,000 CFU/100 mL. These targets were used because they correspond to *Pennsylvania Code* regarding fecal coliform bacteria.

Table 6-1. TMDL endpoints

Water quality criterion	Period	Instantaneous TMDL target (CFU/100 mL)	Geometric mean TMDL target (CFU/100 mL)
Fecal coliforms	May 1 through September 30	Not to exceed 400 for more than 10% of daily modeled values	200
Fecal coliforms	October 1 through April 30	--	2,000

6.2. Baseline Conditions

The calibrated model provides the basis for performing the allocation analysis. The first step is to simulate baseline conditions, which represent existing nonpoint source loadings and point sources loadings at permit limits. Baseline conditions allow for an evaluation of in-stream water quality under the highest expected loading conditions.

6.3. TMDLs and Source Allocations

The bacteria TMDLs for the Pine Creek watershed were developed using the LSPC model, and targets were based on water quality criteria, as discussed in Section 6.1. Source allocations were developed for all modeled subwatersheds because they all are contributing to the bacteria-impaired streams in the Pine Creek watershed. Loading contributions were reduced from applicable sources until the TMDL endpoints were attained at the outlet of each subwatershed. The loading contributions were then routed through downstream water bodies. Permitted source reductions did not result in allocated loadings to any industrial or public/private sewerage permittee that would be more stringent than water quality criteria. The following methodology was used when allocating to bacteria sources.

- Septic failures that were estimated during the model calibration process were eliminated (i.e., allocated zero load). Removing this source assumes that under the TMDL condition, septic systems function normally or have been removed and are serviced by a sewer system.
- Bacteria contributions from the land surface were reduced if needed. Forested, open space, and wetland land use types were not to be reduced in any subwatersheds unless necessary to meet the TMDL targets. Bacteria reductions were applied to residential, pasture, and cropland land use types as a priority. Bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals.
- For watersheds with permitted point sources (i.e., not CSO or SSO outfalls), discharges were set at the loads defined by applicable permit limits for flow and water quality criteria for fecal coliform (flow limit and 200 CFU/100 mL for May–October or flow limit and 2,000 CFU/100 mL for October–April).
- Source X contributions were eliminated because of the assumption that they are illicit in nature.
- CSO contributions were reduced uniformly by 85 percent (flow and bacteria load) from their existing contributions. The 85 percent reduction is based on EPA’s Combined Sewer Overflow Control Policy, which is a national framework for control of CSOs through the NPDES permitting program. The framework provides that no less than 85 percent of the CSO volume should be eliminated or captured.

The baseline and TMDL bacteria loads for the watershed were generated from the calibrated LSPC model, with point sources represented by their permitted limits during the recreation and non-recreation season. The simulated allocation period covered 2 years, from May 1, 2006, through April 30, 2008. The target TMDL values for these bacteria sources were calculated by iteratively adjusting loading rate input until simulated in-stream concentrations achieved water quality standards.

6.3.1. TMDL Subwatershed Groupings

To effectively display the detailed source allocations associated with successful TMDL scenarios, the 68 modeled Pine Creek watersheds were aggregated into 17 regions representing separate hydrologic units (Figure 5-9). The 17 regions provide a basis for georeferencing the source allocations, and are referred to as *Allocation Groups*.

6.3.2. Allocation Process

The allocation process applied a *top-down* reduction methodology. This methodology entails a watershed by watershed application of reductions (starting with headwaters), until waters in all subwatersheds meet the TMDL endpoint. LSPC output for baseline conditions was compared directly with the bacteria TMDL endpoints. If predicted bacteria concentrations exceeded the TMDL endpoint in a given watershed, the bacteria sources represented in LSPC required additional reductions according to the guidelines discussed in the previous section. Figure 6-1 and Figure 6-2 show a representative TMDL condition at the mouth of Pine Creek (modeled subwatershed 1) indicating modeled sources have been reduced sufficiently to meet TMDL endpoints.

The top-down reduction methodology has the effect of also reducing in-stream concentrations in downstream subwatersheds by discharging waters of higher quality to subsequent reaches in the simulated network. The reductions to headwaters are necessary so that the TMDL target is met in these locations and in downstream segments. Often the allocations produce conditions under which *higher quality* upstream waters are just meeting the TMDL target. As the quantity of water increases downstream in the system, these waters then serve to dilute fecal coliform bacteria loads that enter in the downstream segments. This methodology sometimes requires large reductions in headwater subbasins. This occurs when significant sources of a pollutant exist in that watershed and diluting flows from upstream reaches are not available. Larger reductions are required in these watersheds to meet the TMDL target. Large reductions in excess of 90 percent are often required in areas where excessive in-stream pollutant concentrations have been observed. For example, Figure 5-8 shows a water quality calibration where in-stream measurements exceeding 100,000 colonies/100 mL have been observed. The geometric mean water quality standard for fecal coliform bacteria is 200 colonies/100 mL, so a simplistic reduction from 100,000 colonies to 200 colonies suggests greater than a 99 percent reduction in bacteria loading. This example illustrates the magnitude of the bacteria impairment in the Pine Creek watershed.

6.3.3. Land Surface Loadings

Precipitation runoff that drains through a municipal separate storm sewer system (MS4) subject to NPDES permitting requirements is considered a point source discharge, though runoff outside the regulated MS4 boundaries is a nonpoint source discharge of fecal coliform bacteria. The LA is the portion in the TMDL that is assigned to nonpoint sources. Table 6-2 shows the total bacteria load by land use type for Pine Creek and includes all lands inside and outside of the MS4 boundaries. Loading rates are the same within and outside the MS4 regulated area. The A-68 interceptor service area loads are not associated with loads since those land areas drain to a combined sewer.

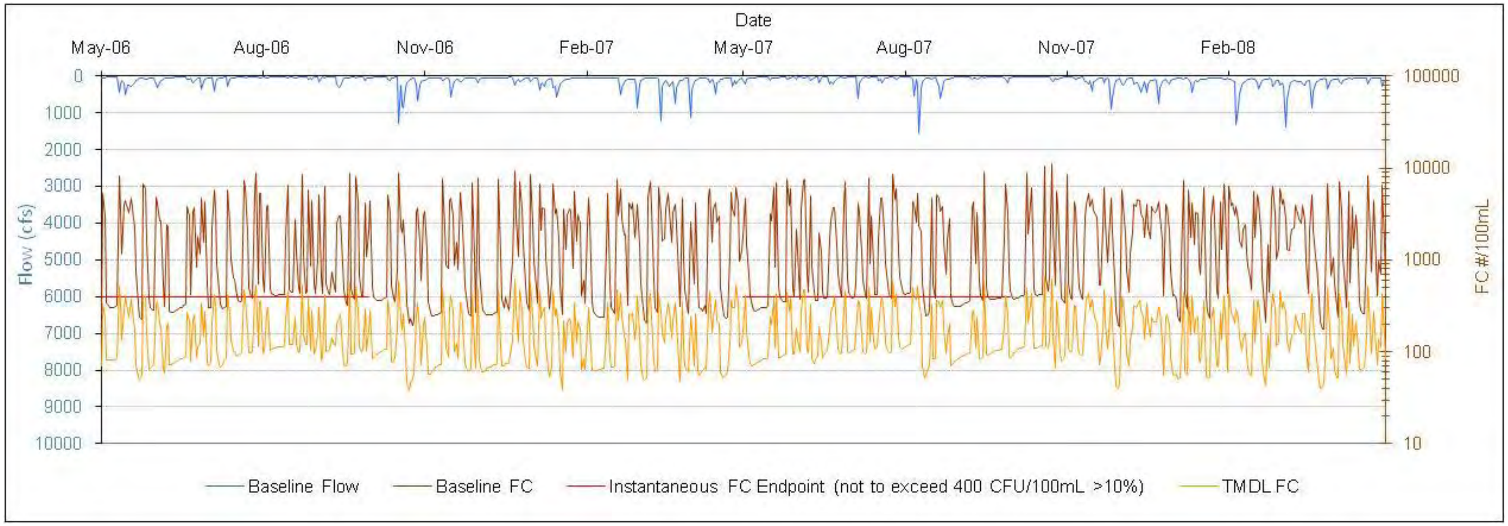


Figure 6-1. Simulated baseline and TMDL results at the mouth of Pine Creek (modeled watershed 1) in relation to the instantaneous TMDL Endpoint.

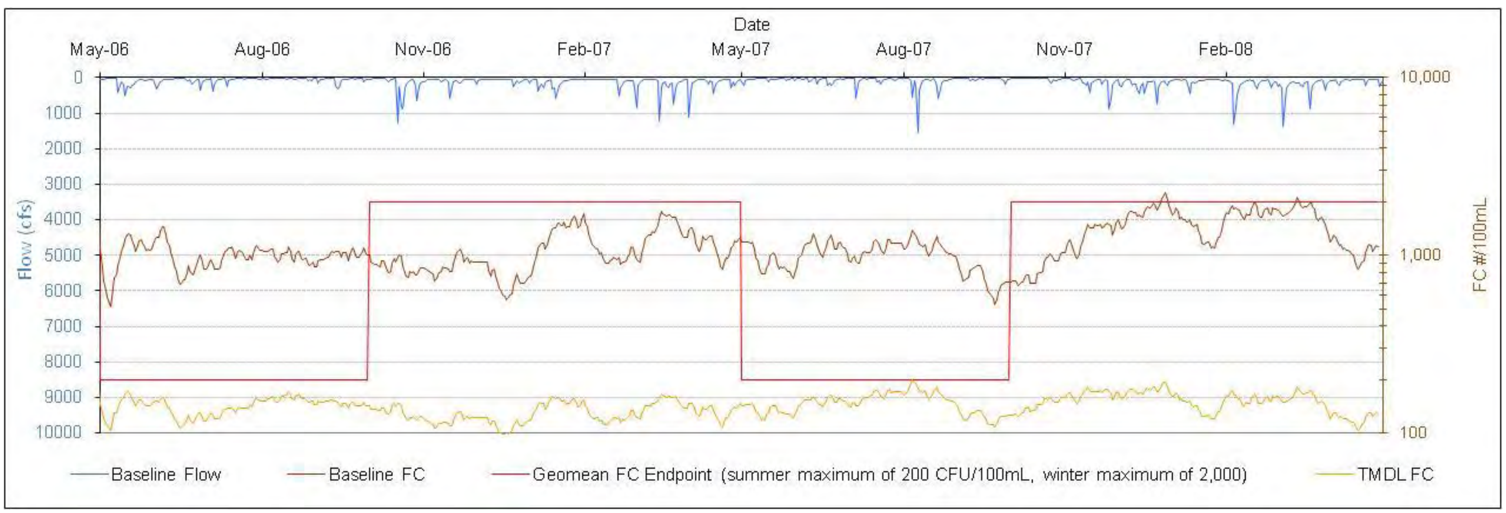


Figure 6-2. Simulated baseline and TMDL results at the mouth of Pine Creek (modeled watershed 1) in relation to the geometric mean TMDL Endpoint.

Table 6-2. Baseline and target bacteria loads by land use

Land use	Area (acres)	Baseline daily FC (#)	Allowable daily FC (#)
OpenSpace_Pervious	11,773	9.10E+11	1.10E+11
LIR_Pervious	5,546	3.43E+12	1.56E+11
MIR_Pervious	618	5.65E+11	2.64E+10
HIR_Pervious	73	7.90E+10	3.08E+09
Forest	17,405	1.32E+12	1.37E+11
Pasture	907	1.93E+12	7.35E+10
Cropland	472	4.51E+10	1.65E+09
Wetlands	18	1.91E+10	8.18E+08
OpenSpace_Impervious	1,308	1.16E+11	1.40E+10
LIR_Impervious	2,986	2.12E+12	9.45E+10
MIR_Impervious	1,147	7.55E+11	3.47E+10
HIR_Impervious	660	6.96E+11	2.71E+10
Totals	**43,006**	**1.20E+13**	**6.78E+11**

The existing condition scenario indicates that the primary source contributions to the study area are from the land surface. Septic contributions to the overall nonpoint source load are not as significant. Source-based reductions were achieved by iteratively reducing the sources present in a subwatershed (according to the guidelines outlined in Section 6.3) until the TMDL endpoint was met. Specifically, land surface loads were reduced by subwatershed until fecal coliform bacteria concentrations in that segment met the TMDL endpoints described in Section 6.1.

The land surface LAs are presented by land use and separate from septic loads, which are also considered a component of the LA.

Watershed Areas Receiving LAs Compared to MS4 Areas Receiving WLAs

As mentioned in Section 3.1.3, the boundaries of the MS4 communities were obtained from the U.S. Census Bureau's UA determination for 2000. The regulated communities were selected from the U.S. Census Bureau data set and used to develop the MS4 WLAs. Without information identifying specific portions of the MS4 communities that discharge to regulated outfalls, it was assumed that all stormwater generated in UAs of the regulated jurisdictions discharge to the MS4 outfalls and receive WLAs. All non-UAs of regulated jurisdictions were assumed not to discharge to regulated outfalls of the MS4s and receive LAs. Figure 6-3 illustrates what areas of the watershed received a LA and which areas (MS4s) received a WLA.

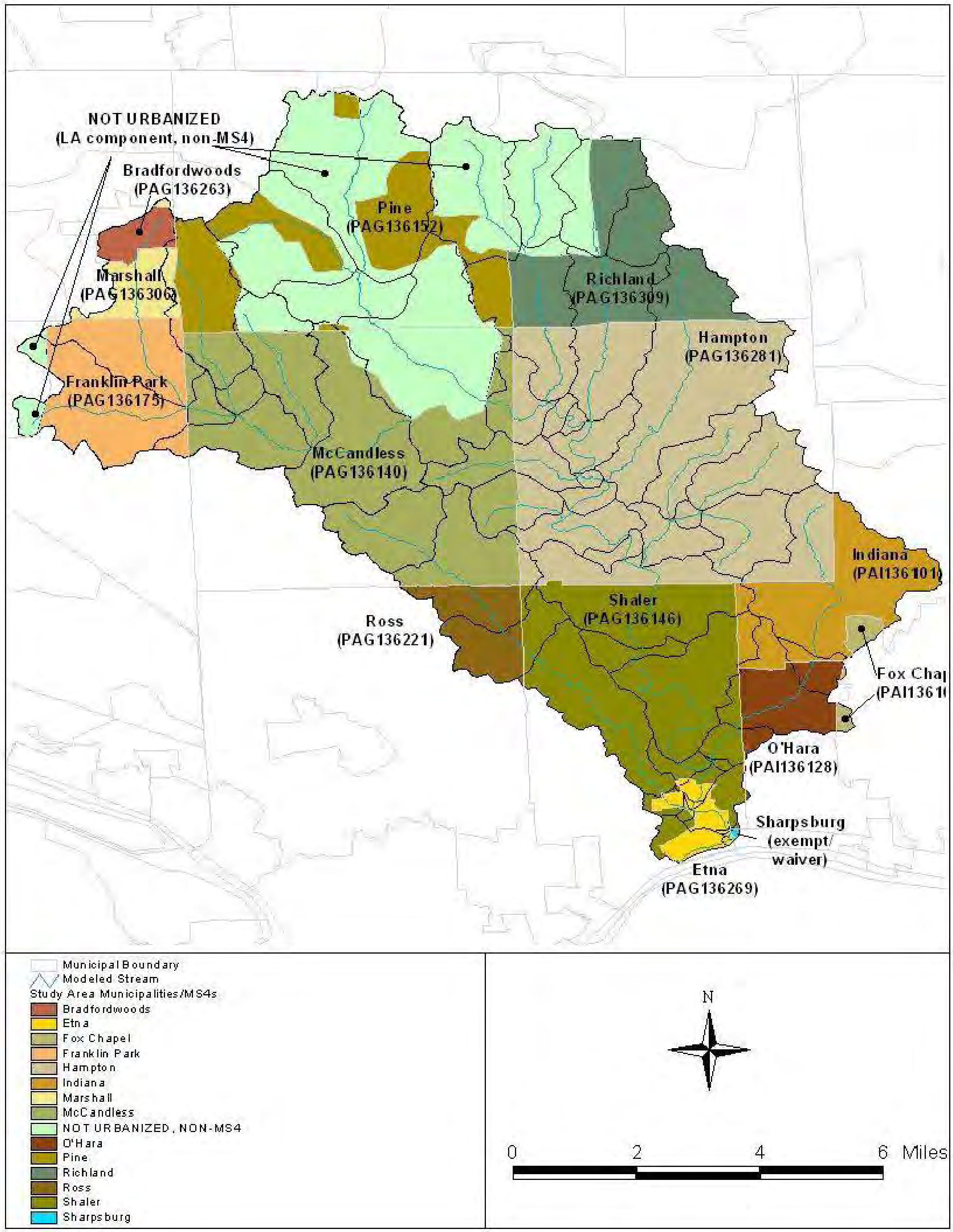


Figure 6-3. Pine Creek watershed MS4 jurisdictions (WLA) and non-UAs (LA).

6.3.4. Wasteload Allocations

Federal regulations (40 CFR 130.7) require TMDLs to include WLAs for each point source. WLAs were developed for all point sources permitted to discharge fecal coliform bacteria under an NPDES permit in the Pine Creek watershed. The components of the WLA are summarized below.

WLA: MS4 Municipalities

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from urban MS4s. A November 22, 2002, EPA Memorandum from Robert Wayland and James Hanlon, Water Division Directors (http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/final-wwtmdl.pdf) clarified existing regulatory requirements for MS4s connected with TMDLs. The key points are the following:

- NPDES-regulated MS4 discharges must be included in the WLA of the TMDL and may not be addressed by the LA component of TMDL.
- The stormwater allotment can be a gross allotment and does not need to be apportioned to specific outfalls.

In accordance with this memorandum, MS4s were treated as point sources for TMDL and NPDES permitting purposes, and the bacteria loading generated within the boundary of an MS4 area was assigned a WLA. The Pine Creek watershed contains portions of 14 MS4 communities (Figure 6-3), all requiring WLAs.

To determine the loading associated with each MS4, the township boundary GIS layer was overlaid with the watershed boundaries, and the land-based WLA was proportionally assigned to each municipality on the basis of area. As mentioned in Section 3.1.3 of this document, the boundaries of the MS4 communities were based on a GIS shapefile of municipal boundaries for Pennsylvania. The regulated areas of the MS4 communities were determined according to the U.S. Census Bureau's UA determination for 2000. If information identifying specific portions of the MS4 communities that discharge to regulated outfalls did not exist, it was assumed that all stormwater generated in UAs of the regulated jurisdictions discharge to the MS4 outfalls and receive WLAs. Figure 6-3 illustrates the MS4 areas of the watershed that received WLAs.

Stormwater bacteria loads in the MS4 regulated area are covered under the Phase II NPDES Stormwater Program. Runoff from urban areas during storm events can be a significant fecal coliform bacteria source, delivering bacteria to the water body. EPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified UAs
Because the road areas covered under the two transportation MS4 permits are intertwined with the land area covered under the municipality MS4 permits, the loads from transportation MS4 permittees have been aggregated with municipality MS4s. Table 6-3 provide aggregate WLAs for MS4s.

It is important to note that this TMDL has identified and accounted for the sources of bacteria within the watershed for which EPA had data to represent, including SSOs, CSOs, wastewater treatment plants and septic systems. The TMDL provides separate allocations and reductions for each of those sources apart from the MS4 loads. However, because the MS4 allocations are based on precipitation driven sources associated with landcover, bacteria from failing infrastructure, septic systems and illicit connections may be sources of contamination for the MS4 discharges. Because the TMDL provides for 100% reduction of these sources of bacteria separate from the MS4 WLAs, the dominant sources of bacteria represented in the MS4 WLAs are from animals, particularly wildlife, pets, and livestock. With the elimination of the failing septics and infrastructure, the reductions presented in Tables 6.3 and 6.6 can best be achieved by addressing animal wastes from pets and livestock. It is not the intent of this TMDL to reduce wildlife, nor does this TMDL recommend the MS4 permittee consider the reduction of wildlife as a BMP. The TMDL considers wildlife as a natural condition within the watershed unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals.

EPA anticipates that implementation of the MS4 permit WLAs in the Pine Creek watershed will be achieved over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. For additional information regarding implementation and EPA guidance, see Section 7 and Appendix G.

Table 6-3. Summary of MS4 municipality allocations in the Pine Creek watershed

MS4 entity[1]	NPDES permit	Baseline load (#/day)	Reduced load (#/day)	% Reduction
Bradford Woods	PAG136263	2.10E+10	2.25E+09	89%
Etna	PAG136269	3.05E+10	9.13E+09	70%
Fox Chapel	PAI136102	3.28E+09	8.72E+08	73%
Franklin Park	PAG136175	4.90E+11	1.62E+10	97%
Hampton	PAG136281	2.20E+12	2.19E+11	90%
Indiana	PAI136101	2.91E+11	1.91E+10	93%
Marshall	PAG136306	1.72E+11	6.73E+09	96%
Mccandless	PAG136140	2.73E+12	7.02E+10	97%
Ohara	PAI136128	7.25E+10	6.38E+09	91%
Pine	PAG136152	5.32E+11	2.48E+10	95%
Richland	PAG136309	3.54E+11	2.27E+10	94%
Ross	PAG136221	3.18E+11	2.80E+09	99%
Shaler	PAG136146	1.73E+12	1.28E+11	93%
Sharpsburg	Exempt/waiver	7.28E+09	2.18E+09	70%
			Average reduction:	**89%**

[1]MS4 Allocations are aggregates which include two transportation permittees: Pennsylvania DOT, Pennsylvania Turnpike Commission. These entities are not provided discrete allocations, but are discussed further in Section 3.1.

WLA: Industrial and Private/Public Sewerage Permitted Facilities

For the nine NPDES permitted facilities in the Pine Creek watershed, the fecal coliform bacteria WLAs were set at the loads defined by applicable permit limits for flow and water quality criteria for fecal coliform (flow limit and 200 CFU/100 mL for May–October or flow limit and 2,000 CFU/100 mL for October–April). The baseline load is calculated using the facility's current flow limit and the water quality criteria.

WLA: CSOs

For the seven CSOs represented in the Pine Creek watershed (see Section 5.2.5 and Table 3-3), WLAs were calculated using an 85 percent reduction to CSO discharges. The 85 percent reduction is based on EPA's Combined Sewer Overflow Control Policy, which is a national framework for control of CSOs through the NPDES permitting program. The framework provides that no less than 85 percent of the CSO volume should be eliminated or captured

6.3.5. Margin of Safety

The MOS is the portion of the pollutant loading reserved to account for uncertainty in the TMDL development process, specifically to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. The MOS may be implicit or explicit. This TMDL employs an implicit MOS because of a number of conservative assumptions used in the modeling process. Examples of the conservative assumptions that justify an implicit MOS used in developing these TMDLs follow:

- Extensive monitoring data were used to calibrate the model and represent in stream conditions.
- Permitted WWTPs were represented at the maximum allowable fecal coliform concentration and design flows as opposed to actual discharges from the WWTP
- The TMDL captured both low- and high-flow critical conditions and was developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability.

6.3.6. Critical Conditions and Seasonal Variations

TMDL developers must select the environmental conditions that will be used for defining allowable loads. TMDLs are designed around the concept of a *critical condition*. The goal of the TMDL is to determine the assimilative capacity of a water body and to identify potential allocation scenarios that enable the water body to meet the TMDL target. The critical condition is the set of environmental conditions, which, if met, will ensure attainment of objectives for all other conditions. This is typically the period in which the impaired water body exhibits the most vulnerability. Nonpoint source loading is typically precipitation-driven; thus, in-stream impacts tend to occur during wet weather in which storm events cause surface runoff to carry pollutants to water bodies. Under low-flow conditions, non-precipitation driven point sources dominate bacteria loading with their more constant flow and pollutant loading.

These TMDLs are presented as average daily counts that were developed to meet the identified TMDL endpoints under a range of conditions observed throughout the year. Analysis of available bacteria data indicated that critical conditions occur during both high- and low-flow events depending on specific sources and conditions in a given watershed. In some cases, a predominance of land-based sources might result in precipitation-driven loading with critical conditions during high-flow events. In other areas, the predominance of continuous sources might result in critical conditions with low-flow events because of a lack of dilution. In still other areas, where there could be a mix of significant land-based sources, and significant point sources, critical conditions might occur during both low- and high-flow events because of the presence of both types of sources. During low-flow periods, continuous/point sources contribute to the critical loading, while during high flow periods, precipitation-driven sources are responsible for the critical loading. To appropriately address the low- and high-flow critical conditions, the TMDLs were developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability. The period of May 1, 2006, through April 30, 2008, was used in the allocation analysis.

The LSPC model simulates seasonal precipitation variability throughout the watershed as represented by the weather time-series used to drive the model covering a range of hydrologic conditions, including the critical condition(s). Seasonal variation is also captured in the time variable simulation, which represents seasonal precipitation on a year-to-year basis.

6.3.7. Future TMDL Modifications and Growth

EPA has established the Pine Creek TMDL, including its component WLAs, LAs, and implicit MOS, based on the applicable WQS and the totality of the information available concerning water quality and hydrology, and present and anticipated pollutant sources and loadings. EPA recognizes, however, that neither the world at large, nor the watershed, is static. In a dynamic environment, change is inevitable. Much change can be generated during TMDL implementation and could include new monitoring data, installation of BMPs and land use changes.

It might be possible to accommodate some of those changes in the existing TMDL framework without the need to revise it in whole, or in part. For example, EPA's permitting regulations at 122.44(d)(1)(vii)(B) require that permit WQBELs be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge" in the TMDL. As the EPA Environmental Appeals Board has recognized, "WLAs are not permit limits per se; rather they still require translation into permit limits." *In re City of Moscow*, NPDES Appeal No. 00-10 (July 27, 2001). In providing such translation, the Environmental Appeals Board said that "[w]hile the governing regulations require consistency, they do not require that the permit limitations that will finally be adopted in a final NPDES permit be identical to any of the WLAs that may be provided in a TMDL." Id. Accordingly, depending on the facts of a situation, it might be possible for Pennsylvania to write a permit limit that is consistent with (but not identical to) a given WLA without revising that WLA (either increasing or decreasing a specific WLA), provided the permit limit is consistent with the operative *assumptions* (e.g., about the applicable WQS, the sum of the delivered point source loads, the sufficiency of reasonable assurance) that informed the decision to establish that particular WLA. It is an assumption of this TMDL that any new or expanded POTW permittee or wastewater treatment plant could discharge into the watershed at the bacteria water quality criteria without a TMDL revision.

There might, however, be circumstances with which the permitting authority is not comfortable, or the CWA would not allow, the degree to which a permit limit might deviate from a WLA in the TMDL such that one or more WLAs and LAs in the TMDL would need to be revised. In such cases, it might be appropriate for EPA to revise the TMDL (or portions of it). EPA would consider a request made by the public or PADEP to revise the TMDL. Alternatively, PADEP could propose to revise a portion(s) of the TMDL (including specific WLAs and LAs) and submit those revisions to EPA for approval. A proposed WLA can be made available for public comment concurrent with the associated permits revision/reissuance public notice. If EPA approved any such revisions, those revisions would replace their respective parts in the EPA-established TMDL framework. In approving any such revisions or in making its own revisions, EPA would ensure that the revisions themselves met all the statutory and regulatory requirements for TMDL approval and did not result in any component of the original TMDL not meeting applicable WQS.

6.4. Pine Creek Watershed TMDLs

As described in Section 6.3, the 68 modeled Pine Creek watersheds were aggregated into 17 Allocation Groups representing separate hydrologic units (Figure 5-9). These 17 regions provide a basis for georeferencing more detailed source information. Tables 6-4 through 6-6 are the TMDLs for Pine Creek watershed.

Table 6-4. Baseline bacteria load summary—Existing loads

BASELINE	Allocation Group:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)
Nonpoint Sources	Landuse	5.10E+10				2.86E+11	2.69E+11	1.73E+10	2.17E+10	2.36E+12			3.32E+10					
	Septics	1.33E+09	2.53E+09	1.33E+09	1.86E+08	1.10E+10	0.00E+00	1.61E+09	2.36E+09	1.16E+10	7.77E+09	3.76E+10	6.18E+09	1.56E+08	9.71E+08	8.54E+09	4.67E+10	5.61E+09
	Source X										2.07E+10							7.73E+10
	wildlife, direct discharge	7.31E+07									6.41E+09	1.36E+09						3.73E+09
Sum Nonpoint Sources:		5.24E+10	2.53E+09	1.33E+09	1.86E+08	2.97E+11	2.69E+11	1.90E+10	2.41E+10	2.37E+12	3.49E+10	3.89E+10	3.94E+10	1.56E+08	9.71E+08	8.54E+09	4.67E+10	8.67E+10
MS4	BRADFORD WOODS																	
	ETNA																	
	FOX CHAPEL																	
	FRANKLIN PARK																	
	HAMPTON																	
	INDIANA																	
	MARSHALL																	
	MCCANDLESS																	
	OHARA																	
	PINE																	
	RICHLAND																	
	ROSS																	
	SHALER																	
	SHARPSBURG																	
Sum MS4:		2.66E+11	6.69E+11	3.45E+11	1.28E+11	1.51E+11	1.82E+11	4.01E+11	2.52E+11	6.94E+11	1.58E+12	5.69E+11	1.13E+12	3.95E+11	1.18E+11	2.09E+11	1.33E+12	5.26E+11
CSO	CSO1															8.25E+09		
	CSO1A															1.81E+09		
	CSO2															9.49E+05		
	CSO3															3.53E+08		
	CSO4															3.00E+09		
	CSO5															7.03E+08		
	CSO7										4.29E+08							
	SSO22										1.70E+09							
Permitted Point Sources	PA0216143								1.89E+07									
	PA0205141					1.89E+07												
	PA0027669																	2.49E+11
	PA0028177														1.66E+10			
	PA0043729																1.33E+11	
	PA0000515				3.77E+07													
	PA0025992										7.89E+10							
	PA0003425																2.19E+08	
Sum Point Sources:		2.66E+11	6.69E+11	3.45E+11	1.28E+11	1.51E+11	1.82E+11	4.01E+11	2.52E+11	6.94E+11	1.66E+12	5.69E+11	1.13E+12	3.95E+11	1.34E+11	2.23E+11	1.47E+12	7.75E+11
Total Load:		3.18E+11	6.71E+11	3.47E+11	1.28E+11	4.48E+11	4.51E+11	4.20E+11	2.76E+11	3.07E+12	1.69E+12	6.08E+11	1.17E+12	3.95E+11	1.35E+11	2.32E+11	1.51E+12	8.62E+11

[1] MS4s loads are aggregates that include each municipal and transportation MS4 located in that allocation group.

Table 6-5. TMDL bacteria load summary

ALLOCATED	Allocation Group:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)
Nonpoint Sources	Landuse	1.04E+09				1.76E+10	5.39E+09	4.00E+08	2.73E+09	1.21E+11			1.00E+09					
	Septics	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Source X										0.00E+00							0.00E+00
	wildlife, direct discharge	7.31E+07									6.41E+09	1.36E+09						3.73E+09
Sum LA:		1.11E+09	0.00E+00	0.00E+00	0.00E+00	1.76E+10	5.39E+09	4.00E+08	2.73E+09	1.21E+11	6.41E+09	1.36E+09	1.00E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E+09
MS4	BRADFORD WOODS																	
	ETNA																	
	FOX CHAPEL																	
	FRANKLIN PARK																	
	HAMPTON																	
	INDIANA																	
	MARSHALL																	
	MCCANDLESS																	
	O HARA																	
	PINE																	
	RICHLAND																	
	ROSS																	
	SHALER																	
	SHARPSBURG																	
Sum MS4:		7.05E+09	2.20E+10	2.17E+10	5.95E+09	1.40E+10	3.64E+09	1.25E+10	2.06E+10	3.13E+10	3.21E+10	3.62E+10	4.18E+10	7.90E+09	6.42E+09	4.70E+10	1.39E+11	8.07E+10
CSO	CSO1															1.24E+09		
	CSO1A															2.71E+08		
	CSO2															1.42E+05		
	CSO3															5.30E+07		
	CSO4															4.50E+08		
	CSO5															1.06E+08		
	CSO7										6.44E+07							
	SSO22										0.00E+00							
Permitted Point Sources	PA0216143								1.89E+07									
	PA0205141					1.89E+07												
	PA0027669																	2.49E+11
	PA0028177														1.66E+10			
	PA0043729																1.33E+11	
	PA0000515				3.77E+07													
	PA0025992										7.89E+10							
	PA0003425																2.19E+08	
Sum WLA:		7.05E+09	2.20E+10	2.17E+10	5.99E+09	1.40E+10	3.64E+09	1.25E+10	2.06E+10	3.13E+10	1.11E+11	3.62E+10	4.18E+10	7.90E+09	2.30E+10	4.91E+10	2.72E+11	3.30E+11
TMDL:		8.16E+09	2.20E+10	2.17E+10	5.99E+09	3.16E+10	9.03E+09	1.29E+10	2.33E+10	1.52E+11	1.18E+11	3.76E+10	4.28E+10	7.90E+09	2.30E+10	4.91E+10	2.72E+11	3.34E+11

[1] MS4s loads are aggregates that include each municipal and transportation MS4 located in that allocation group.

Table 6-6. Percent reduction in bacteria loading by component

PERCENT REDUCTION	Allocation Group:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)	(#/day)
Nonpoint Sources	Landuse	98%				94%	98%	98%	87%	95%			97%					
	Septics	100%	100%	100%	100%	100%	-	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Source X										100%							100%
	wildlife, direct discharge	0%									0%	0%						0%
LA:		98%	100%	100%	100%	94%	98%	98%	89%	95%	82%	96%	97%	100%	100%	100%	100%	96%
MS4	BRADFORD WOODS																	
	ETNA																	
	FOX CHAPEL																	
	FRANKLIN PARK																	
	HAMPTON																	
	INDIANA																	
	MARSHALL																	
	MCCANDLESS																	
	O HARA																	
	PINE																	
	RICHLAND																	
	ROSS																	
	SHALER																	
	SHARPSBURG																	
Aggregate MS4:		97%	97%	94%	95%	91%	98%	97%	92%	95%	98%	94%	96%	98%	95%	78%	90%	85%
CSO	CSO1															85%		
	CSO1A															85%		
	CSO2															85%		
	CSO3															85%		
	CSO4															85%		
	CSO5															85%		
	CSO7										85%							
	SSO22										100%							
Permitted Point Sources	PA0216143								0%									
	PA0205141					0%												
	PA0027669																	0%
	PA0028177														0%			
	PA0043729																0%	
	PA0000515				0%													
	PA0025992										0%							
	PA0003425																0%	
WLA:		97%	97%	94%	95%	91%	98%	97%	92%	95%	93%	94%	96%	98%	83%	78%	81%	57%
TMDL Percent Reduction:		97%	97%	94%	95%	93%	98%	97%	92%	95%	93%	94%	96%	98%	83%	79%	82%	61%

[1] [1] MS4s loads are aggregates that include each municipal and transportation MS4 located in that allocation group.

7. Reasonable Assurance for TMDL Implementation

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the TMDL must provide reasonable assurances that nonpoint source control measures will achieve the expected load reductions. For point sources, such as MS4s, it is expected that the TMDL will be implemented through the NPDES program. NPDES permits must be consistent with the assumptions and requirements of the WLAs in the TMDL.

The Pine Creek TMDL does not direct or require implementation of any specific set of actions or selection of controls. For example, it is not the intent of this TMDL to reduce wildlife, nor does this TMDL recommend the reduction of wildlife as a BMP. It is expected that the TMDL will be implemented through a variety of regulatory and non-regulatory programs operating under federal, state, and local law. The implementation of pollutant reductions from nonpoint sources relies heavily on incentive-based programs; however, Pennsylvania has a number of funding programs in place to ensure that the LAs assigned to nonpoint sources in the Pine Creek TMDL can be achieved. Some of the potential sources of funding for LA implementation are EPA's Section 319 funds, Pennsylvania's State Revolving Loan Program (also available for permitted activities), and landowner contributions.

The issuance of an NPDES permit provides the reasonable assurance that the WLAs assigned to point sources in the Pine Creek TMDL will be achieved. This is because 40 CFR 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an EPA-approved TMDL. Furthermore, EPA has the authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

While implementation generally is beyond the scope of this TMDL, EPA attaches an Implementation Framework to this report. Developed in cooperation with stakeholders and found in Appendix G, the framework provides examples of an iterative, adaptive management approach to achieving water quality standards. EPA provides the following clarification of the assumptions and requirements of this TMDL. EPA anticipates that implementing the MS4 permit WLAs in the Pine Creek watershed will be achieved over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. EPA's November 22, 2002, guidance document titled *Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on those WLAs,* states:

> The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality.

Efforts to address CSO noncompliance are covered by a Federal Consent Decree established in 2008 between EPA, PADEP*,* ACHD and ALCOSAN. Partner municipalities served by ALCOSAN have also entered into Consent Order and Agreements established in 2003 among ALCOSAN, PADEP and ACHD. These agreements call for phased remediation activities. In general, Phase I activities were to result in a full inventory and assessment of sewers and repair of any major defects. Phase II requires municipalities to monitor sewer flows and implement operation and maintenance plans to prevent future system deterioration.

As part of the Federal Consent Decree and the Consent Orders and Agreement, the municipalities are also required to cooperate with ALCOSAN in developing a regional Wet Weather Plan to control CSO- and

SSO-related loading to area waters. This TMDL will help ensure an adequate Wet Weather Plan by assessing and quantifying bacteria loads, which might not be confined solely to wet-weather periods, for management and potential remediation purposes.

7.1.1. Previous Studies and Management Efforts

Several studies and management efforts related to bacteria contamination have been conducted in the Pittsburgh area and can be expected to play a significant role in TMDL implementation efforts.

Three Rivers Wet Weather Demonstration Program

The 3RWW was created in 1998 by ALCOSAN and ACHD to help ALCOSAN municipalities address the region's sewage overflow problem that EPA had cited in 1997. The organization has devoted itself to improving the county’s water resources by helping municipalities find solutions to the region’s wet weather problem. 3RWW has been and continues to be involved in numerous studies and data collection efforts regarding bacteria problems in the Pittsburgh region and has been involved as a stakeholder in the quality assurance project plan development and data gathering phases of TMDL development.

Pine Creek Watershed Plans

In 2005 the Pennsylvania Environmental Council (PEC) with the North Area Environmental Council (NAEC) and the communities and residents of the Pine Creek watershed prepared the *Pine Creek: Watershed Assessment, Protection, and Restoration Plan* (PEC et al. 2005). The plan describes the current conditions of the water quality, quantity, land use, vegetation, and other environmental characteristics of the watershed. It provides a preliminary protection and restoration plan that addresses impacts or threats from nonpoint source pollution. It also provides communities and organizations with attainable recommendations for improving the water quality in this watershed. Although this study included data collection, bacteria data were not analyzed. Stakeholders should consider updating this plan with the results of this TMDL.

A 2009 Watershed Implementation Plan for the Pine Creek Watershed was developed by the Pennsylvania Environmental Council (PEC) using PADEP-allocated 319 money. The goal of the plan is to determine how best to reduce the nonpoint source pollutant loads in the Pine Creek Watershed, including nutrients, pathogens, and siltation impairments identified on PADEP’s 2008 IR. Consistent with this TMDL, the plan suggests that these pollutants are primarily from urban runoff and storm sewers, but other sources include land development, on site wastewater, small residential runoff, and unknown sources. Detailed analyses of BMP placement and efficiency are included in the 2009 Watershed Implementation Plan and should be consulted when implementing this TMDL. Although primarily focused on reducing the volume of stormwater, more specific recommendations found in the plan could be useful for TMDL implementation.

Consent Decrees and Consent Order and Agreements

The municipalities under administrative orders and consent agreements have been focused on stormwater management and sewer overflow problems in conjunction with ALCOSAN.

8. PUBLIC PARTICIPATION

On August 31, 2011, EPA began a 45-day public comment period for the draft Pine Creek watershed bacteria TMDL. EPA held a public meeting to present the details and answer questions regarding the proposed Pine Creek Watershed Bacteria TMDL on September 28, 2011, from 5:00 to 7:00 p.m. at the Shaler Township municipal building in Glenshaw, Pennsylvania. Stakeholders attending the meeting included ACHD, Pine Creek Watershed Coalition, PEC, ALCOSAN, and many of the municipalities in the watershed. EPA received requests from a number of stakeholders for an extension to the public comment period. In response to requests for more time to gather available data and provide meaningful comments on the draft TMDL, EPA extended the public comment period twice providing a 75-day public comment period that closed on November 15, 2011. EPA publicized the draft TMDL by placing notice in local newspapers, including the *Pittsburgh Post-Gazette*, *Greensburg Tribune-Review* and *Pine Creek Journal*. The notices included information about the public meeting and instructions to the public on how to access and submit comments on the draft TMDL. EPA also published this information on its website.

In addition to the formal public participation of the Pine Creek watershed bacteria TMDL, EPA worked with stakeholders throughout the TMDL development process to request data and request feedback on TMDL methodologies. In March 2011, EPA had a conference call to familiarize stakeholders with our draft TMDL, discuss the TMDL timeline and request feedback and assistance as we moved forward. In addition, representatives of the North Hills Council of Governments and EPA met on October 20, 2011 to discuss NHCOG's concerns, development of an Implementation Framework (Appendix G) and the inclusion of additional datasets that may have been available. EPA continued our dialog with all stakeholders while working towards the establishment of the TMDL.

A list of the comments that were submitted during this period, as well as EPA's responses, are provided in EPA's *Fecal Coliform TMDL for Pine Creek Response to Comments Document.* This document is provided as Appendix H of this report.

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Appendix A. FLOW LOADING ANALYSIS GRAPHS

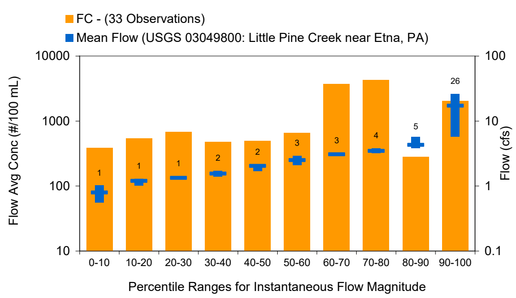
Below are flow-weighted concentration analysis and a seasonal concentration analysis performed for each water quality monitoring station . The goal of flow-weighted concentration analysis is to help identify trends in concentration levels that can be associated with low-flow conditions, high-flow conditions, mixed low-flow/high-flow conditions, or non-flow-related conditions. The goal of the seasonal/monthly analysis is to help determine whether upstream land management activities and practices might be affecting water quality.

The first graph (flow-weighted analysis) examines the potential relationship between bacteria criteria violations and flow levels by presenting the flow-weighted average fecal coliform concentrations. Flow values are ranked from highest to lowest and divided into percentiles. For each percentile range, average flow is shown in blue, and the minimum and maximum flow range for that percentile. Concentration data are presented in bar graph format for each percentile range. The data table above the graph provides additional summary statistics for flows and concentrations. The mean concentration listed in the data table represents the flow-weighted average concentration. For example, for the flows and concentrations in the 0–10 percentile range, bacteria are calculated and summed, flows are summed, and the total bacteria count is divided by the total flow to derive the flow-weighted average concentration.

The second graph for each water quality station presents the monthly analysis of water quality observations and shows seasonal patterns. Observations are grouped according to the month in which they were recorded. Corresponding flow values are averaged and plotted with the monthly mean concentration.

Location: Site 25
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.793	0.550	1.000	383.94	288.00	530.00
10-20	3	1.200	1.100	1.300	539.44	100.00	960.00
20-30	3	1.333	1.300	1.400	678.20	410.00	1167.00
30-40	4	1.550	1.400	1.700	474.77	125.00	811.00
40-50	3	2.033	1.900	2.100	494.67	145.00	820.00
50-60	3	2.500	2.100	2.900	659.92	545.00	806.00
60-70	3	3.067	3.000	3.200	3726.63	155.00	10150.00
70-80	3	3.467	3.200	3.800	4279.98	626.00	11545.00
80-90	3	4.300	3.800	5.200	281.37	81.00	675.00
90-100	4	17.200	5.800	26.000	2045.61	71.00	5400.00



Location: Site 25
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	80.33	71.00	155.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	3464.88	165.00	5400.00
June	4	3.625	1.700	5.800	1950.60	675.00	3700.00
July	4	1.523	0.790	3.000	5366.29	530.00	10150.00
August	5	5.990	0.550	22.000	2628.68	430.00	11545.00
September	4	1.508	0.830	2.500	632.87	330.00	1167.00
October	3	1.267	1.000	1.400	287.63	125.00	450.00
November	3	2.667	1.300	3.800	605.77	100.00	806.00
December	2	2.100	2.100	2.100	347.50	145.00	550.00

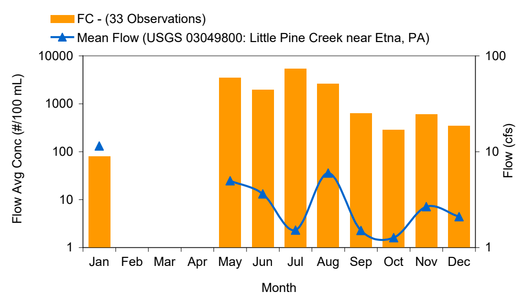
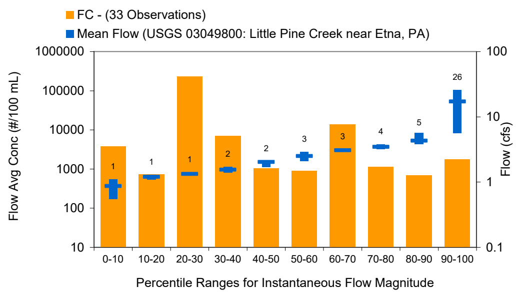


Figure A-1. Station 25 flow-loading analysis.

Location: Site 24
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	3756.93	230.00	20000.00
10-20	3	1.200	1.100	1.300	729.92	297.00	1300.00
20-30	3	1.333	1.300	1.400	234839.22	1160.00	720000.00
30-40	4	1.550	1.400	1.700	7061.29	1000.00	17400.00
40-50	3	2.033	1.900	2.100	1033.56	87.00	2300.00
50-60	3	2.500	2.100	2.900	911.27	213.00	2200.00
60-70	3	3.067	3.000	3.200	14022.87	97.00	22900.00
70-80	3	3.467	3.200	3.800	1128.85	340.00	2000.00
80-90	3	4.300	3.800	5.200	693.01	50.00	2200.00
90-100	4	17.200	5.800	26.000	1773.36	87.00	4100.00



Location: Site 24
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	85.97	74.00	97.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	41052.21	50.00	720000.00
June	4	3.625	1.700	5.800	2915.03	1140.00	6200.00
July	4	1.600	1.100	3.000	9878.11	297.00	20000.00
August	5	5.990	0.550	22.000	3803.41	680.00	20000.00
September	4	1.508	0.830	2.500	676.67	213.00	1333.00
October	3	1.267	1.000	1.400	6923.68	550.00	17400.00
November	3	2.667	1.300	3.800	464.38	340.00	580.00
December	2	2.100	2.100	2.100	1193.50	87.00	2300.00

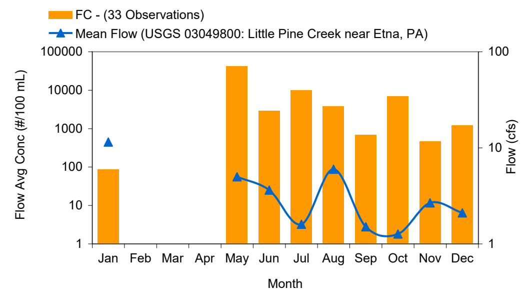
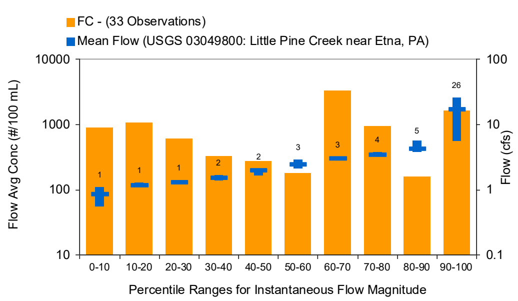


Figure A-2. Station 24 flow-loading analysis.

Location: Site 23
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	911.22	225.00	2200.00
10-20	3	1.200	1.100	1.300	1073.33	100.00	2800.00
20-30	3	1.333	1.300	1.400	615.13	205.00	1140.00
30-40	4	1.550	1.400	1.700	332.90	175.00	600.00
40-50	3	2.033	1.900	2.100	273.97	110.00	380.00
50-60	3	2.500	2.100	2.900	181.93	100.00	270.00
60-70	3	3.067	3.000	3.200	3388.65	58.00	9750.00
70-80	3	3.467	3.200	3.800	955.77	180.00	2200.00
80-90	3	4.300	3.800	5.200	159.80	50.00	420.00
90-100	4	17.200	5.800	26.000	1659.59	200.00	7600.00



Location: Site 23
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	164.42	52.00	200.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	768.82	50.00	1100.00
June	4	3.625	1.700	5.800	3342.90	420.00	7600.00
July	4	1.600	1.100	3.000	5210.98	333.00	9750.00
August	5	5.990	0.550	22.000	1920.11	270.00	2200.00
September	4	1.508	0.830	2.500	478.98	203.00	1140.00
October	3	1.267	1.000	1.400	737.37	175.00	2200.00
November	3	2.667	1.300	3.800	138.00	100.00	180.00
December	2	2.100	2.100	2.100	245.00	110.00	380.00

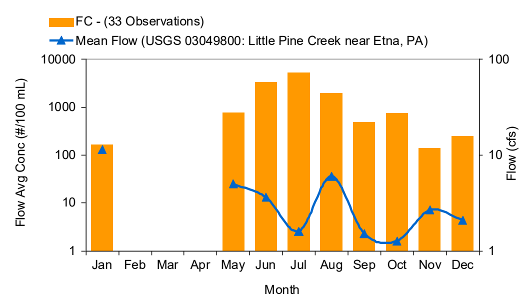
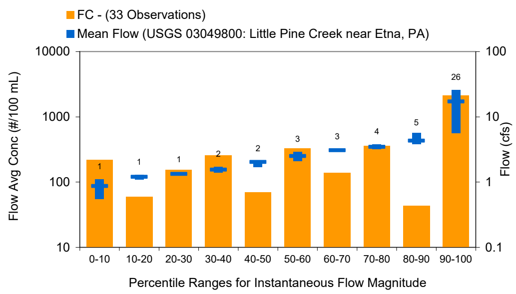


Figure A-3. Station 23 flow-loading analysis.

Location: Site 22
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	Count	Mean	Min	Max	Mean	Min	Max
0-10	4	0.870	0.550	1.100	218.98	86.00	435.00
10-20	3	1.200	1.100	1.300	59.22	0.00	100.00
20-30	3	1.333	1.300	1.400	153.90	42.00	215.00
30-40	4	1.550	1.400	1.700	256.34	37.00	740.00
40-50	3	2.033	1.900	2.100	69.77	5.00	140.00
50-60	3	2.500	2.100	2.900	330.28	53.00	652.00
60-70	3	3.067	3.000	3.200	138.00	42.00	330.00
70-80	3	3.467	3.200	3.800	362.31	250.00	560.00
80-90	3	4.300	3.800	5.200	43.83	8.00	105.00
90-100	4	17.200	5.800	26.000	2126.74	200.00	4900.00



Location: Site 22
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	Count	Mean	Min	Max	Mean	Min	Max
January	3	11.467	3.200	26.000	159.56	26.00	200.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	673.68	8.00	1100.00
June	4	3.625	1.700	5.800	1266.37	105.00	2900.00
July	4	1.600	1.100	3.000	215.50	86.00	330.00
August	5	5.990	0.550	22.000	3677.08	53.00	4900.00
September	4	1.508	0.830	2.500	189.01	125.00	215.00
October	3	1.267	1.000	1.400	425.79	105.00	740.00
November	3	2.667	1.300	3.800	369.35	0.00	652.00
December	2	2.100	2.100	2.100	38.00	5.00	71.00

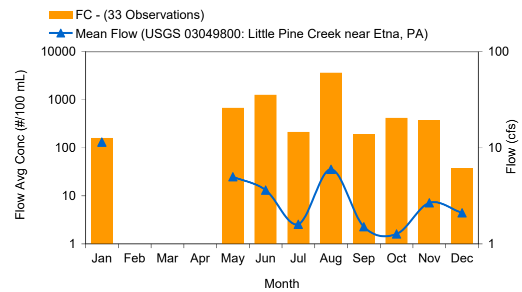
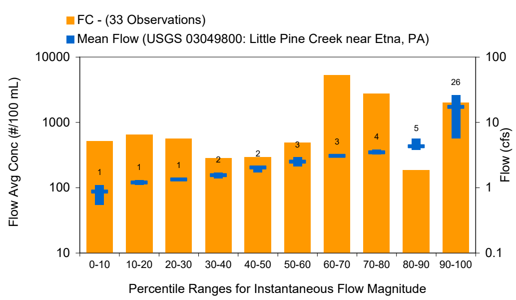


Figure A-4. Station 22 flow-loading analysis.

Location: Site 21
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	Count	Mean	Min	Max	Mean	Min	Max
0-10	4	0.870	0.550	1.100	515.75	260.00	710.00
10-20	3	1.200	1.100	1.300	645.67	225.00	1333.00
20-30	3	1.333	1.300	1.400	560.98	253.00	1080.00
30-40	4	1.550	1.400	1.700	284.40	103.00	520.00
40-50	3	2.033	1.900	2.100	293.69	165.00	545.00
50-60	3	2.500	2.100	2.900	485.20	250.00	840.00
60-70	3	3.067	3.000	3.200	5287.52	61.00	15050.00
70-80	3	3.467	3.200	3.800	2729.67	435.00	7454.00
80-90	3	4.300	3.800	5.200	186.51	48.00	510.00
90-100	4	17.200	5.800	26.000	2006.32	225.00	11700.00



Location: Site 21
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	Count	Mean	Min	Max	Mean	Min	Max
January	3	11.467	3.200	26.000	182.99	48.00	225.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	977.81	56.00	1355.00
June	4	3.625	1.700	5.800	4946.00	310.00	11700.00
July	4	1.600	1.100	3.000	7459.83	393.00	15050.00
August	5	5.990	0.550	22.000	2419.07	545.00	7454.00
September	4	1.508	0.830	2.500	544.08	260.00	1080.00
October	3	1.267	1.000	1.400	466.11	238.00	710.00
November	3	2.667	1.300	3.800	333.81	225.00	435.00
December	2	2.100	2.100	2.100	180.00	165.00	195.00

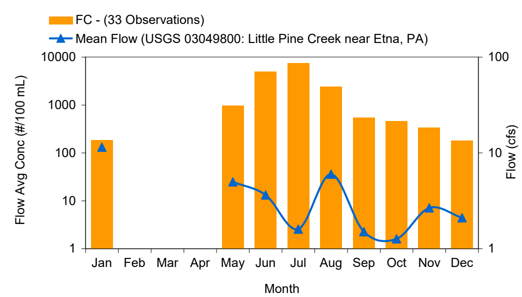
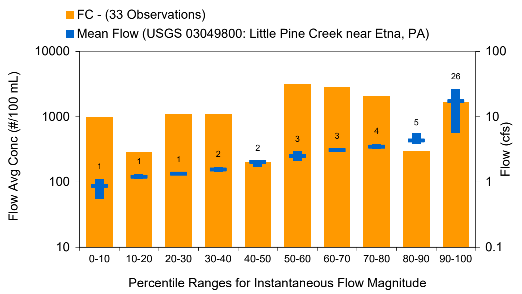


Figure A-5. Station 21 flow-loading analysis.

Location: Site 20
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	994.68	310.00	1933.00
10-20	3	1.200	1.100	1.300	282.64	265.00	295.00
20-30	3	1.333	1.300	1.400	1108.75	450.00	2100.00
30-40	4	1.550	1.400	1.700	1079.27	150.00	2300.00
40-50	3	2.033	1.900	2.100	200.33	110.00	300.00
50-60	3	2.500	2.100	2.900	3095.07	270.00	8300.00
60-70	3	3.067	3.000	3.200	2866.96	180.00	6400.00
70-80	3	3.467	3.200	3.800	2058.90	257.00	5600.00
80-90	3	4.300	3.800	5.200	294.86	47.00	820.00
90-100	4	17.200	5.800	26.000	1651.24	235.00	3600.00



Location: Site 20
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	209.02	97.00	235.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	941.70	47.00	2200.00
June	4	3.625	1.700	5.800	2339.48	245.00	5600.00
July	4	1.600	1.100	3.000	3187.66	290.00	6400.00
August	5	5.990	0.550	22.000	2802.25	190.00	3600.00
September	4	1.508	0.830	2.500	4217.25	800.00	8300.00
October	3	1.267	1.000	1.400	2092.89	1933.00	2300.00
November	3	2.667	1.300	3.800	263.01	257.00	270.00
December	2	2.100	2.100	2.100	205.00	110.00	300.00

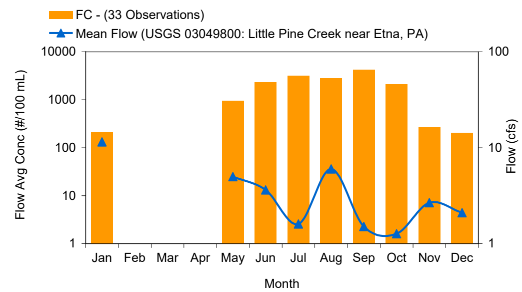
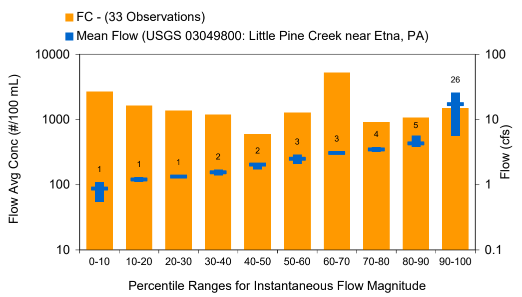


Figure A-6. Station 20 flow-loading analysis.

Location: Site 19
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	2674.32	2400.00	2900.00
10-20	3	1.200	1.100	1.300	1623.92	248.00	2800.00
20-30	3	1.333	1.300	1.400	1364.28	1180.00	1733.00
30-40	4	1.550	1.400	1.700	1189.82	900.00	1570.00
40-50	3	2.033	1.900	2.100	598.69	320.00	1060.00
50-60	3	2.500	2.100	2.900	1273.77	457.00	2300.00
60-70	3	3.067	3.000	3.200	5204.35	2000.00	11400.00
70-80	3	3.467	3.200	3.800	919.92	252.00	2200.00
80-90	3	4.300	3.800	5.200	1065.08	135.00	3200.00
90-100	4	17.200	5.800	26.000	1491.03	168.00	3100.00



Location: Site 19
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	370.64	135.00	2400.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	1046.37	225.00	2000.00
June	4	3.625	1.700	5.800	1995.99	353.00	3200.00
July	4	1.600	1.100	3.000	6705.27	1967.00	11400.00
August	5	5.990	0.550	22.000	2726.13	1060.00	3100.00
September	4	1.508	0.830	2.500	1972.79	1180.00	2700.00
October	3	1.267	1.000	1.400	1714.37	1369.00	2400.00
November	3	2.667	1.300	3.800	325.66	248.00	457.00
December	2	2.100	2.100	2.100	390.00	320.00	460.00

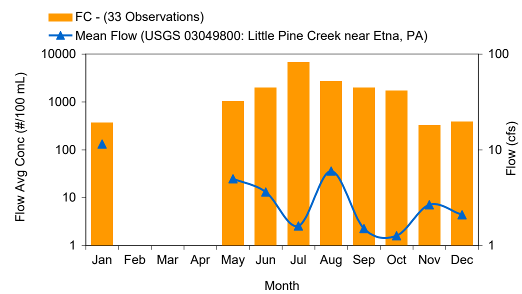
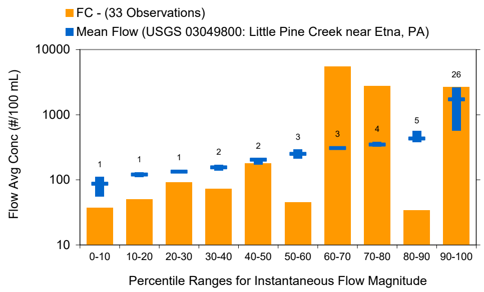


Figure A-7. Station 19 flow-loading analysis.

Location: Site 18
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	37.49	25.00	50.00
10-20	3	1.200	1.100	1.300	50.69	39.00	64.00
20-30	3	1.333	1.300	1.400	91.53	50.00	125.00
30-40	4	1.550	1.400	1.700	73.45	25.00	120.00
40-50	3	2.033	1.900	2.100	178.75	50.00	416.00
50-60	3	2.500	2.100	2.900	45.09	11.00	72.00
60-70	3	3.067	3.000	3.200	5453.37	145.00	15200.00
70-80	3	3.467	3.200	3.800	2749.42	83.00	8181.00
80-90	3	4.300	3.800	5.200	34.24	19.00	47.00
90-100	4	17.200	5.800	26.000	2645.06	120.00	6000.00



Location: Site 18
Pollutant: FC
Data from: 11/15/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	107.06	19.00	145.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	4.980	1.300	15.000	1082.21	47.00	1500.00
June	4	3.625	1.700	5.800	1723.39	42.00	4200.00
July	4	1.600	1.100	3.000	7152.12	38.00	15200.00
August	5	5.990	0.550	22.000	5344.75	25.00	8181.00
September	4	1.508	0.830	2.500	58.62	11.00	125.00
October	3	1.267	1.000	1.400	55.16	25.00	89.00
November	3	2.667	1.300	3.800	90.40	39.00	135.00
December	2	2.100	2.100	2.100	237.00	58.00	416.00

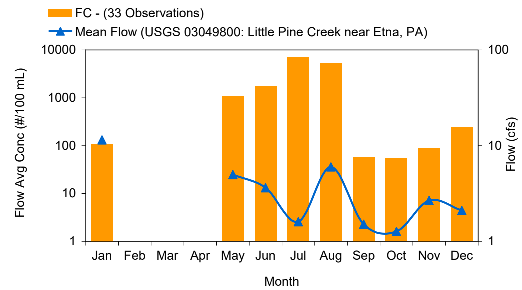
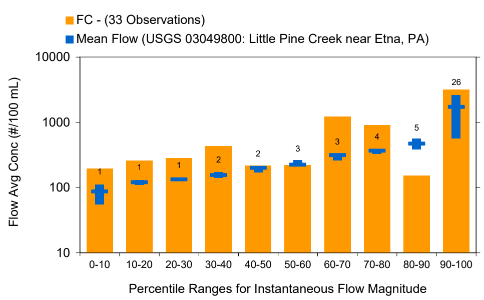


Figure A-8. Station 18 flow-loading analysis.

Location: Site 17
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	197.41	75.00	275.00
10-20	3	1.200	1.100	1.300	259.22	110.00	400.00
20-30	3	1.333	1.300	1.400	285.50	135.00	500.00
30-40	4	1.550	1.400	1.700	433.69	185.00	790.00
40-50	3	2.000	1.900	2.100	218.52	26.00	335.00
50-60	3	2.233	2.100	2.500	219.40	105.00	410.00
60-70	3	3.133	3.000	3.200	1238.68	238.00	3350.00
70-80	3	3.667	3.400	3.800	907.49	223.00	2100.00
80-90	3	4.700	3.900	5.200	151.70	50.00	220.00
90-100	4	17.200	5.800	26.000	3210.03	140.00	7200.00



Location: Site 17
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	163.26	140.00	260.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	1291.17	50.00	2200.00
June	4	3.625	1.700	5.800	2062.73	238.00	4450.00
July	4	1.600	1.100	3.000	1741.05	275.00	3350.00
August	5	5.990	0.550	22.000	5564.35	165.00	7200.00
September	4	1.508	0.830	2.500	199.05	75.00	500.00
October	3	1.267	1.000	1.400	281.05	185.00	440.00
November	3	2.367	1.300	3.800	226.82	110.00	310.00
December	2	2.100	2.100	2.100	218.00	26.00	410.00

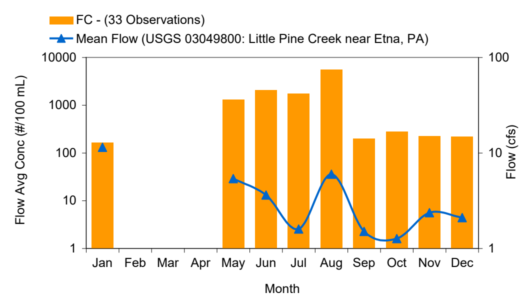
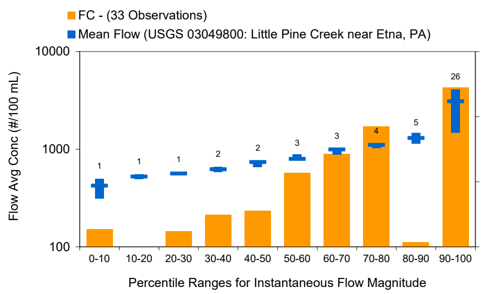


Figure A-9. Station 17 flow-loading analysis.

Location: Site 16
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	151.36	89.00	205.00
10-20	3	1.200	1.100	1.300	94.39	23.00	195.00
20-30	3	1.333	1.300	1.400	144.53	78.00	243.00
30-40	4	1.550	1.400	1.700	214.26	64.00	385.00
40-50	3	2.000	1.900	2.100	234.83	223.00	253.00
50-60	3	2.233	2.100	2.500	570.91	140.00	1491.00
60-70	3	3.133	3.000	3.200	896.64	77.00	2450.00
70-80	3	3.667	3.400	3.800	1712.82	145.00	5100.00
80-90	3	4.700	3.900	5.200	111.32	6.00	225.00
90-100	4	17.200	5.800	26.000	4294.80	115.00	11636.00



Location: Site 16
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	106.33	77.00	115.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	588.05	6.00	964.00
June	4	3.625	1.700	5.800	1680.18	250.00	3800.00
July	4	1.600	1.100	3.000	1225.22	69.00	2450.00
August	5	5.990	0.550	22.000	9153.78	89.00	11636.00
September	4	1.508	0.830	2.500	160.53	105.00	243.00
October	3	1.267	1.000	1.400	232.63	100.00	385.00
November	3	2.367	1.300	3.800	146.61	23.00	230.00
December	2	2.100	2.100	2.100	857.00	223.00	1491.00

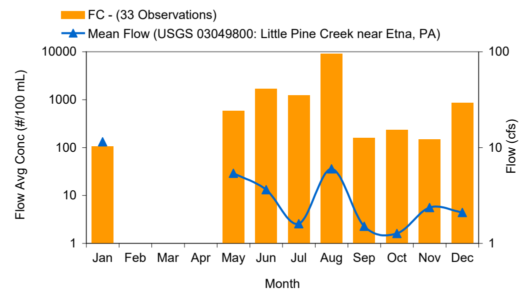
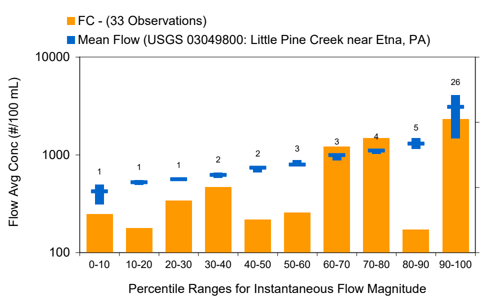


Figure A-10. Station 16 flow-loading analysis.

Location: Site 15
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	246.04	100.00	445.00
10-20	3	1.200	1.100	1.300	176.94	105.00	275.00
20-30	3	1.333	1.300	1.400	341.15	155.00	507.00
30-40	4	1.550	1.400	1.700	467.58	165.00	700.00
40-50	3	2.000	1.900	2.100	216.97	68.00	380.00
50-60	3	2.233	2.100	2.500	255.52	185.00	325.00
60-70	3	3.133	3.000	3.200	1211.28	480.00	2750.00
70-80	3	3.667	3.400	3.800	1483.36	180.00	4000.00
80-90	3	4.700	3.900	5.200	173.02	64.00	230.00
90-100	4	17.200	5.800	26.000	2313.78	248.00	5800.00



Location: Site 15
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	262.33	200.00	480.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	612.52	64.00	900.00
June	4	3.625	1.700	5.800	2652.62	500.00	5800.00
July	4	1.600	1.100	3.000	1443.75	155.00	2750.00
August	5	5.990	0.550	22.000	4015.25	165.00	4800.00
September	4	1.508	0.830	2.500	222.88	155.00	360.00
October	3	1.267	1.000	1.400	234.47	100.00	400.00
November	3	2.367	1.300	3.800	222.61	105.00	380.00
December	2	2.100	2.100	2.100	196.50	68.00	325.00

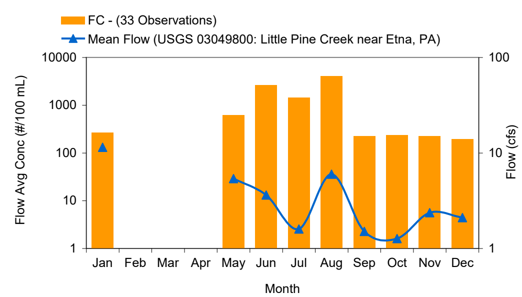
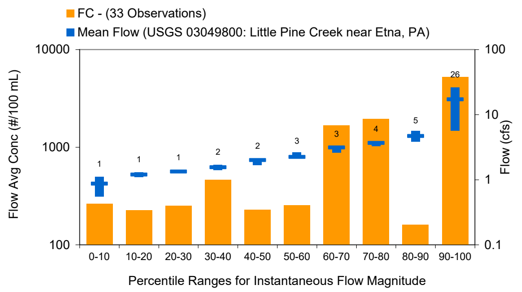


Figure A-11. Station 15 flow-loading analysis.

Location: Site 14
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	262.88	102.00	425.00
10-20	3	1.200	1.100	1.300	225.39	68.00	410.00
20-30	3	1.333	1.300	1.400	252.00	130.00	395.00
30-40	4	1.550	1.400	1.700	465.00	200.00	800.00
40-50	3	2.000	1.900	2.100	228.33	155.00	270.00
50-60	3	2.233	2.100	2.500	254.93	230.00	300.00
60-70	3	3.133	3.000	3.200	1680.89	277.00	4550.00
70-80	3	3.667	3.400	3.800	1952.00	220.00	5600.00
80-90	3	4.700	3.900	5.200	159.98	83.00	220.00
90-100	4	17.200	5.800	26.000	5242.09	145.00	13600.00



Location: Site 14
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	159.55	145.00	277.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	1187.09	83.00	2000.00
June	4	3.625	1.700	5.800	5731.03	395.00	13600.00
July	4	1.600	1.100	3.000	2318.83	210.00	4550.00
August	5	5.990	0.550	22.000	8946.45	155.00	11273.00
September	4	1.508	0.830	2.500	251.85	102.00	395.00
October	3	1.267	1.000	1.400	374.47	205.00	640.00
November	3	2.367	1.300	3.800	206.25	68.00	270.00
December	2	2.100	2.100	2.100	277.50	255.00	300.00

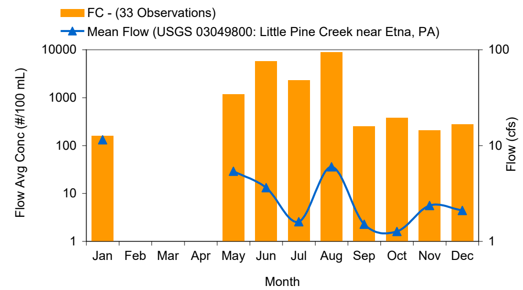
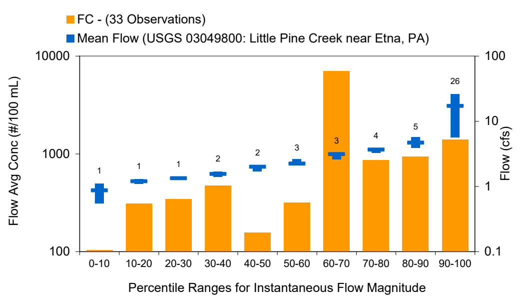


Figure A-12. Station 14 flow-loading analysis.

Location: Site 13
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	103.30	39.00	245.00
10-20	3	1.200	1.100	1.300	308.06	160.00	570.00
20-30	3	1.333	1.300	1.400	342.78	217.00	520.00
30-40	4	1.550	1.400	1.700	473.56	47.00	1550.00
40-50	3	2.000	1.900	2.100	156.08	125.00	171.00
50-60	3	2.233	2.100	2.500	317.49	56.00	826.00
60-70	3	3.133	3.000	3.200	7044.77	308.00	20000.00
70-80	3	3.667	3.400	3.800	862.53	185.00	1256.00
80-90	3	4.700	3.900	5.200	936.40	47.00	2100.00
90-100	4	17.200	5.800	26.000	1402.70	791.00	2800.00



Location: Site 13
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	1067.48	791.00	2100.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	600.20	47.00	900.00
June	4	3.625	1.700	5.800	1698.86	308.00	2800.00
July	4	1.600	1.100	3.000	9451.41	110.00	20000.00
August	5	5.990	0.550	22.000	1692.88	56.00	2100.00
September	4	1.508	0.830	2.500	236.94	78.00	520.00
October	3	1.267	1.000	1.400	68.47	39.00	105.00
November	3	2.367	1.300	3.800	251.55	171.00	570.00
December	2	2.100	2.100	2.100	498.00	170.00	826.00

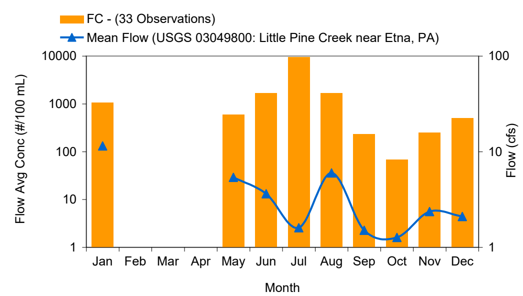
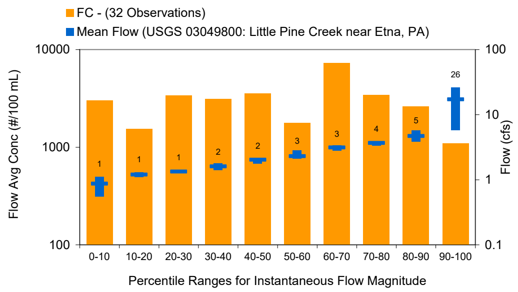


Figure A-13. Station 13 flow-loading analysis.

Location: Site 12
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (32 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	3004.91	920.00	7100.00
10-20	3	1.200	1.100	1.300	1543.47	613.00	2600.00
20-30	3	1.333	1.300	1.400	3395.00	3100.00	3900.00
30-40	3	1.600	1.400	1.700	3113.12	595.00	6200.00
40-50	4	2.025	1.900	2.100	3560.37	279.00	8000.00
50-60	2	2.300	2.100	2.500	1767.39	900.00	2800.00
60-70	3	3.133	3.000	3.200	7271.49	510.00	20000.00
70-80	3	3.667	3.400	3.800	3423.64	3100.00	3700.00
80-90	3	4.700	3.900	5.200	2613.26	250.00	6800.00
90-100	4	17.200	5.800	26.000	1093.02	480.00	2600.00



Location: Site 12
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (32 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	510.00	360.00	540.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	3071.19	250.00	6800.00
June	4	3.625	1.700	5.800	2802.76	2000.00	6200.00
July	4	1.600	1.100	3.000	11339.00	1583.00	20000.00
August	5	5.990	0.550	22.000	1357.18	480.00	5700.00
September	3	1.543	0.830	2.500	1557.15	900.00	3100.00
October	3	1.267	1.000	1.400	1640.26	595.00	3200.00
November	3	2.367	1.300	3.800	2064.07	279.00	3500.00
December	2	2.100	2.100	2.100	4155.00	310.00	8000.00

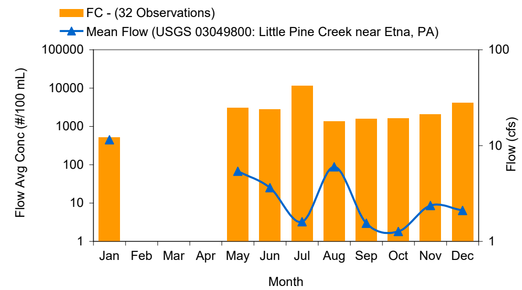
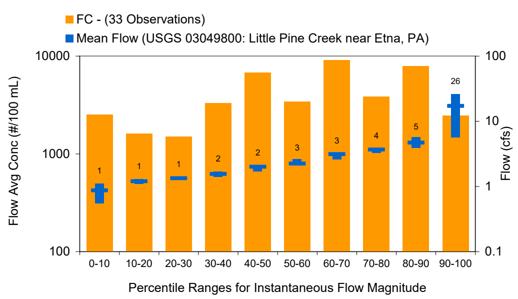


Figure A-14. Station 12 flow-loading analysis.

Location: Site 11
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	2528.06	375.00	6400.00
10-20	3	1.200	1.100	1.300	1600.69	625.00	2200.00
20-30	3	1.333	1.300	1.400	1503.72	505.00	2400.00
30-40	4	1.550	1.400	1.700	3289.68	1000.00	6600.00
40-50	3	2.000	1.900	2.100	6749.33	1040.00	16950.00
50-60	3	2.233	2.100	2.500	3407.46	900.00	8800.00
60-70	3	3.133	3.000	3.200	9029.11	1073.00	20000.00
70-80	3	3.667	3.400	3.800	3850.91	3500.00	4300.00
80-90	3	4.700	3.900	5.200	7936.16	605.00	21100.00
90-100	4	17.200	5.800	26.000	2458.20	864.00	9200.00



Location: Site 11
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	870.29	777.00	1073.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	5694.41	605.00	21100.00
June	4	3.625	1.700	5.800	6928.28	3800.00	9200.00
July	4	1.600	1.100	3.000	11248.44	2100.00	20000.00
August	5	5.990	0.550	22.000	2394.07	375.00	4300.00
September	4	1.508	0.830	2.500	1036.70	505.00	1683.00
October	3	1.267	1.000	1.400	2084.47	445.00	4200.00
November	3	2.367	1.300	3.800	6762.32	625.00	16950.00
December	2	2.100	2.100	2.100	5500.00	2200.00	8800.00

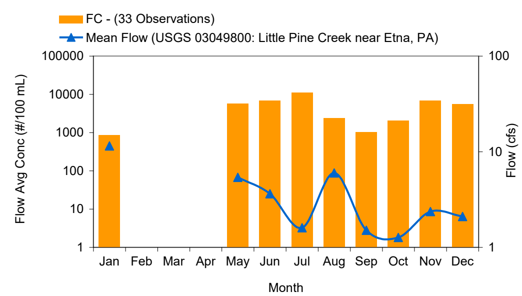
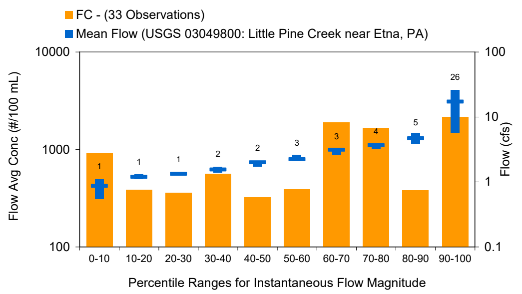


Figure A-15. Station 11 flow-loading analysis.

Location: Site 10
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	916.74	335.00	3500.00
10-20	3	1.200	1.100	1.300	387.50	160.00	595.00
20-30	3	1.333	1.300	1.400	358.25	250.00	485.00
30-40	4	1.550	1.400	1.700	563.47	75.00	900.00
40-50	3	2.000	1.900	2.100	322.58	205.00	550.00
50-60	3	2.233	2.100	2.500	388.16	270.00	580.00
60-70	3	3.133	3.000	3.200	1886.38	340.00	5100.00
70-80	3	3.667	3.400	3.800	1660.40	278.00	4100.00
80-90	3	4.700	3.900	5.200	380.33	110.00	760.00
90-100	4	17.200	5.800	26.000	2162.79	160.00	4900.00



Location: Site 10
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	185.51	160.00	340.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	508.61	75.00	760.00
June	4	3.625	1.700	5.800	2338.90	420.00	4800.00
July	4	1.600	1.100	3.000	2666.33	430.00	5100.00
August	5	5.990	0.550	22.000	4187.57	337.00	4900.00
September	4	1.508	0.830	2.500	354.19	270.00	485.00
October	3	1.267	1.000	1.400	589.21	335.00	900.00
November	3	2.367	1.300	3.800	242.87	160.00	278.00
December	2	2.100	2.100	2.100	392.50	205.00	580.00

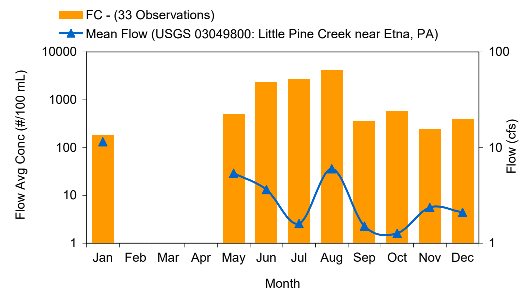
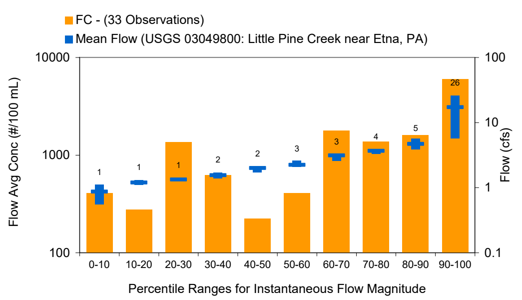


Figure A-16. Station 10 flow-loading analysis.

Location: Site 9
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	409.90	343.00	520.00
10-20	3	1.200	1.100	1.300	277.25	77.00	455.00
20-30	3	1.333	1.300	1.400	1363.88	170.00	3400.00
30-40	4	1.550	1.400	1.700	625.56	125.00	1020.00
40-50	3	2.000	1.900	2.100	223.50	145.00	335.00
50-60	3	2.233	2.100	2.500	409.60	313.00	470.00
60-70	3	3.133	3.000	3.200	1794.26	220.00	4950.00
70-80	3	3.667	3.400	3.800	1378.73	145.00	3600.00
80-90	3	4.700	3.900	5.200	1601.14	175.00	4100.00
90-100	4	17.200	5.800	26.000	5992.59	215.00	44000.00



Location: Site 9
Pollutant: FC
Data from: 11/13/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	223.48	215.00	268.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	1528.48	125.00	4100.00
June	4	3.625	1.700	5.800	17973.86	410.00	44000.00
July	4	1.600	1.100	3.000	2550.00	320.00	4950.00
August	5	5.990	0.550	22.000	4865.56	313.00	6000.00
September	4	1.508	0.830	2.500	1097.71	343.00	3400.00
October	3	1.267	1.000	1.400	608.42	380.00	920.00
November	3	2.367	1.300	3.800	148.04	77.00	200.00
December	2	2.100	2.100	2.100	307.50	145.00	470.00

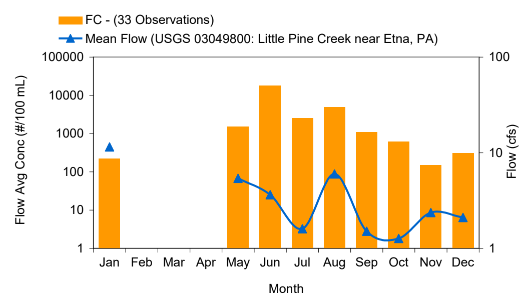
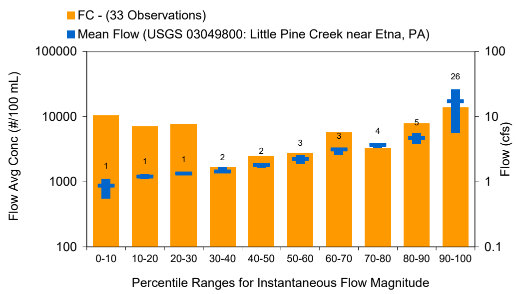


Figure A-17. Station 9 flow-loading analysis.

Location: Site 8
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	10469.25	3100.00	20000.00
10-20	3	1.200	1.100	1.300	7144.64	739.00	20000.00
20-30	3	1.333	1.300	1.400	7704.00	1120.00	20000.00
30-40	3	1.433	1.400	1.500	1677.09	645.00	3300.00
40-50	4	1.800	1.700	1.900	2524.78	636.00	5900.00
50-60	3	2.233	2.100	2.500	2790.30	338.00	6200.00
60-70	3	3.133	3.000	3.200	5799.40	3667.00	10100.00
70-80	3	3.667	3.400	3.800	3341.05	582.00	5600.00
80-90	3	4.700	3.900	5.200	7911.49	680.00	17100.00
90-100	4	17.200	5.800	26.000	13922.97	400.00	135000.00



Location: Site 8
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	1345.35	400.00	4500.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	3809.96	680.00	17100.00
June	4	3.625	1.700	5.800	56968.58	3667.00	135000.00
July	4	1.600	1.100	3.000	10321.88	2300.00	20000.00
August	5	5.990	0.550	22.000	6267.11	2400.00	7000.00
September	4	1.508	0.830	2.500	5435.82	338.00	20000.00
October	3	1.267	1.000	1.400	6906.32	1160.00	20000.00
November	3	2.333	1.300	3.800	625.81	582.00	739.00
December	2	1.800	1.500	2.100	1610.42	645.00	2300.00

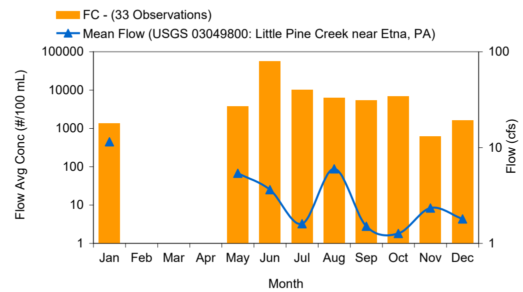
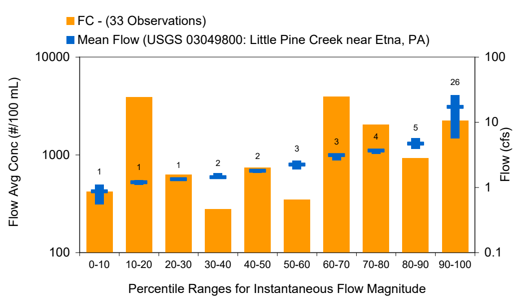


Figure A-18. Station 8 flow-loading analysis.

Location: Site 7
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	419.05	290.00	550.00
10-20	3	1.200	1.100	1.300	3910.56	400.00	9800.00
20-30	3	1.333	1.300	1.400	629.28	440.00	900.00
30-40	3	1.433	1.400	1.500	276.98	215.00	400.00
40-50	4	1.800	1.700	1.900	744.65	210.00	2000.00
50-60	3	2.233	2.100	2.500	347.03	308.00	400.00
60-70	3	3.133	3.000	3.200	3931.23	660.00	10800.00
70-80	3	3.667	3.400	3.800	2028.25	310.00	4700.00
80-90	3	4.700	3.900	5.200	930.09	97.00	2100.00
90-100	4	17.200	5.800	26.000	2230.20	213.00	7500.00



Location: Site 7
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	296.97	213.00	763.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	907.56	97.00	2100.00
June	4	3.625	1.700	5.800	3735.50	660.00	7500.00
July	4	1.600	1.100	3.000	5366.09	400.00	10800.00
August	5	5.990	0.550	22.000	3671.20	323.00	4700.00
September	4	1.508	0.830	2.500	532.97	400.00	900.00
October	3	1.267	1.000	1.400	302.89	215.00	400.00
November	3	2.333	1.300	3.800	2045.29	210.00	9800.00
December	2	1.800	1.500	2.100	271.33	220.00	308.00

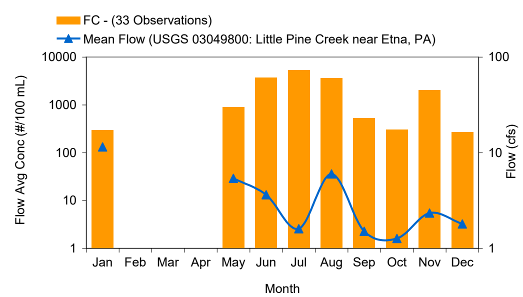
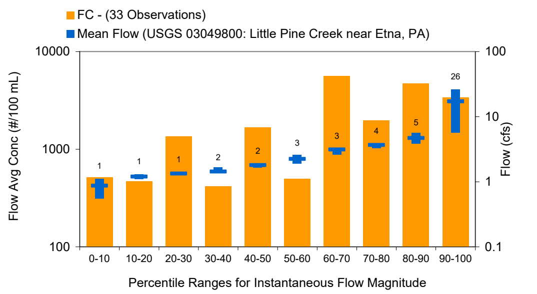


Figure A-19. Station 7 flow-loading analysis.

Location: Site 6
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	Count	Mean	Min	Max	Mean	Min	Max
0-10	4	0.870	0.550	1.100	514.63	280.00	780.00
10-20	3	1.200	1.100	1.300	470.83	360.00	570.00
20-30	3	1.333	1.300	1.400	1354.50	340.00	2700.00
30-40	3	1.433	1.400	1.500	418.37	210.00	700.00
40-50	4	1.800	1.700	1.900	1675.14	220.00	5500.00
50-60	3	2.233	2.100	2.500	496.21	363.00	671.00
60-70	3	3.133	3.000	3.200	5654.77	664.00	16050.00
70-80	3	3.667	3.400	3.800	1974.75	1369.00	2400.00
80-90	3	4.700	3.900	5.200	4722.22	243.00	12500.00
90-100	4	17.200	5.800	26.000	3398.98	655.00	8900.00



Location: Site 6
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	Count	Mean	Min	Max	Mean	Min	Max
January	3	11.467	3.200	26.000	647.98	603.00	664.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	3978.35	220.00	12500.00
June	4	3.625	1.700	5.800	4762.22	900.00	8900.00
July	4	1.600	1.100	3.000	7752.42	360.00	16050.00
August	5	5.990	0.550	22.000	4459.30	440.00	5600.00
September	4	1.508	0.830	2.500	958.03	340.00	2700.00
October	3	1.267	1.000	1.400	408.95	210.00	700.00
November	3	2.333	1.300	3.800	1514.57	570.00	2200.00
December	2	1.800	1.500	2.100	537.25	350.00	671.00

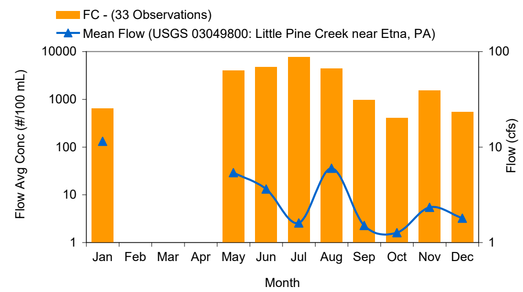
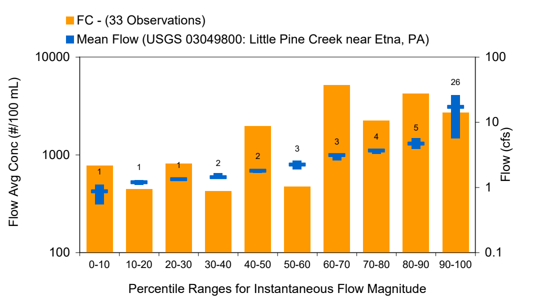


Figure A-20. Station 6 flow-loading analysis.

Location: Site 5
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	Count	Mean	Min	Max	Mean	Min	Max
0-10	4	0.870	0.550	1.100	771.49	293.00	1100.00
10-20	3	1.200	1.100	1.300	447.22	340.00	515.00
20-30	3	1.333	1.300	1.400	816.50	580.00	1200.00
30-40	3	1.433	1.400	1.500	425.58	155.00	820.00
40-50	4	1.800	1.700	1.900	1962.18	285.00	7100.00
50-60	3	2.233	2.100	2.500	473.24	330.00	642.00
60-70	3	3.133	3.000	3.200	5137.15	718.00	14250.00
70-80	3	3.667	3.400	3.800	2225.89	1160.00	4300.00
80-90	3	4.700	3.900	5.200	4225.18	170.00	11200.00
90-100	4	17.200	5.800	26.000	2712.06	580.00	7950.00



Location: Site 5
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	Count	Mean	Min	Max	Mean	Min	Max
January	3	11.467	3.200	26.000	589.81	560.00	718.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	3379.24	170.00	11200.00
June	4	3.625	1.700	5.800	4539.97	1013.00	7950.00
July	4	1.600	1.100	3.000	7051.25	500.00	14250.00
August	5	5.990	0.550	22.000	3643.56	380.00	4300.00
September	4	1.508	0.830	2.500	685.54	330.00	1200.00
October	3	1.267	1.000	1.400	436.32	155.00	820.00
November	3	2.333	1.300	3.800	964.29	340.00	1436.00
December	2	1.800	1.500	2.100	503.67	310.00	642.00

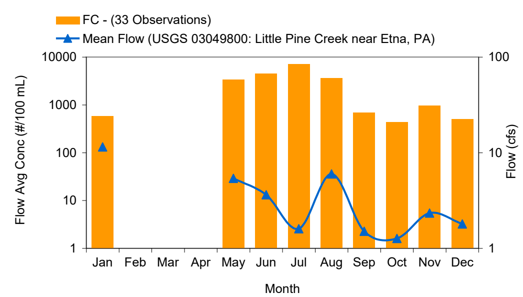
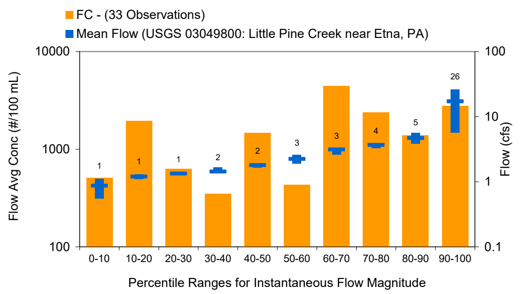


Figure A-21. Station 5 flow-loading analysis.

Location: Site 4
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	506.32	385.00	720.00
10-20	3	1.200	1.100	1.300	1950.56	640.00	4100.00
20-30	3	1.333	1.300	1.400	633.00	500.00	780.00
30-40	3	1.433	1.400	1.500	351.09	215.00	570.00
40-50	4	1.800	1.700	1.900	1476.25	240.00	3200.00
50-60	3	2.233	2.100	2.500	432.39	390.00	470.00
60-70	3	3.133	3.000	3.200	4451.49	745.00	12300.00
70-80	3	3.667	3.400	3.800	2389.31	648.00	4100.00
80-90	3	4.700	3.900	5.200	1394.83	89.00	3500.00
90-100	4	17.200	5.800	26.000	2766.10	288.00	6000.00



Location: Site 4
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	339.88	288.00	745.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	1447.92	89.00	3500.00
June	4	3.625	1.700	5.800	3393.10	800.00	5400.00
July	4	1.600	1.100	3.000	6131.41	590.00	12300.00
August	5	5.990	0.550	22.000	5042.40	430.00	6000.00
September	4	1.508	0.830	2.500	562.02	400.00	780.00
October	3	1.267	1.000	1.400	413.74	278.00	570.00
November	3	2.333	1.300	3.800	1178.34	240.00	4100.00
December	2	1.800	1.500	2.100	317.08	215.00	390.00

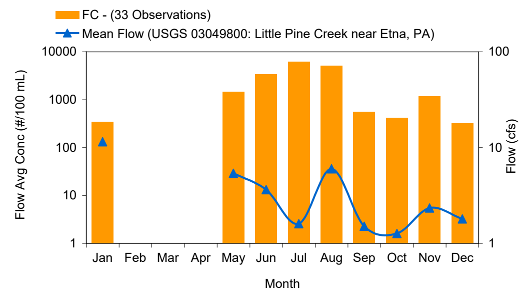
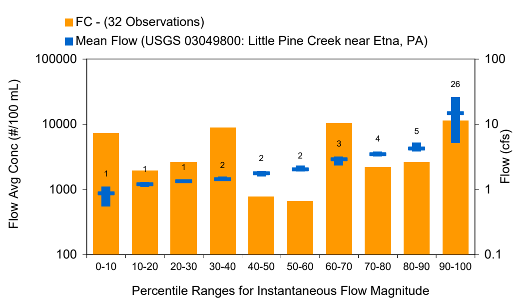


Figure A-22. Station 4 flow-loading analysis.

Location: Site 3
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (32 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	7347.13	550.00	13600.00
10-20	3	1.200	1.100	1.300	1941.47	940.00	3000.00
20-30	3	1.333	1.300	1.400	2615.50	640.00	4000.00
30-40	3	1.433	1.400	1.500	8828.49	295.00	21000.00
40-50	3	1.767	1.700	1.900	778.49	400.00	1440.00
50-60	3	2.033	1.900	2.100	661.10	357.00	1120.00
60-70	3	2.900	2.500	3.200	10415.68	927.00	20000.00
70-80	3	3.467	3.200	3.800	2184.69	716.00	5200.00
80-90	3	4.233	3.800	5.000	2605.31	125.00	5000.00
90-100	4	14.750	5.200	26.000	11461.97	280.00	33000.00



Location: Site 3
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (32 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	4587.86	280.00	5900.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	4	2.975	1.300	5.000	2288.87	125.00	5000.00
June	4	3.625	1.700	5.800	14052.97	725.00	33000.00
July	4	1.600	1.100	3.000	6460.05	550.00	12550.00
August	5	5.990	0.550	22.000	11762.37	550.00	15000.00
September	4	1.508	0.830	2.500	11554.39	3100.00	20000.00
October	3	1.267	1.000	1.400	13452.63	5800.00	21000.00
November	3	2.333	1.300	3.800	1054.40	400.00	3000.00
December	2	1.800	1.500	2.100	331.17	295.00	357.00

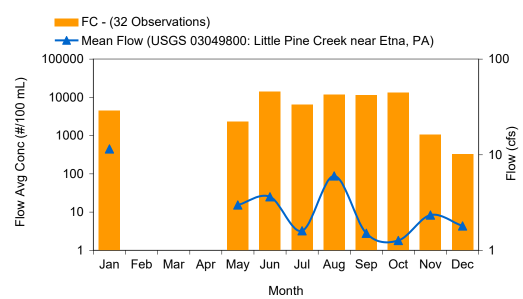
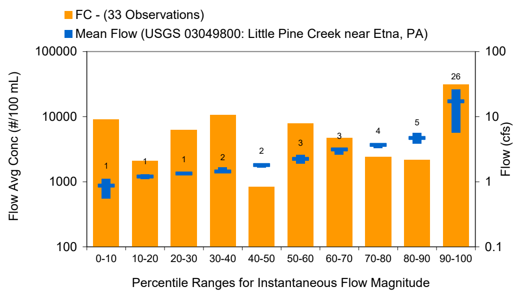


Figure A-23. Station 3 flow-loading analysis.

Location: Site 2
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	9072.37	980.00	17900.00
10-20	3	1.200	1.100	1.300	2087.72	920.00	3800.00
20-30	3	1.333	1.300	1.400	6328.50	780.00	10300.00
30-40	3	1.433	1.400	1.500	10760.98	218.00	25000.00
40-50	4	1.800	1.700	1.900	840.56	300.00	1600.00
50-60	3	2.233	2.100	2.500	7829.40	350.00	20000.00
60-70	3	3.133	3.000	3.200	4746.13	893.00	12900.00
70-80	3	3.667	3.400	3.800	2423.82	690.00	4500.00
80-90	3	4.700	3.900	5.200	2189.54	115.00	5700.00
90-100	4	17.200	5.800	26.000	31225.29	1300.00	102000.00



Location: Site 2
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	7098.26	370.00	9200.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	1866.56	115.00	5700.00
June	4	3.625	1.700	5.800	41787.42	893.00	102000.00
July	4	1.600	1.100	3.000	6617.78	920.00	12900.00
August	5	5.990	0.550	22.000	44012.45	820.00	59000.00
September	4	1.508	0.830	2.500	14785.57	7600.00	20000.00
October	3	1.267	1.000	1.400	15906.63	7818.00	25000.00
November	3	2.333	1.300	3.800	1161.71	300.00	3800.00
December	2	1.800	1.500	2.100	295.00	218.00	350.00

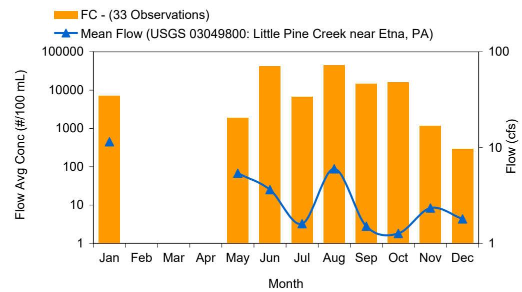
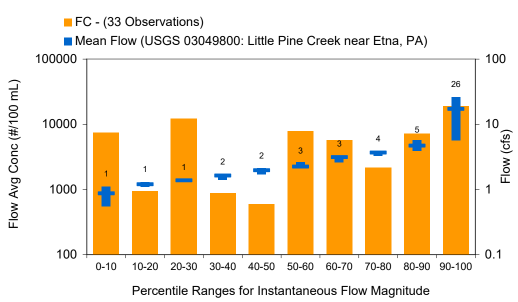


Figure A-24. Station 2 flow-loading analysis.

Location: Site 1
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Flow Range	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Percentile	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
0-10	4	0.870	0.550	1.100	7482.18	780.00	19000.00
10-20	3	1.200	1.100	1.300	937.69	720.00	1267.00
20-30	4	1.375	1.300	1.400	12124.18	4400.00	22000.00
30-40	3	1.633	1.500	1.700	869.08	255.00	1700.00
40-50	3	1.967	1.900	2.100	591.53	220.00	1020.00
50-60	3	2.233	2.100	2.500	7879.55	550.00	20000.00
60-70	3	3.133	3.000	3.200	5692.47	720.00	15750.00
70-80	3	3.667	3.400	3.800	2149.95	713.00	3700.00
80-90	3	4.700	3.900	5.200	7130.45	86.00	19500.00
90-100	4	17.200	5.800	26.000	19155.52	1500.00	104000.00



Location: Site 1
Pollutant: FC
Data from: 11/14/2006 to 10/17/2007 (33 Observations)

Time Period	# Obs	Flow (cfs)			Concentration (#/100 mL)		
Month	*Count*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
January	3	11.467	3.200	26.000	7524.98	520.00	9700.00
February	0	No Data	No Data	No Data	No Data	No Data	No Data
March	0	No Data	No Data	No Data	No Data	No Data	No Data
April	0	No Data	No Data	No Data	No Data	No Data	No Data
May	5	5.380	1.300	15.000	4551.65	86.00	19500.00
June	4	3.625	1.700	5.800	42534.76	720.00	104000.00
July	4	1.600	1.100	3.000	7869.64	720.00	15750.00
August	5	5.990	0.550	22.000	15270.98	780.00	20000.00
September	4	1.508	0.830	2.500	14641.79	4400.00	20000.00
October	3	1.267	1.000	1.400	13779.74	8200.00	22000.00
November	2	2.850	1.900	3.800	548.67	220.00	713.00
December	3	1.900	1.500	2.100	468.68	255.00	550.00

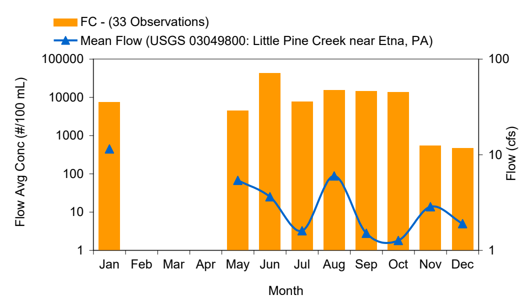


Figure A-25. Station 1 flow-loading analysis.

Appendix B. WATERSHED-SPECIFIC MODELED LAND USE TABLE

This table provides the land use distribution used by modeled watershed.

Modeled subwatershed	Modeled land use	Area (ac)
1	Water	0
1	Open Space Pervious	44.766662
1	LIR Pervious	44.08342
1	MIR Pervious	11.564484
1	HIR Pervious	0.677066
1	Forest	9.06873
1	Pasture	0
1	Cropland	0
1	Wetland	0
1	Open Space Impervious	2.356141
1	LIR Impervious	11.020855
1	MIR Impervious	6.22703
1	HIR Impervious	2.708264
2	Water	0
2	Open Space Pervious	0.492973
2	LIR Pervious	0
2	MIR Pervious	0.160618
2	HIR Pervious	0.706719
2	Forest	0
2	Pasture	0
2	Cropland	0
2	Wetland	0
2	Open Space Impervious	0
2	LIR Impervious	0
2	MIR Impervious	0
2	HIR Impervious	2.826874
3	Water	0
3	Open Space Pervious	1.549344
3	LIR Pervious	2.233824
3	MIR Pervious	3.196295
3	HIR Pervious	0.731429
3	Forest	2.149808
3	Pasture	0
3	Cropland	0
3	Wetland	0
3	Open Space Impervious	0
3	LIR Impervious	0.558456
3	MIR Impervious	1.721082
3	HIR Impervious	2.925716
4	Water	0
4	Open Space Pervious	0
4	LIR Pervious	0.652356
4	MIR Pervious	0.642471
4	HIR Pervious	0
4	Forest	0.247104

Modeled subwatershed	Modeled land use	Area (ac)
4	Pasture	0
4	Cropland	0
4	Wetland	0
4	Open Space Impervious	0
4	LIR Impervious	0.163089
4	MIR Impervious	0.25946
4	HIR Impervious	0
5	Water	0
5	Open Space Pervious	56.55107
5	LIR Pervious	36.729594
5	MIR Pervious	10.070738
5	HIR Pervious	0
5	Forest	74.699651
5	Pasture	0
5	Cropland	0
5	Wetland	0
5	Open Space Impervious	2.976373
5	LIR Impervious	9.182398
5	MIR Impervious	5.344868
5	HIR Impervious	0
6	Water	0
6	Open Space Pervious	1.267645
6	LIR Pervious	0.296525
6	MIR Pervious	0
6	HIR Pervious	0
6	Forest	0
6	Pasture	0
6	Cropland	0
6	Wetland	0
6	Open Space Impervious	0
6	LIR Impervious	0
6	MIR Impervious	0
6	HIR Impervious	0
7	Water	0
7	Open Space Pervious	3.638612
7	LIR Pervious	7.096838
7	MIR Pervious	4.770349
7	HIR Pervious	1.334364
7	Forest	28.960632
7	Pasture	0
7	Cropland	0
7	Wetland	0
7	Open Space Impervious	0.179151
7	LIR Impervious	1.774209
7	MIR Impervious	2.56865
7	HIR Impervious	5.337454
8	Water	0

Modeled subwatershed	Modeled land use	Area (ac)
8	Open Space Pervious	1.29112
8	LIR Pervious	0.494209
8	MIR Pervious	2.762627
8	HIR Pervious	0.138378
8	Forest	14.15908
8	Pasture	0
8	Cropland	0
8	Wetland	0
8	Open Space Impervious	0
8	LIR Impervious	0.123552
8	MIR Impervious	1.487568
8	HIR Impervious	0.553514
9	Water	0
9	Open Space Pervious	0.727722
9	LIR Pervious	0.909344
9	MIR Pervious	0.915522
9	HIR Pervious	0
9	Forest	0
9	Pasture	0
9	Cropland	0
9	Wetland	0
9	Open Space Impervious	0
9	LIR Impervious	0.227336
9	MIR Impervious	0.492973
9	HIR Impervious	0.316294
10	Water	0
10	Open Space Pervious	20.024102
10	LIR Pervious	37.797085
10	MIR Pervious	25.281247
10	HIR Pervious	3.29143
10	Forest	22.461787
10	Pasture	0
10	Cropland	0
10	Wetland	0
10	Open Space Impervious	1.0539
10	LIR Impervious	9.394908
10	MIR Impervious	13.612979
10	HIR Impervious	13.165721
11	Water	0
11	Open Space Pervious	302.990725
11	LIR Pervious	393.745992
11	MIR Pervious	61.291765
11	HIR Pervious	12.617149
11	Forest	414.715263
11	Pasture	6.844791
11	Cropland	0
11	Wetland	0

Modeled subwatershed	Modeled land use	Area (ac)
11	Open Space Impervious	15.929583
11	LIR Impervious	98.357425
11	MIR Impervious	33.003259
11	HIR Impervious	50.468597
12	Water	0
12	Open Space Pervious	81.833553
12	LIR Pervious	59.641111
12	MIR Pervious	9.990429
12	HIR Pervious	2.989963
12	Forest	54.214699
12	Pasture	8.945178
12	Cropland	0
12	Wetland	0
12	Open Space Impervious	4.307029
12	LIR Impervious	14.910278
12	MIR Impervious	5.379462
12	HIR Impervious	11.959852
13	Water	0
13	Open Space Pervious	561.496488
13	LIR Pervious	586.823465
13	MIR Pervious	60.906283
13	HIR Pervious	5.238613
13	Forest	387.95386
13	Pasture	10.403094
13	Cropland	9.63707
13	Wetland	0
13	Open Space Impervious	29.552448
13	LIR Impervious	146.705866
13	MIR Impervious	32.795692
13	HIR Impervious	20.95445
14	Water	0
14	Open Space Pervious	51.175314
14	LIR Pervious	53.512923
14	MIR Pervious	4.722164
14	HIR Pervious	0
14	Forest	2.174518
14	Pasture	0
14	Cropland	0
14	Wetland	0
14	Open Space Impervious	2.693438
14	LIR Impervious	13.378231
14	MIR Impervious	2.542704
14	HIR Impervious	0
15	Water	0
15	Open Space Pervious	183.456459
15	LIR Pervious	92.891476
15	MIR Pervious	8.930352

Modeled subwatershed	Modeled land use	Area (ac)
15	HIR Pervious	0
15	Forest	200.451064
15	Pasture	4.225485
15	Cropland	0
15	Wetland	0
15	Open Space Impervious	9.655603
15	LIR Impervious	23.222869
15	MIR Impervious	4.808651
15	HIR Impervious	0
16	Water	1.334364
16	Open Space Pervious	50.588441
16	LIR Pervious	24.868584
16	MIR Pervious	3.24448
16	HIR Pervious	0
16	Forest	63.011614
16	Pasture	0
16	Cropland	0
16	Wetland	1.11197
16	Open Space Impervious	2.66255
16	LIR Impervious	6.217146
16	MIR Impervious	1.747028
16	HIR Impervious	0
17	Water	0
17	Open Space Pervious	10.93931
17	LIR Pervious	5.139771
17	MIR Pervious	1.060078
17	HIR Pervious	0
17	Forest	24.586885
17	Pasture	0
17	Cropland	0
17	Wetland	0
17	Open Space Impervious	0.575753
17	LIR Impervious	1.284943
17	MIR Impervious	0.570811
17	HIR Impervious	0
18	Water	0
18	Open Space Pervious	95.754177
18	LIR Pervious	25.165109
18	MIR Pervious	3.389036
18	HIR Pervious	0
18	Forest	270.208628
18	Pasture	5.040929
18	Cropland	0
18	Wetland	0
18	Open Space Impervious	5.039694
18	LIR Impervious	6.291277
18	MIR Impervious	1.824866

Modeled subwatershed	Modeled land use	Area (ac)
18	HIR Impervious	0.158147
19	Water	0
19	Open Space Pervious	23.263641
19	LIR Pervious	8.678306
19	MIR Pervious	7.38842
19	HIR Pervious	1.709962
19	Forest	4.176064
19	Pasture	0
19	Cropland	0
19	Wetland	0
19	Open Space Impervious	1.224402
19	LIR Impervious	2.169576
19	MIR Impervious	3.97838
19	HIR Impervious	6.839849
20	Water	0
20	Open Space Pervious	27.4187
20	LIR Pervious	6.503787
20	MIR Pervious	4.866721
20	HIR Pervious	1.077375
20	Forest	45.81315
20	Pasture	2.471044
20	Cropland	0
20	Wetland	0
20	Open Space Impervious	1.44309
20	LIR Impervious	1.625947
20	MIR Impervious	2.620542
20	HIR Impervious	4.3095
21	Water	0
21	Open Space Pervious	85.073091
21	LIR Pervious	69.465982
21	MIR Pervious	8.143324
21	HIR Pervious	0.830271
21	Forest	287.654197
21	Pasture	8.055602
21	Cropland	0
21	Wetland	0
21	Open Space Impervious	4.477531
21	LIR Impervious	17.366496
21	MIR Impervious	4.384867
21	HIR Impervious	3.321083
22	Water	78.65332
22	Open Space Pervious	627.014974
22	LIR Pervious	157.375832
22	MIR Pervious	13.909504
22	HIR Pervious	0.523861
22	Forest	1563.948265
22	Pasture	60.293466

Modeled subwatershed	Modeled land use	Area (ac)
22	Cropland	27.650979
22	Wetland	16.234757
22	Open Space Impervious	32.925422
22	LIR Impervious	39.343958
22	MIR Impervious	7.489733
22	HIR Impervious	2.095445
23	Water	0
23	Open Space Pervious	557.036253
23	LIR Pervious	418.001757
23	MIR Pervious	66.319104
23	HIR Pervious	8.964947
23	Forest	443.898288
23	Pasture	26.514299
23	Cropland	12.083405
23	Wetland	0
23	Open Space Impervious	29.317697
23	LIR Impervious	104.475729
23	MIR Impervious	35.710287
23	HIR Impervious	35.978397
24	Water	0
24	Open Space Pervious	224.420186
24	LIR Pervious	149.923166
24	MIR Pervious	30.276462
24	HIR Pervious	3.207415
24	Forest	257.3592
24	Pasture	6.745949
24	Cropland	0
24	Wetland	0
24	Open Space Impervious	11.811589
24	LIR Impervious	37.480791
24	MIR Impervious	16.30271
24	HIR Impervious	12.829659
25	Water	0
25	Open Space Pervious	68.265052
25	LIR Pervious	34.416697
25	MIR Pervious	0.72278
25	HIR Pervious	0
25	Forest	70.029378
25	Pasture	4.225485
25	Cropland	0
25	Wetland	0
25	Open Space Impervious	3.592898
25	LIR Impervious	8.604174
25	MIR Impervious	0.389189
25	HIR Impervious	0
26	Water	0
26	Open Space Pervious	706.876634

Modeled subwatershed	Modeled land use	Area (ac)
26	LIR Pervious	354.96049
26	MIR Pervious	31.352601
26	HIR Pervious	1.250348
26	Forest	461.665093
26	Pasture	30.072602
26	Cropland	65.210843
26	Wetland	0
26	Open Space Impervious	37.094073
26	LIR Impervious	88.740124
26	MIR Impervious	16.88217
26	HIR Impervious	5.357223
101	Water	0
101	Open Space Pervious	8.756143
101	LIR Pervious	3.242009
101	MIR Pervious	0
101	HIR Pervious	0
101	Forest	5.510427
101	Pasture	0
101	Cropland	0
101	Wetland	0
101	Open Space Impervious	0.385483
101	LIR Impervious	0.810502
101	MIR Impervious	0
101	HIR Impervious	0
102	Water	0
102	Open Space Pervious	14.272748
102	LIR Pervious	9.192282
102	MIR Pervious	1.108263
102	HIR Pervious	0
102	Forest	23.227811
102	Pasture	0.716603
102	Cropland	0
102	Wetland	0
102	Open Space Impervious	0.751197
102	LIR Impervious	2.298071
102	MIR Impervious	0.596757
102	HIR Impervious	0
103	Water	0
103	Open Space Pervious	315.174205
103	LIR Pervious	439.628331
103	MIR Pervious	49.775467
103	HIR Pervious	2.826874
103	Forest	272.630251
103	Pasture	3.187646
103	Cropland	0
103	Wetland	0
103	Open Space Impervious	16.580703

Modeled subwatershed	Modeled land use	Area (ac)
103	LIR Impervious	109.907083
103	MIR Impervious	26.802175
103	HIR Impervious	11.307496
104	Water	0
104	Open Space Pervious	227.3076
104	LIR Pervious	251.196421
104	MIR Pervious	9.990429
104	HIR Pervious	5.278149
104	Forest	128.518983
104	Pasture	8.006182
104	Cropland	0
104	Wetland	0
104	Open Space Impervious	11.963559
104	LIR Impervious	62.720032
104	MIR Impervious	5.379462
104	HIR Impervious	21.112598
105	Water	0
105	Open Space Pervious	454.709099
105	LIR Pervious	530.799961
105	MIR Pervious	53.999715
105	HIR Pervious	5.915678
105	Forest	125.03481
105	Pasture	19.125878
105	Cropland	0
105	Wetland	0
105	Open Space Impervious	23.932058
105	LIR Impervious	132.699991
105	MIR Impervious	29.076771
105	HIR Impervious	23.662715
106	Water	0
106	Open Space Pervious	224.420185
106	LIR Pervious	231.032704
106	MIR Pervious	77.963897
106	HIR Pervious	5.115061
106	Forest	166.721318
106	Pasture	24.389201
106	Cropland	0
106	Wetland	0
106	Open Space Impervious	11.811589
106	LIR Impervious	57.758176
106	MIR Impervious	41.980561
106	HIR Impervious	20.460242
201	Water	0
201	Open Space Pervious	52.536859
201	LIR Pervious	22.476614
201	MIR Pervious	4.930968
201	HIR Pervious	0.548572

Modeled subwatershed	Modeled land use	Area (ac)
201	Forest	150.115904
201	Pasture	0
201	Cropland	0
201	Wetland	0
201	Open Space Impervious	2.765098
201	LIR Impervious	5.619154
201	MIR Impervious	2.655136
201	HIR Impervious	2.194287
202	Water	0
202	Open Space Pervious	199.231601
202	LIR Pervious	86.585372
202	MIR Pervious	5.123709
202	HIR Pervious	0
202	Forest	614.647408
202	Pasture	14.257922
202	Cropland	6.004636
202	Wetland	0
202	Open Space Impervious	10.485874
202	LIR Impervious	21.646343
202	MIR Impervious	2.75892
202	HIR Impervious	0
203	Water	0
203	Open Space Pervious	63.38227
203	LIR Pervious	18.740396
203	MIR Pervious	1.879229
203	HIR Pervious	0
203	Forest	140.034046
203	Pasture	7.759078
203	Cropland	6.647108
203	Wetland	0
203	Open Space Impervious	3.335909
203	LIR Impervious	4.685098
203	MIR Impervious	1.011892
203	HIR Impervious	0
204	Water	0
204	Open Space Pervious	392.4771
204	LIR Pervious	123.374271
204	MIR Pervious	20.269971
204	HIR Pervious	1.759383
204	Forest	1642.280349
204	Pasture	125.306626
204	Cropland	75.984593
204	Wetland	0
204	Open Space Impervious	20.656691
204	LIR Impervious	30.843568
204	MIR Impervious	10.9146
204	HIR Impervious	7.037533

Modeled subwatershed	Modeled land use	Area (ac)
301	Water	0
301	Open Space Pervious	160.028494
301	LIR Pervious	85.359735
301	MIR Pervious	9.396143
301	HIR Pervious	0.222394
301	Forest	83.076489
301	Pasture	0
301	Cropland	8.154444
301	Wetland	0
301	Open Space Impervious	8.422553
301	LIR Impervious	21.339934
301	MIR Impervious	5.059462
301	HIR Impervious	0.889576
302	Water	0
302	Open Space Pervious	220.33555
302	LIR Pervious	89.906455
302	MIR Pervious	14.487729
302	HIR Pervious	0.518919
302	Forest	230.301272
302	Pasture	17.593831
302	Cropland	0
302	Wetland	0
302	Open Space Impervious	11.596608
302	LIR Impervious	22.476614
302	MIR Impervious	7.801085
302	HIR Impervious	2.075677
303	Water	0
303	Open Space Pervious	19.507654
303	LIR Pervious	10.378384
303	MIR Pervious	3.919075
303	HIR Pervious	0
303	Forest	34.817006
303	Pasture	0
303	Cropland	0
303	Wetland	0
303	Open Space Impervious	1.026719
303	LIR Impervious	2.594596
303	MIR Impervious	2.110271
303	HIR Impervious	0
304	Water	0
304	Open Space Pervious	252.284909
304	LIR Pervious	76.503514
304	MIR Pervious	6.93869
304	HIR Pervious	1.260232
304	Forest	357.9801
304	Pasture	37.708127
304	Cropland	10.501936

Modeled subwatershed	Modeled land use	Area (ac)
304	Wetland	0
304	Open Space Impervious	13.278153
304	LIR Impervious	19.125878
304	MIR Impervious	3.736218
304	HIR Impervious	5.040929
305	Water	0
305	Open Space Pervious	345.433371
305	LIR Pervious	66.698412
305	MIR Pervious	3.276604
305	HIR Pervious	0
305	Forest	251.033329
305	Pasture	20.534373
305	Cropland	13.047111
305	Wetland	0
305	Open Space Impervious	18.180704
305	LIR Impervious	16.674603
305	MIR Impervious	1.764325
305	HIR Impervious	0
401	Water	0
401	Open Space Pervious	233.974476
401	LIR Pervious	134.444548
401	MIR Pervious	5.814365
401	HIR Pervious	0.444788
401	Forest	89.847149
401	Pasture	1.087259
401	Cropland	0
401	Wetland	0
401	Open Space Impervious	12.314446
401	LIR Impervious	33.611136
401	MIR Impervious	3.130812
401	HIR Impervious	1.779151
501	Water	0
501	Open Space Pervious	939.301765
501	LIR Pervious	379.710464
501	MIR Pervious	130.05226
501	HIR Pervious	33.581484
501	Forest	927.827486
501	Pasture	22.313525
501	Cropland	4.670273
501	Wetland	0
501	Open Space Impervious	49.436937
501	LIR Impervious	94.927616
501	MIR Impervious	70.028142
501	HIR Impervious	134.325937
601	Water	0
601	Open Space Pervious	193.128125
601	LIR Pervious	104.475729

Modeled subwatershed	Modeled land use	Area (ac)
601	MIR Pervious	19.691747
601	HIR Pervious	2.120155
601	Forest	255.357656
601	Pasture	1.581468
601	Cropland	5.559848
601	Wetland	0
601	Open Space Impervious	10.164639
601	LIR Impervious	26.118932
601	MIR Impervious	10.603248
601	HIR Impervious	8.480623
701	Water	0
701	Open Space Pervious	597.460057
701	LIR Pervious	133.258446
701	MIR Pervious	22.871979
701	HIR Pervious	0.746255
701	Forest	615.487563
701	Pasture	2.81699
701	Cropland	1.037838
701	Wetland	0
701	Open Space Impervious	31.445267
701	LIR Impervious	33.314612
701	MIR Impervious	12.315682
701	HIR Impervious	2.985021
702	Water	0
702	Open Space Pervious	248.575873
702	LIR Pervious	50.765123
702	MIR Pervious	6.66564
702	HIR Pervious	0
702	Forest	516.34929
702	Pasture	17.717384
702	Cropland	17.569121
702	Wetland	0
702	Open Space Impervious	13.082941
702	LIR Impervious	12.69128
702	MIR Impervious	3.589191
702	HIR Impervious	0
703	Water	0
703	Open Space Pervious	281.863302
703	LIR Pervious	34.159709
703	MIR Pervious	2.457453
703	HIR Pervious	0
703	Forest	142.851036
703	Pasture	7.042475
703	Cropland	0
703	Wetland	0
703	Open Space Impervious	14.834911
703	LIR Impervious	8.539927

Modeled subwatershed	Modeled land use	Area (ac)
703	MIR Impervious	1.323244
703	HIR Impervious	0
801	Water	2.668727
801	Open Space Pervious	360.973764
801	LIR Pervious	98.426613
801	MIR Pervious	14.712593
801	HIR Pervious	0
801	Forest	857.92166
801	Pasture	16.012363
801	Cropland	13.195374
801	Wetland	0
801	Open Space Impervious	18.99862
801	LIR Impervious	24.606654
801	MIR Impervious	7.922166
801	HIR Impervious	0
802	Water	0
802	Open Space Pervious	306.277213
802	LIR Pervious	52.781494
802	MIR Pervious	9.155217
802	HIR Pervious	0
802	Forest	787.150968
802	Pasture	51.397709
802	Cropland	23.845572
802	Wetland	0
802	Open Space Impervious	16.039545
802	LIR Impervious	13.150895
802	MIR Impervious	4.929732
802	HIR Impervious	0
803	Water	1.334364
803	Open Space Pervious	69.673547
803	LIR Pervious	17.020549
803	MIR Pervious	2.120155
803	HIR Pervious	0
803	Forest	534.041963
803	Pasture	66.248681
803	Cropland	45.986123
803	Wetland	0
803	Open Space Impervious	3.667029
803	LIR Impervious	4.255137
803	MIR Impervious	1.141622
803	HIR Impervious	0
901	Water	0
901	Open Space Pervious	106.012715
901	LIR Pervious	37.579633
901	MIR Pervious	1.847105
901	HIR Pervious	0
901	Forest	420.892872

Modeled subwatershed	Modeled land use	Area (ac)
901	Pasture	23.054838
901	Cropland	23.153679
901	Wetland	0
901	Open Space Impervious	5.542551
901	LIR Impervious	9.315835
901	MIR Impervious	0.994595
901	HIR Impervious	0.375599
902	Water	0
902	Open Space Pervious	436.609939
902	LIR Pervious	120.211335
902	MIR Pervious	36.122951
902	HIR Pervious	3.701623
902	Forest	641.606494
902	Pasture	42.180715
902	Cropland	20.732057
902	Wetland	0
902	Open Space Impervious	22.94117
902	LIR Impervious	30.052834
902	MIR Impervious	19.45082
902	HIR Impervious	14.806494
903	Water	9.118152
903	Open Space Pervious	585.323525
903	LIR Pervious	214.763352
903	MIR Pervious	32.412679
903	HIR Pervious	1.818688
903	Forest	1457.075624
903	Pasture	129.828636
903	Cropland	58.588446
903	Wetland	0
903	Open Space Impervious	30.806502
903	LIR Impervious	53.690838
903	MIR Impervious	17.452981
903	HIR Impervious	7.274753
1001	Water	0
1001	Open Space Pervious	242.425444
1001	LIR Pervious	167.912364
1001	MIR Pervious	32.364494
1001	HIR Pervious	9.241704
1001	Forest	403.719118
1001	Pasture	31.184571
1001	Cropland	5.559849
1001	Wetland	0
1001	Open Space Impervious	12.693752
1001	LIR Impervious	41.978091
1001	MIR Impervious	17.427035
1001	HIR Impervious	36.966815
1101	Water	0

Modeled subwatershed	Modeled land use	Area (ac)
1101	Open Space Pervious	67.49038
1101	LIR Pervious	26.410515
1101	MIR Pervious	12.560315
1101	HIR Pervious	2.466102
1101	Forest	43.292685
1101	Pasture	0
1101	Cropland	0
1101	Wetland	0
1101	Open Space Impervious	3.552125
1101	LIR Impervious	6.602629
1101	MIR Impervious	6.763246
1101	HIR Impervious	9.864407
1102	Water	0
1102	Open Space Pervious	419.097654
1102	LIR Pervious	239.315644
1102	MIR Pervious	70.752155
1102	HIR Pervious	7.783788
1102	Forest	300.997832
1102	Pasture	30.739784
1102	Cropland	14.233212
1102	Wetland	0
1102	Open Space Impervious	22.057772
1102	LIR Impervious	59.828911
1102	MIR Impervious	38.097315
1102	HIR Impervious	31.13515
1201	Water	1.11197
1201	Open Space Pervious	549.782504
1201	LIR Pervious	327.344104
1201	MIR Pervious	25.088505
1201	HIR Pervious	1.398611
1201	Forest	474.811045
1201	Pasture	12.355218
1201	Cropland	5.164481
1201	Wetland	0
1201	Open Space Impervious	28.874146
1201	LIR Impervious	81.776721
1201	MIR Impervious	13.509196
1201	HIR Impervious	5.594443
9001	Water	0
9001	Open Space Pervious	31.855459
9001	LIR Pervious	30.443259
9001	MIR Pervious	23.241401
9001	HIR Pervious	3.657145
9001	Forest	9.167572
9001	Pasture	0
9001	Cropland	0
9001	Wetland	0

Modeled subwatershed	Modeled land use	Area (ac)
9001	Open Space Impervious	1.676603
9001	LIR Impervious	7.610815
9001	MIR Impervious	12.514601
9001	HIR Impervious	14.628579
9002	Water	0
9002	Open Space Pervious	0.469498
9002	LIR Pervious	1.047723
9002	MIR Pervious	0.706718
9002	HIR Pervious	0
9002	Forest	0
9002	Pasture	0
9002	Cropland	0
9002	Wetland	0
9002	Open Space Impervious	0
9002	LIR Impervious	0.261931
9002	MIR Impervious	0.380541
9002	HIR Impervious	0.375599
9003	Water	0
9003	Open Space Pervious	0
9003	LIR Pervious	0.158147
9003	MIR Pervious	0.963707
9003	HIR Pervious	0.276757
9003	Forest	0
9003	Pasture	0
9003	Cropland	0
9003	Wetland	0
9003	Open Space Impervious	0
9003	LIR Impervious	0
9003	MIR Impervious	0.518919
9003	HIR Impervious	1.107028
9004	Water	0
9004	Open Space Pervious	0
9004	LIR Pervious	0
9004	MIR Pervious	1.092201
9004	HIR Pervious	0.47444
9004	Forest	0
9004	Pasture	0
9004	Cropland	0
9004	Wetland	0
9004	Open Space Impervious	0
9004	LIR Impervious	0
9004	MIR Impervious	0.588108
9004	HIR Impervious	1.897762
9005	Water	0
9005	Open Space Pervious	4.295909
9005	LIR Pervious	15.755375
9005	MIR Pervious	21.892211

Modeled subwatershed	Modeled land use	Area (ac)
9005	HIR Pervious	6.612513
9005	Forest	4.077222
9005	Pasture	0
9005	Cropland	0
9005	Wetland	0
9005	Open Space Impervious	0.226101
9005	LIR Impervious	3.938844
9005	MIR Impervious	11.788114
9005	HIR Impervious	26.450052
9006	Water	0
9006	Open Space Pervious	0.868572
9006	LIR Pervious	2.075677
9006	MIR Pervious	2.585947
9006	HIR Pervious	0.92417
9006	Forest	0
9006	Pasture	0
9006	Cropland	0
9006	Wetland	0
9006	Open Space Impervious	0
9006	LIR Impervious	0.518919
9006	MIR Impervious	1.392433
9006	HIR Impervious	3.696681
9007	Water	0
9007	Open Space Pervious	8.450969
9007	LIR Pervious	12.968037
9007	MIR Pervious	12.239079
9007	HIR Pervious	1.270116
9007	Forest	2.050966
9007	Pasture	0
9007	Cropland	0
9007	Wetland	0
9007	Open Space Impervious	0.444788
9007	LIR Impervious	3.242009
9007	MIR Impervious	6.590273
9007	HIR Impervious	5.080466
9010	Water	0
9010	Open Space Pervious	0
9010	LIR Pervious	0.395367
9010	MIR Pervious	3.886952
9010	HIR Pervious	0
9010	Forest	0
9010	Pasture	0
9010	Cropland	0
9010	Wetland	0
9010	Open Space Impervious	0
9010	LIR Impervious	0
9010	MIR Impervious	2.092974

Modeled subwatershed	Modeled land use	Area (ac)
9010	HIR Impervious	0
9101	Water	0
9101	Open Space Pervious	0.657298
9101	LIR Pervious	1.779151
9101	MIR Pervious	1.911352
9101	HIR Pervious	0.311352
9101	Forest	0
9101	Pasture	0
9101	Cropland	0
9101	Wetland	0
9101	Open Space Impervious	0
9101	LIR Impervious	0.444788
9101	MIR Impervious	1.02919
9101	HIR Impervious	1.245406
9102	Water	0
9102	Open Space Pervious	9.272591
9102	LIR Pervious	9.923712
9102	MIR Pervious	15.258694
9102	HIR Pervious	0.301467
9102	Forest	0.938997
9102	Pasture	0.197683
9102	Cropland	0
9102	Wetland	0
9102	Open Space Impervious	0.488031
9102	LIR Impervious	2.480928
9102	MIR Impervious	8.21622
9102	HIR Impervious	1.205869
9103	Water	0
9103	Open Space Pervious	0
9103	LIR Pervious	0.11861
9103	MIR Pervious	0
9103	HIR Pervious	0
9103	Forest	0
9103	Pasture	0
9103	Cropland	0
9103	Wetland	0
9103	Open Space Impervious	0
9103	LIR Impervious	0
9103	MIR Impervious	0
9103	HIR Impervious	0

Appendix C. ANIMAL-BASED ACCUMULATION RATE CALCULATIONS

Table C-1. References and conversions used in estimating contributions from animals in the Pine Creek watershed. This table expands on the information presented in Table 5-5, and the resulting application to modeled land use groups shown in Figure 5-6.

	Pasture	cropland	forest	wetland	open space	LIR	MIR	HIR	Water- NPL	Pasture- NPL	cropland- NPL	forest- NPL	wetland- NPL	open space- NPL	LIR- NPL	MIR- NPL	HIR- NPL	FC loading rate applied per acre (#/ac/day) [to each assigned LU]	Animal Population in Allegheny Co. (inventory; from 2007 Ag Census)	Allegheny Co. Farms (ac; from 2007 Ag Census)	Allegheny Co. Cropland (ac; from 2007 Ag Census)	Pasture acreage (ac; from 2007 Ag Census)	Animal density (#/mi2)	Animal density (#/ac)	FC loading rate per animal (NCSU, 1994; #/day)	FC loading rate per animal (BPJ; #/day)	FC loading rate per animal (LIRPB, 1978; #/day)	FC loading rate per acre (#/ac/day)	Confineme nt/ in stream factor (%)	FC l rate per (#/ac e assig
Beef cow	x									x								1.26E+10	1096	38023	18397	9213		0.1190	1.06E+11			1.26E+10	100%	1.2
Hog	x									x								1.79E+08	133	38023	18397	9213		0.0144	1.24E+10			1.79E+08	100%	1.7
Sheep	x									x								7.95E+08	603	38023	18397	9213		0.0655	1.22E+10			7.95E+08	100%	7.9
Horse	x									x								5.47E+06	1206	38023	18397	9213		0.1309	4.18E+08			5.47E+07	10%	5.4
Deer	x	x	x	x	x	x	x			x	x	x	x	x	x	x		3.59E+07					46	0.0719		5.00E+08		3.59E+07	100%	3.5
Chicken	x									x								4.09E+07	2732	38023	18397	9213		0.2965	1.38E+08			4.09E+07	100%	4.0
Turkey	x		x		x					x		x		x				2.29E+06					16.4	0.0256	8.93E+07			2.29E+06	100%	2.2
Duck (in streams)[1]																									2.43E+09				10%	
Goose				x														3.45E+08					4.5	0.0070			4.90E+10	3.45E+08	100%	3.4
Goose (NPL)										x	x	x	x	x	x	x	x	9.58E+09					139.1	0.2173			4.90E+10	1.06E+10	90%	9.5
Beaver			x	x								x	x					1.95E+06					5	0.0078		2.50E+08		1.95E+06	100%	1.9
Raccoon	x		x	x	x					x		x	x	x				1.95E+06					10	0.0156		1.25E+08		1.95E+06	100%	1.9
Domestic Pets (Dogs, cats)						x	x	x							x	x	x	2.56E+09						0.6597			4.09E+09	2.70E+09	95%	2.5
Area (ac):	818	438	15758	1	12434	8426	1722	712	79	91	34	1653	16	653	111	44	20													

[1] Duck contributions were added directly to modeled stream segments, and not to the land surface.

NPL = North Park Lake areas

LIR = Low Intensity Residential

MIR = Medium Intensity Residential

HIR = High Intensity Residential

Appendix D. HYDROLOGY CALIBRATION RESULTS

Key considerations in the hydrology calibration included the overall water balance, high-flow and low-flow distribution, storm flow volumes and timing, and seasonal variation. At least three criteria for goodness of fit were used for calibration: volumetric comparison, graphical comparison, and the relative error method. Calculating runoff volumes at various time scales (e.g., daily, monthly) provides an assessment of the model's ability to accurately simulate the water budget. The model calibration was performed using the guidance of error statistics criteria specified in HSPEXP (Lumb et al. 1994). The complete hydrology calibration results are in Appendix D.

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Short Form (Printer View)

Quick Navigator

Long

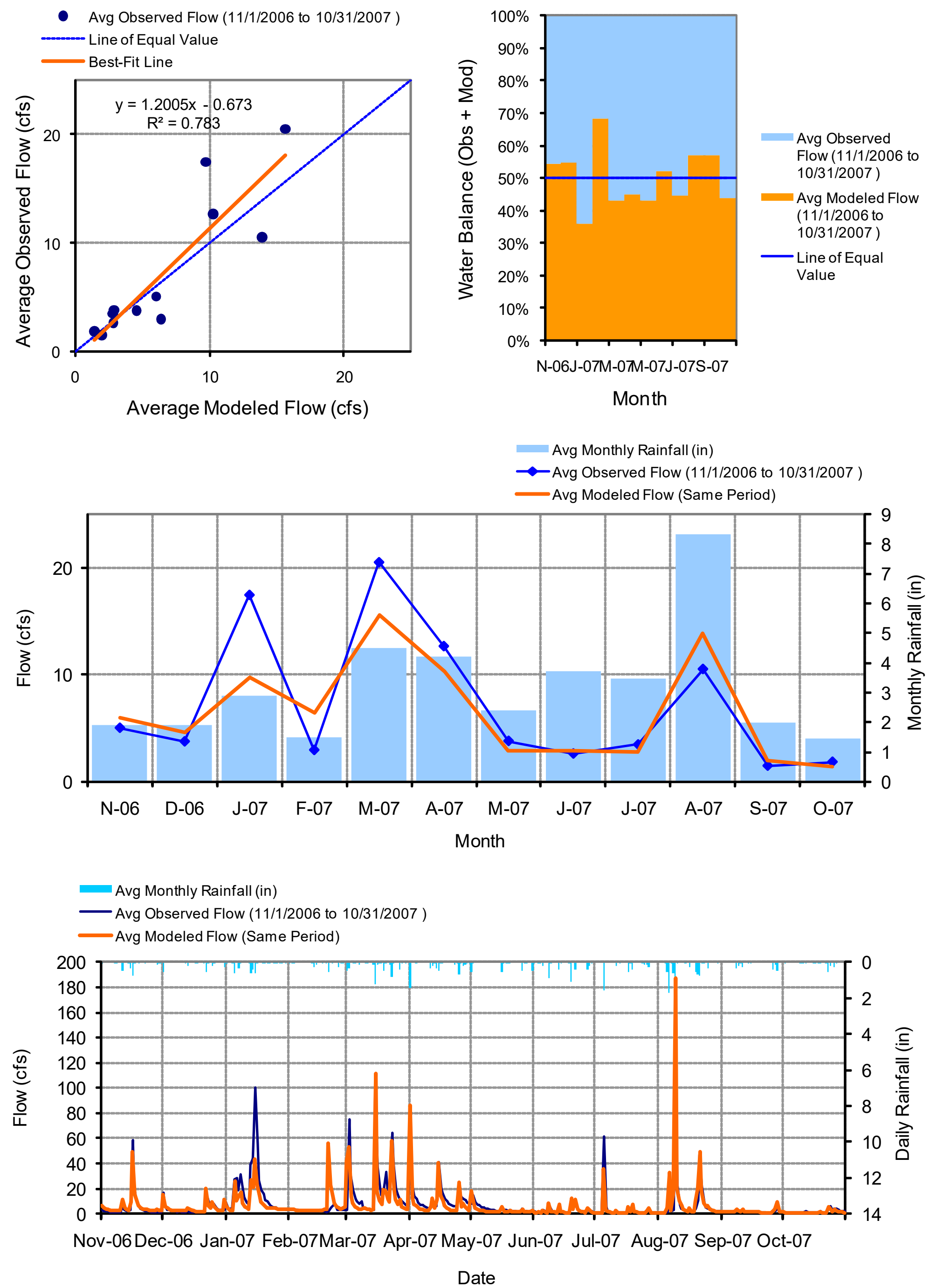
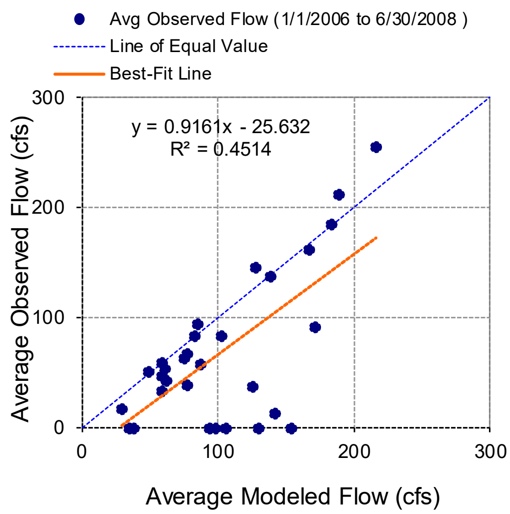


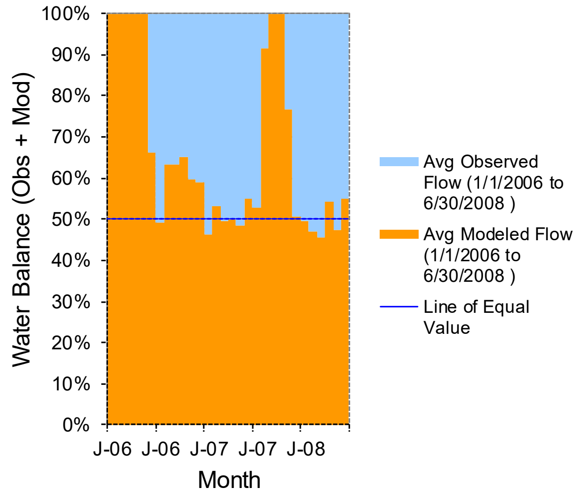
Figure D-1. Flow calibration graphics: Station 8, SWS 201: East Little Pine Creek USGS gauge

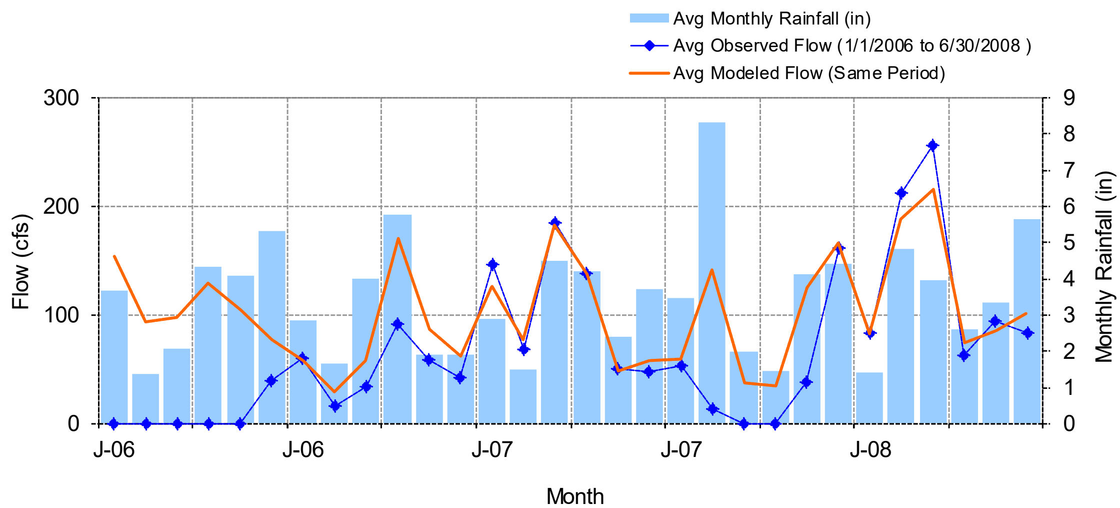
Table D-1. Calibration statistics: Station 8, SWS 201: East Little Pine Creek USGS gauge

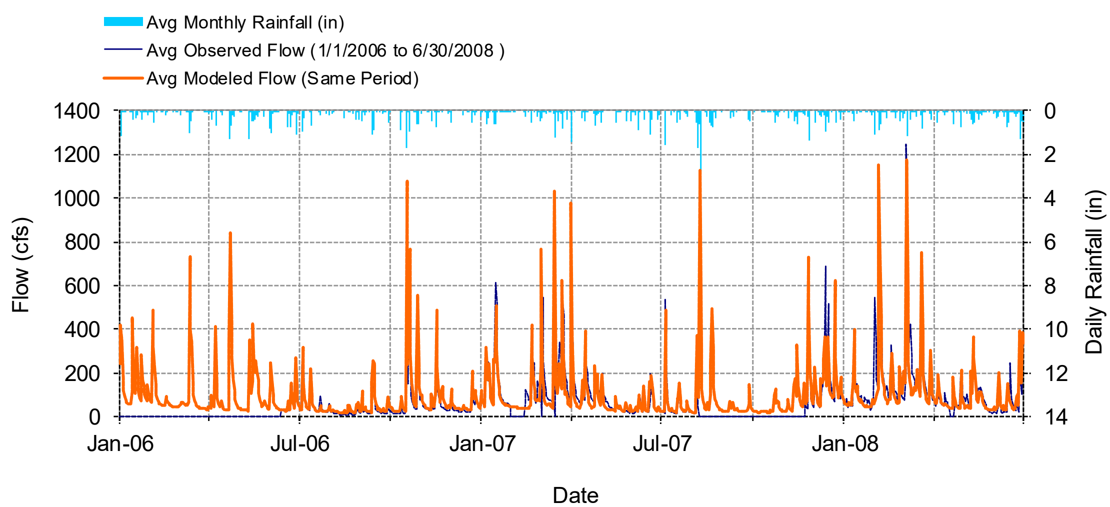
LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 202 1-Year Analysis Period: 11/1/2006 - 10/31/2007 Flow volumes are (inches/year) for upstream drainage area		USGS 03049800 Little Pine Creek near Etna, PA Hydrologic Unit Code: 5010009 Latitude: 40.5203462 Longitude: -79.93810799 Drainage Area (sq-mi): 5.78		
Total Simulated In-stream Flow:	**15.41**	Total Observed In-stream Flow:		**17.00**
Total of simulated highest 10% flows:	**8.31**	Total of Observed highest 10% flows:		**9.39**
Total of Simulated lowest 50% flows:	**1.97**	Total of Observed Lowest 50% flows:		**1.82**
Simulated Summer Flow Volume (months 7-9):	**3.71**	Observed Summer Flow Volume (7-9):		**3.08**
Simulated Fall Flow Volume (months 10-12):	**2.36**	Observed Fall Flow Volume (10-12):		**2.09**
Simulated Winter Flow Volume (months 1-3):	**6.22**	Observed Winter Flow Volume (1-3):		**8.12**
Simulated Spring Flow Volume (months 4-6):	**3.11**	Observed Spring Flow Volume (4-6):		**3.71**
Total Simulated Storm Volume:	**6.55**	Total Observed Storm Volume:		**5.75**
Simulated Summer Storm Volume (7-9):	**2.14**	Observed Summer Storm Volume (7-9):		**1.74**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	-9.37	10	-8.61	17.58
Error in 50% lowest flows:	8.25	10	-7.31	10.77
Error in 10% highest flows:	-11.52	15	-4.55	9.05
Seasonal volume error - Summer:	20.55	30	-5.88	9.36
Seasonal volume error - Fall:	13.04	30	-9.93	21.13
Seasonal volume error - Winter:	-23.41	30	-15.40	23.02
Seasonal volume error - Spring:	-16.12	30	-4.83	16.53
Error in storm volumes:	14.01	20	-5.79	8.52
Error in summer storm volumes:	23.07	50	4.43	38.58

* Note all statistics are within recommended criteria.









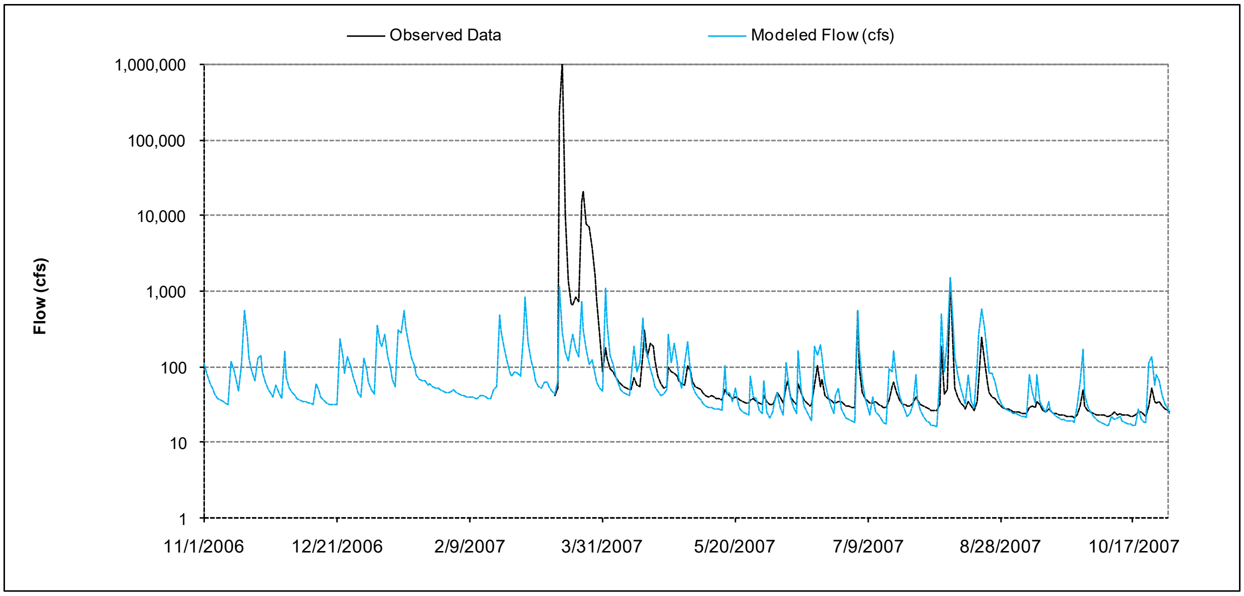
Note overestimation of flow due to missing observed data at gage.

Figure D-2. Calibration graphics: SWS 6: Pine Creek at Grant Avenue in Etna, PA USGS gauge.

Table D-2. Calibration statistics: SWS 6: Pine Creek at Grant Avenue in Etna, PA USGS gauge.

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 202 2.5-Year Analysis Period: 1/1/2006 - 6/30/2008 Flow volumes are (inches/year) for upstream drainage area		USGS 03049800 Little Pine Creek near Etna, PA Hydrologic Unit Code: 5010009 Latitude: 40.5203462 Longitude: -79.93810799 Drainage Area (sq-mi): 5.78		
Total Simulated In-stream Flow:	**240.10**	Total Observed In-stream Flow:		**159.80**
Total of simulated highest 10% flows:	**99.75**	Total of Observed highest 10% flows:		**76.66**
Total of Simulated lowest 50% flows:	**42.89**	Total of Observed Lowest 50% flows:		**8.85**
Simulated Summer Flow Volume (months 7-9):	**30.43**	Observed Summer Flow Volume (7-9):		**14.05**
Simulated Fall Flow Volume (months 10-12):	**50.92**	Observed Fall Flow Volume (10-12):		**31.08**
Simulated Winter Flow Volume (months 1-3):	**94.97**	Observed Winter Flow Volume (1-3):		**74.33**
Simulated Spring Flow Volume (months 4-6):	**63.78**	Observed Spring Flow Volume (4-6):		**40.34**
Total Simulated Storm Volume:	**67.99**	Total Observed Storm Volume:		**37.17**
Simulated Summer Storm Volume (7-9):	**9.86**	Observed Summer Storm Volume (7-9):		**4.49**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	**50.25**	**10**	**-8.61**	**17.58**
Error in 50% lowest flows:	**384.64**	**10**	**-7.31**	**10.77**
Error in 10% highest flows:	**30.12**	**15**	**-4.55**	**9.05**
Seasonal volume error - Summer:	**116.58**	**30**	**-5.88**	**9.36**
Seasonal volume error - Fall:	**63.84**	**30**	**-9.93**	**21.13**
Seasonal volume error - Winter:	27.76	30	-15.40	23.02
Seasonal volume error - Spring:	**58.12**	**30**	**-4.83**	**16.53**
Error in storm volumes:	**82.90**	**20**	**-5.79**	**8.52**
Error in summer storm volumes:	**119.55**	**50**	**4.43**	**38.58**

Note overestimation of flow due to missing observed data at gage.



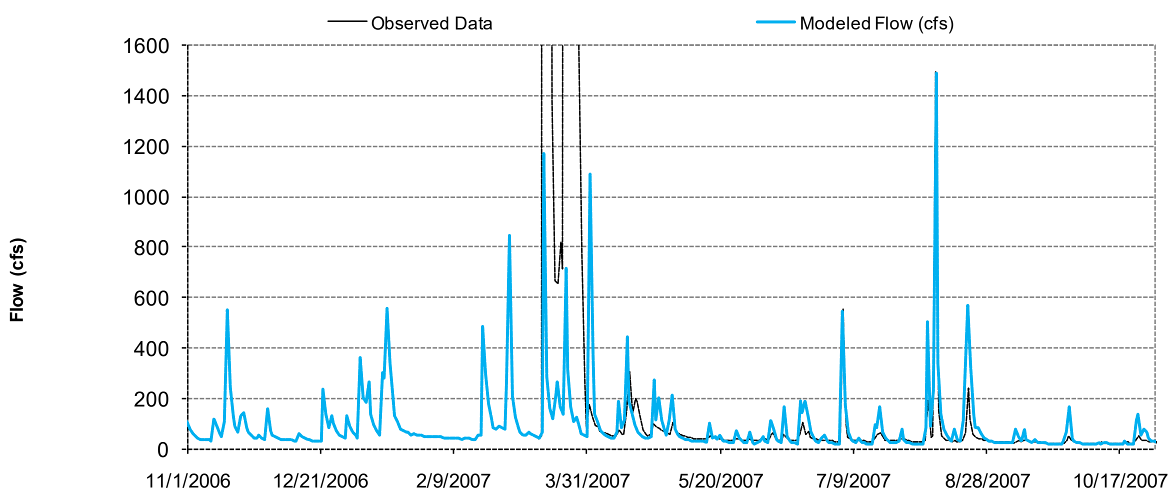
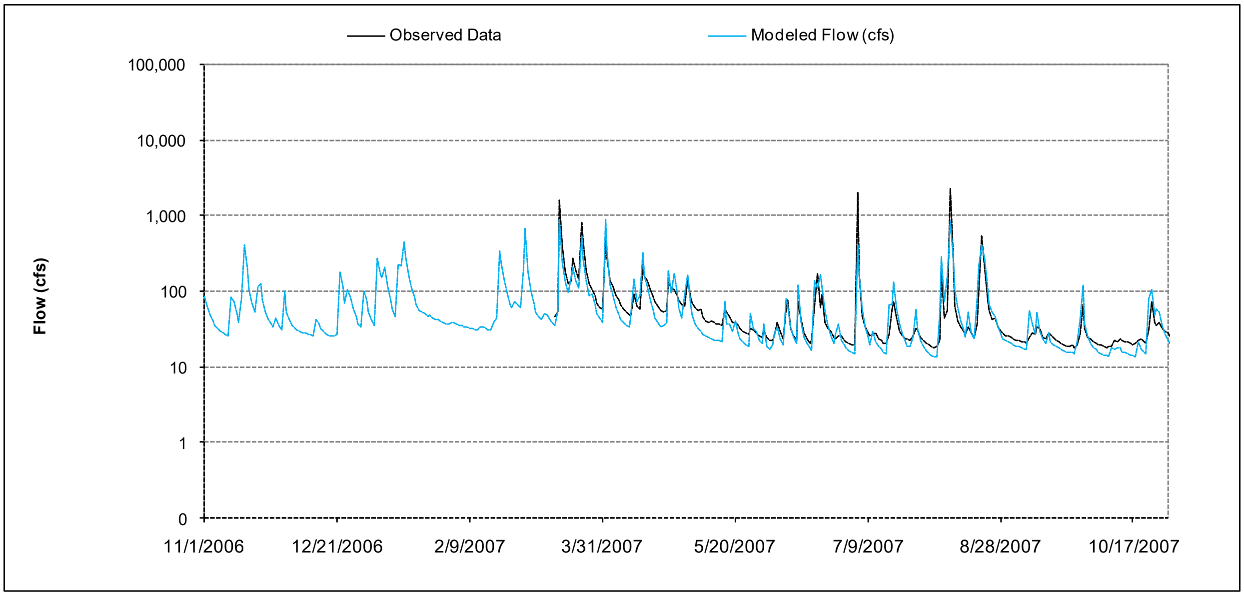


Figure D-3. Flow calibration graphics: DEP station “MOUTH” vs. SWS 1



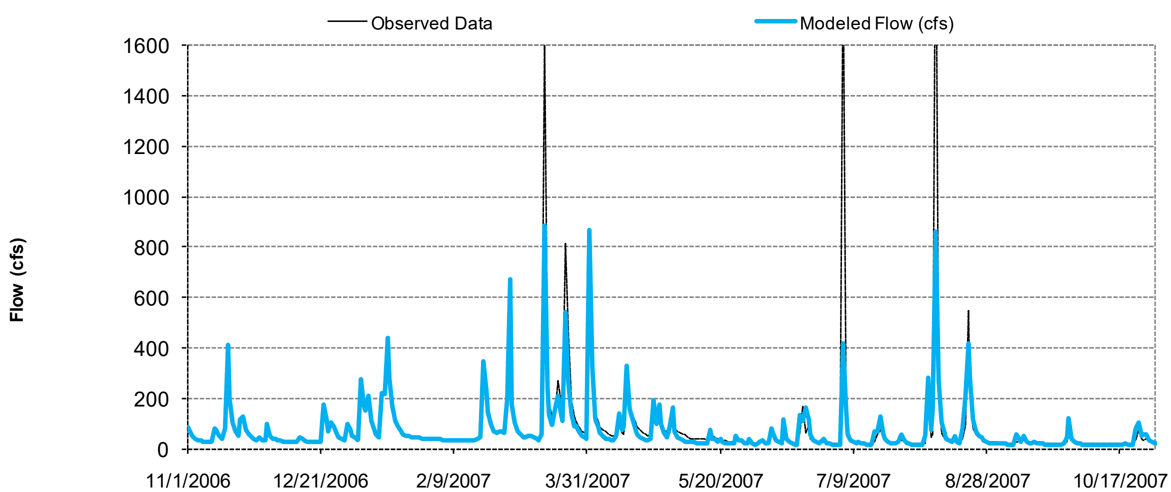
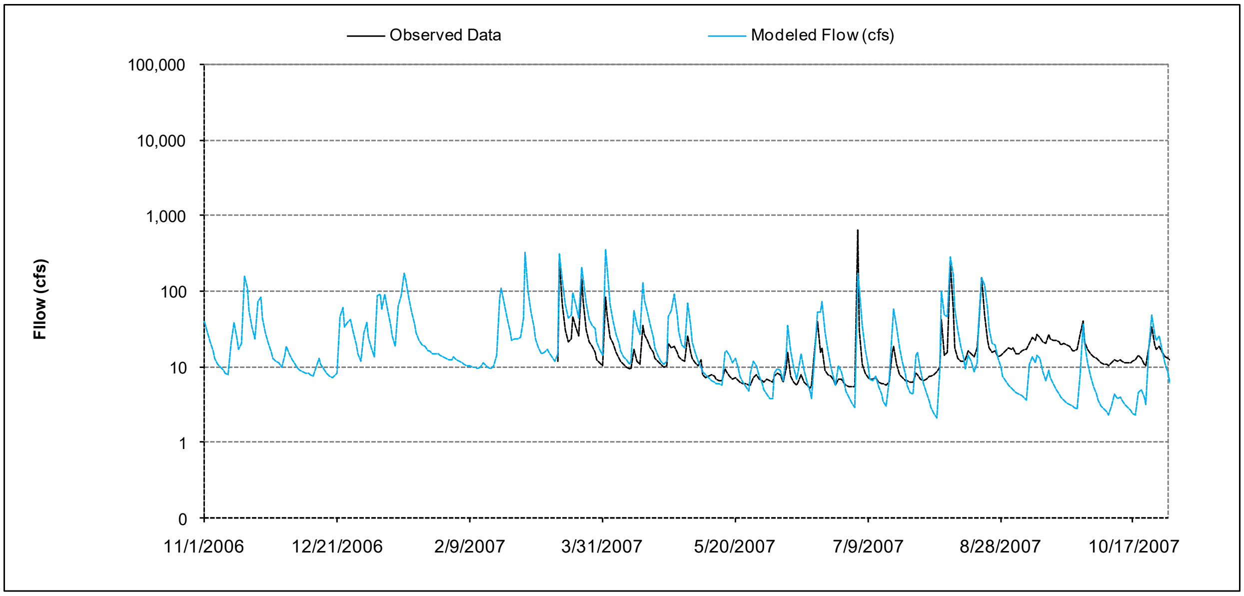


Figure D-4. Flow calibration graphics: DEP station “MCD” vs. SWS 11



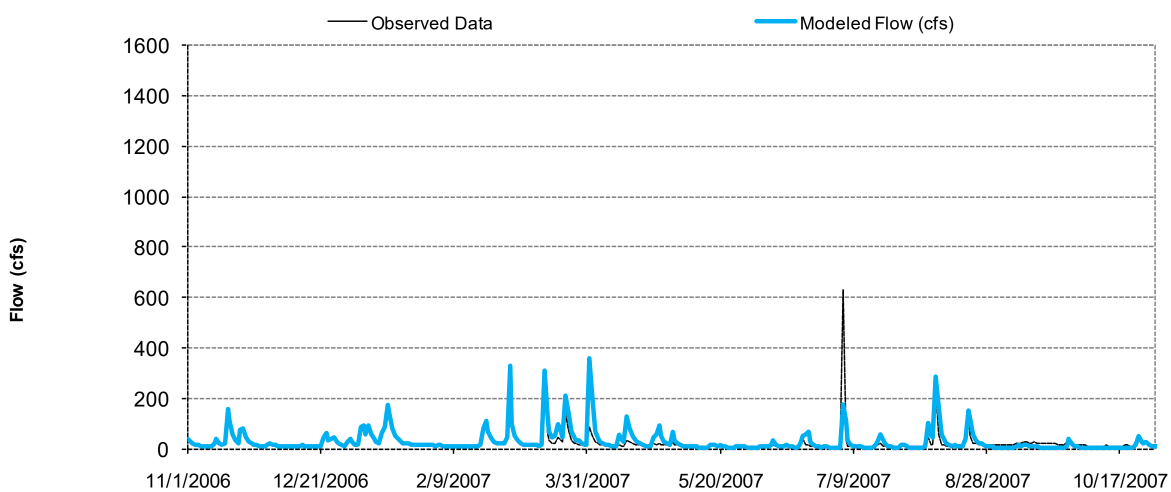
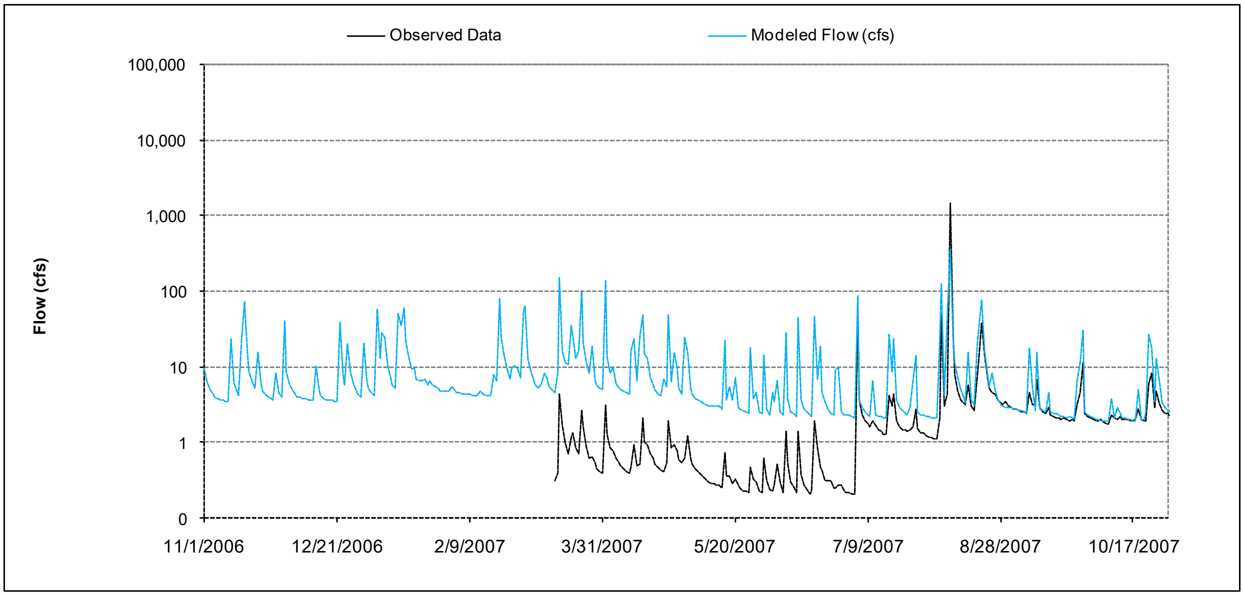
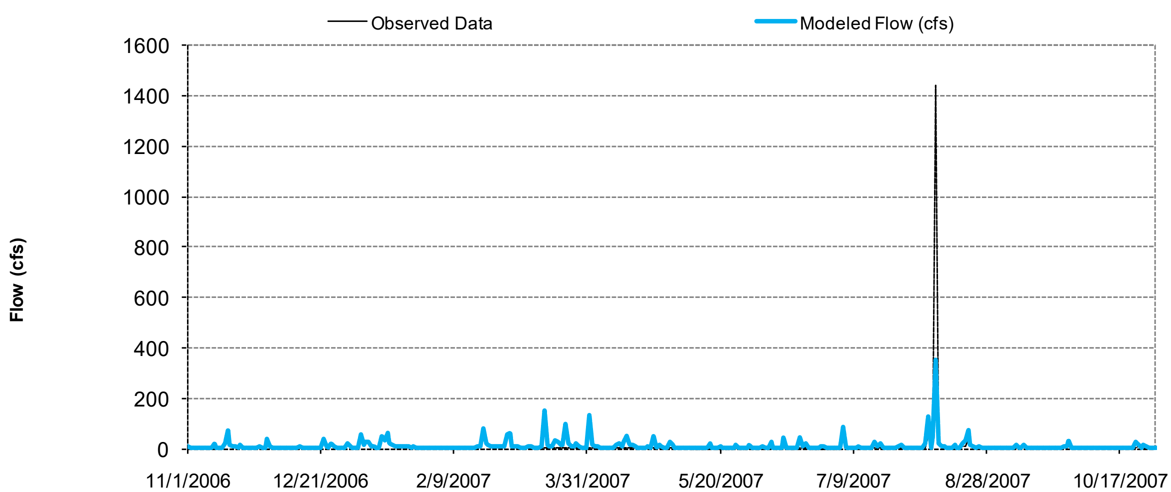


Figure D-5. Flow calibration graphics: DEP station “BELOW LAKE” vs. SWS 22





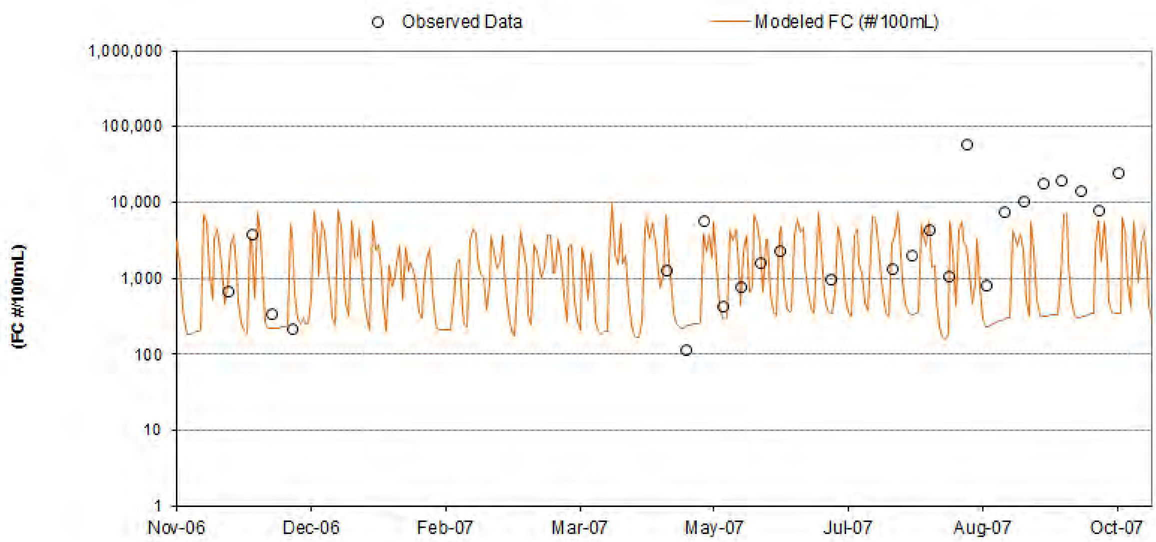
*Note possible recording error. PADEP staff noted that the logger remained stable throughout the monitoring period, but that a storm event in early July modified the channel characteristics at this site.

Figure D-6. Flow calibration graphics: DEP station “WEST BRANCH” vs. SWS 103.

Appendix E. WATER QUALITY CALIBRATION RESULTS

During the calibration process, predicted pollutant concentrations were graphically compared to observed values. After calibrating the model for selected locations, modelers obtained a calibrated data set containing parameter values for each modeled land use and soil type. Appendix E provides the full water quality calibration results for the simulation.

Figure E-1. Bacteria (fecal coliform; CFU/100 mL) calibration at station 1 vs. SWS 2.



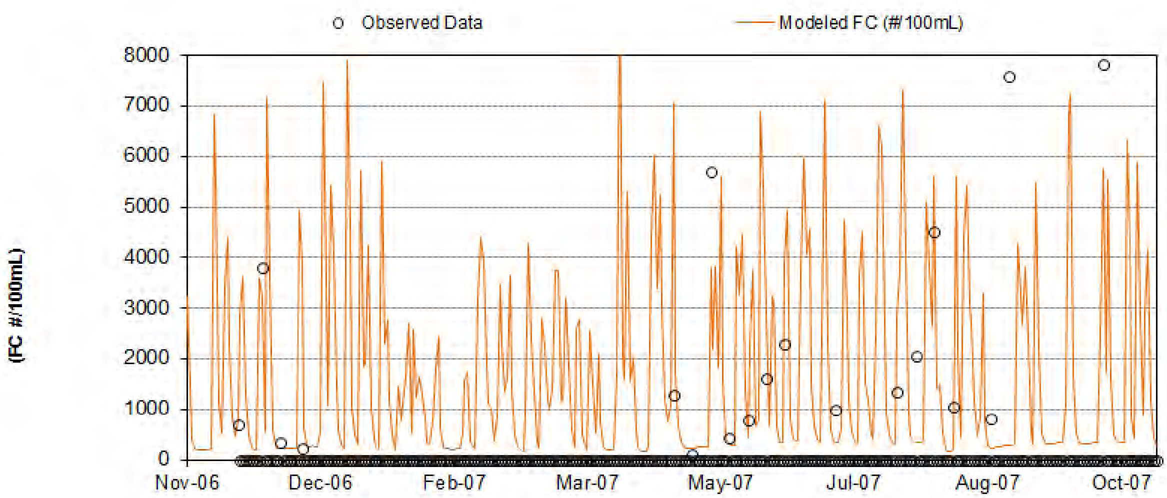


Figure E-2. Bacteria (fecal coliform; CFU/100 mL) calibration at station 2 vs. SWS 4.

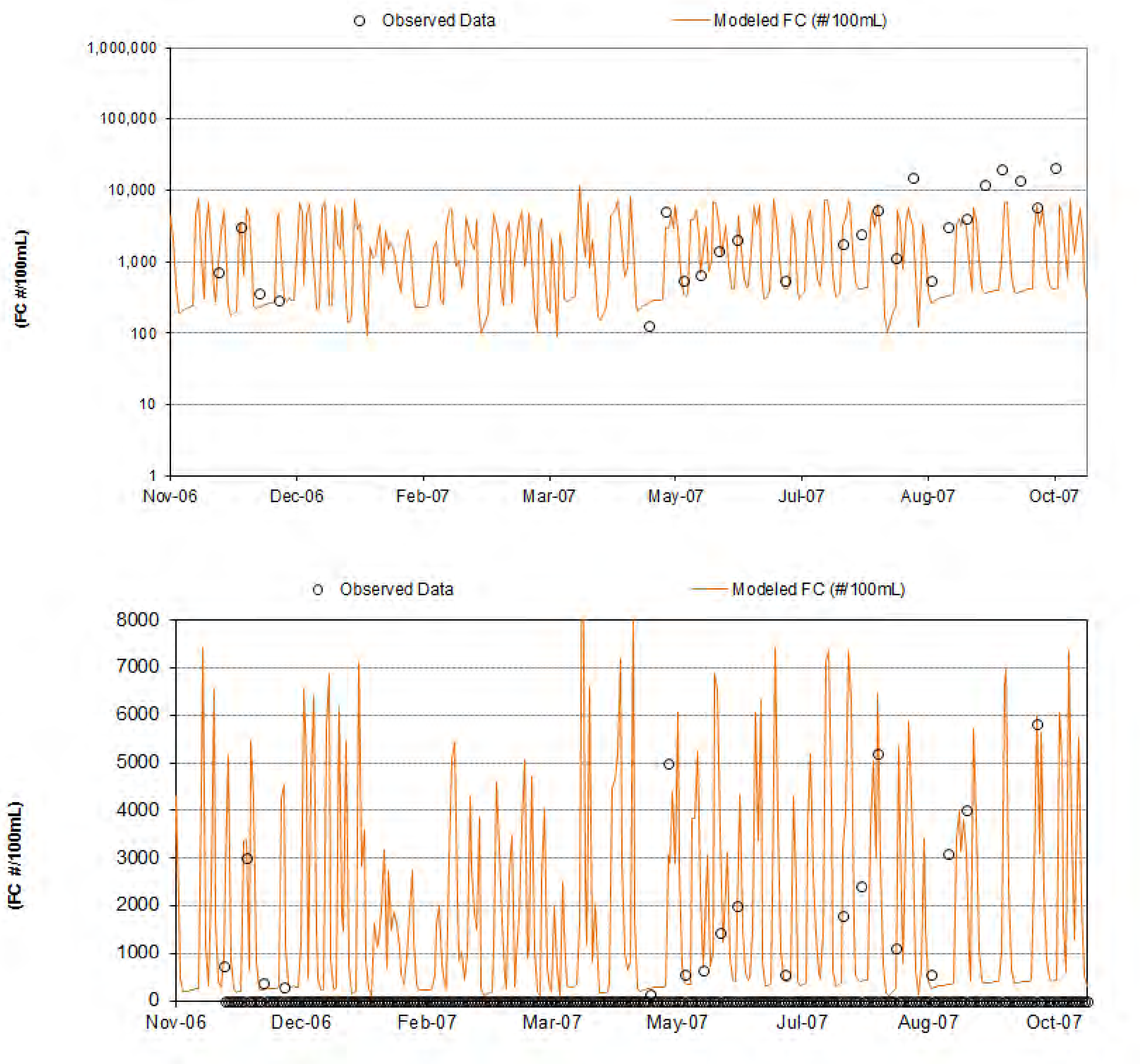
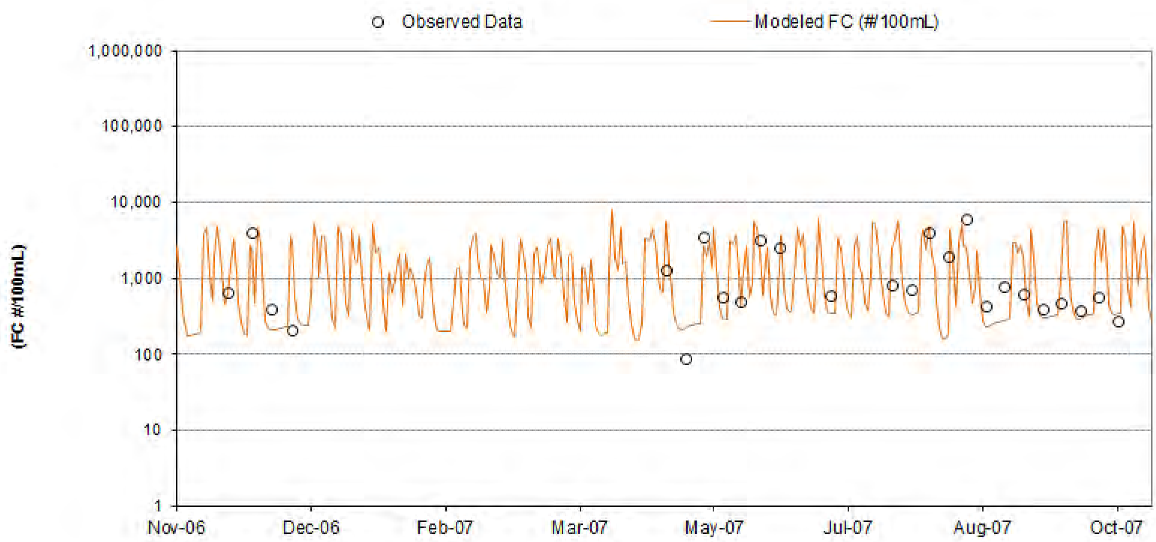


Figure E-3. Bacteria (fecal coliform; CFU/100 mL) calibration at station 3 vs. SWS 5.



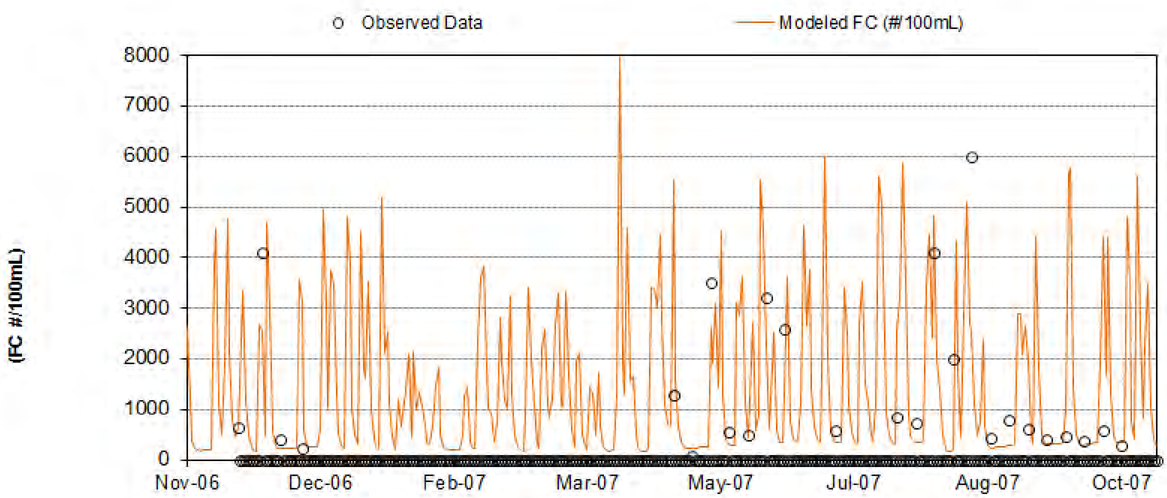


Figure E-4. Bacteria (fecal coliform; CFU/100 mL) calibration at station 4 vs. SWS 6.

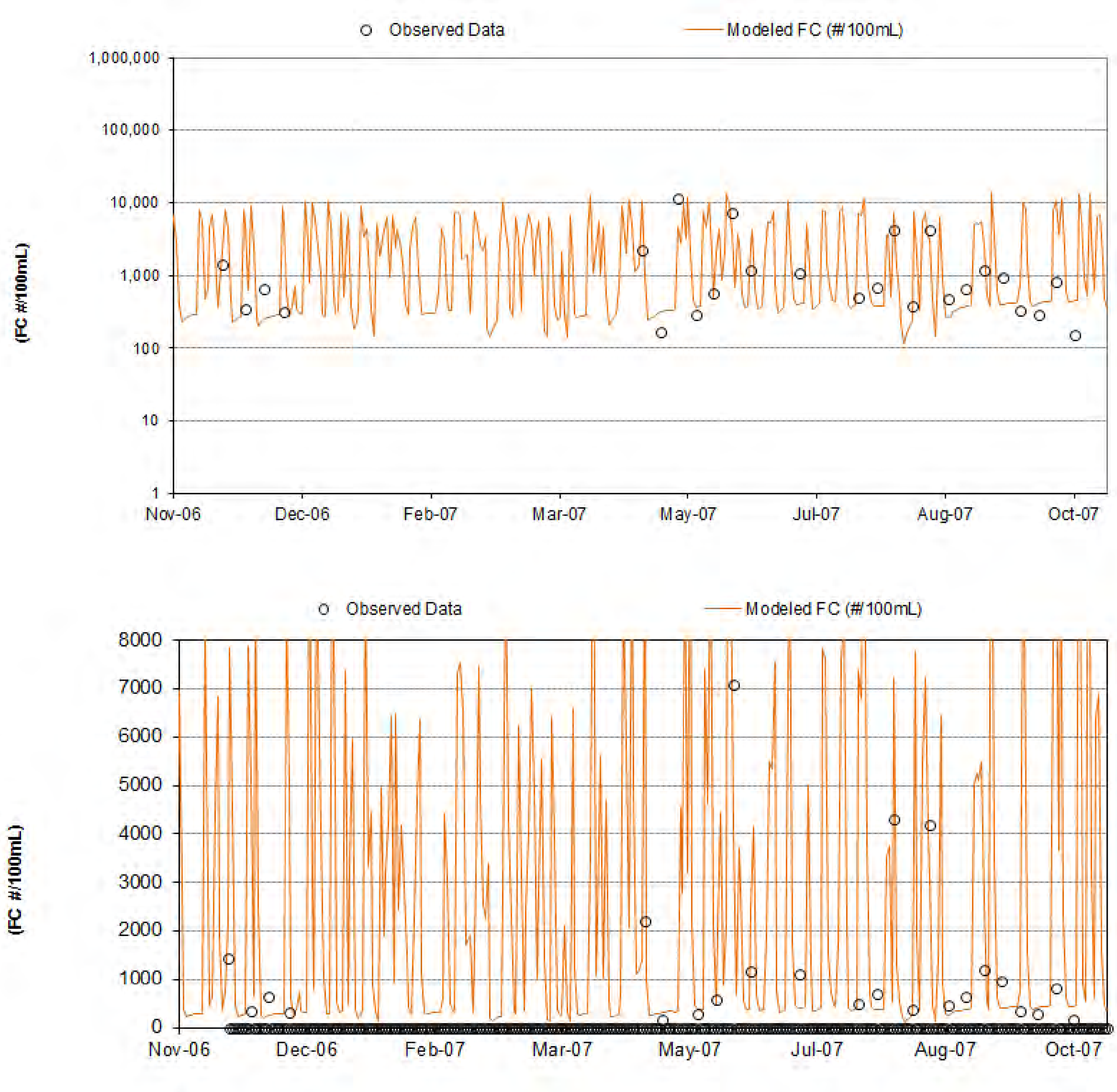


Figure E-5. Bacteria (fecal coliform; CFU/100 mL) calibration at station 5 vs. SWS 102.

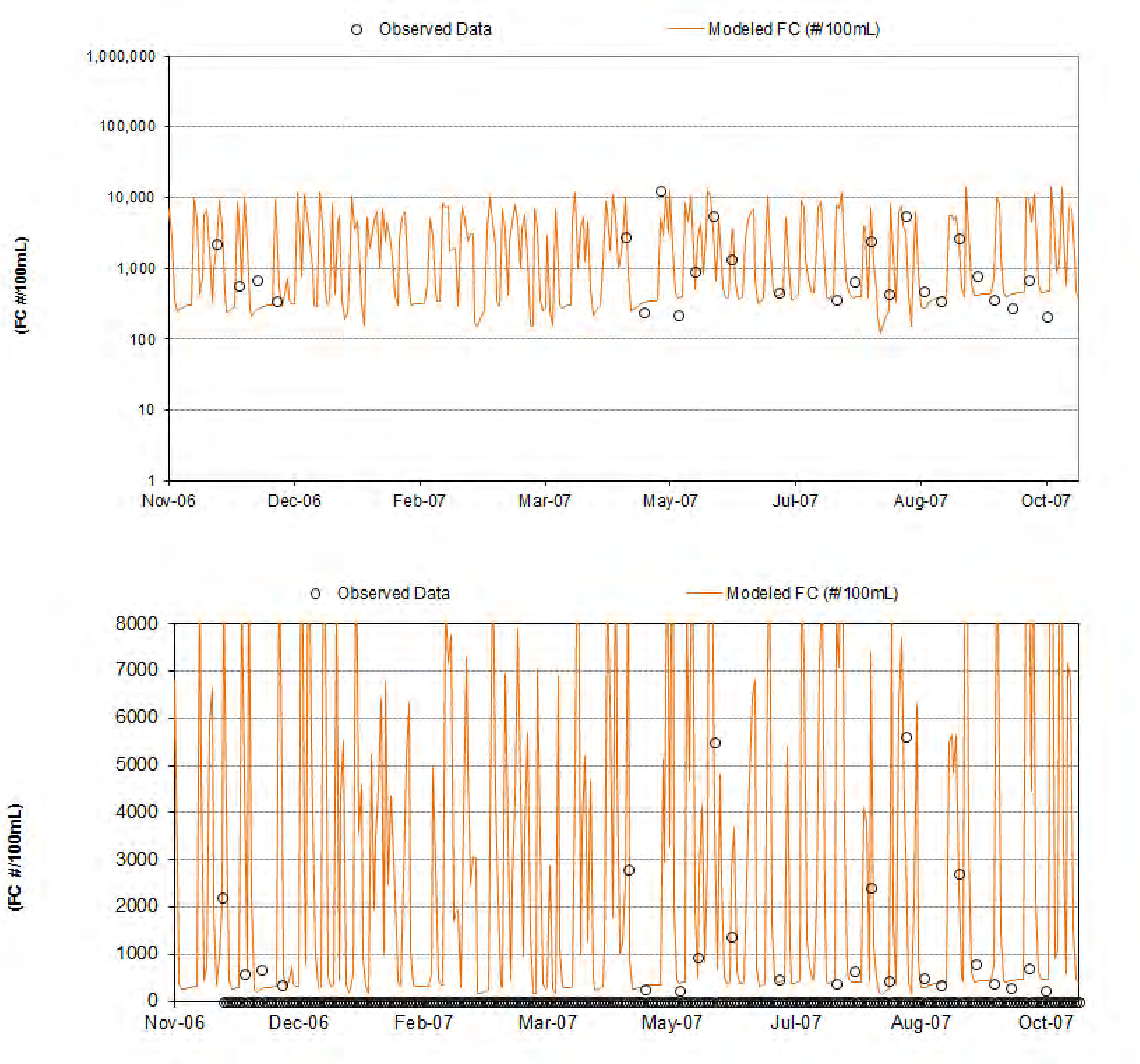


Figure E-6. Bacteria (fecal coliform; CFU/100 mL) calibration at station 6 vs. SWS 103.

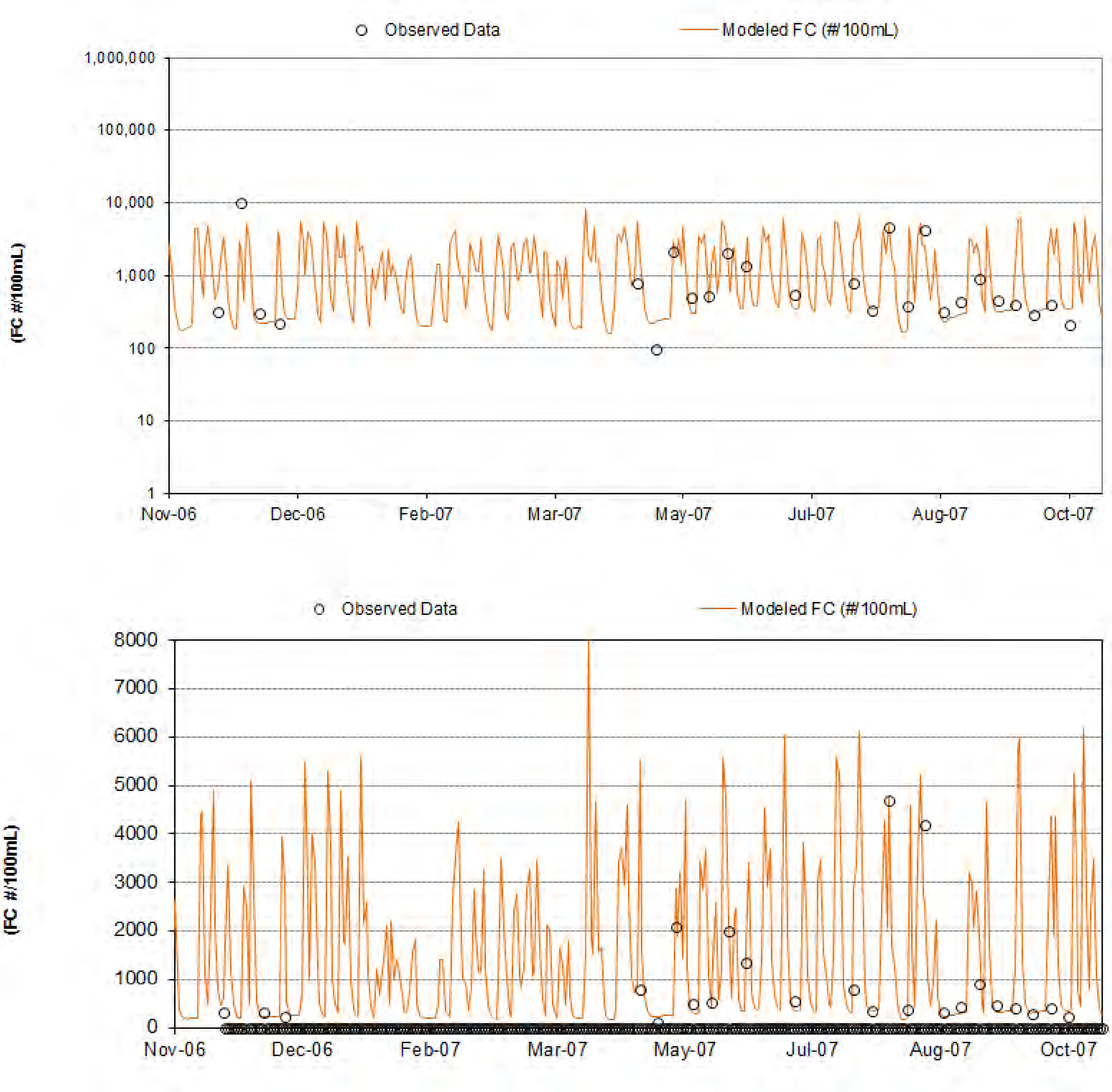
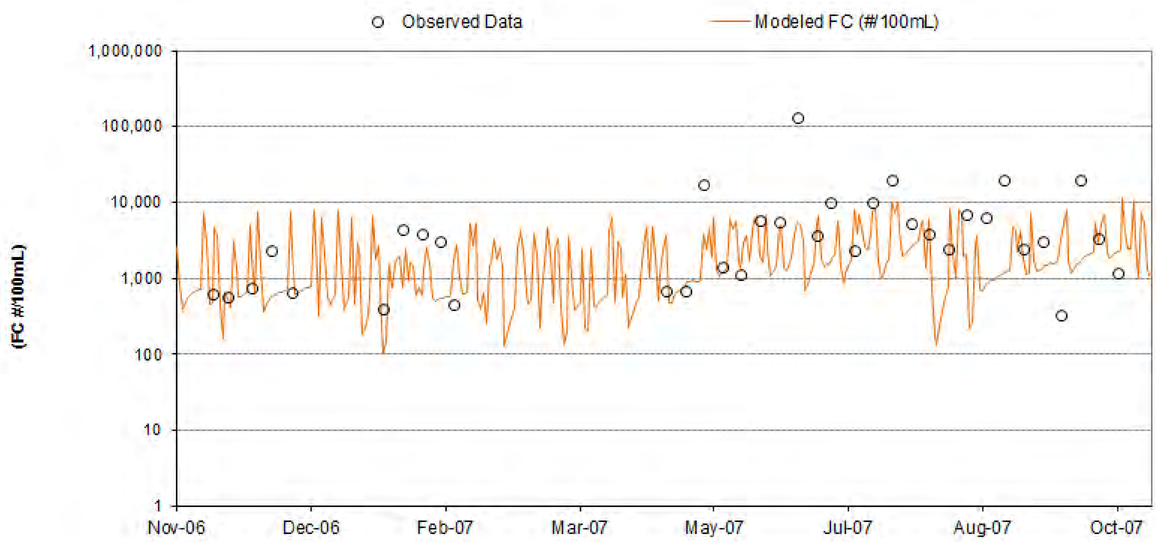


Figure E-7. Bacteria (fecal coliform; CFU/100 mL) calibration at station 7 vs. SWS 7.



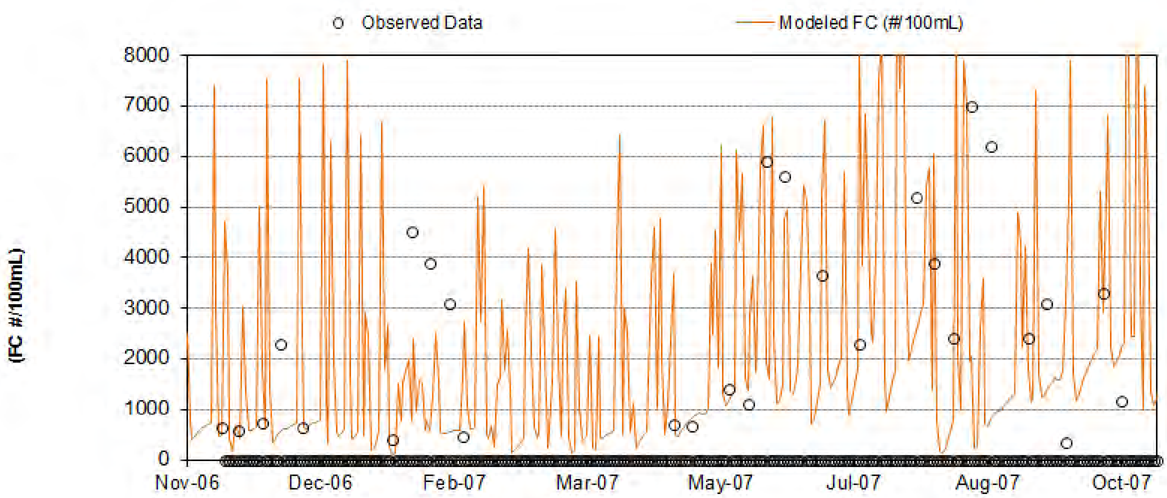
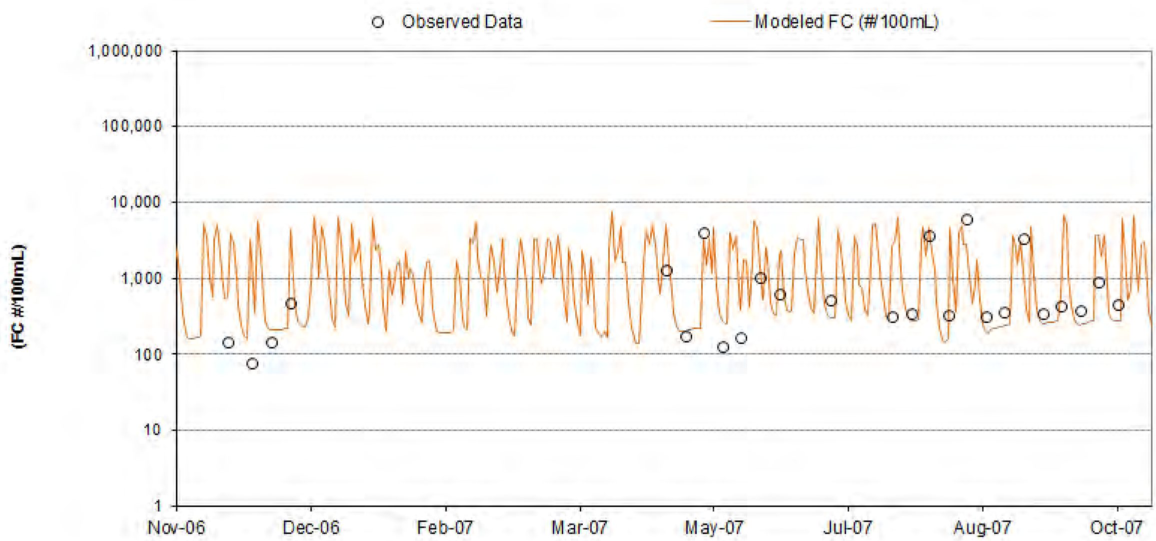


Figure E-8. Bacteria (fecal coliform; CFU/100 mL) calibration at station 8 vs. SWS 201.



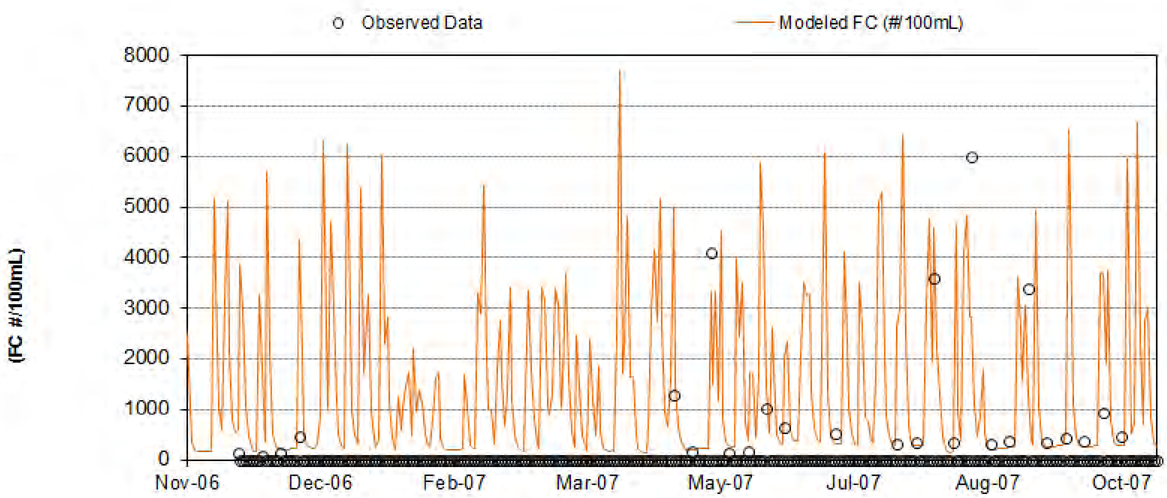
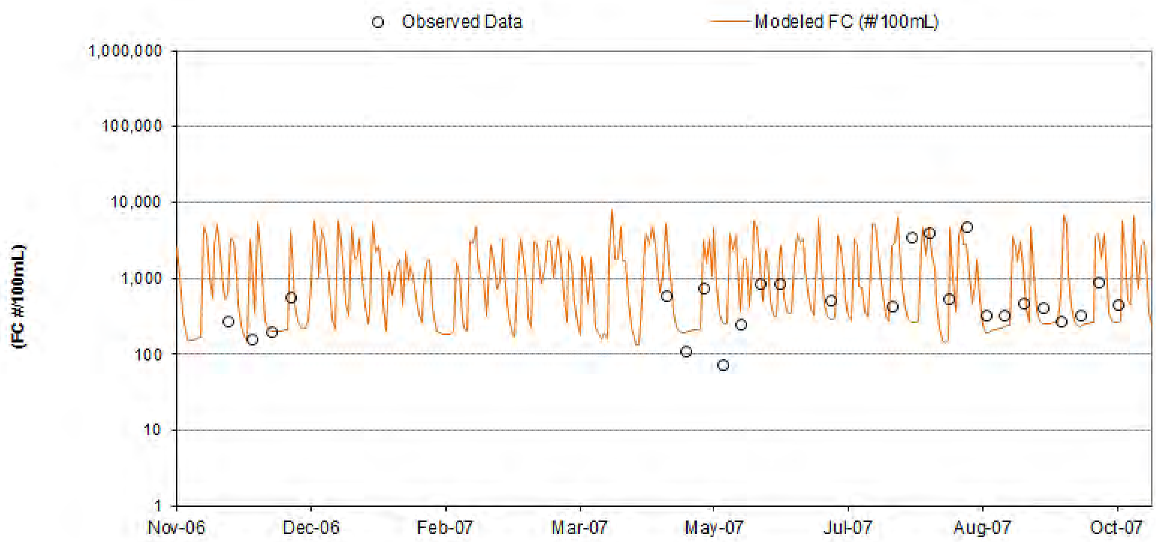


Figure E-9. Bacteria (fecal coliform; CFU/100 mL) calibration at station 9 vs. SWS 13.



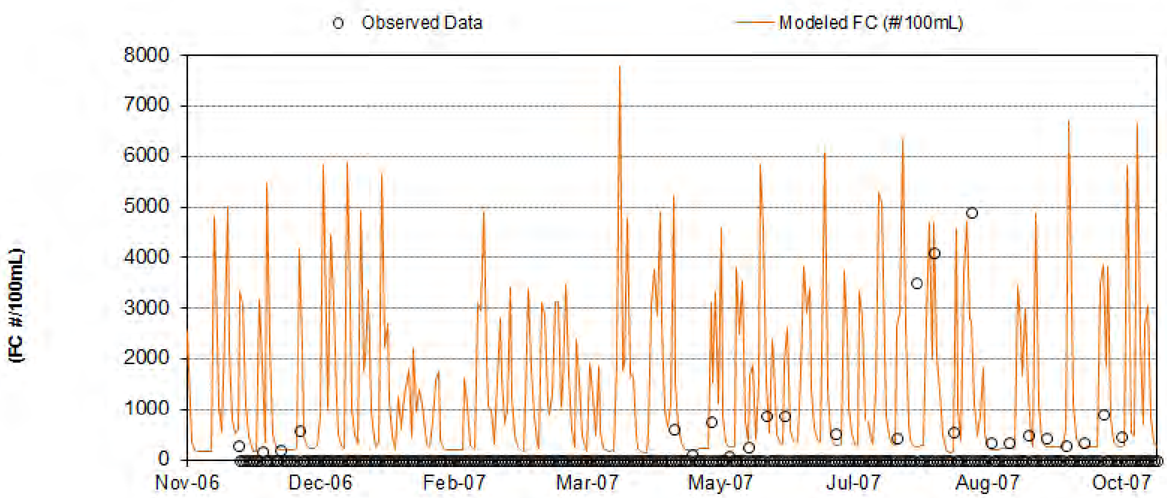
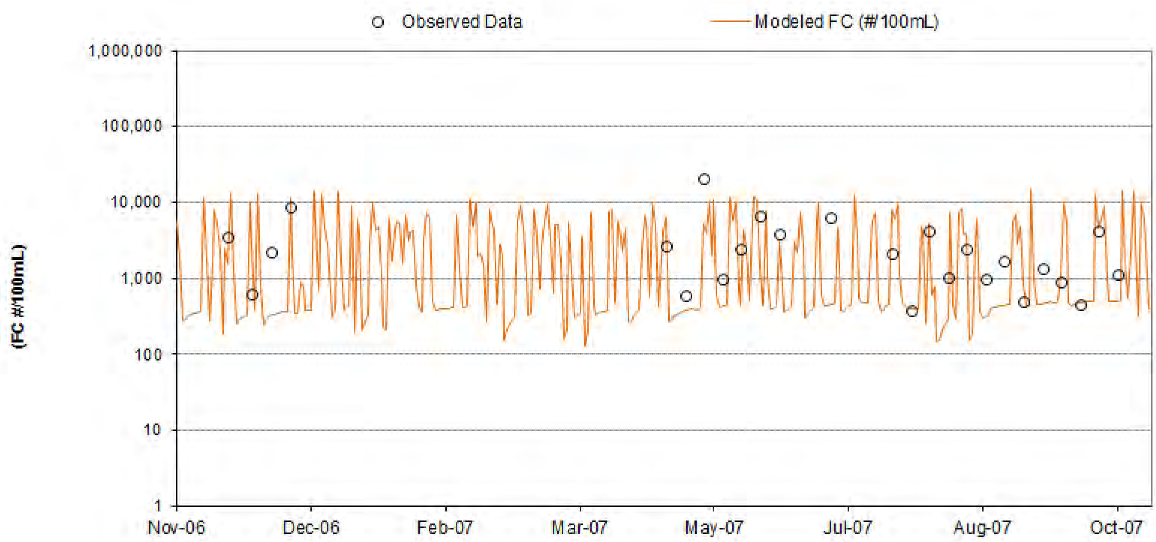


Figure E-10. Bacteria (fecal coliform; CFU/100 mL) calibration at station 10 vs. SWS 12.



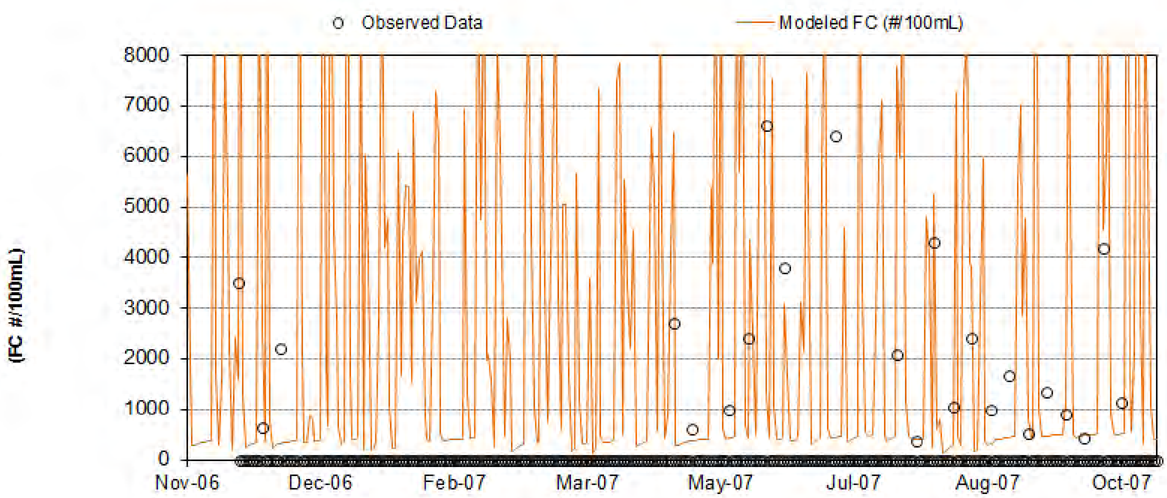
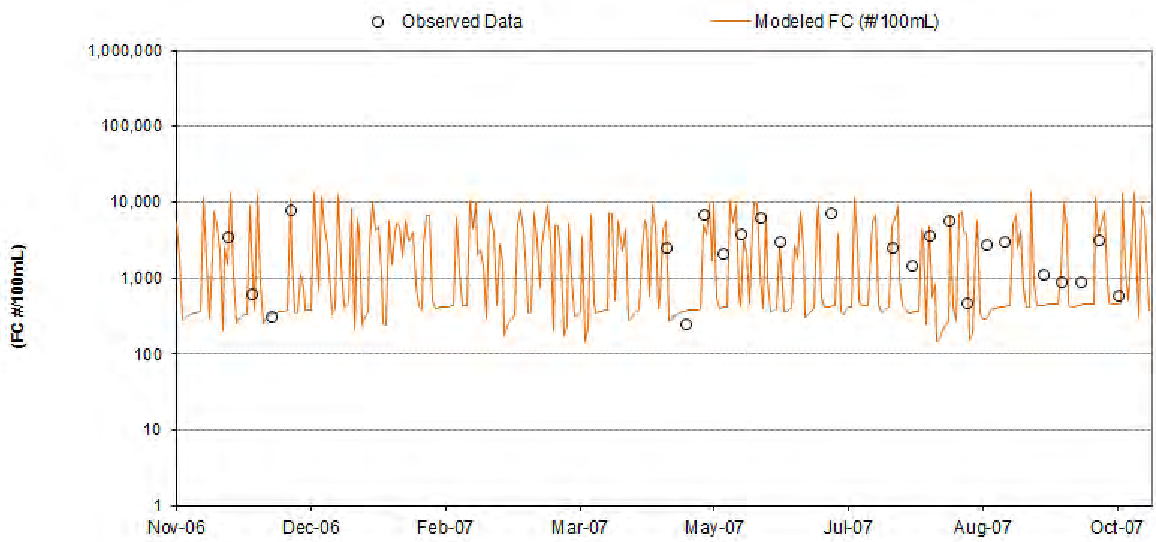


Figure E-11. Bacteria (fecal coliform; CFU/100 mL) calibration at station 11 vs. SWS 104.



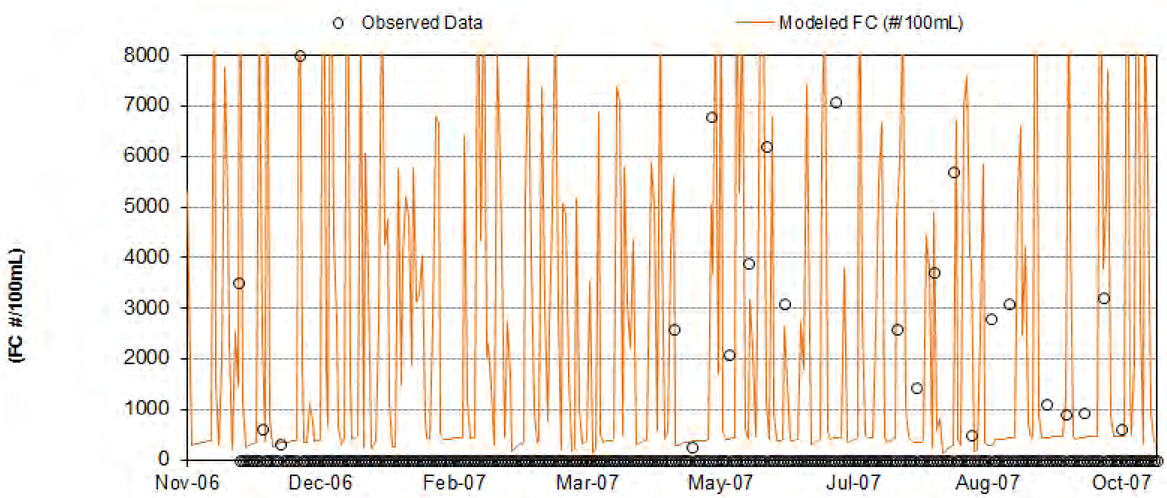


Figure E-12. Bacteria (fecal coliform; CFU/100 mL) calibration at station 12 vs. SWS 105.

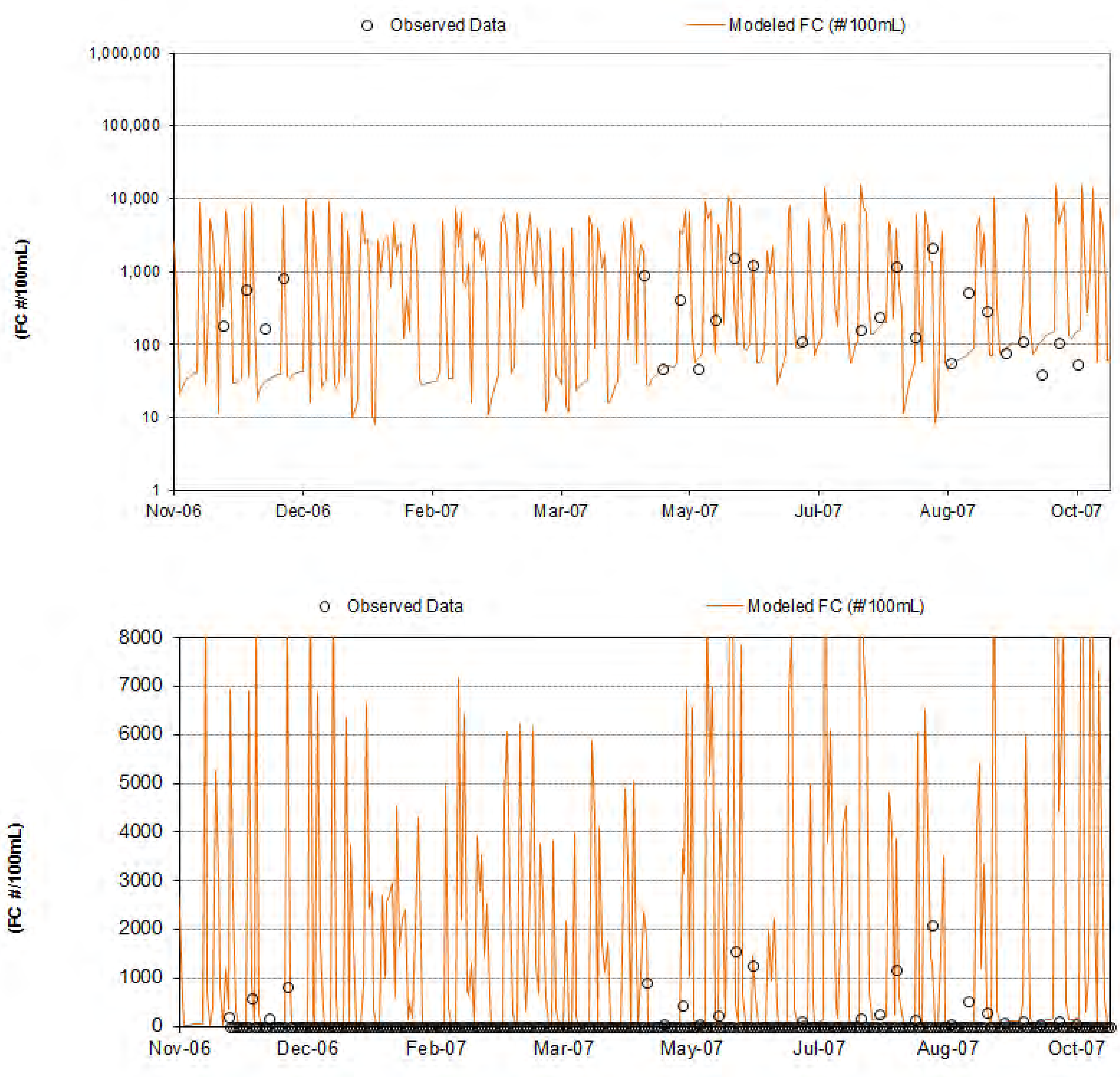


Figure E-13. Bacteria (fecal coliform; CFU/100 mL) calibration at station 13 vs. SWS 301.

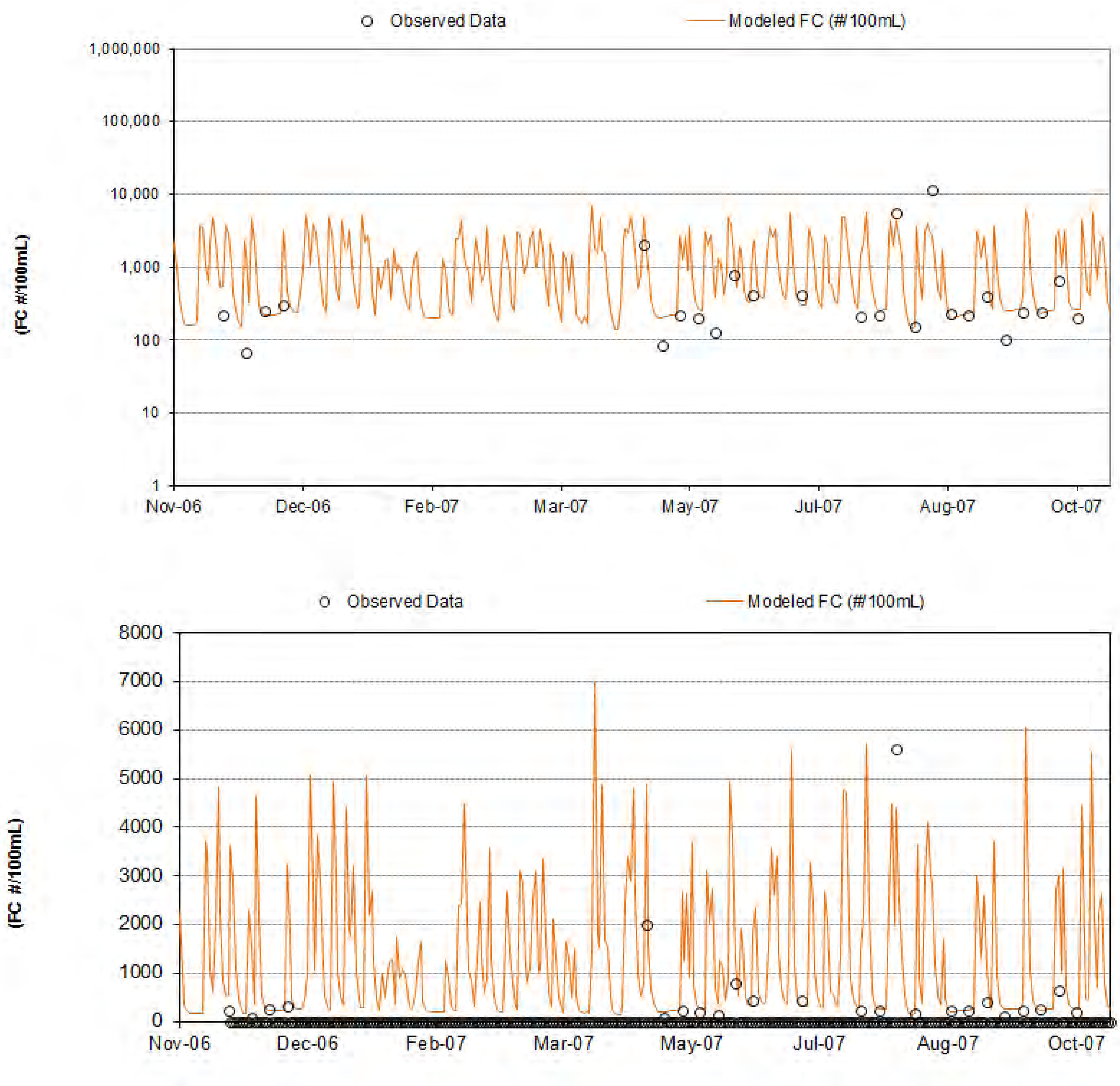
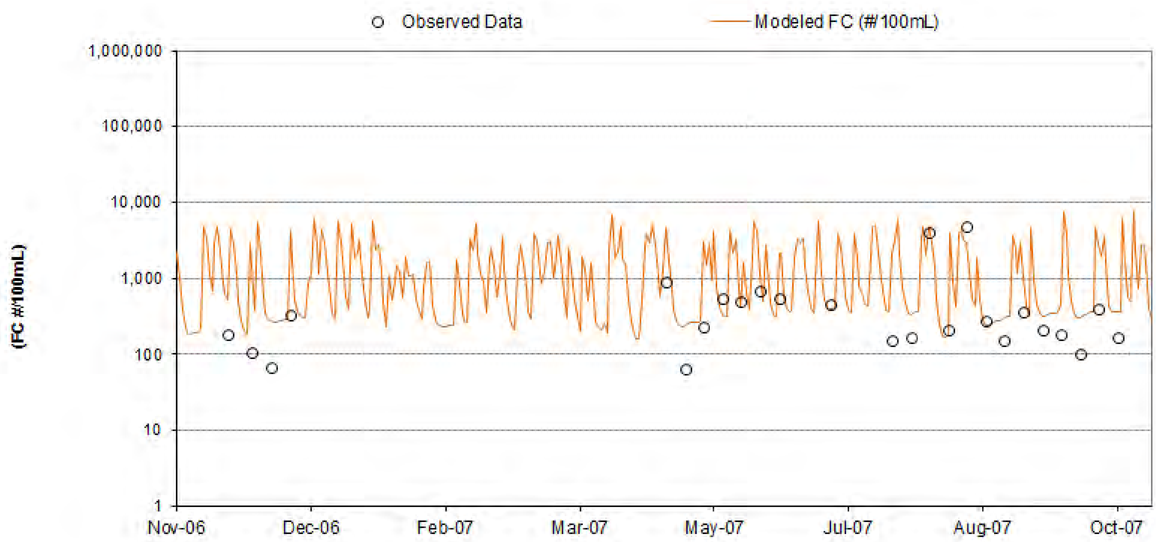


Figure E-14. Bacteria (fecal coliform; CFU/100 mL) calibration at station 14 vs. SWS 14.



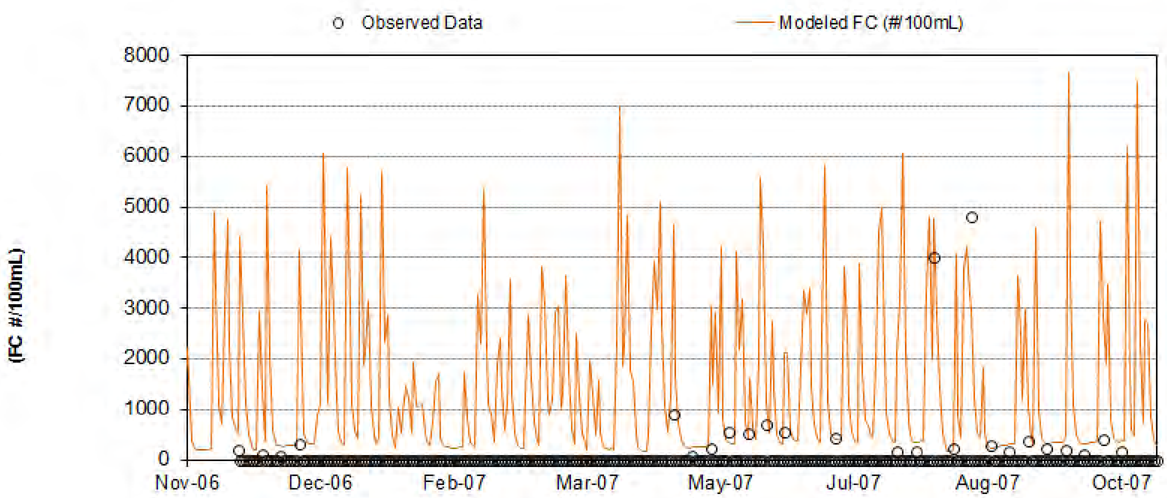
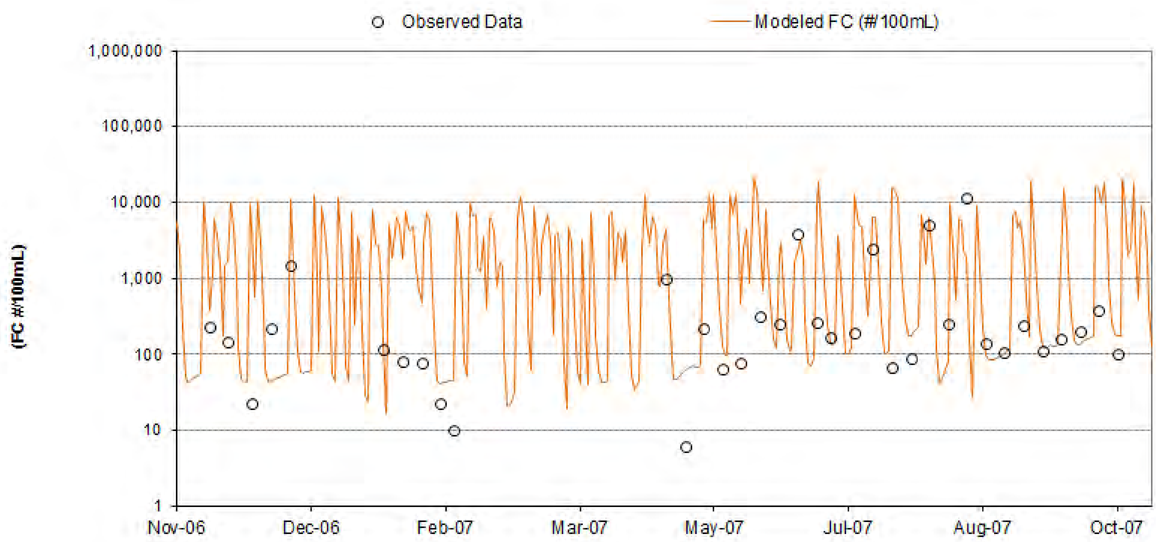


Figure E-15. Bacteria (fecal coliform; CFU/100 mL) calibration at station 15 vs. SWS 16.



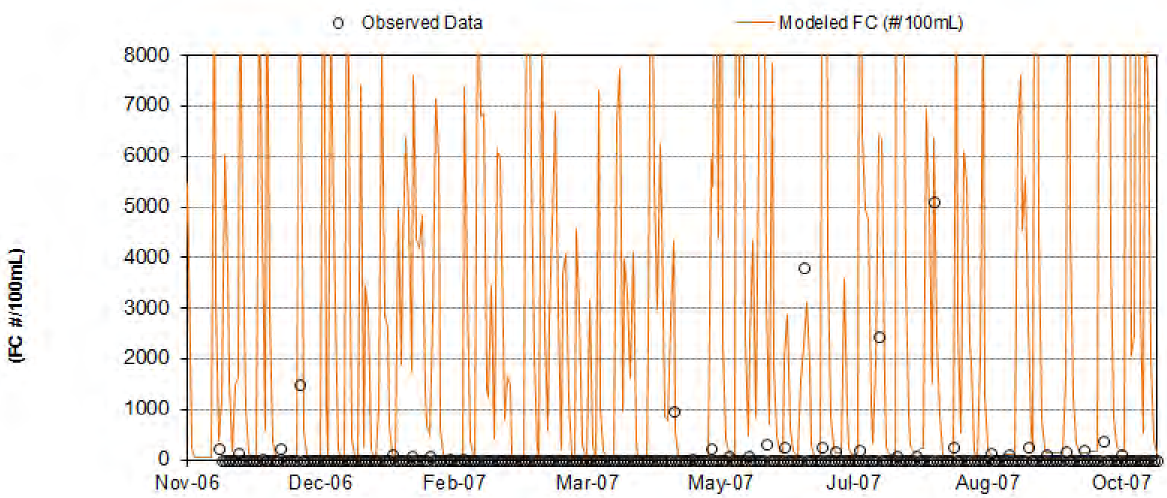
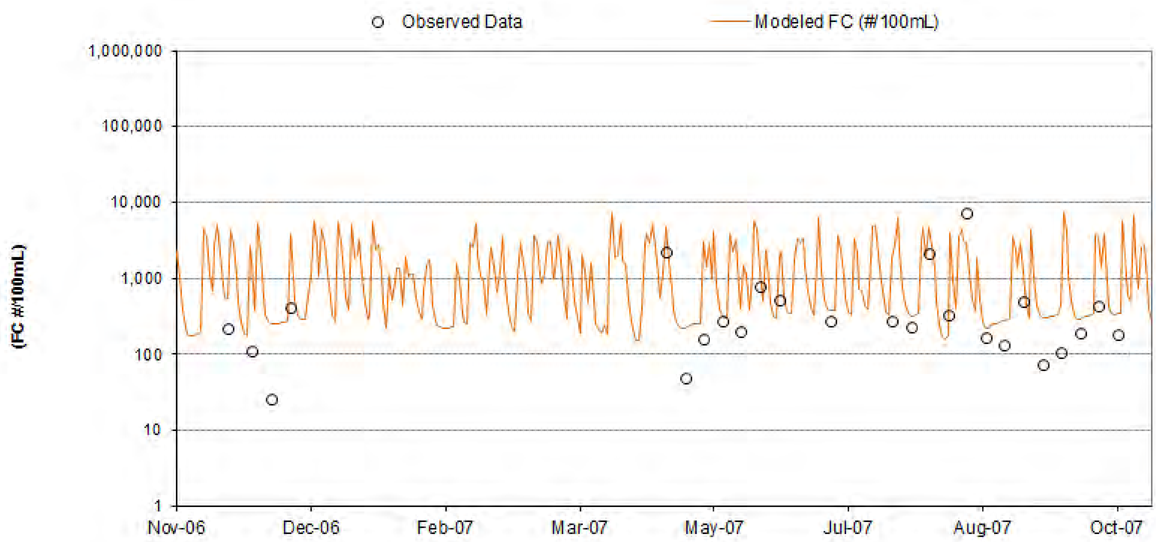


Figure E-16. Bacteria (fecal coliform; CFU/100 mL) calibration at station 16 vs. SWS 501.



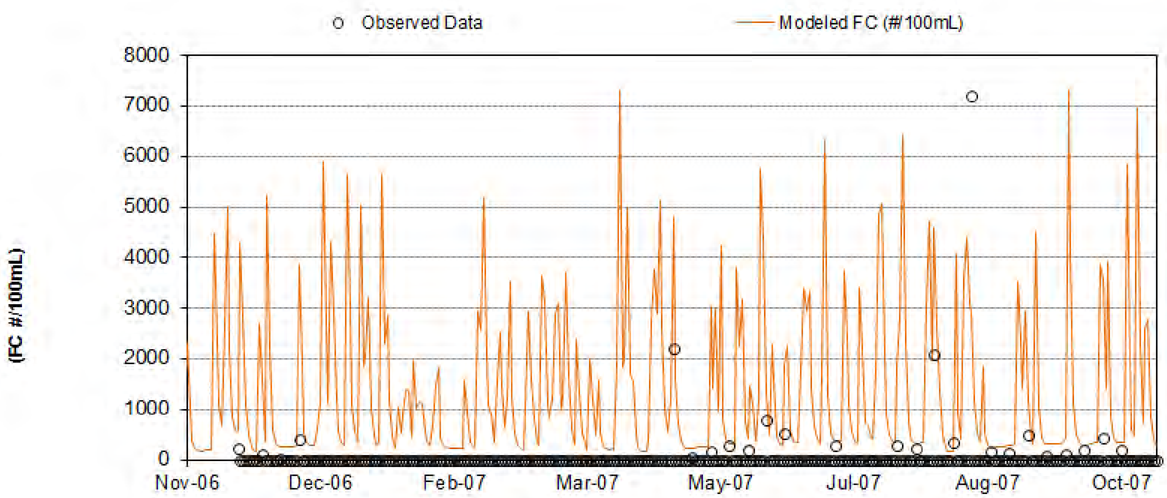


Figure E-17. Bacteria (fecal coliform; CFU/100 mL) calibration at station 17 vs. SWS 15.

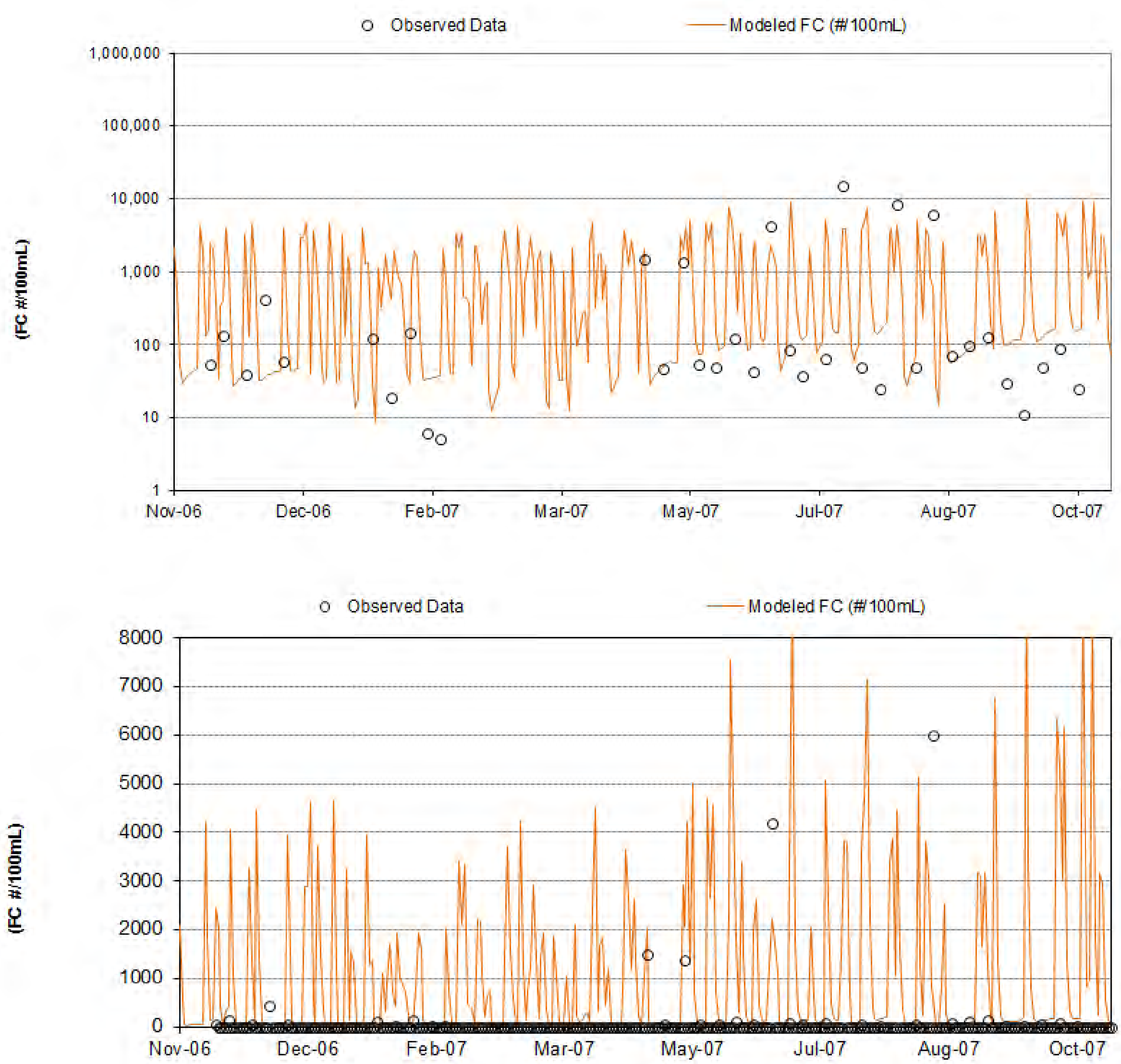


Figure E-18. Bacteria (fecal coliform; CFU/100 mL) calibration at station 18 vs. SWS 701.

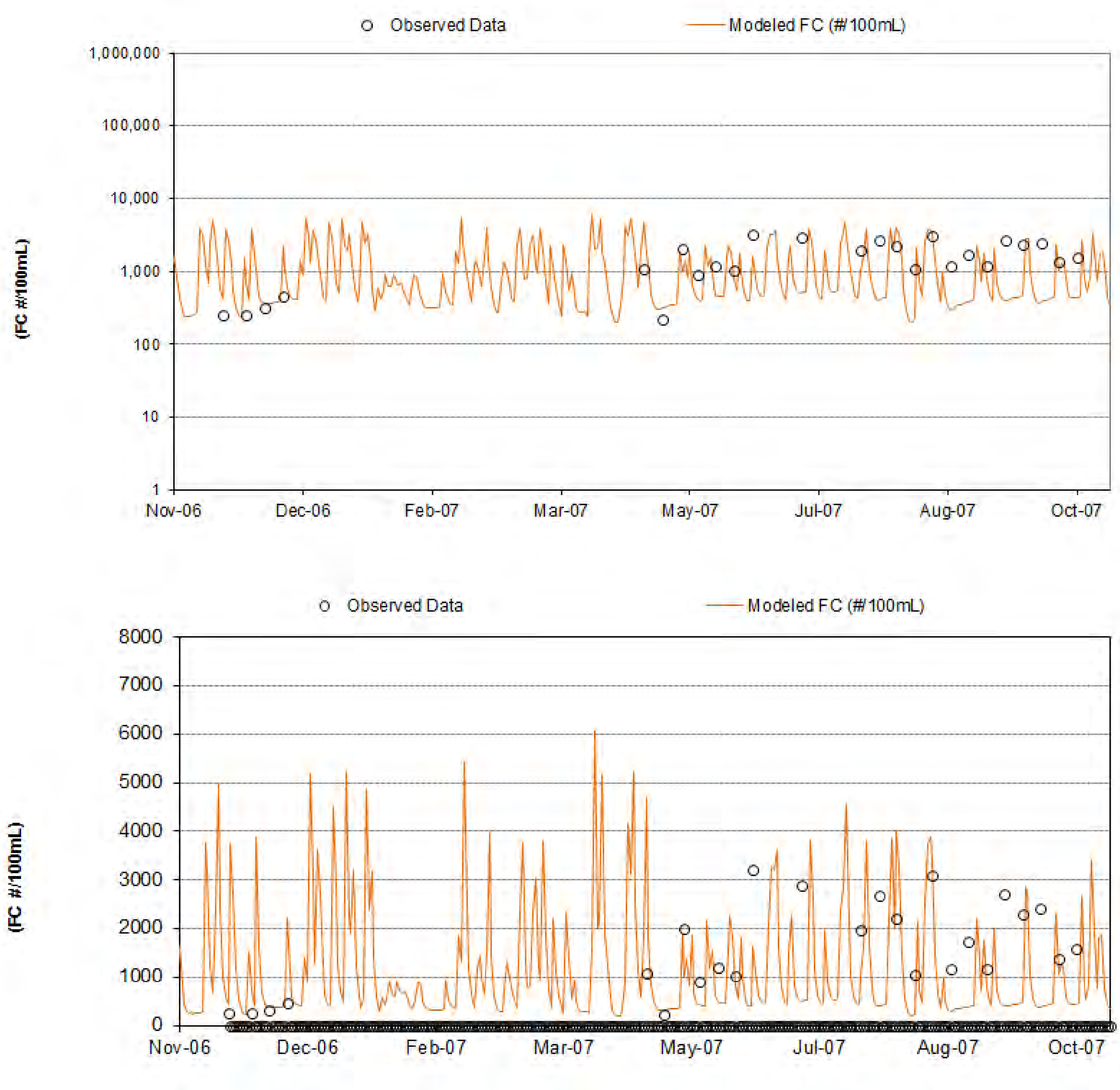


Figure E-19. Bacteria (fecal coliform; CFU/100 mL) calibration at station 19 vs. SWS 20.

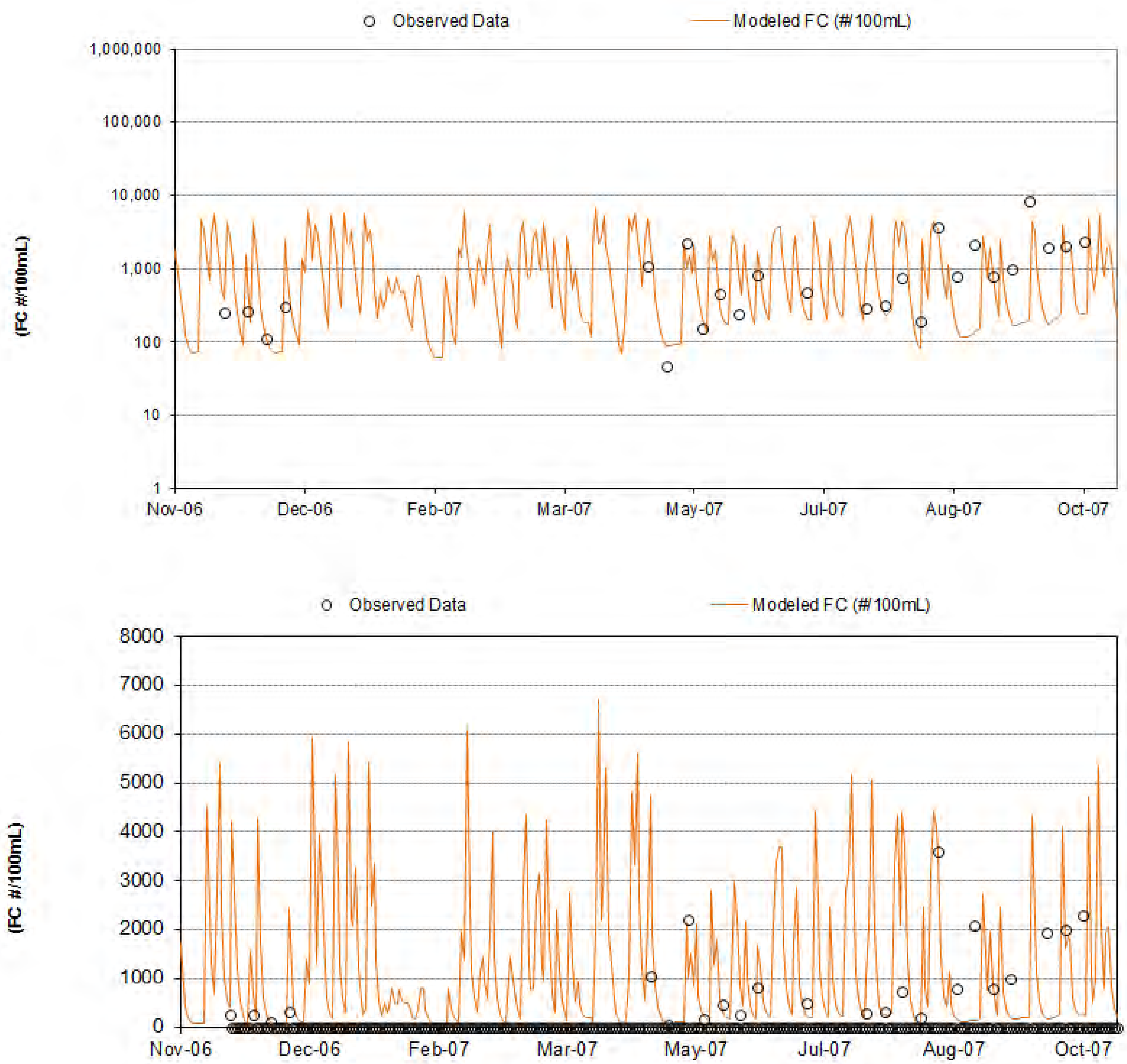
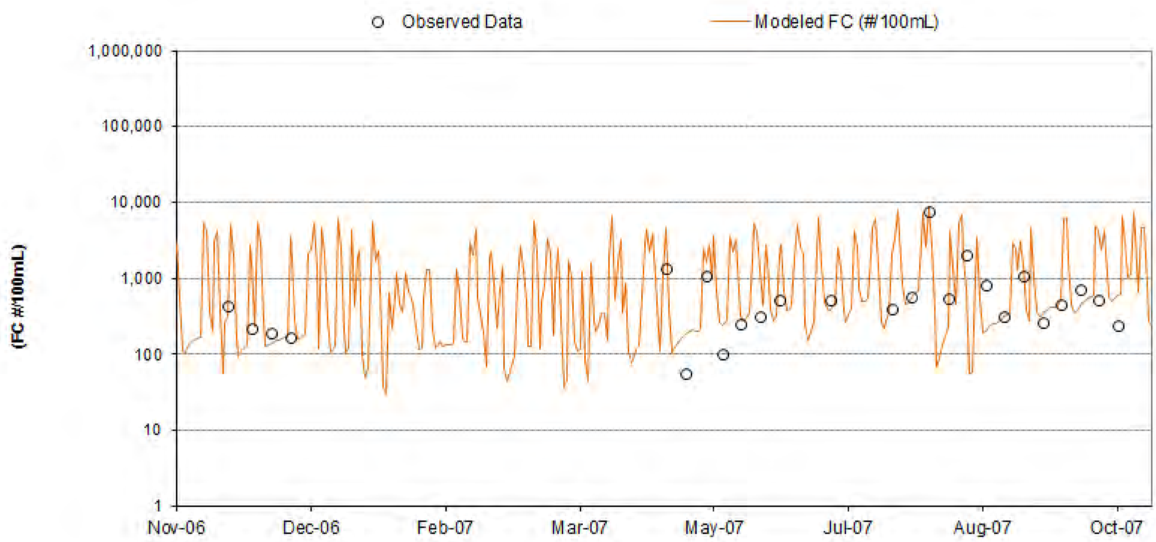


Figure E-20. Bacteria (fecal coliform; CFU/100 mL) calibration at station 20 vs. SWS 21.



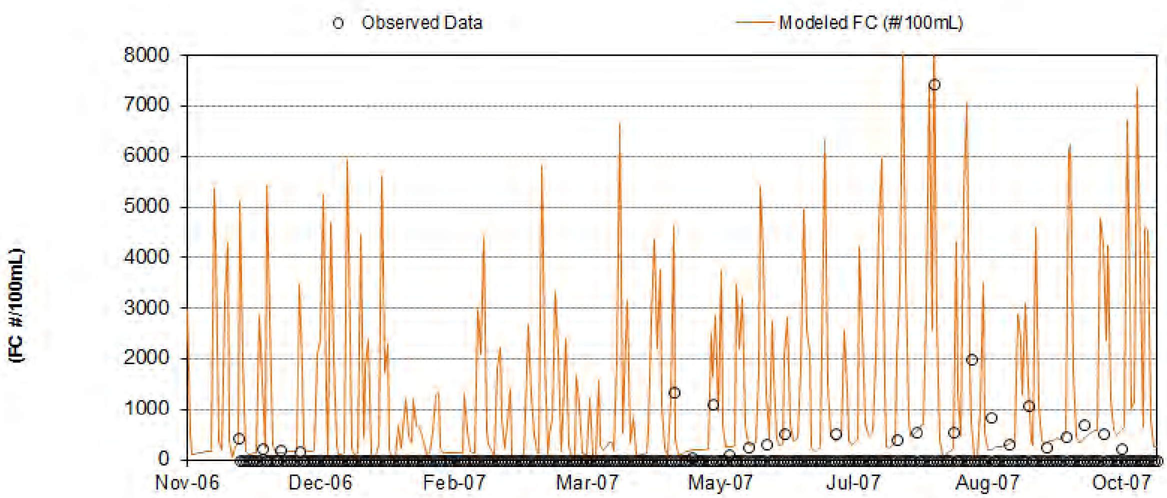


Figure E-21. Bacteria (fecal coliform; CFU/100 mL) calibration at station 21 vs. SWS 801.

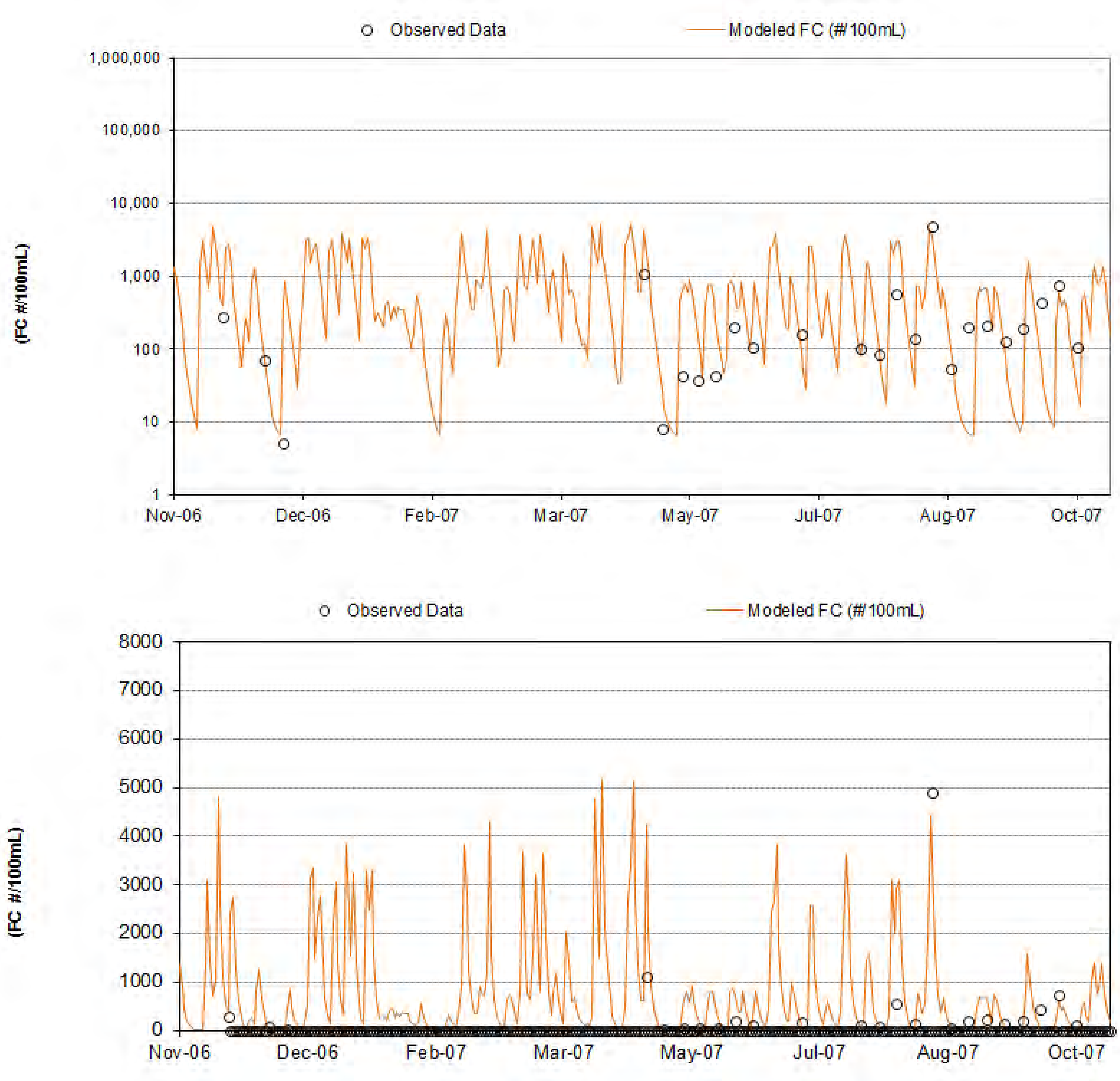
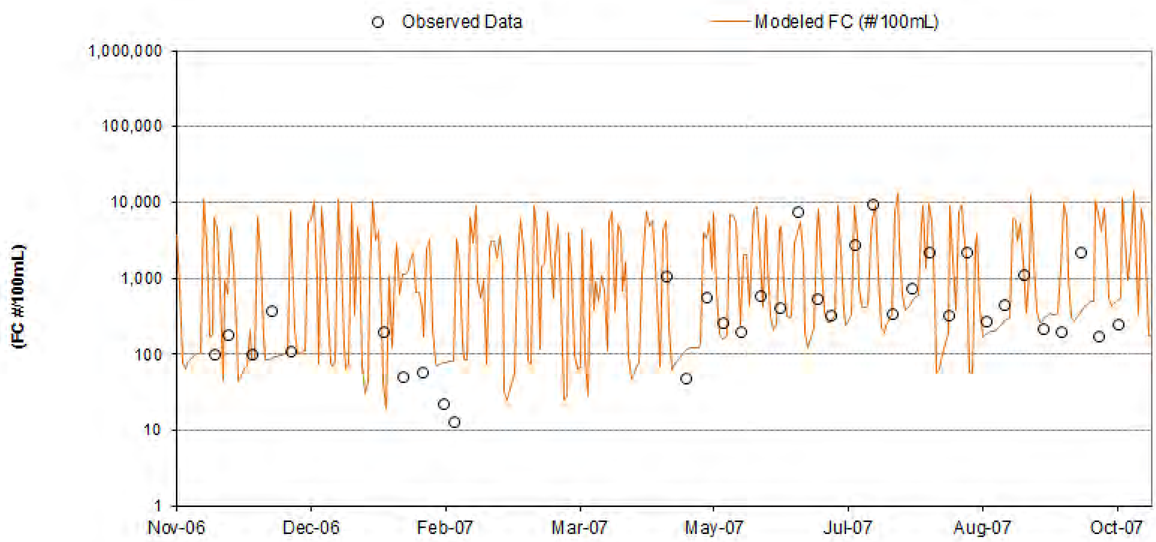


Figure E-22. Bacteria (fecal coliform; CFU/100 mL) calibration at station 22 vs. SWS 22.



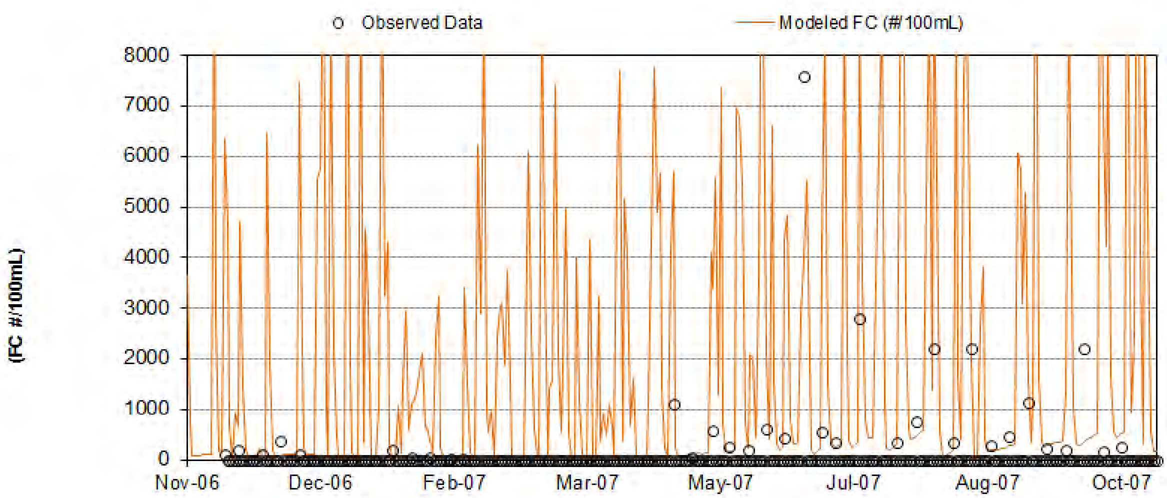
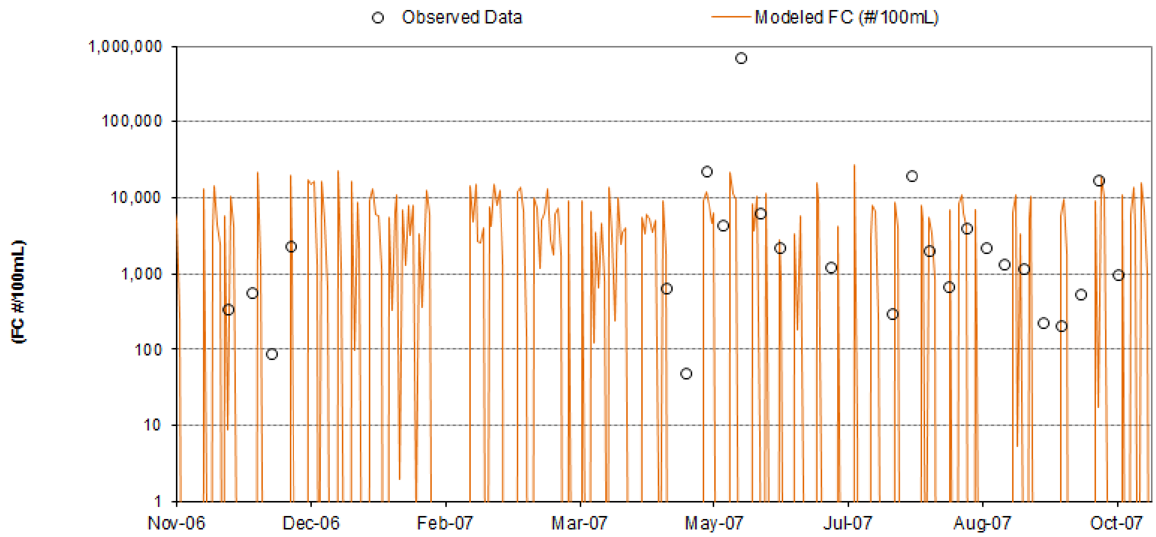


Figure E-23. Bacteria (fecal coliform; CFU/100 mL) calibration at station 23 vs. SWS 901.



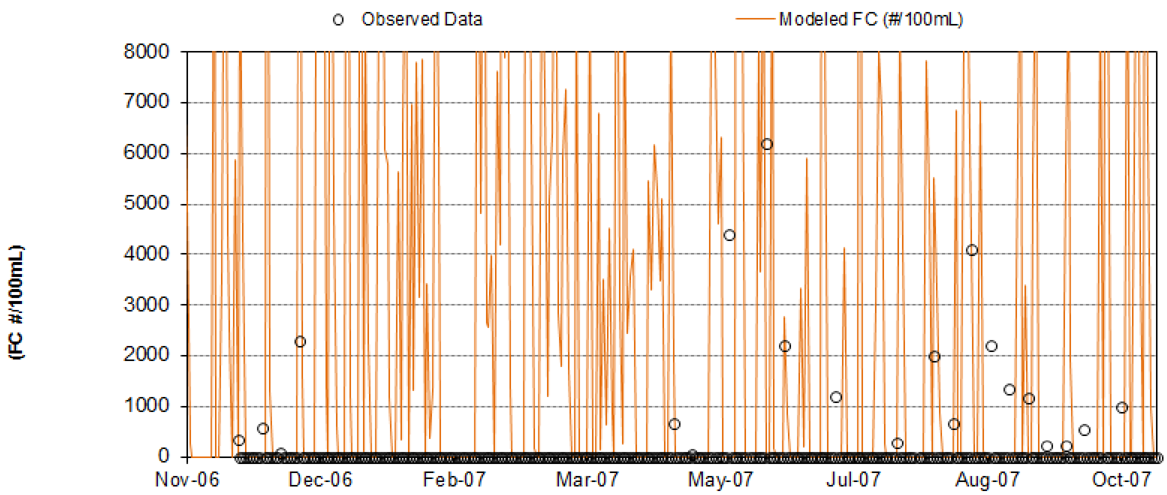


Figure E-24. Bacteria (fecal coliform; CFU/100 mL) calibration at station 24 vs. SWS 1001.

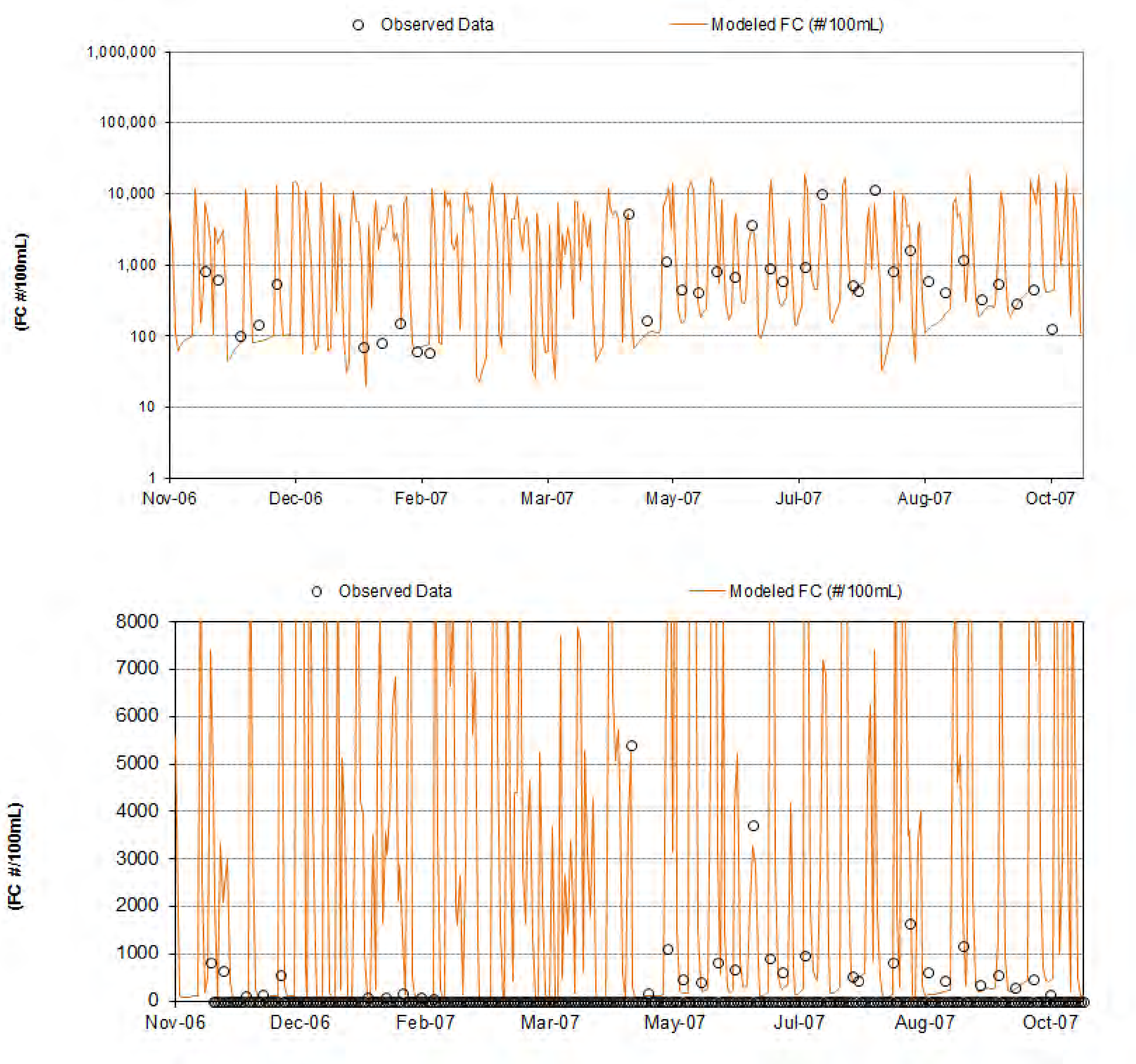


Figure E-25. Bacteria (fecal coliform; CFU/100 mL) calibration at station 25 vs. SWS 1102.

Appendix F. WILDLIFE SOURCES

The model methodology to simulate contributions from animals across the landscape requires estimates of animal densities by land use. Sources for these data are varied and applying them directly to modeling is difficult due to differing methodologies, types of data collected and areas represented. EPA reviewed a variety of potential sources and applied estimates that were most directly translatable to the Pine Creek watershed.

Deer

Sources reviewed to derive estimates of deer densities included Pennsylvania Game Commission (PAGC) deer harvest and GIS data, regional studies, and estimates utilized for deer management in nearby localities. A review of this information provides a range of possible densities. Findings are summarized briefly below.

A study presented at the 10th Central Hardwood Forest Conference, *History of Deer Population Trends and Forest Cutting on the Allegheny National Forest*, presents some estimates of deer densities in the forests of the Allegheny Plateau region in northwestern Pennsylvania through various historical periods. The study says that for the period from 1980 to the present (1995) the PAGC estimated deer densities at about 30 per square mile in the area. It also cited data from 11 sites in 1992 that showed a range across the forest of 19 to 49 deer per square mile, (averaging 29 deer per square mile).

Information related to the PAGC's relevant data collection activities was available in its 2009-2018 Deer Management Plan (PAGC 2009). Annually, the PAGC collects information on deer harvest (among other indicators) to establish management guidelines for each of its 22 WMUs. WMU B2, in which Pine Creek is located, is a heavily developed WMU and the current management objective for the deer population is to decrease herd size. Estimated deer populations for the period 2005-2009 for WMU 2b have been relatively stable (PAGC 2010).

The PAGC does not collect data on population densities as they manage based on a suite of indicators related to habitat health, herd health and relative population trends. However harvest data are available which can help to establish at least minimum population densities for the purposes of estimating fecal loading from deer. Numbers related to what percentage of the total population is harvested in a given year are not available. Depending on herd structure, age, sex and other factors such as management objectives, the number harvested as a percentage of the total population size may vary from 6 to 44 percent (Guynn 1985).

PAGC Deer Harvest by County GIS data were available for 2003. This GIS coverage shows that a total of 6,490 deer were harvested in Allegheny County in 2003. Harvested deer are reported as antlered (1,700) or antlerless (4,790). Total area for the county is approximately 1,927,021,645 square meters (744 square miles). Given these numbers, a harvest density of approximately 8.7 deer per square mile can be calculated. Assuming the number harvested was 25 percent of the total population (an average value based on the estimates from Guynn), there would be approximately 34.9 deer per square mile.

In addition, GIS deer harvest data by WMU are also available for the years 2005, 2006, 2008, 2009 and 2010. The total area of WMU 2B is 3,529,792,196.45 square meters (1362.86 square miles). Table F-1 provides a summary of density estimates derived from PAGC GIS data. If one assumes that the number of deer harvested is 35 percent of the total, and averaging the data for all the available years, one can calculate an estimated deer density for the WMU as 38.4 deer per square mile.

Table F-1. PAGC deer harvest data-derived density estimates

Unit	Year	Antler	Antlerless	Total	Total Area (mile^2)	Harvest Density (mile^2)	Estimated Deer Population[a]	Estimated Deer Density (per mile^2)
County	2003	1700	4790	6490	744	8.7	18542.9	24.9
WMU	2005	4200	16000	20200	1362	14.8	57714.3	42.4
WMU	2006	5200	14500	19700	1362	14.5	56285.7	41.3
WMU	2008	4400	15300	19700	1362	14.5	56285.7	41.3
WMU	2009	4000	15300	19300	1362	14.2	55142.9	40.5
WMU	2010	4300	20000	24300	1362	17.8	69428.6	51.0
			AVERAGE			15.2	52233.3	38.4

a. Assuming number harvested represents 35 percent of the total

The deer management plan for the nearby Town of Mt. Lebanon, (approximately 7 miles south of the mouth of Pine Creek) estimates approximately 15 deer per square mile (Pittsburgh Post-Gazette 2006). This was the estimate used by EPA in the original Draft TMDL as it was suggested by a local stakeholder (Bill Moul via Jennifer Novack of the Pennsylvania Environmental Council).

In 1993 and 1994, the Borough of Fox Chapel, on the southeastern edge of the Pine Creek watershed, performed two deer density studies. In 1993, the Borough commissioned a consulting biologist to study deer density in the Borough pursuant to a Game Management Plan submittal to the PAGC (Wiggers 1993). His report in 1993, documented by the Borough Council Minutes, estimated 272 deer (Fox Chapel Borough 1993). A 1994 infrared census counted approximately 340 deer in the Borough (Airscan Inc. 1994). Table F-2 provides density estimates for deer based on these findings, which assumed approximately 1900 acres of woodland habitat. Note that the total area of Fox Chapel Borough is approximately 7.8 square miles. It is not entirely clear that both count efforts limited their survey to only wooded areas; there was one statement by the study author in the Committee minutes (from which these estimates are derived) that noted there were approximately 1900 acres of woodland habitat in the Borough.

> Dr. Wiggers reported that his survey found 272 deer in the Borough, and he indicated that there are about 1,900 acres of woodland cover in the Borough. Given a desired density of between 12 and 20 deer per square mile of woodland, the herd needs to be reduced to between 36 and 60 total deer. Based on projections of "normal" birth and mortality rates, he indicated that a minimum of 221 deer would have to be removed during the next three years in order to reach the desired population. Thereafter[1], he predicted that about 10 deer a year would need to be removed in order to maintain the low density levels.

Considering deer might potentially be found on land uses other than wooded, a second calculation of density based on the area of the entire borough results in estimates of 34.9 and 43.6 deer per square mile for the 1993 and 1994 studies respectively.

Table F-2. Fox Chapel Borough deer density estimates

	# Deer	Woodland habitat		Deer density (per acre)	Deer density[a] (per square mile)	Deer density[b] (per square mile)
		Acres	Square miles			
1993 Study	272	1,900	2.97	0.143	91.6	34.9
1994 Census	340	1,900[c]	2.97	0.1789	114.5	43.6

[a] Based on 1900 acres of woodland habitat
[b] Based on area of entire borough (7.8 square miles)
[c] no information provided related to area studied; assumed 1,900 acres

Finally, Table F-3 presents the recorded deer accidents and deaths from several of the Pine Creek Municipal Police Department reports for 2006, 2007, and 2011. This information seems to indicate a higher rate of deer incidents in the southern townships (Shaler and McCandless in particular), which are more developed. This could be due to a higher population of deer or a higher volume of traffic.

Table F-3. Recorded deer accidents and deaths from local police reports

Municipality(ies) reporting	Municipal area ($mile^2$)	Deer killed/injuries		
		2006	2007	2011
Pine-Richland-Marshall-Bradford Woods	47.8	325	321	245
Shaler	11.2	136	156	147
McCandless	16.5	215	175	163
Indiana	17.5	57	55	44
Totals	93	733	707	599

Source: North Hills Council of Governments

In summary, deer density estimates are highly variable and dependent upon assumptions used to calculate them. Review of the references above yields per square mile estimates from as low as 15 per square mile to as high as 114. See Figure F-4 for a summary. The average of all the estimated densities is 46 deer / $mi^2$and that is the number used to represent deer density in the Pine Creek watershed for the TMDL.

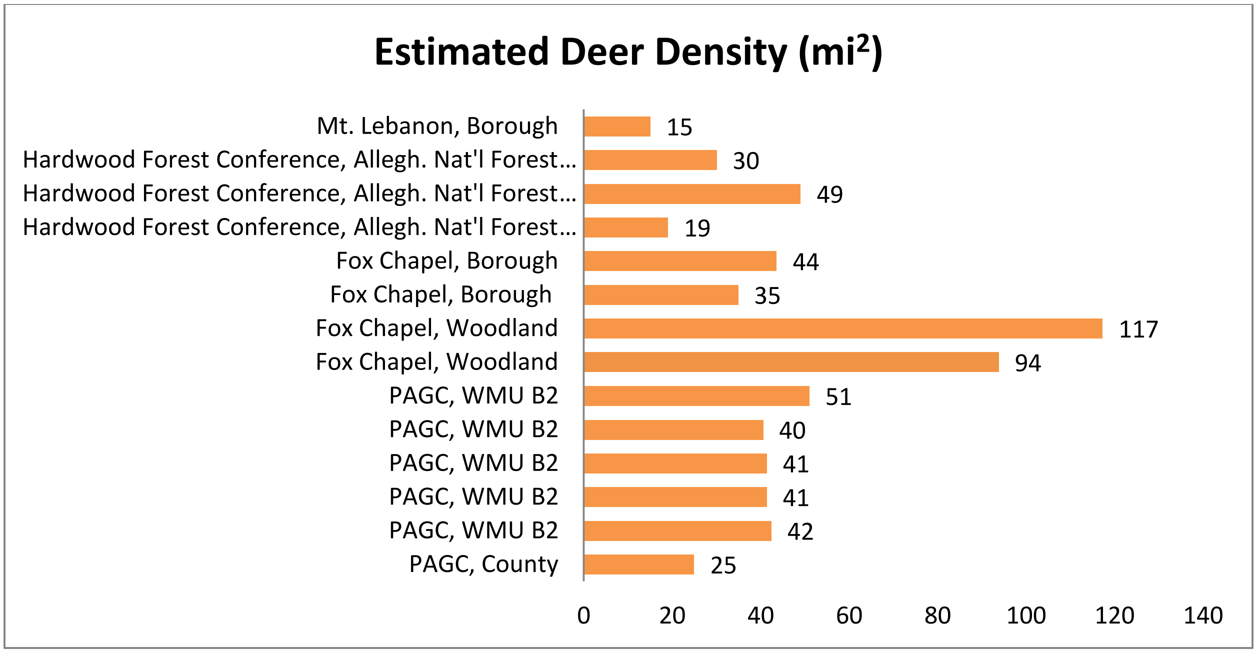


Figure F-4. Estimates of regional deer densities based on various data sources (average = 46 / square mile).

Turkey

Turkey harvest data in GIS form are available from PAGC by WMU for the period 2003-2009.

Bird counts are available from the Audubon Society of Western PA. The Christmas Bird Count (CBC) is a winter survey, in which volunteer observers conduct a day-long count within a 15-mile diameter sample unit, or *circle.* Counts are conducted within the period from December 14 to January 5. The center of the specific CBC circle is Glenshaw, Pennsylvania, and encompasses much of the Pine Creek watershed. Indicated subareas surveyed are Fox Chapel, Franklin Park, Hampton, Indiana, Kilbuck, North Park, Oakmont, O'Hara, Penn Hills, Pittsburgh, Ross, and Shaler. The CBC is a sampling—not a census—therefore, the counts represent a floor for bird population observed in the greater CBC circle and subcircles.

A March 2011 online article from *American Hunter* reviewed top turkey hunting states and provided some statistics related to turkeys harvested and total population. "Last year Pennsylvania hunters tagged 42,478 (4th overall) of the state's estimated 360,000 (3rd highest population) wild turkeys, part of that success, no doubt, is the result that the state is among one of the most crowded with sportsmen. Despite the high rankings, the harvest rate was only 12 percent of the overall population meaning there is still ample seed stock for producing more birds each year." http://www.americanhunter.org/articles/top-states-turkey-hunting/

Table F-4 provides a summary of turkey data from both the PAGC harvest information and the CBC. Since the CBC data are more representative of a minimum for the survey area, the PAGC data are probably more appropriate for estimating average densities of turkey in the watershed. Turkey density in the TMDL was therefore based on an average of the PAGC-based estimates.

Table F-4. PAGC turkey harvest data for WMU B2 and density estimates

Data	Year	Spring	Fall	Total harvested	Total area mi^2	Estimated turkey population	Turkey density per mi^2
PAGC	2003	2,173	1,086	3,259	1,362	27,158	19.9
PAGC	2004	1,995	1,046	3,041	1,362	25,342	18.6
PAGC	2005	1,658	839	2,497	1,362	20,808	15.3
PAGC	2006	1,851	1,117	2,968	1,362	24,733	18.2
PAGC	2007	1,382	805	2,187	1,362	18,225	13.4
PAGC	2008	2,221	319	2,540	1,362	21,167	15.5
PAGC	2009	1,555	714	2,269	1,362	18,908	13.9
CBC	2006			142	177		0.8
CBC	2007			84	177		0.5
CBC	2008			149	177		0.8
CBC	2009			154	177		0.9
CBC	2010			128	177		0.7
						Average	9.9[b]
						Average (PAGC only)	16.4

[a] Assume number harvested is 12 percent of total population
[b] Draft TMDL modeling assumed density of 4 per mi^2

Geese

Data from the CBC have been collected for nearly 100 years. Annual data from the 2006, 2007, 2008, 2009, and 2010 CBC were reviewed. Data for the species important for modeling are summarized in Table F-5. It is important to note that for the years 2006, 2007, and 2008 the North Park subarea was responsible for 46, 41 and 41 per cent respectively of the CBC total for Canada Geese. Geese counts in North Park went down in 2009 and 2010 (presumably due to dredging of North Park Lake) with 30 per cent and 15 per cent of the CBC total for those years. According to staff of the Audubon Society of Western PA, the boundaries of the North Park survey subsection are analogous to the boundaries of Allegheny County's North Park. GIS data for North Park were obtained from the Allegheny County Parks layer (available from PASDA). The area of North Park is approximately 4.2 mi^2. Density of geese in North Park can therefore be calculated based on the CBC data and the surveyed area of the park. For the years 2006-2008, average density of Canada Geese was 139.1 per square mile. In the rest of the survey area, density of geese is 4.5 / mi^2.

Table F-5. Audubon CBC area bird count data

	2006	2007	2008	2009	2010	Area (mi^2)	Average #	Average # ('06-'08)	Average density (mi^2)
Canada Geese (CBC area)	1,197	1,499	1,415	963	805	177	1,176	1,370	6.6
Canada Geese (North Park)	556	615	582	330	118	4.2	440	584	139.1
Canada Geese (non-North Park)	641	884	833	633	687	174.9	736	786	4.49
Mallard Ducks	1,019	917	540	819	1,044	177	868	--	4.9
Wild Turkey	142	84	149	154	128	177	131	--	0.7

Waterfowl

CBC data for waterfowl in the survey area are listed in Table F-6. According to staff from the Audubon Society of Western PA, mallards and other non-geese waterfowl are generally found on the open waters of the creeks and rivers. For modeling, it is appropriate to represent them as direct contributors to streams rather than simulating their contributions on the basis of densities.

Table F-6. CBC data for waterfowl (non-geese)

YEAR	Fox Chapel	**Fr. Park**	**Hampton**	**Indiana**	Kilbuck	**North Park**	Oakmont	**O'Hara**	Penn Hills	Pittsburgh	**Ross**	**Shaler**
2010	3	**0**	**35**	**2**	39	**160**	19	**12**	6	486	**154**	**146**
2009	13	**0**	**52**	**2**	51	**77**	29	**3**	11	1596	**0**	**164**
2008	3	**2**	**36**	**0**	13	**94**	23	**28**	8	239	**21**	**91**
2007	4	**2**	**75**	**0**	4	**92**	195	**6**	13	493	**0**	**50**
2006	19	**0**	**87**	**36**	8	**170**	130	**10**	48	454	**13**	**55**
2005	13	**0**	**144**	**18**	38	**132**	92	**22**	49	786	**101**	**75**
Annual Average	9	**1**	**72**	**10**	26	**121**	81	**14**	23	676	**48**	**97**

Bold townships are those where the counted waterfowl are likely to be in/on portions of the Pine Creek network. For example, the mallards counted in the Pittsburgh subsection were most likely on the open waters of the Allegheny River and thus, should not be counted as part of the Pine Creek population.

For modeling, all waterfowl (excluding Canada geese) counted during the CBC during the years 2005-2010 were used. The total number of water fowl surveyed (excluding Canada geese) was calculated for each year by subsection and then the average annual total for each subsection was calculated. This number was the initial number used to represent direct contributions of waterfowl (non-Canada geese) to stream reaches (i.e. , this number of animals was assumed to be in the stream each day) and then adjusted as a calibration parameter. See Table F-7. For example, in model stream reach 202, representing a portion of the East Little Pine Creek in O'Hara Township, the initial calibration simulated 14 *waterfowl* directly contributing bacteria to the stream.

Table F-7. Average numbers of waterfowl by CBC subsection for survey years 2005-2010

Borough	Franklin Park	Hampton	Indiana	North Park	O'Hara	Ross	Shaler
# waterfowl	1	72	10	121	14	48	97
Stream Reach	1201	18	204	21	202	104	103

Appendix F References

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Appendix G. Implementation Framework

Appendix to Pine Creek Bacteria TMDL

PINE CREEK TMDL IMPLEMENTATION FRAMEWORK

IMPLEMENTATION GOALS AND EXAMPLES FOR MS4 ENTITIES

Introduction

State water quality standards are the basis of the biennial assessment of a state's water quality pursuant to Section 303(d) of the Clean Water Act (CWA). Pursuant to Section 303(d) implementing regulations and applicable guidance, each state is required to identify a list of impaired waters, referred to as the "303(d) list," for which technology based effluent limits and other controls are not sufficient to attain applicable water quality standards and/or designated uses. For those waters on the final 303(d) list, the CWA requires States to develop Total Maximum Daily Loads (TMDL) to address these water quality impaired segments. A TMDL sets the maximum amount of a pollutant that may be introduced into a receiving water and still attain applicable water quality standards. A TMDL also establishes pollutant load allocations to various sources discharging to the stream, including wasteload allocations (WLAs) for point sources and load allocations (LAs) for non-point sources. Municipal separate storm sewer systems (MS4s) are among those sources defined as point sources under the CWA.

EPA has developed the "Bacteria TMDLs for the Pine Creek Watershed, Allegheny County, Pennsylvania" to which this Implementation Framework refers. The purpose of this document is to articulate an effective and feasible framework for the implementation of the Pine Creek TMDL WLAs for MS4s. EPA intends this document to assist municipalities in developing their own strategy to address required National Pollutant Discharge Elimination System (NPDES) MS4 provisions and controls issued consistent with the WLAs established in the Pine Creek TMDL. This document is intended to outline a framework for implementing the Pine Creek TMDL and does not establish any additional requirements or authority beyond those existing CWA requirements and authority. This document is intended for informational purposes and does not represent a final agency decision.

While implementation generally is beyond the scope of this TMDL, EPA provides the following clarification of the assumptions and requirements of this TMDL. EPA anticipates that implementation of the MS4 WLAs in the Pine Creek watershed will be achieved over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. Below are EPA documents that provide guidance for expressing wasteload allocations in stormwater permits.

- November 22, 2002 guidance document titled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on those WLAs."

- November 12, 2010 guidance document titled, "Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs"

EPA expects that the Pennsylvania Department of Environmental Protection (PADEP), as the NPDES permitting authority, will review the information provided by the TMDL and by the Pine Creek communities over time, and determine how best to incorporate the TMDL WLAs into NPDES permits. In addition to EPA's 2002 and 2010 guidance, factors to be considered might include:

- The appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality.

- The work achieved under the Wet Weather Plan that the Allegheny County Sanitary Authority (ALCOSAN) is required to implement by September 30, 2026 pursuant to the federal consent decree between the United States, Commonwealth of Pennsylvania Department of Environmental Protection, the Allegheny County Health Department and ALCOSAN, in Civil Action No. 07-0737 of the United States District Court for the Western District of Pennsylvania. To the extent that ALCOSAN's Wet Weather Plan addresses separate sanitary and combined sanitary sewer systems in part of the Pine Creek watershed, improvements under the Wet Weather Plan are likely to further implement the TMDL.

- PADEP and/or the Pine Creek communities may request for EPA to amend the TMDL to reflect information obtained during the course of its implementation.

- Whether the Pine Creek municipalities use an integrated resource approach that involves watershed-wide storage and reuse and onsite treatment.

In order to reduce pollutant discharges from stormwater, permittees are likely to be required to reduce loadings by implementing a suite of structural and non-structural BMPs over a certain period of time. Choosing effective stormwater BMPs is one of the key challenges facing anyone interested in improving or protecting the quality of our local waters, and it is important to have a good understanding of sources of bacteria, treatment processes expected to be effective in reducing bacteria, and the performance of BMPs. Potential BMPs that can be used to implement this TMDL include both structural and non-structural techniques. Structural BMPs are engineered systems and methods designed to control contamination from the discharge of bacteria and may include temporary storage and treatment of stormwater runoff, as well as elimination of SSOs, CSOs, leaking infrastructure, failing septic systems and illicit connections. Other structural BMPs that could improve the water quality of Pine Creek specifically might include fencing for livestock and/or stream buffering to keep animals from directly introducing wastes into the stream. Non-structural BMPs include stormwater runoff management techniques that use natural measures to reduce pollution levels, do not require extensive construction efforts, and either limit the generation of stormwater runoff, or reduce the amounts of pollutants contained in the runoff. They usually work by changing behavior through government regulation (e.g., planning and environmental laws), incentives, persuasion, training and/or economic instruments. This type of BMP includes institutional, educational or pollution prevention practices such as pet waste management ordnances, and management practices such as the collection, storage, transportation, and application of animal waste on farm land.

Permittees then need to evaluate the effectiveness of BMPs implemented to work toward achievement of loading reductions, make adjustments where performance was less than expected, and incorporate lessons learned in future BMP implementation activities.

In Pennsylvania, "small MS4s," as defined by 40 C.F.R. § 122.26(b)(16), within defined urbanized areas are regulated either by the State's General NPDES Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems, PAG-13, or individual permits where stormwater discharges to special protection waters. Typically, the individual permit would follow the same requirements as the general permits, but also contain additional protective conditions to ensure that the special protection waters are not degraded. The renewed general permit contains a requirement in Part C.1 of the Authorization to Discharge which states "[i]f the regulated small MS4 discharges stormwater into any portion of a receiving water with applicable wasteload allocations (WLAs) in approved TMDLs, the permittee shall implement an approved MS4 TMDL Plan that is designed to achieve pollutant reductions consistent with the applicable wasteload allocations (WLAs) in the TMDLs". The PAG-13 permit further requires the MS4 TMDL Plan to include implementation of pollutant control measures designed to achieve pollutant reductions consistent with the conditions and assumptions of the applicable WLAs in the TMDL. In addition, PAG-13 requires the MS4 TMDL plan strategy (narrative) to be submitted with the permittee's application and approved by PADEP. Within one year of the approval of coverage from PADEP to discharge, the permittee is required to submit to PADEP the MS4 TMDL Plan design details for, *inter alia,* the BMPs that will be implemented during the term of the permit . The Permit also requires that MS4 TMDL Plans include a timeline (schedule) with milestones that are implemented as soon as practicable, but no later than the approved timeline. Moreover, the Permit identifies the required contents of MS4 TMDL Plans and requires that the permittee's progress as to implementation of the MS4 TMDL Plan (including any additional or modified BMPs) be fully described in each periodic report to the PADEP Regional Office. In the case of Pine Creek, the Southwest Regional Office will receive the applicable MS4 TMDL Plans.

The following Implementation Framework contains an outline of goals and milestones options to assist municipalities in developing their own strategy to address required NPDES MS4 provisions and controls issued consistent with the WLAs established in the Pine Creek TMDL.

I. Identify sources of bacteria within the regulated portion of your MS4

Sources listed within the TMDL include:

a. Municipal Sanitary Systems
b. Septic Systems
c. Stormwater
d. Agriculture
e. Wildlife

The Pine Creek TMDL identifies the existing sources of pollutant loading from the stormwater source's discharge to the impaired waterbody based on a 2006 to 2008 timeframe. The TMDL WLA establishes the loading (and estimates of load reductions) needed from each of these sources to achieve applicable water quality standards. The TMDL analysis provides information on the sources of pollutants under conditions in 2006 to 2008. It does not provide comprehensive information on BMPs that may have been installed after 2008. One starting place for permittees in drafting their respective MS4 TMDL Plans might be to provide an accounting of BMPs installed after 2008 and quantifying and documenting the associated pollutant load reductions from those BMPs. The first activity involves developing an inventory of existing BMPs that would affect loads of the pollutant of concern that may have not been accounted for in the TMDL. The second activity involves measuring and documenting the pollutant load reductions from the BMPs identified in the inventory and its impact on achieving the WLAs.

II. Develop goals and milestones for those sources of bacteria identified

a. <u>Municipal Separate Sanitary Sewer Systems and Storm Sewer Systems</u>

Goal #1: Reduce sources of bacteria in residential and urban areas through the repair and replacement of failing infrastructure

(PAG-13 MCM #3, BMP #1 requires that permittees develop and implement a written program for the elimination and prevention of illicit discharges into the regulated MS4)**

<u>Examples:</u>

- Ensure sanitary sewage collection system and stormwater system maps are up to date
  (PAG-13 MCM #3, BMP #2 requires that permittees update and maintain a map of the regulated MS4 including the location of all outfalls and identity of receiving waters)**
- Survey sanitary sewer systems using smoke testing, dye testing, or CCTV to locate bacteria sources resulting from inflow and infiltration
- Upgrade lines that are known sources of sanitary sewer overflows
- Prevent infiltration/exfiltration through manhole relining
- Repair known sources of inflow and infiltration in sanitary sewage collection system
  (PAG-13 MCM #3, BMP #5 requires permittees to enact a stormwater ordinance to implement and enforce a stormwater management program that includes the prohibition of non-stormwater discharges to the regulated MS4)**

Goal #2: Reduce urban and residential inputs by performing inspection, monitoring and maintenance activities to eliminate illicit discharges, ensure proper stormwater system performance and prevent pollution

(PAG-13 MCM #3, BMP #4 requires the permittee to follow their Illicit Discharge Detection and Elimination (IDDE) program and conduct outfall field screening during dry weather to identify the source of any illicit discharges and effectively remove or correct them)**

Goal #3: Consider sewerage of areas with large quantities of failing septic systems to public sewers

(PAG-13 MCM #3, BMP #1 states that your written IDDE program shall include procedures for assessing the potential for illicit discharges caused by the interaction of sewage disposal systems {e.g. on-lot septic systems, sanitary piping} with your storm drain systems)**

Goal #4: Reduce sources of bacteria in urban and residential areas through education

(PAG-13 requires that permittees develop, implement and maintain a written Public Education and Outreach Program as part of MCM #1. In addition, MCM #3, BMP #6 requires that permittees provide educational outreach to the public about the program to detect and eliminate illicit discharges)**

<u>Examples:</u>

- Homeowner lateral connection responsibilities
- Illicit Discharge Detection and Elimination (IDDE)

b. <u>Septic Systems</u>

Goal #1: Reduce sources of bacteria through removal of unsewered facilities

(See PAG-13 requirements listed above)**

<u>Examples:</u>

- Repair/replace failing septic systems, starting in areas with known problems specified in the TMDL
- Develop plans for straight pipe detection and elimination
- Educate owners of septic systems regarding proper care and maintenance

c. <u>Stormwater</u>

Goal #1: Implement stormwater best management practices to aid in reducing bacteria from urban sources

<u>Examples:</u>

- Based on available studies and info found in the EPA BMP database, Table 1 below was created to give MS4s options for BMP selection, if needed.

Goal #2: Seek opportunities for remediation with redevelopment

(PAG-13 MCM #5, BMP #5 requires permittees to develop and implement measures to encourage and expand the use of Low Impact Development (LID) in new and redevelopment, including enacting ordinances consistent with LID**

practices and repealing sections of existing ordinances which conflict with LID practices.)

Examples:

- Green Infrastructure and Ordinances
- Impervious Cover Reduction
- Restore and protect stream banks for additional reductions, where found to be cost-effective

Goal #3: Ensure municipal storm sewer system maps are up to date and include pertinent information such as drainage areas and watershed boundaries

(PAG-13 MCM #3, BMP #3 requires renewal permittees to update the entire storm sewer collection system, including roads, inlets, piping, swales, catch basins, etc. and other features)**

Goal #4: Reduce sources of bacteria in urban and residential areas through education

(PAG-13 MCM #3, BMP #6 requires that permittees provide educational outreach about the program to detect and eliminate illicit discharges)**

Examples:

- Pet waste management
  http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=4&minmeasure=1
- IDDE awareness
  http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=111&minmeasure=3
- Trash/debris management
  http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=5&minmeasure=1,3
- Proper Landscaping/Lawn Care
  http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=97&minmeasure=1

Table 1 Stormwater BMP Examples

BMP	Effectiveness [1]	Cost [2]	Maintenance (H,M,L)	Limitations	Links
Infiltration Trench	90%	$\$5/ft^3$	H	Groundwater concerns	http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=70&minmeasure=5
Bioretention	90%	$\$7.3/ft^3$	L	Arid or cold climates may require minor design modifications.	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=72
Storm Drain System Cleaning	65%-75% [3]	\$1-2/ft [4]	L		http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=102&minmeasure=6
Sand & Organic Filters	55%	$\$5/ft^3$ [5]	H	Not recommended on fill sites, near steep slopes or in cold climates	http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=73&minmeasure=5
Stormwater Wetland	76-78%	\$57K/1ac-ft \$289K/10 ac-ft	M	Large area needed, proper design required, may release nutrients	http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=74&minmeasure=5
Wet Ponds	≈65% [6]	\$46K/1ac-ft \$232K/10ac-ft	L	Require large area, potential safety hazards	http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=68&minmeasure=5

1. Removal average is based on good design and well maintained BMPs, which are sized to treat the 1-inch storm.
2. Estimated dollar amounts based on volume of stormwater treated.
3. % Removal rate for organic material which would include bacteria sources.
4. The cost of a vactor truck can range from \$175,000 to \$200,000, and labor rates range from \$125 to \$175 per hour.
5. Although underground and perimeter sand filters can be more expensive, they are relatively cost effective in ultra urban areas where land is at a premium.
6. Highly variable due to location, design and maintenance of ponds.

d. Agriculture

Goal #1: Cooperate with agricultural landowners regarding selection and implementation of BMPs on their properties

Examples:

- Removal of livestock from streams
- http://ohioline.osu.edu/ls-fact/0004.html
- Installation of fencing, buffers, and stream crossings on pasturelands http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=50&minmeasure=4
- Alternative water systems
- Proper fertilizer and manure application http://www.umich.edu/~nppcpub/resources/compendia/AGRIpdfs/AGRIcons.pdf

Goal #2: Contact PADEP to report stockyards out of compliance with state standards

e. Wildlife

Goal #1: Identify areas prone to wildlife congregation

Goal #2: Develop a plan for effective source control

Examples:

- Pick up after pets and properly dispose of the waste (proper disposal includes flushing pet waste down the toilet, throwing it out with the trash, or burying it in the yard)
- Refrain from feeding wildlife, especially near streams, rivers, or beaches
- Secure outdoor trash cans
- Do not leave pet food in areas accessible to wildlife
- Encourage local government to introduce pet waste programs

III. Develop Implementation Timeline

Milestones: For each option selected, include a timeline for completion. An **example** is provided in the table below.

NOTE: PAG-13 requires the development of an MS4 TMDL Plan, which must include a schedule and milestones for implementation. Any options selected in a particular MS4 TMDL Plan will become enforceable requirements of the permit for that MS4. Therefore it is important to specify dates for implementation rather than using a general schedule as is depicted below. Instead of stating Years 1-5 for implementation of stormwater BMPs, the TMDL Plan should state, for example, that BMP #1 will be completed by Dec. 31, 2014; BMP #2 will be completed by June 1, 2016, etc.

Example	Responsible Party	Stage 1 (Years 1-5)	Stage 2 (Years 6-10)	Stage 3 (Years 11-15)
Municipal Sanitary Systems				
Update Sewage Collection System Maps	Municipal Authority	Year 1	Year 6	Year 11
Survey Sanitary Sewer System	Municipal Authority	Years 1-3		
Upgrade lines that are known sources of SSOs	Municipal Authority	Years 1-5	Years 6-7	
Prevent Infiltration/Exfiltration through manhole relining	Municipal Authority	Years 1-3		
Repair Known sources of I/I in sanitary sewage collection system	Municipal Authority	Years 1-5		
Septic Systems				
Repair /Replace failing septic systems	Municipal Authority	Years 1-5	Years 6-8	
Develop Plans for straight pipe detection and elimination	Municipal Authority	Years 1-3		
Educate owners of Septic systems	Municipal Authority	Years 1-5	Years 6-10	Years 11-15
Stormwater				
Implement Stormwater BMPs	Municipality	Years 1-5	Years 6-10	Years 11-15
Seek Opportunities for remediation with redevelopment	Municipality	Years 3-5	Years 6-10	Years 11-15
Ensure MS4 Map is up to date	Municipality	Year 1	Year 6	Year 11
Reduce sources of bacteria through education	Municipality	Years 1-5	Years 6-10	Years 11-15
Agriculture				
Contact agricultural Landowners	Municipality	Years 1-3		
Remove Livestock from Streams	Agricultural landowner	Years 2-5	Years 6-10	
Install Agricultural buffers and fencing	Agricultural landowner	Years 2-5		
Alternative water sources	Agricultural landowner	Years 3-5		
Wildlife				
Identify areas prone to wildlife congregation	Municipality	Years 2-4		
Develop a plan for effective source control	Municipality	Year 5	Year 6	

IV. Assessment of Examples/Options Selected

Achieving Reductions

There are a couple of options that can be utilized to determine the reductions expected to result from the practices that are implemented by the MS4.

1. Mathematical calculations using BMP removal efficiencies and flow data can be used to quantify expected pollutant reductions. A number of studies and the EPA BMP database provide percent effectiveness which can be used as a tool to assist in performing an engineering statistical analysis to demonstrate measurable progress toward meeting the TMDL reduction. (See Table 1 above for further information)

2. Post-construction monitoring of BMPs may also be performed to determine BMP effectiveness. Using grab sampling techniques, discharge outfalls can be evaluated for the amount of pollutant reduced as a result of the selected practices.

V. Pennsylvania Environmental Council's October 2009 Pine Creek Watershed Implementation Plan

A 2009 Watershed Implementation Plan for the Pine Creek Watershed was developed by the Pennsylvania Environmental Council (PEC) using PADEP-allocated 319 money. The goal of the plan is to determine how best to reduce the nonpoint source pollutant loads in the Pine Creek Watershed, including nutrients, pathogens, and siltation impairments identified on PADEP's 2008 IR. Consistent with this TMDL, the plan suggests that these pollutants are primarily from urban runoff and storm sewers, but other sources include land development, on site wastewater, small residential runoff, and unknown sources. Detailed analyses of BMP placement and efficiency are included in the 2009 Watershed Implementation Plan and should be consulted when implementing this TMDL. Although primarily focused on reducing the volume of stormwater, more specific recommendations found in the plan could be useful for TMDL implementation.

VI. North Park Lake Dredging Modification Scenario

The model used in this TMDL was calibrated using 2006 to 2008 data which are representative of pre-dredged conditions of the North Park Lake, as characterized in the *Draft Detailed Project Report and Integrated Environmental Assessment* developed by USACE (2006). The model was calibrated to the conditions occurring in 2006 to 2008 because this time frame coincides with the period when the monitoring data were collected. Since then, North Park Lake was dredged to address sedimentation of the impoundment. A potential result of the dredging activity would be a change in bacteria concentrations in the lake and in downstream water bodies. Therefore, a model scenario was developed to highlight the potential effects of the North Park Lake dredging on predicted bacteria concentrations.

In this scenario, the dimensions of North Park Lake were altered to reflect the original dimensions and capacity of the impoundment at the time it was created in the 1930s. The original (1930s) capacity of the lake was roughly double what existed in 2006 during the model calibration period (USACE 2006). According to the 2006 USACE environmental assessment performed before dredging, North Park Lake had been reduced in surface area from approximately 75 acres to 63 as a result of sedimentation. In addition, its capacity had been reduced from approximately 568 to 297 acre-feet.

The model was then rerun under calibration conditions, and the change in loading was compared along the mainstem of Pine Creek. Figure 7-1 compares the two scenarios that characterize North Park Lake, and shows the in-stream bacteria concentrations for each at the outlet of the lake. Figure 7-2 compares in-stream concentrations at the pour point of the Pine Creek watershed, where it discharges to the Allegheny River.

In-stream concentrations under the new scenario, with a larger capacity, are generally reduced, with bacteria concentrations reduced by an average of 333 CFU/100 mL at the outlet of North Park Lake. At certain times, concentrations are reduced by over 2,000 CFU/100 mL. At the pour point of the watershed, where Pine Creek discharges to the Allegheny River, concentrations are reduced by 74 CFU/100 mL on average for the 2006–2008 period.

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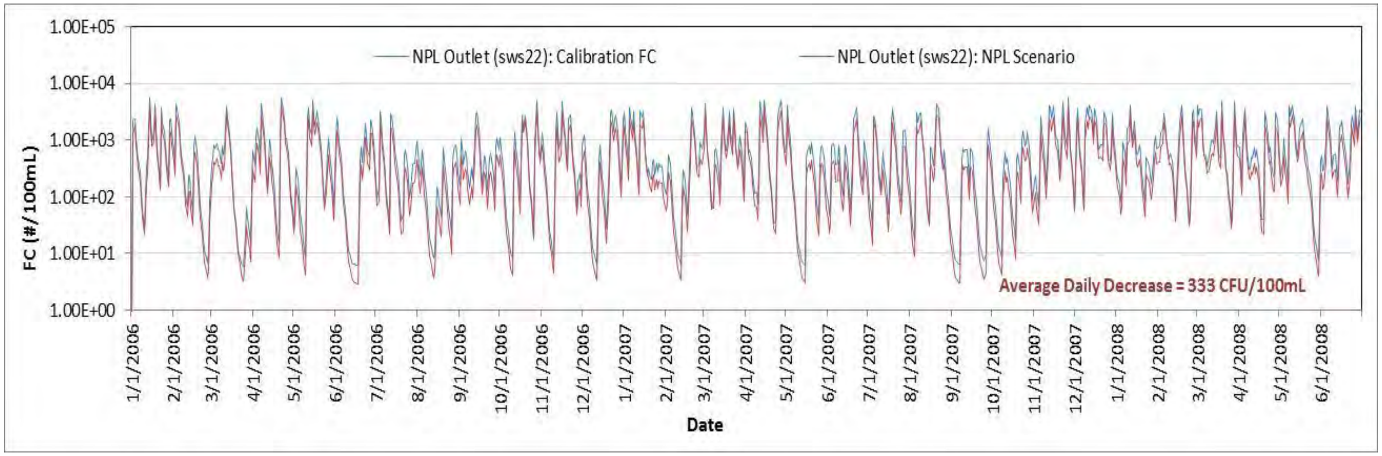


Figure G-1. Existing and hypothetical scenario results showing bacteria concentrations at North Park Lake.

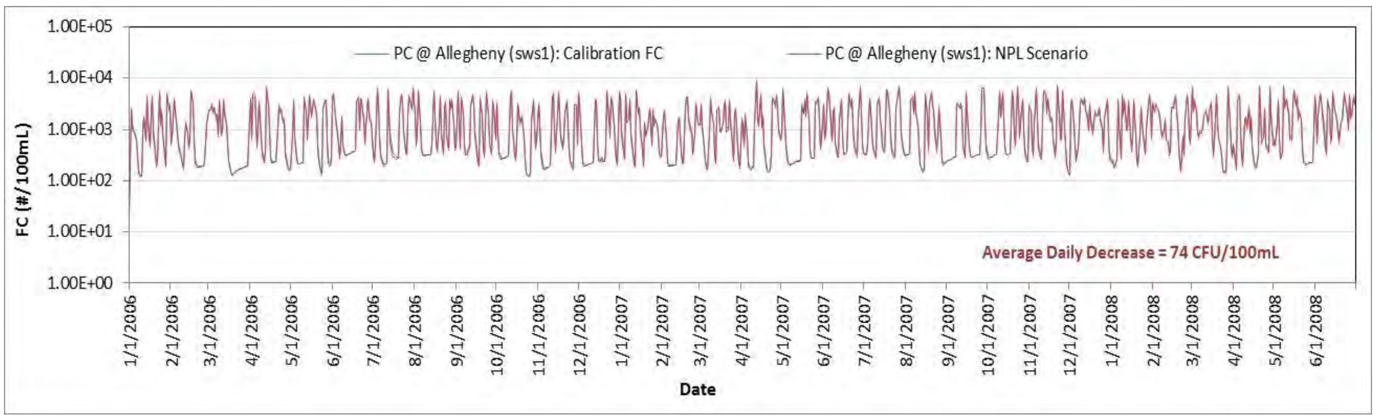


Figure G-2. Existing and hypothetical scenario results showing bacteria concentrations at the confluence of Pine Creek and the Allegheny River.

Figures 7-1 and 7-2 compare the effects of North Park Lake at two locations in the watershed. Figure 7-3 shows the reduction in annual bacteria load longitudinally along the mainstem of Pine Creek. The headwaters of Pine Creek are shown at the left (subwatershed 26) in Figure 7-3, and the confluence with the Allegheny River is shown at right as subwatershed 1. The location of North Park Lake is also identified. Average annual loads passing through the stream segments are shown for the calibration (blue) and hypothetical (red) scenarios, as is the percent reduction in load (in green) between the scenarios. The percentages of monthly exceedances are also shown in red, and relate to the TMDL target of a maximum of 10 percent of samples exceeding the instantaneous standard of 400 CFU/100 mL

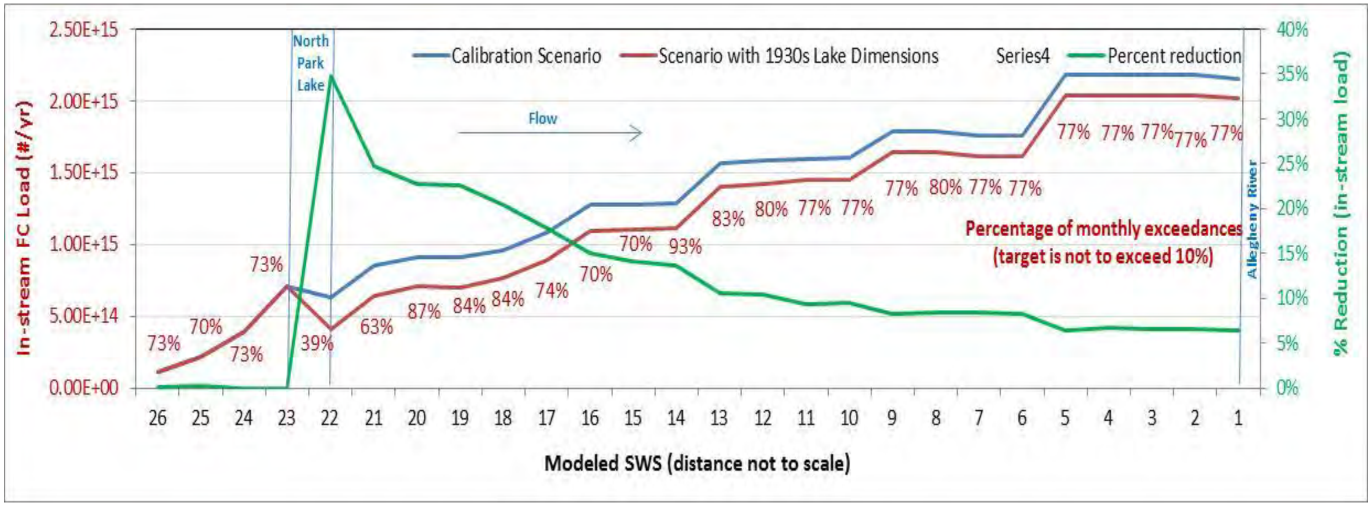


Figure G-3. Difference in fecal coliform bacteria load along the mainstem of Pine Creek, showing the location of North Park Lake and the Allegheny River

The recent dredging activity at North Park Lake could provide similar benefits to the Pine Creek system as the hypothetical 1930's bathymetry scenario. Implementation is not discussed as a component of this TMDL report, and dredging of North Park Lake was not considered in the TMDL calculations, because the modeling and allocation period represented by the model occurred a few years before the dredging activity at North Park Lake. Therefore, the effects of the recent dredging efforts at North Park Lake should be considered in the context of implementation and BMP credit toward achieving the TMDL.

Appendix F References

USACE (U.S. Army Corps of Engineers). 2006. *Draft Detailed Project Report and Integrated Environmental Assessment*. U.S. Army Corps of Engineers

Appendix H. RESPONSE TO PUBLIC COMMENTS

On August 31, 2011 EPA began a 45 day public comment period for the draft Pine Creek watershed bacteria TMDL. The Environmental Protection Agency (EPA) held a public meeting to present the details and answer questions regarding the proposed Pine Creek Watershed Bacteria Total Maximum Daily Load (TMDL) on September 28, 2011, from 5:00-7:00 PM at the Shaler Township municipal building in Glenshaw, PA. Stakeholders attending the meeting included Allegheny County Health Department (ACHD), Pine Creek Watershed Coalition (PCWC), Pennsylvania Environmental Council (PEC), Allegheny County Sanitary Authority (ALCOSAN), and many of the municipalities within the watershed. EPA received requests from a number of stakeholders for an extension to the public comment period. In response to requests for more time to gather available data and provide meaningful comments on the draft TMDL, EPA extended the public comment period twice providing a 75 day public comment period that closed on November 15, 2011. EPA publicized the draft TMDL by placing notice in local newspapers, including the Pittsburgh Post-Gazette, Greensburg Tribune-Review and Pine Creek Journal. The ads included information about the public meeting and instructions to the public on how to access and submit comments on the draft TMDL. We also published this information on EPA's website.

The comments in this appendix have been extracted exactly as they were submitted to EPA and have not been edited, except where noted.

Comments submitted by North Hills Council of Governments

Comment 1

At the public meeting held by the EPA on September 28, 2011 at the Shaler Township Municipal Building, the EPA representative indicated that the Pine Creek TMDL had to be finished quickly due to a court order (consent order) requiring EPA to complete a set number of TMDLs in Pennsylvania. We have since been advised that there is no such order. It one exists, please provide additional background information on the court ordered time frame and the specifics of the court order and/or consent decree.

Response

There is no consent decree order mandating a deadline for the Pine Creek TMDL.

Comment 2

The municipalities and sanitary authorities located in the Pine Creek Watershed were not informed that a TMDL was being developed for the watershed and were not invited by EPA to be part of a TMDL development stakeholder group. EPA's decision to exclude the municipalities and sanitary authorities who hold NPDES permits and are to be held responsible to address this TMDL is unacceptable and led to numerous oversights and false assumptions in the development of the Draft TMDL. These significant errors will be detailed later in these comments.

Response

EPA made every effort to include as many interested parties as possible in the development of the Pine Creek TMDL. Starting in late 2005 and early 2006, EPA and the Pennsylvania Department of Environmental Protection (PADEP) jointly began an effort to determine the impairment status of the Pine Creek watershed. Both PADEP and EPA hoped that the use of volunteer data collected in Pine Creek could inform statewide assessment protocols. PADEP and EPA, as well as Three Rivers Wet Weather Demonstration Program (3RWWDP), the PCWC, the ACHD, and ALCOSAN worked together to develop a sampling plan and associated Quality Assurance and Quality Control (QA/QC) protocols. The sampling effort was a true collaboration, with PADEP coordinating a team of volunteers from the PCWC and ALCOSAN agreeing to run samples in their lab.

As EPA moved forward to develop the TMDL using the bacteria data described above, EPA had many meetings and conference calls with interested stakeholders to discuss the results of the data, the model to represent the watershed, and the TMDL methodology. One such call with stakeholders was to discuss EPA's first rough draft of the TMDL on 3/30/11. EPA invited stakeholders to attend the March conference call by email and included representatives from PADEP, ALCOSAN, 3RWWDP, ACHD, Carnegie Mellon University (CMU), Shaler Township, and PCWC (though the Pennsylvania Environmental Council participated in the place of PCWC). EPA modified the draft TMDL based on the feedback received during that meeting.

On August 31, 2011, EPA Region 3 began a 75 day public comment period for the draft Pine Creek watershed bacteria TMDL. EPA held a public meeting to present the details and answer questions regarding the proposed Pine Creek Watershed Bacteria TMDL on September 28, 2011, from 5:00-7:00 PM at the Shaler Township municipal building in Glenshaw, PA. Stakeholders attending the meeting included ACHD, PCWC, PEC, ALCOSAN and many of the municipalities within the watershed.

At the request of North Hill Council of Governments (NHCOG), a voluntary coalition of nineteen municipalities within the Pine Creek Watershed, and other stakeholders, EPA extended the public comment period twice providing a 75 day public comment period that closed on November 15, 2011. To reach as many stakeholders and members of the community as possible, EPA publicized the draft TMDL by placing notice in local newspapers, including the Pittsburgh Post-Gazette, Greensburg Tribune-Review and Pine Creek Journal. The ads included information about the public meeting and instructions to the public on how to access and submit comments on the draft TMDL. We also published this information on EPA's website.

Even though we believe our outreach during the development of the draft TMDL was extensive, in response to this comment, EPA provided a face-to-face meeting on October 20, 2011 with representatives from the NHCOG to discuss their concerns and answers questions and specifically seek the feedback of the NHCOG. In addition, EPA held formal conference calls with NHCOG on January 10, 2012 and March 6, 2012 to continue our dialog, answer questions and solicit additional data needed. EPA exchanged many emails and had many other informal calls with representatives of NHCOG.

The process described above satisfies all requirements under the CWA to include the public in the establishment of the final TMDL. With regards to the commenter's assertion that the TMDL has significant errors, EPA disagrees. This final TMDL has been established with extensive and site specific data that is representative of the watershed, a well established and accepted model, and thorough stakeholder involvement. Stakeholder comments have significantly shaped and strengthened this TMDL including information provided by the commenter, and EPA is grateful for the feedback it has received.

Comment 3

NHCOG Stormwater Project Manager, has requested a list of stakeholders and meetings that were held to discuss the TMDL. The EPA Project Manager…has indicated that these could not be provided without a Freedom of Information Act request. We reiterate our request for a list of the stakeholders, meetings, agendas, and meeting minutes of all stakeholder meetings.

Response

Over the course of 7 years, EPA had numerous meetings with many agencies, organizations, and stakeholders as we developed the TMDL as described throughout this document. The comments and information collected by EPA through that process have been incorporated into the final TMDL as explained in the TMDL document and in this document.

Comment 4

The EPA chose not to request readily available information such as surface cover information sanitary sewer maps and MS4 outfall mapping from the municipalities in the watershed.

Response

EPA used readily available information to develop the TMDL. EPA obtained NPDES permit information from PADEP, and CSO and SSO information from the all of the municipalities in coordination with PADEP. For the purpose of calculating bacteria loading associated with MS4s and other stormwater sources, uniform, basin-wide information was needed for landcover and the 2001 national land cover database (NLCD) was used. Sanitary sewer maps were obtained from multiple sources, including the ALCOSAN service area GIS layer and, for areas of the watershed not addressed by the ALCOSAN layer, directly from municipalities (see Table 3-5 of the TMDL report). It is EPA's understanding that the municipalities do not have their MS4 regulated areas mapped and approved by PADEP. Therefore, EPA defined the boundaries of the MS4 using the federal definition of an MS4. Please refer to response to comment 22 regarding the regulatory definition of an MS4.

Comment 5

The municipalities request that this TMDL not be made final until the stakeholder group is expanded to include all of the NPDES permit holders, municipalities and municipal sanitary authorities within the Pine Creek Watershed and the sampling and modeling used by EPA to develop the TMDL is done properly using the best information available.

Response

EPA refers the commenter to the response to comment 2 where EPA reviewed the public participation process, which included the NHCOG. The public outreach performed throughout the development of this TMDL exceeded federal requirements and included extensive stakeholder involvement. EPA was open to receiving comments and data to inform the TMDL before, during and after the draft TMDL was made public, with the goal of collecting all existing and available data.

EPA develops TMDLs based on the requirements of Section 303(d) of the CWA and the implementing regulations found at 40 CFR 130.7. The CWA and federal regulations require that TMDLs be designed to meet existing, applicable water quality standards (numeric and narrative criteria, designated uses and anti-degradation), include wasteload allocations (WLA) for each point source, load allocations (LA) for non-point sources (allocated to specific sources if data allow, or gross allotments to source types), consider seasonal impacts, and include a margin of safety. This TMDL meets all of these legal requirements.

Comment 6

The TMDL and sourcing of bacteria loads were completed using a model. The report does not provide details of all of the modeling methods, equations and assumptions used to develop the proposed TMDL. Without providing the model to the stakeholders for review we are unable to fully evaluate the accuracy of the TMDL effort. We were informed at our meeting with EPA in Philadelphia on October 20, 2011, that the model and all datasets would be provided to us. Subsequently, during the week of November 1st, a limited amount of modeling information was released to the commenter by the EPA Contractor TetraTech. This data was then forwarded to a reviewer. Review of this information found the following limitations. (see comments 6b - 6d).

Response

It is not EPA's expectation that the commenter reproduce the TMDL modeling or calculations and refers the commenter to the response to comment 2 where EPA reviewed the public participation process. EPA appreciates all readily-available data that can be used by EPA and our contractors to strengthen the Pine Creek TMDL. EPA provided all datasets to the commenter to resolve data sharing issues.

Comment 7

The project shapefiles received from TetraTech were missing projection files and metadata, so they could be not used to overlay with our existing datasets.

Response

Projection information and metadata were provided to the commenter on November 2nd, 2011. To EPA's knowledge the commenter was able to use the information provided to view, overlay and analyze information.

Comment 8

The EPA documentation on the LSPC model states that "Using the WCS extension increases the efficiency of model setup and execution by eliminating unnecessary, repetitive user-input, hence minimizes the chance of human error. Furthermore, the entire system is designed to simplify transfer of information between models and users." We did not receive data that used the WCS extension. Also, the LSPC project files (.lpr) were not provided to us.

Response

The WCS extension and .lpr methodology are optional tools and were not used in this effort. These tools are useful for those who work primarily with Geographic Information System (GIS) data, and provide a visual component for the modeler. The modeler can select to use these tools, or to process data without the WCS and LPR components.

Comment 9

The LSPC GIS interface, which is compatible with ArcView shapefiles, acts as the control center for launching watershed model scenarios. This stand-alone interface communicates with both shapefiles and the Microsoft Access database. We are requesting that all files needed to run the LSPC model and LSPC GIS interface and that were used to prepare the draft TMDL report be provided.

Response

The LSPC GIS interface option was not used. All modeling files needed to run the Pine Creek LSPC model have been made available to the commenter.

Comment 10

Other than the example in Figure 5-6 on page 48, there are no maps showing the locations of assumed septic systems. Please provide these so that the municipalities may verify the location and area of septic systems assumed in the model.

Response

The septic representation used in the modeling has been revised on the basis of information provided by the municipalities since the Draft TMDL was made available. All data and shapefiles used for the original Draft TMDL were provided to the localities and based on their input (including new and/or ground-truthed data for some areas), and revisions have been made to the number and location of septic systems represented across the Pine Creek watershed. Please see Section 3.2.1 of the TMDL report for a thorough description of the revised representation. In addition, a new figure, illustrating the revised representation is included in the TMDL in Figure 3-4.

Comment 11

A tabulation of the sampling data is not included in the draft TMDL. Please provide a tabulation of the bacteria sampling results including the details of the time of sample, location of each sample (coordinates), sample takers name(s), laboratory technicians name, time of the start of the test and the time of the results being determined. This basic underlying data should be included in the report for the record.

Response

EPA provided the sampling data used in this TMDL to representatives of Etna and Shaler Townships on December 1, 2008.

A detailed analysis of the bacteria data is provided in the reference document entitled "Bacteria data analysis to support bacteria modeling and TMDL development for the Pine Creek watershed, Pittsburgh, Pennsylvania dated October 2009. This document has been provided to the commenter by email on October 21, 2011.

Comment 12 The Draft TMDL report does not provide a map of reasonable scale showing the location and station number of each sampling location.

Response:

Figure 2-3 in the final TMDL has been updated to show station sampling numbers.

Comment 13

The supporting document, Bacteria Data Analysis to Support Bacteria Modeling and TMDL Development for the Pine Creek Watershed, Pittsburgh, Pennsylvania (Tetra Tech 2009) was not made available to stakeholders nor were stakeholders made aware that this documentation existed until the release of the proposed TMDL report.

Response

With regards to the supporting document, please see response to comment 11. With regards to commenter not being aware of the document, please see response to comment 2.

Comment 14

Although a copy of the Modeling Quality Assurance Plan has been provided, there has not been sufficient documentation provided to determine whether the sampling was in compliance with the quality assurance Plan. It is critical to verify that stream samples were properly handled and samples were delivered in a timely fashion via the chain of custody. Additional details on the sampling program are needed. For example, the report states that over 1,000 samples were collected but Table 3 on Page 8 of Bacteria Data Analysis to Support Bacteria Modeling and TMDL Development for the Pine Creek Watershed, Pittsburgh, Pennsylvania (Tetra Tech 2009) indicates that 875 samples were utilized in the TMDL data set. It is not discussed for what purpose the other samples were collected.

Response:

Over 800 samples for fecal coliform and another 800 + samples for E. coli were collected and analyzed during this effort. Because field blanks and duplicates were also collected, there were indeed over 1,000 samples collected, with the total number closer to 2,000 than 1,000.

EPA and PADEP worked with stakeholders in the watershed to support the development of a bacteria sampling protocol in the Greater Pittsburgh region. PADEP conducted volunteer training sessions in advance of sampling. EPA, 3RWWDP and the southwest regional PADEP office worked closely to select candidate watersheds and to develop a sampling plan and associated Quality Assurance and Quality Control (QA/QC) protocols. The sampling plan design and QA/QC protocols were coordinated with PADEP and ALCOSAN as well as the regional PADEP watershed management coordinator.

The sampling plan and quality assurance protocol were field tested in beginning the fall of 2006, and more intense sampling was conducted during the 2007 swimming season. Volunteers from the Pine

Creek Watershed Coalition conducted weekly bacteria sampling at 25 sites throughout the Pine Creek Watershed for a full year. Watershed Coordinators from DEP's Central and Regional Offices worked closely with the group to train them and to transport samples to the lab every week. ALCOSAN provided in-kind services to analyze the samples for both fecal coliform and E. coli, as well as evaluated potential impacts of holding times on sample results. Duplicates were collected at all sites and the differences between the duplicates were insignificant. The laboratory analyzed blanks and all blanks had a concentration of $\leq$ 2 cfu/100mL.

Data were collected in accordance with the Monitoring Quality Assurance Plan and trained volunteers followed QA/QC procedures. We reference "Monitoring Plan for Bacteria Sampling: Pine Creek Watershed, Pittsburgh, PA to Support Use Attainment Analysis and Bacteria Modeling in Southwestern Pennsylvania" for more information. This document was provided to the commenter on 10/21/11. Further, PADEP reviewed the data and deemed it met the minimum data requirements and quality needed to be used in the agency's decision making process. The results from the monitoring and analysis effort were used in PADEP's decision to list the Pine Creek watershed as impaired for pathogens in Pennsylvania 2008 Integrated Report. EPA did not use extremely high sampling values (e.g., Site 24 on 5/31/2007 sampled value of 720,000 fecal coliform) to calibrate the model used to develop the TMDL.

Comment 15

As previously discussed with EPA, the municipalities and authorities within the watershed are gathering additional information and datasets to be transmitted to EPA by under a separate transmittal. We will make our best efforts to provide this additional data prior to the end of November.

Response:

EPA has received data from the municipalities and authorities within the watershed and has included that data in the TMDL as appropriate.

Comment 16

The model should be revised to account for the significant storage capacity improvements resulting from the dredging of the North Park Lake. This project started in 2009 after the monitoring period was completed and was recently completed. As a result, the dimensions tabulated in Table 5-1 on page 35 are no longer correct and the hydraulic representation of the lake in the model should be updated and the model re-run. It is recommended that additional bacteria testing be done at station 22 and the monitoring points upstream of station 22 to insure the modeling is done properly before a TMDL is made final.

Response

The model used in this TMDL was calibrated using the 2006 to 2008 actual conditions in the watershed including the pre-dredged conditions of the North Park Lake. Calibration of the model must use the conditions occurring in 2006 to 2008 because this timeframe coincides with the time period when the monitoring data was collected. To address the commenters' concerns that the TMDL does not capture the current conditions of the lake and its current storage capacity, a scenario was developed to evaluate the effects of the North Park Lake dredging on predicted bacteria concentrations. Updated bathymetry was assigned to represent conditions observed when the dam was first constructed in the 1930s. However, it should be noted that EPA requested the current dredged bathymetry of North Park Lake and that information was not provided. Therefore EPA was unable to model the actual effects of the dredging on bacteria conditions. Assuming that the Lake was dredged to its original 1930 bathymetry, the model representation changed from 63 acres of surface area and 297 ac-ft of capacity to 75 acres of surface area and 568 ac-ft of capacity.

Results of this model scenario showed a decrease in bacteria concentrations at the outlet of North Park Lake, as well as in downstream segments receiving loads from this feature. Please refer to Appendix G, Section VI. North Park Lake Dredging Modification Scenario for additional information.

Comment 17

The Longvue No.1 Waste Water Treatment Plant (PA0027669) on West Little Pine Creek was significantly upgraded after the bacteria sampling was completed. Additional bacteria testing should be done and the modeling revised based upon the updated sampling results. It should be noted that the Draft TMDL Report (page 51-52) notes a significant "Source X" bacteria load just downstream of this treatment plant.

Response

The final TMDL appropriately provides WLAs to all WWTPs including Longvue No.1 Waste Water Treatment Plant at water quality standards. EPA is grateful to learn that the Longvue No.1 Waste Water Treatment Plant has received significant upgrades. EPA recommends that the TMDL implementers monitor downstream and in the area of Source X to determine whether the WWTP upgrades were sufficient to remove the Source X discharge.

With that said, EPA has no evidence to support the commenter's suggestion that the Longvue No.1 WWTP may have been responsible for the significant and illegal discharges to the watershed and may be the responsible party for the unidentified "Source X." It is EPA's recommendation that the TMDL implementation plan should immediately investigate and eliminate the unidentified but significant discharges in Subwatersheds 20, 21 and 105.

Comment 18

Hampton Township made significant improvement to the Glannon's Sanitary Pump Station. The work performed included the construction of auxiliary wet well capacity, a new emergency generator and replacement of level sensors. The work was completed in late 2007. The coordinate location is: Latitude: 40° 33' 16" North, Longitude: 79° 58' 16.7" West. The Hampton Department of Environmental Services completed a trenchless rehabilitation project of approximately 2,900 LF of 8" sewer line. All of the lining was performed within the Glannon's Pump Station watershed. This work was prioritized based upon wet-weather flow metering conducted in 2007. The lining process was completed in June 2011. Since the completion of this process, Hampton has noticed a reduction in wet weather flow coming into Glannon's Pump Station, and a significant reduction in the number of SSO occurrences.

Response

EPA recognizes that the TMDL represents a snapshot in time. All BMPs installed in the watershed after the 2006 and 2008 timeframe may be considered as progress made towards implementing the TMDL. If monitoring the Glannon's Pump Station provides evidence that water quality has improved with regards to bacteria, resulting in reductions of fecal coliform in the subwatershed, the implementers may consider this in the development of their TMDL implementation plan and take credit for the BMP and progress made towards achieving the TMDL reductions. It is EPA's expectation and understanding that a number of BMPs have been installed in the watershed after 2008 but prior to the establishment of the TMDL. In each instance, EPA agrees that the implementers, after appropriately monitoring and documenting the permanent bacteria reductions, could take credit for those already installed BMPs in their TMDL implementation plan as required under their MS4 permits.

EPA requested information concerning SSO and CSO locations and monitoring data in 2006 and Hampton Twp did not share any SSO data with EPA at that time. As a result of this comment, EPA reached out again to NHCOG and Hampton Township for any SSO information. EPA requested location, flow/volume of discharge and water quality data associated with these SSO occurrences and was informed that none existed. Without such data EPA is unable to represent the SSO sources in the TMDL modeling.

Comment 19

It is expected that additional improvements and information would come to light if EPA were to engage the watershed municipalities and authorities in the stakeholder process.

Response:

Please refer to response to comment 2.

Comment 20

O'Hara Township is aware of SSOs resulting from sanitary sewer pump station overflows in East Little Pine Creek and is planning upgrades to the pump stations. Why were known issues with sanitary sewer pump stations and other possible sanitary sewer overflows not itemized and addressed in the report?

Response

EPA commends O'Hara Township's work to stop raw sewage from flowing into East Little Pine Creek. Information concerning SSO and CSO locations and data was sought in 2006 and O'Hara Twp did not share any SSO data with EPA at that time. As a result of this comment, EPA reached out to ALCOSAN, NHCOG and O'Hara Township again for any SSO information. EPA requested location, flow/volume of discharge and water quality data associated with these SSO occurrences and was informed that none existed. Without such data EPA is unable to represent the SSO sources in the TMDL modeling.

Comment 21

There is significant sanitary sewer and combined sewer monitoring and modeling information available. This available information could have been used to reduce the need for assumptions in the TMDL model.

Response

EPA requested information on CSO/SSO water quality data from 3RWWDP and ALCOSAN, but EPA was told that none was available. On several occasions in 2009, EPA sought feedback on its methodology for representing CSOs and SSOs in the watershed to stakeholders including ALCOSAN, 3RWW, ACHD, Etna and Shaler Township (who are members of NHCOG) and PADEP. EPA's data request was discussed on a November 20, 2008 conference call that included ACHD, Etna Borough and Shaler Township. Etna and Shaler agreed to provide data and EPA proposed a methodology based on the Etna and Shaler data. A memo dated January 14, 2009 was circulated by email and was discussed on a February 23, 2009 conference call which included PADEP, ALCOSAN, 3RWWDP, ACHD, Etna Borough, and CMU. EPA received no suggestions for revisions regarding its proposed methodology. Based on the methodology described in the January 14, 2009 memo, EPA sent an email titled "CSO representations in Pine Creek TMDL" to PADEP, ALCOSAN, 3RWWDP, ACHD, Etna Borough, Shaler Township and CMU and received minor feedback from ACHD that errors with a few acronyms needed to be corrected.

Based on this comment, EPA again sought the CSO/SSO information from ALCOSAN and the municipalities through January 31, 2012. EPA did not receive additional data and so none was incorporated into the final TMDL.

Comment 22

The assumption in the model that all of the Urbanized Area contributes to the WLA is incorrect as only a portion of the total contributing area flows to MS4 discharge locations. Municipalities were required to locate MS4 outfalls as a condition of our current MS4 Permits. Why did the EPA choose not to contact the municipalities and obtain this information for use in the model? The model should be revised by the EPA to delineate areas tributary to MS4 outfalls.

Response

For regulatory purposes, EPA's NPDES Stormwater Program regulates "medium," "large," and "regulated small MS4s." A medium MS4 is a system that is located in an incorporated place or county with a population between 100,000 - 249,999. A large MS4 is a system that is located in an incorporated place or county with a population of 250,000 or more. In addition, some MS4s that serve a population below 100,000 have been brought into the Phase I program by an NPDES permitting authority and are treated as medium or large MS4s, independent of the size of the population served. A regulated small MS4 is any small MS4 located in an "urbanized area" (UA), as defined by the Bureau of the Census, or located outside of a UA and brought into the program by the NPDES permitting authority. (40 CFR 122.32) The MS4s in the Pine Creek watershed are considered regulated small MS4 permittees.

The MS4 boundaries in this TMDL have been appropriately defined given the data that is currently available. As indicated in Section 6.3.4 of the TMDL report, EPA used the best available data to determine the boundaries of the MS4 communities. The boundaries were based on a GIS shapefile of municipal boundaries for the state of Pennsylvania and the regulated areas of the MS4 communities were appropriately determined based on the U.S. Census Bureau's Urbanized Area determination for 2000.

While the North Hills Council of Governments provided data that delineated where the MS4 outfalls were located in the watershed, this data does not define or delineate the lands that flow into those outfalls and is therefore regulated under its MS4 permit. If in the future, the Commonwealth or the municipalities further refine the area regulated under their MS4 permit and that area definition is approved by the permitting authority, the TMDL can be revised to reflect this information.

Until that information is developed and approved, EPA believes it is reasonable to assume that all stormwater generated in urbanized areas of the regulated jurisdictions discharge to the MS4 outfalls and therefore received WLAs. All non-urbanized areas of regulated jurisdictions were assumed not to discharge to regulated outfalls of the MS4s and received LAs.

Comment 23

It is recommended that the assumed animal populations predicted by EPA be reviewed and verified by the municipalities using available animal control and other data.

Response

On the basis of this comment and information provided by municipal representatives, EPA has revised assumptions related to animal populations and densities in the modeling representation. The range of density estimates derived from new data (including data from the Pennsylvania Game Commission, the Audubon Society, regional studies, municipal animal incident reports, and other data provided by the municipalities) and potential approaches under consideration by EPA was presented to municipal representatives and discussed on a conference call March 6, 2012. The references used to support selected densities for all wildlife species and assumptions are more fully described in Appendix F.

Comment 24

MTSA has attempted to review the unsewered structure map contained in the Proposed TMDL Report in the Pine Creek Watershed. At best, it is very difficult to follow. MTSA did compare their map to the MTSA GIS and found many apparent discrepancies when compared to their knowledge of the area. They were able to identify at least 200 structures erroneously represented in the TMDL report as unsewered in Marshall Township and Franklin Park. It is not clear that the methodology applied to spatial data sets can yield accurate results without correlation with local knowledge or verification in the field. Sewer system maps are also readily available for those areas not serviced by ALCOSAN.

Response

EPA used spatial data of sewered areas that were provided by the municipalities in the watershed in the summer of 2010. Additionally, EPA used sewered and unsewered structure data in GIS format to support the septic representation in the original Draft TMDL. Table 3-5 of the TMDL report summarizes the available data sources and the origin of the data.

The septic and unsewered representation used in the modeling has been revised using information provided by the municipalities since the Draft TMDL was made available for public review. All data and shapefiles used by EPA for the original Draft TMDL were provided to the municipalities and based on their input (including new and/or ground-truthed data for some areas), revisions have been made to the number and location of septics represented across the Pine Creek watershed. Please see SECTION 3.2.1

of the TMDL report for a thorough description of the revised representation. In addition, a new figure illustrating the revised representation is included in the TMDL in FIGURE 3-4.

Comment 25

For those areas served by ALCOSAN, in some cases it appears the sewer system maps used are inaccurate and out of date. Specifically, Figure 5-3 and 5-4 (page 24 and 25 respectively of the "Data Review for the Pine Creek Watershed, Pittsburgh, PA to Support Bacteria Modeling in Southwestern Pennsylvania" (2006)) contain significant errors. For example, SWS 2 in Etna is counted as unsewered/septic. However, this area is serviced by Sharpsburg Borough sewer system under an inter-municipal agreement. The Poplar Street area in SWS 1 in Figure 5-3 is also erroneously shown as unsewered. Review of the actual number of unsewered structures with the Borough yielded virtually no structures in the Borough that could be identified as unsewered. The buildings shown in Figure 5-4 as unsewered therefore needs to be reviewed with the local municipalities and corrected as needed.

Response

The referenced report was developed in the initial phases of the project to provide background on potential sources of bacteria in the watershed and was not the basis for the septic analysis for the TMDL. In the Draft TMDL, a total of 18 structures were assumed to be unsewered and within 1000 feet of a stream in these two subwatersheds (SWS 1 and 2). In the final TMDL, a total of 1 septic structure was modeled in these two subwatersheds (SWS 1 and 2) as shown in Table 5-7. The revised septic numbers are based on EPA's ongoing data exchange with NHCOG during and after the public comment period which is detailed in the response to comment 2.

Please refer to response to comments 10 and 24 above.

Comment 26

Our analysis indicates potential quality problems in 319 of 839 bacteria samples (36.5%) on the basis of reported fecal coliform/E. coli ratios. As a subset of fecal coliform, E. coli counts should be approximately equal to or be less than fecal coliform counts. This is consistent with the EC/FC ratio of 0.63 of the 2002 USEPA recommended geometric-mean criterion of 126 CFU/100 mL for E. coli to the current geometric-mean primary contact criterion for fecal coliform bacteria of 200 CFU/100 mL. However, for a significant proportion of the Pine Creek sampling data results the ratio of fecal coliform to E. coli (EC/FC) is greater than one. At several stations, more than 50% of the samples may have problems as indexed by the associated EC/FC ratios as seen in the following table (Comment 23b). Chain of custody, laboratory procedures, and other issues are not documented sufficiently for evaluation. Based upon this finding, at a minimum the finalization of the Draft TMDL should not proceed until bacteria data issues are resolved. Resampling must be considered if there are quality problems of this magnitude.

Sta ID	Total # Samples	EC>FC (#)	EC>FC (%)
1	36	11	30.56%
2	35	8	22.86%
3	34	9	26.47%
4	35	11	31.43%
5	35	14	40.00%
6	35	11	31.43%
7	35	14	40.00%
8	35	14	40.00%
9	35	10	28.57%
10	35	12	34.29%
11	35	12	34.29%
12	35	12	34.29%
13	35	13	37.14%
14	35	8	22.86%
15	35	14	40.00%
16	35	16	45.71%
17	35	19	54.29%
18	35	13	37.14%
19	35	10	28.57%
20	35	11	31.43%
21	35	19	54.29%
22	35	13	37.14%
23	35	18	51.43%
24	35	13	37.14%
25	35	14	40.00%
Total:	**875**	**319**	**36.46%**
		MAX	54.29%
		MIN	22.86%

Response

The commenter has misunderstood the bacteria sampling and analysis that occurred in the Pine Creek watershed. Trained volunteers filled a minimum of two bottles at each monitoring location. One sample bottle was to analyze *E. coli* concentrations and one sample bottle was used to analyze fecal coliform concentrations. Please refer to response to comment 96 for information regarding the monitoring plan. The samples collected for this project and used in this TMDL were analyzed by the ALCOSAN laboratory. The ALCOSAN laboratory is a State Accredited lab that is in compliance with the Pennsylvania Environmental Laboratory Accreditation Regulations, (25 Pa Code, Chapter 252). A rigorous quality assurance and quality control plan was followed by ALCOSAN in conducting the analysis. ALCOSAN's standard operating procedures for analysis of fecal coliform and *E. coli* are included in the TMDL reference "Monitoring Plan for Bacteria Sampling: Pine Creek Watershed, Pittsburgh, PA to Support Use Attainment Analysis and Bacteria Modeling in Southwestern Pennsylvania." Note that ALCOSAN's procedure includes reproducibility, constant and consistent test conditions, and quality control. EPA has no reason to doubt the quality of the laboratory analysis provided by the ALCOSAN laboratories.

Both *E.coli* and fecal coliform samples were analyzed and on 316 occasions the *E. coli* concentration was greater than the fecal coliform concentration. This discrepancy can be explained by the fact that *E.coli* and fecal coliform measurements were from two separate grab samples. According to PADEP's Biological Services Supervisor at DEP's Bureau of Laboratories, an expert on bacteria plating and analysis, "When two samples are taken, one is always at a different time and possibly different location than the other. Even though it may be several minutes between sample collection, it is not the same sample. The collector may not sample from the exact same spot or depth in the stream. Hence, there will be an inherent difference between samples." It is important to note here that the differences in the counts of *E.coli* and fecal coliform did not reflect an error but rather presented similar results. If fecal coliform results indicated water quality standard exceedances, the *E. coli* results also indicated exceedances, and visa versa.

A better method to examine the quality of the data would be to study the results from the blanks and duplicates that were collected and analyzed by the lab. The results from the fecal coliform duplicates were statistically compared and it was determined that there was no significant difference between the fecal coliform duplicate counts. In addition, the ALCOSAN labs analyzed blanks for both fecal coliform and *E. coli* and all blanks had a concentration of $\leq$2 cfu/100mL. The majority of lab starting and ending blanks contained no quantities of *E. coli* or fecal coliform. Where significant quantities were found on blanks, the results were discarded.

PADEP reviewed the data and deemed it met the minimum data requirements and quality needed to be used in the agency's decision making process. The results from the monitoring and analysis effort were used in PADEP's decision to list the Pine Creek watershed as impaired for pathogens in Pennsylvania 2008 Integrated Report.

Finally, it is also important to note that because the Commonwealth uses fecal coliform as its bacteria water quality standards, only the fecal coliform data were used in the TMDL.

Comment 27

The data under the proposed TMDL is demonstrably weak with respect to dry weather impairments. Other than POTWs and septic systems, we are left with Source X to explain dry weather flow bacteria levels. Land use data is not sufficient to identify sources. The procedure used in the Pine Creek TMDL shows only that the model can be manipulated to produce results that fit the sampling data in some cases. It runs the substantial risk of failing to properly predict the actual pollutant sources in the watershed.

Response

In urban watersheds such as Pine Creek, it is not uncommon to have undocumented but significant sources of bacteria. Source X has been associated with discrete areas in the watershed where it is suspected that the source has not been fully characterized. The majority of the watershed, however, has been successfully calibrated by incorporating known bacteria sources into the modeling effort. EPA believes the good calibration in the other areas of the watershed lends credibility to the model and that further source identification in the areas of the potential "source x" is a reasonable activity for municipalities to pursue.

To prepare for model setup, EPA communicated with the watershed stakeholders to accurately identify all known sources within the watershed. Stakeholders included PADEP, ACHD, ALCOSAN, North Area Environmental Council (NAEC), Carnegie Mellon University (CMU) and cooperating municipalities. Dry weather sources identified are typical of most watersheds suffering from bacteria contamination and include sources such as failing onsite systems, direct discharges of untreated sewage through failing infrastructure, direct contamination from wildlife and farm animals, and contaminated effluent from sewage treatment facilities and publicly owned treatment works. In the Pine Creek model, dry weather sources include failing septic systems, Source X, and direct animal deposits to streams (e.g., ducks in streams). Other than Source X, EPA did not represent additional explicit dry weather sources because there were no specific data or information to support that other sources were present and should be included in the model. Section 3 of the TMDL discusses the sources of bacteria within the Pine Creek watershed. Appendix F discusses estimates related to wildlife and waterfowl contributions.

EPA believes the TMDL appropriately represents the known pollutant sources in the watershed. Model output for the majority of the watershed shows that the model calibration is quite good based on comparison with monitoring data. The good calibration statistics document the credibility of the model. The model identified 3 areas that appear to have significant sources that can't be explained by contributions from known sources such as WWTPs or failing septic systems.

EPA's modeling suggests that Subwatersheds 105 (West Little Pine Creek), 20 and 21 (both on the Pine Creek mainstem) are the recipients of significant, bacteria loads from unspecified sources. Note that permitted wastewater bacteria loading rates are represented explicitly in the model using Discharge Monitoring Reports (DMRs) from the POTWs that include flow and bacteria concentration data. Since the DMRs from the facility are legally binding and falsification of DMRs is punishable with financial penalties and/or imprisonment, it does not seem reasonable to assume that the POTWs are the sources of the Source X load because they have already been represented based on DMR data. EPA believes it is reasonable to suspect that Source X may be due to failed infrastructure or leaking lines and reiterates that further source identification in the areas of the identified "Source X" is a reasonable activity for municipalities to pursue. Section 5.3 of the final TMDL discusses how Source X was modeled in the watershed.

Comment 28

In other cases, model outputs are not supported by the data. For example, Station 21 data shows perhaps 5 points > 1000 CFU/100 ml where the model indicated more than 25 peaks exceeding 1000 CFU/100 ml. Similar problems may exist between model outputs and sampling data for Stations 5, 7, 8, 9, 10, 11,12,1 3, 14, 15, 16, 17, 18, 22, and 25. The TMDL report or other supporting documents do not present any objective criteria or statistical measures that indicate an appropriate number of samples have been taken to verify and support modeling results. In addition, there do not appear to be a sufficient number of samples to determine whether outlier values are real or artifacts of sampling problems. This is acknowledged in the TMDL in the discussion of Station 24 on page 18. It is not known whether the extreme values were verified by duplicate samples or other quality control measures.

Response

The LSPC model is known as a continuous simulation model. In this case, for the time period modeled, it provides a continuous time series of fecal coliform predicted concentrations on the basis of hourly precipitation data and sources. LSPC can be configured to provide output on an hourly, sub-hourly or daily basis. For the Pine Creek watershed, the model was configured to provide daily output. In other words, there is an estimate of the average daily fecal coliform load at every subbasin for each day modeled. Since field samples were only taken on a weekly basis, the model provides a greater number of data points relative to field monitoring data. For this reason, the model output will show additional peaks in bacteria. This is not an indication that model outputs are not supported by the data. The quality of the watershed model calibration is very high, even considering the rich data set and number of calibration targets that needed to be met. The calibration statistics presented in Appendix D suggest that the model performs well across seasons and in all types of flow conditions. All calibration statistics are within the acceptable ranges used in HSPFEXP (Lumb et al 1994).

The Pine Creek watershed is relatively small at approximately 67 square miles. This TMDL was developed using over 800 fecal coliform samples that were collected at 25 monitoring stations over the course of a year. EPA considers this an extensive and rich data set. However, volunteer safety was a priority and volunteers did not collect samples during periods of bad weather and/or high flows.

It is widely known and accepted by citizens, public health officials and regulators that streams across the entire Pittsburgh area, including the Pine Creek watershed are subject to significant bacteria loading due to combined sewer overflows and aging sewer infrastructure as well as other sources. The high bacteria counts are a reflection of the magnitude of the problem as are the 83 separate Consent Order Agreements between ALCOSAN, its service area communities, and the EPA, PADEP and the Alleghany County Health Department regarding sewage collection infrastructure. In addition, several citizen comments submitted to EPA regarding the Draft TMDL provide accounts of raw sewage surface discharges from failing septic systems (e.g., comments 82 and 83). Please see the response to comment 26 for information about data quality, duplicate sampling and field blanks.

Comment 29

The explanatory value of the flow loading analysis under the TMDL is compromised by the limited number of samples. As each percentile class consists of 3-4 samples as in Site 25, one extreme value sample can bias the mean for the class. Again the analysis suffers from an insufficient number of samples to determine whether outlier values are real or artifacts of sampling problems. The explanatory value of this analysis is further compromised by the limited range of flow in a percentile flow class-examples one flow class ranges from 1.9 to 2.1 cfs & another from 3.0 to 3.2 cfs. Overall the range of flow encompassed by 70% of the flow values is just 2.65 cfs (0.55 to 3.20 cfs).

Response

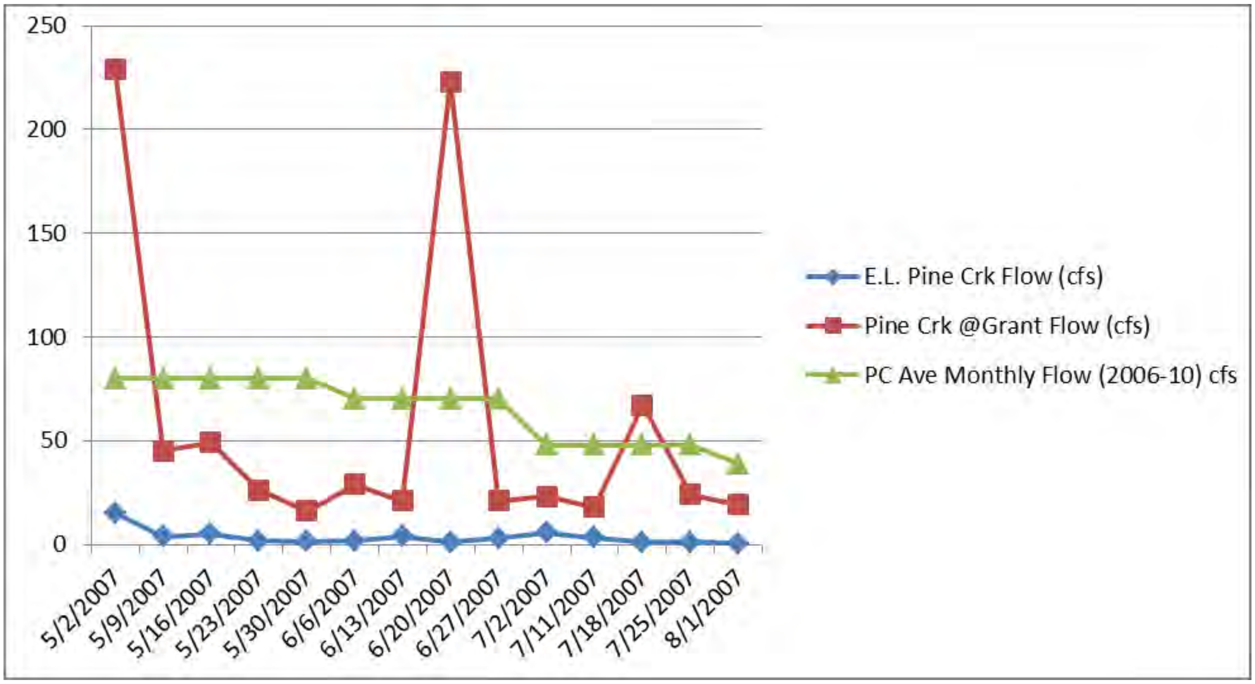
The bacteria monitoring conducted was an intensive weekly effort at 25 locations within the small watershed. The sampling effort was conducted over the course of a year to capture a variety of flow ranges through different seasons. Samples were not collected at very high flows due to issues associated with human health and safety. The USGS flow gauge 03049800 located on Little Pine Creek near Etna, PA was used to garner current and historic flow data in the Pine Creek watershed. Four additional locations were monitored between March and October 2007 by PADEP to support TMDL development and are listed in Table 2-1.

In addition, weather data to drive the hydrology of the model came from the National Climatic Data Center (NCDC) weather station at the Pittsburgh International Airport. NCDC data included temperature, precipitation, and snow measurements, as well as other surface airways information (e.g., pressure and wind speed measurements). In addition to weather data available from the NCDC, the Three Rivers Wet Weather Demonstration Program (3RWW) operates an extensive system of 33 rain gauges throughout Allegheny County that collect rainfall data during wet weather events. The data gathered by these gauges are supplemented with National Weather Service NEXRAD radar data collected during the same time period for every square kilometer in the county. EPA used this additional wet weather information to confirm, validate, and patch if necessary, the hourly rainfall data available from NCDC stations.

The model was used to predict bacteria levels within the watershed based during all flow regimes. Please refer to response to comment 28 for a discussion on how the extensive monitoring and hydrologic data was used to develop the loads within the TMDL.

Comment 30

The loading analysis also uses the gage data for East Little Pine Creek for all 25 stations. As Pine Creek is 67 square miles, it is questionable as to whether this sub-watershed can account for loading variations from rainfall patterns, baseflow, and other factors dependent on location. Since 2006, there has been a functioning USGS Stream Gage on the main stem: 03049807 Pine Creek at Grant Avenue in Etna. When the flow data for the two gages are compared as in the graph below, the East Little Pine Creek gage data poorly correlates (R2=0.2919) with the gage data for Pine Creek in Etna. It can be seen that several significant wet weather flow events during the period are clearly missing in the East Little Pine Creek gage data record. Moreover, comparing the Pine Creek flow data during the sampling period with the monthly averages for the Pine Creek gage period of record (2006 to 2010) indicates that the TMDL sampling may have occurred during significantly below-average flow conditions. These results further suggest potential problems with using the East Little Pine Creek gage flow values in loading analysis to represent flow conditions at the time of sampling.



Response

EPA believes that this comment originates from a misunderstanding about how the USGS gage data are used in the LSPC modeling exercise and how the model generates flows. USGS gage data are not used as input or to derive flows in the model. Gage data are used during the calibration process as a "check" to make sure the model is representing flows accurately. The model generates flows primarily on the basis of rainfall data as well as physical attributes such as slopes and underlying soils (See Section 5.2 of the TMDL).

Based on this comment, the data from the 03049807 Pine Creek at Grant Avenue in Etna gage station was also used as "check" to make sure the model is representing flows accurately. A regression analysis of the daily data from the two gage stations from 6/13/2006 (data gap until this date) to 6/30/2008 (the end date for simulation) was performed. A comparison of coincident flow records for this time period between the two gage station sites shows a strong relationship, with an r^2 of 0.75.

In addition, the model results at watershed 6, which coincides with the commenter's suggested Pine Creek USGS 03049807 gage location were compared with observed data from that gage. Figure 5 shows the calibration of the model is good because observed flow from the gage station (blue line) closely mirrors the modeled flow (orange line). A regression analysis of monthly observed vs. modeled data (Figure 6) shows underestimation by the model. This underestimation is mainly due to missing observed data in the gage station that was recommended by the commenter. Gaps in the observed data make statistical analysis less meaningful.

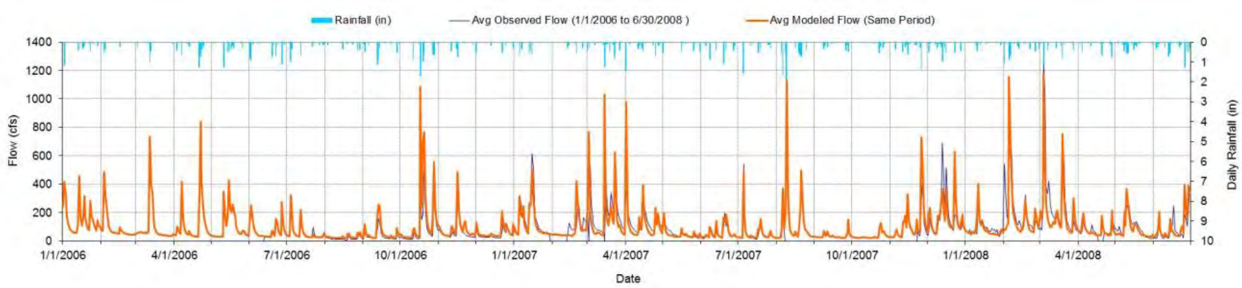


Figure 5. Comparison of modeled vs. observed data at USGS Gage 03049807.

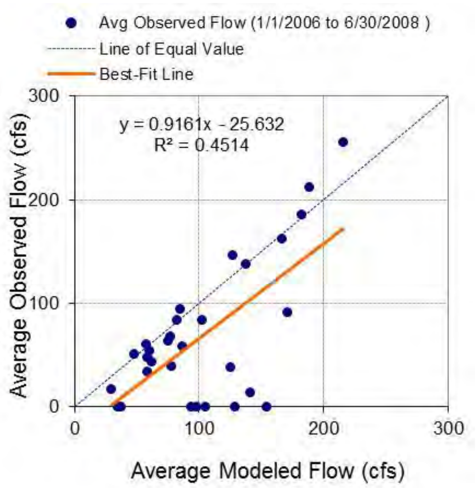


Figure 6. Regression of Observed vs. Modeled flows at USGS Gage 03049807

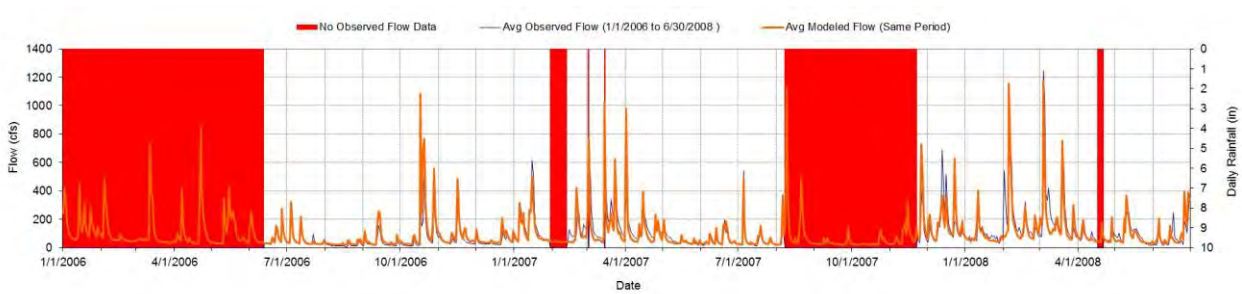


Figure 7. Gaps in flow record at USGS 03049807

Figure 3 illustrates that lack of data that is available at 03049807 Pine Creek at Grant Avenue. Finally, Figure 8 shows the flow record for the modeling period is 100% complete at the East Little Pine Creek gage, making it more useful to use in source analysis.

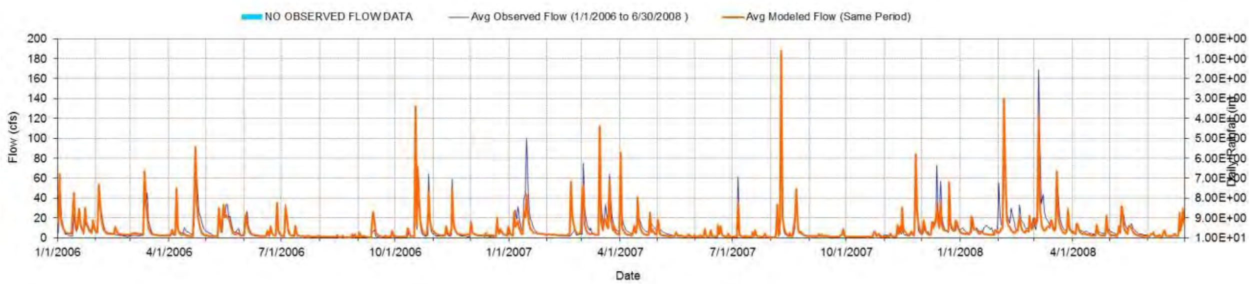


Figure 8. Record 100% complete for modeled period for East Little Pine Creek gage.

Based on the analysis discussed above, which can be thought of as a "check" of the model using the data from 03049807 Pine Creek at Grant Avenue gage station, the model represents the flows in the watershed accurately. However, EPA believes the gage station at East Little Pine Creek presents a more complete flow record and is better suited as a calibration location for the model.

Comment 31

The flow data comparison between the USGS gages also illustrates the problems in reliance on land use data without corroborating reliable data and information. If land use data is used as the sole basis of comparison as in the following table (comment 28b), the East Little Pine watershed appears to be generally representative of the land use of the Pine Creek Watershed.

	East L. Pine			Pine Creek Watershed		
11	Water	0	0.00%	Water	94	0.22%
11	OpenSpace_Pervious	670	37.82%	OpenSpace_Pervious	11,773	27.37%
11	LIR_Pervious	320	18.04%	LIR_Pervious	5,546	12.90%
11	MIR_Pervious	33	1.85%	MIR_Pervious	618	1.44%
11	HIR_Pervious	6	0.36%	HIR_Pervious	73	0.17%
11	Forest	414	23.39%	Forest	17,405	40.47%
11	Pasture	7	0.39%	Pasture	907	2.11%
11	Cropland	0	0.00%	Cropland	472	1.10%
11	Wetlands	0	0.00%	Wetlands	18	0.04%
11	OpenSpace_Impervious	32	1.80%	OpenSpace_Impervious	1,308	3.04%
11	LIR_Impervious	172	9.71%	LIR_Impervious	2,986	6.94%
11	MIR_Impervious	61	3.44%	MIR_Impervious	1,147	2.67%
11	HIR_Impervious	57	3.20%	HIR_Impervious	660	1.53%
	Total	1772	100.00%		43007	100.00%

Response

EPA believes the comment is based on a misunderstanding of how flows were generated and how land use was used in the modeling. Please see response to comments 29 and 30 for information about flows are generated in the LSPC model.

With regards to land use, as explained in Section 5.2.2 of the final TMDL, the LSPC watershed model requires a basis for distributing hydrologic and pollutant loading parameters. Hydrologic variability within the entire watershed is influenced by land surface and subsurface characteristics throughout the watershed. To explicitly model land-based sources of bacteria in the impaired Pine Creek watershed, the existing 2001 NLCD land use categories were consolidated to create the model land use groupings shown in Table 5-2 of the final TMDL. The land use coverage provided the basis for estimating and distributing bacteria associated with land-based, precipitation-driven sources. LSPC algorithms require that land use categories be divided into separate pervious and impervious land units for modeling. This division was made for the appropriate land uses (urban) to represent impervious and pervious areas separately. It was based on typical impervious percentages that were checked against watershed-specific values, as summarized in Table 5-2 of the final TMDL. Land use distribution in the Pine Creek watershed was tabulated in Table 2-3, and differences in land use distribution between the watersheds can be seen in Figure 5-2 of the final TMDL.

Comment 32

As can be seen in the preceding discussion, the correspondence is demonstrably poor when the actual flow data (comment 27) is compared among the respective watersheds. Therefore, use of land use data runs the risk of obscuring real differences in the hydrologic responses between the Sub-Watersheds (SWS) and the overall Pine Creek Watershed. Unfortunately the some of the short term gage data appears to have either reliability problems (a flow event of 1,000,000 cfs is reported for the Main Stem Pine Creek) or problems with the gage site shorten the available data record to several months (W. Branch Little Pine Creek). These factors limit the ability to evaluate and adjust the East Little Pine Creek gage data to other watersheds. The comparison between gages makes it clear that unless the East Little Pine Creek data is adjusted by reliable watershed specific flow data, potentially misleading linkages are likely to be created to pollutant sources.

Response

Please see the responses to comments 28, 29, 30 and 31.

Comment 33

The Proposed TMDL projects loadings from Pasture Land Use from Allegheny County average livestock data. The allocation as to whether land falls into pasture or open space is significant from the standpoint of the TMDL. Using the Town of McCandless data as an example and comparing it to MRLC data reveals problems with using remote data alone as a basis for TMDL process as well as the assumption that loads contributed by pasture land are a composite of cows, horses, poultry, etc. The following Table presents the current Town of McCandless data on all farms in the municipality:

NAME	ADDRESS	STREAM	SWS	AREA		DESCRIPTION
Eichner Farm	**Richard Road**	Pine Creek Tributary	1001	14.9	Acres	Small chicken operation/annual turkey operation/vegetables
Rimbach	**Pine Creek Road**	Pine Creek	24	32.5	Acres	None/not an active farm
Klinestiver	**Grubbs Road**	Pine Creek Watershed	23	6.1	Acres	6-8 horses
Reinhart	**Grubbs Road**	Pine Creek Tributary	23	11.3	Acres	Part-time llama farm
Simon	**Grubbs Road**	Pine Creek Tributary	23	1.9	Acres	4-6 horses
Raupp	**Grubbs Road**	Pine Creek	23	19.7	Acres	10 horses

Response

2007 USDA census data (Ag Census) for Allegheny County formed the basis of the livestock representation. The Ag Census provides estimates of acres of farmland as well as livestock population data (see Table 4, which is Table 3-2 in the TMDL report). County-wide ratios of animals to farmland acres taken from the Census were developed and these ratios were applied to all subbasins with pasture land. Pasture lands were derived from the MRLC. The model scale is not fine enough to specify different animal densities by watershed; rather, it assumes a uniform distribution for the pasture landuse across the entire watershed. Both the MRLC and the Ag Census represent uniform, publicly available datasets, available for the entire watershed.

Table 4. 2007 Agricultural Census data for Allegheny County

Item	Value
Farms (number)	534
Land in farms (acres)	38,023
Land in farms – Average size of farm (acres)	71
Land in farms – Median size of farm (acres)	40
Total cropland (acres)	18,397
Pastureland, all types (acres)	9,213
Cattle and calves inventory (number)	2,021
Cattle and calves inventory – Beef cows (number)	1,096
Cattle and calves inventory – Milk cows (number)	122
Hogs and pigs inventory (number)	133
Sheep and lambs inventory (number)	603
Layers 20 weeks old and older inventory (number)	2,467
Horses and ponies inventory (number)	1,206

Source: USDA's 2007 National Agricultural Statistics Service database

Comment 34

Whereas the TMDL projects 213.5 acres of pasture in McCandless, the active pasture land use is actually 25% of that value (53.9 acres accounted for by 6 farms). Using the actual animal census numbers and the actual pasture acreage yields a Pasture Loading Rate of 1.49E+08 lbs/acre/day which is two orders of magnitude less than the TMDL rate of 1.37E+10 total lbs/acre/day computed from the Allegheny County data. The actual cropland land use acreage in the Town of McCandless appears to be 14.9 acres rather than the 55.14 acres in MRLC data.

Response

EPA has used the MRLC as the landuse base for the TMDL as it is a uniform dataset available for the entire watershed. See also the response to the above comment 33.

Comment 35

The assumption on the 25% septic system failure rate did not appear to be verified with ACHD or the local municipalities. The report fails to document or discuss the source of this assumed failure rate.

Response

On May 6 and 7, 2010 PADEP and EPA requested septic failure rates from ACHD through PADEP's SWRO. The Health Department informed EPA that that data was not readily available, though PADEP was able to provide an Allegheny County specific estimate of the percent of septic systems that were *repaired* for the years 2004 through 2008.

The septic methodology used in the draft TMDL was developed in consultation with the Health Department. The model was set up to represent bacteria loading from septic systems within a 1000-foot buffer of a stream, and estimating (as a calibration starting point) a 25% failure rate of those septic systems, based on 2008 percent of systems repaired for Allegheny County provided by PADEP. The model was then calibrated by adjusting the failure rate as a calibration variable. This calibration resulted in septic system failure rates that varied from 0.5 to 6% in the different subwatersheds. See Section 5.3.2 of the TMDL report for more information.

Comment 36

The model assumes a 50% raw sewage component for CSOs. This assumption is contradicted by the ALCOSAN/3RWW monitoring data. Our analysis of 34 storms in 2008 at 5 Etna CSOs indicates an average dilution ratio of 11 stormwater: 1 raw sewage on a volume basis. Higher dilutions occur during peak flows of approximately 60:1. This would translate into an order of magnitude dilution in the model.

Response

Based on this comment, EPA again requested water quality data to represent the magnitude of bacteria in CSO discharges but were informed that no such data exists. Please refer to response to comment 21 describing EPA's request for data regarding the CSOs.

To estimate CSO and SSO overflows, a relationship between precipitation and the magnitude of estimated CSO flows was developed so that rainfall could be used to estimate CSO overflows and subsequently allow for estimation outside of the CSO monitoring period. Once overflow events were estimated, bacteria concentrations were applied to the flows based on typical literature raw sewage concentrations, or from values measured in the region. A value of 10^6 colony forming units (CFU) of fecal coliforms per

100 mL is a common literature value used for TMDL purposes to characterize raw sewage (Horsley and Witten 1996). This value was multiplied by the overflow volume only to calculate the bacteria from a given CSO.

Once overflow occurs, a fraction of the CSO volume is stormwater; therefore, a partitioning estimate was applied to estimate bacteria contributions. Fifty percent of the excess measured volume (volume exceeding the overflow volume) was modeled as raw sewage, and the bacteria loading was subsequently calculated relative to the overflow magnitude as shown on Figure 5-5. EPA does not possess data to suggest a raw sewage partitioning estimate, so fifty percent was used. Once the time series of bacteria were estimated for a given CSO, the time-series data were applied as a point source at the outfall location in the model.

Comment 37

There is a major technical deficiency in the TMDL methodology in handling combined sewer systems (CSS). As a combined sewer system, the Etna's system collects both stormwater and sewage. However, as Etna is located within an urbanized area, it was required to also hold an MS4 permit. Therefore, in applying EPA policy that allows the TMDL from MS4 systems to be modeled as runoff from an area rather than point sources, the proposed TMDL assumes this area equals the municipal boundary. This creates an issue of double counting for Etna and potentially other CSS that are part of MS4 jurisdictions because the same catchment areas in Etna will be assumed to simultaneously contribute to combined sewer systems and the stormwater systems. In reality, these stormwater bacteria loadings are already accounted for in the CSO loadings.

Response

EPA agrees with the commenter. EPA has revised the model to incorporate the boundary for CSO Interceptor A68, provided by the commenter. Runoff-related loads generated by the model within this boundary are no longer assigned to the MS4 base line load for Etna. These loads have been removed from the overall allocation as the CSO methodology is assumed to adequately account for the loading to Etna's CSO.

Comment 38

Also, why is the Land Use Category of Water assumed to have no fecal coliform loads? Significant water quality impacts from waterfowl have been documented in the literature for other locales. The monitoring notes document the presence of waterfowl during sampling at sampling stations.

Response

EPA has revised the wildlife representation on the basis of this comment. Direct contributions from waterfowl are now simulated in the model for stream reaches using data provided by the commenter from the Audubon Society's Winter Bird Count. Please refer to Appendix F of the final TMDL.

Comment 39

The 5% Margin of Safety (MOS) is not justified in the TMDL report. The model incorporates a series of conservative implicit assumptions: literature fecal coliform loading concentrations; the handling of MS4 as runoff from jurisdictional areas rather than actual areas and point sources; the use of 50% raw sewage in SSO/CSO discharges; 25% failure assumptions; and segregation of wildlife fecal coliform load sources, agricultural livestock loadings, etc. The method itself is conservative as it averages over wet and dry weather fecal coliform loadings and includes extreme value data outliers over a limited data. The use of an explicit MOS of 5% on top of the TMDL conservative assumptions is not justified by the protected use or observed water quality impacts.

Response

EPA agrees with the commenter that TMDL incorporates sufficient conservative assumptions within the TMDL to justify an implicit margin of safety. EPA does not agree that the TMDL used limited data and data outliers in the TMDL. Examples of the conservative assumptions that would justify an implicit MOS used in the development of these TMDLs are:

- Extensive monitoring data was used to calibrate the model and represent in stream conditions.
- Permitted WWTPs were represented at the maximum allowable fecal coliform concentration and design flows as opposed to actual discharges from the WWTP
- The TMDL captured both low- and high-flow critical conditions and was developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability.

The explicit 5% MOS has been removed from the TMDL and Section 6.3.5 of the TMDL has been revised to discuss the implicit MOS within the TMDL.

Comment 40

EPA defines an MS4 as, “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.” Why were Allegheny County and the Pennsylvania Department of Transportation, who are also MS4 NPDES Permit holders, not included and assigned a MS4 load? The Pennsylvania Turnpike Commission may also hold an MS4 permit.

Response

The TMDL report has been revised in accordance with this comment. EPA agrees that all MS4 permittees should be included in this TMDL and have included PennDOT, PAI-1315-00-05-0002, and the Pennsylvania Turnpike Authority, PAI-1315-00-06-0001, in Table 3.4 of the TMDL.

Because the roads, streets and highways are within the boundaries of the municipalities, counties and towns, bacteria loads from PennDOT, Allegheny County, and the Pennsylvania Turnpike Authority areas are aggregated within the municipalities MS4 WLAs as provided in Section 6 of the TMDL.

However, the Allegheny County MS4 permit, PAI-136130, does not cover transportation-related parcels. Instead, it covers County-owned properties and is not authorized to discharge to Pine Creek. Therefore, Allegheny County PAI-136130, was not included in the TMDL.

Comment 41

The draft report does not indicate the number and location of existing industrial stormwater permits within the watershed. The area associated with these permits should be defined in the study and not included in the municipal MS4 component of the TMDL.

Response:

Industrial Stormwater permittees are not considered significant sources of bacteria within the watershed and therefore are not given WLAs in the TMDL.

Comment 42

We question how EPA can allocate MS4 loads to each municipality without having sampled at each municipal boundary.

Response

It is not necessary to monitor at MS4 outfalls or boundaries to develop TMDL loads for MS4s. Models are widely used, acceptable and scientifically defensible method to develop loads for MS4. In the Pine Creek TMDL, the LSPC model was used, to represent a landuse-specific buildup-washoff bacteria relationship. Bacteria were modeled as a pollutant which builds up or accumulates, and then washes off based on rainfall. Accumulation rates were assigned to model land uses to simulate buildup of bacteria on the land surface and removal during overland flow. The removal simulation removes pollutants at a rate related to the volume of water flowing over the land surface. The LSPC-predicted landuse specific loading rates were used to identify the MS4 loads in the following manner within a municipal boundary: 1) calculated total area of each landuse; 2) multiplied area of each landuse by its associated loading rate (derived from the model; 3) summed the landuse-specific loads.

The landuse loading methodology used by EPA, and described above, provides an accurate representation of bacteria delivered to Pine Creek and is a common method used in TMDLs to estimate MS4 loads.

Comment 43

The MS4 load bacteria reductions required ranges from 84% to 98% (Table 6-3). Does EPA believe these MS4 percent load reductions are accurate? Does EPA believe these are attainable? For example, EPA is proposing that Fox Chapel Borough be responsible to reduce the bacteria load by 84% in the Beechwood Farms Nature Reserve. This 134 acre wildlife sanctuary has no publicly owned storm sewer systems and does not allow dogs. How would EPA propose the Borough address this issue?

Response

This Bacteria TMDL identifies and provides allocations to sources within the watershed, including SSOs, CSOs, septic systems, wildlife, pets and livestock. MS4 allocations were based on precipitation driven sources associated with landcover. The dominant sources of bacteria contamination represented in the MS4 WLAs are from wildlife, pets, livestock and where applicable failing infrastructure and septics. The purpose of a TMDL is to calculate and allocate the total load of a pollutant that an impaired waterbody can assimilate and still meet applicable water quality standards. The Pine Creek TMDL does not direct or require implementation of any specific set of actions or selection of controls and EPA understands that some of the sources of bacteria may beyond the control of the MS4 permittee as a result of natural conditions (i.e. wildlife). EPA agrees that the MS4 permittee should not implement this TMDL by reducing wildlife and does not recommend the reduction of wildlife as a BMP. EPA added language in Section 6 of the final TMDL to clarify that bacteria from wildlife is considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. In addition, language was added in Section 6 to better clarify the sources of bacteria represented in the MS4 WLA.

It is expected that the TMDL will be implemented through a variety of regulatory and non-regulatory programs operating under federal, state, and local law. For point sources, such as MS4s, it is expected that the TMDL will be implemented through the NPDES program. NPDES permits must be consistent with the assumptions and requirements of the WLAs in the TMDL. See 40 CFR 122.44(d)(1)(vii)(B). As explained in the Preamble to EPA's Phase II stormwater regulations, NPDES permits for MS4s must, at a minimum, require the operator to develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from a regulated system to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. That requirement exists regardless of whether this TMDL is established. Implementing the applicable water quality requirements of the CWA "recognizes the Agency's specific determination under the [Act] of the need to achieve reasonable further progress toward attainment of water quality standards according to the iterative BMP process, as well as the determination that State or EPA officials who establish TMDLs could allocate waste loads to MS4s as they would to other point sources." See 64 Fed. Reg. 68722, 68752-53 (Dec. 8, 1999). EPA policy acknowledges the appropriateness of an iterative, adaptive management BMP approach that addresses storm water discharges, implements mechanisms to evaluate the performance of such controls, and makes adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality.

EPA anticipates the use of a coordinated, comprehensive approach to TMDL implementation that relies upon an appropriate mix of available "tools." The implementers of the Pine Creek watershed TMDL have many obvious BMPs available to them to directly reduce bacteria contaminations (such as repairing leaking infrastructure and failing septic systems) as well as BMPs that change the public's behavior (such as ordinances that manage pet waste and training programs for farmers to manage manure). As part of a comprehensive implementation strategy, EPA anticipates the use of an iterative, adaptive management approach to assess progress, with appropriate monitoring, so that any necessary corrections can be made as implementation proceeds over time. EPA believes this TMDL provides significant opportunities for flexibility in identifying appropriate implementation responses.

Comment 44

It is our belief that the municipal MS4 baseline loads are significantly over-predicted in the model for the following reasons: The assumption in the model that all of the Urbanized Area contributes to the MS4 WLA is incorrect as only a portion of the total contributing area flows to MS4 discharge locations;

Lack of any sampling of any MS4 discharge locations within the watershed;

No model calibration based upon actual sampling of any MS4 discharges within the watershed;

MS4 discharges were not explicitly monitored.

There is zero Load Allocation (LA) in the urbanized area. All natural background loads should be contained in the LA. The assumption that there is no natural background load in the urbanized area is incorrect; and

The Borough of Etna which is primarily a CSO community also has an MS4 allocation for the entire area of the Borough. As stated previously, this is incorrect and should be revised.

Response

With regards to the boundaries of the MS4 area, please refer to response to comment 22. With regards to the adequacy of the monitoring data, please refer to response to comment 26. With regards to explicitly monitoring the MS4 discharges, please see response to comment 42.

With regards to the Etna MS4 WLA in the CSO area, please refer to response to comment 37. With regards to providing a LA for natural background, please refer to response to comments 43 and 45.

Comment 45

It appears that all of the natural background and wildlife loads were assigned to the MS4 component of the WLA. The analysis avoids answering the question of how much of the bacteria load is due to natural background conditions such as geese and other wildlife?

Response

The MS4 permittee is responsible for all water and pollutants entering its conveyance systems and discharging from its outfalls into the Pine Creek watershed regardless of its source. The WLAs appropriately reflect all loads from all sources regardless if the bacteria source comes from wildlife or natural background. With that said, it is not EPA's intention that this TMDL should reduce wildlife. EPA has added language to the final TMDL that notes that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Further, please refer to response to comment 43.

Comment 46

Is it the intended goal of the TMDL to force local stakeholders to reduce wild animal populations within the watershed?

Response

It is not the intent of this TMDL to reduce wildlife nor does this TMDL recommend the reduction of wildlife as a BMP. Please refer to response to comment 43 and 45.

Comment 47

If EPA is unable to determine the natural background conditions, will EPA initiate a "Use Attainability Analysis" to demonstrate that the nonpoint and MS4 bacteria levels may be controlled by BMPs and effluent limitations?

Response

Pine Creek is subject to applicable water quality standards found in the *Pennsylvania Code*, Title 25, Environmental Protection, Department of Environmental Protection, Chapter 93. The bacteria standard is excerpted below, in part, from Table 3 in Section 93.7 of the Pennsylvania Code:

> During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.

In waters designated for potable water supply:

> Maximum of 5,000/100 ml as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000/100 mL in more than 5% of the samples.

It is beyond the scope of this TMDL to initiate a Use Attainability Analysis and change the watershed's designated uses. Further, it would be premature for any entity to do so at this juncture since the TMDL has not yet been implemented. Instead, EPA encourages the implementation of the Pine Creek Bacteria TMDL so water quality standards can be attained and the waters can be used for swimming, fishing, boating, drinking water without fear of illness and disease.

For additional information please refer to the response to comment 60, especially in encouraging municipalities to address the raw sewage discharges from SSOs, CSOs, leaking/failing infrastructure, failing septic systems and illicit connections. As an example, EPA has posted the successful installation of BMP for managing bacterial contamination in a watershed published at http://water.epa.gov/polwaste/nps/success319/wv_windmill.cfm. In this example, failing household septic systems in McDowell County contributed to water quality impairments in West Virginia's Windmill Gap Creek, but addressing the failing septic systems resulted in attaining the water quality standard for bacteria.

Comment 48

Why were wildfowl and wildlife sources excluded from residential areas in the model? It is common knowledge that significant wildlife populations exist in these areas throughout the Pine Creek watershed.

Response

Wildlife and waterfowl representation in the model have been revised based on data and suggestions submitted by the commenters, including increasing the land uses on which wildlife, particularly deer, are simulated. Please see Table 5-5, Appendix C (Table C-1), and Appendix F of the TMDL for a discussion of the representation.

Comment 49

Was any testing done to develop the bacteria load of storm sewer discharges within the watershed?

Response

Please refer to response to comment 14 and 42.

Comment 50

Was any testing done to develop the bacteria load of combined sewer discharges within the watershed?

Response

Please refer to response to comment 36.

Comment 51

Why are municipal storm sewer discharges located within urbanized areas considered part of the waste load allocation, when the very same type of storm sewer outfall, located outside of the urbanized area is considered a nonpoint source load allocation?

Response

Please see the response to comment 22 for the regulatory definition of an MS4.

Comment 52

Where else has the LSPC model been calibrated and provided reliable results on the basis of approximately 1,000 fecal coliform/E. coli bacteria samples?

Response

LSPC has successfully been applied to hundreds of watersheds across the nation for purposes of simulating bacteria and for TMDL development. Examples include:

- Delaware (Mispillion River, Cedar Creek, Cristina River, HSPF used (LSPC uses exact same algorithms))
- In WV:
    - (16) 8-digit HUCs (EPA approved);
    - (4) 8-digit HUCs (under development);
    - 667 EPA approved fecal TMDLs;
    - 431 fecal TMDLs under development
- Alabama (Hurricane Creek, Scarham Creek, Big Nance Creek, etc.)

- Puerto Rico (Rio Grande de Añasco, Arecibo, and Manati, Rio Grande de Culebrinas).
- California (San Diego Bay, San Diego Lagoons, San Diego Beaches, LA Harbor, Long Beach City Beaches)
- Virginia (e.g., Hunting Camp, Beaver Creek, Smith Creek, Hawksbill Creek)
- Indiana (West Fork White River)
- Ohio (Mahoning River)
- South Carolina (Twelve Mile Creek watershed, Fishing Creek, Gills Creek)

EPA is not aware of any previous LSPC modeling effort where available calibration data were more extensive than those available for the Pine Creek modeling effort. Modeling efforts and availability of water quality data for calibration vary for individual projects. Available calibration data for most efforts would be representative of data collected by typical state water quality monitoring programs—generally monthly monitoring at specific locations for multiple years. Often monthly monitoring can be focused on one group of stations for a year or a season and then the focus will be on another group of stations during the next year or season. Rarely are weekly monitoring data available, especially for periods of a year or more, as is the case for the Pine Creek watershed. The Pine Creek watershed is relatively small at approximately 67 square miles. This TMDL was developed using over 800 fecal coliform samples that were collected at 25 monitoring stations over the course of a year. EPA considers this an extensive and rich data set.

Comment 53

Why are Source X contributions assumed to be illicit in nature? Why can they be assumed to be able to be eliminated? The data under the proposed TMDL is demonstrably weak with respect to dry weather impairments. Other than POTWs and septic systems, we are left with Source X to explain dry weather flow bacteria levels. Planning level data is not sufficient to identify sources- it shows only that the model outputs can be adjusted to fit the sampling data in some cases.

Response

Please refer to the response to comment 27. Source X is assumed to be illicit because of its magnitude and the fact that known sources have been represented in the modeling.

Comment 54

How can the baseline load allocation for the following sub-watersheds (regions) be zero? Is no natural background assumed?

Response

There is no LA for these areas because all the sources of bacteria, including the land-based run-off and the septic systems are within the federally defined MS4 conveyance systems and are therefore regulated under the NPDES program. All discharges from a NPDES permittees must be assigned a WLA. Septic contributions were reduced to zero as failed septic systems are considered illicit.

Comment 55

Why is the Source X in the West Little Pine only assigned to Region 105 and not also shared with the upstream Region 106?

Response

Modeling suggests the location of Source X is within the bounds of subwatershed 105. EPA's assumption is that the source is illicit and must be reduced 100%; however EPA leaves remediation of any illicit sources of bacteria to the implementers of the TMDL, regardless of the subwatershed location.

Comment 56

Please provide the land area for each land use in the MS4 Land Use Table in Appendix F, so that the municipal TMDL assignments in this table may be verified. For example, the MS4 Land Use Detail spread sheet in Appendix F assigns a load to Ross Township in SWS 103. Very little, if any, area in SWS 103 is located in Ross.

Clearly, a detailed review of the TMDL is needed so these and other issues are examined in order to provide the communities, as stakeholders, the level of confidence that the TMDL process is based on the best available and accurate data, including the identification and appropriate characterization of sources.

Response

EPA would like to clarify that Appendix F of the draft TMDL was not the TMDL, but rather Section 6 provides the TMDLs and associated WLAs and LAs with the appropriate bacteria reductions. The spreadsheets contained in Appendix F provided supporting information for the implementation of the bacteria TMDLs developed for each modeled subwatershed in the Pine Creek watershed and provided a possible successful TMDL implementation scenario. In the final TMDL, EPA has removed Appendix F referred to by the commenter to avoid any confusion by implementers. EPA believes that permittees, communities and the Commonwealth should consider all available BMPs and options to determine the optimal activities that will meet the reductions and allocations provided in the TMDL tables in Section 6 of this document.

With regards to the comment about the load assigned to Ross Township in SWS 103, the table provided allocations if any area of a municipality was located within the watershed regardless of how small. However, if the TMDL implementer determines that Ross Township contributes little to the load in SWS 103 and it is appropriate to apply BMPS elsewhere to achieve the reductions, the implementer has the flexibility to choose another scenario to meet the bacteria reductions needed for that subwatershed.

As requested by the commenter, EPA has provided the commenter the land use as GIS files. Appendix B of the final TMDL report contains watershed-specific modeled land use.

Comments submitted by North Area Environmental Council

Comment 57

When the PCWC was first approached to assist with a program to collect water samples for a bacteria monitoring protocol, the emphasis was placed on PA DEP's goal to pilot a program to determine if volunteers could effectively serve as a means for collecting samples for monitoring bacteria with the data acquired to be used in developing a model for bacteria movement, etc. in the watershed. It was understood that the developed protocol, if successful, would be used across the Commonwealth to support bacteria TMDL development. The goal of developing TMDLs for Pine Creek was not made at all clear out the outset of the project. (See Fact Sheet 1, attached.)

As the project, either by design or by evolution, became a TMDL development project it was incumbent upon the EPA and the DEP to communicate directly and concisely with the municipal stakeholders about that goal and to directly engage them in the entire process. Furthermore, there were numerous opportunities throughout this project to report directly to the municipalities about the status of the project and renew their understanding of the goal to establish TMDLs. To our knowledge, at no point in this entire endeavor were the municipalities directly invited into the TMDL stakeholder process. As very significant stakeholders regarding the intent to develop TMDLs for bacteria their considered input needs to be included."

Due to this serious oversight, we feel it is imperative that the TMDL process be reopened so that the municipalities can be involved and so that there can be a more thorough review of the materials and data.

Response

EPA agrees with the commenter that the Pine Creek Bacteria Project did not begin as a TMDL project. Instead, the goal of the sampling effort was intended to support model development that could be used in developing an assessment tool to be used by PADEP and as mentioned by the commenter to support bacteria TMDL development throughout Pennsylvania. A relatively small percentage of Pennsylvania's streams have been assessed for recreational use attainment because of the time and expense associated with bacteria sampling. EPA is very grateful to the Pine Creek Watershed Coalition for collecting the samples, which provided hundreds of fecal coliform concentration data points, on which watershed modeling effort was based.

The same modeling effort that was used to develop an assessment tool for PADEP can also be used to drive TMDL scenarios. To develop the assessment tool for the Commonwealth, EPA modeled the Pine Creek watershed using the extensive monitoring data that included hydrologic data, precipitation data, land use information and bacteria monitoring analysis. A natural outgrowth of this extensive monitoring and modeling was the development of a TMDL for the watershed once it was determined that the watershed was severely impaired for bacteria. PADEP listed the Pine Creek watershed on its 2008 303(d) list based on the monitoring data and assessment tool that was developed.

With regards to the comment that EPA should engage the stakeholders within the watershed, please refer to response to comments 2 and 3.

Comment 58

The municipalities and other stakeholders within the Pine Creek watershed have been actively working to address overwhelming challenges of flooding, combined sewer overflows, as well as erosion and sedimentation that chronically impact the lives of residents in the watershed. As part of these endeavors, several municipalities are engaged in efforts to meet Consent Orders regarding sanitary and combined sewers feeding into the Allegheny County Sanitary Authority (ALCOSAN) system. These issues, as well as efforts to meet MS4 guidelines present an extraordinary burden on municipalities, especially the older, lower income communities at the bottom of the watershed. Since flooding, stormwater management and CSO's are the most important priorities in the watershed, and since BMPs to address those challenges can directly conflict with efforts to reduce bacteria in the streams (see article "Can Stormwater BMPs Remove Bacteria" at http://www.udfcd.org/downloads/pdf/tech_papers/Can%20Stormwater%20BMPs%20Remove%20Bacteria.pdf)," We feel that setting TMDLs for bacteria in Pine Creek before those matters are successfully addressed is a severely misguided effort.

Response

EPA strongly believes that the health of the Pine Creek community should be a priority and should not take a back seat to other environmental problems within the watershed. The bacteria TMDL in Pine Creek is designed to address the local bacteria impairment, much of which is caused by raw sewage discharges from SSOs, CSOs, leaking infrastructure, failing septic systems and illicit connections. The monitoring data in the Pine Creek watershed clearly show that the waterbodies within this watershed are contaminated by fecal coliform and *E. coli*, both indicators of human and animal waste. EPA considers the magnitude of the contamination to be a significant human health problem. Human waste is the source of pathogenic viruses and bacteria; animal waste is a source of some bacterial pathogens. The principal pollutants present in contamination from raw sewage include hundreds of different types of bacteria, viruses, and parasites. The presence of specific microbial pathogens in wastewater depends on what is endemic or epidemic in the local community. In general, microbial pathogens are easily transported by water. The predominant symptoms of pathogenic bacterial infections include abdominal cramps, diarrhea, fever, and vomiting. In addition to attacking the human digestive tract, the pathogenic bacteria can cause illnesses such as pneumonia, bronchitis, and swimmer's ear, eye infections and hepatitis.

EPA does not agree that BMPs to address CSOs and stormwater management directly conflicts with the goals of the bacteria TMDL. Rather, EPA believes that the goals of the bacteria TMDL in the Pine Creek watershed will complement the goals of the community's desire to also address flooding, CSOs and stormwater management. The successful control of CSOs, the SSOs and stormwater runoff discharges, which are significant sources of bacteria in the watershed, will have the additional benefit of controlling the bacteria contamination. EPA recommends addressing these obvious sources of bacteria contamination within the stormwater system.

As noted in the article provided by the commenter entitled "**Can Stormwater BMPs Remove Bacteria? New Findings from the International Stormwater BMP Database"**

> "In some cases, human-induced problems exist due to illicit connections of sanitary sewers to storm sewers, sanitary sewer overflows, improper disposal of pet waste, and leaking sanitary sewers, as a few examples. Correction of these problems is of unquestionable benefit to the environment and human health. . . Obvious first steps in controlling bacteria discharges from

> storm sewers include dry weather screening of stormwater outfalls to remove blatant sources of bacteria associated with illicit connections and leaking sanitary sewers, …

In addition, to the above statement, the article presented mixed results from the installation of such BMPS as swale and detention ponds. The International Stormwater BMP Database provides a relatively large and growing bacterial data set that is useful in evaluating the effectiveness of various structural BMPs with regard to bacteria removal. The article presented that media filters and retention ponds were most effective based on their current data set.

Finally, Appendix G provides additional information regarding appropriate BMPs for the Pine Creek watershed and clarifies that it is EPA's intent that this TMDL be implemented over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. Please refer to Section 7 of the TMDL which provides more detail.

Comment 59

If EPA's goal is to promote the welfare of the residents of the Pine Creek watershed, adding the burden of meeting TMDLs for bacteria to the already severe burden of addressing flooding, MS4s and SSO/CSOs creates a conflict that will force municipalities to redirect critical resources toward meeting TMDLs for a contaminant that does not pose an immediate, major threat to residents or businesses.

Response

Please refer to response to comment 58.

Comment 60

In the meantime however, we recommend researching and using stormwater BMPs that are more likely to reduce bacteria contributions.

Response

Developing BMPs is beyond the scope of this TMDL study and EPA does not recommend or endorse one particular TMDL implementation approach over another. However, because stakeholders have requested information regarding implementation of this TMDL, EPA has included Appendix G that provides additional information regarding appropriate BMPs for the Pine Creek watershed and clarifies that it is EPA's intent that this TMDL be implemented over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. Please refer to Section 7 of the TMDL which provides more detail and Appendix G of the TMDL which provides an Implementation Framework.

Comment 61

There is considerable thought that the recreational water quality standards should be adjusted to recognize primary (e.g., swimming) and secondary (e.g., fishing) recreational uses and to adjust the levels upwards for both uses to recognize what is safe and reasonably attainable (see "Scientific Basis for Bacterial TMDLs in Georgia" at http://www.rivercenter.uga.edu/publications/pdf/tag_tmdl_bacteria.pdf). In addition, it seems reasonable that very high flow events should not be included in the standard for primary and secondary uses since avoidance of waters at these times is common behavior.

It also appears that water quality standards are going to use E-coli instead of fecal coliform at some point in the future. It would be appropriate to delay bacteria TMDLs until such changes are worked out.

Response

The document "Scientific Basis for Bacterial TMDLs in Georgia" presents recommendations as part of a Georgia Statewide Water Planning process (among other things) including recommendations from EPA to adopt new bacterial standards for freshwaters (using *E. coli*) and marine waters (using fecal enterococci) and that Georgia should consider designating its waters as for primary or secondary contact recreational uses. This document has no bearing on Pennsylvania's water quality standards nor the implementation of those standards.

Section 303(c) of the Clean Water Act (CWA) provides the statutory basis for water quality standards. It is primarily a state program subject to EPA oversight to maintain compliance with CWA requirements. EPA's regulations implementing this section require states to adopt sufficient criteria and monitoring in their standards to protect designated uses. EPA has strongly encouraged all states to adopt the updated (1986) *E. coli*/enterococcus standards recommended by EPA. To date, the Commonwealth of Pennsylvania has not adopted the *E. coli* bacteria criteria in its water quality standards. However, Pennsylvania's water quality standards do designate its water bodies for recreational uses and its current fecal coliform standards are established to protect those designated uses.

A TMDL must be developed to meet the current water quality standards. The Pine Creek TMDL has been developed to meet the water quality standards found in the *Pennsylvania Code*, Title 25, Environmental Protection, Department of Environmental Protection, Chapter 93. The bacteria standard is excerpted below, in part, from Table 3 in Section 93.7 of the Pennsylvania Code:

> During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period

Pennsylvania has not advised EPA that they have plans to revise their bacteria standard in the near future, therefore, the TMDL was established based on the fecal coliform standards. EPA sees no reason to delay the establishment of this TMDL based on the current or future bacteria water quality standards of Pennsylvania.

EPA reminds the commenter that the Pine Creek watershed would still be impaired if Pennsylvania did adopt EPA's 1986 *E. coli* standard.

Comment 62

Should there be changes to standards after Pine Creek bacteria TMDLs are finalized: What impact will that have on the requirements for any TMDLs set for Pine Creek? Will TMDLs for Pine Creek be adjusted accordingly or will the watershed be held to stricter standards than other watersheds for whom TMDLs are set after revisions are made?

Response:

According to EPA's national database, ATTAINS, found at http://iaspub.epa.gov/waters10/attains_nation_cy.control, there are over 157,000 miles of rivers and over 543,000 acres of lakes, ponds and reservoirs impaired by pathogens. In addition, ATTAINs provides that there are over 10,000 TMDLS established in the nation addressing waters impaired by pathogens, with many more TMDLs being established every year. Those TMDLs were established to meet the current water quality standards of the State at the time the TMDL was established, be it fecal coliform, total coliform or *E. coli*. The Pine Creek watershed is not being held to a stricter standard, but rather is being appropriately held to the current bacteria standard of the Commonwealth of Pennsylvania in order to address the bacteria impairments within Pine Creek watershed.

If Pennsylvania revises its bacteria criteria from fecal coliform to E. coli, EPA believes that the Pine Creek TMDL does not necessarily need to be revised to meet that new standard. States have the option to revise a TMDL's pathogen allocations by translating the original fecal coliform-based allocations to *E. coli* allocations using site specific or other available data. As the sampling done in the Pine Creek watershed was for both fecal coliform and *E. coli*, such a dataset is available. However, if future monitoring data show the water body is still impaired under the *E. coli* criteria despite implementation of the earlier fecal coliform TMDL, revisions to the TMDLs allocations may be necessary. Conversely, if monitoring of a new indicator demonstrates that the designated use of the water body is being met under the newly adopted standard, the State may choose to request that EPA withdraw the Pine Creek TMDL.

Comment 63

Since the sampling of the Pine Creek watershed in 2006-2007, several significant changes have taken place that could have significant impact on bacteria counts and the modeled bacteria sources: at least one sewer treatment plant has been upgraded (West Little Pine Longvue #1), and the 60 acre North Park Lake has been drained, dredged and refilled, more than doubling its capacity.

Due to these changes, we feel that data for these areas should be resampled so that that data, model outputs and TMDLs reflect the current conditions."

Response:

Please refer to response to comments 16 and 17.

Comment 64

There is extensive information available that was not incorporated into the model used to generate the bacteria TMDL for Pine Creek, making it far less accurate than it might otherwise be. Current land use maps, comprehensive municipal sewer maps and MS4 updates would contribute significantly. The TMDLs should be reevaluated with more up to date and complete information on these parameters.

Response:

Please refer to response to comments 22, 24, 25 and 77.

Comment 65

The projections for land based bacteria sources are undoubtedly inflated due to the use of regional wildlife harvest data that does not relate to highly urbanized areas such as much of the Pine Creek watershed. On the other hand, projections for contributions of bacteria from faulty septic systems are probably low since failure rates were reduced significantly from earlier estimates. It is also likely that some of the high count samples are the result of sanitary sewer problems. Any significant shifts in the model results from these parameters alone will impact priority setting and assessments for work to address bacteria TMDLs.

We feel these projections should be reevaluated with data more accurately reflecting the actual conditions in the watershed."

Response

Appendix F of the Final TMDL provides detailed description of the wildlife data used in developing the TMDL and model representation, reflecting the latest information provided by commenters and stakeholders. In addition, septic representation has been updated since the Draft TMDL on the basis of feedback and data from the municipalities (Section 3.2.1 and Section 5.2.5). In an effort to respond to comments submitted on the Draft TMDL, EPA requested additional water quality data to characterize sanitary sewer issues. The drainage area for Interceptor A68 was provided by the Borough of Etna and EPA utilized this information to revise the MS4 WLA for Etna Borough. No additional CSO or SSO data were provided.

Comment 66

The draft of the bacteria TMDLs released for the Pine Creek watershed did not include either sampling location information or sample data. Without that information, the data discussed in the draft document cannot be evaluated. A map with site numbers and location information sufficient to accurately locate the sampling sites should be included in a TMDL document.

Response

Please refer to response to comments 11, 12 and 14.

Comment 67

It is unclear how the sampled counts/100 ml translate into the counts/day used in the TMDL draft document.

Response

The LSPC model predicts bacteria in the unit of counts/100 mL, consistent with the units of the sampling data. Note that while the sample data represent a single sample collected during the course of one day, the LSPC model output provides predicted fecal counts on an average daily basis.

Comment 68

"Background on the life history of the bacteria in question, such as lifespan, life-supporting conditions, responses to changes in conditions, etc., will be needed to understand the most effective ways to address the TMDLs. Will that information be provided in the final TMDLs?"

Response

The principal pollutants present in contamination from raw sewage include hundreds of different types of bacteria, viruses, and parasites. The presence of specific microbial pathogens in wastewater depends on what is endemic or epidemic in the local community. Providing the life history of each bacteria, virus or parasite that might be present is beyond the scope of the TMDL and is not needed to effectively control the pathogenic contamination. The most effective way to implement TMDL is to eliminate the SSOs, CSOs, leaking infrastructure, failing septic systems, elicit discharges, animal wastes, etc.

Bacteria are simulated as being subject to a first-order decay rate. This is a simplistic representation of bacteria die-off once introduced into surface waters. The decay rate is calculated on a daily basis in the LSPC model, and is conceptualized as a fraction per day of bacteria that survive.

Comment 69

Inconsistent results found from analysis of flow based rates vs. seasonal based rates indicate that access to the full data set and seasonal and flow analysis for each monitoring site is needed to fully assess possible sources and design remediation strategies. How will that data be available to stakeholders?"

Response

EPA does not agree that results are inconsistent. The TMDL is a rich resource to help implementers understand the most significant sources of bacteria in the Pine Creek watershed. However, if the commenter is interested in flow information, USGS gage station 03049800 flow information is published in the USGS National Water Information System on line data base at http://waterdata.usgs.gov/usa/nwis/uv?03049800. Four additional locations were monitored between March and October 2007 by PADEP. PADEP flow monitoring data can be requested from EPA.

Comment 70

During the presentation on September 28th, 2011 it was indicated that driveways were included in the impervious surface calculation for the model. If building areas were not included as well, the impervious surface calculations are undoubtedly underestimated. Were building areas also included?"

Response

General land use and land cover data for the Pine Creek watershed were extracted from the Multi-Resolution Land Use Characteristics Consortium's (MRLC) satellite image-derived 2001 Land Use and Land Cover (LULC) dataset (Homer et al 2004). This data set includes 29 categories, 14 of which are present in the Pine Creek watershed. Table 2-3 of the final TMDL summarizes land cover in this watershed, and the LULC coverage for the Pine Creek watershed is shown on Figure 2-2.

The MRLC has a National Land Cover Dataset (NLCD) which is a land cover classification scheme that has been applied consistently across all 50 United States and Puerto Rico at a spatial resolution of 30 meters and is comprised of three different elements: *land cover, percent developed impervious surface and percent tree canopy density.* Initial estimates of impervious areas were made for low intensity residential (LIR), medium intensity residential (MIR), high intensity residential (HIR), and developed open space on the basis of the MRLC developed impervious surface data.

Overall percentage imperviousness for Pine Creek on the basis of initial estimates was approximately 14%. This compares to local impervious area data that suggest the Pine Creek watershed is closer to 8 % impervious overall (See also response to comment 86). As a result, EPA revised downward the Impervious area estimates as follows: low intensity residential (20 % of total LIR), medium intensity residential (35 % of total MIR), high intensity residential (80 % of total HIR), developed open space (5 % of total Developed, open space) as presented in Table 5.2 of the TMDL. This results in an estimated 8.3% imperviousness for the watershed overall, which was applied in the final modeling.

Comment 71

What is the process and timetable for implementation of TMDL regulations?

Response

The Pine Creek TMDL is not a regulation. The purpose of a TMDL is to calculate and allocate the total load of a pollutant that an impaired waterbody can assimilate and still meet applicable water quality standards. The Pine Creek TMDL does not direct or require implementation of any specific set of actions or selection of controls. Instead, it is expected that the TMDL will be implemented through a variety of regulatory and non-regulatory programs operating under federal, state, and local law. For point sources, such as MS4s, CSOs and WWTPs, it is expected that the TMDL will be implemented through the NPDES program. NPDES permits must be consistent with the assumptions and requirements of the wasteload allocations in the TMDL. See 40 CFR 122.44(d)(1)(vii)(B). As explained in the Preamble to EPA's Phase II stormwater regulations, NPDES permits for MS4s must, at a minimum, require the operator to develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from a regulated system to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. That requirement exists regardless of whether this TMDL is established. Implementing the applicable water quality requirements of the CWA "recognizes the Agency's specific determination under the [Act] of the need to achieve reasonable further progress toward attainment of water quality standards according to the iterative BMP process, as well as the determination that State or EPA officials who establish TMDLs could allocate waste loads to MS4s as they would to other point sources." See 64 Fed. Reg. 68722, 68752-53 (Dec. 8, 1999). EPA policy acknowledges the appropriateness of an iterative, adaptive management BMP approach that addresses storm water discharges, implements mechanisms to evaluate the performance of such controls, and makes adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. This approach is further supported by a recent report from the National Research Council (NRC), Assessing the TMDL Approach to Water Quality Management (NRC, 2001). To be clear, the goal of EPA's stormwater program is attainment of water quality standards; EPA, however, expected that many municipal stormwater dischargers would need several permit cycles to achieve that goal.

EPA expects that the NPDES permitting authority will review the information provided by the TMDL, see 40 C.F.R. § 122.44(d)(1)(vii)(B), and determine whether the effluent limit is appropriately expressed using a BMP approach (including an iterative BMP approach) or a numeric limit. Where BMPs are used, EPA recommends that the permit provide a mechanism to require use of expanded or better-tailored BMPs when monitoring demonstrates they are necessary to implement the WLA and protect water quality.

Comments submitted by Pennsylvania Dept. of Environmental Protection, Bureau of Watershed Management

Comment 72

Language on pages 63-64 of TMDL: While implementation generally is beyond the scope of this TMDL, EPA provides clarification of the assumptions and requirements of this TMDL. EPA anticipates that implementation of the MS4 permit WLAs in the Pine Creek watershed will be achieved over the course of multiple permit cycles using an iterative, adaptive approach to stormwater management. See Section 7 for additional information regarding implementation and EPA guidance.

PADEP Comment on this language:_ PADEP appreciates EPA's confirmation that TMDL implementation is an iterative process that will take place over multiple permit cycles. In addition, PADEP is requesting clarifying language regarding permit consistency with the assumptions and requirements of this TMDL. Specifically, DEP would like acknowledgement by EPA that the overall reduction goal set forth in the TMDL are to be achieved in phases. Also, please clarify that a permit is consistent with the assumptions and requirements of the TMDL if: the permittee has an approved MS4 TMDL Implementation Plan, within an MS4 permit; and that plan describes specific bacteria reducing BMPs to be implemented in that permit cycle.

Response

It is not within the scope of the TMDL to determine what the MS4 permit or an approvable MS4 implementation plan should include, nor whether BMPs chosen in the implementation plan will meet the goals of MS4 permit. NPDES permits must be consistent with the assumptions and requirements of the wasteload allocations in the TMDL. See 40 CFR 122.44(d)(1)(vii)(B). EPA's expectation is that the permitting authority will consider the TMDL and its WLA's to ensure the TMDL implementation plans will be consistent with the regulations and requirements of the NPDES stormwater regulations. The guidance memorandum titled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" (Nov. 22, 2002) states:

> EPA expects that the NPDES permitting authority will review the information provided by the TMDL, see 40 C.F.R. § 122.44(d)(1)(vii)(B), and determine whether the effluent limit is appropriately expressed using a BMP approach (including an iterative BMP approach) or a numeric limit. Where BMPs are used, EPA recommends that the permit provide a mechanism to require use of expanded or better-tailored BMPs when monitoring demonstrates they are necessary to implement the WLA and protect water quality.

This is consistent with the November 12, 2010 guidance document issued by EPA clarifying and supplementing the 2002 guidance.

EPA expects that the NPDES permitting authority will review the information provided within the TMDL and determine whether the effluent limit is appropriately expressed using an iterative BMP approach or a numeric limit. As explained in the Preamble to EPA's Phase II stormwater regulations, NPDES permits for MS4s must, at a minimum, require the operator to develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from a regulated system to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. That requirement exists regardless of whether this TMDL is established. NPDES permits also must specify the monitoring necessary to determine compliance with the permit requirements, whether expressed as BMPs or numeric limit.

Implementing the applicable water quality requirements of the CWA "recognizes the Agency's specific determination under the [Act] of the need to achieve reasonable further progress toward attainment of water quality standards according to the iterative BMP process, as well as the determination that State or EPA officials who establish TMDLs could allocate waste loads to MS4s as they would to other point sources." See 64 Fed. Reg. 68722, 68753 (Dec. 8, 1999). EPA policy acknowledges the appropriateness of an iterative, adaptive management BMP approach that addresses storm water discharges, implements mechanisms to evaluate the performance of such controls, and makes adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. To be clear, the goal of EPA's stormwater program is attainment of water quality standards; Congress, however, expected that many municipal stormwater dischargers would need several permit cycles to achieve that goal.

Comment 73

Language on page 63 of TMDL: To determine the loading associated with each MS4, the township boundary GIS layer was overlaid with the watershed boundaries, and the land-based WLA was proportionally assigned to each municipality based on area. At this time, EPA cannot determine what portion of the municipalities are designated/used for collecting or conveying stormwater, as opposed to portions that are truly nonpoint sources. As part of the Phase II stormwater permit process, MS4s will be responsible for evaluating and mapping out areas that are draining to or discharging to storm sewers. Because these systems have not yet been delineated, the TMDL lumps nonpoint source loadings into the WLA portion of the TMDL within the defined urbanized area.

PADEP Comment on this language: The federal definition of municipal separate storm sewer is the foundation of the MS4 municipalities' permitting obligation and is clearly focused on the system of conveyances rather than the municipal land area. Inclusion of land area that does not drain to the MS4 should not be included in the WLA assigned to MS4 permittees. The TMDL should be revised to include language that clarifies the MS4 permittee's WLA is limited to, and based upon, drainage to and discharge from the MS4 system as that term is defined in the federal regulations.

Response

On July 9, 2010, EPA provided a letter to PADEP that clarified the definitions and boundaries of the MS4 area under the MS4 Stormwater Program. We are referencing that July 9, 2010 letter to PADEP as a response to this comment and a scanned image of that letter is included below.

To the extent the comment refers to how the MS4 area was calculated, please refer to response to comment 22.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. John Hines
Deputy Secretary for Water Management
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, Pennsylvania 17105-8775

JUL 0 9 2010

Dear Mr. Hines:
John

In a recent conversation in the context of the Chesapeake Bay TMDL Stormwater Methodology, the Pennsylvania Department of Environmental Protection (PADEP) advised the Environmental Protection Agency (EPA) that it considers only the actual pipes and roadways that are located within a municipal right-of-way to be part of a Municipal Separate Storm Sewer System (MS4) program which is regulated by the Pennsylvania Phase II Stormwater MS4 permit (PAG-13). In a subsequent email of June 25, 2010 from Ken Murin, PADEP requested clarification regarding the scope of a discharge program for a regulated MS4 and how that applies to NPDES permit-regulated activity. This letter is intended to respond to PADEP's request and clarify this issue.

The definition of MS4 in 40 C.F.R. § 122.26(b)(8) includes subparagraph (ii), which further defines MS4 as "designed or used for collecting or conveying storm water." Because of its function of collecting stormwater from a defined area (the "urbanized area" or designated area) regulating pollutants in stormwater conveyed by and discharged from the MS4 must include controlling inflow to the MS4. EPA's clear intent in creating the MS4 Stormwater Program was to regulate stormwater discharging from municipalities where dense populations exist (Phase I) or that are wholly or in part located within urbanized areas (Phase II) by requiring that the municipalities develop strategic management programs to control stormwater flowing into the MS4, *i.e.*, stormwater collected by the MS4 from throughout its service area.

With respect to Phase II MS4s, EPA considers stormwater discharges from within the geographic boundary of the urbanized area (and designated areas) served by small MS4s to be covered by the permit. *See* 64 Fed. Reg. 68722, 68751-52 and 68804 (Appendix 2) (Dec. 8, 1999). As the preamble explains, the reason for regulating small MS4s in urbanized areas was based on the correlation between the degree of development/urbanization and adverse water quality impacts from stormwater discharged from such areas. *Id.* at 68751. Moreover, in addition to the Census Bureau-defined urbanized areas, EPA also intended small MS4s serving areas outside of the "urbanized area" boundary to be designated for regulation.

Pursuant to 40 C.F.R. §§ 122.32(a) and 123.35(b), states must look beyond the urbanized area boundaries to determine whether "regulated MS4s" should include only MS4 service areas within the urbanized area boundaries or whether states should designate MS4s and MS4 service areas outside of those boundaries. 40 CFR § 123.35(b) states that authorized states "must develop a process, as well as criteria, to designate small MS4s other than those described in section 122.32(a)(1) of this chapter, as regulated small MS4s to be covered under the NPDES storm water discharge control program." Section 122.35(b)(2) then requires the state to "apply such criteria *at a minimum* to any small MS4 located outside of an urbanized area serving a jurisdiction with a population density of at least 1,000 people per square mile and a population of at least 10,000" (emphasis added). In addition, section 123.35(b)(4) requires the state to "designate any small MS4 that contributes substantially to the pollutant loadings of a physically interconnected municipal separate storm sewer that is regulated by the NPDES storm water program." In sum, by regulating MS4s located in "urbanized areas" and requiring states to designate and regulate stormwater discharged by MS4s serving smaller densely populated areas, the MS4 definition and the Phase II rule together define the scope of regulated small MS4 discharges as the discharges collected by or conveyed by the system of conveyances serving these areas.

In light of the definition of MS4 as a system of stormwater conveyances that collects or conveys stormwater, both the Phase I and Phase II MS4 rules require MS4 stormwater management programs to control pollutants discharged from the MS4 by controlling stormwater entering the MS4 from the service area. As explained in the Phase I Rule preamble, this is consistent with the manner of regulation envisioned by Congress in enacting section 402(p) of the Clean Water Act:

> When enacting this provision, Congress was aware of the difficulties in regulating discharges from municipal separate storm sewers solely through traditional end-of-pipe treatment and intended for EPA and NPDES States to develop permit requirements that were much broader in nature than requirements which are traditionally found in NPDES permits for industrial process discharges or POTWs. The legislative history indicates, municipal storm sewer system "permits will not necessarily be like industrial discharge permits. Often, end of the pipe treatment technology is not appropriate for this type of discharge.
> 55 Fed. Reg. 47990, 48037-88 (Nov. 16, 1990).

Similarly, the content of the Phase II rule expresses EPA's intent to regulate all stormwater flowing into and through the municipal system from throughout the regulated service area. Specifically, the six minimum control measures require the MS4 permittee to reduce discharges of pollutants in stormwater from the MS4 by training its department staff and construction site contractors, educating the public and imposing controls on construction sites and other sources. *See,* 40 C.F.R. § 122.34(b).

Also, it is inconsistent with the requirements of section 122.34(b)(6) to only include the streets and pipes in the municipal roadways when defining the MS4 when there are a number of areas that are owned or operated by the municipality that have stormwater drainage associated with them and may not be located within a municipal right-of-way. Some examples of such areas are municipal garages/public works areas, parks and recreational areas, police, fire and emergency service facilities, municipal buildings such as a city hall, parking areas associated with the aforementioned facilities and any facilities with associated drainage easements. PADEP's definition of MS4 would exclude these areas.

As it relates to the Chesapeake Bay TMDL, the MS4 area cannot for purposes of the Watershed Implementation Plan (WIP) be considered only the pipes and streets because the purpose of the WIP is to account for various types of loadings so that the TMDL allocations can be accurately distributed. Currently, the WIP separates the stormwater loads for the TMDL Wasteload Allocation (WLA) into three categories -- MS4, Industrial and Construction -- because these categories have permits and therefore have a distinct mechanism for controlling their discharges. The remaining portion is considered non-point source load and is charged to the Load Allocation (LA) portion of the TMDL. As a result, if the MS4 boundary does not include the area that drains into and through the MS4, Pennsylvania's WLA will be inaccurate; furthermore, such a definition would limit Pennsylvania's ability to track the reductions occurring as a result of BMPs implemented on land draining to the MS4 if that drainage area is not included in the MS4 boundary.

EPA recognizes that not all activities which occur within the footprint of a municipal boundary may be under the direct control of the MS4 permit. However, there was a clear expectation from the beginning of the program that the MS4 permit would include source reductions beyond the sewer pipes. For example, Pennsylvania's current MS4 permit (PAG-13), requires municipalities to enact an ordinance requiring review and approval of Erosion and Sediment (E&S) Plans; ensure installation, operation, and maintenance of post-construction best management practices (BMPs); implement special practices for vehicle maintenance, fueling, and washing; and other practices which rely on better source control as opposed to end-of-pipe treatment.

Please do not hesitate to direct any questions or comments to me or to Evelyn MacKnight, at 215-814-5717.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

cc: Ken Murin, PADEP
Glenn Rider, PADEP

Comment 74

Language on page 66: In the future, PADEP may adjust the load and/or wasteload allocations in this TMDL according to the following procedures and to account for new information or circumstances that develop or are discovered during implementation of the TMDL.

DEP Comment on this language: PADEP requests modification of this language to clarify that adjustments to this TMDL would require an EPA modification of this TMDL to adjust load and wasteload allocations, based on new information.

Response

EPA has modified the language in Section 6.3.7 to better reflect EPA's authority to revise the TMDL or approve a TMDL revision as follows:

> EPA has established the Pine Creek TMDL, including its component WLAs, LAs, and margin of safety, based on the applicable WQS and the totality of the information available to it concerning water quality and hydrology, and present and anticipated pollutant sources and loadings. EPA recognizes, however, that neither the world at large, nor the watershed is static. In a dynamic environment, change is inevitable. Much change may be generated during TMDL implementation and may include new monitoring data, installation of BMPs and land use changes.
>
> It may be possible to accommodate some of those changes within the existing TMDL framework without the need to revise it in whole, or in part. For example, EPA's permitting regulations at 122.44(d)(1)(vii)(B) require that permit WQBELs be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge" contained in the TMDL. As the EPA Environmental Appeals Board has recognized, "WLAs are not permit limits per se; rather they still require translation into permit limits." In re City of Moscow, NPDES Appeal No. 00-10 (July 27, 2001). In providing such translation, the EAB said that "[w]hile the governing regulations require consistency, they do not require that the permit limitations that will finally be adopted in a final NPDES permit be identical to any of the WLAs that may be provided in a TMDL." Id. Accordingly, depending on the facts of a particular situation, it may be possible for Pennsylvania to write a permit limit that is consistent with (but not identical to) a given WLA without revising that WLA (either increasing or decreasing a specific WLA), provided the permit limit is consistent with the operative "assumptions " (e.g., about the applicable WQS, the sum of the delivered point source loads, the sufficiency of reasonable assurance) that informed the decision to establish that particular WLA. It is an assumption of this TMDL that any new or expanded publicly owned treatment works (POTW) permittee or wastewater treatment plant may discharge into the watershed at the bacteria water quality criteria without a TMDL revision.
>
> There might be, however, circumstances in which the permit authority is not comfortable with, or the CWA would not allow, the degree to which a permit limit might deviate from a WLA in the TMDL such that one or more WLAs and LAs in the TMDL would need to be revised. In these cases, it might be appropriate for EPA to revise the TMDL (or portions of it). EPA would consider a request made by the public or PADEP to revise the TMDL. Alternatively, PADEP

could propose to revise a portion(s) of the TMDL (including, but not limited to specific WLAs and LAs) and submit those revisions to EPA for approval. A proposed wasteload allocation can be made available for public comment concurrent through the associated permits revision/reissuance public notice. If EPA approved any such revisions, those revisions would replace their respective parts in the EPA-established TMDL framework. In approving any such revisions or in making its own revisions, EPA would ensure that the revisions themselves met all the statutory and regulatory requirements for TMDL approval and did not result in any component of the original TMDL not meeting applicable WQS.

Comments submitted by McCandless Township Sanitary Authority

Comment 75

"Table 3-2 (page 21) lists summary data characterizing these facility discharges based on discharge monitoring report (DMR) data and permit limits. The table erroneously gives the average effluent fecal coliform as 2580 CFU/100mL) for our Pine Creek Plant NPDES ID PA0027669. We are requesting this entry be corrected. In addition if this value was used in the TMDL computations, those calculations should be rerun with loads that are representative of Pine Creek WWTP performance.

For the record we are providing the following table that summarizes MTSA WWTP performance with respect to both annual and May to October fecal coliform effluent loads. This readily available information was derived from DMRs submitted for the period 2006-2010 for each facility.

MTSA DMR Data: Effluent Fecal Coliform # CFU/100ml

Year	Pine Creek WWTP		Longvue No.1 WWTP		A&B WWTP	
	Yearly Ave.	May-Oct. Ave.	Yearly Ave.	May-Oct. Ave.	Yearly Ave.	May-Oct. Ave.
2006	220	64	125	29	68	68
2007	220	191	152	27	171	34
2008	517	160	278	17	68	59
2009	187	100	54	3	61	52
2010	128	141	9	11	106	68

Note: NPDES Permits set May-Oct Limit 200 CFU/100ml Oct-April Limit 2000 CFU/100ml

Response

The average value presented in Table 3-2 was calculated based on DMR data collected between February, 2001 and June 2006, and is accurate for that time period. The table was developed for the report, as a means to illustrate the discharge characteristics of the facilities in Pine Creek. For the TMDL, the facility was represented using its permitted discharge limits (May-Oct Limit 200 CFU/100 ml; Oct-Apr Limit 2000 CFU/100 ml). The time period for which the DMR data were collected has been added as a note to Table 3-2 in the final document.

Comment 76

It is our understanding that discharges from MTSA facilities were set at the loads defined by applicable permit limits for flow and water quality criteria for fecal coliform (flow limit and 200 CFU/100mL). Current bacteria permit limits are identical to TMDL endpoints: NPDES Permits set May-October limit of 200 CFU/100m1 and the October-April limit is 2000 CFU/100ml. It is not clear from the text on page 56 that October—April limit was used for the baseline and TMDL endpoint loads. MTSA believes that if point sources are represented by the permitted limits, this should properly include the seasonal limits in effect during the simulation period.

Response:

EPA agrees with the commenter. The final TMDL report has been corrected to reflect the seasonal baseline water quality criteria including the May-October limit of 200 CFU/100m1 and the October-April l is 2000 CFU/100ml.

Comment 77

It is anticipated that A & B WWTP will be converted to a pump station and the current NPDES discharge point will be abandoned within the next five years. MTSA's Longvue No. 1 WWTP will treat sewage currently treated by A & B WWTP.

Response

The TMDL has been established to include all currently discharging WWTPs at water quality standards, including Longvue No. 1 and A&B WWTP. Any new or expanded wastewater treatment plant may discharge into the watershed at the bacteria water quality criteria without a TMDL revision. Conversely, any WWTP may stop discharging into the watershed without a TMDL revision.

Comment 78

MTSA has attempted to review the unsewered structure map contained in the EPA publication on TMDLs in the Pine Creek Watershed. At best it is very difficult to follow. MTSA did compare their map to the MTSA GIS and found many apparent discrepancies when compared to our knowledge of the area:

Response:

Please see the response to comments 10, 24, 79 and 80. In addition, please see Section 3.2.1 of the TMDL report for a thorough description of the revised representation as well as a new figure, illustrating the revised representation (Figure 3-4).

Comment 79

Marshall Township: there are two significant areas shown as unsewered that are actually sewered through a Pumping Station. This would account for approximately 100 structures.

Franklin Park: there are three areas shown as being unsewered that are serviced by MTSA through the Fish Run Sewershed Project. Likewise it appears that some of the homes along Rochester Road near 1-79 show they are unsewered were they too connect to the Fish Run System. This would equate to at least another 100 plus structures.

Pine Township: there are in fact "pockets" of unsewered structures but MTSA believes the more densely developed areas are in fact connected to the North Branch Interceptor.

Bradford Woods: It is our understanding that there are a minimal amount of structures that are unsewered in the Pine Creek Watershed.

The Town of McCandless: MTSA is aware of very few unsewered structures. The grouping along the more easterly side of McCandless appears to be part of North Park, a large county park. For those structures in the county park, some are connected to MTSA. Otherwise, they rely on port-a-johns or septic systems for waste disposal service.

In trying to review this proposed TMDL, MTSA is extremely disappointed that we were not approached for assistance or to provide a clarification on this unsewered structure issue, prior to putting it into a report of this importance.

Response:

Between March and July of 2010, EPA requested available septic data from municipalities where sewer coverage data had not already been obtained (Indiana, Fox Chapel, Hampton, McCandless, Pine, Franklin Park, Marshall and Bradford Woods, and Richland). Data received in response to this request were in various formats and were processed by EPA's contractor and are summarized in the Draft TMDL's Table 5-7, and were incorporated into the modeling effort.

Based on this comment, on January 10, 2012, EPA again requested mapping information from each municipality listed by the commenter. Stakeholders confirmed that GIS files could be provided to help represent the unsewered structures in the watershed. EPA received data from McCandless, Etna, and Richland as a result of the second request. EPA reviewed all new data provided by municipalities and developed a revised draft estimation of septics by subwatershed. This was forwarded to NHCOG for their review and the revised septics were returned to EPA's, at which point they were incorporated into the modeling. Sections 3.2.1 and 5.2.5 of the final TMDL were revised to reflect this additional information.

Comment 80

The draft TMDL report indicates on page 7 that sanitary sewer mapping was not used to determine the location of septic systems. MTSA has provided GIS mapping of its system to ALCOSAN, Allegheny County Health Department and 3RWW and updated this information on a regular basis. MTSA does not understand why this readily available sewer mapping information was not used by EPA to determine the TMDL. MTSA respectfully recommends that EPA and its contractor utilize this information to remedy the draft TMDL deficiencies with respect to septic systems in the MTSA service area. The number and location of septic systems sources elsewhere in the watershed needs to be verified with other municipalities and with Allegheny County for the North Park facilities.

Response

Based on this comment, EPA requested the data that could be used to refine our estimates of unsewered structures. However, the additional sanitary sewer mapping data that was made available by Indiana, McCandless, and Richland Township were not sufficient to determine the location of sewered vs.

unsewered structures. In order to represent septic systems in the model, it was still necessary to determine the number of structures in a sewered/unsewered area. The additional data provided was helpful in determining whether structures in a given area were likely connected to sewer lines or not. See Section 3.2.1 for a full description of the methodology. For additional information, please refer to response to comment 79.

Comment 81

As the second largest sanitary authority in Allegheny County and serving a significant population in the watershed, we consider ourselves to be a stakeholder in the Pine Creek Watershed. In addition, we understand stakeholder involvement is critical in the TMDL development process. However, along with other Pine Creek communities our input and participation was not solicited while regional organizations such as 3RWW, PEC, and ALCOSAN were involved. This carried over into the comment period as we did not receive direct notice of the EPA posting and thus were not aware of the comment period until September 9, which was after the comment period began. We respectfully recommend that EPA and its contractor rectify this deficiency in local stakeholder participation by implementing an extended period of stakeholder involvement in finalizing the TMDL. MTSA participation under an extended public process will only strengthen the TMDL process if the opportunity is afforded for the planning level data extensively employed in the Pine Creek TMDL process to be reconciled with local knowledge.

Response

EPA agrees that stakeholder involvement is critical for successful implementation of any TMDL. In response to public comment, EPA extended the 45 day public review period of the draft TMDL an additional 30 days for a public review and comment. EPA provided the public a total of 75 days to review and comment on the draft TMDL. During that time period, EPA held a public meeting within the watershed. The public meeting included a technical presentation on the data and model used to establish the TMDL, an explanation of the TMDL itself and a questions and answer period. EPA also invited stakeholders including McCandless Township Sanitary Authority to an additional meeting within EPA offices to discuss any concerns and respond to any additional questions from each stakeholder. After the conclusion of the public comment period, EPA has reached out to each stakeholder including McCandless Township Sanitary Authority for any additional data that may be available and incorporated that data in the final TMDL as appropriate.

Please see the response to comment 2 for more details about the public participation process.

Comments submitted by private citizens

Comment 82 (made by multiple commenters)

The Pine Creek Watershed project was brought to our attention by a neighbor. We live in Pine Township. We, along with 13 other homes on our road, have on-lot sewage and well water. All but 2 of these on-lot systems are all well over 30 years in age. Since the winter of 2003, we have been working to obtain public sewers.

We have been working with the following agencies to correct an existing, known and documented septic problem:

1. Department of Environmental Protection – has been to the site and been involved in meetings with Pine Township

2. Environmental Protection Agency – has been to the site and been involved in meetings with Pine Township

3. Mike Turzai's office – has been to the site

4. Allegheny County Health Department – has been to the site and been involved in meetings with Pine Township

5. Pine Township – has been to the site and been involved in meetings with various agencies

6. MTSA – has been to the site and been involved in meetings with Pine Township

7. Richland Properties llc (George Saad, land developer) – has been to the site, owns property on the road, has offered to sewer the road (along with other amenities) if the township would change the zoning, Pine Township has had "off the record" discussions regarding this and we have been told that they will NOT rezone.

Allegheny County Health Department has recently conducted an area wide survey. Our neighborhood has 2 confirmed failing systems and 3 homes with confirmed contaminated wells. While there are only 2 confirmed septic failures, there are an additional 9 homes with "significant lot limitations" in regards to septic system repairs. These homes are not able to repair/replace their systems for a variety of reasons. The only solution is public sewer. And while there are only 3 confirmed contaminated wells, there are multiple homes that were not tested and multiple homes which utilize UV light and Chlorinating systems for decontamination.

Our neighborhood very well could contribute to the Pine Creek Watershed contamination problems. We are in the North Fork section and close to seasonal and year round water sources. These water sources are likely associated with Pine Creek.

While we have been in continued contact with the agencies above, we have yet to obtain permission to correct this serious health concern. We obtained the necessary requirements to create a sewer district (set by Pine Township). Pine Township has "tabled" our petition. We are in a perpetual holding pattern. We are having very little luck getting them to assist. We live on a private road and they do not feel they want to intervene.

This is a health concern for our neighborhood and honestly, after hearing about this project, a concern that seems to be adding to a larger public problem."

Response

EPA shares your concern regarding the two septic failures and three contaminated drinking wells in your neighborhood. Assurance that the drinking water is not contaminated by human or animal fecal waste is a key issue for any drinking water system. Human waste is the source of pathogenic viruses and bacteria; animal waste is a source of some bacterial pathogens. The principal pollutants present in contamination from raw sewage include hundreds of different types of bacteria, viruses, and parasites. The presence of specific microbial pathogens in wastewater depends on what is endemic or epidemic in the local community and is often transient. In general, microbial pathogens are easily transported by water. The predominant symptoms of pathogenic bacterial infections include abdominal cramps, diarrhea, fever, and vomiting. In addition to attacking the human digestive tract, the pathogenic bacteria can cause illnesses such as pneumonia, bronchitis, and swimmer's ear, eye infections and hepatitis.

While EPA regulates public drinking water systems, it does not have the authority to regulate private drinking water wells. Approximately 15 percent of Americans rely on their own private drinking water supplies, and these supplies are not subject to EPA standards, although some state and local governments do set rules to protect users of these wells. These households must take special precautions to ensure the protection and maintenance of their drinking water supplies. Guidelines for private wells in Pennsylvania are published at http://www.dep.state.pa.us/dep/deputate/watermgt/wc/subjects/SrceProt/well/default.htm

With regards to surface water contamination, there is a large body of evidence that correlates disease outbreaks and illness with swimming in surface water contaminated with *E. coli*. A direct linear relationship was observed between gastrointestinal illness and bacterial densities of *E. coli*. EPA agrees that the entire Pine Creek watershed suffers from bacteria contaminated water that in some areas is severe and is a human health problem.

This TMDL provides that all failing septic systems should be eliminated within the watershed and 90% reduction of all bacteria sources within the North Fork watershed. Further, the TMDL provides WLA for MS4 permittees that must be implemented. Please refer to response to comments 43 and 60 for EPA's expectations on how the permittees should implement the TMDL.

This particular comment was made by more than one commenter. The response above should be considered the response to the duplicate comments.

Comment 83

I live in Pine Township and my home resides in the North Fork Pine Creek area of your TMDL study.

I purchased my house here in 2004, and this neighborhood has been dealing with Septic issues before I arrived. To be clear, when I say 'septic issues' I specifically mean SURFACE DISCHARGE of effluent raw sewage.

The 14 homes on a private lane are all on well water and septic systems. We are zoned E-1 (one house per 3 acres) Over 50% of the homes are less than 3 acre lots. Therefore, most of the neighborhood is non-conforming to Allegheny County Health Department requirements for on lot disposal systems on a minimum of 3 acres.

Since 2006 to current I have been in communication with Pine Township, MTSA sewer authority and developers to seek creative ways to solve our ongoing issues. The township was unwilling to change zoning, SA was unwilling to extend public lines or financially work with residents and developers are limited to the Right of Way recordings on our road.

In 2010 we submitted a petition to Pine Township per their chapter 65 ordinance to create a Sewer District. A feasibility study was conducted and the neighborhood was violently split regarding the financial estimates. None of us on this road can endure a severe financial hardship over this. However, a qualified majority of residents still wanting to proceed with the project. In late 2010 ACHD got involved and conducted their own study. These findings confirmed the problems on the road but now the situation is seemingly stifled as pine recently wrote to the residents in a letter dated 11/8/11 - "the township is not currently pursuing the installation of a sewer line for Baur drive citing the Board is awaiting a consensus of the residents" - this is written while the Board of Supervisors has a Petition with a qualified majority per their own ordinance currently tabled on their agenda from 2010. I'm at a complete loss of words to describe this charade of a so called local government.

If EPA Region III mandates corrective action to Pine Township, MTSA (who serves this area) or other Government entity. Please realize fixing the problem on this road is picking 'THE LOW HANGING FRUIT' to help resolve the overall magnitude of Pine Creek Impairments.

I will say, It disturbs me deeply that the township/authorities/agencies directly involved to this point have not prioritized human health and safety as their main objective. I sincerely hope and trust your involvement will help rectify the current path and bring resolution to our quality of life, the environment in Pine creek watershed and the Commonwealth of Pennsylvania for that matter."

Response

Please refer to response to comment 82.

Comments submitted by the Allegheny County Sanitary Authority

Comment 84

We have summarized the above points (for complete comment, please refer to worksheet "ALCOSAN" or introduction in original file: ALCOSAN - Pine Creek Bacteria TMDL Comments (B0632121)) to ensure EPA recognizes that ALCOSAN and its customer municipalities have agreed to a logical, comprehensive, and legally enforceable program to improve water quality in the service area including Pine Creek. The Consent Decree and the consent orders may not be amended without the express agreement of all parties. The TMDL cannot be permitted to upset or supersede this agreed upon legal process.

Response

The purpose of a TMDL is to calculate and allocate the total load of a pollutant that an impaired waterbody can assimilate and still meet applicable water quality standards. The Pine Creek TMDL does not direct or require implementation of any specific set of actions or selection of controls, nor is its intention to amend the Consent Decree or any consent orders. Instead, it is expected that the TMDL will be implemented through a variety of regulatory and non-regulatory programs operating under federal, state, and local law. For point sources, such as MS4s, CSOs and WWTPs, it is expected that the TMDL will be implemented through the NPDES program. NPDES permits must be consistent with the assumptions and requirements of the wasteload allocations in the TMDL. See 40 CFR 122.44(d)(1)(vii)(B).

Comment 85

The TMDL Should be Placed on Hold until the Wet Weather Plan is Completed. ALCOSAN believes EPA should suspend any further action on the proposed TMDL until the Wet Weather Plan is developed and submitted for review, to avoid interfering with or undermining the activities required by the Consent Decree and municipal consent orders. Otherwise, a TMDL based on inadequate and inaccurate data (rather than the agreed-upon Consent Decree process) will drive water quality activities in Pine Creek. This may conflict with or be inconsistent with the regional efforts for the rest of the ALCOSAN service area, in which the Wet Weather Plan will be developed, implemented, and revised if necessary to address water quality in the other receiving waters. Further, given the substantial amount of information that will be obtained by monitoring the receiving streams and preparing the stream models, it is very likely that the proposed Pine Creek bacteria TMDL would have to be revised, or possibly even eliminated, when considering the additional information. Such a revision would render the EPA's efforts in developing the TMDL moot. We believe suspending further action on the TMDL now eliminates the risks of interfering with the Consent Decree and revising the TMDL.

Response

EPA disagrees that the TMDL should be placed on hold. This TMDL was based on extensive monitoring data within the watershed that clearly indicates severe bacteria contamination throughout the watershed. The Pine Creek watershed has been plagued with a history of CSOs, SSOs, failing infrastructure, failing septic systems and illicit discharges. The Pennsylvania Department of Environmental Protection (PADEP), Allegheny County Health Department (ACHD), Allegheny County Sanitary Authority (ALCOSAN), the 3 Rivers Wet Weather Demonstration Program (3RWWDP), and multiple area municipalities have been engaged in a longstanding effort to resolve noncompliance associated with sewage overflows. Efforts to address ALCOSAN's noncompliance are covered by a federal judicial consent decree (CD) entered in 2007 with the PADEP and the ACHD. Partner municipalities served by ALCOSAN have entered into consent agreements with PADEP and/or ACHD. As part of the federal consent decree and the PADEP and the ACHD consent orders, the municipalities are also required to cooperate with ALCOSAN in the development of a regional Wet Weather Plan to control CSOs SSOs related loading to area waters.

Yet despite years of acknowledgment of the problem and attempts to resolve the problem, the Pine Creek watershed remains severely contaminated with bacteria and raw sewage discharges. The polluted state of the Pine Creek watershed render it unfit for the uses that the Commonwealth have designated the watershed to support, including contact recreation (*e.g.*, swimming), secondary contact recreation (*e.g.*, boating), and the protection and propagation of plant and animal life.

Rather than postponing this TMDL, EPA believes it is imperative to provide one more tool to help clarify the sources of bacteria contamination as well as clearly provide the permittees who are responsible for the eliminating the sources of bacteria a target for areas that are experiencing the worst contamination. It is clear from the monitoring that while wet weather conditions can cause bacteria contamination due to such sources as CSOs and stormwater runoff, there are a surprising number of dry weather violations, which is indicative of illicit discharges and failing infrastructure. It is EPA's recommendation that the TMDL be used as tool to inform ALCOSAN's wet weather plan to help implementers target, prioritize and correct the significant wet weather sources. But also, the TMDL is an important tool to help target, prioritize and correct dry weather sources.

If future monitoring indicates that the receiving streams are attaining water quality standards and sources have been eliminated, that does not trigger a need to revise the TMDL, but rather acknowledges that the stakeholders have taken successful action to correct a significant contamination problem within the watershed. With the support of appropriate monitoring data the waterbody can be removed from Pennsylvania's list of impaired waters and at that point, the State can request that EPA withdraw the TMDL.

Comment 86

EPA Neglected to Inform and Include Appropriate Stakeholders in TMDL Development. ALCOSAN and the municipalities located in the Pine Creek Watershed were not informed that a TMDL was under development and were not invited to participate in stakeholder meetings. Excluding ALCOSAN and the affected municipalities from the TMDL development process led to numerous oversights and false assumptions in the development of the TMDL. For example, EPA apparently did not consider the Pine Creek: Watershed Assessment Protection and Restoration Plan, March 2005, developed by the Pennsylvania Environmental Council ("PEC"), the North Area Environmental Council, and the communities and residents of the Pine Creek Watershed. Also apparently overlooked by EPA was the Pine Creek Watershed Implementation Plan, October 2009, prepared by the PEC. Notably, both of these plans were funded by the Pennsylvania Department of Environmental Protection ("PADEP").

Response

EPA disagrees with the comment that EPA neglected to inform stakeholders in the watershed. Please refer to response to comment 2 for a summary of TMDL's history and public participation.

In addition, ALCOSAN has been an important partner to this TMDL development from the beginning of the project in early 2006. ALCOSAN provided, and PADEP and EPA accepted, the use of ALCOSAN labs for the analysis of the monitoring data. ALCOSAN has been invited to meetings and conference calls as EPA proceed with the assessment tool and later the development of TMDL.

The Pine Creek Watershed Coalition (associated with NAEC and PEC) was also a key player in the Pine Creek project and was included in many of the meetings and calls referenced in the response to comment 2.

The Pine Creek: Watershed Assessment Protection and Restoration Plan referred to by the commenter describes the 2002 – 2004 condition of water quality including temperature, pH, dissolved oxygen, conductivity, phosphate, sulfate, alkalinity, nitrate, and stream flow. It also provides a preliminary protection and restoration plan that addresses impacts or threats from non-point source pollution. This plan provides communities with recommendations for achieving improved water quality as it relates to temperature, pH, dissolved oxygen, conductivity, phosphate, sulfate, alkalinity, and nitrate. The plan provides no information related to bacteria contamination and is irrelevant to the Bacteria TMDL.

The commenter suggests that the TMDL should have considered The Pine Creek Watershed Implementation Plan. This is a 2009 plan designed to reduce the nonpoint source pollutant loads associated with urbanization in the Pine Creek Watershed. The analysis included model simulation of nutrient and sediment but not bacteria and determined the approaches that might be followed to reduce the impacts of urbanization specifically the effects of erosion, sediment, phosphorus and nitrogen. The watershed plan recognizes that TMDLs need to be developed to address the pathogen impairment within the watersheds but otherwise does not address the bacteria contamination. Consistent with this TMDL, the plan suggests that pollutants are primarily from urban runoff and storm sewers, but other sources include land development, on site wastewater, small residential runoff, and unknown sources. Detailed analyses of BMP placement and efficiency are included in the 2009 Watershed Implementation Plan and should be consulted when implementing this TMDL. Although primarily focused on reducing the volume of stormwater, more specific recommendations found in the plan could be useful for TMDL implementation. The plan also notes that in addition to the pathogen impairment for which this TMDL has been developed, most waterbodies in the watershed are also impaired by nutrients.

An estimate of impervious cover in the watershed was included in the analysis for the Pine Creek Watershed Implementation Plan based on Allegheny County GIS data (building footprints, road pavement edges and parking lots) updated with orthophotos from 2006. Working with a representative from NHCOG, who was responsible for the engineering analysis for the plan, EPA received and reviewed the impervious cover data used for the plan to determine whether the Draft TMDL's impervious representation should be revised.

Figure 9 shows impervious cover percentages derived for the analysis for the 2009 Implementation Plan, which estimates the overall impervious cover percentage for Pine Creek is 8.3% with several of the sub basins exceeding 10%. Note that the scale of subbasin delineation is coarser for the 2009 analysis.

Figure 9. Pine Creek Watershed Percent Impervious Cover Estimates (PEC 2009)

In comparison, EPA's impervious estimates were made by estimating impervious percent by specific landuse (Table 5). For the entire Pine Creek watershed, EPA's percent impervious estimate in the Draft TMDL was 14 percent. On the basis of this comparison, EPA elected to revise its original impervious cover estimates downward so that the overall percent imperviousness in Pine Creek is closer to that of the 2009 Watershed Implementation Plan estimate. The final percent impervious estimates result in an overall watershed percent imperviousness of 8.3% and are presented in Table 5.

Table 5. Consolidation of 2001 NLCD land uses for the Pine Creek LSPC model and % Impervious Estimates

Model category	2001 NLCD code and category	Draft TMDL % Impervious	Final TMDL % Impervious

Water	11 Open water	0	0
Wetland	90 Woody wetlands	0	0
	95 Emergent herbaceous wetlands	0	0
Forest	41 Deciduous forest	0	0
	42 Evergreen forest	0	0
	43 Mixed forest	0	0
Cropland	82 Cultivated crops	0	0
Pasture	31 Barren Land	0	0
	71 Grassland/herbaceous	0	0
	81 Pasture/hay	0	0
LIR	22 Developed, low-intensity residential	35	20
MIR	23 Developed, medium-intensity residential	65	35
HIR	24 Developed, high-intensity residential	90	80
Open Space	21 Developed, open space	10	5

Note that the purpose of the Pine Creek TMDL is to calculate and allocate the total load of fecal coliform that an impaired waterbody can assimilate and still meet applicable water quality standards. The Pine Creek TMDL does not direct or require implementation of any specific set of actions or selection of controls, nor does it provide any information about the reduction of other pollutants. This TMDL is unrelated to the plans mentioned by the commenter and does not preclude the continued use of these implementation plans by stakeholders, though the BMPs and goals of both could be complementary.

Comment 87

Further, we understand that EPA has not yet provided, to the North Hills Council of Governments ("COG"), data that EPA's contactor used to run the TMDL model, even though the COG requested the data. That data is essential to evaluate whether the model results and corresponding bacterial load reductions are accurate and/or achievable.

Response

Please refer to the response to comment 6 and the response to comment 11.

Comment 88

O'Hara Township is aware of sanitary sewer overflows resulting from sanitary sewer pump station overflows in East Little Pine Creek and is planning to upgrade the pump stations. Known issues with sanitary sewer pump stations and other possible sanitary sewer overflows should have been addressed in the TMDL.

Response

EPA contacted ALCOSAN on December 8, 2011 and December 12, 2011 to obtain the information regarding O’Hara Township and was informed that ALCOSAN did not have any additional data to provide EPA for the final TMDL. ALCOSAN provided contact information for O’Hara Township and

EPA reached out to O'Hara Township by phone and email on December 29, 2011. During a January 10, 2012 conference call with NHCOG EPA was told EPA has all of the SSO data that exists.

For more information, please refer to response to comments 20 and 21.

Comment 89

The assumption in the model that all of the Urbanized Area contributes to the WLA is incorrect as only a portion of the total contribution area flows to MS4 discharge locations. Municipalities were required to locate MS4 outfalls as a condition of current MS4 permits. EPA should have contacted the municipalities to obtain this information for use in the model. The Model should be revised by EPA to delineate the area tributary to MS4 outfalls.

Response

Please refer to response to comment 22.

Comment 90

We request that EPA provide a list of the stakeholders, meeting agendas, and meeting minutes of all stakeholder meetings. Further, we request that the TMDL not be made final until the stakeholder group is expanded to include all of the NPDES permit holders, ALCOSAN, and the municipalities within the Pine Creek Watershed and the sampling and modeling used by EPA to develop the TMDL is done properly using the best information available.

Response

Please refer to the response to comment 2 and 85.

Comment 91

ALCOSAN understands that the COG has many comments concerning the data EPA relied on for the TMDL that was not provided to stakeholders for review, including the following:

The TMDL and source of bacteria loads were completed using a model; however, the TMDL does not provide details of all of the modeling methods, equations, and assumptions used to develop it. Without providing the model and input data to the stakeholders for review, we are unable to fully evaluate the accuracy of the TMDL effort.

Response

Please refer to response to comment 2 for a summary of the public participation process and the response to comment 6 with regarding stakeholder verification of modeling and data.

Comment 93

There are no maps showing the locations of assumed septic systems. Please provide these so that the municipalities may verify the location and area of septic systems assumed in the model.

Response

EPA worked with the municipalities of the NHCOG to resolve septic mapping issues. Please refer to the response to comment 79 for more information.

Comment 94

McCandless was the only municipality with data that provides discrete locations of septic structures. Other municipalities provided other data sources that helped to estimate the number of septic systems, but specific locations were not identified.

Response

In addition to McCandless, Three Rivers Wet Weather (3RWW) provided data that estimates locations of specific structures that are not serviced by sanitary sewers. Shaler Township, and portions of Ross, Indiana, and O'Hara are characterized by the 3RWW dataset. Approximately half of the watershed is characterized by the McCandless and 3RWW datasets. Please refer to the response to comment 79 for additional background on septic data. Please see Section 3.2.1 of the TMDL report for a thorough description of the revised representation as well as a new figure, illustrating the revised representation (Figure 3-4).

Comment 95

The TMDL does not provide a map of reasonable scale showing the location and station number of each sampling location.

Response

Please refer to the response to comment 12.

Comment 96

The TMDL Executive Summary indicates that data was collected by citizen volunteers of the Pine Creek Watershed Coalition. Although their efforts are admirable, there is no documentation with which to evaluate the training and experience of citizen volunteers. Further, the TMDL report did not include copies of sampling or analytical data such as sample collection forms, chain-of-custody forms, laboratory analytical reports, and/or quality assurance procedures.

Response

EPA is surprised by ALCOSAN's comment regarding the monitoring plan since ALCOSAN was central to the implementation of the plan and provided the laboratory where samples were analyzed.

EPA reminds ALCOSAN that the sampling plan and quality assurance protocol were field tested beginning in the fall of 2006 and more intense sampling was conducted during the 2007 swimming season. Volunteers from the Pine Creek Coalition conducted weekly bacteria sampling at 25 sites throughout the Pine Creek Watershed for a full year. Watershed Coordinators from DEP's Central and Regional Offices worked closely with the group to train them and to transport samples to the lab every week. ALCOSAN provided in-kind services to analyze the samples for both fecal coliform and *E. coli*.

Data was collected in accordance with the Monitoring Quality Assurance Plan and followed QA/QC procedures. We reference "Monitoring Plan for Bacteria Sampling: Pine Creek Watershed, Pittsburgh, PA to Support Use Attainment Analysis and Bacteria Modeling in Southwestern Pennsylvania" for your information. Further, PADEP reviewed the data and deemed it met the minimum data requirements and quality needed to be used in the agency's decision making process. The results from the monitoring and analysis effort were used in PADEP's decision to list the Pine Creek watershed as impaired for pathogens in Pennsylvania 2008 Integrated Report.

Please refer to the response to comment 26 for more information about data quality, field blanks and duplicate samples.

Comment 97

Although samples were collected at 25 locations, these locations were largely clustered in several areas rather than providing adequate and representative aerial coverage across the entire watershed (see Figure 2-3, page 13). Further, much of the sampling was conducted in Etna Borough rather than being spread out to provide adequate characterization of headwaters. The TMDL states in Section 6.3.2, Allocation Process, that the top-down reduction methodology was used to reach the WLAs and that such a methodology begins with headwaters. Figure 2-3 shows very little analysis of headwaters. The clustering of monitoring sites attempted to address specific source locations such as CSOs, SSO, and permitted facility discharges. The density of these features is higher in the Etna region. A top-down methodology was used in the allocations, and provided reductions to headwaters as well as downstream sources.

Response

EPA disagrees with the commenter's characterization that sampling locations do not provide adequate coverage across the entire watershed. Sampling locations were strategically located at the mouths of almost every headwater tributary in the entire Pine Creek watershed to quantify loading from those areas. The density of sampling in the vicinity of Etna borough was designed to characterize loading from known CSO discharges. As a result, there are clusters of sampling stations up and downstream of certain outfalls.

Comment 98

Since the completion of the monitoring period used to develop the TMDL, several significant projects have occurred in the Pine Creek Watershed that directly impact EPA's findings:

The model should be revised to account for the significant storage capacity improvements resulting from the dredging of North Park Lake. Dredging began in 2009, after the TMDL monitoring period was completed, and was completed in 2011. Accordingly, it is recommended that additional bacteria testing be done at station 22 and the monitoring points upstream of station 22 to ensure the modeling is done properly before a TMDL is made final.

Response

Please refer to response to comments 16.

Comment 99

The Longvue No.1 Waste Water Treatment Plant (NPDES Permit No. PA0027669) on West Little Pine Creek was significantly upgraded after the bacteria sampling was completed. Additional bacteria testing should be done and the modeling revised based upon the updated sampling results. The TMDL Report notes (on pages 51 to 52) a significant "source x" bacteria load just downstream of this treatment plant.

Response

Please refer to the response to comment 17.

Comment 100

Why were waterfowl and wildlife sources excluded from residential areas in the model? It is common knowledge that significant wildlife populations exist in these areas throughout the Pine Creek watershed.

Response

Please refer to the response to comment 38.

Comment 101

Was any testing done to develop the bacteria load of storm sewer discharges within the watershed?

Response

Please refer to response to comments 14 and 42.

Comment 102 Was any testing done to develop the bacteria load of combined sewer discharges within the watershed?

Response

The sampling effort was conducted over the course of a year to capture a variety of flow ranges through different seasons. Samples were not collected at very high flows due to issues associated with human health and safety. However, the monitoring plan did included sampling locations upstream and downstream of CSO outfalls to better characterize the CSO discharges.

Please refer to the response to comment 21 for more information about available CSO water quality data and the response to comment 36 about EPA's CSO bacteria loading methodology.

Comment 103

Why are municipal storm sewer discharges located within urbanized areas considered part of the waste load allocation, when the same type of storm sewer outfall located outside of the urbanized area is considered a nonpoint source load allocation?

Response

Please refer to the response to comment 22.

Comment 104

Where else has the LSPC model been calibrated and provided reliable results on the basis of approximately 1,000 fecal coliform/e. coli bacteria samples? Does this justify the 5% margin of safety?

Response:

EPA agrees with the commenter that the extensive monitoring data reduces the uncertainty in this TMDL and has revised the TMDL to include an implicit MOS rather than the explicit MOS that was included in the draft TMDL. Please refer to response to comment 39.

Comment 105

How can the baseline load allocation for the following sub-watersheds (regions) be zero? Is no natural background assumed?

Response

Please refer to the response to comment 45.

Comment 106

Why is Source X in the West Little Pine only assigned to Region 105 and not also shared with the upstream Region 106? These areas are essentially the same and assigning the load only to Region 105 seems to be an arbitrary assumption.

Response

Please refer to the response to comment 27.

Comment 107

Please provide the land area for each land use listed in the MS4 land use Table in Appendix F so that the municipal TMDL assignments in this table may be verified. For example, the MS4 Land Use Detail spread sheet in Appendix F assigns a load to Ross Township in SWS 103. Very little, if any, area in SWS 103 is located in Ross. A detailed review of the TMDL is needed so these and other issues are examined in order to provide the communities, as stakeholders, the level of confidence that the TMDL process is based on the best available and accurate data, including the identification and appropriate characterization of sources.

Please refer to the response to comment 56.

Comment 108

A solid scientific foundation to the EPA's various programs is critical. The current Administrator has repeatedly stressed EPA's intent to use the best available science in making its decisions, consistent with an executive directive from the President. See generally Transcript, Remarks by the President at the National Academy of Sciences Annual Meeting (April 27, 2009), available at http://www.whitehouse.gov/thepress office/Remarks-by-the-President-at¬the-National-Academy-of-

Sciences-Annual-Meeting; see also Lisa P. Jackson, Administrator, U.S. Environmental Protection Agency, Opening Memo to EPA Employees (Jan. 23, 2009), available at http://blog.epa.gov/administrator/2009/01/26/opening-memo-to-epa-employees. In light of this initiative, the analytical data set used to develop the TMDL should be more extensive and the methods used and data obtained should be subject to EPA's peer review policy. See U.S. Environmental Protection Agency, Peer Review and Peer Involvement at the U.S. Environmental Protection Agency (January 1993, updated January 31, 2006). The TMDL does not discuss whether the above policies were followed.

Response

EPA develops TMDLs based on the requirements of Section 303(d) of the CWA and the implementing regulations found at 40 CFR 130.7. The CWA and federal regulations require that TMDLs be designed to meet existing, applicable water quality standards (numeric, narrative, uses and anti-degradation), include wasteload allocations (WLA) for each point source, load allocations (LA) for non-point sources (allocated to specific sources if data allow, or gross allotments to source types), consider seasonal impacts, and include a margin of safety. This TMDL used the most recent monitoring data available, a well-established model for allocating its loads, and the best available science in developing the final TMDL. As such, this TMDL meets all of these legal requirements.

EPA refers the commenter to a peer reviewed paper about LSPC which includes discussion of a comparison of LSPC and HSPF applied to the same watershed. Please see:

Shen, J., A. Parker, J. Riverson. 2004. A new approach for a Windows-based watershed modeling system based on a database-supporting architecture. *Environmental Modeling and Software* 20 (2005):1127-1138.

The Pine Creek TMDL has been developed using water quality standards that have been promulgated by Pennsylvania, a commonly used model, site specific data analyzed using accepted methodology, and other commonly used and accepted tools and therefore, does not require peer review. The documents “Peer Review and Peer Involvement at the U.S. Environmental Protection Agency,” and the “Peer Review Handbook,” (3rd edition, EPA 100/B-06/002 2006) establish the policy of the EPA for peer review of new science and technology , including economic and social science products, that are deemed to be influential scientific information or highly influential scientific assessment.