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TMDLs for Streams Impaired by Acid Mine Drainage in the Kiskiminetas-Conemaugh River Watershed, Pennsylvania

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Acid Mine Drainage TMDLs for the Kiskiminetas-Conemaugh River Watershed, Pennsylvania:
Established by the U.S. Environmental Protection Agency

Jon Capacasa, Director,
Water Protection Division

FINAL

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EXECUTIVE SUMMARY

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody 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 (USEPA 1991a).

A TMDL for a given pollutant and waterbody 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 waterbody. The TMDL components are illustrated using the following equation:

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

Stream reaches in the Kiskiminetas River and Conemaugh River watersheds in southwestern Pennsylvania are included on the state's 2008 Section 303(d) list because of various impairments, including metals, pH, and sediment. TMDLs were developed to address metals, pH, and sediment impairments associated with abandoned mine drainage or discharge using the Mining Data Analysis System (MDAS). MDAS is a comprehensive data management and modeling system capable of representing loads from nonpoint and point sources in the watershed and simulating instream processes.

Modeled subwatershed loadings were iteratively reduced to estimate the load reductions required to meet instream concentration targets for metals. The target concentrations were based on established water quality criteria of 0.750 milligrams per liter (mg/L) total aluminum, 1.5 mg/L total iron, 0.3 mg/L dissolved iron, and 1.0 mg/L manganese. Iron reductions were used as a surrogate for sediment reductions. For purposes of this TMDL, sediment includes total suspended solids (TSS). Streams placed on Pennsylvania's Section 303(d) list with a designated use of high quality or exceptional value are subject to additional protection pursuant to the state's antidegradation policy. Data from a PADEP reference stream was obtained from PADEP and used to develop endpoints for high quality or exceptional value streams. Long-term loads based on the TMDL allocations were identified, as well as median and maximum allowable daily loads. Loads are presented in full in Appendix G of this report.

WLAs were assigned to permitted facilities and municipal separate storm sewer systems (MS4s) that discharge in the watershed. The LAs include nonpoint sources and include drainage from abandoned mine lands. An explicit MOS of five percent is included in the TMDL to account for uncertainty. The state reserves the right to revise these allocations, with approval from EPA, provided that the revised allocations are consistent with achieving the water quality standards. This TMDL addresses waters that have not been previously addressed by a TMDL and will supersede all preexisting metals TMDLs in the watershed. EPA is establishing these TMDLs at the request of PADEP.

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1. INTRODUCTION AND BACKGROUND

Section 303(d) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA's) Water Quality Planning and Management Regulations (codified at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. A TMDL establishes the amount of a pollutant that a waterbody 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 (USEPA 1991 a). The development of TMDLs requires an assessment of the waterbody's assimilative capacity, critical conditions, and other considerations.

A TMDL for a given pollutant and waterbody 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 a margin of safety (MOS) to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. The TMDL components are illustrated using the following equation:

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

In the mid-1990s, environmental advocacy groups began a series of lawsuits against EPA for not requiring states to complete TMDLs, one of the elements of the Clean Water Act. EPA entered into a Consent Decree (CD) and agreement with the advocacy groups, which required completion of TMDLs for all resource extraction (mine drainage) impaired waterbody segments on the 1996 Section 303(d) list. The final deadline for completion was specified as 2009. Pursuant to the memorandum of understanding (MOU) between EPA and PADEP, Pennsylvania pursued development of TMDLs for many segments in the watershed. As a result, these segments already have approved TMDLs, largely addressing abandoned mine drainage or discharge (AMD) impacts. The method used in Pennsylvania to calculate TMDLs for streams affected by mine drainage is data-intensive. It requires at least one year of seasonal sampling for mine drainage parameters to provide a *shot-in-time* profile of the pollutant sources and their spatial distribution within watersheds. The CD requires that TMDLs be approved/established for all remaining AMD waters originally identified on the 1996 Section 303(d) list. Segments that have not been addressed in previous TMDLs include portions of the Little Conemaugh River, Clear Run, Shade Creek and Dark Shade Creek, South Fork Bens Creek, Stonycreek River, Conemaugh River, Harbridge Run, Yellow Creek, Two Lick Creek, Loyalhanna Creek, Beaver Run, and Kiskiminetas River. This TMDL addresses waters that have not been previously addressed by a TMDL and will supersede all preexisting metals TMDLs in the watershed. EPA is establishing these TMDLs at the request of PADEP. These TMDLs also address other subsequently identified impairments (post-1996) in this watershed. The Mining Data Analysis System (MDAS) was used to develop these TMDLs; details regarding this model are provided in Section 4.

Local stakeholder groups are active in the watershed (the Kiskiminetas-Conemaugh Stream Team and SCRIP—the Stonycreek River Improvement Project, among others), and they should be included as an integral part of all TMDL implementation efforts.

This document describes the development of TMDLs for the Kiskiminetas and Conemaugh river watersheds in southwestern Pennsylvania for metals, pH, and total suspended solids (TSS) impairments.

This report consists of a main section, appendices, and spreadsheet data tables. The main section describes the overall TMDL development process for the Kiskiminetas and Conemaugh river watersheds, identifies impaired streams, and outlines the source assessment of metals. It also describes the modeling process, presents TMDL allocations, and lists measures that will be taken to ensure that the TMDLs are met. The main section and appendices are supported by a compact disc containing spreadsheets (Microsoft Excel format) that provide the data used during the TMDL development process, as well as allocations associated with successful TMDL scenarios.

1.1. Watershed Description

The Kiskiminetas River watershed[1] is in western Pennsylvania. It encompasses part or all of Cambria, Somerset, Indiana, and Westmoreland counties, including the drainages of the Conemaugh, Little Conemaugh, and Stonycreek rivers (Figure 1-1). The watershed contains several large and small reservoirs, including the Loyalhanna, Conemaugh, Beaver Run, Two Lick Creek, and Yellow Creek reservoirs. The City of Johnstown, a municipal separate storm sewer system (MS4) community, is in the watershed, along with the towns of Blairsville, Ebensburg, and Indiana. The watershed is in U.S. Geological Survey (USGS) hydrological unit codes (HUC) 05010007 (Conemaugh), and 05010008 (Kiskiminetas).

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[1] When this document refers to the Kiskiminetas River watershed, it implies the inclusion of the Conemaugh River watershed, unless otherwise stated.

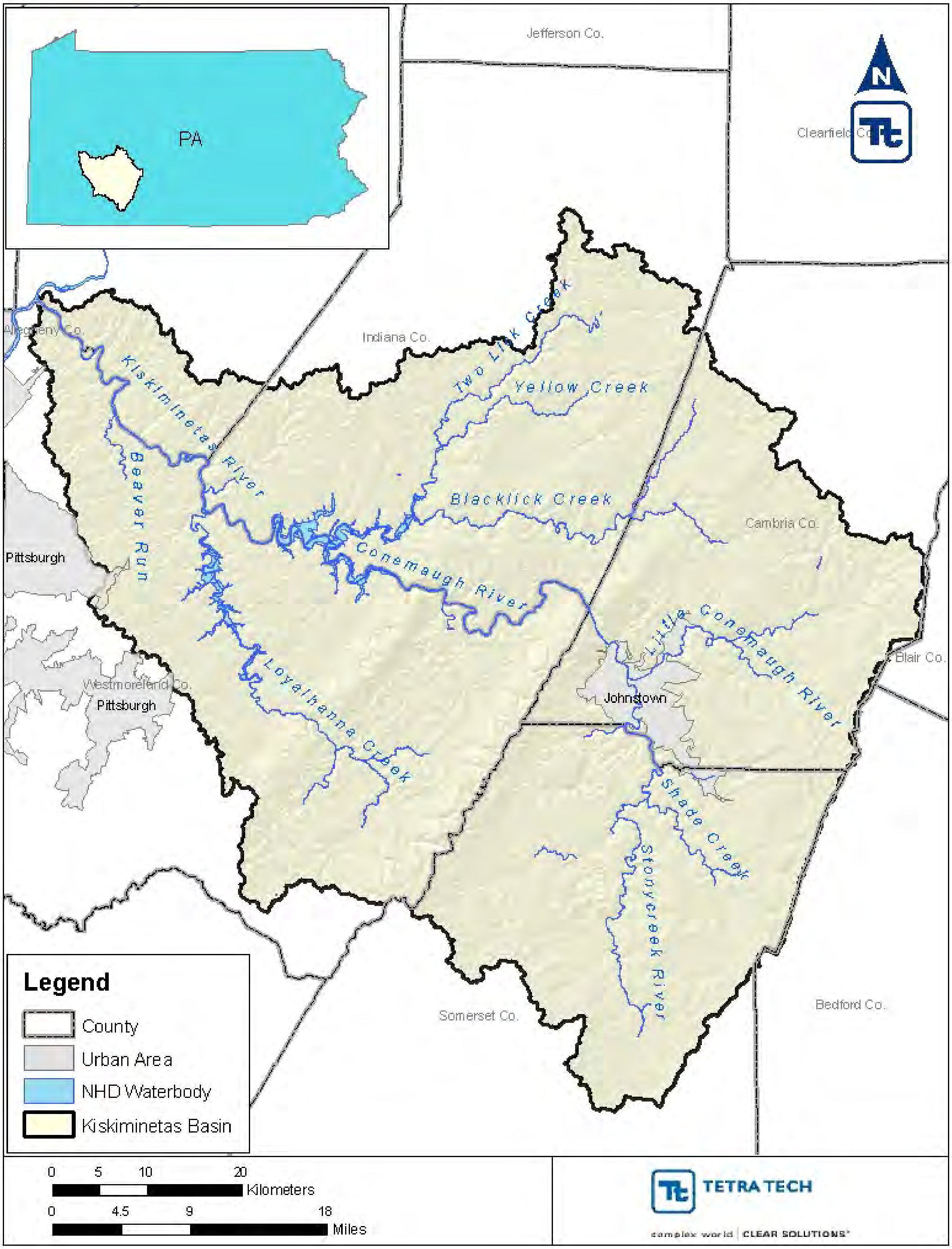

Figure 1-1. Location of the Kiskiminetas River Watershed.

1.2. Previous and Existing Studies

The Kiskiminetas River watershed has been the site of numerous previous studies and TMDLs. Most of the previous TMDLs were completed only for small sections of the watershed. Table 1-1 lists the completed studies and TMDLs in the watershed. Allocated loadings from such reports are superseded by this TMDL.

Table 1-1. Previous Studies and TMDLs in the Kiskiminetas River Watershed

TMDL Document Title	TMDL Stream	TMDL Analytes	TMDL Status	TMDL Date
Bens Creek TMDL	Bens Creek	Metals; pH; siltation	Final	03/29/05
Boone Run TMDL	Boone Run	Metals; pH	Final	03/14/07
Elk Creek	Elk Creek	Metals; other inorganics; pH	Final	04/01/05
Ferrier Run TMDL	Ferrier Run	Metals; pH	Final	08/02/06
Freeman Run TMDL	Freeman Run	Metals; pH	Final	03/27/07
Getty Run TMDL	Getty Run	Metals; pH	Final	04/04/05
Harbridge Run	Harbridge Run	Suspended solids	Draft	
Marsh Run and McCarthy Run TMDL	Marsh Run and McCarthy Run	Siltation; thermal modifications	Final	08/09/04
Marsh Run and McCarthy Run TMDL	McCarthy Creek	Siltation; suspended solids; thermal modifications	Final	08/09/04
McCune Run TMDL	McCune Run	Metals; pH; suspended solids	Final	11/01/05
Monastery Run Watershed	Monastery Run Watershed	Metals; pH	Final	03/17/05
Monastery Run Watershed TMDL	Fourmile Run	Metals; other inorganics; pH	Final	03/17/05
Oven Run Watershed TMDL	Oven Run	Metals; other inorganics; pH	Final	12/14/04
Paint Creek	Paint Creek Watershed	Metals; pH	Final	03/27/07
Penn Run Watershed TMDL	Penn Run Watershed	Metals; siltation	Final	09/20/06
Reeds Run Watershed	Reeds Run Watershed	Metals	Final	04/26/07
Richards Run Watershed	Richards Run Watershed	Metals; pH	Final	03/14/07
Saxman Run Watershed	Saxman Run Watershed	Metals; pH; suspended solids	Final	03/17/05
Shade Creek Watershed	Shade Creek Watershed	Metals; pH	Draft	
South Branch Blacklick Creek Watershed	South Branch Blacklick Creek Watershed	Metals; pH	Final	04/07/05
Spring Run TMDL	Spring Run	Metals; pH	Final	04/01/05
Stonycreek Watershed TMDL	Stonycreek River	Nutrients; siltation; suspended solids	Final	08/09/04
Sulphur Creek and Otto Run Watersheds	Sulphur Creek and Otto Run Watersheds	Metals; pH	Final	03/14/07
Tearing Run Watershed	Tearing Run Watershed	Metals	Final	08/02/06
Thorn Run Watershed TMDL	Thorn Run Watershed	Metals; pH	Final	04/09/01

TMDL Document Title	TMDL Stream	TMDL Analytes	TMDL Status	TMDL Date
Union Run TMDL	Union Run	Metals; pH; suspended solids	Final	11/18/04
Unnamed Tributary 44769 to Conemaugh River	Unnamed Tributary 44769 to Conemaugh River	Nutrients; suspended solids	Final	10/08/04
UNT 45603 Stonycreek River	UNT 45603 Stonycreek River	Metals	Final	07/03/07
Wells Creek TMDL	Wells Creek	Nutrients	Final	03/27/07

1.3. Impaired Waterbodies

Of the almost 5,000 stream segments in the watershed, 29 percent are listed as impaired and do not support their designated aquatic life use (Figure 1-2). The watershed has a long history of coal mining, which left many abandoned mine lands (AMLs) and associated features that contribute mine drainage to surface waters. Of the total impaired waters in the watershed, 59 percent of all impairments are attributed to AMD and its impacts (singly or in combination with other sources and causes of pollutants): high levels of metals, low pH, and increased rates of siltation. In addition to mining, past and present, the watershed is also affected by agriculture, malfunctioning septic systems, impoundments, urban runoff, land development, and other sources. A complete listing of AMD-impaired stream segments in the watershed is provided in Appendix A. This TMDL covers all the streams covered by the 1996 Consent Decree in the Kiskiminetas River watershed. These streams are listed in Table 1-2. This TMDL also addresses additional impairments for metals, pH and sediment (including total suspended solids) identified in subsequent (post-1996) Section 303(d) lists.

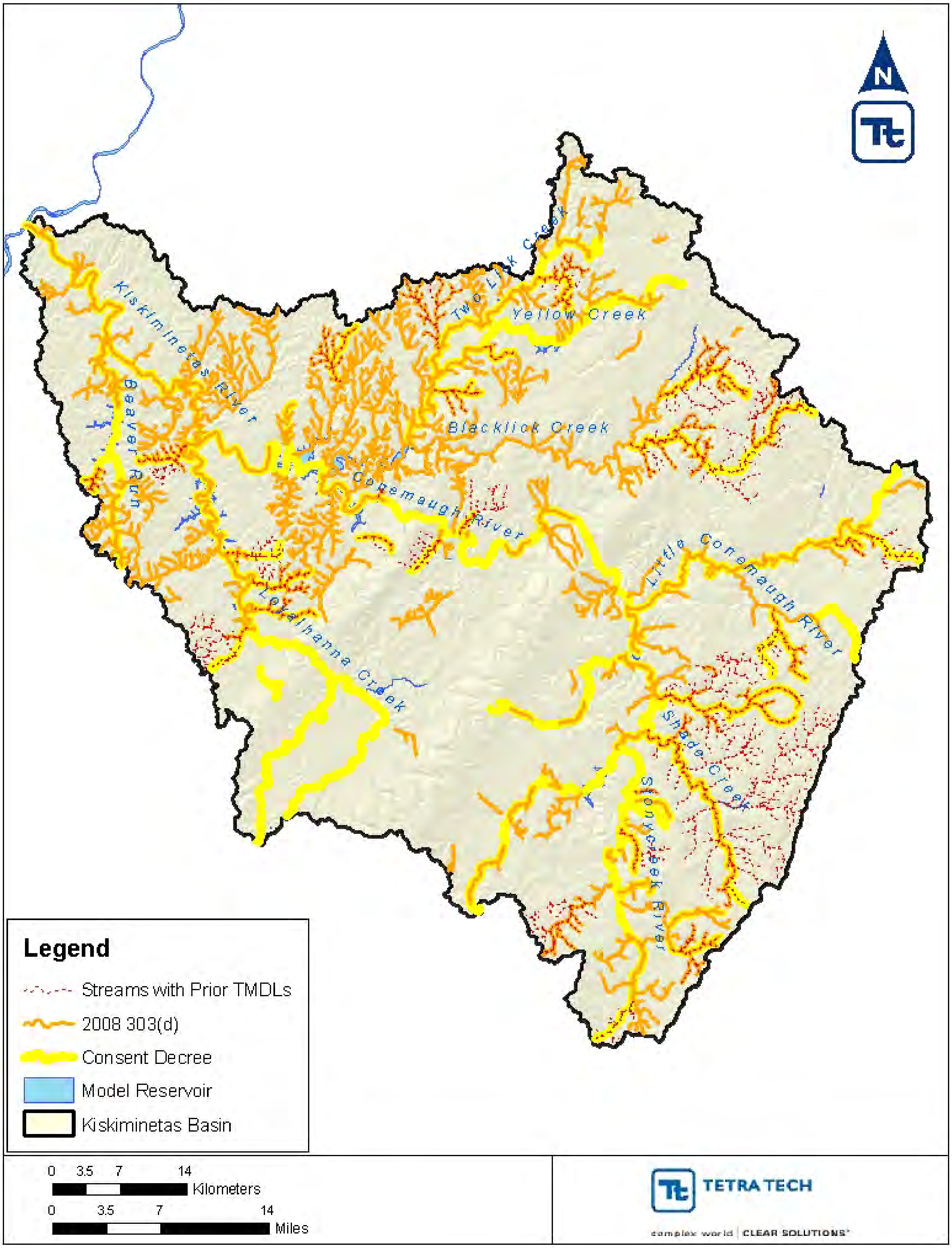

Figure 1-2. Streams Impaired in the Kiskiminetas River Watershed.[2]

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[2] Note: Consent Decree waters are listed by stream name, while the 2008 Section 303(d) list identifies impaired waters by stream reach. Since it is not possible to identify the individual listed reaches from the Consent Decree, the entire stream is shown on the figure.

Table 1-2. Consent Decree Streams in the Kiskiminetas River Watershed Covered by this TMDL

State Water Plan	PA Code	Stream	Previously Approved TMDLs
18-B	42816	Kiskiminetas River	
18-B	42931	Beaver Run	
18-B	42977	Thorn Run	Metals; pH
18-B	42991	Unnamed tributary of Thorn Run	Metals; pH
18-C	43255	Loyalhanna Creek	
18-C	43257	Getty Run	Metals; pH
18-C	43397	McCune Run	Metals; pH; Suspended Solids
18-C	43417	Union Run	Metals; pH; Suspended Solids
18-C	43448	Saxman Run	Metals; pH; Suspended Solids
18-C	43457	Monastery Run	Metals; pH
18-C	43495	Indian Camp Run	Delisted in 1998- sediment
18-C	43542	Fourmile Run	Delisted in 1998- metals
18-C	43832	Conemaugh River	
18-D	43902	Roaring Run	Delisted in 2004- metals
18-D	43950	Reeds Run	Metals
18-D	44073	Two Lick Creek	
18-D	44112	Tearing Run	Metals
18-D	44118	Yellow Creek	
18-D	44125	Ferrier Run	Metals; pH
18-D	44276	Penn run	Metals; Siltation
18-D	44523	Elk Creek	Metals; Other Inorganics; pH
18-D	44618	South Branch Blacklick Creek	Metals; pH
18-D	44728	Harbridge Run[a]	
18-D	44799	Freeman Run	Metals; pH
18-D	44924	Richards Run	Metals; pH
18-E	45084	Stony Creek	
18-E	45101	Bens Creek	
18-E	45132	South Fork Bens Creek	
18-E	45223	Paint Creek	Metals; pH
18-E	45259	Unnamed tributary of Paint Creek	Metals; pH
18-E	45260	Babcock Creek	Metals; pH
18-E	45270	Shade Creek[a]	
18-E	45330	Dark Shade Creek[a]	
18-E	45354	Unnamed tributary of Dark Shade Creek[a]	
18-E	45371	Quemahoning Creek	
18-E	45603	Unnamed tributary of Stoney Creek	Metals; pH
18-E	45604	Fallen Timber Run	Delisted in 2002- metals
18-E	45621	Oven Run	Metals; Other Inorganics; pH
18-E	45710	Lamberts Run	
18-E	45742	Boone Run	Metals; pH
18-E	45757	Clear Run	
18-E	45815	Little Conemaugh River	
18-E	45901	Otto Run	Metals; pH
18-E	45902	Sulphur Creek	Metals; pH
18-E	45917	Beaverdam Run	Delisted in 1998- metals
18-E	46070	Spring Run	Metals; pH
18-E	46098	Bens Creek	Metals; pH; Siltation

[a] Draft TMDLs.

1.4. Water Quality Criteria

Water quality standards consist of protected uses and water quality criteria. Protected uses in the watershed are summarized in Table 1-3. Due to the large number of streams in the watershed, the list of protected uses from 25 Pa. Code Section 93.3t [3] is provided in Appendix A.

Table 1-3. Protected Uses in the Kiskiminetas River Watershed

Protected Use	Protected Use Description	Number of Segments
CWF	Cold water fishes	116
EV	Exceptional value waters	20
HQ-CWF	High-quality cold-water fishes	40
HQ-WWF	High-quality warm-water fishes	1
TSF	Trout stocking	13
WWF	Warm-water fishes	32

Applicable water quality criteria for Pennsylvania waterbodies are included in the *Pennsylvania Code*, Chapter 93, Water Quality Standards. They are listed in Table 1-4. For comparison, the EPA water quality criteria are presented in Table 1-5.

With respect to sediment as a pollutant, Pennsylvania uses narrative criteria to ensure protection of water quality. Specifically, Chapter 93.6 provides the following:

a) Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life.

b) In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances that produce color, tastes, odors, turbidity or settle to form deposits.

Table 1-4. Pennsylvania Water Quality Criteria

Pollutant	Limit	Designated uses
Aluminum	750 µg/L as total recoverable	CWF, WWF, TSF, MF
Iron	30-day average 1,500 µg/L as total recoverable	CWF, WWF, TSF, MF (migratory fishes)
	300 µg/L as dissolved	PWS (potable water source)
Manganese	1,000 µg/L as total recoverable	PWS
pH	6.0–9.0	CWF, WWF, TSF, MF

µg/L = micrograms per liter
Source: 25 Pa. Code section 93. Accessed September 5, 2008.

Table 1-5. EPA-Recommended Criteria for Non-Priority Pollutants

	Freshwater		Human health for consumption of	
Pollutant	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism only (µg/L)
Aluminum[a]	750[b,c]	87[b,c,d]	—	—
Iron	—	1,000[e]	300[f]	—
Manganese	—	—	50[f,g]	—
pH	—	6.5–9.0 (standard units)	5–9 (standard units)	—

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[3] http://www.pacode.com/secure/data/025/chapter93/s93.9t.html (Accessed April 23, 2008)

Notes:
The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

[a] Aluminum is applicable only at a pH between 6.5 and 9.0.

[b] This value is based on a Clean Water Act Section 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985); it was issued in EPA 440/5-86-008.

[c] This value for aluminum is expressed in terms of total recoverable metal in the water column.

[d] There are three major reasons why the use of Water-Effect Ratios might be appropriate. (1) The value of 87 µg/L is based on a toxicity test with the striped bass in water with pH = 6.5–6.6 and hardness < 10 mg/L. Data in *Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia* (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified; (2) In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide; (3) EPA is aware of field data indicating that many high-quality waters in the United States contain more than 87 micrograms of aluminum per liter when either total recoverable or dissolved is measured.

[e] The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July 1976).

[f] This human health criterion is the same as that originally published in the Red Book, which predates the 1980 methodology and did not use the fish ingestion BCF approach. This same criterion value is now published in the Gold Book (EPA 440/5-86-001).

[g] This criterion for manganese is not based on toxic effects, but rather is intended to minimize objectionable qualities such as laundry stains and objectionable tastes in beverages.

Source: USEPA 2008.

Streams placed on the Section 303(d) list with a designated use of high quality (HQ) or exceptional value (EV) are subject to additional protection under Pennsylvania's antidegradation policy. PADEP must establish instream goals for TMDLs to restore the waterbody to existing (pre-mining) quality. Applicable water-quality criteria for high-quality waters are determined using an unimpaired segment of the TMDL water or the 95th percentile of a reference Water Quality Network (WQN) stream. For segments in the report, WQN870 on Clear Shade Creek is used as the reference stream. Table 1-6 shows the criteria used in this report. Figure 1-3 shows the high quality waters in the watershed.

Table 1-6. Reference Stream Water Quality

Parameter	Criterion value (µg/L)
Aluminium, total (Al)	231
Iron, total (Fe)	212

1.5. TMDL Targets

When calculating TMDLs, numeric instream water quality target concentrations are established to ensure meeting water quality criteria and protection of beneficial uses, in this case, various aquatic life uses and potable water supply. The target concentrations for this TMDL were based on established numeric water quality criteria of 750 micrograms per liter (µg/L) aluminum, 1,500 µg/L total iron, 300 µg/L dissolved iron, and 1,000 µg/L manganese. For pH, values must be between 6.0 and 9.0. Table 1-6 lists the TMDL targets for high-quality water streams. The sediment portion of the TMDL includes TSS, and is addressed through a surrogate approach, which is discussed later in this report.

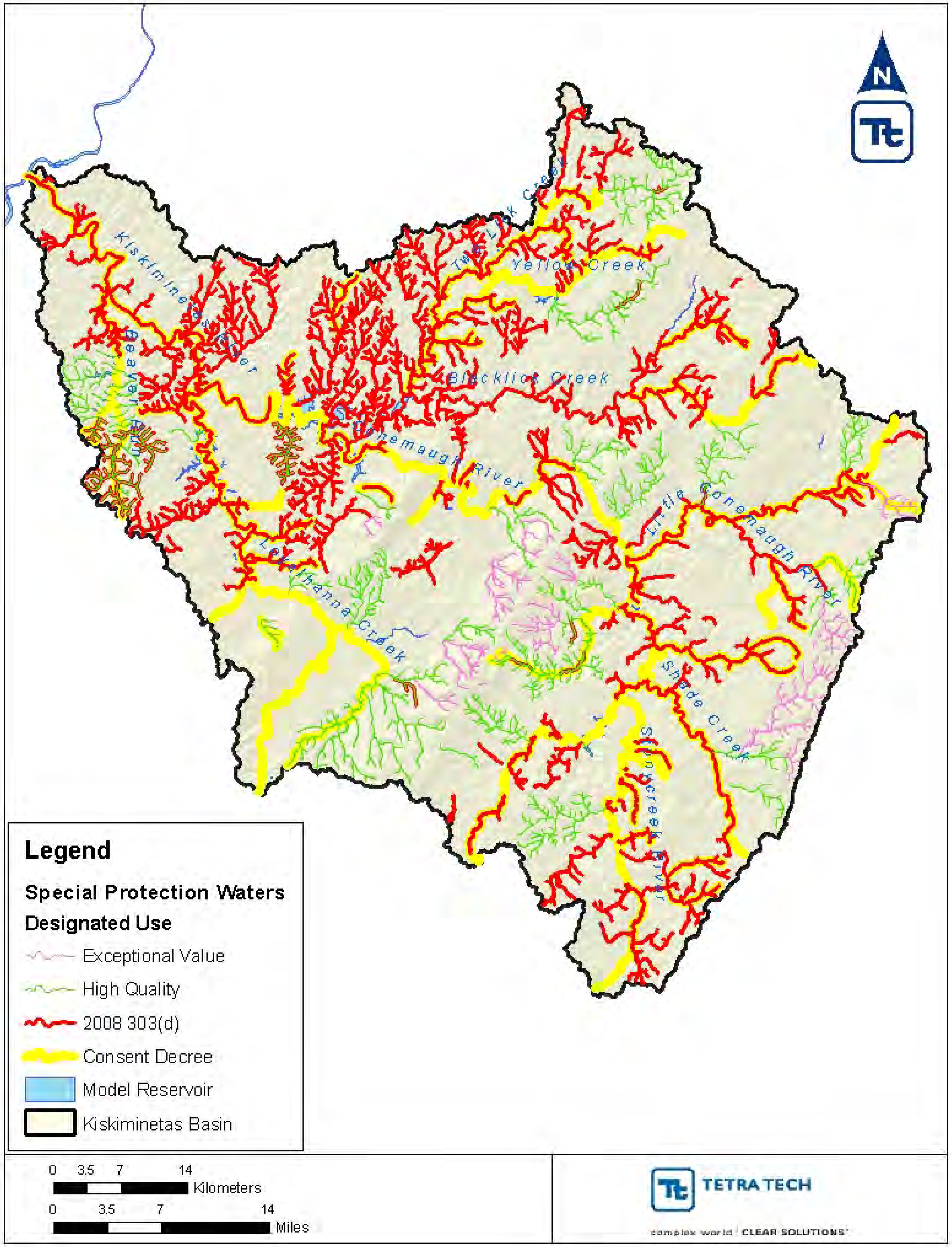

Figure 1-3. High Quality Waters in the Kiskiminetas River Watershed.[4]

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[4] Note: Consent Decree waters are listed by stream name, while the 2008 Section 303(d) list identifies impaired waters by stream reach. Since it is not possible to identify the individual listed reaches from the Consent Decree, the entire stream is shown on the figure.

2. DATA INVENTORY AND ANALYSIS

TMDL development requires a complete review of existing data to establish existing conditions in the study area. Data from numerous sources were used to characterize the watersheds and water quality conditions, identify pollutant sources, and support the calculation of metals TMDLs for the Kiskiminetas River watershed.

2.1. Data Inventory

Descriptions of the data sets that were used in data analysis and model development are provided in Sections 2.1.1 through 2.1.4. For discussion of the context in which each data set is incorporated into the TMDL technical approach, see Section 4.

2.1.1. Hydrology

Flow data are available from USGS for the Kiskiminetas River watershed at ten locations. Flow data provided by the U.S. Army Corps of Engineers (USACE) and the Municipal Authority of Westmoreland County (MAWC) were also obtained for reservoirs in the watershed. Table 2-1 provides a summary of the flow gage data for the watershed. The locations of these stations are shown in Figure 2-1.

Table 2-1. Summary of Hydrologic Data for the Kiskiminetas River Watershed

Source	Station	Location	Data type	Range
USGS	03039925	North Fork Bens Creek at North Fork Reservoir, PA	Daily flow	10/01/1984–09/30/1998
USGS	03040000	Stonycreek River at Ferndale, PA	Daily flow	10/01/1913–present
USGS	03041000	Little Conemaugh River at East Conemaugh, PA	Daily flow	04/01/1939–present
USGS	03041029	Conemaugh River at Minersville, PA	Daily flow	12/12/1901–present
USGS	03041500	Conemaugh River at Seward, PA	Daily flow	10/01/1938–present
USGS	03042000	Blacklick Creek at Josephine, PA	Daily flow	02/01/1952–present
USGS	03042280	Yellow Creek near Homer City, PA	Daily flow	10/01/1967–present
USGS	03042500	Two Lick Creek at Graceton, PA	Daily flow	10/01/1951–present
USGS	03045000	Loyalhanna Creek at Kingston, PA	Daily flow	01/01/1940–present
USGS	03048500	Kiskiminetas River at Vandergrift, PA	Daily flow	10/01/1937–present
USACE	—	Loyalhanna Reservoir discharge	Daily flow	01/01/1999–05/07/2008
USACE	—	Conemaugh Reservoir discharge	Daily flow	01/01/1999–05/07/2008
MAWC	—	Beaver Run Reservoir discharge	Average monthly	01/2000–05/2008

Discharge records were available for three dams in the Kiskiminetas River watershed, which impound and form the Loyalhanna, Conemaugh, and Beaver Run reservoirs. Available records were used to verify the model representation of reservoirs and hydrology calibration, as described in Section 4.2. Several smaller reservoirs lacking discharge data are also in the watershed. Two of the larger of these reservoirs are described below.

- Two Lick Creek Reservoir: The discharge from the reservoir typically equals the flow entering the reservoir. The major exception to this rule is during dry weather, when a flow of 11 cubic feet per second (cfs) is required to be maintained. Flow from this reservoir can be approximated by subtracting the flow from USGS 03042280 (8 miles downstream of the reservoir) from USGS 03042500 (Gary Cline, EME Homer City Generation, personal communication, May 12, 2008).

- Yellow Creek Reservoir: The discharge from this reservoir typically equals the amount of flow entering the reservoir. The major exception to this rule is during extremely dry weather typical of late July and early August, when a flow of 7.8 cfs is required to be maintained (*Ken Bisbee, Pennsylvania Department of Conservation and Natural Resources, personal communication, June 9, 2008).*

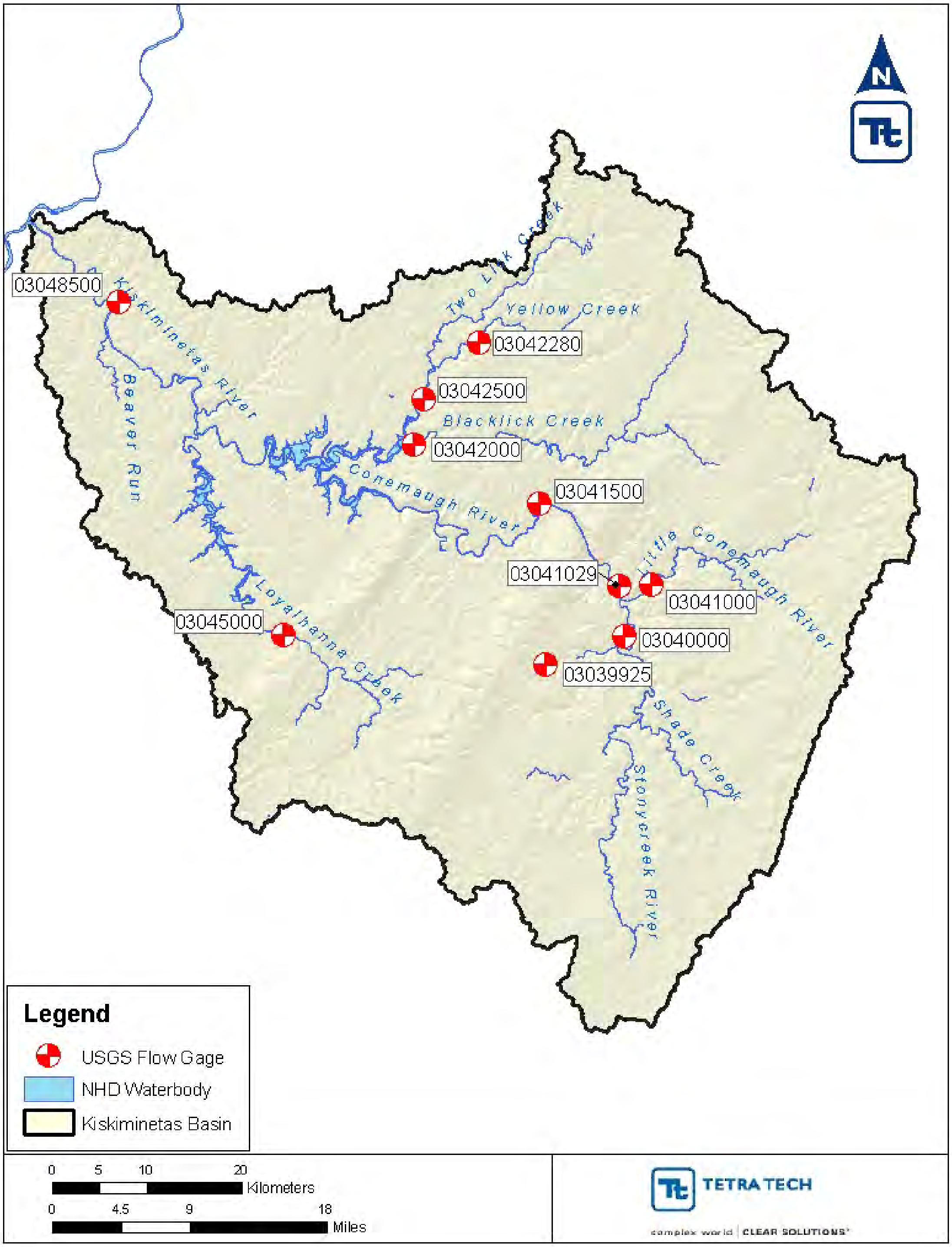

Figure 2-1. Hydrology Stations in the Kiskiminetas River Watershed.

2.1.2. Weather

Meteorological data required for data analysis and modeling were obtained from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA). The NCDC stores and distributes weather data gathered by the Cooperative Observer Network (COOP) throughout the United States and from Weather Bureau Army-Navy (WBAN) airways stations, also known as surface airway stations. The COOP stations record hourly or daily rainfall data, while the surface airway stations record various hourly meteorological data, including rainfall.

The meteorological data were subjected to a quality assurance/quality control (QA/QC) regime that identified gaps and unreasonable values inconsistent with observed conditions. Flagged data were deleted and replaced as available data allowed. In addition, gaps in rainfall time-series, representing missing or deleted data, were filled using a patching process that employs the *normal-ratio method* to estimate missing totals. Estimates are calculated as a weighted average from an index of surrounding weather stations with similar rainfall patterns. A list of meteorological data that have been QA/QC reviewed and a description of how the data are used in the TMDL watershed model are provided in Section 5.

2.1.3. Surface Water Chemistry Data

Water quality data related to AMD impairments in the Kiskiminetas River watershed were reviewed as part of TMDL development. Surface water quality data were available from multiple sources, including EPA Legacy and Modern STORET databases, USACE, USGS National Water-Quality Assessment Program (NAWQA), and PADEP. Metals- and pH-related data were extracted, formatted, and combined in a single database for analysis. Data from select stations with robust records were used in a spatial analysis of water quality in the watershed, as well as in calibrating the water quality model. For discussion of the selected data, see Section 2.2.

Water quality data were available from the STORET databases for 1977–2004, consisting of data submitted by PADEP's WQN, the National Park Service (NPS), and EPA's National Aquatic Resource Survey. The majority of the data were available from WQN (2,632 samples) and NPS (5,281 samples). WQN is a statewide, fixed-station water quality sampling system operated by PADEP's Bureau of Water Standards and Facility Regulation (BWSFR). NPS collects water quality data under its Water Quality Program (WQP), administered by the Water Operations Branch (WOB) of the Water Resources Division.

Water quality data were also obtained from the USACE for 43 stations in the Kiskiminetas River watershed. The data record for these stations was for 1999–2007. Most of the stations are within the Loyalhanna and Conemaugh reservoirs, whose dams are managed by USACE.

A limited amount of field water quality data related to AMD impairments was also obtained from the USGS NAWQA database. These data were collected in 1996–1998 and consist of field measurements of pH, carbonate, and total alkalinity.

To support TMDL development, PADEP collected additional water quality data for 2007–2008 at 96 monitoring locations in the watershed. Samples were analyzed for metals (aluminum, iron, and manganese), pH, alkalinity, and acidity. The locations of PADEP water quality stations in the watershed are shown in Figure 2-2. Table 2-2 provides a summary of the available data by source.

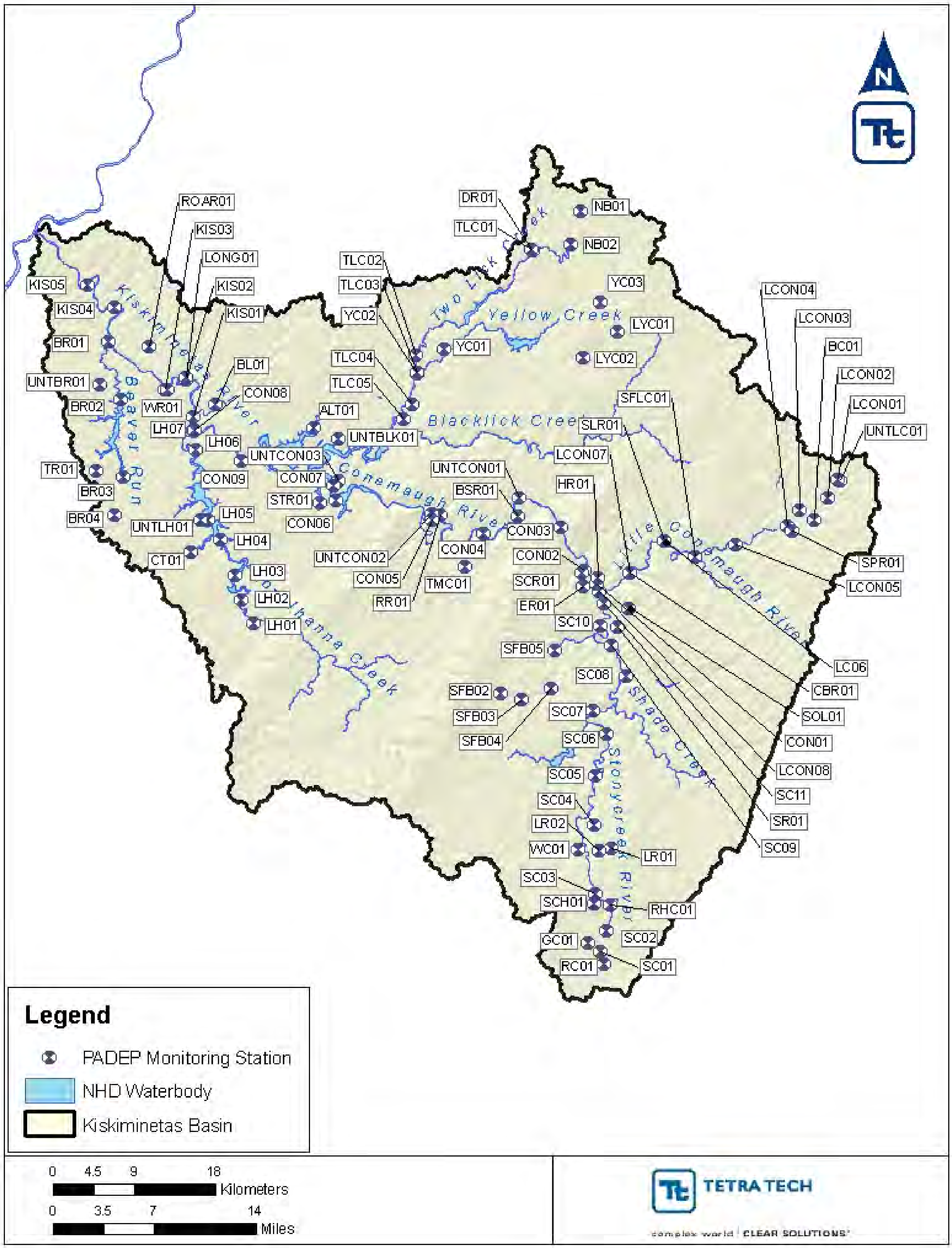

Figure 2-2. PADEP Water Quality Sampling Sites.

Table 2-2. Summary of Water Quality Data in the Kiskiminetas River Watershed

Data source	Pollutant	Period of record	No. of stations
NAWQA field data	pH	04/23/96–09/28/98	11
NAWQA field data	Total alkalinity	04/23/96–09/28/98	4
NAWQA field data	TSS	04/23/96–09/28/98	1
PADEP	pH	07/16/07–06/05/08	96
PADEP	Total acidity	07/16/07–06/05/08	96
PADEP	Total alkalinity	07/16/07–06/05/08	96
PADEP	Total aluminum	07/16/07–06/05/08	96
PADEP	Total iron	07/16/07–06/05/08	96
PADEP	Total manganese	07/16/07–06/05/08	96
PADEP	TSS	07/16/07–06/05/08	96
STORET	pH	06/02/92–11/18/04	289
STORET	Dissolved aluminum	05/02/00–11/18/04	14
STORET	Dissolved iron	06/02/92–11/18/04	286
STORET	Dissolved manganese	06/02/92–11/18/04	286
STORET	Total Acidity as $CaCO_3$	06/02/92–11/18/04	287
STORET	Total aluminum	06/02/92–04/30/01	282
STORET	Total iron	06/02/92–04/30/01	281
STORET	Total manganese	06/02/92–04/30/01	282
USACE	Dissolved aluminum	07/30/07–08/02/07	6
USACE	Dissolved iron	07/30/07–08/02/07	6
USACE	Dissolved manganese	07/30/07–08/02/07	6
USACE	Mineral acidity	06/14/99–04/25/06	30
USACE	pH	05/18/99–08/02/07	41
USACE	Phenolphthalein alkalinity	01/10/00–04/25/06	22
USACE	Sulfate	05/05/00–08/02/07	39
USACE	Total acidity	01/11/99–12/19/07	38
USACE	Total alkalinity	01/11/99–12/19/07	38
USACE	Total aluminum	05/18/99–08/02/07	39
USACE	Total hardness	01/11/99–12/19/07	38
USACE	Total iron	01/12/99–08/02/07	39
USACE	Total manganese	01/12/99–08/02/07	39
USACE	TSS	05/18/99–12/18/07	40

2.1.4. Land Use Data

National Land Cover Data (NLCD) are available through the Multi-Resolution Land Characteristics Consortium (MRLC) as a joint effort between EPA and USGS. NLCD data from 2001 were obtained for the Kiskiminetas River watershed. Section 4 provides further details on how the data were used for modeling and TMDL development.

2.2. Data Analysis

Water quality samples were collected by various government agencies as part of the assessment of AMD impairments in the Kiskiminetas River watershed, as described in Section 2.1.3. Data collected in the basin were compiled and summarized to help identify spatial trends and for use in calibrating the water quality model. Because of the size of the watershed and the large number of water quality stations monitored, only data collected for 2007–2008 as part of the PADEP study conducted in support of development of this TMDL are presented in the analysis that follows. These data are presented for selected water quality stations representing model calibration locations. For a complete summary of the water quality data by station, see Appendix B.

2.2.1. Instream Sampling

PADEP Data

Ninety-six PADEP sampling locations in the Kiskiminetas River watershed were selected for data analysis on the basis of location on impaired segments and data record. The specific results of these analyses are included in Appendix B. Monitoring for parameters related to AMD impairments was conducted during five sampling events at each station. The water quality results for the parameters being modeled as part of TMDL development (pH, total aluminum, total iron, and total manganese) were analyzed and compared to applicable standards. The selected locations include sampling along the mainstem drainage areas of the Kiskiminetas and Conemaugh rivers and in the watersheds of four major tributaries—Little Conemaugh and Stonycreek rivers, and Loyalhanna and Two Lick creeks (see Figure 2-2).

Analysis of the metals data from PADEP confirms that in-stream metals concentrations, particularly total aluminum and iron but also manganese, exceed water quality criteria. Ninety-two of the 96 stations recorded aluminum exceedances, 81 of the 96 stations recorded iron exceedances and 31 stations recorded manganese violations. Results for pH suggest that the high metals concentrations do not always translate into pH criteria violations. Fourteen of the 96 stations recorded pH violations and of these, two stations recorded 100 percent violations.

2.2.2. Flow Analysis/Gage Data

Possible relationships between metals and stream flow levels were evaluated at two water quality monitoring locations in the Kiskiminetas River watershed with available concurrent flow data. Water quality data from station KIS04 (Kiskiminetas River) were compared with flow data from USGS gage 03048500, and water quality data from SC10 (Stoneycreek River) were compared with flow data from USGS gauge 03040000. Results of these analyses are presented graphically in Appendix B and are summarized below for each site.

It is important to note that there are few water quality data for each flow range and any patterns identified might not accurately represent instream conditions. However, the data were used to gain insight into the general conditions and potential trends, relationships, and critical conditions.

Station KIS04/Gage 03048500

Station KIS04 and USGS gage 03048500 are on the Kiskiminetas River, 11 miles upstream of its confluence with the Alleghany River. The drainage area represented by this site is 1,825 square miles, capturing almost the entire area of the watershed. Loadings of pollutants at this station appear to be most characteristic of a predominantly nonpoint source-driven situation in which increased pollutant concentrations are correlated with higher stream flow.

Aluminum
Aluminum concentrations show a possible relationship to flow. When concentrations were compared to flow percentiles, an obvious increasing trend was not present, but the highest concentrations occurred with the highest flow percentile (Figure B-1).

Iron
Graphical analysis of the relationship between iron and flow suggests a relationship similar to that of aluminum and flow. There is not a steady increase in iron concentration with increasing flow percentiles, but the highest concentrations occurred with the highest flow percentile (Figure B-2).

Manganese
Manganese concentrations show a strong possible relationship to flow. When concentrations were compared to flow percentiles, an obvious trend was apparent: a relatively steady increase in manganese concentrations with increasing flow percentiles (Figure B-3).

pH
Graphical analysis of pH suggests no consistent relationship with flow. The highest and lowest pH values were recorded at very similar flow percentiles, and the remaining observations fall within this range regardless of flow conditions (Figure B-4).

Station SC10/Gage 03040000

Station SC10 and USGS gage 03040000 are on the Stonycreek River 3.8 miles upstream of its confluence with the Conemaugh River. The drainage area represented by this site, 451 square miles, is predominantly forested with significant areas of pastoral and agricultural lands. Loadings of pollutants at this station appear to be most characteristic of a predominantly point source-driven situation in which increased pollutant concentrations are correlated with lower stream flow. This area is downstream of numerous mining areas and seeps, which tend to dominate water quality during low flow.

Aluminum
Aluminum concentrations show a possible inverse relationship with flow. When concentrations were compared to flow percentiles, an obvious decreasing trend was not present, but the highest concentrations occurred during base-flow conditions (Figure B-5).

Iron
Graphical analysis of the relationship between iron and flow suggests a relationship similar to that of aluminum and flow. There is not a definite inverse relationship to flow, but the highest concentration occurred during base-flow conditions (Figure B-6).

Manganese
Manganese concentrations show a strong possible inverse relationship to flow. When concentrations were compared to flow percentiles, an obvious trend was apparent: a relatively steady decrease in manganese concentrations with increasing flow percentiles (Figure B-7).

pH
Graphical analysis of pH shows a possible relationship with flow. The lowest pH values were recorded during base-flow conditions; the highest pH values were recorded during high-flow conditions (Figure B-8).

2.2.3. Geology

The Kiskiminetas River watershed is in the Allegheny Mountain and Pittsburgh Lowlands sections of the Appalachian Plateaus Geological Province. The Appalachian Plateau is characterized by gently folded sedimentary rocks, such as sandstone, shale, and siltstone. The surface geology ranges in age from Devonian to Permian and contains several coal and limestone beds.

The surface geology of the area consists of the Allegheny Group, Burgoon Sandstone, Casselman Formation, Catskill Formation, Glenshaw Formation, Mauch Chunk Formation, Monongahela Group, Pottsville Group, Rockwell Formation, Shenango Formation (through the Oswayo Formation), and the Waynesburg Formation. The predominant rock types are sandstone and shale, with siltstone, limestone, coal, and conglomerate. The Casselman Formation and Glenshaw Formation form the majority of the surficial geology. The Burgoon Sandstone forms most of the ridges in the watershed. Figure 2-3 presents the surface geology of the watersheds.

The Allegheny Formation contains the Upper Freeport, Kittanning, and Brookville-Clarion coals). The Upper Freeport coal forms the boundary with the overlaying Glenshaw Formation. Most mines in the watershed are in the Allegheny Formation or near this boundary. The Monongahela Group and Pottsville Formation also contain commercial coals and some mines. The Pottsville Formation also contains high-alumina clays, which are commercially valuable.

There are several formations that contain limestone and calcareous shale (Monongahela Group, Casselman Formation, Glenshaw Formation, Pottsville Formation, and Waynesboro Formation). These rock types act as a natural acidity buffer.

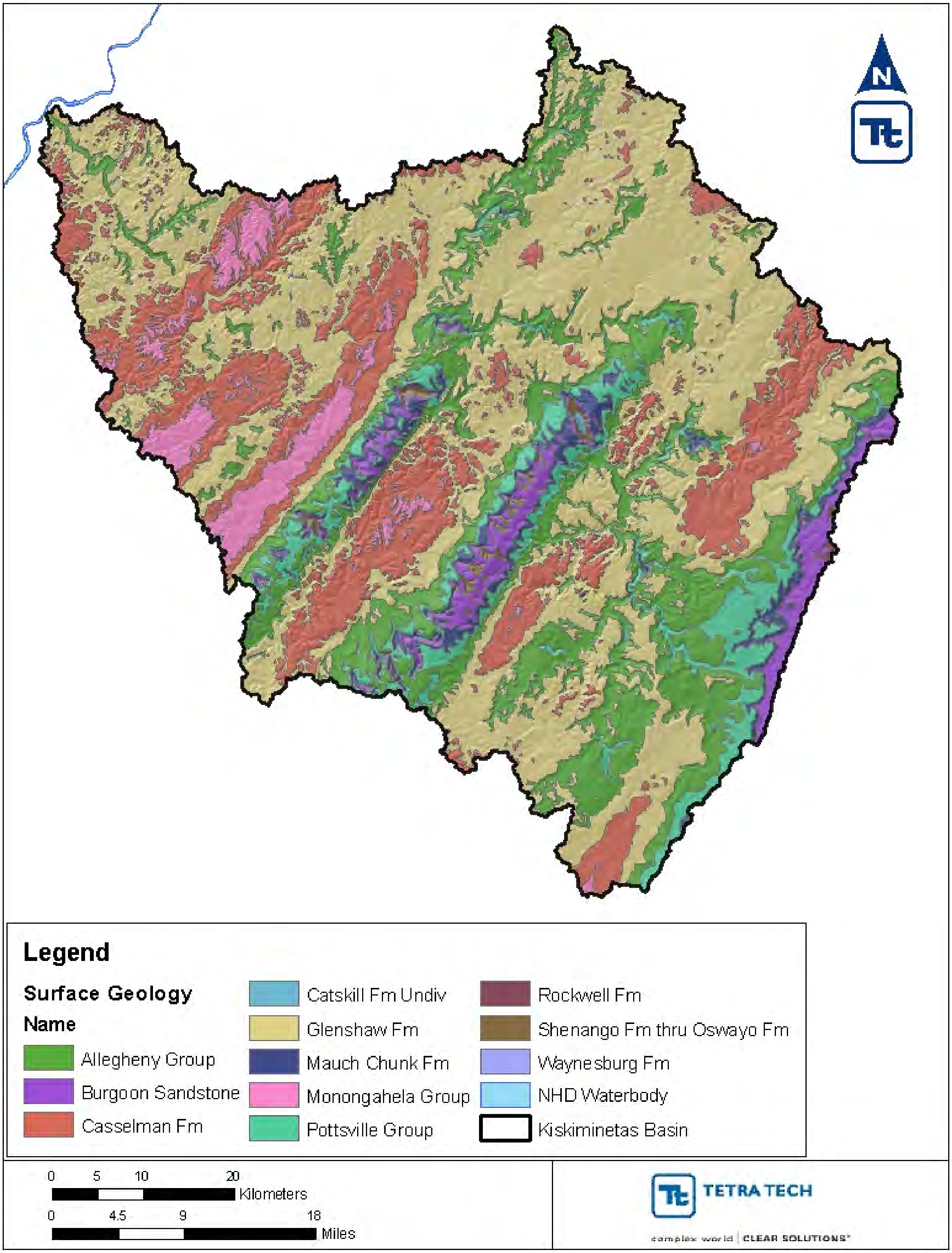

Figure 2-3. Surface Geology of the Kiskiminetas River Watershed.

3. SOURCE ASSESSMENT

3.1. Point Sources

A point source, according to 40 CFR §122.3, is any discernible, confined, and discrete conveyance, including but not limited to 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 may be discharged. The National Pollutant Discharge Elimination System (NPDES), established under Clean Water Act Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

In the Kiskiminetas watershed, permits are used to manage discharges from industrial facilities, mining facilities, municipal treatment facilities, and MS4s. NPDES permit information was obtained for all permitted facilities in the Kiskiminetas River watershed. Data sources included PADEP permit records, EPA’s Permit Compliance System (PCS), and EPA’s Integrated Compliance Information System (ICIS). These data include permit ID, outlet locations, areas associated with surface and deep mining operations, permit limits and some discharge monitoring reports (DMRs) for active facilities. These point source data were used to establish physical representation in the model of all permitted discharges in the watershed and to determine existing and baseline loading conditions. To the extent that EPA was able to obtain current information, permits represented in this TMDL are up to date as of July, 2009. For details on how point sources were included in the model, see Section 4. Please refer to Appendix C for the full list of permits included in this TMDL.

3.1.1. Non-Mining Facilities

Information on 544 permitted discharges for 360 permitted facilities in the watershed was reviewed. The permitted facilities include sewage treatment facilities, industrial wastewater dischargers, stormwater permits, oil and gas permits, and other small dischargers governed by general permits. Characterization information included permit and outfall number, facility name, location, receiving stream, permit limits, flow, and monitoring data. Information was not available for all facilities. Many permits for small discharges have little information associated with their permits. Because of the large number of facilities included in this analysis, facilities are listed in Appendix C, which contains tables of facility-related information such as NPDES identification, design flows, parameter limits and outlet locations.

3.1.2. Withdrawals

In addition to discharging, several facilities withdraw large amounts of water from the watershed, only to discharge the water back into the system. Nine facilities had withdrawals greater than one million gallons per day (MGD; Table 3-1). Withdrawals were reported as 12 monthly averages or a yearly average. These were incorporated into the model, either varying monthly or as a constant withdrawal, to better simulate hydrology.

Table 3-1. Major Water Withdrawals in the Kiskiminetas River Watershed

Facilities	Minimum withdrawal (cfs)	Maximum withdrawal (cfs)	Average withdrawal (cfs)	Withdrawal type
Cambria Somerset Authority	1.4	10.4	4.7	Average monthly
Cambria Twp Water Authority Cambria County	1.0	2.1	1.7	Average monthly
EME Homer City Generation LP	24.9	24.9	24.9	Average yearly
Greater Johnstown City Water Authority Cambria County	8.8	8.8	8.8	Average yearly

Facilities	Minimum withdrawal (cfs)	Maximum withdrawal (cfs)	Average withdrawal (cfs)	Withdrawal type
Highland Sewer and Water Authority	5.4	7.0	6.2	Average monthly
PA Amer Water Company	5.1	5.1	5.1	Average yearly
RRI Energy, Inc. (Seward)	3.4	10.4	7.8	Average monthly
RRI Energy, Inc., (Conemaugh)	21.4	46.6	37.6	Average monthly
Westmoreland County Municipal Authority	28.2	34.6	31.7	Average monthly

3.1.3. Permitted Mining

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to establish a nationwide program to protect the beneficial uses of land or water resources, protect public health and safety from the adverse effects of current surface coal-mining operations, and promote the reclamation of mined areas left without adequate reclamation before August 3, 1977. The SMCRA requires a permit for developing new, previously mined, or abandoned sites for surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by a regulatory authority if the applicant forfeits its permit. Mines that ceased operations before the effective date of SMCRA (often called *pre-law* mines) are not subject to the requirements of the act.

SMCRA Title IV is designed to provide assistance for the reclamation and restoration of abandoned mines, while Title V states that any surface coal-mining operations are required to meet all applicable performance standards. The general performance standards include the following:

- Restoring the land affected to a condition capable of supporting the uses that it was capable of supporting before any mining.
- Backfilling and compacting (to ensure stability or to prevent leaching of toxic materials) to restore the approximate original contour of the land, including all highwalls.
- Minimizing disturbances to the hydrologic balance and to the quality and quantity of water in surface water and groundwater systems both during and after surface coal-mining operations and during reclamation by avoiding acid or other toxic mine drainage.

Untreated coal mining-related point source discharges from deep, surface, and other mines typically have low pH values (that is, they are acidic) and contain high concentrations of metals such as iron, aluminum, and manganese. Coal mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, total manganese, nonfilterable residue, and pH. Many permits also include effluent monitoring requirements for total aluminum.

There are 271 mining-related NPDES permits in the watershed, with 1,288 associated outlets, (Figure 3-1). In addition, there are several proposed facilities under consideration. Because of the large number of mining permits in the watershed, Appendix C provides information related to these facilities, including name, type, disturbed areas, and related permit limits.

3.2. Nonpoint Sources

Nonpoint sources of pollutants are diffuse, non-permitted sources, most often resulting from precipitation-driven runoff. The following sections identify the potential nonpoint sources of metals in the Kiskiminetas River watershed.

3.2.1. Acid Mine Drainage (AMD)

One of the main sources of nonpoint source pollution that contributes to the high metals levels in the Kiskiminetas River watershed is AMD. AMD is drainage that flows from open or deep mines and coal refuse piles. It tends to be highly acidic and to contain high dissolved metals concentrations. The formation of AMD is a function of geology, hydrology, and mining technologies used at the site. When water is exposed to pyrite in coal, refuse, or the overburden of mining operations, complex reactions occur that result in water with high acidity and dissolved metal content. These metals remain dissolved until the pH of the water increases to the level at which the metals precipitate out. In Pennsylvania, abandoned coal mines have polluted groundwater and more than 3,000 miles of streams. AMD is considered the most extensive problem affecting water quality in Pennsylvania. It has negatively affected fish populations. Pennsylvania loses approximately $67 million annually that could be generated if fish populations recovered and sport fishing could be restored (PADEP 2006).

EPA obtained and utilized two significant sources of data from PADEP in order to characterize acid mine drainage in the Kiski-Conemaugh watershed. The Bureau of Abandoned Mine Reclamation’s (BAMR’s) Abandoned Mine Lands Inventory provides the most comprehensive compilation of GIS layers related to abandoned mine lands in Pennsylvania. Continually updated, its uses include supporting the reporting of annual Abandoned Mine Land Program accomplishments to Congress. In addition, the data is used in the National Atlas of the United States for geographic display and analysis at the national level, and for large regional areas. The dataset includes boundaries encompassing known problem areas as well as specific problem structures such as AML discharges and dangerous highwalls. Additionally, EPA incorporated discharge data from BAMR’s Orphan Mine Discharge database which includes discharge data for known abandoned mine discharges with average flows larger than 100 gpm. In the Kiski-Conemaugh, data were available for 26 such discharges. Appendix G under Tab “AML Discharges (Seeps)” provides a list of those discharges.

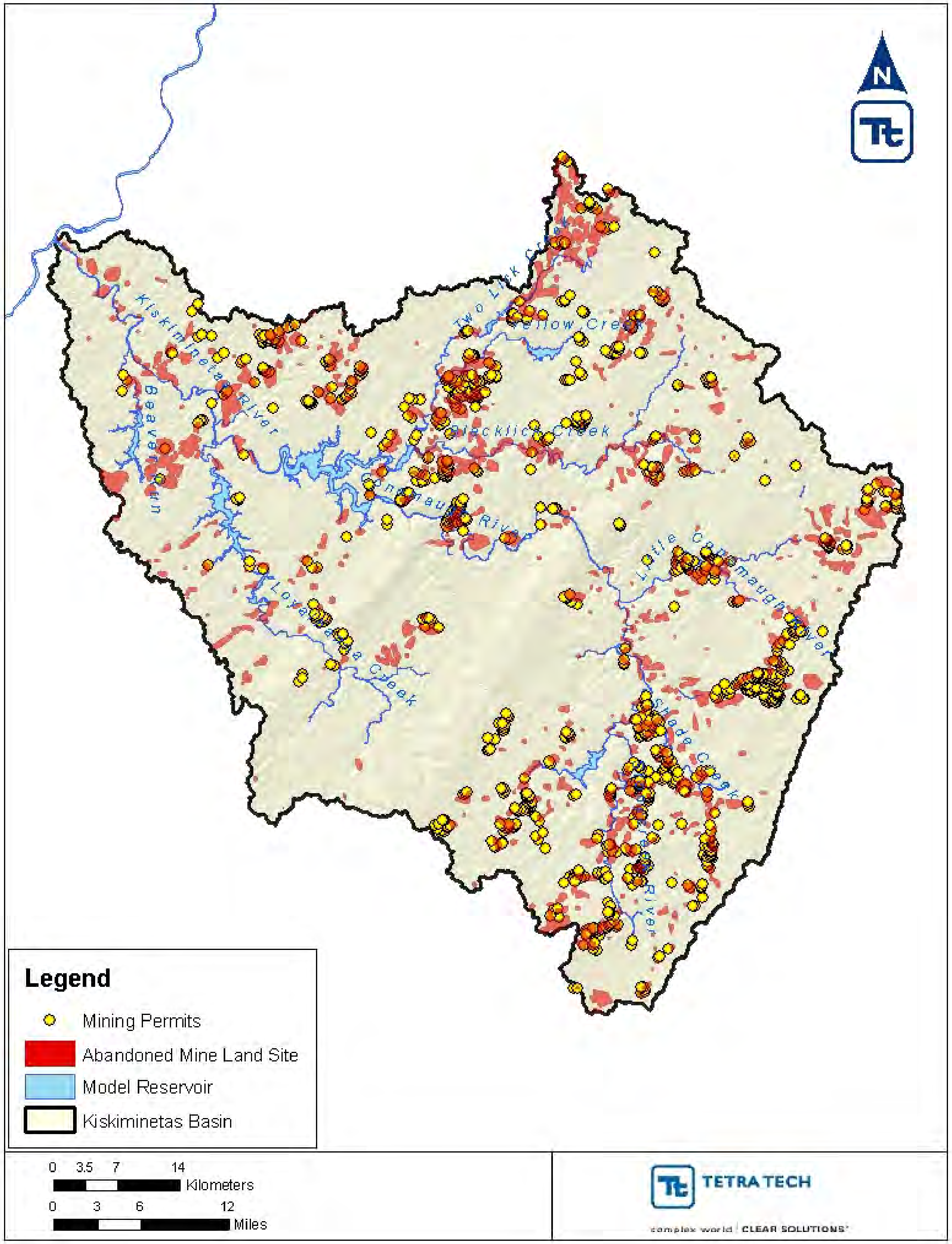

Figure 3-1. Mining and AML Sites in the Kiskiminetas River Watershed.

3.2.2. *Urban Sources*

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 waterbodies. Most stormwater discharges are considered point sources and require coverage by an NPDES permit.

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 within 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.

MS4s are characteristic of urban areas and, through stormwater, they might contribute metals to the waters. The permitted MS4s in the Kiskiminetas River watershed include the municipalities of Johnstown and Indiana. Table 3-2 lists the permitted municipalities in the watershed.

Several municipalities have received waivers from PADEP. Municipalities may apply for waivers to their NPDES MS4 general permit. Specific information on general permits and waivers is available on the PADEP Web site.[5] Municipalities with fewer than 1,000 persons that discharge to impaired waters are eligible for waivers if stormwater controls are not needed on the basis of WLAs from an EPA-approved or established TMDL. Municipalities with between 1,000 and 10,000 persons are eligible for waivers if PADEP evaluations show that stormwater controls are not needed on the basis of WLAs from an EPA-approved or established TMDL or if TMDL has not been developed or approved on the basis of an equivalent analysis that determines pollutant sources and allocations.

Table 3-2. Permitted MS4 Municipalities in the Kiskiminetas River Watershed

Permit No.	Municipality	County	Type
PAI136115	Adams Township	Cambria	Individual
PAG136360	Brownstown Borough	Cambria	Waiver
PAG136139	Conemaugh Township	Cambria	General
PAG136321	Daisytown Borough	Cambria	Waiver
PAG136224	Dale Borough	Cambria	Waiver
PAG136361	East Conemaugh Borough	Cambria	General
PAG136341	East Taylor Township	Cambria	General
PAG136286	Ferndale Borough	Cambria	Waiver
PAG136362	Franklin Borough	Cambria	Waiver
PAG136232	Geistown Borough	Cambria	General
PAG136114	Jackson Township	Cambria	General
PAG136245	Johnstown City	Cambria	General
PAG136244	Lorain Borough	Cambria	General
PAG136288	Lower Yoder Township	Cambria	General

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[5] http://www.depweb.state.pa.us/watershedmgmt/cwp/view.asp?a=1437&q=519543&watershedmgmtNav= (Accessed February 2009)

Permit No.	Municipality	County	Type
PAG136349	Middle Taylor Township	Cambria	Waiver
PAG136249	Richland Township	Cambria	General
PAG136233	Scalp Level Borough	Cambria	Waiver
PAG136218	Southmont Borough	Cambria	General
PAG136107	Stonycreek Township	Cambria	General
PAI136120	Upper Yoder Township	Cambria	Individual
PAI136117	West Taylor Township	Cambria	Waiver
PAI136121	Westmont Borough	Cambria	Individual
PAG136247	Indiana Borough	Indiana	General
PAG136345	Conemaugh Township	Somerset	General
PAG136119	Paint Borough	Somerset	General
PAG136352	Paint Township	Somerset	General
PAG136340	Windber Borough	Somerset	General
PAG136277	Allegheny Township	Westmoreland	General
PAI136125	Delmont Borough	Westmoreland	Individual
PAG136328	Derry Borough	Westmoreland	General
PAG136330	Derry Township	Westmoreland	General
PAG136331	Hempfield Township	Westmoreland	General
PAG136329	Latrobe Borough	Westmoreland	General
PAG136112	Ligonier Borough	Westmoreland	Waiver
PAG136333	Ligonier Township	Westmoreland	Waiver
PAI136127	Mount Pleasant Township	Westmoreland	Individual
PAI136109	Murrysville Borough	Westmoreland	Individual
PAG136116	Penn Township	Westmoreland	General
PAI136123	Salem Township	Westmoreland	Individual
PAG136332	Unity Township	Westmoreland	General
PAG136181	Washington Township	Westmoreland	General
PAG136251	Youngstown Borough	Westmoreland	Waiver

3.2.3. Soil and Sediment

Sediment produced from land-based activities is another potential source of high metal contamination in the Kiskiminetas River watershed. Pennsylvania is composed of three basic geologic areas: the northwestern half has relatively flat-lying rocks, and the southeastern half has folded and faulted rocks. The Appalachian Plateau Province is in the northwest and the Valley and Ridge Province and Piedmont Province in the southeast. The Appalachian Plateau Province and Valley and Ridge Province are separated by the Allegheny Front. The Kiskiminetas River watershed is in the Appalachian Plateau Province. The oldest formations in the Kiskiminetas River watershed are the Shenango Formation through Oswayo Formation, undivided (Mississippian/Devonian); the youngest is the Waynesburg Formation (Permian/Pennsylvanian). Quaternary alluvium overlays much of the formations.

The Appalachian Plateau, composed mostly of Pennsylvanian and Permian strata, is where much of the minable coal is. The rocks of the Pennsylvanian System are widely exposed at the surface, having been extensively mined for coal and drilled extensively for oil and gas. Mississippian and Pennsylvanian rocks that are exposed in the northwestern portion of the watershed consist primarily of shales (Casselman, Glenshaw, and Mauch Chunk Formations). The rocks exposed in the southeastern portion of the watershed consist primarily of sandstones from the Pennsylvanian (Pottsville Formation and Allegheny Formation), the Mississippian (Burgoon Sandstone), and the Mississippian/Devonian (the Shenango Formation through Oswayo Formation, undivided).

Because of the relatively high iron and aluminum content of the soils (e.g., Gilpin, Ernest, Rayne, Wharton, Cavode, Buchanan, Clymer, and Laidig) in the Kiskiminetas River watershed, sediment produced from land-based activities is a potential source of high metal contamination. Correlation analyses using pre-TMDL monitoring data collected throughout the watershed were performed to establish sediment/metal relationships and to evaluate spatial variability. In the majority of the impaired waters assessed, a strong, positive correlation between iron and TSS was identified. The results were then applied as potency factors for the sediment-producing land uses to calculate the amount of iron and aluminum loads delivered to the streams along with the sediment loads. Control of the sediment produced from these landuses is necessary in order to achieve total iron TMDL endpoints. The results of the correlation analysis are shown in Appendix H.

4. TMDL TECHNICAL APPROACH

Establishing the relationship between the instream water quality targets and source loadings is a critical component of TMDL development. It allows for evaluation of management options that will achieve the desired source load 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 waterbody responses with flow and loading conditions. This section presents the approach taken to develop the linkage between sources and instream response for TMDL development in the Kiskiminetas River watershed.

A watershed model is a useful tool for providing a quantitative linkage between sources and instream 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 instream 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 also can be used to assess the impacts of a variety of management scenarios.

4.1. Modeling Framework

The following technical factors were critical to selecting an appropriate watershed model to support development of the Kiskiminetas River metals TMDLs:

- The model should be able to address a variety of pollutants, including the pollutants of concern (e.g., metals and sediment/TSS).
- The model should be able to address a watershed with mixed land uses.
- To provide accurate representation of rainfall events/snowmelt 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 large reservoir features.
- The model should be capable of simulating various pollutant transport mechanisms (e.g., groundwater contributions, sheet flow).
- The model should include an acceptable snowmelt routine.

Using the above considerations, the MDAS was selected for modeling. MDAS was developed by Tetra Tech, Inc., specifically to support TMDL studies for areas affected by AMD. It consists of a re-coded C++ version of the Hydrologic Simulation Program FORTRAN (HSPF) model, and a chemical species transformation model. Although MDAS and HSPF are similar models fundamentally, MDAS offers a number 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 formats, 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 user 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 MDAS's algorithms are identical to those in the HSPF model. A brief overview of the HSPF model and MDAS-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 includes 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 MDAS.

Table 4-1. HSPF Modules Included in MDAS

RCHRES Modules	HYDR	Simulates instream hydraulic behavior
	ADCALC	Simulates instream advection of dissolved or entrained constituents
	CONS	Simulates instream conservative constituents
	HTRCH	Simulates instream heat exchange
	SEDTRN	Simulates instream behavior of inorganic sediment
	GQUAL	Simulates instream 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 and 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, MDAS 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 waterbodies using storage routing techniques. The stream model includes precipitation and evaporation from the water surfaces, as well as 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 and SED modules, both of which have PERLND/IMPLND and RCHRES components that define the upland and instream characteristics of each. Together these routines provide 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 instream conditions. It allows for a constituent to be present in a dissolved or 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 different combinations of constituents to be modeled depending on data availability and the objectives of the study. SED simulates the production and transport of sediments. The parameterization of its upland component (SEDMNT) is closely related to the factors of the Universal Soil Loss Equation (USLE) (Wischmeier and Smith 1978), while its instream component (SEDTRN) is highly dependent on the hydraulic characteristics of the model stream reaches.

5. MODEL DEVELOPMENT

An MDAS model was configured for the areas contributing to impaired streams in the Kiskiminetas River watershed as a series of hydrologically connected subwatersheds. Configuration of 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 metals data. Development and application of the watershed model to address the project objectives involved the following major steps:

- Watershed delineation
- Configuration of key model components
- Hydrology calibration and validation
- Water quality calibration and validation

5.1. Watershed Delineation

Watershed delineation refers to the subdivision of the entire watershed into smaller, discrete subwatersheds for modeling and analysis. MDAS 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, 719 subwatersheds were defined for the Kiskiminetas River watershed, as shown in Figure 5-1.

5.2. Configuration of Key Model Components

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

- Waterbody representation
- Land use representation
- Meteorological data
- Hydrologic representation
- Pollutant representation
- pH representation

These components provided the basis for MDAS's ability to estimate flow and pollutant loadings and translate those inputs into instream pH levels. Detailed discussions about the development of each component are provided in the following subsections.

5.2.1. Waterbody Representation

Waterbody representation refers to the modules, or algorithms, in MDAS 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, MDAS 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 (NED) to calculate reach slope. The NED is a geographic information system (GIS) grid coverage of land surface elevation at a resolution of 10 meters; it was developed by 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).

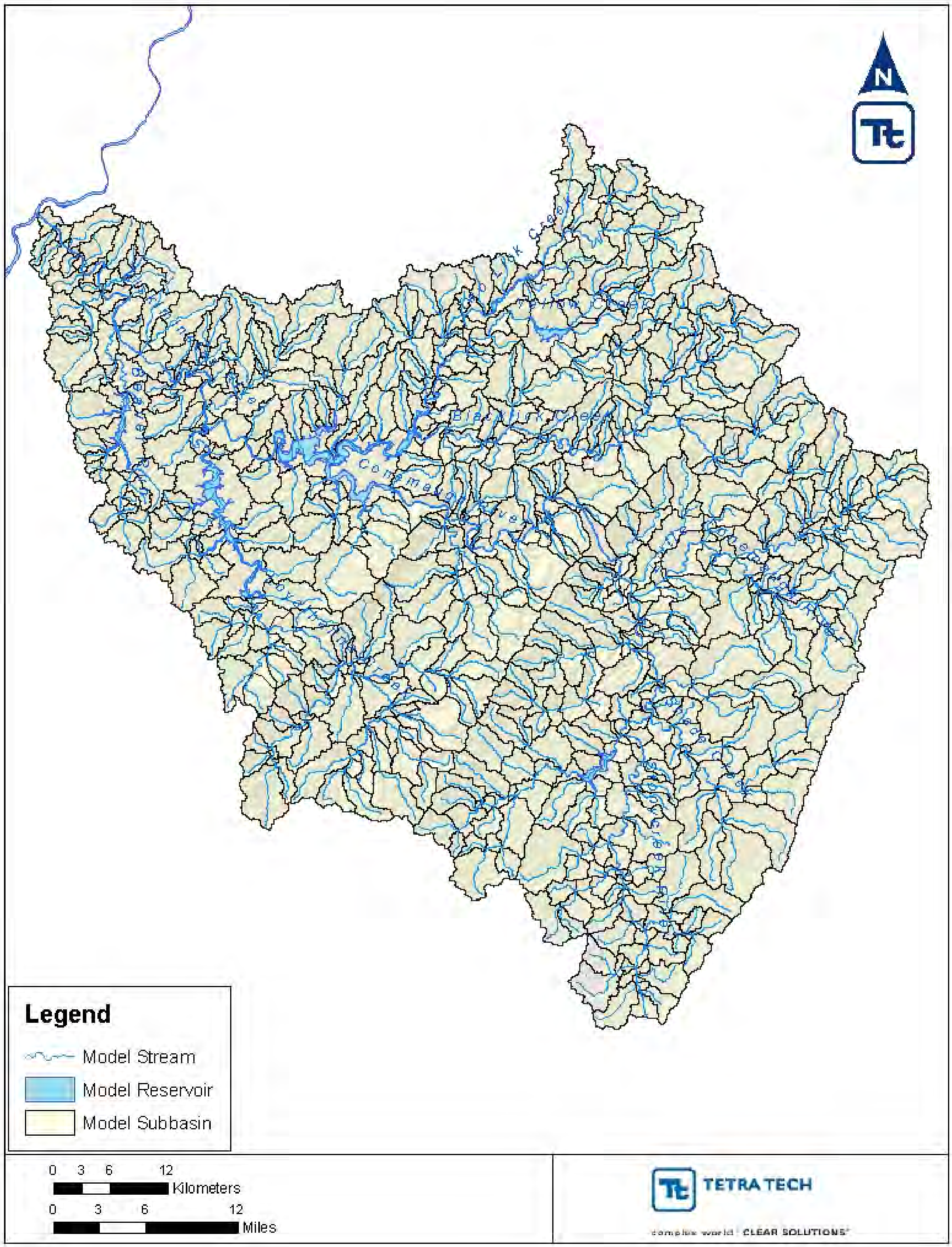

Figure 5-1. Modeled Subwatersheds.

In addition to the streams, there are 80 known dams in the Kiskiminetas River watershed, six of which were determined to significantly affect hydrology. The reservoirs of the selected dams were incorporated into the model setup to represent the impact on stream hydraulics and water quality associated with each. Dams create barriers to sediment transport and associated pollutants. Therefore, they must be taken into consideration when simulating watershed conditions in the TMDL study area. To represent these reservoirs in the watershed model, storage and spillway dimensions were estimated from available data.

For every model stream reach, MDAS requires a rating curve or function table (FTABLE) that defines the representative depth-outflow-volume-surface area relationship of the reach. As described above, stream FTABLEs are automatically generated by MDAS. 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 design data provided in the National Inventory of Dams (NID) maintained by USACE.

All model reservoirs were assumed trapezoidal. The average lakebed width was estimated from contours generated from the 10-meter NED. The NHD was used to estimate the length of each reservoir. The storage and surface area at maximum stage of each reservoir was obtained from the NID. The bank angle of the simplified geometry of each reservoir was solved to represent as closely as possible the associated storage and surface area characteristics given the estimated lakebed width and length. Dam discharge was then estimated using a simplified weir representation of spillway geometry either provided in the NID or estimated from available photographs, topographic maps, and the NHD. The dams represented in the MDAS model and the associated NID design data are presented in Table 5-1.

Table 5-1. Model Represented Dam Design Data

Dam	Storage (acre-ft)	Surface area (acres)	Width (ft)	Height (ft)	Length (ft)
Beaver Run	74,000	1,250	1,095	92	18,142
Two Lick Creek	23,000	510	1,200	115	6,000
Yellow Creek	37,800	710	625	62	10,000
Quemahoning Creek	52,700	845	955	100	14,000
Conemaugh	355,000	800	1,266	144	40,000
Loyalhanna	183,000	3,280	960	114	30,000

5.2.2. Land Use Representation

The MDAS watershed model requires a basis for distributing hydrologic and pollutant loading parameters. Hydrologic variability within 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 Kiskiminetas River watershed, the existing 2001 NLCD land use categories were consolidated to create the model land use groupings shown in Table 5-2. Several additional land use categories were created and added to the modeled land use groupings in order to provide for a representation more customized to the Kiskiminetas River watershed. The additional categories include sources such as AMLs, highwalls, various types of mining activities, and bond forfeiture sites. Information used to update the NLCD landuse coverage for the Kiski-Conemaugh include PADEPs Abandoned Mine Lands Inventory GIS, the Orphan Mine Discharge database, and various permitting data described in previous sections. The updated land use coverage provided the basis for estimating and distributing sediment, total aluminum, and total iron loadings associated with land-based, precipitation-driven sources.

Table 5-2. Consolidation of 2001 NLCD Landuses for the Sediment and Metals MDAS Model

Model Category	2001 NLCD Code and Category
Water	11 Open water
Wetland	90 Woody wetlands
	95 Emergent herbaceous wetlands
Forest	41 Deciduous forest
	42 Evergreen forest
	43 Mixed forest
Cropland	82 Cultivated crops
Pasture/grassland	52 Shrub/scrub
	71 Grassland/herbaceous
	81 Pasture/hay
Urban impervious	21 Developed, open space (10% impervious)
	22 Developed, low-intensity (35% impervious)
	23 Developed, medium-intensity (65% impervious)
	24 Developed, high-intensity (90% impervious)
Urban pervious	21 Developed, open space (90% pervious)
	22 Developed, low-intensity (65% pervious)
	23 Developed, medium-intensity (35% pervious)
	24 Developed, high-intensity (10% pervious)
Barren	31 Barren land

Watershed-specific modeled land use tables are presented in Appendix D.

MDAS 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 5-3. Modeled land use distribution in the Kiskiminetas River watershed is shown in Table 5-3 and Figure 5-2.

Table 5-3. NLCD Land use Data and Simulated Land use Types and Perviousness

NLCD Land use Description	Modeled Land use Category	Percent Pervious
Open water	Water	0%
Developed, open space	Urban pervious/urban impervious	90%
Developed, low-intensity	Urban pervious/urban impervious	65%
Developed, medium-intensity	Urban pervious/urban	35%

NLCD Land use Description	Modeled Land use Category	Percent Pervious
	impervious	
Developed, high-intensity	Urban pervious/urban impervious	10%
Deciduous forest	Forest	100%
Evergreen forest	Forest	100%
Mixed forest	Forest	100%
Transitional	Forest	100%
Quarries/strip mines/gravel pits	Pasture/grassland	100%
Pasture/hay	Pasture/grassland	100%
Other grasses (urban/recreational; e.g., parks, lawns)	Pasture/grassland	100%
Row crops	Cropland	100%
Woody wetlands	Wetlands	100%
Emergent herbaceous wetlands	Wetlands	100%

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 MDAS and MDAS 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.

Key meteorological data were accessed from NOAA’s National Climatic Data Center (NCDC) to develop a representative data set for the study area covering the modeling period. NCDC stores and distributes weather data gathered by the COOP and WBAN airways stations throughout the United States. COOP stations record hourly or daily rainfall data, while airways stations record various climatic data at hourly intervals, including rainfall, temperature, wind speed, dew point, humidity, and cloud cover.

Rainfall and other meteorological data 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.

The identification of the most representative weather data for the model was based on several factors, including geographic coverage, data record, and data completeness. Eleven COOP and three WBAN stations were chosen for the model, mainly on the basis of geographic location (Figure 5-3). Tables 5-4 and 5-5 list the selected daily COOP and WBAN stations, 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.

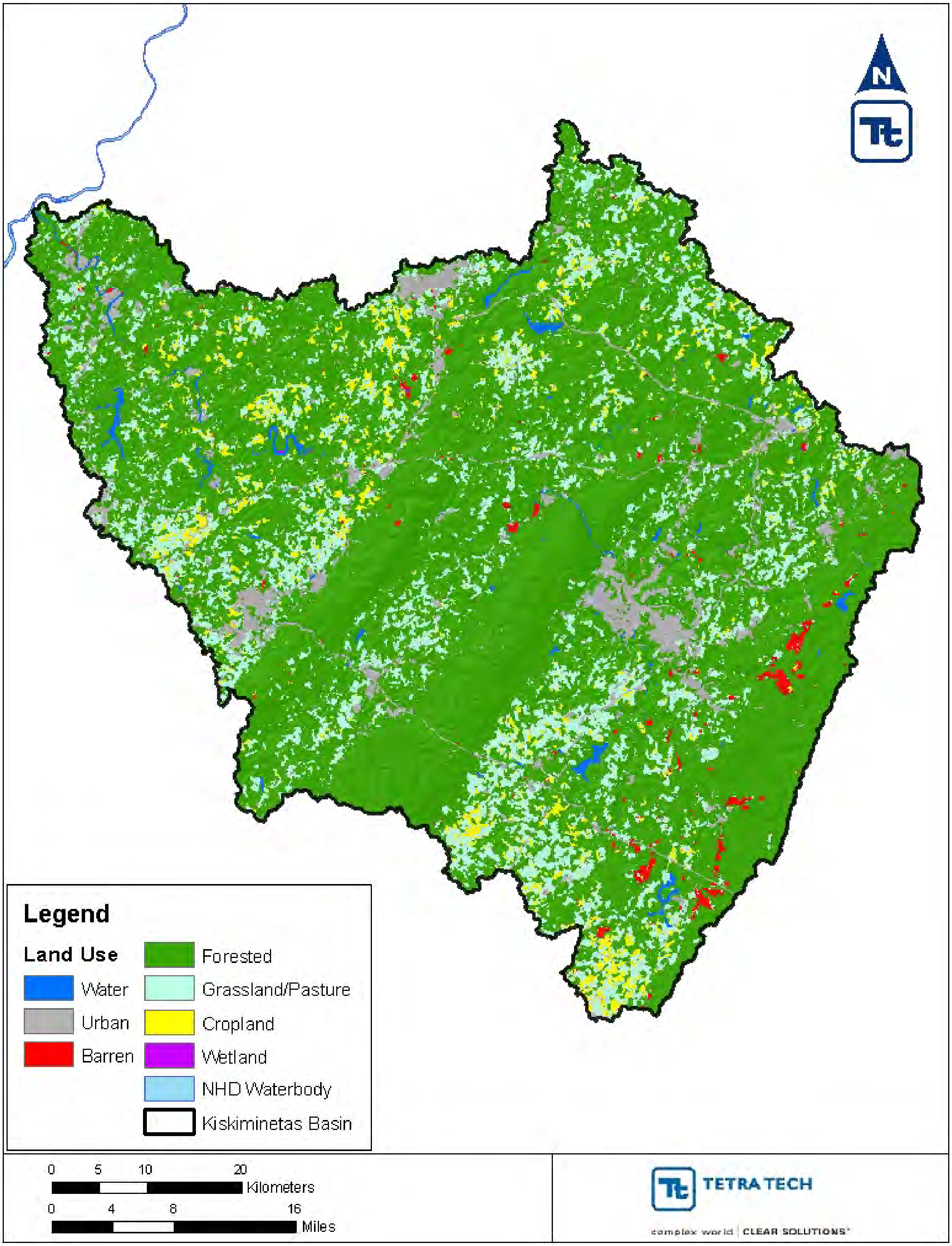

Figure 5-2. Land use Distribution in the Kiskiminetas River Watershed.

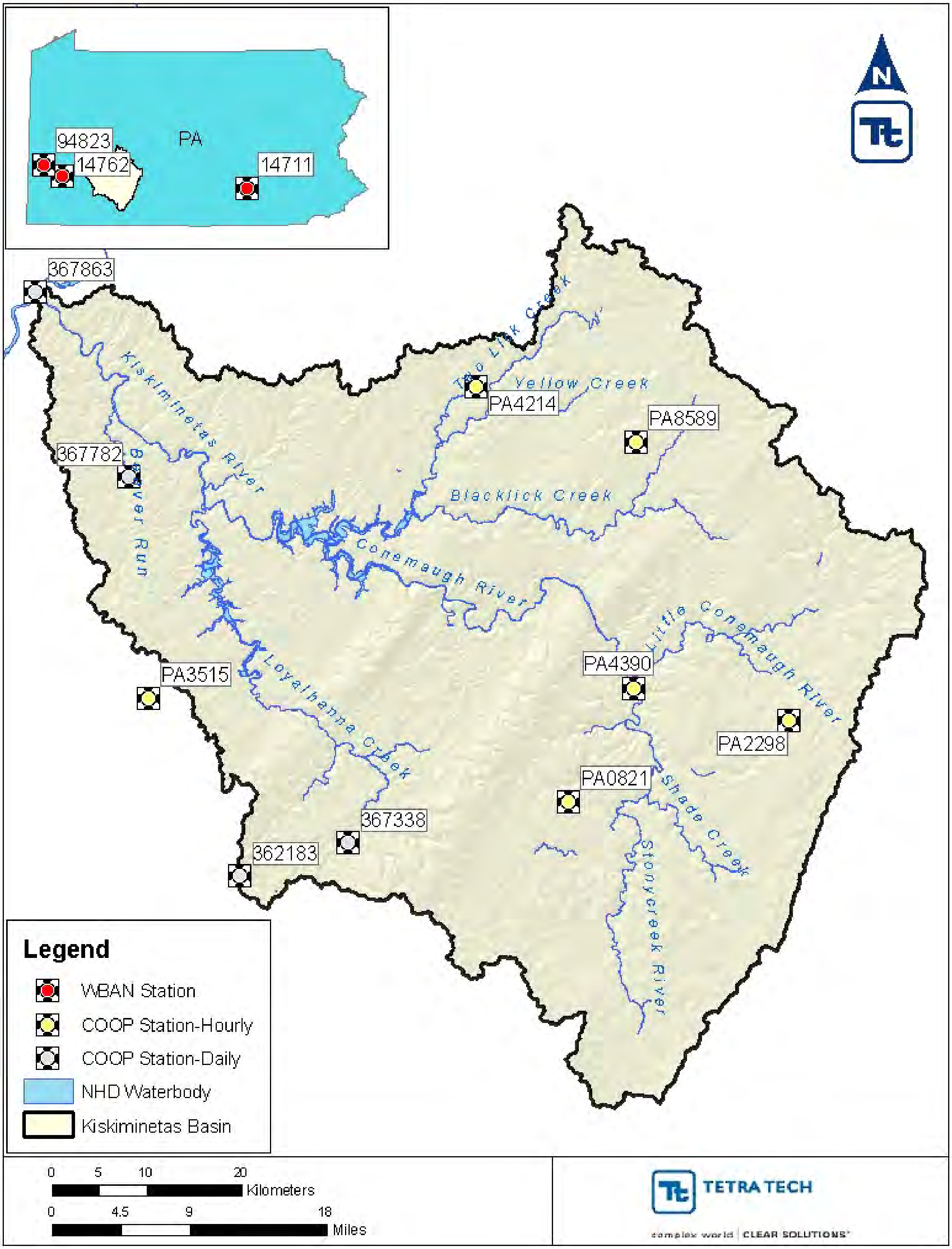

Figure 5-3. Weather Stations used in the Kiskiminetas River Watershed Modeling Process.

Table 5-4. WBAN Climate Stations

WBAN ID	Station name	Elevation (ft)	Parameter	Model range	Percent complete
94823	Pittsburgh International Airport	1,150	Dry-bulb temp	01/01/90–01/31/99	100%
			Wind speed	01/01/90–01/31/99	99%
			Dew point temp	01/01/90–01/31/99	100%
			Cloud cover	01/01/90–06/30/96	97%
14711	Harrisburg International AP	303	Dry-bulb temp	Not used	
			Wind speed	Not used	
			Dew point temp	Not used	
			Cloud cover	07/01/96–01/31/99	51%
14762	Alleghany County AP	1,248	Dry-bulb temp	02/01/99–06/30/08	84%
			Wind speed	02/01/99–06/30/08	100%
			Dew point temp	02/01/99–06/30/08	84%
			Cloud cover	02/01/99–06/30/08	98%

Table 5-5. COOP Precipitation Stations

ID	Station Name	Elevation (ft)	Model Range	Percent Complete
PA0821	Boswell 4 N	1,820	01/01/90–06/30/08	57%
PA2298	Dunlo	2,360	01/01/90–06/30/08	78%
PA3515	Greensburg 2 E	1,230	01/01/90–06/30/08	32%
PA4214	Indiana 3 SE	1,102	01/01/90–06/30/08	30%
PA8589	Strongstowm	1,880	01/01/90–06/30/08	46%
PA6111	Murrysville 2 SW	860	01/01/90–06/30/08	58%
PA4390	Johnstown 2	1,280	01/01/90–10/31/03	35%
367863	Schenley Lock 5	783	01/01/90–06/30/08	98%
367782	Salina 3W	1,109	01/01/90–06/30/08	100%
367338	Rector 3 SSW	1,330	05/01/91–06/30/08	90%
362183	Donegal 2 NW	1,800	01/01/90–06/30/08	85%

The data obtained were subjected to a QA/QC regime that identified gaps in data that might misrepresent observed conditions. An effort was made to select weather stations with a high level of completeness. However, data time series had various intervals of accumulated, missing, or deleted data. In such instances, rainfall patching was performed to ensure proper representation. Patching involves using the normal-ratio method, which estimates a missing rainfall record with a weighted average from surrounding stations with similar rainfall patterns. Accumulated, missing, and deleted data records are repaired on the basis of hourly rainfall patterns at nearby stations with unimpaired data. Figures 5-4 and 5-5 are examples of precipitation time series that have been patched for missing and accumulated data, respectively. Notice in Figure 5-5 that where no hourly data are available to disaggregate the accumulated data (October 14, 1999), a normal distribution is assumed.

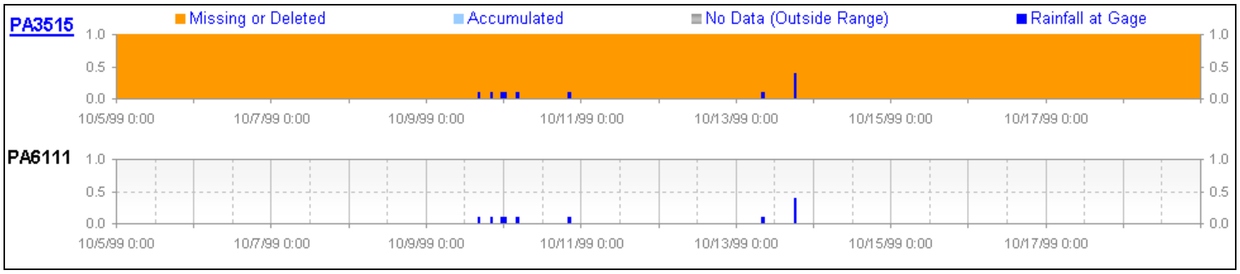

Figure 5-4. Example of Patched Missing Time Series.

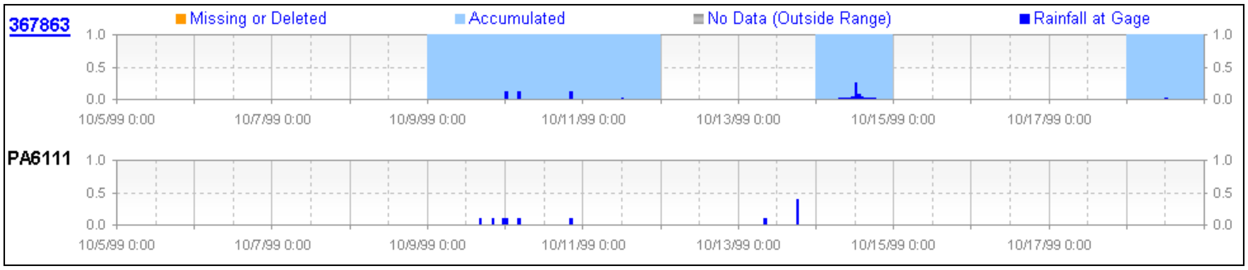

Figure 5-5. Example of Patched Accumulated Time Series.

5.2.4. Hydrologic Representation

Hydrologic representation refers to the MDAS modules or algorithms used to simulate hydrologic processes (e.g., surface runoff, evapotranspiration, and infiltration). The MDAS 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 5-6. Typically, clay soils that are poorly drained, have the worst infiltration rates (D soils), while 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 5-6. 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 every MUID soil mapping unit in the watershed. This hydrologic group served as a starting point for the designation of infiltration and ground water flow parameters during the MDAS setup.

Table 5-6. NRCS Hydrologic Soil Groups

Hydrologic Soils 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.

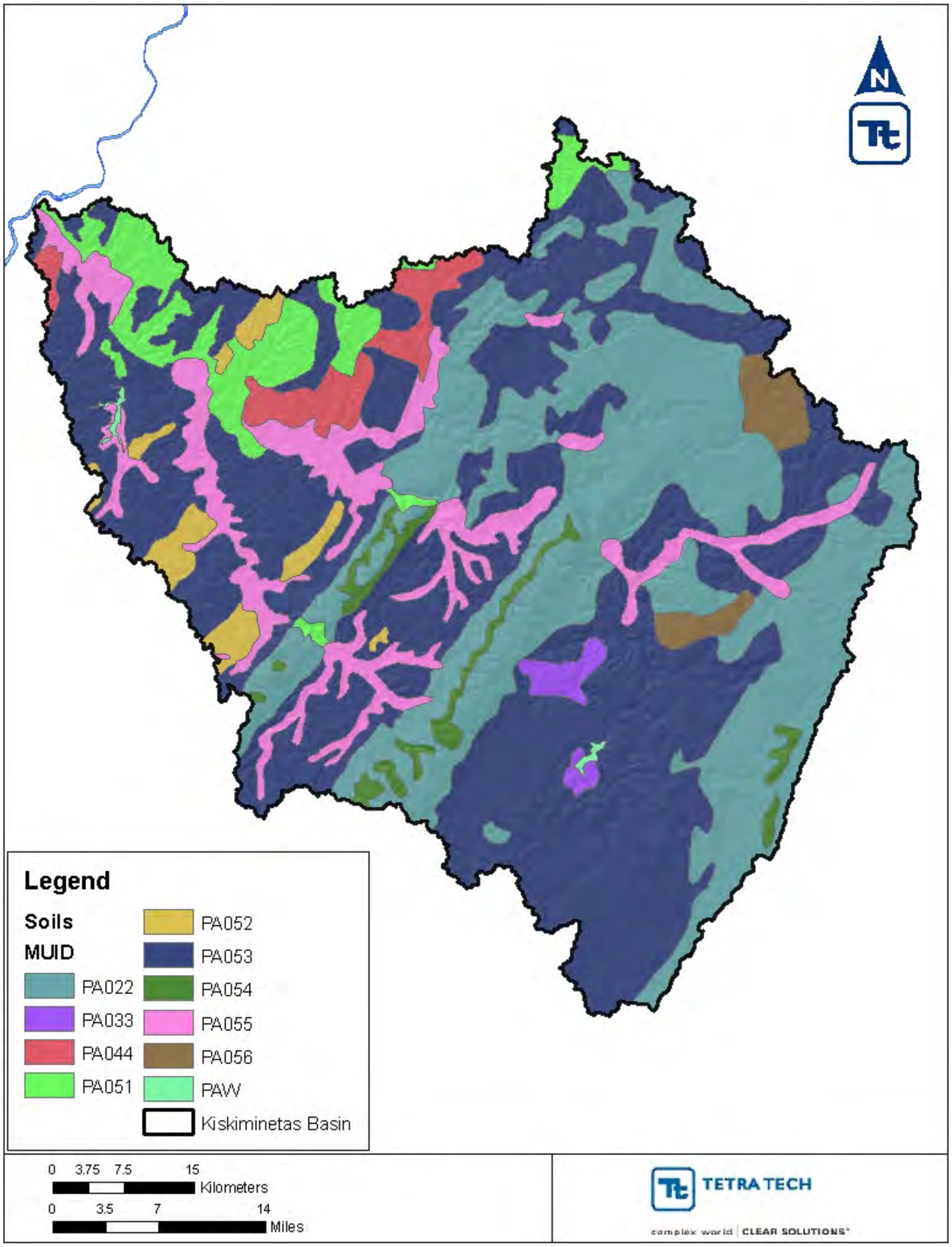

Figure 5-6. STATSGO Soil MUID Groups in the Kiskiminetas River Watershed.

5.2.5. *Pollutant Representation*

An analysis of the water quality data and a review of previous studies indicate possible nonpoint sources of metals, including AMD and soils high in metals content. Point sources also contribute to loading of metals in the watershed. The primary pollutants represented in the watershed model to estimate loading included sediment, aluminum, iron, and manganese.

Point Source Representation

Point source contributions of flow, sediment, aluminum, iron, and manganese were incorporated into the model to represent the sources described in Section 3. For non-mining 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 MDAS model, and hours between monthly monitoring data points were linearly interpolated if the actual data were used. Permitted flows and limits, or water quality endpoints, were used when DMR information was not available.

For permits with stormwater outfalls, the stormwater outfall drainage area was obtained or estimated to determine a flow under precipitation events. Stormwater outfall drainage area was available for many industrial facilities and can be found in Appendix C on the 'Non-mining Facilities' tab, though some facilities have little information available for characterizing the quality and quantity of outflows. For the TMDL, dischargers were represented using available or representative flows and water quality was simulated using available water quality limits or TMDL endpoints. Calculations to develop stormwater WLA's are further described in the Section 6.4.4.

Two types of mining permits were represented in the model: surface mines and deep mines. Flow information was not available for these permits. Surface mines and deep mines were represented in the model by two different methods. Point source discharges from surface mines were represented in the model as land uses. This is because discharges from such facilities are precipitation-induced and vary depending on precipitation patterns. Discharges from permitted deep mines were simulated in the model as point sources. To do this, an estimated flow of 0.5 gallon per minute per acre was assigned to deep mines. In addition to deep mines, orphan mines were simulated in the model as constant point sources on the basis of flow and water quality information obtained from PADEP. These seeps from the orphan mines are listed in Appendix G on the "AML_Discharges (Seeps)" tab. Modeling discharges as a point source or nonpoint source is not a determination that an NPDES permit is or is not required.

Because of the large number of permitted outfalls, these facilities are presented in Appendix C, along with the flow and metals concentrations.

Nonpoint Source Representation

Land Use

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 dataset based on MRLC's 2001 NLCD land use coverage was used to configure the model. MDAS model algorithms that simulate hydrologic and pollutant loading processes for pervious and impervious lands were then applied to the corresponding land units.

Sediment

Loading processes for sediment were represented for each land unit using the MDAS SEDMNT (simulation of sediment for pervious land segments) and SOLIDS (simulation of sediment for impervious land segments) modules, which are identical to those in HSPF. Sediment erosion from pervious land areas is represented as the net mass of soil particles detached from the land surface by rainfall and transported by overland flow. An unlimited reservoir of sediment is assumed for pervious surfaces. On impervious surfaces, sediment loadings are determined by an estimated rate of soil particle accumulation, which is available for transport during rainfall events.

Sediment loadings to the stream channel are estimated by land use category and are represented as the sum of three particle size fractions--sand, silt, and clay. Model parameters are closely related to the factors of the USLE (Wischmeier and Smith 1978). In addition to sediment loadings simulated as the result of soil detachment, MDAS allows for the specification of fixed event mean concentrations (EMCs).

Metals

Loading processes for non-sediment pollutants were represented for each land unit using the MDAS 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 EMC in land segment outflow, or a combination of the three.

Aluminum, iron, and manganese were modeled as sediment-associated pollutants. Potency factors were assigned to model land uses that define the mass of metals per ton of sediment generated during a storm event. As rainfall erodes sediment from the land surface, the metals are mobilized with the sediment and discharged to receiving waters. Initial parameter values used to estimate potency factors were based on metals-TSS regression correlations. These values served as starting points for water quality calibration. The appropriateness of the values to the Kiskiminetas River watershed was validated through comparison to local water quality data during the calibration process (described in Section 5.3).

5.2.6. Dissolved Iron Representation

Figure 5-7 shows the limited availability of dissolved iron data for the entire watershed. Dissolved iron data were obtained from the NPS through EPA’s STORET online database. PADEP does not routinely sample for dissolved iron therefore data was not available. STORET data were available for only the Little Conemaugh River and the South Fork of the Little Conemaugh River watersheds. The PADEP dissolved iron criterion is 0.3 mg/L for potable water supply (PWS). Available data were compared to this criterion and exceedences were noted from the Little Conemaugh River, Sulphur Run, Spring Run, and an unnamed tributary to Trout Run. To appropriately address dissolved iron violations in these areas, it was necessary to use the aqueous chemical reaction module in MDAS to represent instream iron speciation. The module simulates the concentrations for different chemical species and pH, and if metals become supersaturated, the model precipitates the metals out of solution. The aqueous chemical reaction module is based on a chemical speciation model, MINEQL (Westall et al. 1974). MINEQL uses the same numerical solution method used for EPA’s MINTEQA4 (Allison et al. 1991). EPA is only able to develop TMDLs for streams with violations (Little Conemaugh River, Sulphur Run, Spring Run, and an unnamed tributary to Trout Run); and EPA is not able to develop TMDLs for the remainder of the watershed where violations of the dissolved iron criterion have not been observed. This is further discussed in Section 6.4.2.

This methodology was used in dissolved iron impaired watersheds with mining-related sources. To establish the linkage between instream dissolved iron concentration and various iron sources in the watershed, the MDAS model was first set up and calibrated to simulate instream concentrations of total metals (iron, aluminum, and manganese). Once calibration was complete, the total chemical concentration and flows time series generated by MDAS are used as inputs for the aqueous chemical reaction modules’ pollutant transformation and transport routines. The modules simulate soil subsurface and instream chemical reactions, assuming instant mixing and concentrations equally distributed throughout soil and stream segments. The model supports major chemical reactions, including acid/base, complexation, precipitation, and dissolution reactions and some kinetic reactions, if selected by the user.

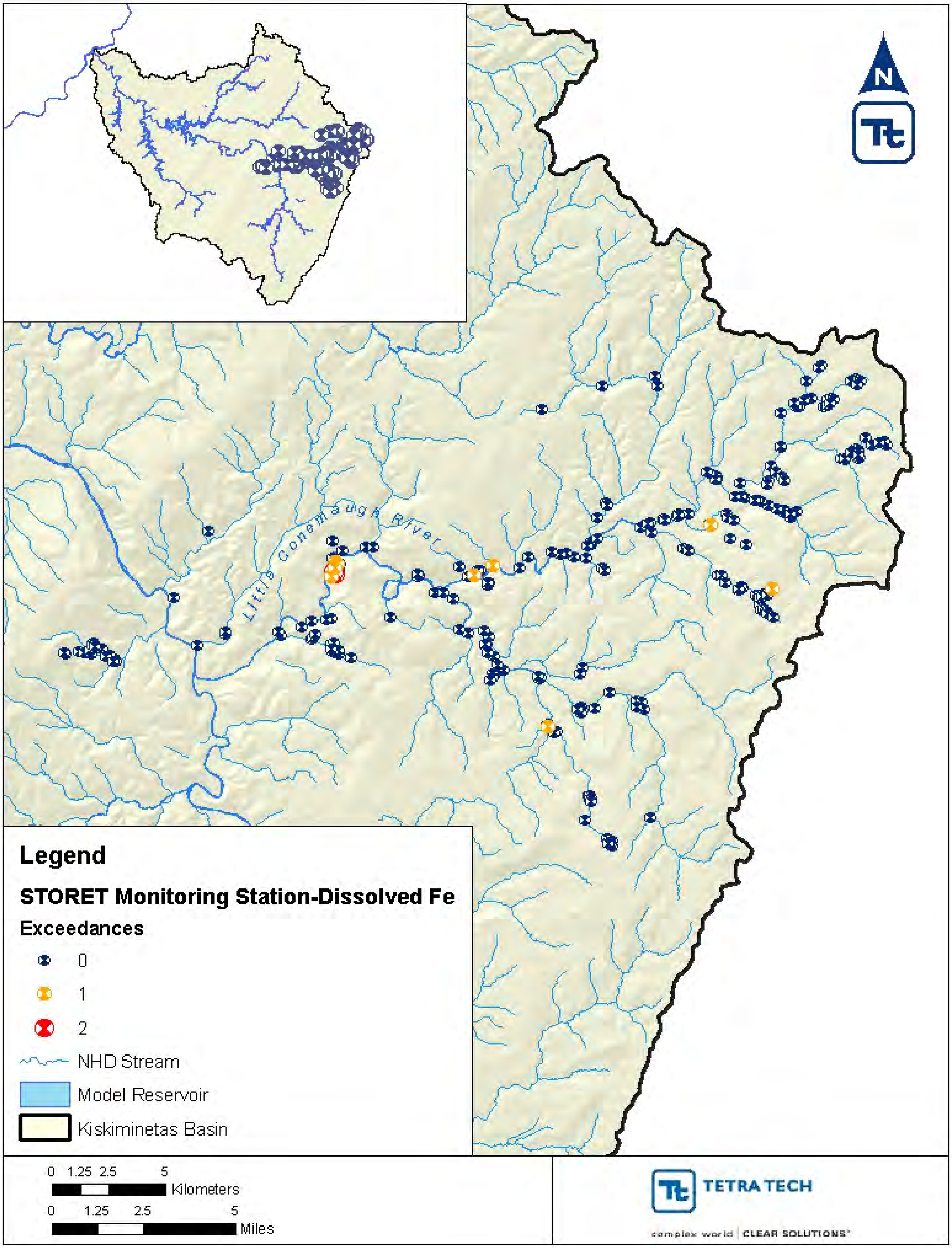

Figure 5-7. Locations of Dissolved Iron Monitoring Data.

5.2.7. pH Representation

With respect to AMD, pH is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near-neutral pH (7.0) but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions can become acidic after oxidation and precipitation of the iron (PADEP 2000). Therefore, a more practical approach to meeting the water quality criteria for pH is to use the concentration of metal ions as a surrogate for pH. It was assumed for these TMDLs that reducing instream concentrations of dissolved metals (iron, aluminum, and manganese) to meet water quality criteria (or TMDL endpoints) would result in meeting the water quality standard for pH. This assumption was verified by applying the model. By executing the model under TMDL conditions (conditions in which TMDL endpoints for metals were met), the equilibrium pH could be predicted.

Streams affected by AMD often exhibit high dissolved metal concentrations, specifically for iron and aluminum, along with low pH. The relationship between these metals and pH provides justification for using metals TMDLs as a surrogate for a separate pH TMDL calculation. Figure 5-8 shows three representative physical components that are critical to establishing this relationship.

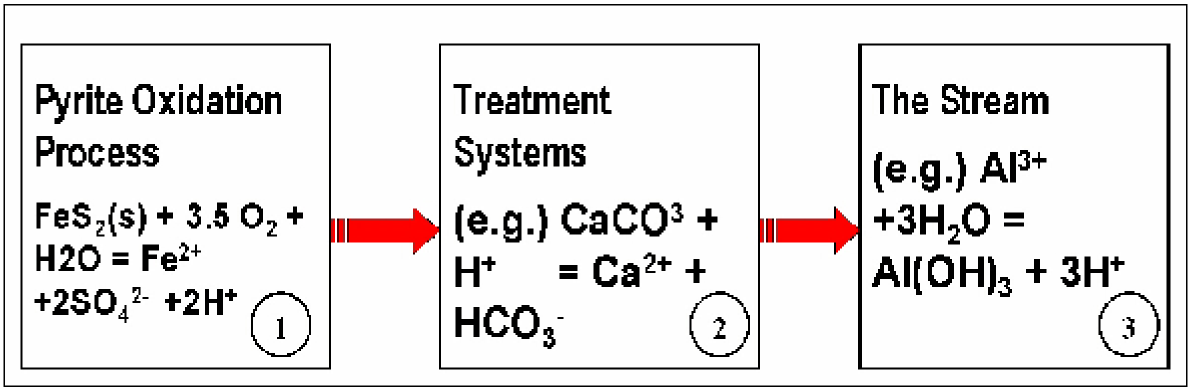

Figure 5-8. Three physical components of the relationship between high metals and pH.

Note: Several major ions compose the water chemistry of a stream. The cations are usually Ca^{2+}, Mg^{2+}, Na^+, K^+, and H^+, and the anions consist of HCO_3^-, CO_3^{2-}, NO_3^-, Cl^-, SO_4^{2-}, and OH^- (Stumm and Morgan 1996).

Component 1 in the figure describes the beginning of the pyrite (FeS_2) oxidation process, which results from the exposure of pyrite to water (H_2O) and oxygen (O_2). This process is common in mining areas. The kinetics of pyrite oxidation processes are also affected by bacteria (*Thiobacillus ferrooxidans*), pH, pyrite surface area, crystallinity, and temperature (PADEP 2000). The overall stoichiometric reaction of the pyrite oxidation process is as follows:

$$FeS_2(s) + 3.75O_2 + 3.5H_2O \rightarrow Fe(OH)_3\ (s) + 2SO_4^{2-} + 4H^+$$

Component 2 presents an example chemical reaction occurring in a mining treatment system. Examples of treatment systems are wetlands, successive alkalinity-producing systems, and open limestone channels. Carbonate and other bases (e.g., hydroxide) created in treatment systems consume hydrogen ions produced by pyrite oxidation and hydrolysis of metals, thereby increasing pH. The increased pH of the solution precipitates metals as metal hydroxides. Treatment systems might not necessarily work properly, however, because the removal rate of metals, and therefore the attenuation of pH, depends on the chemical constituents of the inflow, the age of the systems, and the physical characteristics of the systems, such as flow rate and detention rate (West Virginia University Extension Service 2000).

It is assumed that implementing TMDLs for total aluminum, iron, and manganese will result in instream dissolved metals concentrations that meet the pH water quality criteria. This assumption is based on the assumption that treatment systems will be implemented properly and will effectively increase pH to precipitate metals and thereby lower their instream concentrations. After treatment, the focus shifts to Component 3 and the relationship between metals concentrations and pH in the stream. The chemical process that needs to be considered is the hydrolysis reaction of metals in the stream. Component 3 presents an example of this reaction. To estimate the pH resulting from chemical reactions occurring in the stream, MINTEQA2, a geochemical equilibrium speciation model for dilute aqueous systems, was used.

5.2.8. MINTEQA2 Application

MINTEQA2 is an EPA geochemical equilibrium speciation model capable of computing equilibrium aqueous speciation, adsorption, gas phase partitioning, solid phase saturation states, and precipitation-dissolution of metals in an environmental or lab setting. The model includes an extensive database of reliable thermodynamic data. The MINTEQA2 model was run using the inputs shown in Table 5-7.

Table 5-7. Input Values for MINTEQA2

Species	Input values (mg/L)
Ca	36.64
Mg	10.59
Na	11.44
K	2.07
Cl	3.61
SO_4	210.84
Fe[a]	1.5 0.212 (HQ/EV)
Al [a]	0.75 0.231 (HQ/EV)
Mn[a]	1.0

Notes:
[a] Allowable maximum concentrations
Total carbonates estimated from Ca and Mg ions.

Input values for aluminum, iron, and manganese were based on TMDL endpoints (maximum allowable limits). The alkalinity value was based on the geometric mean of observed instream concentrations in the Kiskiminetas River watershed. Similarly, the geometric means of observation values were used for the remaining ions requiring input for MINTEQA2. Where observation data were not available, literature values were used for the chemical species. Additionally, the model was set to equilibrium with atmospheric carbon dioxide (CO_2). On the basis of the inputs presented, the resultant equilibrium pH was estimated to be 8.57 using the aquatic life water quality criteria for total iron and total aluminum and 8.59 using the HQ or EV criteria.

Results from MINTEQA2 imply that pH will be within the criterion of above 6.0 and below 9.0 (inclusive) if instream metals concentrations simultaneously meet applicable water quality criteria. Once instream metal concentrations are within water quality criteria, natural alkalinity in the Kiskiminetas River watershed will also help to resolve pH impairments.

5.2.9. *Assumptions*

The chemical processes generating AMD and the processes to treat AMD are subject to many variables that might or might not be addressed in the chemical equations. Some of these variables are discussed below.

Iron

It was assumed that that ferric iron (Fe2+), the oxidized state of iron, is the dominant form of iron using the assumption that the stream will be in equilibrium with the atmospheric oxygen. The reduced state of iron, ferrous iron, can be oxidized to ferric iron through abiotic and biotic oxidation processes in the stream. The first process refers to oxidation by increasing the dissolved oxygen through the mixing of flow. The other process is oxidation by microbial activity in acidic conditions on bedrock (McKnight and Bencala 1990). Photoreduction of hydrous oxides can also increase the dissolved ferrous form. This reaction could increase the pH of the stream followed by oxidation and hydrolysis reactions of ferrous iron (McKnight et al. 1988). Because water quality data are limited, the concentration of total iron was assumed constant at 1.5 mg/L, and it was assumed that the total iron increase by photoreduction would be negligent. This assumption could ignore pH changes during daytime.

Sodium, Potassium, and Chloride

The concentrations of sodium, potassium, and chloride can be higher in streams affected by AMD. These ions are conservative and are not reactive in natural water, so it is likely that the pH of the stream would not be affected.

Calcium and Magnesium

Lack of specific water quality data (including calcium and magnesium ions) from streams not impacted by acid mine drainage (AMD) limited the ability to characterize natural buffering capacity in the Kiskiminetas watershed. Calcium and magnesium ions from non-impacted areas may exist in higher concentrations than the values used for the modeling in this study because of the dissolution of minerals under acidic conditions that are caused by acid mine drainage. Furthermore, the presence of AMD treatment systems could increase the concentrations of these ions in the stream which could result in more complex forms with sulfate. It was assumed that the uncertainty of calcium and magnesium ion concentration had a negligible effect on pH.

Manganese

Manganese oxide (MnO_2) can have a reduction-oxidation reaction with ferrous iron and produce ferric iron (Evangelou 1998). This ferric iron can then undergo a hydrolysis reaction and produce hydrogen ions, thereby decreasing pH.

Biological Activities

Biological activities such as photosynthesis, respiration, and aerobic decay can influence the pH of localized areas in the stream. These reactions include the reaction of CO_2 and oxygen, such as the following:

$$CO_2 + H_2O \leftrightarrow 1/6\ C_6H_{12}O_6 + O_2$$

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. Validation is performed for different monitoring stations without further adjustments to ensure the model represents other locations as well as it does at the original calibration locations and periods.

5.3.1. Flow Calibration and Validation

Hydrologic calibration was performed after the initial model setup. The years 1998–2006 were used to calibrate and validate the model, and six USGS flow gaging stations and the Conemaugh Dam outfall were selected as assessment points. Calibration was performed at three USGS gages--03045000, 03042000, and 03040000. These gages were selected as calibration points because they represent relatively upstream locations characterized by predominantly rural drainage areas (forest and agricultural land uses) with low percent imperviousness. This allowed for the adjustment of surface and subsurface hydrologic parameters without the *noise* generated by impervious urban land areas.

Stream flow data available at USGS gages 03048500, 03045000, 03041500, and 03042500 and the Conemaugh Dam outfall were used to validate the model. The USGS gage points of assessment represent downstream watershed locations and capture the overall hydrological conditions of the Kiskiminetas River watershed, including rural and urban areas and the effects of reservoir impoundments. Validation at the Conemaugh Dam outfall also allowed for the direct analysis of model reservoir representation. Selection criteria for the calibration and validation periods are discussed below.

Calibration and validation years were selected after examining annual precipitation variability and the availability of observation data. The periods were determined to represent hydrologic conditions common to the region with respect to seasonal flow regimes. Calibration for these conditions is necessary to ensure that the model accurately predicts the seasonal range of conditions over the entire simulation period. The average annual rainfall for 1990–2007 is 37.1 inches per year, and the annual total ranges from 24.6 to 53.5 inches per year. The period 1998–2006 was selected as the calibration period on the basis of its average annual rainfall of 33.8 inches, which is equal to the average rainfall value between 1990 and 2004. In addition, flow data are available from four locations in the watershed during this period (see Table 2-1).

Designation of key hydrologic parameters in the PWATER and IWATER modules of MDAS was required. These parameters are associated with infiltration, ground water flow, and overland flow. The STATSGO soil groups served as a starting point for the designation of infiltration and ground water flow parameters. For parameter values not easily derived from these sources, documentation on recent HSPF applications was reviewed. Starting values were refined through the hydrologic calibration process.

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. An attempt was made to keep the modeling parameters within the guidelines included 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. The calculation of 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 and a water budget analysis are shown in Figure 5-9 and Table 5-8, respectively. Complete hydrology calibration results are included in Appendix E.

Overall, the calibrated model predicted the watershed water budget well. All calibration and validation locations showed the modeled water budget to be within nine 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 gages. Since 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 gage stations.

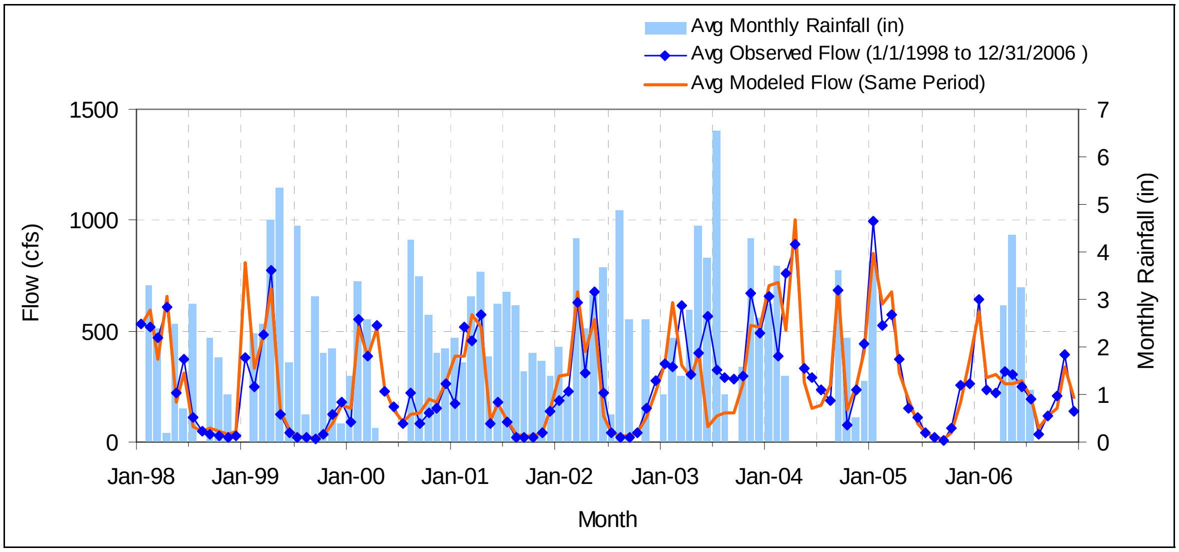

Figure 5-9. MDAS Hydrology Calibration 1998–2006 at USGS 03042000: Backlick Creek.

Table 5-8. Water Budget Statistical Comparison 1998–2006 at USGS 03102850: 03042000: Backlick Creek at Josephine, Pennsylvania

Simulated Versus Observed Flow	Percent Error	Recommended Criterion[a]
Error in total volume	-8.16%	10
Error in 50% lowest flows	10.53%	10
Error in 10% highest flows	-0.71%	15
Seasonal volume error - summer	-7.38%	30
Seasonal volume error - fall	-9.70%	30
Seasonal volume error - winter	-6.26%	30
Seasonal volume error - spring	-10.15%	30
Error in storm volumes	9.89%	20
Error in summer storm volumes	3.25%	50

[a] Recommended criterion: HSPEXP.

5.3.2. Water Quality Calibration and Validation

Significant amounts of monitoring data were necessary to calibrate the sediment and water quality portions of the model. Available monitoring data in the watershed were identified and assessed for application to calibration. The data collected by PADEP in 2007–2008 provided the most recent water quality data as well as good spatial coverage. Stations with five or more recorded samples and located at or near the outlet of a subwatershed were used for calibration.

The period selected for water quality calibration, July 1, 2007 through June 30, 2008, was the period for which pre-TMDL monitoring data were available. Permitted dischargers that were issued permits after the calibration period were not considered during the calibration process.

Sediment Calibration

Nonpoint source sediment production is directly related to the intensity of surface runoff. Sediment yield varies by land use and the soil characteristics of the land segment and is delivered to the streams through surface runoff erosion. Once sediment reaches the stream channel, it can be transported, deposited, and scoured, depending on the sediment size and flow energy.

MDAS sediment land use parameters are closely related to the factors of the USLE (Wischmeier and Smith 1978), which served as the basis for designating related soil detachment and washoff parameters. Sediment parameters are included in the SEDMNT and SOLIDS modules, which are identical to those in HSPF.

Appropriate values were assigned to land segments on the basis of the sediment-producing capabilities of the land cover and hydrologic soil group. EMCs were applied to represent background concentrations not captured by the discrete erosive processes simulated by the model for the range of flow conditions. All sediments and soils represented in the model are assigned particle class fractions (e.g., % sand, silt, clay). Analysis of the distribution of STATSGO soil groups in the watershed was used to estimate the particle class fractions of eroded upland soils.

Model results indicate that all the sediment-impaired streams exhibited impairments pursuant to total iron water quality criteria and that the sediment reductions needed to ensure compliance with iron criteria exceed those necessary to resolve the impairments. As such, the iron TMDLs presented for the listed waters are being used as surrogates for necessary sediment TMDLs. For a comparison of sediment reductions needed to attain iron criteria with those needed to resolve impairment under the reference watershed approach, see Section 6.4.1. For the metal and TSS relationship plots, see Appendix H.

Water Quality Calibration

Iron, manganese, and aluminum loads are delivered to the tributaries with surface runoff, subsurface flows, and direct point sources. Sediment-producing land uses and bank erosion are also sources of iron and aluminum because these metals are associated with sediment. MDAS provides mechanisms for representing all these various pathways of pollutant delivery.

A detailed water quality analysis was performed using statistically based load estimates with observed flow and instream monitoring data. The confidence in the calibration process increases with the quantity and quality of the monitoring data. The PADEP pre-TMDL data provide very good spatial and temporal coverage of water quality data.

Statistical analyses using pre-TMDL monitoring data collected throughout the Kiskiminetas River watershed were performed to establish the correlation between metals loads and sediment loads and to evaluate spatial variability. The results were then applied to the sediment-producing land uses during the water quality calibration. The results of the correlation analysis are shown in Appendix H.

In addition, non-sediment-related iron, manganese, and aluminum land-based sources were modeled using average concentrations for the surface, interflow, and groundwater portions of the water budget. For these situations, discharges were represented in the model by adjusting parameters affecting pollutant concentrations in the PQUAL and IQUAL modules of MDAS.

For the permitted mining land-based sources, parameters developed from the Dunkard Creek (West Virginia) watershed model setup were initially used. Concentrations from these mines were adjusted to make them consistent with typical discharge characteristics from similar mining activities or to match site-specific, instream monitoring data.

For AML areas, parameters to simulate iron, manganese, and aluminum loads were developed by calibrating subwatersheds where the only significant source of metals were the AMLs.

To validate the sediment/metals model, daily average instream concentrations from the model were compared directly with observed data at several locations throughout the watershed. The goal was to confirm that low flow, mean flow, and storm peaks at water quality monitoring stations draining mixed land use areas were being represented. The representative stations were selected on the basis of location (distributed throughout the Kiskiminetas River watershed) and loading source type.

Seventeen Pennsylvania stations with recent data were used for water quality calibration and validation (Figure 5-10). The stations were selected on the basis of the quantity, age, and temporal resolution of data. Initial water quality calibration was conducted by varying the constituent concentrations in overland flow, interflow, and groundwater. 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 SC04 (Stonycreek River) are shown in Figures 5-11 through 5-13, and full water quality calibration results for the simulation are presented in Appendix F.

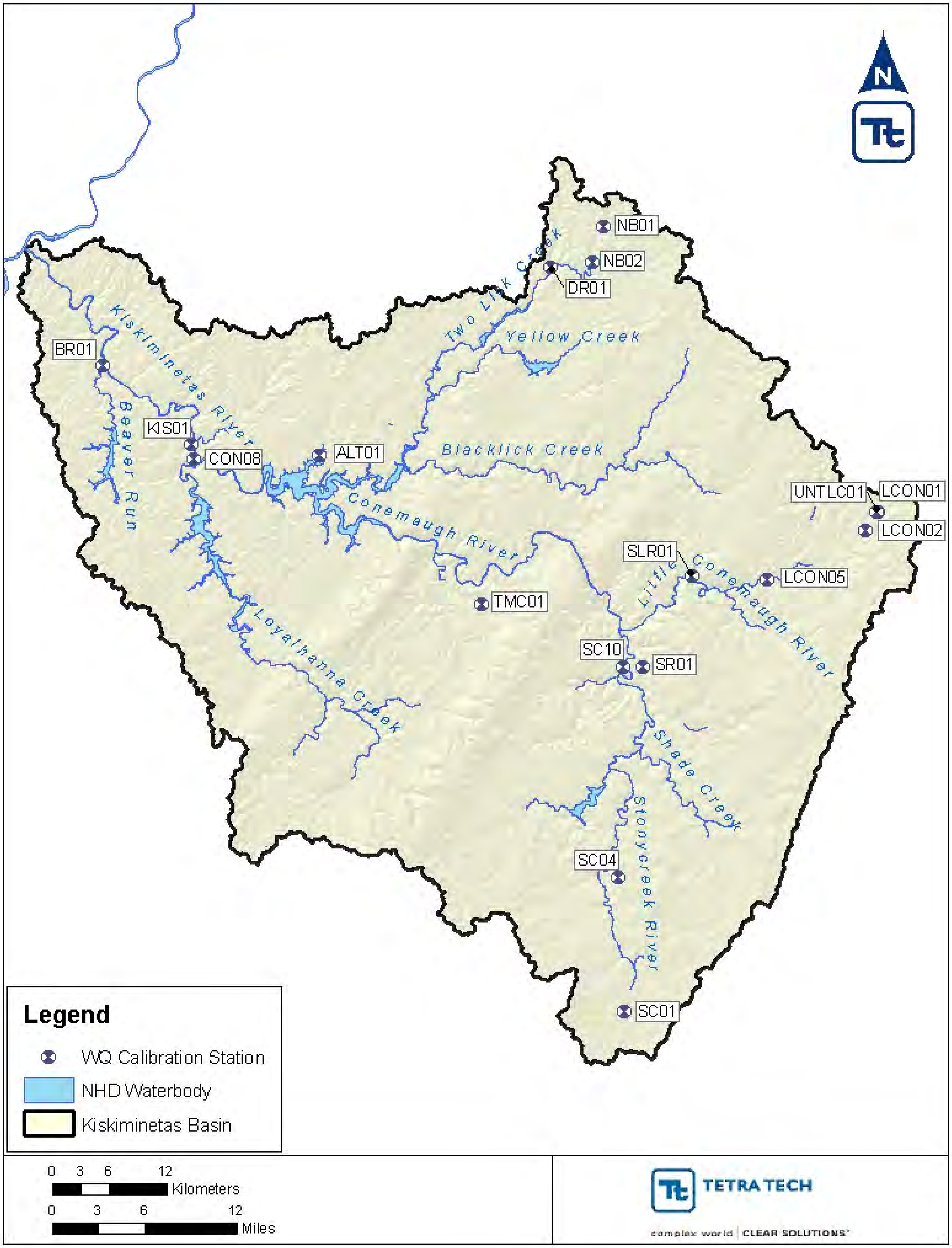

Figure 5-10. MDAS Water Quality Calibration and Validation Locations, PADEP WQN Stations.

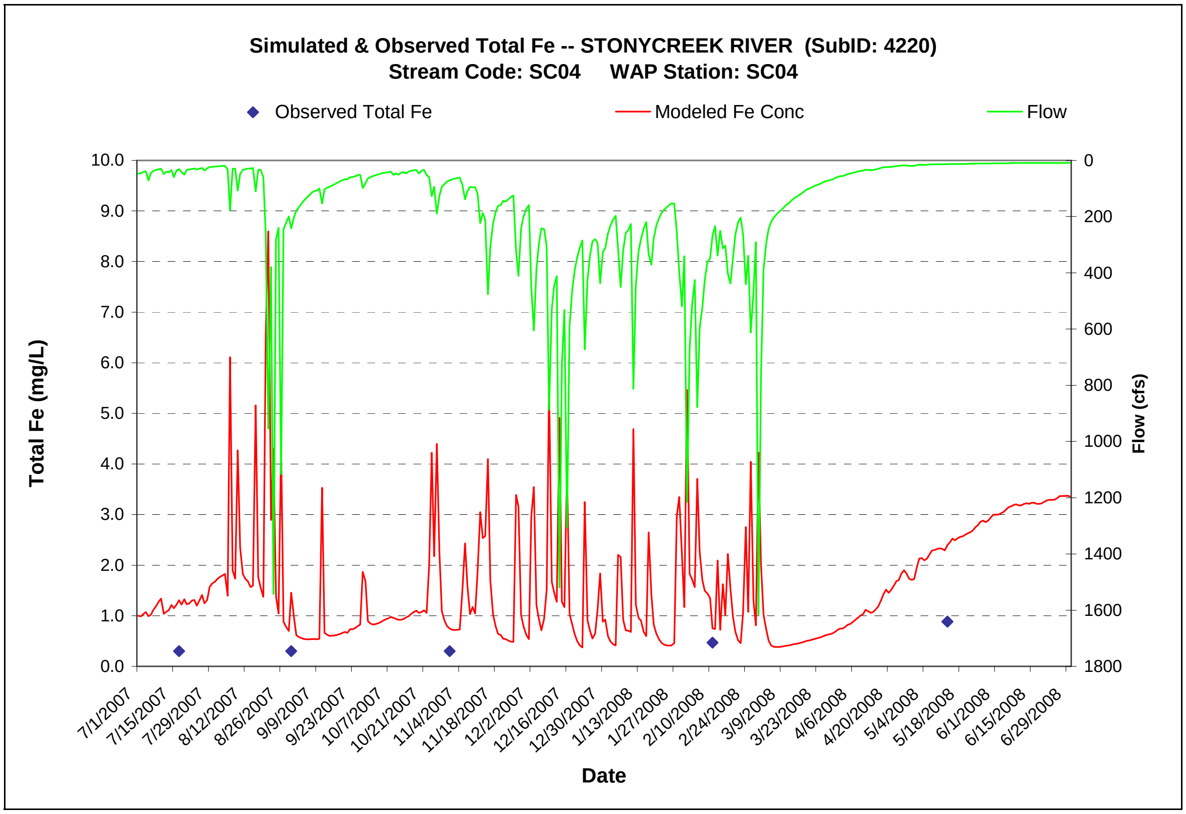

Figure 5-11. MDAS Water Quality Calibration for Iron at SC04, 2007–2008.

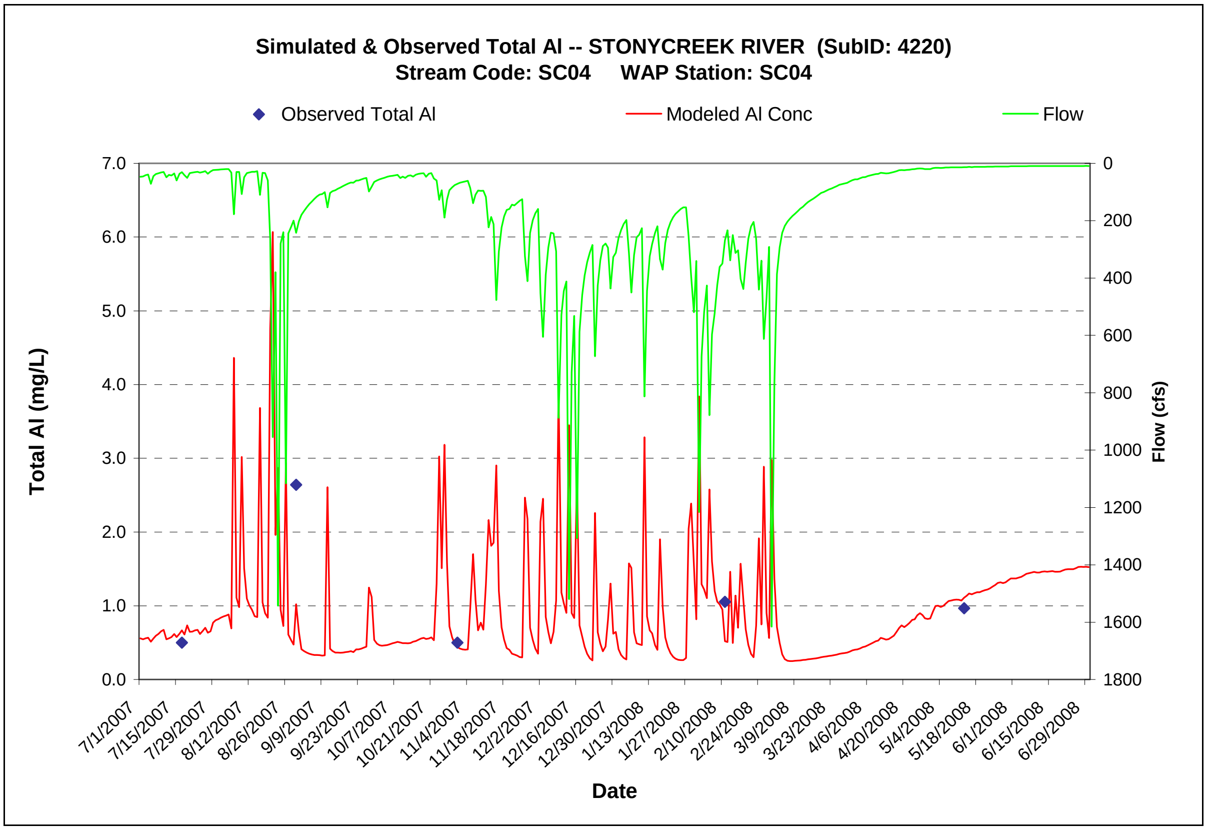

Figure 5-12. MDAS Water Quality Calibration for Aluminum at SC04, 2007–2008.

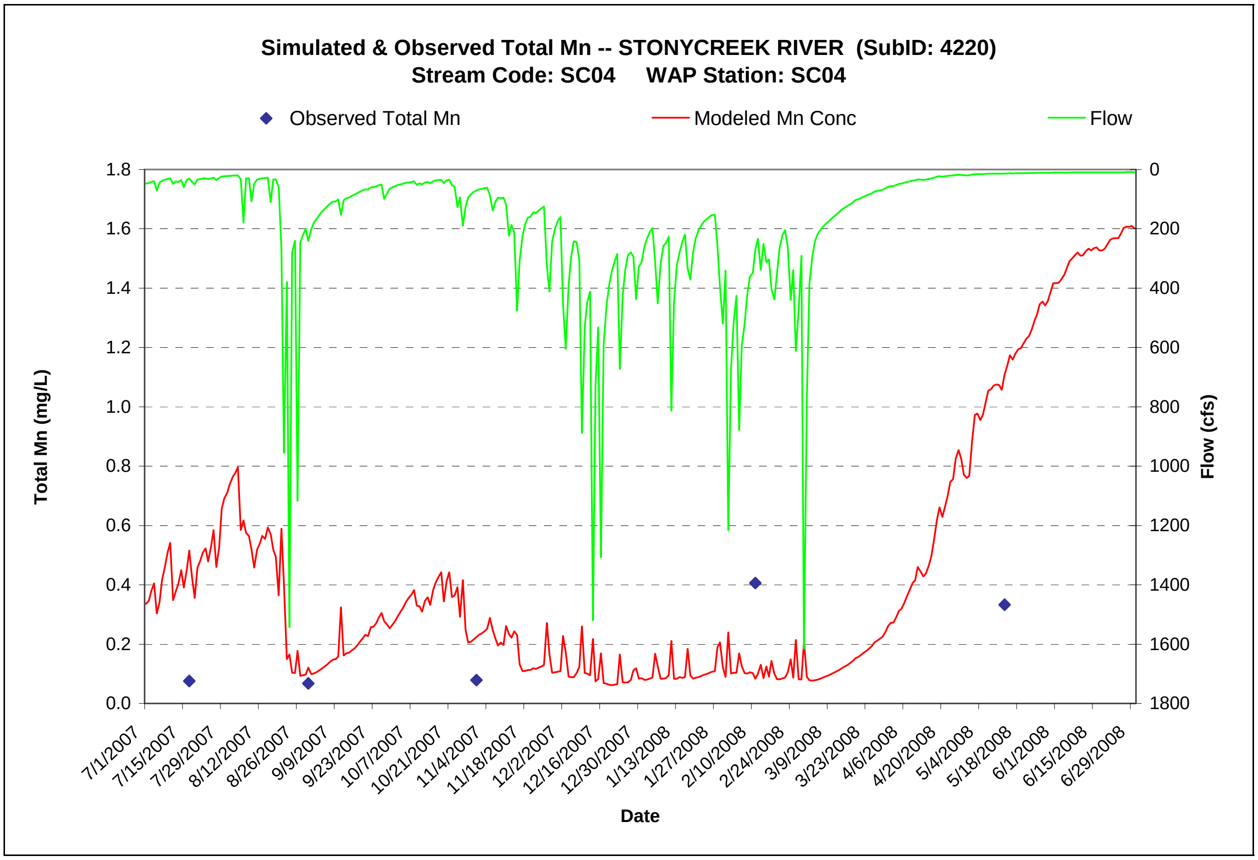

Figure 5-13. MDAS Water Quality Calibration for Manganese at SC04, 2007–2008.

5.3.3. MDAS Model Assumptions and Limitations

The major underlying assumptions associated with the Kiskiminetas River watershed model development are as follows:

- The impact of sediment transport and siltation on channel geometry is not significant.
- No significant vertical stratification is assumed in the stream reaches.
- Each MDAS reach is assumed to be completely mixed for water quality parameters.
- MDAS is a spatially lumped model and does not represent the spatial orientation of individual land uses within 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 within tributaries cannot be represented.

6. ALLOCATION ANALYSIS

A TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while still achieving water quality standards or goals. It is composed of the sum of individual WLAs for point sources and LAs for nonpoint sources and natural background levels. In addition, the TMDL must include an MOS, implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the 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). The state 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

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. In general, Pennsylvania's numeric water quality criteria for the subject pollutants and an explicit five percent MOS were used to identify endpoints for TMDL development. The five percent explicit MOS was used to counter uncertainty in the modeling process. Long-term water quality monitoring data were used for model calibration. Although these data represented actual conditions, they were not of a continuous time series and might not have captured the full range of instream conditions that occurred during the simulation period. The explicit five percent MOS also accounts for those cases in which monitoring might not have captured the full range of instream conditions. The TMDL endpoints for the various metals criteria are shown in Table 6-1.

Table 6-1. TMDL Endpoints

Water quality criterion	Designated use	Criterion value (mg/L)	TMDL endpoint (mg/L)
Total iron	CWF, TSF, WWF	1.5	1.425 (30-day average)
Total iron	HQ, EV	0.212	0.2014 (30-day average)
Total aluminum	CWF, TSF, WWF	0.75	0.7125
Total aluminum	HQ, EV	0.231	0.2195 (30-day average)
Total manganese	CWF, TSF, WWF	1.0	0.95
Dissolved iron	CWF, TSF, WWF	0.3	0.285

TMDLs are presented as average daily loads that were developed to meet TMDL endpoints under a range of conditions observed throughout the year. For most pollutants, analysis of available data indicated that critical conditions occur during both high and low-flow events depending upon specific sources and conditions in a given watershed. In some cases, a predominance of landbased sources may result in precipitation driven loading with critical conditions during high-flow events. In other areas, the predominance of continuous sources may result in critical conditions with low-flow events due to lack of dilution. In still other areas, where there may be a mix of significant landbased sources as well as significant point sources, whether permitted or AML, critical conditions may occur during both low and high-flow events due to the presence of both types of sources. During low-flow periods, continuous/point sources contribute to the critical loading, while during high-flows, 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 water quality criteria for pH require it to be above 6.0 and below 9.0 (inclusive). In the case of AMD, pH, is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near neutral pH (7.0), but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions and aluminum (Al^{3+}) ions can become acidic after oxidation and precipitation of the iron and aluminum (PADEP 2000). Therefore, a more practical approach to meeting the water standards of pH is to use the concentration of metal ions as a surrogate for pH. Through reducing instream metals, namely iron and aluminum, to meet water quality criteria (or TMDL endpoints), it is assumed that the pH will result in meeting the WQS. This assumption is based on the application of MINTEQA2, a geochemical equilibrium speciation model, to aqueous systems representative of waterbodies in the Kiskiminetas River watershed. By inputting into the model the total concentrations of metals, a pH value can be predicted. For a detailed description of the modeling, see Section 5.

6.2. Sediment Reference Watershed Approach

A reference watershed approach was used to identify sediment/TSS loading targets for sediment impaired reaches in the Kiskiminetas River watershed. The approach was based on selecting a non-impaired watershed that shares similar land use, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to be representative of the conditions needed for the impaired streams to attain their designated uses, and the normalized loading associated with the reference stream was used as the TMDL endpoint for the impaired streams. Given these parameters and on the basis of a recommendation by PADEP, the unimpaired portion of Loyalhanna Creek (above PADEP water quality station LH10) was selected as the reference watershed. The location of the reference watershed is shown in Figure 6-1.

Using the calibrated model, sediment loading rates were determined for the impaired and reference watersheds. Both point and nonpoint sources were considered in the analysis of sediment sources and in watershed modeling. Endpoints for impaired reaches were based on the reference watershed loading. Table 6-3 provides a subwatershed comparison of the target sediment loading rates associated with the iron TMDL and the target sediment loading rates associated with the reference watershed-based analysis. The sediment loading rate for Loyalhanna Creek, 4,015 tons/yr, was derived by modeling sediment loads from the existing landuses in the watershed and is considered a *target* loading rate based on its unimpaired status. The reference loading rates for the other subwatersheds were then derived from this target rate by normalizing for subwatershed size.

Sediment load reductions necessary to meet these endpoints were then determined. TMDL allocation scenarios were developed on the basis of EPA’s allocation approach to nonpoint sources described in Section 6.4. That is, sediment loads from sediment producing land uses were reduced to a maximum loading of 25 percent above background conditions (undisturbed forest). Sediment models were developed using the MDAS model that quantified land-based sediment loads. BASINS 4.0 and watershed data were used to develop the input data needed for modeling and TMDL development. Adequately representing erosion processes and nonpoint source loads in the watershed was a primary concern in selecting the appropriate modeling system.

After finalizing the modeling, the model results showed that (1) all the sediment-impaired streams exhibited impairments pursuant to total iron water quality criteria, and (2) the sediment reductions needed to ensure compliance with iron criteria exceed the sediment reductions needed to resolve biological impairments (based on the reference watershed approach). On the basis of that relationship, EPA determined that the iron TMDLs presented for the subject waters are appropriate surrogates for necessary sediment TMDLs. For affected streams, Table 6-3 contrasts the sediment reductions needed to attain iron criteria with those needed to resolve biological impairment under the reference watershed approach. Section 6.4.1 further describes the sediment allocations in this TMDL.

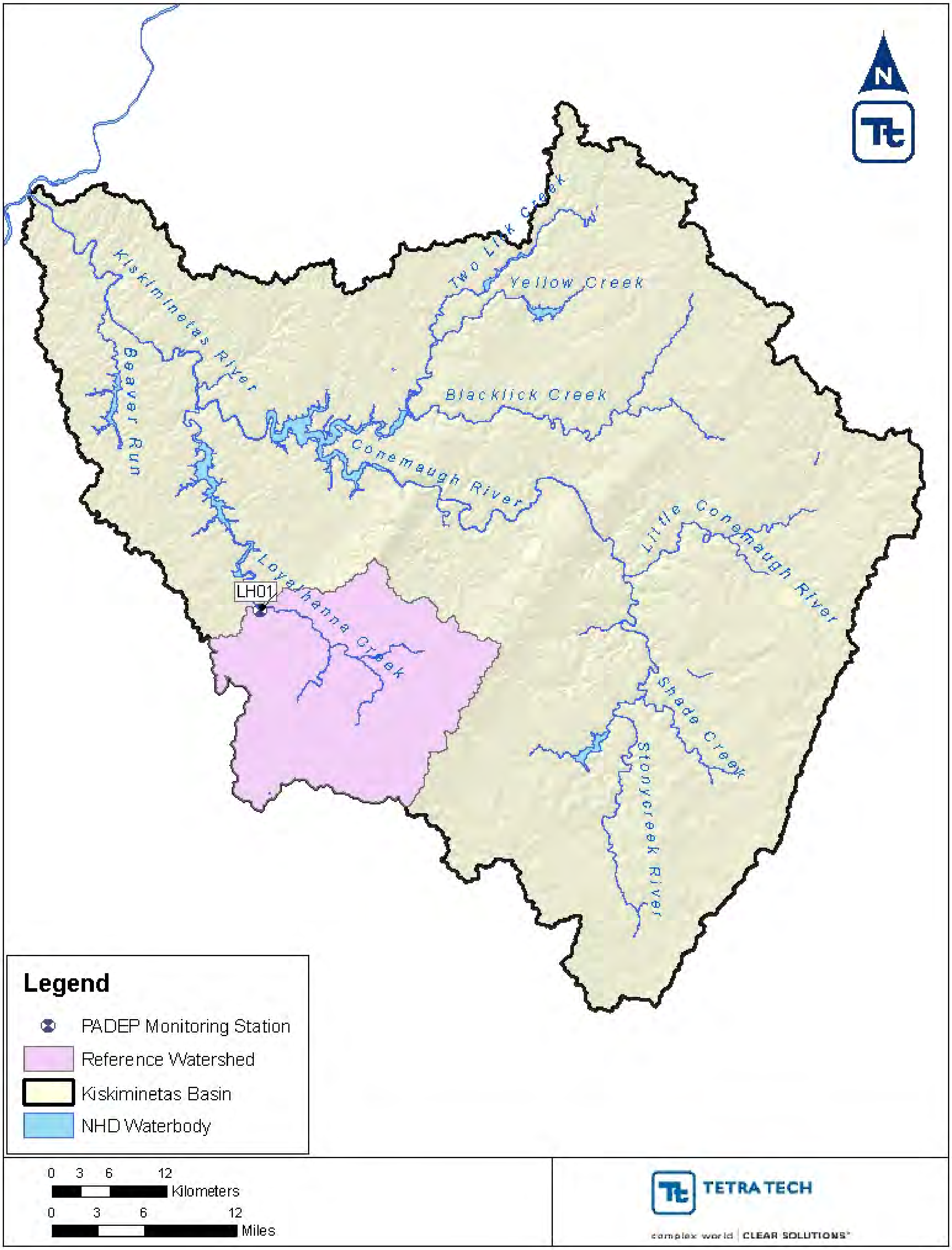

Figure 6-1. Location of the Loyalhanna Creek (LH10) Reference Watershed.

6.3. Baseline Conditions and Source Loading Alternatives

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 instream water quality under the highest expected loading conditions.

6.3.1. Baseline Conditions for MDAS

The MDAS model was run for baseline conditions using hourly precipitation data for a representative 6-year simulation period (January 1, 1998 through December 31, 2003) to capture a range of hydrologic conditions. The selection of this time period also considered the quality of continuous record precipitation data available from the nine stations shown in Figure 5-3. While the two year period prior to the selected simulation period included a high flow year (1996), the data record for several of the weather stations used to drive the modeling had significant gaps of recorded data as well as suspect or unverified data. Because of this missing data, 1996 was not included in the baseline simulation period. The precipitation experienced over the simulation period was applied to the land uses and pollutant sources as they existed at the time of TMDL development. Predicted instream concentrations were compared directly with the TMDL endpoints. This comparison allowed for evaluating the magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods. Figure 6-2 presents the annual rainfall totals for the years 1990 through 2006 at the Salina (367782) weather station. The red years, 1998 to 2003, indicate the range of precipitation conditions used for TMDL development in the Kiskiminetas River watershed.

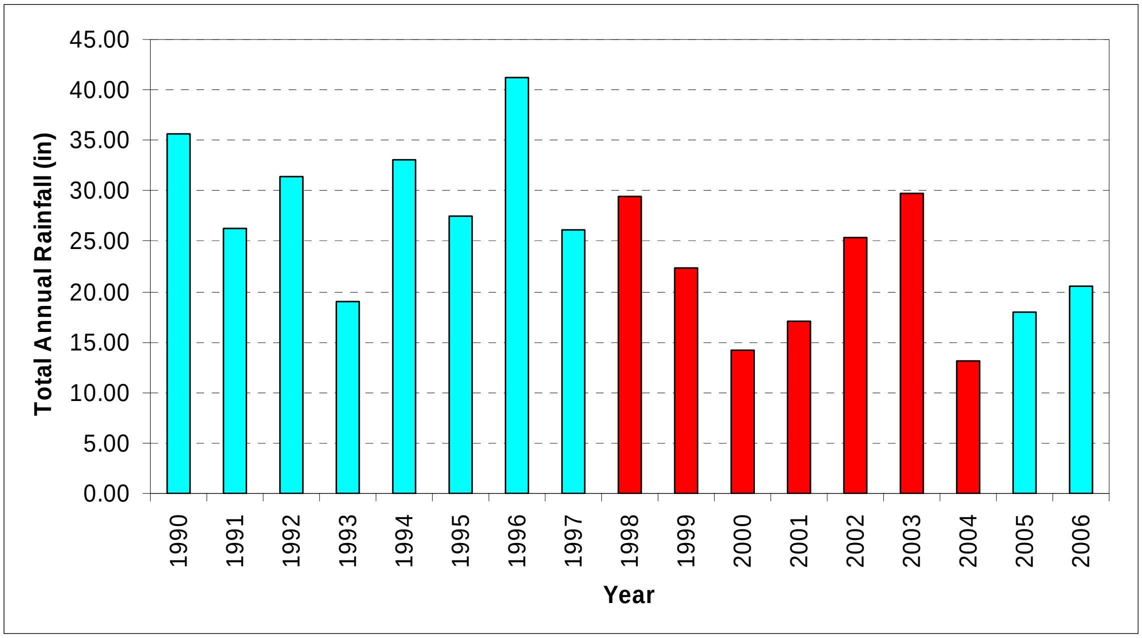

Figure 6-2. Annual Precipitation Totals for the Salina Weather Station.

Mining discharge permits either have technology-based or water quality-based limits. Average permit concentrations for technology-based limits are 3.0 mg/L monthly average and 6.0 mg/L daily maximum for total iron, 2.0 mg/L monthly average and 4.0 mg/L daily maximum for total manganese, and with no limits for total aluminum. Because the modeling approach is based on an hourly simulation—output on a daily basis—it was necessary to establish a single representative concentration for model point sources that is commensurate with the dual technology-based effluent limits, which specify both a long-term average (monthly average) and a short-term maximum (daily maximum). The average discharge concentration for modeled iron point sources was calculated as 3.2 mg/L using a statistical approach recommended in the *Technical Support Document for Water Quality-based Toxics Control* (TSD) (USEPA 1991 b). The TSD includes statistical methods that allow for identifying appropriate long-term average concentrations associated with corresponding daily maximum values. The average discharge concentration for modeled manganese sources was calculated as 2.0 mg/L using the same approach. Because there are no technology-based limits for aluminum, baseline conditions for aluminum were represented as 2.0 mg/L to be commensurate with the existing mining-related aluminum effluent limits in the Kiskiminetas River watershed. Mining discharges that are influenced by precipitation were represented during baseline conditions using precipitation, drainage area, and applicable effluent limitations. For non-precipitation-induced mining discharges, available flow or pump capacity information was used in conjunction with applicable effluent limitations.

The metals concentrations associated with common effluent limitations are presented in Table 6-2. The concentrations displayed in Table 6-2 accurately represent existing permit limits for the majority of mining discharges. In the limited instances where existing effluent limitations vary from the displayed values, the outlets were represented at the next higher condition. For example, existing iron effluent limits between 1.5 and 3.2 mg/L were represented at 3.2 mg/L.

Table 6-2. Concentrations used in Representing Permitted Conditions for Active Mining

Pollutant	Technology-based permits (mg/L)
Aluminum, total	2.0
Iron, total	3.2
Manganese	2.0

The baseline conditions for bond forfeiture sites were represented using precipitation, drainage area, and the technology-based effluent limitations for iron. AML seeps identified were represented as continuous discharges using estimated flows and pollutant concentrations from orphan mining sites provided by PADEP and were further refined during the water quality calibration process (see Appendix G, “AML_Discharges (Seeps)” tab).

Baseline conditions were also modified from calibration conditions with the removal of the Dumans Treatment Plant discharge from the model. The Dumans treatment plant was constructed by the Barnes and Tucker Coal Company in 1970 to treat its Lancashire No. 15 mine pool after a mine blowout. The Lancashire No. 15 mine complex straddles the continental divide between the Susquehanna and Allegheny River Basins. The Dumans treatment facility discharges to Crooked Run in the Blacklick Creek watershed. PADEP-BAMR and the Susquehanna River Basin Commission have approved plans to construct a new treatment facility known as Lancashire No. 15 that would treat the entire mine flow and divert treated flow to the West Branch of the Susquehanna River. With the relocation of the discharge to the Susquehanna River basin, PADEP expects to provide as much as ten million gallons per day (MGD) to the West Branch of the Susquehanna for agricultural consumption. As a result of this diversion, the Dumans Treatment Facility was used to calibrate current conditions; however, to reflect the future removal of the discharge from the watershed, the average flow of 7.4 MGD for this discharge has been removed for calculating baseline and TMDL allocations.

6.3.2. Source Loading Alternatives

Simulating baseline conditions allowed for evaluating each stream's response to variations in source contributions under a variety of hydrologic conditions. This sensitivity analysis gave insight into the dominant sources and the mechanisms by which potential decreases in loads would affect instream pollutant concentrations. The loading contributions from the various existing sources were individually adjusted; the modeled instream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies. Successful scenarios achieved the TMDL endpoints under all flow conditions throughout the modeling period. The averaging period and allowable exceedance frequency associated with Pennsylvania's water quality criteria were considered in these assessments. In general, loads contributed by sources that had the greatest effect on instream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, less significant source contributions were subsequently reduced. Figure 6-3 shows an example of model output for a baseline condition and a successful TMDL scenario.

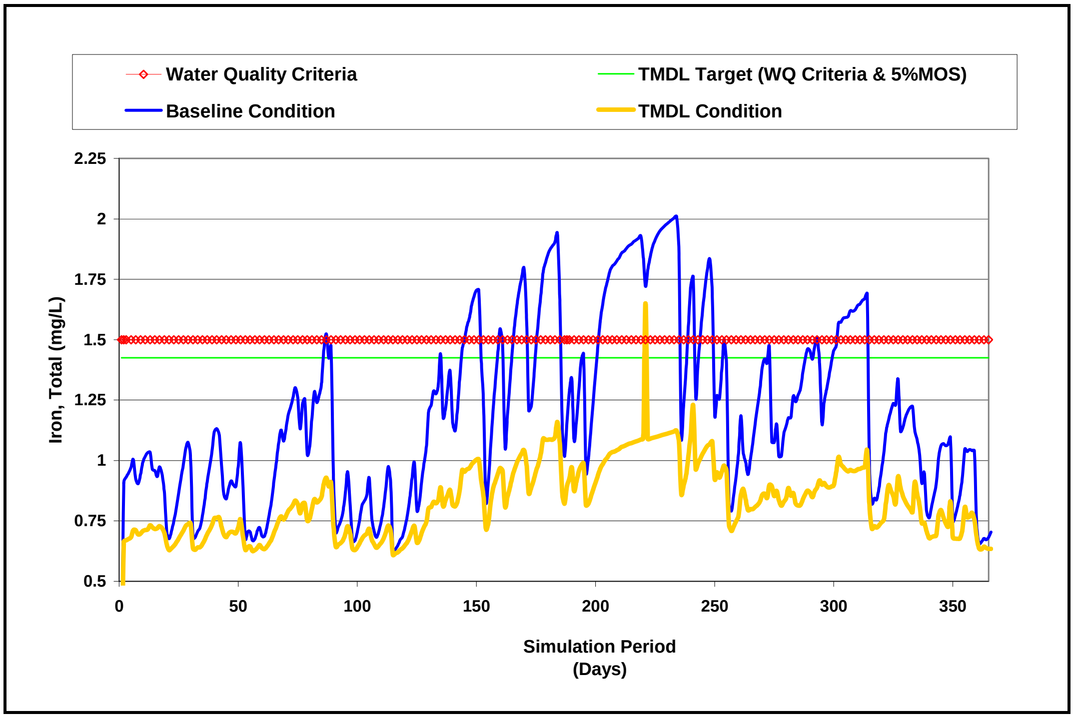

Figure 6-3. Example of Baseline and TMDL Conditions for Total Iron.

6.4. TMDLs and Source Allocations

The metals TMDLs for the Kiskiminetas River watershed were developed using the MDAS model, and targets were based on water quality criteria, as discussed in Section 1. Source allocations were developed for all modeled subwatersheds contributing to the metals-impaired streams in the Kiskiminetas River watershed. Loading contributions were reduced from applicable sources until the TMDL endpoints were attained at the outlet of each impaired stream. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream waterbodies. EPA's allocations to nonpoint sources were not reduced below a loading that was less than natural conditions. EPA's allocations to permitted sources did not result in concentrations more stringent than water quality criteria.

The rationale for allocations was based on a sensitivity analysis that was conducted for this TMDL to give insight into the dominant sources and the mechanisms by which potential decreases in loads would affect in-stream pollutant concentrations. Multiple allocation scenarios were run for the impaired waterbodies. Successful scenarios achieved the TMDL endpoints under all flow conditions throughout the modeling period. EPA assigned Load Allocations for the abandoned mine seeps reflecting that the seeps are the dominant source of pollutants in some watersheds. It was necessary to reduce the allocations for the seeps to water quality criteria in order for the waterbody to meet water quality standards. The AMD seeps within the watershed provide a magnitude of flow and pollutant concentration that must be reduced to water quality standards in order for streams within the Kiskiminetas-Conemaugh watershed to meet water quality standards regardless of the reductions given to other pollutant sources. In addition, in this TMDL, EPA believes that given the magnitude of the abandoned mine discharges, it not reasonable to assume that nonpoint sources can be controlled 100 percent. Therefore, AML loads were reduced 75 percent to background. For watersheds with point sources, all permits were given wasteload allocations based on their current operations and permits. However, if water quality standards were not met in the watershed, some permits were reduced. The following describes in greater detail the methodology used to allocate to metals sources.

- For watersheds with AML seeps or sediment-contributing land uses but no permitted point sources or bond forfeiture sites, EPA reduced AML allocated loads by first determining the presence of AML seeps and reducing the allocated loads to those seeps to water quality criteria. EPA reduced land-based AML sources to a maximum loading of 25 percent above background conditions (undisturbed forest). That is, AML loadings were reduced 75 percent to background. For example, if an existing AML load to an impaired stream is 125 lb/year and the background load is 25 lb/year, the allocations to AMLs were reduced to 50 lb/year. If further reductions were required, the loads from sediment-contributing nonpoint sources were reduced until water quality criteria were met.
- For watersheds with AMLs and point sources or bond forfeiture sites, point sources and bond forfeiture sites were set at the loads defined by applicable permit limits, and AML loads were reduced based on the methodology described above. If further reduction was required after loads from AMLs were reduced, sediment sources were reduced. If even further reduction was required, the technology-based loadings from mining point sources and bond forfeiture sites were reduced to a maximum of water quality criteria end-of-pipe.
- If additional reduction was necessary, loadings associated with industrial permits or industrial stormwater permits were reduced from their current permit limits to water quality criteria end-of-pipe.

For an explanation on how each type of allocation load is calculated please refer to the sections below.

The existing and TMDL metal loads for the watershed were generated from the calibrated MDAS model, with point sources represented by their permitted limits. The simulation period covered six years, from January 1, 1998 through December 31, 2003. The target TMDL values for these metals were calculated by iteratively adjusting loading rate input until simulated instream concentrations achieved water quality standards. Appendix G presents a load summary of TMDL components.

As described in Section 5.2.7, the MINTEQA2 model was run to simulate various scenarios in the Kiskiminetas River watershed. Input values for aluminum, iron, and manganese were based on TMDL endpoints (maximum allowable limits). These results imply that pH will be within the Pennsylvania criterion of 6.0 to 9.0, provided that instream metals concentrations simultaneously meet applicable water quality criteria. Once instream metals concentrations are within water quality criteria, the natural alkalinity in the Kiskiminetas River watershed will also help to resolve pH impairments.

6.4.1. Sediment Allocations

To support model calibration, the sediment-iron and sediment-aluminum relationship in the watershed was determined based on monitoring data. A statistical correlation between TSS and total Fe, and TSS and total Al concentrations was performed at each pre-TMDL monitoring station with more than four valid observations. In the majority of the impaired waters assessed, a strong, positive correlation between TSS and total Fe and Al was identified. The relationship is further described and plotted graphically in Appendix H. The results of the iron/TSS linear regression analyses are shown on the "Kiskiminetas Fe Slope" tab in Appendix H. The particulate iron – TSS regression slopes were ranked from least to greatest and then grouped into three categories (slope groups). The average of each slope group was used to establish the iron/sediment relationship. A table is provided in Appendix H showing this relationship. In addition, modeling showed that all the sediment-impaired streams exhibited impairments pursuant to total iron water quality criteria.

A reference watershed approach was used to determine initial sediment loading rate goals for the sediment TMDL. The reference watershed approach is described in Section 6.2, and is based on reducing the loading rate of sediment in the impaired stream segment to a level equivalent to or slightly lower than the loading rate in the unimpaired reference stream segment. Because the segment of Loyalhanna Creek is meeting its aquatic life uses for sediment, its sediment loading rate of 4,015 tons/year served as the goal or reference for the entire Kiskiminetas watershed. Because of the strong relationship between TSS and total Fe in the watershed, the reference-based sediment loading rates were then compared to the sediment loading rates associated with reductions necessary for meeting the iron TMDLs. The comparison of the finalized metals reductions (i.e., the sediment reductions required to meet the iron TMDL) and the reference watershed-based sediment loading targets, revealed that iron TMDLs were more protective than the reference-based sediment TMDLs.

Table 6-3 provides a subwatershed comparison of the target sediment loading rates associated with the iron TMDL and the target sediment loading rates associated with the reference watershed-based analysis. The fourth column lists the loading rates derived from the reference watershed approach. The loading rate for unimpaired segment of Loyalhanna Creek, 4,015 tons/yr, was derived by modeling sediment loads from the existing landuses in the watershed and is considered a *target* loading rate based on its unimpaired status. The reference loading rates for the other subwatersheds were then derived from this target rate by normalizing for subwatershed size. The table shows that reductions required to attain iron criteria are more stringent than those needed to resolve impairment under the reference watershed approach. Appendix G presents a load summary of TMDL components. As a result, the iron reductions were used as a surrogate for sediment reductions.

Table 6-3. Kiskiminetas River Watershed Sediment Approaches Comparison

Region	Impaired stream name	Allocated sediment load – iron TMDL (tons/yr)	Allocated sediment load – reference approach (tons/yr)
1	Kiskiminetas River	20,746	25,482
1	Unnamed Tributary to Kiskiminetas River	26	34
1	Beaver Run	662	740
1	Unnamed Tributary to Beaver Run	622	693
1	Wolford Run	123	126
1	Loyalhanna Creek	3,785	4,015

Region	Impaired stream name	Allocated sediment load – iron TMDL (tons/yr)	Allocated sediment load – reference approach (tons/yr)
1	Conemaugh River	14,095	18,538
2	Thorn Run	20	31
3	Crabtree Creek	219	257
3	McCune Run	59	66
3	Union Run	88	93
3	Saxman Run	79	84
3	Unity Run	16	17
3	Monastery Run	160	164
3	Fourmile Run	111	114
4	Aultmans Run	264	269
4	Harbridge Run/Trout Run	71	106
5	Hinckston Run	144	202
6	South Fork Bens Creek	211	270
6	Paint Creek	365	492
6	Spruce Run	34	34
6	Quemahoning Creek	1,261	1,344
6	Stonycreek River	1,603	1,611
5	Spring Run	29	38
5	Bens Creek	76	108
4	Unnamed Tributary to Blacklick Creek	17	42
4	North Branch Two Lick Creek	126	149
4	Elk Creek	179	306
4	California Run	63	100

6.4.2. Dissolved Iron TMDLs and Source Allocations

As mentioned previously in Section 5.2.6, to appropriately address dissolved iron TMDLs for the Little Conemaugh River and the South Fork of the Little Conemaugh River, it was necessary to use the aqueous chemical reaction module in MDAS to represent instream iron speciation. For watersheds for which dissolved iron TMDLs were developed, source allocations for total iron and total aluminum were developed first because total instream concentrations significantly reduce pH and consequently increase dissolved iron concentrations. After successfully completing the TMDL allocation scenarios for total iron and total aluminum, the MDAS output was compared directly with the dissolved iron TMDL endpoint. If predicted dissolved iron concentrations still exceeded the TMDL endpoint, the total iron sources represented in the MDAS would have required additional reductions. However, after completing the total iron and total aluminum TMDLs for the Little Conemaugh River and the South Fork of the Little Conemaugh River watersheds, modeling indicated no further reduction to total iron sources were necessary to meet dissolved iron criteria, as shown in Figures 6-4 and 6-5. Therefore, the prescribed total iron and total aluminum TMDLs for the Little Conemaugh River and the South Fork of the Little Conemaugh River watersheds are appropriate surrogates to meet the dissolved iron TMDL endpoint.

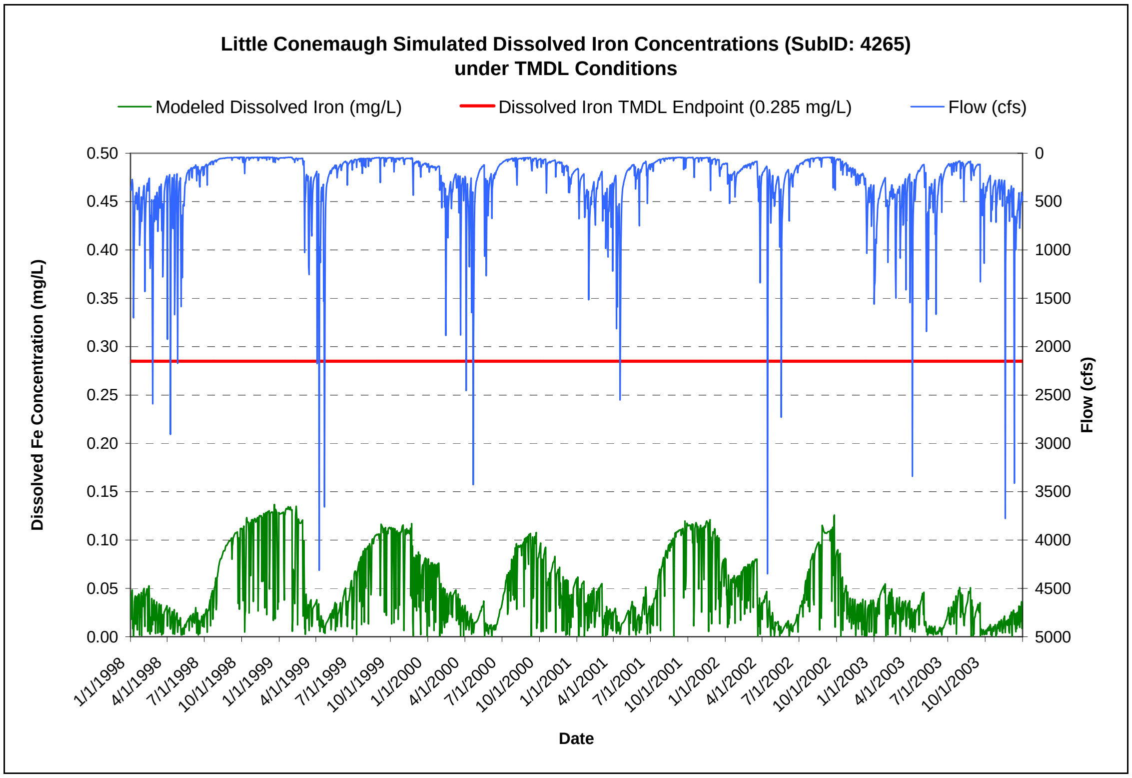

Figure 6-4. Simulated Dissolved Iron Concentrations under TMDL Conditions in the Little Conemaugh River Watershed.

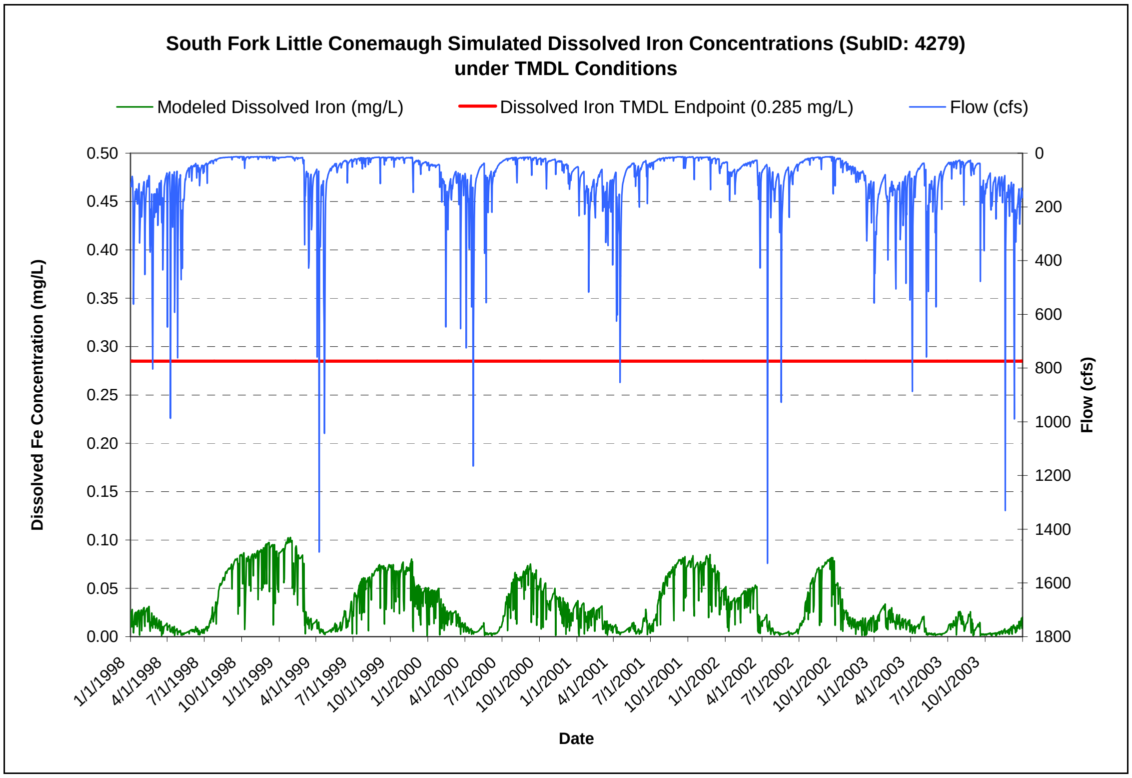

Figure 6-5. Simulated Dissolved Iron Concentrations under TMDL Conditions in the South Fork Little Conemaugh River Watershed.

6.4.3. Load Allocations

The LA is the portion in the TMDL that is assigned to nonpoint sources. For this analysis, loads associated with MS4s, bond forfeiture sites, and *future coal mining* activities were determined from model results as load allocations due to their precipitation driven, nonpoint source nature. However, for the TMDL, these loads were subtracted from the LA and given separate waste load allocations. Their calculation is described in the next sections. Reductions to nonpoint sources were taken extensively throughout the watershed. The 'LAs' tab in the Allocation Spreadsheet (see appendix G) shows that 446 out of 719 subwatersheds have reductions to pollutant sources from abandoned mines, 545 subwatersheds have reductions to urban/road/residential sources, 100 subwatersheds have reductions to barren land, and 40 subwatersheds have reductions to agricultural sources. As discussed in greater detail in Sections 5 and 6, nonpoint source baseline loads were calculated using the MDAS and considering land use, hydrologic, pollutant and meteorological data as well as water chemistry.

LAs are made for the dominant nonpoint source categories as follows:

AML: Loadings from AMLs, included loads from disturbed land, highwalls, deep mine discharges and seeps. As discussed in Section 6.4, EPA reduced land-based AML sources to a maximum loading of 25 percent above background conditions (undisturbed forest) and the abandoned mine seeps were reduced to water quality criteria. Sediment sources: Loadings associated with sediment contributions include barren land, agricultural land and urban pervious land uses in non-MS4 areas. If after reducing AMLs, further reductions were required, the loads from sediment-contributing nonpoint sources were reduced until water quality criteria were met. Background and other nonpoint sources: This category includes loads from undisturbed forest and grasslands. Loadings associated with this category were represented but were not reduced.

6.4.4. Wasteload Allocations

Federal regulations (40 CFR §130.7) require TMDLs to include individual WLAs for each point source. WLAs were developed for all point sources permitted to discharge metals under an NPDES permit. Because of the established relationship between iron and aluminum and TSS, iron WLAs are also provided for facilities with stormwater discharges that are regulated under NPDES permits that contain TSS or iron effluent limitations or benchmarks values, MS4 facilities, bond forfeiture sites, and facilities registered under the General NPDES permit for construction stormwater. Appendix G lists the WLAs assigned to meet water quality standards.

Active Mining Operations

WLAs are provided for all existing outlets of NPDES permits for mining activities, except those where reclamation has progressed to the point where existing limitations are based on the Post-Mining Area provisions of Subpart E of 40 CFR Part 434. The WLAs for active mining operations consider the functional characteristics of the permitted outlets (i.e., precipitation driven, pumped continuous flow, gravity continuous flow, commingled) and their respective impacts at high and low-flow conditions.

The Federal effluent guidelines for the coal mining point source category (40 CFR Part 434) provide various alternative limitations for discharges caused by precipitation. Under those technology-based guidelines, effluent limitations for total iron, total aluminum, total manganese and TSS may be replaced with an alternative limitation for settleable solids during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs preclude the applicability of the *alternative precipitation* provisions of 40 CFR Part 434.

In certain instances, prescribed WLAs may be less stringent than existing effluent limitations. However, the TMDLs are not intended to relax effluent limitations that were developed under antidegradation guidelines. Whereas TMDLs prescribe allocations that minimally achieve water quality criteria (i.e., 100 percent use of a stream's assimilative capacity), the antidegradation provisions of the standards are designed to maintain the existing quality of HQ waters. Antidegradation provisions may result in more stringent allocations that limit the use of remaining assimilative capacity. Also, water quality-based effluent limitations developed in the NPDES permitting process may dictate more stringent effluent limitations for discharge locations that are upstream of those considered in the TMDLs. TMDL allocations reflect pollutant loadings that are necessary to achieve water quality criteria at distinct assessment points (i.e., the pour points of impaired subbasins) and are developed to ensure protection of water quality in all parts of the watershed and its subwatersheds. Effluent limitation development in the permitting process is generally focused on achieving/maintaining water quality criteria only at the permitted point of discharge. Appendix G under the Mining WLA tab provides WLA for mining permits.

Non-mining NPDES Permits

WLA for non-mining facilities were developed and can be found in Appendix G under the "Non-Mining_WLAs" tab. Non-mining point sources of metals may include wastewater discharges from water treatment plants, POTWs, and industrial manufacturing operations that may or may not presently contain NPDES permit effluent limits for aluminum, manganese or iron. For non mining facilities with aluminum, iron, or manganese (metals) permit limits, the WLA was calculated using corresponding metals permit limits and flows. If the permit did not have a metals permit limit, then the water quality limit was used to develop a WLA for that facility. WLAs for facilities with stormwater discharges were also develop and are provided in Appendix G under the "Non-Mining_WLAs" tab.

Non MS4 Stormwater WLAs were determined in the following manner. If flows were available for the outfall, then the flow and criteria were used to determine the WLA. If no flows were available, then the WLA was determined by assuming the discharge is precipitation driven and the model was used to determine the loading based on the drainage area of the outfall and the modeled loading rate for urban lands in the subwatershed in which the outfall is located. If no drainage area information was available, then drainage area associated with the permit's outfall was assumed to be one acre based on EPA's best professional judgement.

Aggregrate WLAs are provided in Appendix G under the "Negligible Discharge Gross WLAs" tab. Facilities identified in Appendix C under "Negligible Discharge Facilities" tab currently are without metals permits limits. EPA developed aggregate WLAs based on the sum of the available information regarding flow from each facility multiplied by the applicable numeric water quality criterion. If information on effluent flows was unavailable, effluent flow was determined on the basis of best professional judgment using flows from the permits of similar facilities. These facilities do not currently have permit limits for the pollutants of concern, and there may not be reasonable potential for the NPDES permitting authority to determine a numeric effluent limit in the permit is necessary. The decision to provide an aggregate WLA to these sources does not reflect any determination by EPA that an effluent limit is needed or required in a NPDES permit.

Based on the types of activities and the minimal flow of the discharges on the "Negligible Discharge Facilities" tab of Appendix C, EPA has determined that the pollutant contributions of metals from these permitted non-mining sources are negligible. Under these TMDLs, these minor discharges are assumed to operate under their current levels. EPA is assigning a gross WLA at the subwatershed level that provides loading for these point sources to discharge the pollutants of concern up to their respective current levels of discharge.

Municipal Separate Storm Sewer System (MS4)

Federal regulations (40 CFR §130.7) require TMDLs to include individual WLAs for each point source. In addition, 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 clarifies existing regulatory requirements for MS4s connected with TMDLs (USEPA 2002). The key points are as follows:

- NPDES-regulated MS4 discharges must be included in the WLA component 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.
- Industrial storm water permits need to reflect technology-based and water quality-based requirements.

On the basis of this memorandum, MS4s were treated as point sources for the TMDL, and the metals loading generated within the boundary of an MS4 area was assigned a WLA in addition to the WLA for the point source dischargers.

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 collection or conveying stormwater, as opposed to portions that are truly nonpoint sources. As part of the Phase II stormwater permit process, MS4s are responsible for evaluating and mapping out areas that are draining to or discharging to storm sewers. Since EPA does not have information regarding these delineations, EPA is including any nonpoint loadings into the WLA portion of the TMDL. Once these delineations are available, the nonpoint source loadings can then be separated out of the WLAs and moved under the LA. After adjusting the WLAs and LAs based on MS4 service area delineation, Pennsylvania may initiate the TMDL revision process as discussed in Section 6.7.

Information related to the MS4 WLAs are included on two tabs in Appendix G:

- MS4_WLAs_Summary – provides baseline loads, allocated loads and required percent reduction by municipality, subwatershed and region.
- MS4_WLAs_Entity_Summary –provides baseline loads, allocated loads and required percent reduction by NPDES ID and MS4 entity.

Bond Forfeiture Allocations

The purpose of the bond forfeiture program was to reclaim and restore mined lands which were abandoned or orphaned by mining companies whose permits were issued under the Surface Mining Control and Reclamation Act of 1977. PADEP provides for the reclamation of bond forfeiture sites under the public bidding and contracting requirements of the Commonwealth. Under this approach, the Department will advertise for bids for reclamation of the bond forfeiture site. Environmental stewardship and partnerships with environmental organizations are an encouraged and important mechanism for restoring these orphaned sites.

Loading from mining facilities that have not effectively reclaimed mining sites and have forfeited their SMCRA bonds were assigned WLAs as EPA has determined these bond forfeiture sites are point sources. The WLAs provided for the bond forfeiture sites are based on technology-based effluent limits for mining operations. Individual WLAs for bond forfeiture sites for which the Department or a trustee is directing reclamation following forfeiture of the performance bond are included in Appendix G under the tab "Bond Forfeiture sites."

6.4.5. Margin of Safety

The MOS is the portion of the pollutant loading reserved to account for uncertainty in the TMDL development process. The five percent explicit MOS was used to counter uncertainty in the modeling process. Long-term water quality monitoring data were used for model calibration. Although these data represented actual conditions, they were not of a continuous time series and might not have captured the full range of instream conditions that occurred during the simulation period. The explicit five percent MOS also accounts for those cases where monitoring might not have captured the full range of instream conditions. Please refer to Section 6.1 and Table 6-1 for further details.

6.5. TMDL Presentation

TMDLs, LAs, and WLAs are shown in the allocation spreadsheets associated with this report (Appendix G). The aluminum, iron, and manganese WLAs for active mining operations are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The associated daily loads presented in the allocation spreadsheets represent average annual loads divided by 365.

The iron WLAs for non-mining activities registered under general permits are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are operable, and because they are equivalent to existing effluent limitations/benchmark values, they are to be directly implemented.

The dissolved iron TMDLs are based on a dissolved iron TMDL endpoint (see section 5.2.6); however, sources are represented in terms of total iron. The WLAs and LAs for iron are also provided in the form of total metal.

To effectively display the detailed source allocations associated with successful TMDL scenarios, the Kiskiminetas River watershed was broken into six regions representing separate hydrologic units (Kiskiminetas River, Beaver Run, Loyalhanna Creek, Blacklick Creek, Conemaugh River, and Stoneycreek River). As shown in Figure 6-2, the six regions provide a basis for georeferencing the source allocations that are presented in the allocation spreadsheets associated with this report. Table 6-4 shows the streams for which TMDLs and their associated components are addressed by this report. Due to the very large number of facilities and landuses addressed in this TMDL, the load and wasteload allocations are presented in tabular format in a separate Appendix G, in spreadsheet form.

Each page of the Appendix G spreadsheet is formatted so that the user may select from one of the pull-down menus in the table header to view specific details regarding a particular stream or pollutant source. The following tabs are included:

- Introduction
- Impaired Streams
- Regional Maps
- TMDLs_Daily
- TMDLs_Annual
- LAs (Landuse Allocations and Reductions)
- AML Discharges (AML Seeps)

- Nonmining_WLAs
- Negligible_Discharge Gross WLAs
- Bond_Forfeiture_Sites
- Mining_WLAs
- Future_Growth
- MS4_WLAs_Summary
- MS4_Entity_WLAs_Summary
- Impaired_Stream_Connectivity

Baseline, TMDL and required percentage reductions are given for each source (i.e., landuse, MS4, NPDES facility, AML seep, or Bond Forfeiture site) by modeled subwatershed and by region.

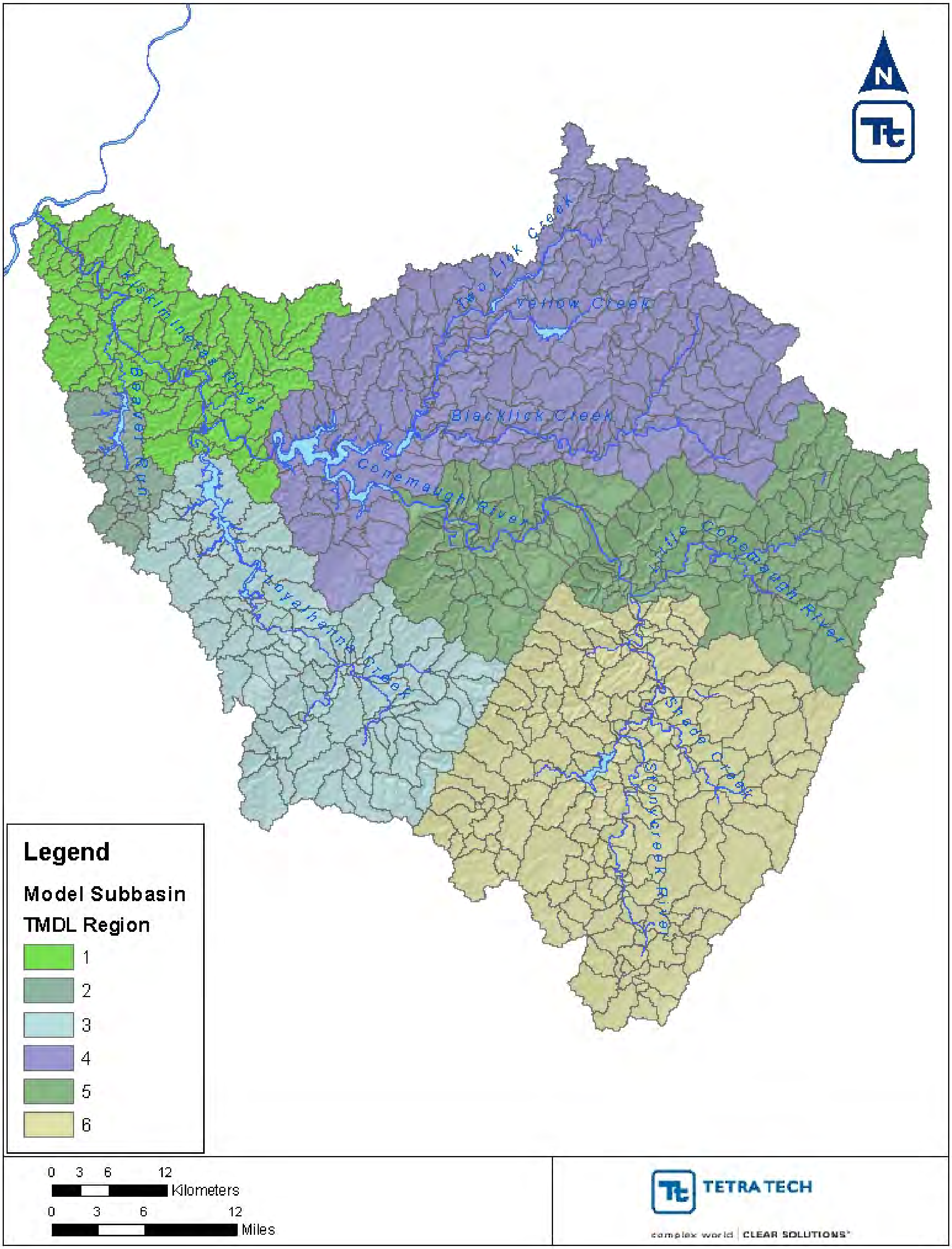

Figure 6-6. The Six Georeferencing Regions in the Kiskiminetas River Watershed.

Table 6-4. Streams Receiving TMDLs

Region	Impaired Stream Name	Consent decree	High quality water	TMDLs presented					
				Total iron	Dissolved iron	Total aluminum	Total manganese	pH surrogate approach	Sediment surrogate approach
1	Kiskiminetas River	X		X		X	X	X	X
1	Unnamed Tributary to Kiskiminetas River			X		X	X	X	X
1	Pine Run			X		X	X	X	
1	Beaver Run	X		X		X	X	X	X
1	Unnamed Tributary to Beaver Run			X		X	X	X	X
1	Roaring Run			X		X	X	X	
1	Wolford Run			X		X	X	X	X
1	Long Run			X		X	X	X	
1	Blacklegs Creek			X		X	X	X	
1	Big Run			X		X	X	X	
1	Unnamed Tributary to Blacklegs Creek			X		X	X	X	
1	Loyalhanna Creek	X		X		X	X	X	X
1	Getty Run	X		X		X	X	X	
1	Conemaugh River	X		X		X	X	X	X
2	Thorn Run[a]	X	X	X		X	X	X	X
2	Beaver Run	X	X	X		X	X	X	
3	Crabtree Creek			X		X	X	X	X
3	McCune Run	X		X		X	X	X	X
3	Union Run	X		X		X	X	X	X
3	Saxman Run	X		X		X	X	X	X
3	Unity Run			X		X	X	X	X
3	Monastery Run	X		X		X	X	X	X
3	Fourmile Run			X		X	X	X	X
3	Indian Camp Run	X	X	X		X	X	X	
3	Fourmile Run	X		X		X	X	X	
4	Roaring Run	X		X		X	X	X	
4	Aultmans Run			X		X	X	X	X
4	Coal Run			X		X	X	X	
4	Reeds Run	X		X		X	X	X	
4	Harbridge Run/Trout Run	X	X	X		X	X	X	X
5	Tubmill Creek			X		X	X	X	
5	Freeman Run	X		X		X	X	X	
5	Unnamed Tributary to Conemaugh River			X		X	X	X	
5	Richards Run	X		X		X	X	X	
5	Unnamed Tributary to Conemaugh River			X		X	X	X	
5	Unnamed Tributary to Conemaugh River			X		X	X	X	
5	Saint Clair Run			X		X	X	X	
5	Strayer Run			X		X	X	X	
5	Gray Run			X		X	X	X	

Region	Impaired Stream Name	Consent decree	High quality water	TMDLs presented					
				Total iron	Dissolved iron	Total aluminum	Total manganese	pH surrogate approach	Sediment surrogate approach
5	Elk Run			X		X	X	X	
5	Hinckston Run			X		X	X	X	X
6	Stonycreek River	X		X		X	X	X	
6	Solomon Run			X		X	X	X	
6	Sams Run			X		X	X	X	
6	Bens Creek	X		X		X	X	X	
6	South Fork Bens Creek	X	X	X		X	X	X	X
6	Paint Creek[b]	X		X		X	X	X	X
6	Seese Run			X		X	X	X	
6	Babcock Creek	X		X		X	X	X	
6	Shade Creek[c]	X		X		X	X	X	
6	Spruce Run			X		X	X	X	X
6	Quemahoning Creek	X		X		X	X	X	X
6	Twomile Run			X		X	X	X	
6	Roaring Run			X		X	X	X	
6	Unnamed Tributary to Stonycreek River	X		X		X	X	X	
6	Fallen Timber Run	X		X		X	X	X	
6	Oven Run	X		X		X	X	X	
6	Stonycreek River			X		X	X	X	X
6	Wells Creek			X		X	X	X	
6	Lamberts Run[d]	X		X		X		X	
6	Grove Run			X		X	X	X	
6	Schrock Run			X		X	X	X	
6	Rhoads Creek			X		X	X	X	
6	Boone Run	X		X		X	X	X	
6	Unnamed Tributary to Boone Run			X		X	X	X	
6	Unnamed Tributary to Boone Run			X		X	X	X	
6	Clear Run	X		X		X	X	X	
6	Unnamed Tributary to Stonycreek River			X		X	X	X	
6	Reitz Creek			X		X	X	X	
5	Little Conemaugh River	X		X	X	X	X	X	
5	Clapboard Run			X		X	X	X	
5	Saltlick Creek		X	X		X	X	X	
5	South Fork Little Conemaugh River			X	X	X	X	X	
5	Unnamed Tributary to South Fork Little Conemaugh R			X		X	X	X	
5	Otto Run	X		X		X	X	X	
5	Sulphur Creek	X		X		X	X	X	
5	Beaverdam Run	X		X		X	X	X	
5	Trout Run			X		X	X	X	
5	Spring Run	X		X		X	X	X	X
5	Bens Creek	X		X		X	X	X	X

Region	Impaired Stream Name	Consent decree	High quality water	TMDLs presented					
				Total iron	Dissolved iron	Total aluminum	Total manganese	pH surrogate approach	Sediment surrogate approach
5	Unnamed Tributary to Little Conemaugh River			X		X	X	X	
4	Unnamed Tributary to Blacklick Creek			X		X	X	X	X
4	Weirs Run			X		X	X	X	
4	Two Lick Creek	X		X		X	X	X	
4	Cherry Run			X		X	X	X	
4	Tearing Run	X		X		X	X	X	
4	Yellow Creek	X		X		X	X	X	
4	Unnamed Tributary to Yellow Creek			X		X	X	X	
4	Ferrier Run	X		X		X	X	X	
4	Unnamed Tributary to Two Lick Creek			X		X	X	X	
4	Allen Run			X		X	X	X	
4	Penn Run	X		X		X	X	X	
4	Unnamed Tributary to Penn Run			X		X	X	X	
4	Dixon Run			X		X	X	X	
4	North Branch Two Lick Creek			X		X	X	X	X
4	Blacklick Creek			X		X	X	X	
4	Unnamed Tributary to Blacklick Creek			X		X	X	X	
4	Downey Run			X		X	X	X	
4	Elk Creek	X		X		X	X	X	X
4	California Run			X		X	X	X	X
4	South Branch Blacklick Creek	X		X		X	X	X	
4	Coalpit Run			X		X	X	X	

[a] Incorporates allocations for Unnamed Tributary to Thorn Run.
[b] Incorporates allocations for Unnamed Tributary to Paint Creek.
[c] Incorporates allocations for Dark Shade Creek and the Unnamed Tributary to Shade Creek.
[d] EPA has developed a manganese TMDL sufficient to protect the public water supply use for the Kiskiminetas River watershed with the exception of Lamberts Run. That exception is necessary to ensure advancement of national interests for a National Park Service Flight 93 (September 11) Memorial within the Lamberts Run watershed. The nearest public water supply intake is at Hooversville. There are no reported exceedances of the manganese criteria at the Hooversville public water supply intake. EPA is establishing TMDLs for Lamberts Run sufficient to protect the aquatic life use.

6.6. 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 waterbody and to identify potential allocation scenarios that enable the waterbody to meet the TMDL target. The critical condition is the set of environmental conditions, which, if met, will ensure the attainment of objectives for all other conditions. This is typically the period of time in which the impaired waterbody exhibits the most vulnerability. Nonpoint source loading is typically precipitation-driven, thus instream impacts tend to occur during wet weather in which storm events cause surface runoff to carry pollutants to waterbodies.

The discussion in Section 2 described the results of the water quality analysis, which show that a variety of conditions affect metals concentrations in the Kiskiminetas River watershed. For most pollutants, analysis of available data indicated that critical conditions occur during both high and low-flow events depending upon specific sources and conditions in a given watershed. In some cases, a predominance of landbased sources may result in precipitation driven loading with critical conditions during high-flow events. In other areas, the predominance of continuous sources may result in critical conditions with low-flow events due to lack of dilution. In still other areas, where there may be a mix of significant landbased sources as well as significant point sources, whether permitted or AML, critical conditions may occur during both low and high-flow events due to the presence of both types of sources. During low-flow periods, continuous/point sources contribute to the critical loading, while during high flows, 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.

Although analyses of aluminum, iron, and manganese suggest a mixed but positive relationship with flow, and thus wet-weather conditions, data available from PADEP station SC10 show that point sources might dominate water quality conditions in certain areas of the watershed. Overall, the analyses presented in Section 2 suggest that wet-weather conditions are critical in the watershed for pH, sediment, aluminum, iron, and manganese. The MDAS model simulates precipitation variability throughout the watershed as represented by the weather time-series used to drive the model covering the range of hydrologic conditions including the critical condition. Seasonal variation is also captured in the time variable simulation, which represents seasonal precipitation on a year-to-year basis.

6.7. Future TMDL Modifications and Growth

In the future, the 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 are developed or discovered during the implementation of the TMDL. Any such adjustment must protect local water quality standards and must be based on an analysis of the pollutant discharge and the reasonable potential to exceed applicable water quality criteria in the receiving water and/or the WLA, whichever is more stringent. EPA’s 2002 “Guidelines for reviewing TMDLs under existing regulations issued in 1992” allows flexibility in a TMDL to redistribute WLAs to different outfalls/permit under certain circumstances. The guidance states that “EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA as expressed in the TMDL remains the same or decreases and there is no reallocation between the total WLA and LA.” Adjustments between the load and wasteload allocation may only be made following an opportunity for public participation and EPA approval. A wasteload allocation adjustment will be made consistent and simultaneous with associated permit(s) revision(s)/reissuances (i.e., permits for revision/reissuance in association with a TMDL revision will be made available for public comment concurrent with the related TMDLs availability for public comment). New information generated during TMDL implementation may include, among other things, monitoring data, BMP effectiveness information, and land use information. Such modifications of the TMDL in one subwatershed do not require the establishment (or modification) of the entire watershed TMDL to reflect these revised WLAs allocations, as long as the total WLA in each of the subwatersheds, as expressed in the overall watershed TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA. There should be public access to the modifications to the TMDL or any of the WLAs for the subwatersheds.

The permitting authority may choose to reassign a WLA to future permittees in the same subwatershed:

- if the WLA assigned to a permitted source has been retired.
- if the discharge represented by the WLA has permanently stopped.
- if the permitting authority has determined that the permit assigned the WLA does not have the reasonable potential to exceed applicable water quality criteria.

The Federal effluent guidelines for the coal mining point source category (40 CFR Part 434) provide various alternative limitations for discharges caused by precipitation. Under those technology based guidelines, effluent limitations for total iron, total manganese and TSS may be replaced with an alternative limitation for “settleable solids” during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs and future growth provisions of the iron TMDLs preclude the applicability of the “alternative precipitation” iron provisions of 40 CFR Part 434. Also, the established relationship between iron and TSS requires continuous control of TSS concentration in permitted discharges to achieve iron WLAs. As such, the “alternative precipitation” TSS provisions of 40 CFR Part 434 should not be applied to point source discharges associated with the iron TMDLs. In certain instances, prescribed WLAs may be less stringent than existing effluent limitations. However, the TMDLs are not intended to relax effluent limitations that were developed under the alternative basis of PADEP’s implementation of the antidegradation provisions of the Water Quality Standards, which may result in more stringent allocations than those resulting from the TMDL process. Whereas TMDLs prescribe allocations that minimally achieve water quality criteria (i.e., 100 percent use of a stream’s assimilative capacity), the antidegradation provisions of the standards are designed to maintain the existing quality of high-quality waters.

Antidegradation provisions may result in more stringent allocations that limit the use of remaining assimilative capacity. Also, water quality-based effluent limitations developed in the NPDES permitting process may dictate more stringent effluent limitations for discharge locations that are upstream of those considered in the TMDLs. TMDL allocations reflect pollutant loadings that are necessary to achieve water quality criteria at distinct locations (i.e., the pour points of delineated subwatersheds). In contrast, effluent limitation development in the permitting process is based on the achievement/maintenance of water quality criteria at the point of discharge.

Specific WLAs are not provided for “post-mining” outlets because programmatic reclamation was assumed to have returned disturbed areas to conditions that approach background. Barring unforeseen circumstances that alter their current status, such outlets are authorized to continue to discharge under the existing terms and conditions of their NPDES permit.

7. Reasonable Assurance for TMDL Implementation

When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the 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 approved TMDL.

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 should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions.

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Kiskiminetas River TMDLs identify the necessary overall load reductions for metals causing use impairments and distributes those reduction goals to the appropriate sources. The reduction goals established by these TMDLs will be reached through NPDES permits to achieve WLAs and nonpoint source controls to achieve LAs. The primary nonpoint source in the Kiskiminetas River watershed is Abandoned Mine Drainage, though contributions from non-MS4 sediment sources also contribute to the impairment. In this TMDL, EPA did not make nonpoint source reductions more than 75 percent of the way to background. In the more severely impaired waters, WLA's call for reductions in NPDES permits from technology based limits to water quality based limits. EPA must consider to what extent nonpoint sources and point sources can and should be reasonably reduced to achieve water quality standards in the impaired watershed. The WLA reductions are necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to achieve water quality standards. In this TMDL, EPA believes that given the magnitude of the abandoned mine discharges, it not reasonable to assume that nonpoint sources can be controlled 100 percent. If, in the future, programs have been put into place to achieve 100 percent reductions from the nonpoint sources, the TMDL and WLAs can be revised.

In the case of the Kiskiminetas River TMDLs, there is reasonable assurance that the goals of these TMDLs can be met with proper watershed planning, implementing pollution-reduction best management practices (BMPs), and using strong political and financial mechanisms. The TMDLs established will require a comprehensive, adaptive approach that addresses the following:

- Nonpoint source pollution, including stream bank erosion and reservoir sediments
- Existing and future sources
- Regulatory and voluntary approaches

The NPDES permit program is an important vehicle through which controls can be implemented. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source, which will have to be achieved by traditional point sources, as well as more diffuse sources such as permitted MS4 systems. Pennsylvania's use of remining permits for operations occurring in previously mined and abandoned areas have the potential for reclaiming abandoned mine lands at no cost to the public.

The Bureau of Abandoned Mine Reclamation is the primary bureau in Pennsylvania dealing with abandoned mine reclamation (AMR) issues. The Bureau has established a comprehensive statewide plan for AMR to prioritize and guide reclamation efforts to make the best use of available funds. Please refer to the following website for more information:
http://www.portal.state.pa.us/portal/server.pt?open=18&objID=503101&mode=2.

With DEP-BAMR's construction of the Lancashire No. 15 plant in the headwaters of the West Branch of the Susquehanna River, discharge from the Dumans treatment plant will be eliminated from entering Crooked Run in the Blacklick Creek watershed. The Lancashire No. 15 mine complex straddles the continental divide between the Susquehanna and Allegheny River Basins. With the relocation of the discharge back to the Susquehanna basin, the department expects to provide as much as 10 million gallons per day (MGD) of 15.7 MGD needed for Pennsylvania's agricultural consumptive use water. The current Dumans plant provides significant benefits to Blacklick Creek by the addition of excess alkalinity. In order to mitigate the impacts of removing this source of alkalinity, the department has committed to the Blacklick Creek Watershed Association for future construction of a treatment plant to treat the Vinton

No. 6 and Wehrum discharges downstream of the village of Vintondale on the main stem of Blacklick Creek. The Barnes and Tucker bankruptcy settlement provided significant assets to a trust held by the Clean Streams Foundation, which will supplement treatment costs in conjunction with the funding provided by the Susquehanna River Basin Commission. The Wehrum plant is expected to largely restore approximately 22 miles of the main stem of Blacklick Creek.

In recent years innovative methods to treat AMD have been explored within the Blacklick Creek watershed. AMD&ART, a nonprofit, largely volunteer-based organization in southwestern Pennsylvania has leveraged Federal and other money to transform a 35 acre abandoned mine polluted area in Vintondale into a recreation and education area using passive treatment technologies and community involvement. For more information about how nonpoint sources to Blacklick Creek are being reduced, see AMD&ART's website: http://www.amdandart.org/projectindex.html (AMD&ART 2009).

As another example of work occurring in the watershed, private industry has proposed the treatment of three large-volume deep mine discharges in the Little Conemaugh and Stonycreek River watersheds in conjunction with either mining operations or power plant development. In two of these cases, mining companies propose to drain an abandoned mine to access coal reserves or have been denied access to reserves due to the presence of a potential hydrologic connection with an abandoned deep mine discharge. Scenarios have been discussed whereby some combination of Commonwealth assistance would be used to either construct treatment plants or operate a plant. In both cases, a trust fund will be established to perpetually provide funds to operate the plant. In the third scenario, a power plant developer is interested in treating a large deep mine discharge to provide cooling water for the plant. This developer is also interested in some sort of partnership of public and private funds to construct and operate the treatment plant. The department sees opportunities to further the Commonwealth's stream restoration efforts by continuing these negotiations and when appropriate to partner with private entities to construct and operate treatment plants.

One discharge from the St. Michael shaft flows as high as 4,000 gallons per minute (GPM) and is the largest pollution source in the Little Conemaugh watershed. A second high volume discharge, up to 1,000 GPM, the Hughes Borehole, also degrades the Little Conemaugh. The third discharge is the largest source of impairment to Shade Creek, one of two severely impacted tributaries to the mostly restored Stonycreek River. If these projects become reality, tens of miles of stream will be restored because these discharges will be treated in perpetuity. The scenarios proposed have already successfully been completed and proven at the Shannopin mine complex on Dunkard Creek in Greene County. Future WLAs have been included in this TMDL for treatment of the St. Michael's discharge and the Hughes borehole at the request of PADEP. For more information, see the PADEP Bureau of Abandoned Mine Reclamation website at http://www.depweb.state.pa.us/abandonedminerec/site/default.asp (PADEP 2009).

Nonpoint source controls can be implemented through a number of other existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. This program can help with installing BMPs, which are methods and practices for preventing or reducing nonpoint source pollution to a level compatible with water quality goals. BMPs can be classified as structural, vegetative, or management, and each class is somewhat more effective in controlling certain types of diffuse pollution than the others (Novotny and Olem 1994).

In addition to EPA's Section 319 Grant program, another funding source to address nonpoint source pollution is Pennsylvania's Growing Greener Program. Federal funding for mine reclamation projects is also available through the Department of the Interior, Office of Surface Mining, for reclamation and mine drainage treatment through the Appalachian Clean Streams Initiative and through Watershed Cooperative Agreements.

Individuals or local watershed groups interested in improving conditions in the watersheds are strongly encouraged to review funding sources available through PADEP and other state and Federal agencies. Numerous state programs, including Section 319 Grant programs, are available. For more information, see http://www.dep.state.pa.us/grantscenter/GrantAndLoanPrograms.asp (PADEP 2008). There are many watershed groups in the area, including the Blacklick Creek Watershed Association, Kiski-Conemaugh Stream Team, Loyalhanna Watershed Association, and the Shade Creek Watershed Association. These groups have been involved in ongoing work in the watershed. For more information, see the Kiski-Conemaugh Stream Team's website at http://kcstreamteam.org/index.htm. There are also other organizations that provide grants such as the Foundation for Pennsylvania Watersheds and the Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR).

There is clearly an expectation by watershed groups that DEP-BAMR develop a grant program to be funded with increased set-aside funds. Grants have proven to be an effective mechanism to accomplish certain projects under the AML Program. In the five year period from 2003 through 2007, DEP-BAMR has awarded 77 grants, totaling $41.6 million from Title IV, set-aside and Growing Greener, to complete all or selected aspects of many AML projects. Grants can often take advantage of the synergy developed between the partners to bring together unique combinations of capabilities and funding to solve AML problems.

The Commonwealth, with collaboration from watershed groups, is taking the lead to restore a significant portion of Pennsylvania's AMD-impaired streams. The strong partnerships that have developed between DEP-BAMR and watershed groups is expected to continue, with projects completed in the most efficient and cost-effective manner either through contracts or grants.

8. PUBLIC PARTICIPATION

As part of the TMDL development process, a public participation process is required. EPA worked closely with PADEP throughout the development of this TMDL. EPA proposed its first draft metals TMDL for the Kiskiminetas-Conemaugh watershed and requested public comments beginning on March 23, 2009 through April 23, 2009. EPA posted draft TMDLs and requests for comments on our website at the following address: http://www.epa.gov/reg3wapd/public_notices.htm. Public notices of the TMDL were provided in the *Johnstown Tribune-Democrat* and the (Greensburg) *Tribune-Review* newspapers, commonly read newspapers within the watershed. E-mails were sent to both PADEP's Central and Southwest Regional Office announcing the draft Kiskiminetas-Conemaugh TMDL and seeking public comment. EPA also held a public meeting to present details and answer questions regarding the proposed TMDLs on April 15, 2009, from 6:30 p.m. to 9:00 p.m., at the Frank J. Pasquerilla Conference Center, 301 Napoleon Street, Johnstown, Pennsylvania. As a result of a request from one commenter to lengthen the public comment period, EPA extended the comment period through May 7, 2009. When that public comment period closed, EPA requested an extension to our PA TMDL Consent Decree in order to thoroughly address comments that were received during the public comment period.

EPA provided a second public comment period on the proposed metals TMDL for the Kiskiminetas-Conemaugh watershed on November 20, 2009, and provided a 45-day public review period requesting comments through January 4, 2010. EPA posted the draft TMDL and its Appendices on our website at the following address: http://www.epa.gov/reg3wapd/public_notices.htm, and requested public comments. In addition, an announcement of the TMDL was provided in two local newspapers, the *Johnstown Tribune-Democrat* and the *Greensburg Tribune-Review*. EPA held a public meeting to present details and answer questions regarding the proposed TMDLs on December 10, 2009, from 2:00 p.m. to 5:00 p.m., at the Frank J. Pasquerilla Conference Center, 301 Napoleon Street, Johnstown, Pennsylvania.

A summary of all public comments received on the Kiskiminetas River Watershed TMDL and EPA's response to those comments can be found in Appendix I.

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