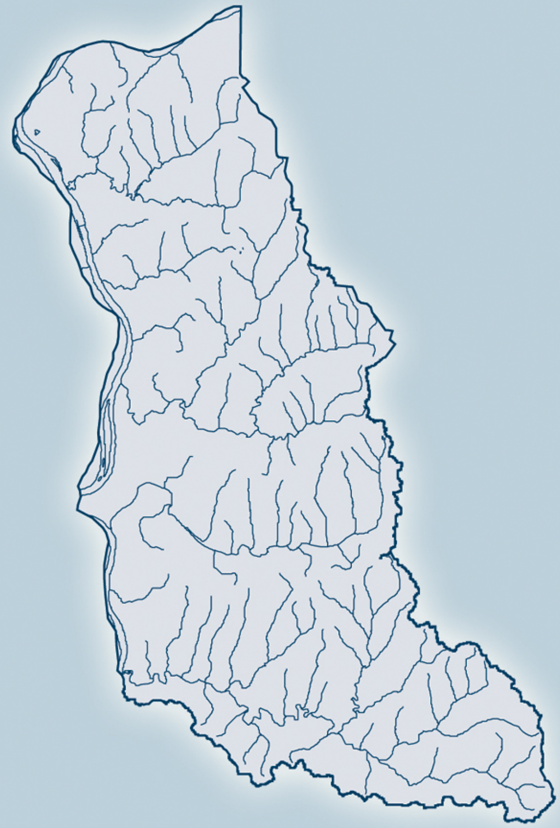
TMDLs for Selected Streams in the Upper Ohio North Watershed, West Virginia

FINAL APPROVED REPORT



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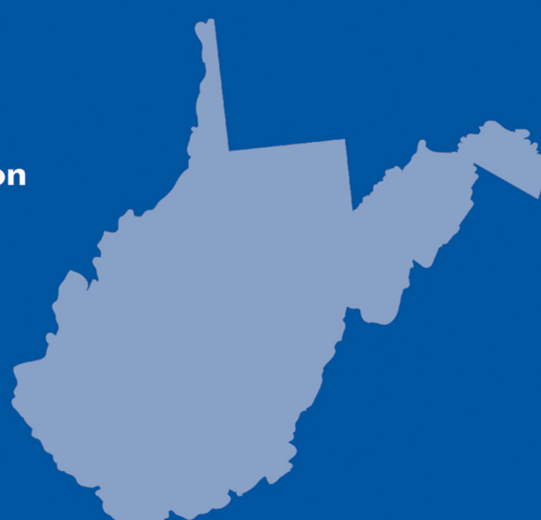

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EXECUTIVE SUMMARY

The Upper Ohio North watershed is in the northern panhandle of West Virginia and in eastern Ohio and western Pennsylvania. The entire watershed encompasses nearly 1,980 square miles. The area of study in this report is the portion of the watershed located in the northern panhandle of West Virginia and western Pennsylvania, which encompasses approximately 240 square miles in Hancock and Brooke counties in West Virginia and portions of Beaver and Washington counties in Pennsylvania. Major tributaries in the area of study include Kings Creek, Harmon Creek, Cross Creek, and Tomlinson Run.

This report includes Total Maximum Daily Loads (TMDLs) for various impaired streams in the Upper Ohio North watershed. A TMDL establishes the maximum allowable pollutant loading for a waterbody to comply with water quality standards, distributes the load among pollutant sources, and provides a basis for taking the actions needed to restore water quality.

In West Virginia, water quality standards are codified at Title 46 of the *Code of State Rules* (CSR), Series 1, and titled *Legislative Rules of the Environmental Quality Board: Requirements Governing Water Quality Standards*. The standards include designated uses of West Virginia waters and numeric and narrative criteria to protect those uses. The West Virginia Department of Environmental Protection (WVDEP) routinely assesses use support by comparing observed water quality data to criteria and reports impaired waters every 2 years as required by Section 303(d) of the Clean Water Act ("303(d) List"). The Act requires TMDLs to be developed for listed, impaired waters.

West Virginia's draft 2004 Section 303(d) list includes 32 impaired streams in the watershed. The impairments are related to numeric water quality criteria for fecal coliform bacteria, dissolved aluminum, total iron, total manganese, and pH. Table 2-1 portrays applicable numeric criteria. Many of the listed waters are also biologically impaired based on the narrative water quality criterion of 46 CSR 1 - 3.2.i, which prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts to the chemical, physical, hydrologic, and biological components of aquatic ecosystems. TMDLs are developed herein for 26 of the listed waters. The impaired waters and applicable impairments are presented in Table 3-3.

Since 1997 the U.S. Environmental Protection Agency (USEPA), Region 3, has developed West Virginia TMDLs under the settlement of a 1995 lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al.* v. *Browner et al*. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 Section 303(d) list. The schedule included TMDL development dates that extend through March 2008. This report accommodates the timely development of the remaining Upper Ohio North watershed TMDLs that were required to be developed by the consent decree.

Impaired waters were organized into six TMDL subwatersheds. Those watersheds were further divided into 110 subwatersheds for modeling purposes. The subwatershed delineation provided a basis for georeferencing pertinent source information and monitoring data, and for presenting TMDLs.

The Mining Data Analysis System (MDAS) was used to represent the source-response linkage for total aluminum, manganese, iron, and fecal coliform bacteria. MDAS is a comprehensive data management and modeling system that is capable of representing loads from nonpoint and point sources in the watershed and simulating in-stream processes. MDAS was linked with the Dynamic Equilibrium In-stream Chemical Reactions model (DESC-R) to appropriately address dissolved aluminum TMDLs in the watershed. TMDLs for pH impairments were developed using a surrogate approach in which it was assumed that reducing instream metals (iron and aluminum) concentrations 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 DESC-R model. West Virginia's numeric water quality criteria and an explicit margin of safety were used to identify endpoints for TMDL development.

Sediment TMDLs were developed under a reference watershed approach. The Generalized Watershed Loading Functions (GWLF) watershed-loading model was integrated with a stream routing model (Tetra Tech Stream Module) that examined stream bank erosion and depositional processes. Load reductions for sediment-impaired waters were based on the sediment loading present in the unimpaired reference watershed.

Metals and pH impairments were present in the Deep Gut Run and Alexanders Run of Harmon Creek watersheds. Only abandoned mine land sources were significant in Deep Gut Run. In Alexanders Run, abandoned mine lands and land disturbance activities that introduce excess sediment are problematic sources of metals. There are no active mining operations in those watersheds.

Both point and nonpoint sources contribute to the fecal coliform bacteria impairments in the watershed. Overflows from publicly owned treatment works (POTW) collection systems, known as combined sewer system overflows (CSOs), are problematic point sources. The City of Weirton's municipal separate storm sewer system (MS4) has discharges in the Kings Creek and Harmon Creek watersheds, and the City has filed a Notice of Intent for MS4 permit issuance. The area within the corporate limits is a fecal coliform bacteria point source. Significant nonpoint sources are those related to the inadequate treatment of sewage (failing onsite systems and direct discharges of untreated sewage) and those from agricultural sources. Bacteria levels in Harmon Creek, Kings Creek, and Cross Creek exceed fecal coliform water quality criteria at the points where those waters enter West Virginia from Pennsylvania.

Point sources of sediment include stormwater discharges from construction sites greater than 1 acre. Nonpoint sources of sediment include roads, timbering, agriculture, and urban and residential land disturbance. The presence of individual nonpoint source categories and their relative significance of impact vary by subwatershed.

Biological integrity/impairment is based on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). The first step in TMDL development for biologically impaired waters is stressor identification. Section 6 discusses the stressor identification process. Identified causative stressors to the benthic communities include metals toxicity, pH toxicity, organic enrichment, and sedimentation.

Stressor identification was followed by stream-specific determinations of the pollutants for which TMDLs must be developed. Metals toxicity and pH toxicity biological stressors were identified in waters that also demonstrated violations of the iron, aluminum, or pH numeric aquatic life protection water quality criteria. It was determined that implementation of those pollutant-specific TMDLs would address the biological impairment. Where organic enrichment was identified as the biological stressor, the waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. It was determined that implementation of fecal coliform TMDLs would remove untreated sewage and thereby reduce the organic and nutrient loading causing the biological impairment. Where the stressor identification process indicated sedimentation as a causative stressor, sediment TMDLs were developed.

The main section of the report describes the TMDL development and modeling processes, identifies impaired streams and existing pollutant sources, discusses future growth, provides assurance that the TMDLs are achievable, and documents the public participation associated with the process. The main report also contains a detailed discussion of the allocation methodologies applied for various impairments. The employed methodologies prescribe allocations that achieve water quality criteria throughout the watershed. Various provisions attempt equity between categories of sources and the targeting of pollutant reductions from the most problematic sources. Nonpoint source reductions did not result in loading contributions less than the natural conditions, and point source allocations were not more stringent than numeric water quality criteria. The TMDLs assign a gross load (expressed as a load allocation) to sources located in the Pennsylvania portion of the watersheds. The TMDLs do not prescribe specific load or wasteload allocations for the contributing area of Pennsylvania. Instead, they allow Pennsylvania and its stakeholders to determine appropriate and necessary source reductions.

The subwatershed appendices provide additional detail relative to their respective impaired waters and the applicable TMDLs (sum of wasteload allocations + sum of load allocations + margin of safety). Applicable TMDLs are displayed in Section 6 of each appendix. Accompanying spreadsheets provide applicable TMDLS, wasteload allocations to individual point sources, and example allocations of loads to categories of nonpoint sources that achieve the TMDL load allocations. Also provided is an interactive ArcExplorer geographic information system (GIS) project that allows exploration of the spatial relationships of the source assessment data and expedient determination of subwatershed allocations.

This report and one developed simultaneously for the impaired waters of the Upper Kanawha River watershed represent the first West Virginia TMDLs developed by WVDEP. Considerable resources were applied to generate recent and robust water quality and pollutant source information on which the TMDLs are based. The applied modeling is among the most sophisticated available and incorporates sound scientific principles. TMDL outputs are presented in various formats to assist user comprehension and facilitate use in implementation.

1. REPORT FORMAT

This report consists of a main section, appendices, a supporting geographic information system (GIS) application, and spreadsheet data tables. The main section describes the overall Total Maximum Daily Load (TMDL) development process for the Upper Ohio North watershed, identifies impaired streams, and outlines source assessment of metals, pH, fecal coliform bacteria, and biological stressors. It also describes the modeling process and TMDL allocations, and it lists actions that will be taken to ensure that the TMDLs are met. The main section is followed by six appendices that describe specific conditions in each of the subwatersheds for which TMDLs are developed. The applicable TMDLs are displayed in Section 6 of each of these appendices. The main section and appendices are supported by a compact disc (CD). The CD contains an interactive ArcExplorer GIS project that allows the user to explore the spatial relationships of the source assessment data, as well as further details related to the data. Users can "zoom in" on streams and other features of interest. Also included on the CD are spreadsheets (in Microsoft Excel format) that provide the data used during the TMDL development process, as well as detailed source allocations associated with successful TMDL scenarios. In addition, a Technical Report that describes the detailed technical approaches used throughout the TMDL development process is available.

2. INTRODUCTION

The West Virginia Department of Environmental Protection (WVDEP), Division of Water and Waste Management (DWWM), is responsible for the protection, restoration, and enhancement of the state's waters. Along with this duty comes the responsibility for TMDL development in West Virginia.

2.1 Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (at 40 CFR Part 130) require states to identify waterbodies not meeting water quality standards and to develop appropriate TMDLs. A TMDL establishes the maximum allowable pollutant loading for a waterbody to achieve compliance with applicable standards. It also distributes the load among pollutant sources and provides a basis for taking the actions needed to restore water quality.

A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate measures. Conceptually, this definition is denoted by the equation:

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

Since 1997 West Virginia's TMDLs have been developed by USEPA Region 3 under the settlement of a 1995 lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al.* v. *Browner et al*. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 Section 303(d) list. The schedule included TMDL development dates that extend through March 2008. WVDEP's TMDL program accommodates the timely development of the remaining TMDLs required by the consent decree.

WVDEP is developing TMDLs in concert with a geographically based approach to water resource management in West Virginia—the Watershed Management Framework. Adherence to the Framework ensures efficient and systematic TMDL development. Each year TMDLs are developed in specific geographic areas. The Framework dictates that 2004 TMDLs should be pursued in Hydrologic Group A, which includes the Upper Ohio North watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the year of each TMDL finalization target.

WVDEP is committed to implementing a TMDL process that reflects the requirements of the TMDL regulations, provides for the achievement of water quality standards, and ensures that ample stakeholder participation is achieved in the development and implementation of TMDLs. A 48-month development process enables the agency to carry out an extensive data generation and gathering effort to produce scientifically defensible TMDLs. It also allows ample time for modeling, report drafting, and frequent public participation opportunities.

The TMDL development process begins with pre-TMDL water quality monitoring and source identification and characterization. Informational public meetings are held in the affected watersheds. Data obtained from pre-TMDL efforts are then compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. WVDEP then presents its allocation strategies in a second public meeting, after which Draft TMDL reports are developed. The Draft TMDL is advertised for public review and comment, and a third informational meeting is held during the public comment period. Public comments are addressed, and the final draft TMDL is submitted to USEPA for approval. The TMDLs contained in this report are scheduled to be finalized by December 31, 2004.

This document provides TMDLs for most Upper Ohio North watershed stream/impairment listings from West Virginia's most recent Clean Water Act Section 303(d) list. All remaining Upper Ohio North impairments for which USEPA committed to TMDL development by 2008 are addressed.

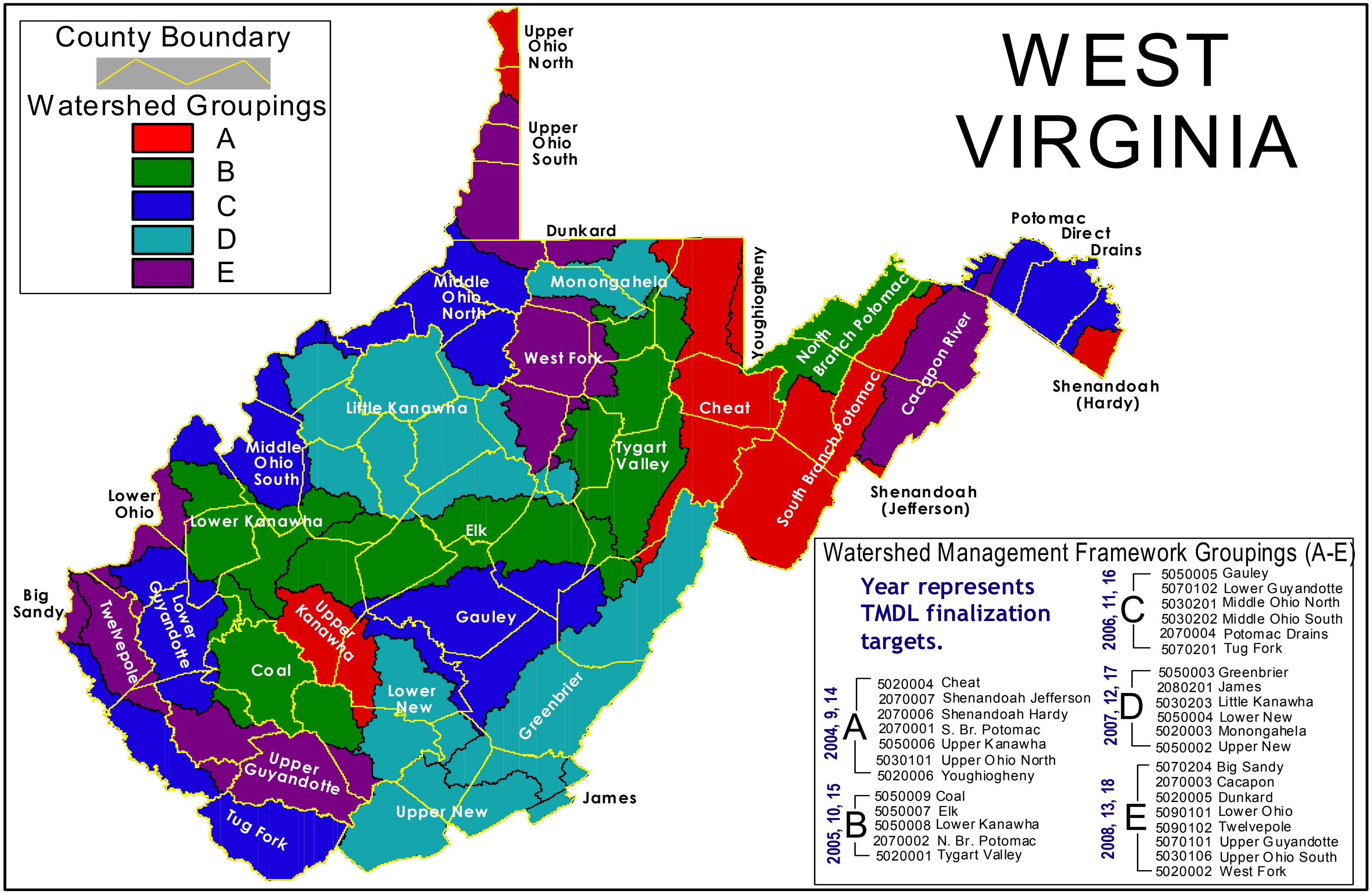

Figure 2-1. Hydrologic groupings of West Virginia's watersheds

2.2 Water Quality Standards

The determination of impaired waters involves comparing in-stream conditions to applicable water quality standards. In West Virginia, water quality standards are codified at Title 46 of the *Code of State Rules* (CSR), series 1, titled *Legislative Rules of the Environmental Quality Board: Requirements Governing Water Quality Standards* (Standards). The Standards can be obtained online from the West Virginia Secretary of State Web site (http://www.wvsos.com/csr/verify.asp?TitleSeries=46-01).

Water quality standards consist of three components: designated uses, narrative and/or numeric water quality criteria necessary to support those uses, and an antidegradation policy. Appendix E of the Standards displays the numeric water quality criteria for a wide range of parameters, while Section 3 contains narrative water quality criteria.

The Standards include numeric criteria for aquatic life protection for dissolved aluminum, total iron, and pH. Human health protection criteria are provided for fecal coliform bacteria, total manganese, and pH. Applicable numeric criteria are shown in Table 2-1.

Table 2-1. Applicable West Virginia water quality criteria

POLLUTANT	USE DESIGNATION				
	Aquatic Life				Human Health
	Warmwater Fisheries		Troutwaters		Contact Recreation/Public Water Supply
	Acute[a]	Chronic[b]	Acute[a]	Chronic[b]	
Aluminum, dissolved (μg/L)	750	87	750	87	--
Iron, total (mg/L)	--	1.5	--	0.5	1.5
Manganese, total (mg/L)	--	--	--	--	1.0[c]
pH	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0
Fecal coliform bacteria	**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.				

[a] One-hour average concentration not to be exceeded more than once every 3 years on the average.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average.
[c] Not to exceed.
Source: West Virginia Water Quality Standards 2003.

The applicable designated uses for all the waters subject to this report are aquatic life protection, water contact recreation, and public water supply. Most of the waters are designated as warmwater fisheries. North Fork of Kings Creek is the only stream in the Upper Ohio North watershed considered a troutwater. For the impaired waters of this report, West Virginia numeric water quality criteria for warmwater fisheries and troutwaters vary only with respect to iron, and North Fork of Kings Creek is not impaired pursuant to the troutwater iron criterion.

All West Virginia waters are subject to the narrative criteria in Section 3 of the Standards. That section, titled *Conditions Not Allowable in State Waters*, contains various general provisions relative to water quality. The narrative water quality criterion at 46 CSR 1 - 3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for "biological impairment" determinations. Biological impairment signifies a stressed aquatic community, and it is discussed in detail in Section 6.

3. WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

The Upper Ohio North watershed (U.S. Geological Survey [USGS] 8-digit hydrologic unit code 05030101) is in the northern panhandle of West Virginia, eastern Ohio, and western Pennsylvania. It encompasses nearly 1,980 square miles. The area of study in this pollutant source report is a portion of the Upper Ohio North watershed located in the northern panhandle of West Virginia and western Pennsylvania, encompassing an area of nearly 240 square miles (Figure 3-1). The major tributaries in the area of study are Kings Creek, Harmon Creek, Cross Creek, and Tomlinson Run.

The area of study includes portions of Hancock and Brooke counties in West Virginia and portions of Beaver and Washington counties in Pennsylvania. Major cities in the watershed are Chester, Weirton, Follansbee, and Hooverson Heights.

The average elevation in the watershed is 1,096 feet. Mt. Pleasant is the highest point in the watershed, with an elevation of 1,470 feet above mean sea level. The minimum elevation is 636 feet along the surface of the Ohio River.

Land use and land cover estimates were obtained from vegetative data gathered from the Multi-Resolution Land Characterization (MRLC) database for the states of West Virginia and Pennsylvania (MRLC 1992). The MRLC database for West Virginia was derived from satellite imagery taken during the early 1990s, and it includes detailed vegetative spatial data. Additional information regarding the MRLC spatial database is provided in the appendices of the Technical Report. The various categories for vegetative cover were consolidated to create six land use categories, summarized in Table 3-1.

As Table 3-1 shows, the Upper Ohio North watershed's dominant land use type is forest, which constitutes 68.1 percent. Other important land use types include pasture and grassland (17.5 percent), cropland (6.7 percent), and urban/residential (4.7 percent). Individually, all other land cover types constitute less than 2 percent of the total watershed area.

The total population for the watershed was derived from an analysis of the 2000 U.S. Census data. The analysis found that approximately 52,233 people reside within the Upper Ohio North watershed. Approximately 42 percent of the total population resides in urban/residential areas, while 58 percent of the people live in nonurban areas.

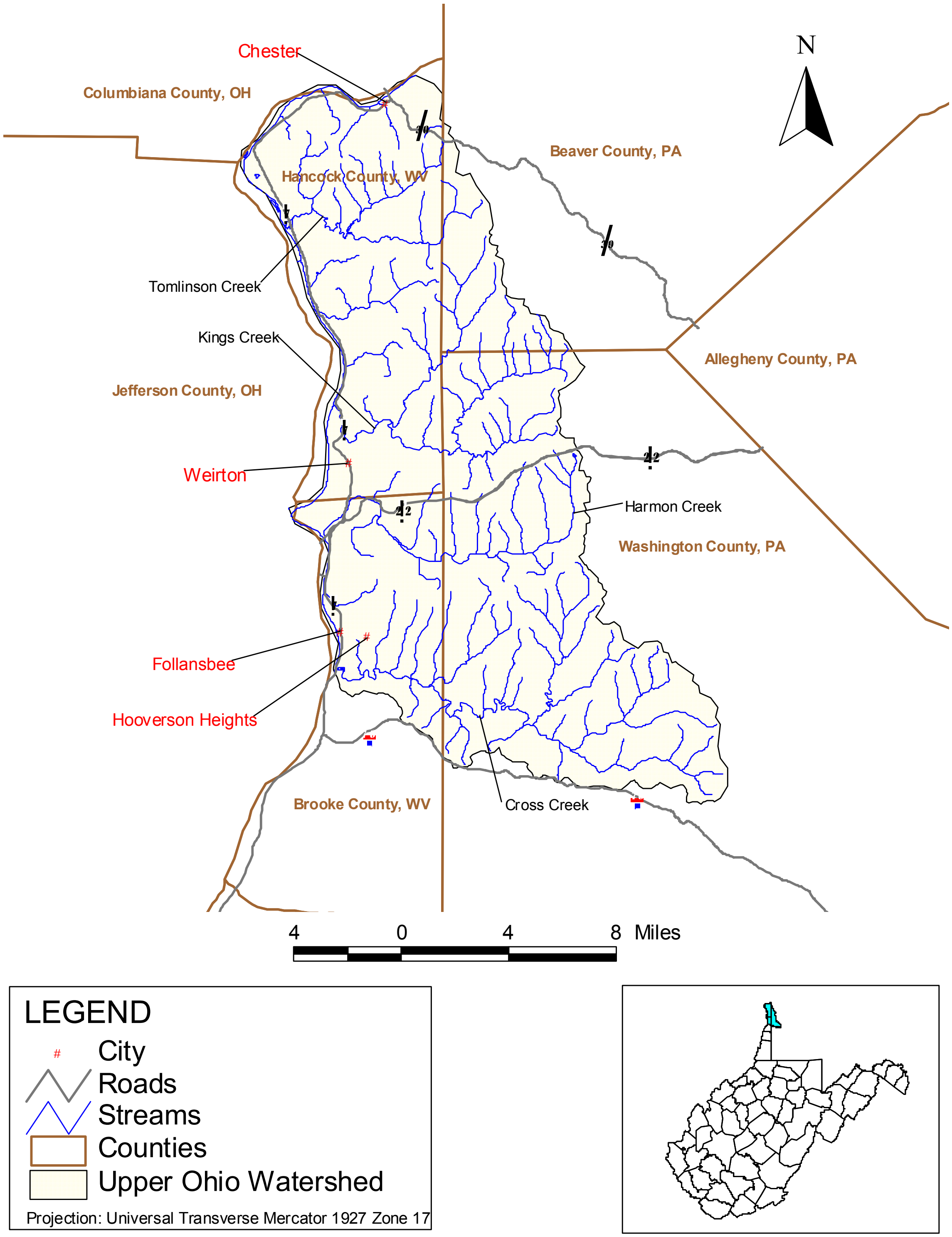

Figure 3-1. Location of the Upper Ohio North watershed

Table 3-1. Land use and land cover in the Upper Ohio North watershed

Land Use Type	Area of Watershed		Percentage
	Acres	Square Miles	
Agriculture	10,563	16.50	6.7
Barren/Mining	2,380	3.72	1.5
Forest	107,187	167.44	68.1
Pasture	27,630	43.16	17.5
Urban/Residential	7,609	11.89	4.7
Water	2,318	3.62	1.5
Total	**157,687**	**246.33**	**100.0**

3.2 Data Inventory

Various sources of data were used in the TMDL development process. The data were used to identify and characterize sources of pollution and to establish the water quality response to those sources. Review of the data included a preliminary assessment of the watershed's physical and socioeconomic characteristics and current monitoring data. Table 3-2 identifies the data used to support the TMDL assessment and modeling effort for the Upper Ohio North watershed. These data describe the physical conditions of the watershed, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. A summary of the data obtained for the Upper Ohio North watershed during the pre-TMDL monitoring effort is provided in the Technical Report. The geographic information is provided in the ArcExplorer GIS project included on the CD version of this report.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Source(s)
Watershed physiographic data	Stream network	West Virginia Division of Natural Resources (DNR)
	Land use	Multi-Resolution Land Characterization (MRLC) Database
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau
	Soils	State Soil Geographic Database (STATSGO) U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NCRS) soil surveys
	Cataloging Unit boundaries	U.S. Geological Survey (USGS)
	Topographic and digital elevation models (DEMs)	National Elevation Dataset (NED)
	Dam locations	USGS
	Roads	U.S. Census Bureau TIGER, WVU WV Roads
	Water quality monitoring station locations	WVDEP, USEPA STORET
	Meteorological station locations	National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC)

Table 3-2. (continued)

Type of Information		Data Source(s)
	Permitted facility information	WVDEP Division of Water and Waste Management (DWWM) , WVDEP Division of Mining and Reclamation (DMR)
	Timber harvest data	USDA Forest Service (FS)
	Oil and gas operations coverage	WVDEP, Office of Oil and Gas (OOG)
	Abandoned mining coverage	WVDEP DMR
	Wastewater disposal methods	WVDEP
	Livestock counts	USDA Agricultural Census
Monitoring data	Physical data	WVDEP DNR
	Historical flow record (daily averages)	USGS
	Rainfall	NOAA-NCDC
	Temperature	NOAA-NCDC
	Wind speed	NOAA-NCDC
	Dew point	NOAA-NCDC
	Humidity	NOAA-NCDC
	Cloud cover	NOAA-NCDC
	Water quality monitoring data	USEPA STORET, WVDEP
	National Pollutant Discharge Elimination System (NPDES) data	WVDEP DMR, WVDEP DWMM
	Discharge Monitoring Report data	WVDEP DMR, mining companies
	Abandoned mine land data	WVDEP DMR, WVDEP DWMM
	Combined sewer overflow volume	City of Follansbee
Regulatory or policy information	Applicable water quality standards	WVDEP
	Section 303(d) list of impaired waterbodies	WVDEP, USEPA
	Nonpoint Source Management Plans	WVDEP

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring from July 2001 through June 2002 in the Upper Ohio North watershed. The results of this effort were used to confirm the listing of waterbodies not meeting applicable water quality criteria and to identify impaired waterbodies that were not previously listed. TMDLs will be developed for these impaired waterbodies.

TMDLs are developed for impaired waters in six subwatersheds (Figure 3-2): Deep Gut Run, Cross Creek, Allegheny Steel Run, Harmon Creek, Kings Creek, and Tomlinson Run. The impaired waters for which TMDLs are developed are presented in Table 3-3. The table includes the stream code, subwatershed, stream name, and impairments for each stream. Table 3-4 provides a cross-reference for all unnamed tributaries that were renamed during the development of West Virginia's 2004 Section 303(d) list.

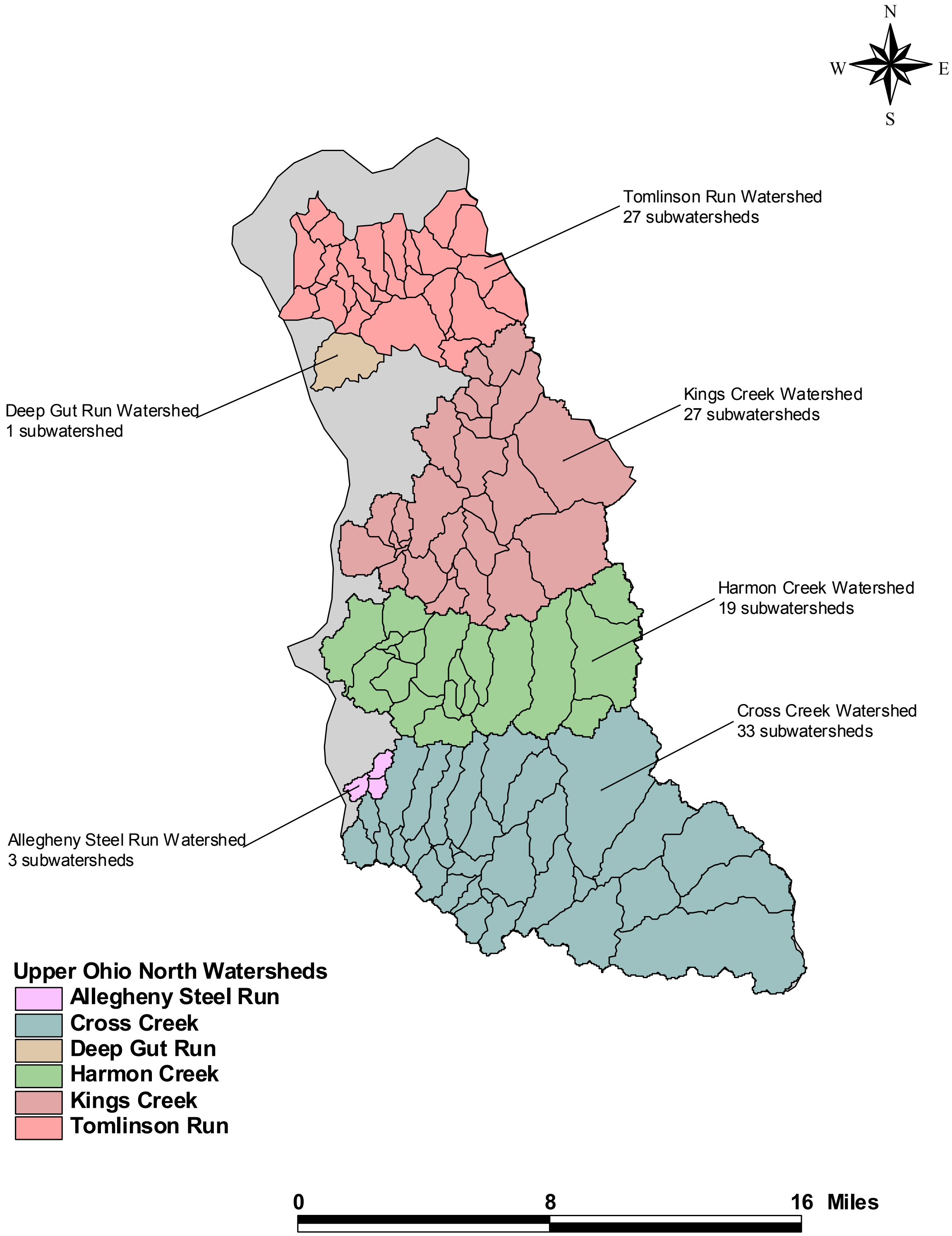

Figure 3-2. Impaired waterbodies in the six subwatersheds of the Upper Ohio North watershed

Table 3-3. Waterbodies and impairments for which TMDLs have been developed

Subwatershed	Stream Code	Stream	Al	Fe	Mn	pH	Bio	FC
Allegheny Steel Run	WVO-95.5	Allegheny Steel Run					X	X
	WVO-95.5-A	UNT/Allegheny Steel Run					X	X
Cross Creek	WVO-95	Cross Creek					X	X
	WVO-95-0.5A	1st UNT/Cross Creek						X
	WVO-95-A	Bosley Run					X	X
	WVO-95-C	North Potrock Run						X
	WVO-95-D	Potrock Run					X	X
Deep Gut Run	WVO-101	Deep Gut Run	X	X	X	X	X	
	WVO-101-E	UNT/Deep Gut Run			X			
Harmon Creek	WVO-97	Harmon Creek					X	X
	WVO-97-0.7A	2nd UNT/Harmon Creek						X
	WVO-97-0.9A	3rd UNT/Harmon Creek						X
	WVO-97-A	Sappingston Run					X	X
	WVO-97-B	Alexanders Run		X	X		X	X
	WVO-97-C	Mechling Run						X
	WVO-97-D	Brown Hollow					X	X
Kings Creek	WVO-98	Kings Creek						X
	WVO-98-0.5A	Turkeyfoot Run						X
	WVO-98-0.7A	Rush Run					X	X
	WVO-98-A	North Fork						X
	WVO-98-A.5	Marrow Run					X	X
	WVO-98-C	UNT/Kings Creek						X
Tomlinson Run	WVO-102-B	South Fork					X	X
	WVO-102-C	North Fork					X	X
	WVO-102-C-1	Mercer Run					X	X
	WVO-102-C-6	Stewarts Run						X

Note: UNT = unnamed tributary; Al = aluminum; Fe = iron; Mn = manganese; Bio = biological impairment; FC = fecal coliform bacteria.

Table 3-4. Cross-reference for all renamed unnamed tributaries per 2004 Section 303(d) list

Stream Code	Work Directive Stream Name	2004 303(d) List Stream Name
WVO-95-0.5A	1st UNT/Cross Creek	UNT/Cross Creek RM 1.7
WVO-95.5-A	UNT/Allegheny Steel Run	UNT/Allegheny Steel Run RM 0.9
WVO-97-0.7A	2nd UNT/Harmon Creek	UNT/Harmon Creek RM 2.9
WVO-97-0.9A	3rd UNT/Harmon Creek	UNT/Harmon Creek RM 3.2
WVO-98-C	UNT/Kings Creek	UNT/Kings Creek RM 6.8
WVO-101-E	UNT/Deep Gut Run	UNT/Deep Gut Run RM 1.8

4. METALS AND pH SOURCE ASSESSMENT

This section identifies and examines the potential sources of aluminum, iron, manganese, pH impairment, and sediment in the Upper Ohio North watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources.

A point source, according to Title 40 of the *Code of Federal Regulations* (CFR), Section 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) program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. For purposes of this TMDL, NPDES-permitted discharge points are considered point sources.

For purposes of these TMDLs only, wasteload allocations are given to NPDES-permitted discharge points and load allocations are given to discharges from activities that do not have an associated NPDES permit, such as mine forfeiture sites and abandoned mine lands, including tunnel discharges, seeps, and surface runoff. The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements.

The physiographic data discussed in the previous section enabled the characterization of pollutant sources. As part of the TMDL development process, WVDEP performed additional field-based source-tracking activities; the resulting information was supplemental to the other available source characterization data. WVDEP staff recorded physical descriptions of pollutant sources and the general condition of the stream in the vicinity of the sources. WVDEP collected global positioning system (GPS) data and water quality samples for laboratory analysis as necessary to characterize the sources and their impacts. Source-tracking information was compiled and electronically plotted on maps using geographic information system (GIS) software. Detailed information, including the locations of pollutant sources, is provided in the subwatershed appendices, the Technical Report, and the ArcExplorer project on the CD version of this TMDL report.

4.1 Metals and pH Point Sources

Metals and pH point sources are classified by the mining and non-mining-related permits issued by WVDEP. No active coal mining operations or industrial manufacturing operations discharge into the impaired waters addressed by this report.

WVDEP issued a general NPDES permit (permit WV0115924) to regulate stormwater flowing into streams from discharges associated with construction activities. Registration under the permit is required for construction activities with a land disturbance greater than 1 acre. Both the land disturbance and the permitting process associated with construction activities are transient in nature. After construction is completed and sites are stabilized, water quality impacts are minimized. Individual registrations under the General Permit are generally limited to a period of less than 1 year. These permits require that the site have properly installed best management practices (BMPs; e.g., silt fences, sediment traps, seeding and mulching, riprap) to prevent or reduce erosion and sediment runoff. At the time of TMDL development, there were six active construction sites registered under the general permit.

4.2 Metals and pH Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to metals- and pH-related water quality impairments. Abandoned mines contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface waters. Similarly, facilities that were subject to the Surface Mining Control and Reclamation Act (SMCRA) during active operations, but subsequently forfeited their bonds and abandoned operations, can be a significant metals and low-pH source. Land disturbance activities that introduce excess sediment are additional nonpoint sources of metals.

4.2.1 Abandoned Mine Lands

WVDEP's Office of Abandoned Mine Lands & Reclamation (AML&R) was created in 1981 to manage the reclamation of lands and waters affected by mining prior to passage of the SMCRA in 1977. The mission of the Office is to protect public health, safety, and property from past coal mining and to enhance the environment through the reclamation and restoration of land and water resources. A fee placed on coal funds the Abandoned Mine Lands (AML) program. Allocations from the AML fund are made to state and tribal agencies through the congressional budgetary process.

Source-tracking efforts by WVDEP DWWM and the Office of AML&R identified a number of AML sources (discharges, seeps, portals, culverts, refuse piles, diversion ditches, and ponds). Field data, such as GPS locations, water samples, and flow measurement, were collected to locate these sources and characterize their impact on water quality. AML sources are the primary cause of metals and pH impairments in the Deep Gut Run watershed.

4.2.2 Bond Forfeiture

Mining permittees are required to post a performance bond to ensure the completion of reclamation. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. The Office of Special Reclamation in WVDEP's Division of Land Restoration made information and data associated with bond forfeiture sites available. There are no bond forfeiture sites in the six selected subwatersheds in the Upper Ohio North watershed.

4.2.3 Sediment Sources

Based on previous watershed modeling (e.g., *Metals and pH TMDLs for the Elk River Watershed* [USEPA, 2001] and *Metals and pH TMDLs for the Tug Fork River Watershed* [USEPA, 2002]), which evaluated sediment/metal interactions and general soil properties in West Virginia, it was concluded that certain sediments contain high levels of aluminum, iron, and to a lesser extent, manganese (Watts et al., 1994). Land disturbance can increase sediment loading to impaired waters, and the control of sediment-producing sources might be necessary to meet water quality criteria for metals during high-flow conditions. Potential sediment-related nonpoint sources of metals are forestry operations, oil and gas operations, roads, agriculture, and barren lands. The number and size of these sources in the Upper Ohio North watershed are summarized below and presented in detail in the appendices of this report.

Significant sediment-related nonpoint sources contribute to iron and manganese impairments only in the Alexanders Run of the Harmon Creek watershed. In the Cross Creek and Tomlinson Run watersheds, sediment was identified as a primary stressor for biological impairment where forestry, roads, agriculture, and other land-disturbing activities are present.

Forestry

The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the watershed. This information included the harvested area and the subset of land disturbed by roads and landings.

West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992 the West Virginia Legislature passed the Logging Sediment Control Act. This act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and the land disturbance associated with creation and use of roads to serve logging sites can increase sediment loading to streams.

According to the Division of Forestry, illicit logging operations account for approximately an additional 2.5 percent of the total harvested forest (registered logging sites) throughout West Virginia. These illicit operations do not have properly installed BMPs and can contribute to sediment loading to streams.

Oil and Gas

The WVDEP Office of Oil and Gas (OOG) is responsible for monitoring and regulating all actions related to the exploration, drilling, storage, and production of oil and natural gas in West Virginia. It maintains records on more than 40,000 active and 25,000 inactive oil and gas wells, manages the Abandoned Well Plugging and Reclamation Program, and ensures that surface water and groundwater are protected from oil and gas activities.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP *OOG* GIS coverage. There are no active oil and gas wells in the subwatersheds addressed in this report.

Roads

Runoff from paved and unpaved roadways can contribute significant sediment loads to nearby streams. Heightened stormwater runoff from paved roads can increase erosion potential. Unpaved roads can contribute sediment through precipitation-driven runoff. Roads that traverse stream paths elevate the potential for direct deposition of sediment. Road construction and repair can further increase sediment loads if BMPs are not properly employed.

Information on roads was obtained from various sources, including the 2000 TIGER/Line GIS shapefiles from the U.S. Census Bureau and the *WV Roads* GIS coverage prepared by West Virginia University (WVU).

Agriculture
Agricultural land can be a significant source of sediment. Agricultural runoff can contribute increased pollutant loads when farming practices allow soils to be washed into the stream, increasing in-stream sediment levels. The erosion potential of cropland and overgrazed pastureland is particularly high because of the lack of year-round vegetative cover. Livestock traffic, especially along stream banks, disturbs the land surface and reduces vegetative cover, causing an increase in erosion from these areas. The use of cover crops and other management practices has been shown to reduce the transport of sediment loads from agricultural lands.

Other Land Disturbance Activities
As stated previously, WVDEP issues general NPDES permits to regulate sediment contributions to streams from discharges associated with construction activities that disturb more than 1 acre. Construction activities that disturb less than 1 acre are not subject to construction stormwater permitting and are uncontrolled sources of sediment. Areas in the Alexanders Run watershed were identified as recently developed. These areas have high erosion potential (during the development phase), which could contribute to the delivery of sediment and associated naturally occurring metals to the stream.

5. FECAL COLIFORM SOURCE ASSESSMENT

5.1 Fecal Coliform Point Sources

The most prevalent point sources of fecal coliform bacteria are the permitted discharges from sewage treatment plants. All treatment plants are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform limitations (200 counts/100 milliliter [average monthly] and 400 counts/100 mL [maximum daily]). However, noncompliant discharges and collection system overflows can contribute loadings of fecal coliform bacteria to receiving streams. The following sections discuss the specific types of fecal coliform point sources identified in the Upper Ohio North watershed.

5.1.1 Individual NPDES Permits

WVDEP issues individual NPDES permits to both publicly owned and privately owned wastewater treatment facilities. Publicly owned treatment works (POTWs) are relatively large facilities with extensive wastewater collection systems, whereas private facilities are generally used in smaller applications such as subdivisions and shopping centers.

No POTWs discharge treated effluent to any of the fecal coliform-impaired waters. However, sections of the sewer systems servicing the King’s Creek and Harmon Creek watersheds were reported to have plugged or leaking lines, resulting in historical discharges of fecal coliform bacteria.

5.1.2 Overflows

Combined sewer overflows (CSOs) are outfalls from POTW sewer systems that carry untreated domestic waste and surface runoff. CSOs contain fecal coliform bacteria and are permitted to discharge only during precipitation events. Two CSO outfalls discharge to the fecal coliform-impaired streams of the Upper Ohio North watershed. The CSO outlets are associated with the City of Follansbee wastewater treatment plant (WV0020273) discharge to Allegheny Steel Run and the 1st Unnamed Tributary of Cross Creek.

5.1.3 Municipal Separate Storm Sewer Systems

USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from municipal separate storm sewer systems (MS4s). There is one designated MS4 municipality, the City of Weirton, in the watershed. Weirton's MS4 has discharges in the Kings Creek and Harmon Creek watersheds, and the City has filed a Notice of Intent for MS4 permit issuance. The area within the corporate limits is assumed to be subject to MS4 stormwater permitting.

5.1.4 General Sewage Permits

General sewage permits are designed to cover similar discharges from numerous individual owners and facilities throughout the state. General Permit WV0103110 regulates small, privately owned sewage treatment plants ("package plants") that have a design flow of less than 50,000 gallons per day (gpd). General Permit WV0107000 regulates Home Aeration Units (HAUs). HAUs are small sewage treatment plants primarily used by individual residences where site considerations preclude typical septic tank and leach field installation. Both general permits contain fecal coliform effluent limitations identical to those in individual NPDES permits for sewage treatment facilities. Within the watersheds addressed by this report, nine facilities are registered under the "package plant" general permit and three are registered under the HAU general permits.

5.2 Fecal Coliform Nonpoint Sources

5.2.1 On-site Treatment Systems

Overall, failing septic systems and straight pipes represent the most significant non-permitted, nonpoint source of fecal coliform bacteria in the Upper Ohio North watershed. According to Dave Thorton of the West Virginia Department of Health, the failure rate for septic systems in the watershed is estimated to be 70 percent during the first 10 years after installation. Information collected during source-tracking efforts by WVDEP yielded an estimate of 1,008 homes in the 6 TMDL subwatersheds that are not served by centralized sewage collection and treatment systems.

For the purposes of this TMDL, discharges from activities that do not have an associated NPDES permit, such as failing septic systems and straight pipes, are considered nonpoint sources. The decision to assign load allocations to those sources does not reflect a determination by WVDEP or USEPA as to whether there are, in fact, nonpermitted point source discharges. In addition, by establishing these TMDLs with failing septic systems and straight pipes treated as load allocations, WVDEP and USEPA are not determining that such discharges are exempt from NPDES permitting requirements.

5.2.2 Stormwater Runoff

Stormwater runoff represents another nonpoint source of fecal coliform bacteria in residential and urbanized areas. Runoff from residential and urbanized areas during storm events can be a significant source, delivering bacteria from the waste of pets and wildlife to the waterbody. MRLC land use was used to determine the number of acres of residential and urbanized areas.

5.2.3 Agriculture

Agricultural activities can contribute fecal coliform bacteria to receiving streams through surface runoff or direct deposition. Grazing livestock and land application of manure result in the deposition and accumulation of bacteria on land surfaces, where the bacteria are available for wash-off and transport during rain events. In addition, livestock with unrestricted access can deposit feces directly into streams.

According to the U.S. Department of Agriculture's 1997 Census of Agriculture, there are 1,695 farms in Brooke, Hancock, Beaver, and Washington counties. Of that total, 95 are in Brooke County, West Virginia; 64 are in Hancock County, West Virginia; 499 are in Beaver County, Pennsylvania; and 1,037 are in Washington County, Pennsylvania. They cover approximately 407 square miles of land in total (USDA 1997) Livestock counts from the 1997 Census of Agriculture and manure characteristics from the American Society of Agricultural Engineers (ASAE) were used to develop fecal coliform accumulation rates for these agricultural areas. Additional information from WVDEP source-tracking efforts was used to determine the accessibility of the livestock to the stream. In general, the animal density on pastured lands in the West Virginia portion of the subwatersheds was fairly low. The densities estimated for Washington County, Pennsylvania, were significantly higher.

5.2.4 Natural Background (Wildlife)

A certain "natural background" contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested areas. Accumulation rates for fecal coliform bacteria in forested areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from the West Virginia Division of Natural Resources. Based on the low fecal accumulation rates for forested areas, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the Upper Ohio North watershed.

6. BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

Initially, TMDL development in biologically impaired waters requires the identification of pollutants that cause the stress to the biological community. Sources of those pollutants are often analogous to those already described: mine drainage, untreated sewage, and sediment are known stressors in this watershed. The Technical Report discusses biological impairment and the stressor identification (SI) process in detail.

6.1 Introduction

Assessment of the biological integrity of a stream is based on a survey of the stream's benthic macroinvertebrate community. Benthic macroinvertebrate communities are rated using a multimetric index developed for use in wadeable streams of West Virginia. The West Virginia Stream Condition Index (WVSCI; Gerritsen et al. 2000) is composed of six metrics that were selected to maximize discrimination between streams with known impairments and reference streams. In general, streams with WVSCI scores of less than 60.6 points, on a normalized 0–100 scale, are considered biologically impaired.

Biological assessments are useful in detecting impairment, but they might not clearly identify the cause(s) of impairment, which must be determined before TMDL development can proceed. USEPA developed *Stressor Identification: Technical Guidance Document* (Cormier et al. 2000) to assist water resource managers in identifying stressors and stressor combinations that cause biological impairment. Elements of the stressor identification process were used to evaluate and identify the primary stressors to the impaired benthic communities. In addition, custom analyses of biological data were performed to supplement the framework recommended by the guidance document.

The general stressor identification process entailed reviewing available information, forming and analyzing possible stressor scenarios, and implicating causative stressors. The stressor identification method provides a consistent process for evaluation of available information. TMDLs were established for the responsible pollutants at the conclusion of the stressor identification process. As a result, the TMDL process established a link between the impairment and benthic community stressor(s).

6.2 Data Review

WVDEP generated the primary data used in stressor identification through its pre-TMDL monitoring program. The program included water quality monitoring, benthic sampling, and habitat assessment. In addition, the biologists' comments regarding stream condition and potential stressors and sources were captured and considered. Other data sources were source-tracking data, MRLC land use information, Natural Resources Conservation Service (NRCS) STATSGO soils data, NPDES point source data, and literature sources.

6.3 Candidate Causes/Pathways

The first step in the stressor identification process was to develop a list of candidate causes, or stressors. The candidate causes responsible for biological impairments are listed below:

- Metals contamination (including metals contributed through soil erosion) causes toxicity.
- Acidity (low pH) causes toxicity.
- High sulfates and increased ionic strength cause toxicity.
- Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations.
- Altered hydrology causes higher water temperature, resulting in direct impacts.

- Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO).
- Algal growth causes food supply shift.
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth).
- Chemical spills cause toxicity.

A conceptual model was developed to examine the relationship between candidate causes and potential biological effects. The conceptual model (Figure 6-1) depicts the sources, stressors, and pathways that affect the biological community.

6.4 Stressor Identification Results

The results of the stressor identification process determined the primary causes of biological impairment. In some cases, biological impairment was linked to a single stressor; in others, multiple stressors were responsible for the impairment. The stressor identification process identified the following stressors for the biologically impaired water of the Upper Ohio North watershed:

- Metals toxicity
- pH toxicity
- Sedimentation
- Organic enrichment (the combined effects of oxygen-demanding pollutants, nutrients, and the resultant algal and habitat alteration)

After stressors were identified, WVDEP determined the pollutant(s) for which TMDLs were required to address the impairment.

The stressor identification process identified metals toxicity and pH toxicity as biological stressors in waters that also demonstrated violations of the iron, aluminum, or pH numeric water quality criteria for protection of aquatic life. WVDEP determined that implementation of those pollutant-specific TMDLs would address the biological impairment.

Where organic enrichment was identified as the biological stressor, the waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. The predominant source of fecal coliform bacteria in the watershed is inadequately treated sewage. Significant agricultural activity is also present, primarily in the Pennsylvania portion of the watershed. WVDEP determined that implementation of fecal coliform TMDLs would remove untreated sewage and limit the introduction of livestock wastes, thereby reducing the organic and nutrient loading causing the biological impairment. Therefore, fecal coliform TMDLs will serve as a surrogate where organic enrichment was identified as a stressor.

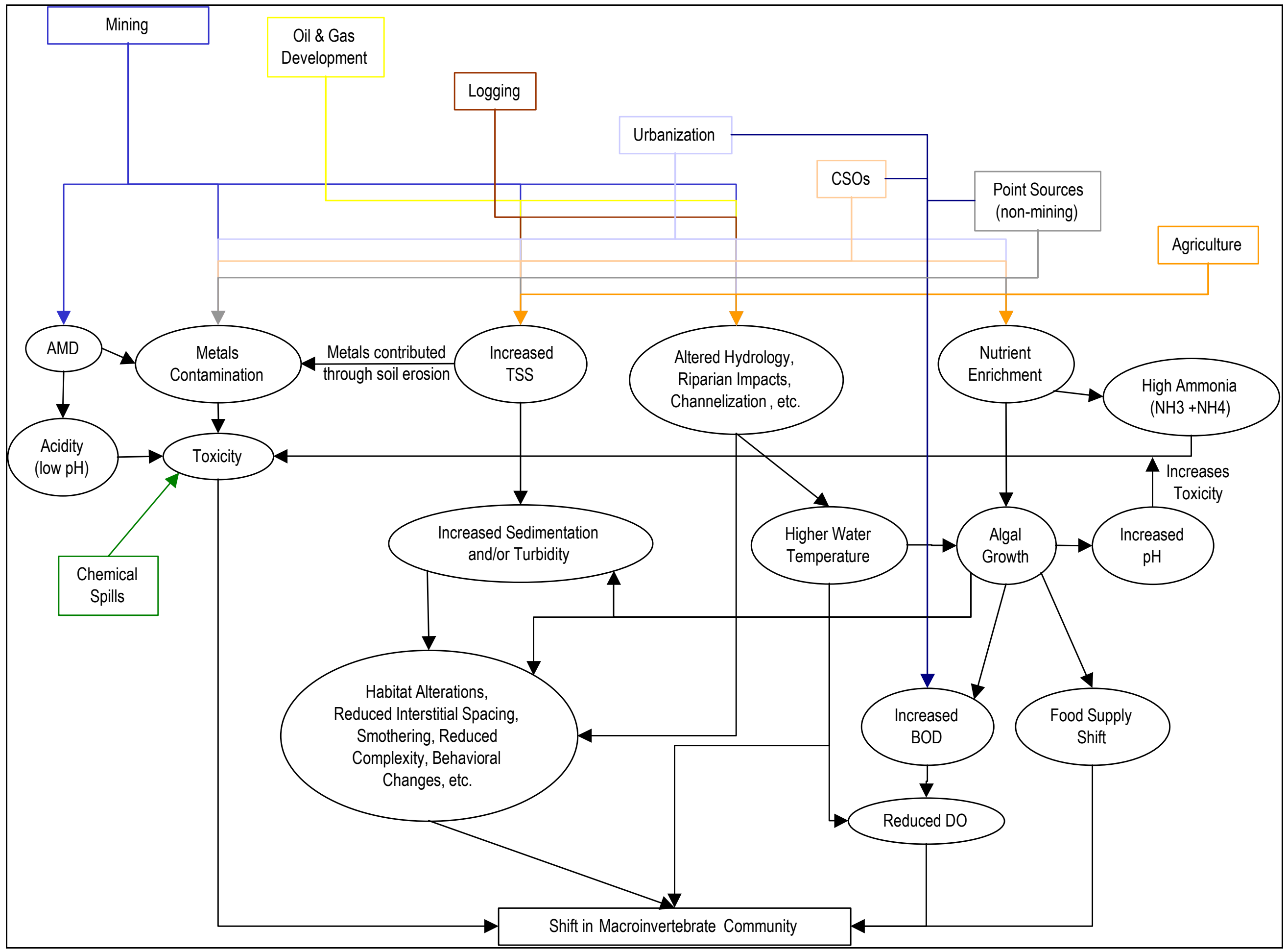

Figure 6-1. Conceptual model of candidate causes and potential biological effects for the Upper Ohio North watershed.(Note: All sources are listed along the top of the figure (in rectangles) except chemical spills, which is on the left side.)

Where the stressor identification process indicated sedimentation as a causative stressor, WVDEP developed sediment TMDLs.

Table 6-1 summarizes the primary stressors' contributions to biological impairments in the Upper Ohio North watershed.

Table 6-1. Primary stressors of biologically impaired streams in the Upper Ohio North watershed

Major Watershed	Stream	Primary Stressors	TMDL Required
Allegheny Steel Run	Allegheny Steel Run	Organic enrichment	Fecal coliform bacteria
	Unnamed tributary to Allegheny Steel Run	Organic enrichment	Fecal coliform bacteria
Cross Creek	Cross Creek	Organic enrichment Sedimentation	Fecal coliform bacteria Sediment
	Bosley Run	Organic enrichment	Fecal coliform bacteria
	Potrock Run	Organic enrichment	Fecal coliform bacteria
Deep Gut Run	Deep Gut Run	Metals toxicity (Al, Fe) Acidity (pH)	Aluminum, Iron pH
Harmon Creek	Harmon Creek	Organic enrichment	Fecal coliform bacteria
	Sappingston Run	Organic enrichment	Fecal coliform bacteria
	Alexanders Run	Organic enrichment Iron toxicity (secondary)	Fecal coliform bacteria Iron
	Brown Hollow	Organic enrichment	Fecal coliform bacteria
Kings Creek	Rush Run	Organic enrichment	Fecal coliform bacteria
	Marrow Run	Organic enrichment	Fecal coliform bacteria
Tomlinson Run	South Fork	Organic enrichment Sedimentation	Fecal coliform bacteria Sediment
	North Fork	Organic enrichment Sedimentation	Fecal coliform bacteria Sediment
	Mercer Run	Organic enrichment Sedimentation	Fecal coliform bacteria Sediment

Note: Al = aluminum; Fe = iron.

7. MODELING PROCESS

Establishing the relationship between the in-stream 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. 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 in-stream response for TMDL development in the Upper Ohio North watershed.

7.1 Modeling Technique for Metals, pH, and Fecal Coliform Bacteria

Selection of the appropriate analytical technique for TMDL development was based on an evaluation of technical and regulatory criteria. The following key technical factors were considered in the selection process:

- Scale of analysis is important.
- Point and nonpoint sources must be considered.
- Metals, pH, and fecal coliform bacterial impairments are temporally variable and occur at low, average, and high flow conditions.
- Time-variable aspects of land practices have a large effect on in-stream metals and bacteria concentrations.
- Metals and bacteria transport mechanisms are highly variable and often weather-dependent.

The primary regulatory factor that drove the selection process was West Virginia's water quality criteria. According to 40 CFR Part 130, TMDLs must be designed to implement applicable water quality standards. The applicable water quality standards for metals, pH, and fecal coliform bacteria in West Virginia are presented in Section 2, Table 2-1. Compliance with the criteria requires attaining conditions that protect against both short-term (acute) effects and long-term (chronic) effects. West Virginia water quality criteria are applicable at all stream flows greater than the 7-day, 10-year low flow (7Q10). The approach or modeling technique must permit representation of in-stream concentrations under a variety of flow conditions to evaluate critical flow periods for comparison to chronic and acute criteria.

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and in-stream fate. For the Upper Ohio North watershed, primary sources contributing to metals, pH, and fecal coliform impairments include an array of point and nonpoint sources. Nonpoint sources are typically rainfall-driven with pollutant loadings primarily related to surface runoff. Point source discharges might or might not be induced by rainfall.

A variety of modeling tools were used to develop the TMDLs, including the Mining Data Analysis System (MDAS), the Dynamic Equilibrium In-stream Chemical Reactions model (DESC-R), and the Fecal Coliform Loading Estimation Spreadsheet (FCLES).

MDAS is a system designed to support TMDL development for areas affected by nonpoint and point sources. The MDAS component most critical to TMDL development is the dynamic watershed model because it provides the linkage between source contributions and in-stream response. MDAS is used to simulate watershed hydrology and pollutant transport, as well as stream hydraulics and in-stream water quality. It is capable of simulating different flow regimes and pollutant loading variations. Metals and fecal coliform bacteria were modeled using MDAS.

Metals are modeled in MDAS in total recoverable form. Therefore, it was necessary to link MDAS with the DESC-R to appropriately address dissolved aluminum TMDLs in the Deep Gut Run watershed. The DESC-R was also used to represent the source-response linkage for pH. The model selection process, modeling methodologies, and technical approaches are discussed further in the Technical Report.

FCLES is a spreadsheet tool used to quantify nonpoint source bacteria accumulation rates based on watershed-specific information. FCLES (Fecal Tool) is a Microsoft Excel spreadsheet tool that estimates the fecal coliform bacteria contribution from multiple sources. Inputs to the Fecal Tool may be generated manually or by using various functions of the Watershed Characterization System. Output from the Fecal Tool is used as input to MDAS. The tool estimates the monthly accumulation rate of fecal coliform bacteria on four land uses (cropland, forest, built-up, and pastureland), as well as the asymptotic limit for that accumulation should no wash-off occur. The tool also estimates the direct input of fecal coliform bacteria to streams from grazing agricultural animals and failing septic systems. The Fecal Tool provides starting values for model input; however, a thorough calibration of the model is still necessary.

7.1.1 MDAS Setup

Configuration of the MDAS model involved subdivision of the Upper Ohio North watershed into modeling units. Continuous simulation of flow and water quality for those units was accomplished by using meteorological, land use, point source loading, and stream data.

The watershed was broken into six separate watershed units based on the watershed groupings of impaired streams shown in Table 3-1. These subwatersheds were further subdivided to allow evaluation of water quality and flow at pre-TMDL monitoring stations**.** This subdivision process also ensured a proper stream network configuration within the basin. The subwatershed delineation for each of the six watersheds is shown in Figure 7-1.

Modeled land uses contributing to metals loads include forest, cropland, pasture, urban/residential pervious lands, urban/residential impervious lands, barren areas, roads, harvested forest, and abandoned mines. These sources were represented explicitly by consolidating existing GAP2000 land use categories to create model land use groupings. Several additional land use categories were created to account for recent land disturbance activities (e.g., harvested forest, oil and gas operations, unpaved roads, and active mining) that are not represented in the GAP2000 land use coverage. The process of consolidating and updating the modeled land uses is explained in further detail in the Technical Report. Other sources, such as AML seeps identified by WVDEP's source-tracking efforts, were modeled as direct, continuous-flow sources in the model.

Modeled land uses contributing bacteria loads include pasture, cropland, urban/residential pervious lands, urban/residential impervious lands, and forest (including barren and wetlands). Other sources, such as failing septic systems, straight pipes, and permitted sources, were modeled as direct, continuous-flow sources in the model. The basis for the initial loading rates for land uses and direct sources is described in the Technical Report. The initial estimates were further refined during the model testing (calibration).

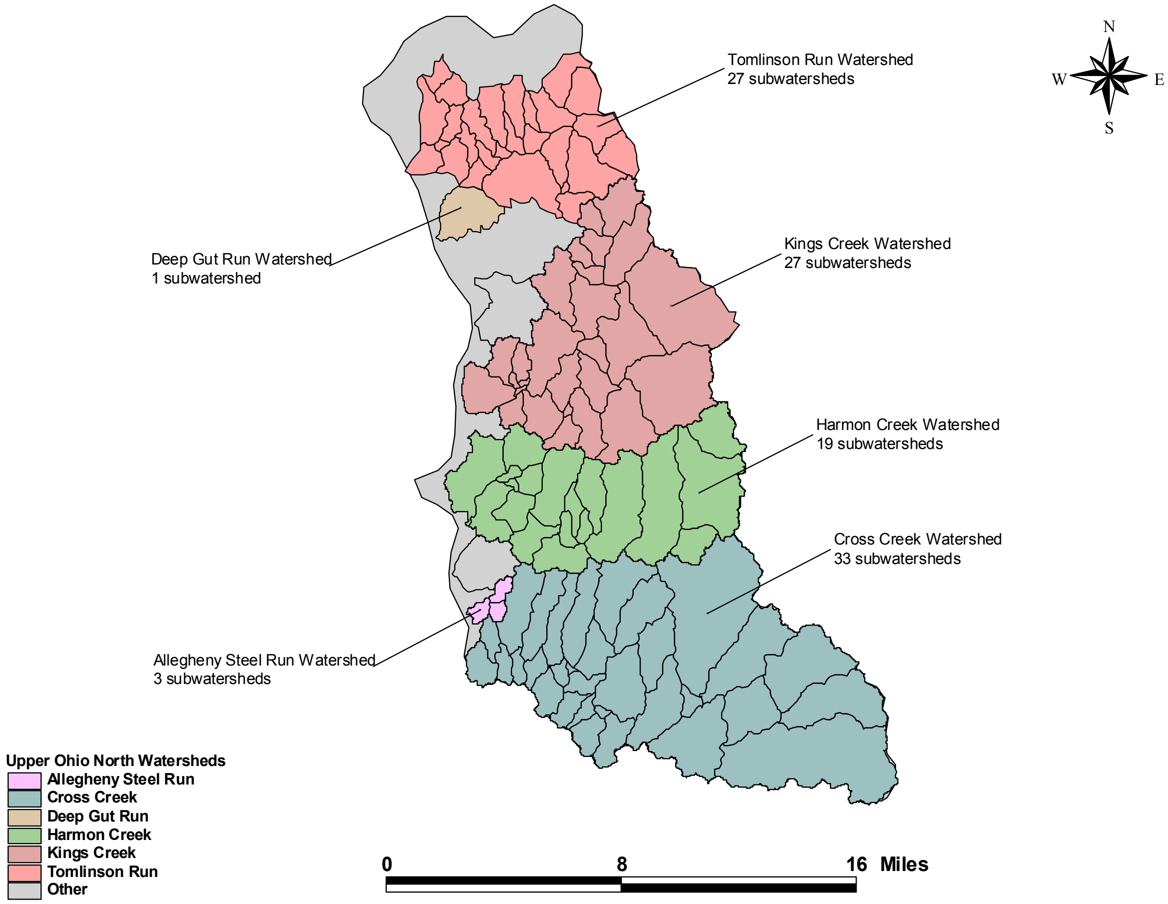

Figure 7-1. Upper Ohio North subwatershed delineation

7.1.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Hydrology calibration typically involves a comparison of model results to in-stream flow observations from USGS flow gauging stations throughout the watershed. Only one USGS flow gauging station in the Upper Ohio North watershed (Kings Creek at Weirton, West Virginia) had adequate data records for hydrology calibration. Key considerations for hydrology calibration included the overall water balance, the high-flow and low-flow distribution, storm flows, and seasonal variation. The model was calibrated to the observed data recorded on the Kings Creek watershed from October 1976 to August 1978. Hydrology calibration was based on observed data from this station and land uses present in the watershed at that time. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the Upper Ohio North watershed. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

7.1.3 Water Quality Calibration

Following hydrology calibration, the water quality was calibrated by comparing modeled versus observed in-stream metals and fecal coliform bacteria concentrations. The water quality calibration consisted of executing MDAS, comparing the model results to available observations, and adjusting water quality parameters within a reasonable range. Ranges were based on previous watershed modeling experience in West Virginia (*pH and Metals TMDLs for the Tug Fork River Watershed, 2002* and *Metals, pH, and Fecal Coliform TMDLs for the Guyandotte River Watershed, West Virginia, 2004*). Parameters for background conditions were established using observations from undisturbed areas.

As stated in Section 7.1, it was necessary to link MDAS with the DESC-R to appropriately address dissolved aluminum TMDLs. The DESC-R was calibrated by adjusting water quality parameters to match the observed in-stream water quality data. Further description and a summary of the results of the DESC-R water quality calibration and validation are presented in the Technical Report.

7.2 Modeling Technique for Sediment

Stressor identification results indicated a need to reduce the contribution of excess sediment to certain biologically impaired streams in the Upper Ohio North watershed, as discussed in Section 6. As a result, sediment TMDLs were developed by integrating a watershed loading model that quantified land-based loads and a stream routing model that examined stream bank erosion and deposition processes.

Selection of this modeling system for the development of sediment TMDLs was based on the evaluation of available technical and regulatory criteria. The key technical factors listed in Section 7.1 were also considerations in the model selection process for sediment TMDL development. The adequate representation of erosion processes and nonpoint source loads in the watershed were of primary concern in selecting the appropriate modeling system.

Narrative criteria are included in West Virginia’s water quality standards (Title 46 CSR Series 1 - 3.2.i), as discussed in Section 2 of this report. The narrative water quality criterion prohibits the presence in state waters of wastes that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for “biological impairment” determinations. WVDEP assesses compliance with the narrative criteria by monitoring the benthic macroinvertebrate community. Sediment reductions are required to restore water quality and habitat conditions in many of the biologically impaired streams in the Upper Ohio North watershed.

A reference watershed approach was used to establish the acceptable level of sediment loading for each impaired stream on a watershed-specific basis. This 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 represent the conditions needed for the impaired stream to attain its designated uses. Given these parameters and a non-impaired West Virginia Stream Conditions Index (WVSCI) score, the North Fork of Kings Creek was selected as the reference**.** The location of the North Fork of Kings Creek watershed is shown in Figure 7-2.

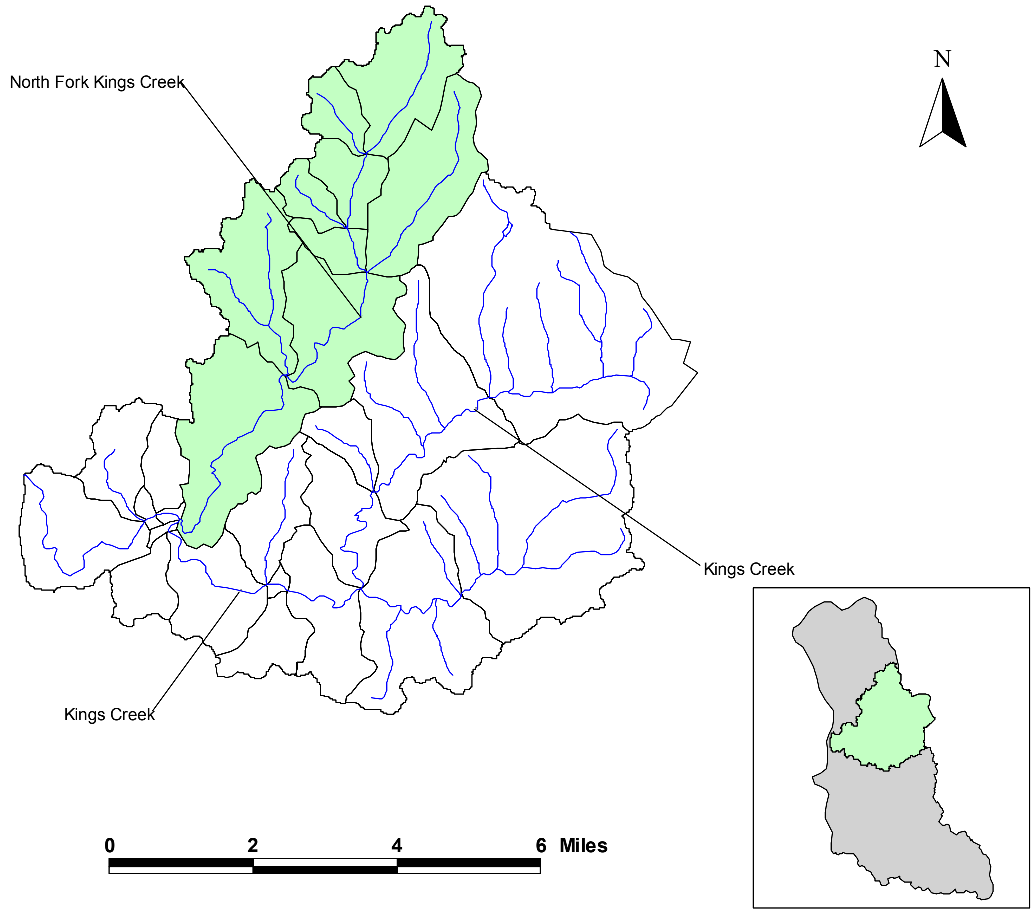

Figure 7-2. Location of the North Fork of Kings Creek watershed

Sediment loading rates were determined for impaired and reference watersheds. Both point and nonpoint sources were considered in the analysis**,** and numeric endpoints were based on the calculated sediment loading from the reference watershed. Sediment load reductions necessary to meet these endpoints were then determined. TMDL allocation scenarios were developed based on an analysis of the degree to which contributing sources could be reasonably reduced.

TMDLs were developed using BasinSim 1.0 (Dai et al. 2000), the Generalized Watershed Loading Functions (GWLF) model (Haith and Shoemaker 1987), and the Stream Module (Tetra Tech 2003). A variety of GIS tools, local watershed data, and site visit observations were used to develop the input data needed for modeling and TMDL development.

The GWLF model was used to estimate the sediment loads contributed by each modeled watershed. GWLF is a continuous-simulation model that simulates runoff, sediment, and nutrient loadings. GWLF modeling was accomplished using the BasinSim 1.0 watershed simulation program. BasinSim 1.0 is a Windows-based GIS platform that facilitates execution of the GWLF model and development of model input data.

The Stream Module was used to model sediment transport/routing and stream bank erosion/deposition processes. The stream bank erosion simulation module employed the algorithm used in the Annualized Agricultural Nonpoint Source (AnnAGNPS) model (Bingner and Theurer 2000). Subwatershed loads calculated by GWLF and point source loads were input into the Stream Module to calculate the sediment loading to each stream channel and the load routed downstream. The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling.

7.2.1 GWLF/Stream Module Setup

The GWLF/Stream Module was configured for each impaired and reference stream in the watershed. Modeled watersheds were subdivided to simulate hydrologic and sediment loading characteristics using available meteorological, land use, point source loading, and stream data. Stream channel observational data provided by WVDEP were used to set up the Stream Module for the simulation of stream routing and erosion/deposition processes.

A continuous simulation period of 2 years was used in the hydrologic simulation analysis. An important factor driving model simulations is precipitation data. The pattern and intensity of rainfall affect erosion and the contribution of sediment from the land to the stream. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land and forested land, land slope, soil erosion potential, and land disturbance activities, in each modeled watershed. Various parameters can be adjusted in the model to account for these conditions and practices.

Modeled land uses include forest (including wetlands), cropland, pasture, urban/residential pervious lands, urban/residential impervious lands, barren areas, roads, harvested forest, and abandoned mines.

7.2.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. The modeling period was determined based on the availability of weather and flow data collected during the same time period. As stated in Section 7.1.1, there is only one USGS flow gauging station in the Upper Ohio North watershed with adequate data records for hydrology calibration. As with MDAS, the GWLF hydrology calibration was performed on the Kings Creek watershed and the model parameters were then applied to the other watersheds. The model was calibrated to the observed data recorded on the Kings Creek watershed from October 1976 to August 1978. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

7.2.3 Water Quality Calibration

GWLF is an empirical model that was developed based on established relationships between rainfall, erosion, and sediment transport. The Universal Soil Loss Equation (USLE) and runoff curve numbers developed by the NRCS form the basis of the GWLF model. Given proper model setup and sediment source representation, water quality calibration is usually not required for this empirically based model. Water quality calibration was performed, however, to verify the accurate representation of land uses in each watershed and the parameter values used in model simulations. GWLF predicted average annual and monthly sediment loads for each modeled watershed. Those results were compared to available water quality data (total suspended solids and turbidity data) and habitat data collected by WVDEP for each stream.

7.3 Allocation Analysis

As explained in Section 2 of this report, a TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate measures. Conceptually, this definition is denoted by the equation:

TMDL = sum of WLAs + sum of LAs + MOS

To develop aluminum, iron, manganese, pH, fecal coliform bacteria, and sediment TMDLs for each of the waterbodies listed in Table 3-3 of this report, the following approach was taken:

- Define TMDL endpoints.
- Simulate baseline conditions.
- Assess source loading alternatives.
- Determine the TMDL and source allocations.

7.3.1 TMDL Endpoints

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. Where applicable, TMDLs are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Analysis of available data indicated that critical conditions occur during both high- and low-flow events. 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. Therefore, because this variability is present throughout the Upper Ohio North watershed, the TMDLs are presented as average annual loads. Different TMDL endpoints are necessary for dissolved aluminum, total iron, total manganese, pH, fecal coliform bacteria, and sediment. West Virginia’s numeric water quality criteria for the subject pollutants (identified in Section 2) and an explicit MOS were used to identify endpoints for TMDL development.

Dissolved Aluminum, Total Iron, and Total Manganese

The TMDL endpoints for dissolved aluminum were selected as 712.5 micrograms per liter (µg/L; based on the 750 µg/L acute criterion for aquatic life minus a 5 percent MOS) and 82.7 µg/L (based on the 87 µg/L chronic criterion for aquatic life minus a 5 percent MOS). The endpoint for total iron was selected as 1.425 mg/L (based on the 1.5 mg/L criterion for aquatic life minus a 5 percent MOS). The endpoint for total manganese was selected as 0.95 mg/L (based on the 1.0 mg/L criterion for human health minus a 5 percent MOS).

Components of the TMDLs for aluminum, iron, and manganese are presented as average annuals loads in terms of pounds of pollutant per year.

Fecal Coliform Bacteria
The endpoint for fecal coliform bacteria was selected as the instantaneous endpoint of 380 counts/100 mL (based on the 400 counts/100 mL criterion for human health minus a 5 percent MOS) and the geometric mean endpoint of 190 counts/100 mL (based on the 200 counts/100 mL geometric mean criterion minus a 5 percent MOS). The instantaneous criterion is more stringent and more difficult to obtain; however, both criteria are satisfied in this TMDL. Components of the TMDLs for fecal coliform bacteria are presented as average annuals loads in terms of total counts (fecal coliform colonies) pollutant per year.

pH
The water quality criteria for pH allow no values below 6.0 or above 9.0. With respect to acid mine drainage, pH is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near-neutral pH (~ 7) 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 that reducing in-stream metals (iron and aluminum) concentrations 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 DESC-R model. By executing the DESC-R model under TMDL conditions (conditions in which TMDL endpoints for metals were met), the equilibrium pH could be predicted. The Technical Report contains a detailed description of the pH modeling approach. The TMDLs for the pH-impaired streams are presented as the median equilibrium pH that was calculated based on the daily equilibrium pH output (6-year simulation period) from the DESC-R model.

Sediment
The endpoints for the sediment TMDLs were based on the simulated reference watershed sediment loading (from the North Fork of Kings Creek watershed). A 5 percent MOS was applied to the reference sediment load, and the sediment load reductions necessary to meet those endpoints were then determined. TMDL allocation scenarios were developed based on an analysis of the degree to which contributing sources could be reasonably reduced.

Components of the TMDLs for sediment are presented as average annuals loads in terms of tons of pollutant per year.

Margin of Safety
A 5 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 in-stream conditions that occurred during the simulation period. The explicit 5 percent MOS also accounts for those cases where monitoring data might not have captured the full range of in-stream conditions.

7.3.2 Baseline Conditions and Source Loading Alternatives

The calibrated model provided the basis for performing the allocation analysis. The first step in this analysis involved simulation of baseline conditions. Baseline conditions represent existing nonpoint source loadings and point source loadings at permit limits. Baseline conditions allow for an evaluation of in-stream water quality under the highest expected loading conditions.

Baseline Conditions for MDAS
The MDAS model was run for baseline conditions using hourly precipitation data for a representative 6-year period (1987 to 1992). The precipitation experienced over this period was applied to the land uses and pollutant sources as they existed at the time of TMDL development. Predicted in-stream concentrations were compared directly to the TMDL endpoints. Using the model linkage described in Section 7.1, total aluminum was simulated using the MDAS model and the DESC-R model was used to compare predicted dissolved aluminum concentrations to the TMDL endpoint. This comparison allowed for the evaluation of the magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods.

Figure 7-3 presents the annual rainfall totals for the years 1980 through 2002 at the Pittsburgh Airport weather station in Pittsburgh, Pennsylvania. The years from 1987 to 1992 are highlighted to indicate that a range of precipitation conditions was used for TMDL development.

Permitted conditions for fecal coliform bacteria point sources were represented during baseline conditions using the design flow for each facility and the monthly average effluent limitation of 200 counts/100 mL.

Baseline Conditions for GWLF
The calibrated GWLF model provided the basis for performing the allocation analysis. The first step in the analysis involved simulation of baseline conditions. The baseline conditions allowed for an evaluation of in-stream water quality under the highest expected loading conditions. The pollutant loadings from nonpoint sources were modeled based on precipitation and runoff; non-mining point sources were represented at design flow and the total suspended solids limits of their permits. The GWLF model was run for baseline conditions using daily precipitation data for the representative period discussed earlier. The precipitation data were applied to the land uses and pollutant sources that existed at the time of TMDL development. The resultant predicted watershed loadings were then compared directly to the TMDL endpoint. Similar to MDAS, this comparison allowed evaluation of sediment loadings under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods.

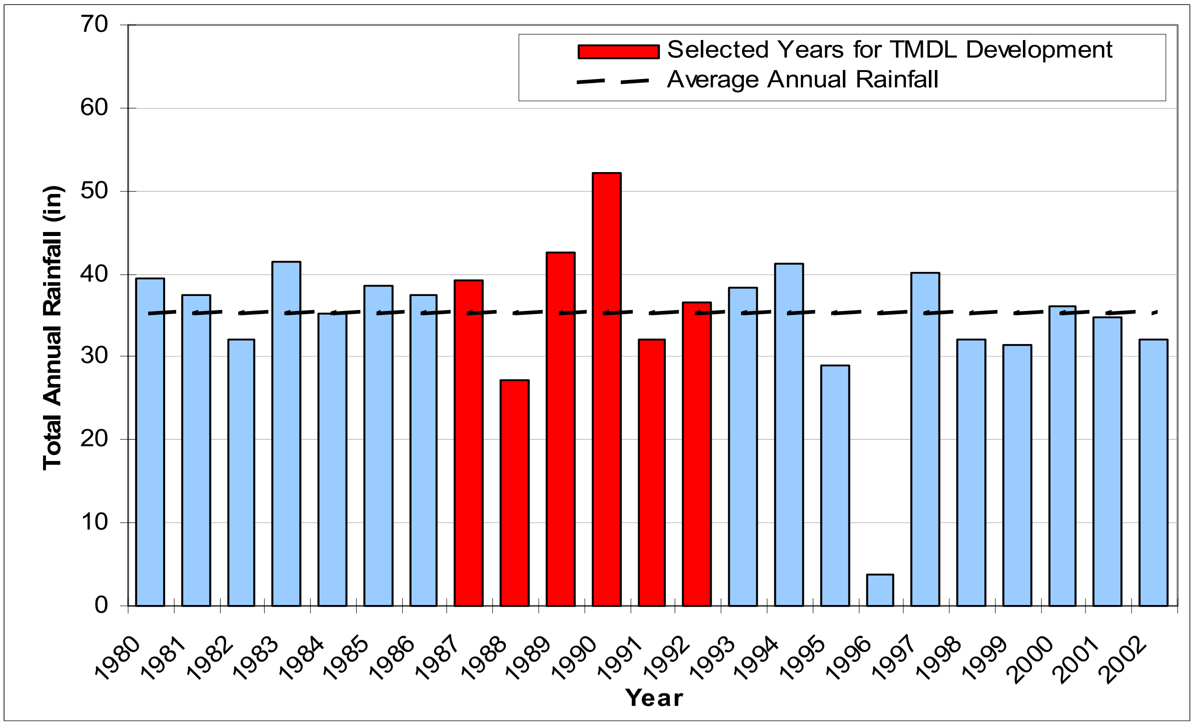

Figure 7-3. Annual precipitation totals and percentile ranks for the Pittsburgh Airport weather station in Pittsburgh, Pennsylvania

Source Loading Alternatives

The simulation of baseline conditions allows for the evaluation of each steam'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 in-stream pollutant concentrations. The loading contributions from abandoned mines and other nonpoint sources were individually adjusted; the modeled in-stream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies. Successful scenarios were those which achieved the TMDL endpoints under all flow conditions throughout the modeling period. For dissolved aluminum scenario development, the DESC-R output was compared directly to the TMDL endpoint. If the predicted dissolved aluminum concentrations exceeded the TMDL endpoint, the total aluminum sources represented in MDAS were reduced. The averaging period and allowable exceedance frequency associated with West Virginia water quality criteria were considered in these assessments. In general, loads contributed by sources that had the greatest impact on in-stream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, subsequent reductions were made to less significant source contributions.

An example of model output for a baseline condition and a successful TMDL scenario is displayed in Figure 7-4.

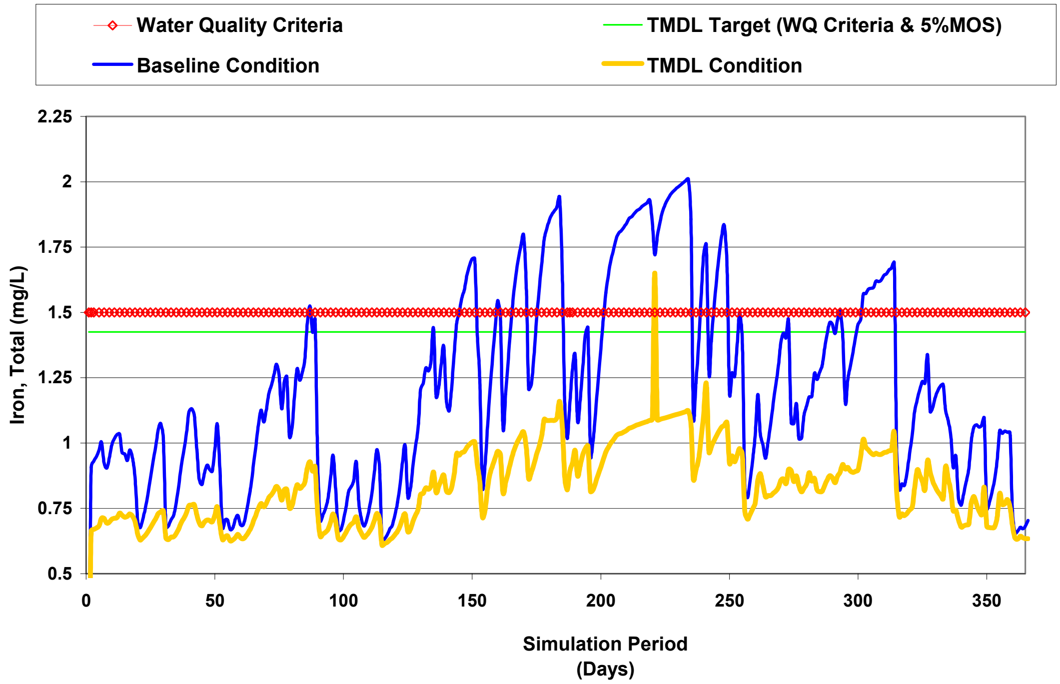

Figure 7-4. Example of baseline and TMDL conditions for iron

7.4 TMDLs and Source Allocations

7.4.1 Dissolved Aluminum, Total Iron, Total Manganese, and pH TMDLs

TMDLs and source allocations were developed for impaired segments of selected steams and their tributaries on a subwatershed basis for each of the six watersheds in the Upper Ohio North watershed shown in Figure 3-3. A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in these waterbodies, and TMDLs were developed. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream waterbodies. Using this method, contributions from all sources were weighted equitably. Reductions in sources affecting impaired headwaters ultimately led to improvements downstream and effectively decreased necessary loading reductions from downstream sources. Nonpoint source reductions did not result in loadings less than natural conditions.

The following general methodology was used when allocating loads to sources for the Upper Ohio North watershed TMDLs:

- For watersheds with AMLs and sediment sources, AML loads were reduced first. This was continued until in-stream water quality criteria were met, or until conditions were equal to those of undisturbed forest. If further reductions were required, the sediment sources were reduced until water quality criteria were met.

- For watersheds where dissolved aluminum TMDLs were developed, source allocations for total iron and manganese were developed first because their total in-stream concentrations (primarily iron) significantly reduce pH and consequently increase dissolved aluminum concentrations. If the dissolved aluminum TMDL endpoint was not attained after source reductions to iron and manganese, the total aluminum source loadings were reduced based on the methodology described above.

Wasteload Allocations (WLAs)
There are no point sources in the six selected subwatersheds specifically permitted to discharge metals. The sediment-related metals loading of the three construction stormwater permits in Alexanders Run was incorporated into the model as a background component. The small area associated with those permits was insignificant in relation to the iron and manganese impairments. The TMDL does not prescribe pollutant reduction from the existing construction stormwater sources.

Load Allocations (LAs)
Load Allocations (LAs) were assigned for the dominant source categories in the following order:

- AMLs, including abandoned mines (surface and deep) and high walls
- Sediment sources (metals loading associated with sediment)
- Other nonpoint sources, including agricultural and forested land contributions; loadings from other nonpoint sources were not reduced

The LAs for dissolved aluminum, iron, and manganese are presented in the Metals Allocation spreadsheets associated with this report. The dissolved aluminum TMDLs were based on a dissolved aluminum TMDL endpoint; however, sources were represented in terms of total aluminum. Load allocations for aluminum are also provided in the form of total metal. The LAs are presented as annual loads (pounds per year because they were developed to meet TMDL endpoints under a range of flow conditions.

The iron, manganese, and aluminum TMDLs are presented in the subwatershed appendices for Deep Gut Run and Harmon Creek.

As stated in Section 7.3.1, a surrogate approach was used for the pH TMDLs. It was assumed that reducing in-stream metal (iron and aluminum) concentrations to meet TMDL endpoints would result in attainment of the water quality standard for pH. This assumption was verified by running the DESC-R model for an extended period (6 years) in which TMDL endpoints for metals were met. A long-term median pH was calculated based on the daily equilibrium pH output from the DESC-R model. These results are also shown in the Deep Gut Run Appendix. (Deep Gut Run is the only pH-impaired water addressed in this report.) The Technical Report provides a detailed description of the pH modeling approach.

7.4.2 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired segments of selected steams and their tributaries on a subwatershed basis for each of the six watersheds in the Upper Ohio North watershed shown in Figure 3-2. As described in Section 7.4.1, a top-down methodology was followed to develop these TMDLs and allocate loads to sources.

The following general methodology was used when allocating loads to sources for the fecal coliform bacteria TMDLs; all point sources in the watershed were set at the permit limit (200 counts/100 mL monthly average). Because West Virginia Bureau for Public Health regulations prohibit discharge of raw sewage into surface waters, all illicit, non-disinfected discharges of human waste (from failing septic systems and straight pipes), were eliminated. Sanitary sewer overflows (SSOs) are illegal under NPDES regulations; all such discharges were also eliminated. If further reduction was necessary, combined sewer overflows (CSOs) and nonpoint source loadings from agricultural lands and residential areas were subsequently reduced until in-stream water quality criteria were met.

Wasteload Allocations (WLAs)
Wasteload allocations (WLAs) were developed for all facilities permitted to discharge fecal coliform bacteria, including MS4s as described below. Applicable fecal coliform effluent limitations are more stringent than water quality criteria; therefore, all permitted fecal coliform sources were represented by the monthly average fecal coliform limit of 200 counts/100 mL and no reductions were applied.

Municipal Separate Storm Sewer System (MS4)
USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. The City of Weirton in the Kings Creek and Harmon Creek watersheds and the City of Follansbee in the Allegheny Steel Run watershed are the designated MS4 municipalities within the six TMDL subwatersheds in this report. These municipalities have filed a Notice of Intent for MS4 permit issuance; the areas within the corporate limits are therefore assumed to be subject to MS4 storm water permitting. The MS4s were provided fecal coliform wasteload allocations, which are presented in Table 7-1. Stormwater permits and their relationship to TMDLs are discussed further in the appendices of the Technical Report.

The WLAs for individual NPDES permits for fecal coliform bacteria are shown in the Fecal Allocation spreadsheets associated with this report. The fecal coliform bacteria WLAs are presented as annual loads, in terms of counts per year. They are presented on an annual basis (as an average annual load) because they are precipitation-driven and they were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

Table 7-1. Individual fecal coliform MS4 WLAs for the cities of Follansbee and Weirton, West Virginia

Town	Watershed	Parameter	Baseline WLA (counts/yr)	WLA (counts/yr)	% Reduction
City of Follansbee	Allegheny Steel Run	Fecal coliform bacteria	3.09E+12	3.09E+12	0.0
City of Weirton	Harmon Creek	Fecal coliform bacteria	2.45E+13	1.36E+13	44.6
City of Weirton	Kings Creek	Fecal coliform bacteria	2.27E+12	1.09E+12	52.0

Load Allocations (LAs)
LAs were assigned as required to the following source categories:

- Agriculture, including pasturelands and croplands
- Failing septic systems (loading from all illicit, non-disinfected discharges of human waste, including failing septic systems and straight pipes)
- Residential (loading associated with urban/residential runoff)
- Wildlife (loading associated with wildlife sources from forested land contributions/ loadings from wildlife sources were not reduced)

The fecal coliform bacteria LAs are presented as annual loads, in terms of counts per year, in the spreadsheets associated with this report. For the West Virginia portion of the watershed, subwatershed load allocations for a successful TMDL scenario are presented for specific nonpoint source categories. The TMDLs assign a gross load (expressed as a load allocation) to sources located in the Pennsylvania portion of the watersheds. The TMDLs do not prescribe specific load or wasteload allocations for the contributing area of Pennsylvania. Instead, they allow Pennsylvania and its stakeholders to determine appropriate and necessary source reductions.

The fecal coliform bacteria TMDLs are presented in the subwatershed appendices for the impaired streams within each of the selected Upper Ohio North subwatersheds.

7.4.3 Sediment TMDLs

TMDLs and source allocations were developed for each of the sediment-impaired streams identified in Table 6-1. The stressor identification process identified sediment as a primary stressor in the Cross Creek and Tomlinson Run watersheds. As described previously, headwaters were analyzed first because their loading frequently has a profound effect on downstream water quality. Loading contributions were reduced from applicable sources for these waterbodies, and TMDLs were developed. Source reductions never resulted in loading contributions less than those under the natural conditions represented by the undisturbed forest. Model results from the selected successful scenarios were then routed through downstream waterbodies using the Stream Module, which incorporated sediment transport/routing and stream bank erosion/deposition processes. If necessary, reductions were made in sediment contributions from stream bank erosion.

When allocating to land use-based sediment sources, a unit area loading approach was used to establish equitable source allocations. This approach was based on the assumptions that point sources subject to water pollution control permits provide the highest degree of sediment control and that activities that are subject to programmatic BMPs contribute less sediment than do uncontrolled sources. Therefore, sediment sources were reduced systematically in a stepwise fashion until the TMDL endpoint was achieved.

- Step 1: Loads from uncontrolled sediment sources (barren areas and unpaved roads) were reduced to the unit area loading of programmatic BMP sources (harvested forest and oil and gas operations).
- Step 2: If further reduction was required, loads from uncontrolled sediment sources and programmatic BMP sources were together reduced to the unit area loading of point sources.
- Step 3: If even further reduction was required to meet the TMDL endpoint, loads from all sediment sources were reduced equally to the extent necessary to achieve the reference watershed loading.

In the Upper Ohio North watershed, there are no existing oil and gas wells or active mining operations. Consequently, Step 1 was executed and then uncontrolled sediment sources and registered forestry operations were reduced equally until the TMDL endpoints were attained.

After the land use-based sources were reduced, sediment produced from in-stream processes (bank erosion/deposition) were evaluated on a subwatershed basis. In subwatersheds where bank erosion was significant, sediment reduction was prescribed for in-stream processes and the land use-based allocations were then adjusted accordingly.

Wasteload Allocations (WLAs)
There are no mining-related point sources in the Upper Ohio North subwatersheds addressed by this report. Within the sediment-impaired watersheds, there are sources that have industrial stormwater and sewage permits. The industrial stormwater permitting procedures generally incorporate a 100 mg/L TSS benchmark value, and regulated facilities develop Stormwater Pollution Prevention Plans to achieve that goal. WLAs for these sources were based on the benchmark value. WLAs for sewage treatment facilities recognize the 30 mg/L monthly average TSS effluent limitations contained in their permits. Under this TMDL, the wasteload allocations for these sources do not require pollutant reductions and are authorized to continue operation under existing permit conditions. The WLAs are presented as average annuals loads, in terms of tons per year, and are shown in the allocation spreadsheets associated with this report.

At the time of TMDL development, there were no construction stormwater permits in the Cross Creek and Tomlinson Run watersheds. A provision for future growth related to construction activity is provided and explained in Section 8.

Load Allocations (LAs)
LAs were assigned as required to the following nonpoint source categories:

- Agriculture (including pasturelands, grasslands, and croplands)
- Barren land areas
- Harvested forest (including skid roads and landing areas)
- Residential (sediment loading associated with urban/residential runoff)
- Roads (including paved and unpaved roads)

- In-stream processes (bank erosion and deposition)
- Other nonpoint sources sources - forested land (loadings from other nonpoint sources were not reduced)

The Sediment LAs are presented as average annuals loads, in terms of tons per year, and are shown in the allocation spreadsheets associated with this report.

The sediment TMDLs are presented in the Cross Creek and Tomlinson Run subwatershed appendices.

7.4.4 Seasonal Variation

The TMDL must consider seasonal variation. For the Upper Ohio North watershed metals and fecal coliform TMDLs**,** seasonal variation was considered in the formulation of the modeling analysis. Continuous simulation (modeling over a period of several years that captured precipitation extremes) inherently considers seasonal hydrologic and source loading variability. The metals and fecal coliform concentrations simulated on a daily time step by the model were compared to TMDL endpoints. Allocations that met these endpoints throughout the modeling period were developed.

7.4.5 Critical Conditions

TMDL developers must select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is the set of environmental conditions that, if met, will ensure the attainment of objectives for all other conditions. Nonpoint source loading is typically precipitation-driven. In-stream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods, little or no land-based runoff occurs, and elevated in-stream pollutant levels may be due to point sources (Novotny and Olem 1994). Analysis of water quality data for the Upper Ohio North watershed shows high pollutant concentrations during both high and low flow, indicating that there are both point and nonpoint source impacts. Both high-flow and low-flow periods were taken into account during TMDL development by using a long period of weather data that represented wet, dry, and average flow periods.

8. FUTURE GROWTH AND WATER QUALITY TRADING

8.1 Metals and pH

This TMDL does not include specific future growth allocations to each subwatershed. However, the absence of specific future growth allocations does not prohibit new mining in the subwatersheds for which iron, aluminum, and manganese TMDLs have been developed. Pursuant to 40 CFR 122.44(d)(1)(vii)(B), effluent limits must be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge...." In addition, the federal regulations generally prohibit issuance of a permit to a new discharger "if the discharge from its construction or operation will cause or contribute to the violation of water quality standards." A discharge permit for a new discharger could be issued under the following scenarios:

1. A new facility could be permitted anywhere in the watershed, provided that effluent limitations are based on the achievement of water quality standards at end-of-pipe for the pollutants of concern in the TMDL.

   NPDES permitting rules mandate that effluent limitations for metals be prescribed in the total recoverable form. For iron and manganese, the West Virginia water quality criteria are in total recoverable form and may be directly implemented. Because aluminum water quality criteria are in dissolved form, a dissolved/total pollutant translator is needed to determine effluent limitations. A new facility could be permitted in the watershed of a dissolved aluminum-impaired stream if total aluminum effluent limitations are based on the dissolved aluminum, chronic, aquatic life protection criterion and a dissolved/total aluminum translator equal to 1.0.

2. Remining (under an NPDES permit) could occur without a specific allocation to the new permittee, provided that the requirements of existing state remining regulations are met. Remining activities will not worsen water quality and in some instances may result in improved water quality in abandoned mining areas.

8.2 Fecal Coliform Bacteria

This TMDL does not include specific future growth allocations to each subwatershed. However, the absence of specific future growth allocations does not prohibit new development in the subwatersheds for which fecal coliform TMDLs have been developed or preclude permitting of new sewage treatment facilities.

In many cases, the implementation of the TMDLs will consist of providing public sewer service to unsewered areas. The NPDES permitting procedures for sewage treatment facilities include technology-based fecal coliform effluent limitations that are more stringent than applicable water quality criteria. Therefore, a new sewage treatment facility can be permitted anywhere in the watershed, provided that the permit includes monthly average and maximum daily fecal coliform limitations of 200 counts/100 mL and 400 counts/100 mL, respectively. Furthermore, WVDEP will not authorize construction of combined collection systems or permit overflows from newly constructed collection systems.

8.3 Sediment

There are no active mining operations in the sediment-impaired watersheds addressed by this report, and little future activity is expected. Because the sources are not considered significant in those watersheds, specific future growth sediment allocations are not provided. New mining activity may be permitted in the sediment-impaired watersheds with the implementation of the technology-based TSS requirements of 40 CFR Part 434.

Non-mining point source discharges generally contain technology-based TSS effluent limitations that would not cause biological impairment. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 60 mg/L. New non-mining point sources may also be permitted in the sediment-impaired watersheds with the implementation of applicable technology-based TSS requirements.

Although there are no construction stormwater permits in the sediment-impaired watersheds, specific future growth allowances are provided. The successful TMDL allocation scenarios allow for 0.5 percent of the area in West Virginia portions of the Cross Creek, North Fork Tomlinson Run, and South Fork Tomlinson Run watersheds to be disturbed subject to the terms and conditions of the Construction Stormwater General Permit. Ten acres are provided for the Mercer Run watershed. The reserved acreage is expected to accommodate future development in the subject watersheds. If development projects are proposed in excess of the acreage provided, they may be permitted by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that tighter controls will result in a loading condition commensurate with the general permit area allocations provided in Table 8-1.

Table 8-1. Future growth for construction stormwater permits

Watershed	West Virginia Total Watershed Area (acres)	West Virginia Future Growth Area – 0.5% Total Watershed Area (Acres)
Cross Creek	10,777	54
North Fork Tomlinson Run	5,837	29
South Fork Tomlinson Run	4,965	25
Mercer Run	886	10

8.4 Water Quality Trading

This TMDL neither prohibits nor authorizes trading in the watersheds addressed in the document. WVDEP generally endorses the concept of trading and recognizes that it might become an effective tool for TMDL implementation. However, significant regulatory framework development is necessary before large-scale trading in West Virginia can be realized. Furthermore, WVDEP supports program development assisted by a consensus-based stakeholder process. Before the development of a formal trading program, it is conceivable that the regulation of specific point source-to-point source trades might be feasible under the framework of the NPDES program.

9. PUBLIC PARTICIPATION

9.1 Public Meetings

An informational public meeting was held on December 4, 2001, at West Virginia Northern Community College in Weirton, West Virginia, to present fundamental TMDL information and introduce interested parties to the local TMDL development process. Two additional meetings were held at the same location on September 30, 2003, and October 1, 2003, at which detailed information was presented relative to WVDEP's proposed allocation strategies. On August 26, 2004, a final public meeting to present draft TMDLs was held at the college.

9.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised in local newspapers on various dates between August 16, 2004, and August 20, 2004. Interested parties submitted comments during the public comment period that began on August 17, 2004, and ended on September 16, 2004.

9.3 Response Summary

The West Virginia Department of Environmental Protection (WVDEP) is pleased to provide this response to comments on the Draft TMDLs developed in the Upper Ohio North. The WVDEP appreciates the efforts commenters have put forth to improve West Virginia listing and TMDL development processes.

The following entities provided written comments on the Draft TMDLs:

- United States Environmental Protection Agency Region 3
- West Virginia Division of Forestry

Comments have been compiled and responded to in this response summary. Comments and comment summaries are in boldface and italic. Agency responses appear in plain text. The commenters suggested various typographical and editorial revisions. Although those comments are not individually detailed in this summary, WVDEP considered all such comments and revised both the main report and subwatershed appendices, as appropriate.

Clarification of the difference between the number of Upper Ohio North watershed streams identified as impaired on the 2004 Draft Section 303(d) list (32) and the number addressed in this report (26) was requested.

The WVDEP TMDL development program is synchronized with the 5-year Watershed Management Framework (WMF) cycle. The WMF organizes the state's 32 watersheds in five hydrologic groups, and WVDEP annually selects streams in a specific hydrologic group for TMDL development.

Initially, WVDEP projected TMDL development needs for the 15-year period through 2018. The 5-year, five-hydrologic group WMF format provides three opportunities for TMDL development in each hydrologic group during that time period. Program resources allow WVDEP to develop

TMDLs for between 80 and 100 impaired waters annually. The remaining commitments of the consent decree between USEPA and the Ohio Valley Environmental Coalition require that TMDLs for waters identified on the 1996 Section 303(d) list as impaired by mine drainage be developed by 2008. That, in turn, mandates TMDL development for those streams during the initial effort in each hydrologic group.

Given all those constraints, stream selection for this effort was initiated in January 2001. Approximately 100 impaired waters were selected in the Upper Kanawha and Upper Ohio North watersheds. All remaining "consent decree" impaired waters were selected and have TMDLs developed herein. For efficiency, geographically proximate impaired waters were also selected, and WVDEP attempted to develop TMDLs for all known or suspected impairments of selected waters.

The Ohio River mainstem and other impaired waters in certain Upper Ohio North subwatersheds (e.g., Mahan Run, Holbert Run, Laurel Hollow, Middle Run, Marks Run) were not selected for TMDL development at this time. Those waters remain on the 303(d) list, and WVDEP will develop TMDLs for them in either the second or third set of Hydrologic Group A TMDLs (i.e., TMDLS that will be developed in 2009 or 2014).

A commenter asked the question "What are Pennsylvania's water quality standards and how do they compare to West Virginia's water quality standards?"

WVDEP considered including a description of Pennsylvania's water quality criteria in Section 2 of the report but decided that the discrepancies between the two states' criteria are not pertinent and would be confusing to the reader. The subject TMDLs have been developed for West Virginia waters based on West Virginia's water quality standards. It is assumed that Pennsylvania's water quality standards contain a provision for the protection of downstream waters similar to that in West Virginia's standards at 46 CSR 1-6.1.c:

> *The State shall take into consideration the quality of downstream waters and shall assure that its water quality standards provide for the attainment of the water quality standards of downstream waters.*

That provision would allow implementation of the TMDLs in the Pennsylvania portion of the subject watersheds.

One commenter requested discussion of the method by which land use and Census data, which were generated during different time periods, were reconciled to accurately represent current conditions.

Section 3 describes watershed characteristics and the data sources that were used in the characterization. Section 7.1.1 details model setup and has been updated to describe the process of reconciling recent data with the outdated land use information.

A commenter asked why a TMDL was not developed for the dissolved aluminum impairment of Cross Creek (WVO-95).

The current dissolved aluminum criteria became effective while Upper Ohio North TMDLs were being developed for waters that were identified as impaired pursuant to the previously applicable total recoverable aluminum criterion. The mid-process shift caused WVDEP to re-evaluate available water quality data and determine the waters that were impaired pursuant to the dissolved aluminum criteria. It further required the addition of a metals speciation component to the MDAS model that allowed prediction of dissolved aluminum water quality.

WVDEP was successful in developing TMDLs for most of the waters that it had identified as impaired pursuant to the currently effective dissolved aluminum water quality criteria, but was unable to do so for Cross Creek. The reassessment of available water quality data identified the dissolved aluminum impairment of Cross Creek, whereas the previous assessment did not identify any total iron, aluminum, or manganese impairment. No metals source tracking activities were pursued, and no MDAS metals modeling had been performed for Cross Creek at the time of approval of the aluminum criteria revision. Consequently, WVDEP could not develop a scientifically defensible dissolved aluminum TMDL in the time frame for this effort.

One commenter suggested that discharges from abandoned mine lands, bond forfeiture sites, failing septic tanks, and straight pipes are unpermitted point sources rather than nonpoint sources. The commenter recognized the practicality of the consideration of such sources as nonpoint sources for TMDL purposes but requested inclusion of a disclaimer to address this issue.

WVDEP revised Sections 4 and 5.2.1 to include the suggested language.

Technical support of the assumption that sediments in the watershed contain iron, aluminum, and manganese was requested.

Because West Virginia soils are known to contain the subject metals, sediment-related nonpoint sources are potential sources of metals. Section 4.2.3 was revised in the final document to provide the requested support for the sediment/metals association.

A more detailed explanation of the biological stressor identification process (than that provided in Section 6 of the report) was requested. The commenter also expressed interest in why a fecal coliform bacteria TMDL is used as a surrogate where organic enrichment was identified as a biological stressor.

Additional detail relative to the stressor pathways and the stressor identification process is contained in the Technical Report. The TMDL linkage between the organic enrichment stressor and a fecal coliform TMDL is described in Section 6.4. All waters where organic enrichment was identified as the biological stressor demonstrated exceedances of the numeric criteria for fecal coliform bacteria. In the Upper Ohio North watershed, source-tracking efforts identified inadequately treated sewage and agricultural land use as the predominant sources of fecal coliform bacteria impairment. WVDEP determined that the elimination of the surface water discharges from failing septic tanks and straight pipes and the restriction of livestock access are necessary actions to implement the fecal coliform TMDLs. Such actions would thereby reduce the organic and nutrient loading causing the biological impairment.

One commenter requested an explanation of why certain TMDL components are prescribed as average annual loads, as opposed to maximum daily loads.

Per 40 CFR 130.2(I), TMDLs may be expressed in terms of mass per time, toxicity, or other appropriate measure. The TMDLs are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Analysis of available data indicated that critical conditions occur during both high- and low-flow events. 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). This modeling approach inherently considers seasonal hydrologic and source loading variability. Because such variability is present throughout the Upper Ohio North watershed, presenting the TMDLs as average annual loads was deemed appropriate. The introductory paragraph of Section 7.3.1 was updated to provide the above explanation.

A commenter requested additional information regarding the conservative assumptions used in determining margins of safety.

The primary margins of safety are those that resulted from the establishment of TMDL endpoints at 95 percent of the value of the water quality criteria (i.e., 5 percent explicit margins of safety). The explicit margins of safety are identical to those provided in West Virginia TMDLs developed by USEPA. The comment resulted from WVDEP's attempt to describe other conservative assumptions in the development process that might be construed as implicit margins of safety (e.g., the assumption that all point sources continuously discharge at their maximum permit limitations). Although such assumptions do exist and provide added safety, Section 7.3.1 was modified to remove mention of an implicit margin of safety to avoid confusion.

One commenter requested explanation of the future growth provision for new aluminum discharges at criteria end-of-pipe and a translator of 1.

NPDES rules require the establishment of metals effluent limitations in the total recoverable form. Because aluminum water quality criteria are in the dissolved form and NPDES effluent limitations must be prescribed in the total recoverable form, a translator that predicts the percentage of total metal that becomes dissolved in-stream must be incorporated into the limitation development process. This future growth provision recognizes that new discharges that achieve water quality criteria end-of-pipe do not cause or contribute to violation of water quality standards. If a translator equal to 1 is used, it is assumed that all the aluminum in a discharge will become dissolved. Prior to TMDL implementation, WVDEP could not propose the use of a less protective translator in aluminum-impaired waters and universally ensure that new discharges would not contribute to the water quality standard violation.

One commenter questioned the timing of TMDL effectiveness monitoring and suggested that this component should commence upon TMDL development, not after some period of implementation.

WVDEP believes that the assessment of water quality improvements resulting from TMDL implementation is an important monitoring component that should be pursued when the agency has reason to believe that implementation is significant enough to cause measurable change. To arbitrarily begin effectiveness monitoring upon TMDL development would not be a prudent use of limited monitoring resources. The timing of assessment would be a stream-specific determination. Where targeted implementation activities have been accomplished in a stream with limited pollutant sources, WVDEP would schedule monitoring at the next available opportunity in the cycle or earlier. Conversely, WVDEP might not schedule effectiveness monitoring at the next cycle opportunity in a stream with a multitude of nonpoint sources and little implementation activity.

A commenter pointed out inaccurate/confusing portrayal of fecal coliform bacteria point and nonpoint sources in Sections A-X-4.2 of certain subwatershed appendices.

Clarification was provided by revising Section 4 in the Allegheny Steel Run, Kings Creek, and Harmon Creek appendices. The revised sections accurately describe CSO discharges as point sources.

Numerical inconsistencies were identified between the displayed TMDLs and the summations of wasteload allocations, load allocations, and margins of safety for UNT/Deep Gut Run (WVO-101-E) and Marrow Run (WVO-98-A.5).

The identified errors have been corrected in the final document.

10. REASONABLE ASSURANCE

Reasonable assurance for maintenance and improvement of water quality in the affected watershed rests primarily with three separate programs. Two of these programs are wholly within WVDEP, and the third program is a cooperative effort involving many state and federal agencies. Within WVDEP, the programs involved in the effort include the NPDES Permitting Program and the Abandoned Mine Lands Program. In addition, WVDEP is involved with the West Virginia Watershed Management Framework (Framework), which includes many state and federal agencies dealing with the protection and restoration of water resources. The Framework process allows the resources of many entities to focus on the protection and/or restoration of water quality in selected streams.

Historically, mine drainage research has been conducted by scientists at West Virginia University, the West Virginia Division of Natural Resources, the U.S. Office of Surface Mining, the National Mine Land Reclamation Center, and the National Environmental Training Laboratory, and other agencies and by individuals within West Virginia. In addition, USEPA Section 319 Grant funding has been used to address issues resulting from acid mine drainage.

10.1 Permit Reissuance

WVDEP's Division of Water and Waste Management is responsible for issuing non-mining NPDES permits within the state. As part of the permit review process, permit writers have the responsibility to incorporate the required TMDL wasteload allocations into new or reissued permits. Both the permitting and TMDL processes have been synchronized with the Watershed Management Framework cycle such that the TMDLs are completed just before the permit expiration/reissuance time frames (July 1, 2005, to June 30, 2006). Existing sewage treatment facilities already have permit limitations for fecal coliform that satisfy the wasteload allocations of the TMDLs. A new MS4 permitting program is being implemented to address stormwater impacts from urbanized areas. DWWM also implements a program to control discharges from combined sewer overflows (CSOs). The CSO pollutant reductions specified will be implemented at the time of reissuance of the NPDES permit for the affected POTW.

10.2 Watershed Management Framework Process

The Framework consists of a group of state and federal agencies whose goal is to develop and implement watershed management strategies through a cooperative, long-range planning effort. The Framework is incorporated by reference into West Virginia’s Continuing Planning Process. The Framework consists of representatives from the following partner agencies:

Bureau for Public Health
Department of Highways
Department of Environmental Protection
State Conservation Agency
Division of Forestry
Division of Natural Resources
West Virginia University (WVU) Extension Service
ORSANCO (Ohio River Valley Water Sanitation Commission
U.S. Geological Survey
U.S. Office of Surface Mining
Monongahela National Forest
U.S. Environmental Protection Agency
Natural Resources Conservation Service
U.S. Army Corps of Engineers
U.S. Department of Agriculture

The principal area of focus for the Framework is correcting problems related to nonpoint source pollution. Each of the partner agencies has placed a greater emphasis on identification and correction of nonpoint source pollution. The combined resources of these agencies are used to address all different types of nonpoint source pollution through both public education and on-the-ground projects. The Framework also incorporates as part of its priority selection criteria, the state’s list of impaired waters under Section 303(d).

Among other things, the Framework includes a management schedule for integration and implementation of TMDLs. In 2000 the schedule for TMDL development under Section 303(d) was merged with the Framework process. Chapter 3.2.2 of the Framework, entitled “Developing and Implementing Integrated Management Strategies,” identifies a six-step process for developing integrated management strategies and action plans for achieving the state’s water quality goals. Step 3 of that process includes “identifying point source and/or nonpoint source management strategies - or Total Maximum Daily Loads - predicted to best meet the needed [pollutant] reduction.” Following development of the TMDL, Steps 5 and 6 provide for preparation, finalization, and implementation of an “action plan” that implements the TMDL and any other appropriate water quality improvement strategy.

The Framework uses the 5-year Watershed Cycle to identify watersheds where restoration efforts will be focused. Each year Framework agencies meet to prioritize watersheds within a certain Hydrologic Group to begin the planning process. This selection process includes a review and evaluation of TMDL recommendations for the watersheds under consideration.

The plan development process used by the Framework is based on the efforts of local project teams. These teams are composed of Framework members and stakeholders having interest in or residing in the watershed. Team formation is based on the type of impairment(s) occurring or protection(s) needed within the watershed. In addition, teams have the ability to use the TMDL recommendations to help plan future activities. The team's goal is to develop a project plan that allows the most efficient use of resources from all involved parties. Once the project plan has been developed and funded, the agencies can implement the planned activities to address the actions recommended by the TMDL.

10.3 Public Sewer Projects

Within WVDEP's Division of Water and Waste Management, the Engineering and Permitting Branch's Engineering Section is charged with the responsibility of evaluating sewer projects and providing funding, where available, for those projects. All municipal wastewater loans issued through the State Revolving Fund (SRF) program are subject to a detailed engineering review of the engineering report, design report, construction plans, specifications, and bidding documents. The staff performs periodic on-site inspections during construction to ascertain the progress of the project and compliance with the plans and specifications. Where the community does not use SRF funds to undertake a project, the staff still performs engineering reviews for the agency on all publicly owned treatment works prior to permit issuance or modification. The following projects are under construction or planned in the Upper Ohio North watershed:

Cross Creek

A $22 million sewer project has been proposed for the Cross Creek area. The project would serve 400 customers and eliminate 6 existing package treatment plants in the watershed. Additional funding is being sought to match the $9 million USEPA has committed to this project.

Harmon Creek

A sewer line extension project along the mainstem of Harmon Creek was recently completed. The extension connected 118 customers from the Colliers area to the City of Weirton's sewage treatment plant. In addition, an elementary school, whose sewage was previously discharged without any form of treatment, was connected as part of this project.

Tomlinson Run/Deep Gut Run

The "Route Eight" project planned by the Hancock County Public Service District (PSD) would provide sewage collection and treatment for 640 customers in New Manchester and surrounding areas. The project includes construction of a new sewage treatment plant at the mouth of Deep Gut Run. The $14 million project is in the design stage and has been fully funded.

Additional Information

In addition to the projects noted above, a list of funded and pending water and wastewater projects in West Virginia can be found at http://www.wvinfrastructure.com/projects/index.html.

10.4 AML Projects

Within WVDEP, the primary entity that deals with abandoned mine drainage issues is the Division of Land Restoration. Within the Division, the Office of Abandoned Mine Lands and Reclamation was created in 1981 to manage the reclamation of lands and waters affected by mining prior to passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. A fee placed on coal mined in West Virginia funds the Office of AML&R's budget. Allocations from the AML fund are made to state and tribal agencies through the congressional budgetary process. AML&R has recently increased its emphasis on correcting water quality problems at sites that were primarily chosen for protection of public health, safety, and property and is actively participating in the Watershed Management Framework.

11. MONITORING PLAN

The following monitoring activities are recommended:

11.1 NPDES Compliance

WVDEP's Division of Water and Waste Management has the responsibility to ensure that NPDES permits contain effluent limitations as prescribed by the TMDL wasteload allocations and to assess and compel compliance. Permits contain effluent self-monitoring and reporting requirements that are periodically reviewed by WVDEP. WVDEP also inspects treatment facilities and independently monitors NPDES discharges. The combination of these efforts will ensure implementation of the TMDL wasteload allocations.

11.2 Nonpoint Source Project Monitoring

All nonpoint source restoration projects should include a monitoring component specifically designed to document resultant local improvements in water quality. These data may also be used to predict expected pollutant reductions from similar future projects.

11.3 TMDL Effectiveness Monitoring

TMDL effectiveness monitoring should be performed to document water quality improvements after significant implementation activity has occurred because little change in water quality would otherwise be expected. Full TMDL implementation will take significant time and resources, particularly with respect to the abatement of nonpoint source impacts. WVDEP will continue monitoring on the rotating basin cycle and will include a specific TMDL effectiveness component in waters where significant TMDL implementation has occurred.

12. ACRONYMS AND ABBREVIATIONS

7Q10	7-day, 10-year low flow
AMD	acid mine drainage
AML	abandoned mine land
AnnAGNPS	Annualized Agricultural Nonpoint Source
BMP	best management practice
BOD	biochemical oxygen demand
CFR	Code of Federal Regulations
CSO	combined sewer overflow
CSR	Code of State Regulations
DEM	Digital Elevation Model
DESC-R	Dynamic Equilibrium In-stream Chemical Reactions model
DMR	[WVDEP] Division of Mining and Reclamation
DNR	Department of Natural Resources
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
FCLES	Fecal Coliform Loading Estimation Spreadsheet
FS	Forest Service
GIS	geographic information system
GPS	global positioning system
GWLF	Generalized Watershed Loading Functions
HAU	Home Aeration Unit
LA	load allocation
MDAS	Mining Data Analysis System
MOS	margin of safety
MPN	most probable number
MRLC	Multi-Resolution Landuse Characteristic
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NOAA-NCDC	National Oceanic and Atmospheric Administration, National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint sources
NRCS	Natural Resources Conservation Service
OOG	Office of Oil and Gas
ORSANCO	Ohio River Valley Water Sanitation Commission
OWR	Office of Water Resources
POTW	publicly owned treatment works
PSD	public service district
SMCRA	Surface Mining Control and Reclamation Act
SRF	State Revolving Fund
SSO	sanitary sewer overflow
STATSGO	State Soil Geographic database
TMDL	Total Maximum Daily Load
TSS	total suspended solids

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UT	unnamed tributary
WAP	Watershed Assessment Program
WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection
WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

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