

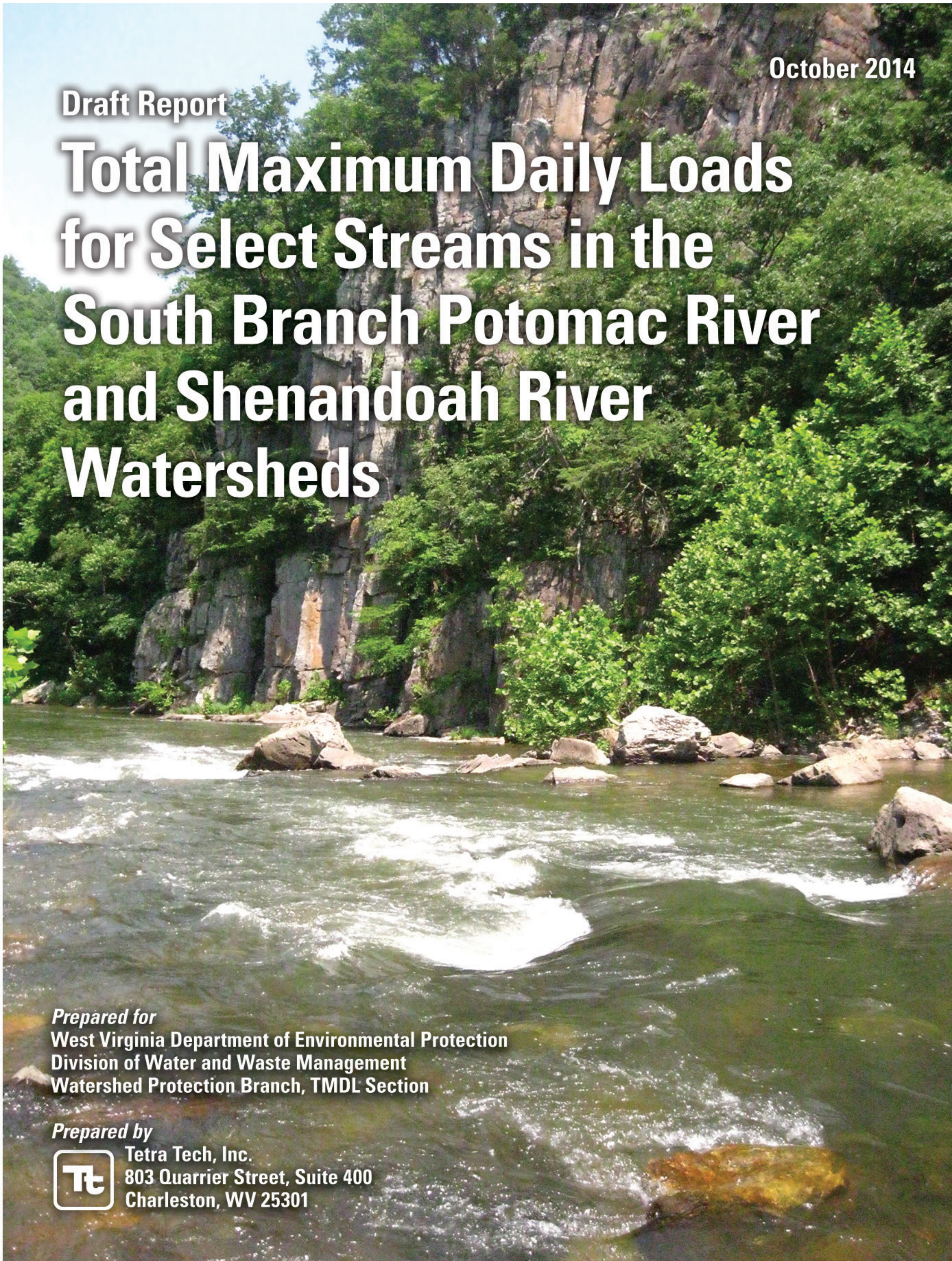

October 2014

Draft Report

Total Maximum Daily Loads for Select Streams in the South Branch Potomac River and Shenandoah River Watersheds

Prepared for

West Virginia Department of Environmental Protection
Division of Water and Waste Management
Watershed Protection Branch, TMDL Section

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On the cover:
Photos provided by WVDEP Division of Water and Waste Management

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

7Q10	7-day, 10-year low flow
AD	Acid Deposition
AMD	acid mine drainage
AML	abandoned mine land
AML&R	[WVDEP] Office of Abandoned Mine Lands & Reclamation
BMP	best management practice
BOD	biochemical oxygen demand
BPH	[West Virginia] Bureau for Public Health
CFR	Code of Federal Regulations
CSGP	Construction Stormwater General Permit
CSO	combined sewer overflow
CSR	Code of State Rules
DEM	Digital Elevation Model
DMR	[WVDEP] Division of Mining and Reclamation
DNR	West Virginia Division of Natural Resources
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
GIS	geographic information system
gpd	gallons per day
GPS	global positioning system
HAU	home aeration unit
LA	load allocation
µg/L	micrograms per liter
MDAS	Mining Data Analysis System
mg/L	milligrams per liter
mL	milliliter
MF	membrane filter counts per test
MPN	most probable number
MOS	margin of safety
MRLC	Multi-Resolution Land Characteristics Consortium
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NLCD	National Land Cover Dataset
NOAA-NCDC	National Oceanic and Atmospheric Administration, National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OOG	[WVDEP] Office of Oil and Gas

POTW	publicly owned treatment works
SI	stressor identification
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
UNT	unnamed tributary
WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection
WVDOH	West Virginia Division of Highways
WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

Watershed

A general term used to describe a drainage area within the boundary of a United States Geologic Survey's 8-digit hydrologic unit code. This report addressed impaired tributaries to the South Branch Potomac and Shenandoah River Watersheds (**Figure I-1**).

TMDL Watershed

This term is used to describe the total land area draining to an impaired stream for which a TMDL is being developed. This term also takes into account the land area drained by un-impaired tributaries of the impaired stream, and may include impaired tributaries for which additional TMDLs are presented. This report addresses 41impaired streams contained within 11 TMDL watersheds in the South Branch Potomac River Watershed, and 5 streams in 2 TMDL watersheds in the Shenandoah River Watershed.

Subwatershed

The subwatershed delineation is the most detailed scale of the delineation that breaks each TMDL watershed into numerous catchments for modeling purposes. The 13 TMDL watersheds have been subdivided into 199 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

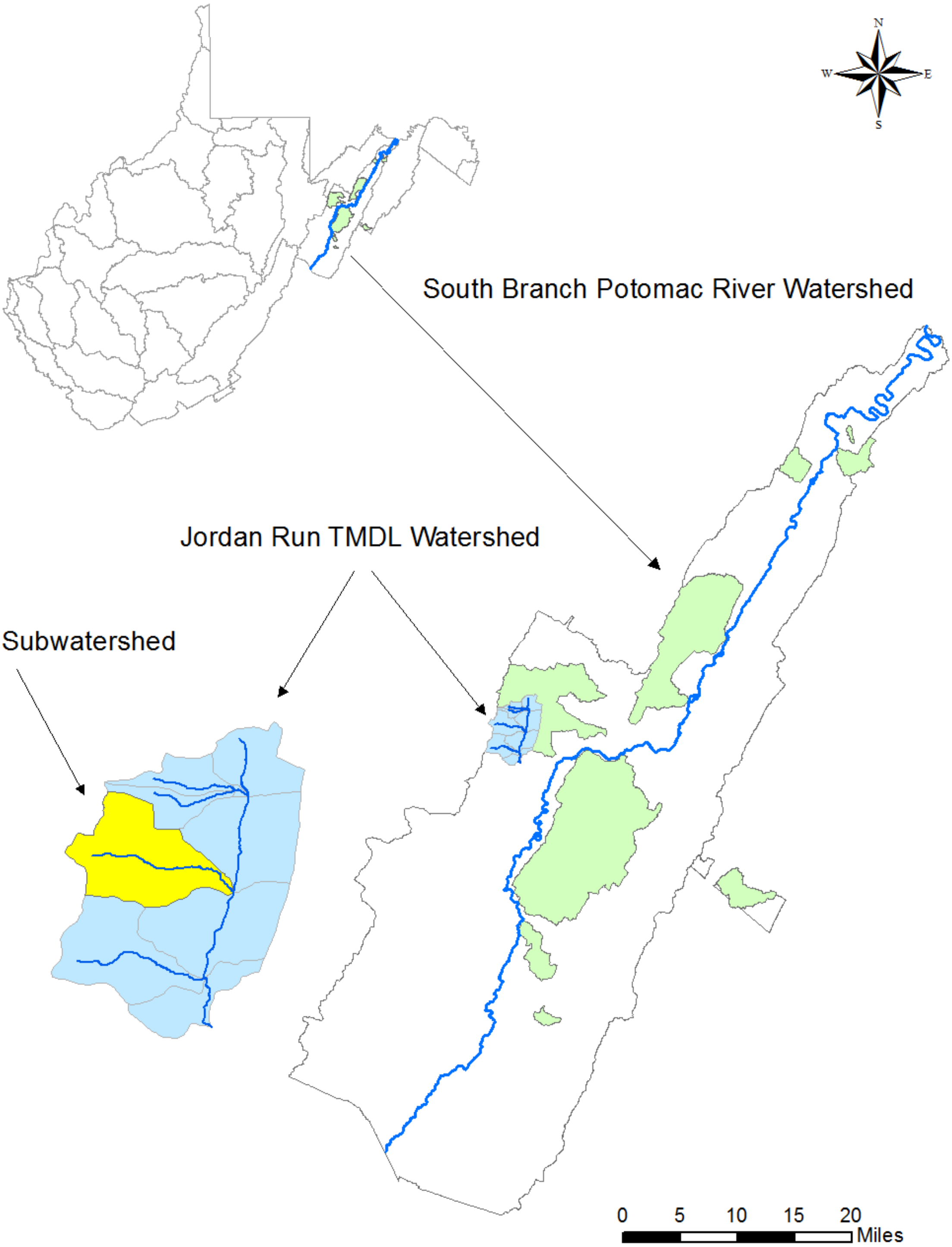


Figure I-1. Examples of a watershed, TMDL watershed, and subwatershed

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 46 impaired streams in the South Branch Potomac and Shenandoah River Watersheds. This project was organized into 13 TMDL watersheds : Anderson Run, Buffalo Creek, Deer Run, Dumpling Run, Mill Creek, Powers Hollow, Robinson Run, South Fork/Lunice Creek, UNT/South Branch Potomac River RM 40.44, UNT/South Branch Potomac River RM 59.19, UNT/South Branch RM 21.86/Potomac River, Crab Run, and Capon Run.

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 actions needed to restore water quality. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, and titled *Legislative Rules, Department of Environmental Protection: 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 routinely assesses use support by comparing observed water quality data with criteria and reports impaired waters every two years as required by Section 303(d) of the Clean Water Act ("303(d) list"). The Act requires that TMDLs be developed for listed impaired waters.

Many of the subject streams impairments are included on the West Virginia's 2012 Section 303(d) List or draft 2014 303(d) List. Documented impairments are related to numeric water quality criteria for total iron, dissolved oxygen, fecal coliform bacteria, and the narrative biological integrity criterion.

The narrative water quality criterion of 47 CSR 2–3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impact to the chemical, physical, hydrologic, and biological components of aquatic ecosystems. Historically, WVDEP based assessment of biological integrity on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). WVSCI-based "biological impairments" were included on West Virginia Section 303(d) lists from 2002 through 2010.

Recent legislative action (Senate Bill 562) directed the agency to develop and secure legislative approval of new rules to interpret the narrative criterion for biological impairment found in 47 CSR 2-3.2.i. A copy of the legislation may be viewed at:

http://www.legis.state.wv.us/Bill_Text_HTML/2012_SESSIONS/RS/pdf_bills/SB562%20SUB1%20enr%20PRINTED.pdf

In response to the legislation, WVDEP is developing an alternative methodology for interpreting 47 CSR 2–3.2.i which will be used in the future once approved. WVDEP has suspended biological impairment TMDL development pending receipt of legislative approval of the new assessment methodology.

Although "biological impairment" TMDLs are not presented in this project, nine streams for which available benthic information demonstrates biological impact (via WVSCI assessment) were subjected to a biological stressor identification process. The results of the SI process are discussed in **Section 4** of this report and displayed in **Appendix K** of the Technical Report. **Section 4** of this report also discusses recent USEPA oversight activities relative to Clean Water Act Section 303(d) and the relationship of the pollutant-specific TMDLs developed herein to WVSCI-based biological impacts.

Impaired waters were organized into 13 TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these 13 TMDL watersheds were further divided into 199 smaller subwatershed units. The subwatershed delineation provided a basis for georeferencing pertinent source information, monitoring data, and presentation of the TMDLs.

The Mining Data Analysis System (MDAS) was used to represent the linkage between pollutant sources and instream responses for fecal coliform bacteria and iron. The 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 instream processes.

Point and nonpoint sources contribute to the fecal coliform bacteria impairments in the watershed. Failing on-site septic systems, direct discharges of untreated sewage, and precipitation runoff from agricultural and residential areas are nonpoint sources of fecal coliform bacteria. Point sources of fecal coliform bacteria include the effluents of sewage treatment facilities. The presence of individual source categories and their relative significance varies by subwatershed.

There are dissolved oxygen impairments in UNT/Robinson Run RM 2.84 (WV-PSB-98-G-4) and South Fork/Lunice Creek (WV-PSB-98-T). In general, sources contributing to dissolved oxygen impairments are the same as those for fecal coliform. Because of the effect of reducing organic loadings, the fecal coliform TMDLs developed by WVDEP are appropriate surrogates for the dissolved oxygen impairment for these streams.

Iron impairments are also attributable to both point and nonpoint sources. Nonpoint sources of iron include roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance and streambank erosion. Iron point sources include the permitted discharges from quarries and stormwater contributions from industrial and construction sites. The presence of individual source categories and their relative significance also varies by subwatershed. Because iron is a naturally-occurring element that is present in soils, the iron loading from many of the identified sources is associated with sediment contributions.

This report describes the TMDL development and modeling processes, identifies impaired streams and existing pollutant sources, discusses future growth and TMDL achievability, and documents the public participation associated with the process. It also contains a detailed discussion of the allocation methodologies applied for various impairments. Various provisions attempt to ensure the attainment of criteria throughout the watershed, achieve equity among categories of sources, and target pollutant reductions from the most problematic sources. Nonpoint source reductions were not specified beyond natural (background) levels. Similarly, point source WLAs were no more stringent than numeric water quality criteria.

In 1998, EPA and WVDEP developed fecal coliform TMDLs for impaired streams in the South Branch Potomac Watershed (USEPA, 1998a, USEPA, 1998b). With two exceptions, this project does not include new TMDLs that override previous work. These exceptions are discussed in **Section 1**.

Considerable resources were used to acquire recent water quality and pollutant source information upon which the TMDLs are based. The TMDL 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, including allocation spreadsheets, an ArcGIS Viewer Project, and Technical Report.

Applicable TMDLs are displayed in **Section 9** of this report. The accompanying spreadsheets provide TMDLs and allocations of loads to categories of point and nonpoint sources that achieve the total TMDL. Also provided is the ArcGIS Viewer Project that allows for the exploration of spatial relationships among the source assessment data. A Technical Report is available that describes the detailed technical approaches used in the process and displays the data upon which the TMDLs are based.

1.0 REPORT FORMAT

This report describes the overall total maximum daily load (TMDL) development process for select streams in the South Branch Potomac River and Shenandoah River Watersheds, identifies impaired streams, and outlines the source assessment for all pollutants for which TMDLs are presented. It also describes the modeling and allocation processes and lists measures that will be taken to ensure that the TMDLs are met. The applicable TMDLs are displayed in **Section 9** of this report. The report is supported by an ArcGIS Viewer Project that provides further details on the data and allows the user to explore the spatial relationships among the source assessment data, magnify streams and view other features of interest. In addition to the TMDL report, a CD is provided that contains spreadsheets (in Microsoft Excel format) that display detailed source allocations associated with successful TMDL scenarios. A Technical Report is included that describes the detailed technical approaches used in the process and displays the data upon which the TMDLs are based.

2.0 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 Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to identify waterbodies that do not meet 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 the actions needed to restore water quality.

A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), 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 units. Conceptually, this definition is denoted by the following equation:

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

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 2014 TMDLs should be pursued in Hydrologic Group A, which includes the South Branch Potomac River Watershed. Because of their proximity to the South Branch Potomac River Watershed, TMDLs for impaired streams in Capon Run and Crab Run of the Shenandoah River Watershed (Hydrologic Group B) were developed in this project. **Figure 2-1** depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the target year for finalization of each TMDL.

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 generating and gathering effort to produce scientifically defensible TMDLs. It also allows ample time for modeling, report finalization, 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 compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. The draft TMDL is advertised for public review and comment, and an informational meeting is held during the public comment period. Public comments are addressed, and the draft TMDL is submitted to USEPA for approval.

In 1998 EPA developed various TMDLs for impaired streams in the South Branch Potomac River Watershed (USEPA, 1998a, USEPA, 1998b). With two exceptions, this project does not include new TMDLs that override previous work. The exceptions include the previously developed fecal coliform TMDLs for Anderson Run (WV-PSB-62) and Mill Creek (WV-PSB-97). The older TMDLs were developed with a less robust stream monitoring and source tracking dataset and a lower resolution modeling approach. While pursuing TMDL development for other impairments, WVDEP obtained more comprehensive data and developed new TMDLs under a more refined modeling approach. Upon approval, the TMDLs presented herein shall supersede those developed previously. **Appendix A** of the Technical Report contains a list of streams for which TMDLs were previously developed.

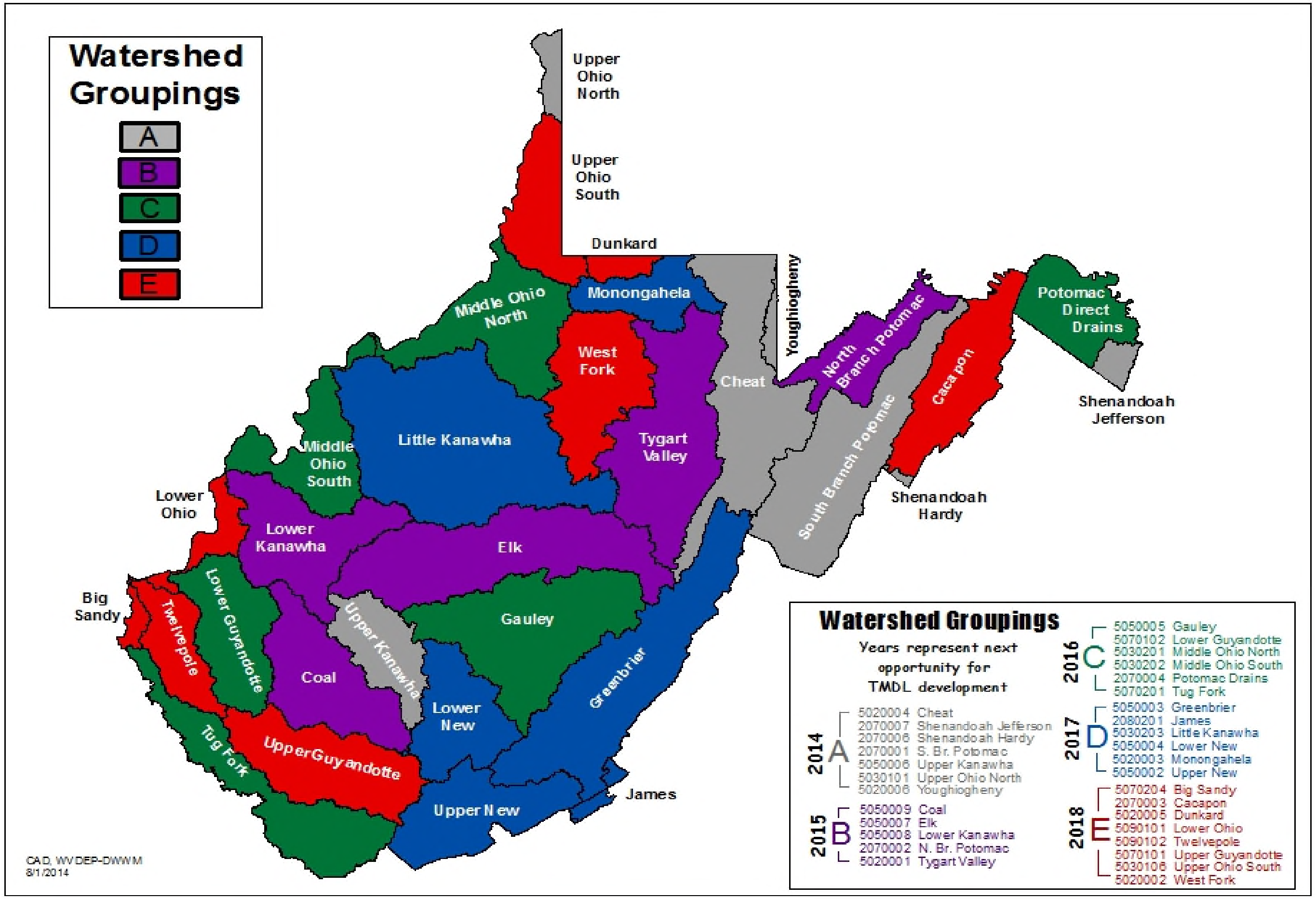


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

2.2 Water Quality Standards

The determination of impaired waters involves comparing instream conditions to applicable water quality standards. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. These standards can be obtained online from the West Virginia Secretary of State Internet site (http://apps.sos.wv.gov/adlaw/csr/rule.aspx?rule=47-02.)

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 contains the numeric water quality criteria for a wide range of parameters, while Section 3 of the Standards contains the narrative water quality criteria.

Designated uses include: propagation and maintenance of aquatic life in warmwater fisheries and troutwaters, water contact recreation, and public water supply. In various streams in the TMDL project watersheds, warmwater fishery and troutwater aquatic life use impairments have been determined pursuant to exceedances of total iron and dissolved oxygen water quality criteria. Water contact recreation and/or public water supply use impairments have also been determined in various waters pursuant to exceedances of numeric water quality criteria for fecal coliform bacteria, dissolved oxygen and total iron.

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 related to water quality. The narrative water quality criterion at Title 47 CSR Series 2 – 3.2.i 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. This provision has historically been the basis for "biological impairment" determinations. Recent legislation has altered procedures used by WVDEP to assess biological integrity and, therefore, biological impairment TMDLs are not being developed. The legislation and related issues are discussed in detail in **Section 4** of this report.

The numeric water quality criteria applicable to the impaired streams addressed by this report are summarized in **Table 2-1**. The stream-specific impairments related to numeric water quality criteria are displayed in **Table 3-3**.

TMDLs presented herein are based upon the water quality criteria that are currently effective. If the West Virginia Legislature adopts Water Quality Standard revisions that alter the basis upon which the TMDLs are developed, then the TMDLs and allocations may be modified as warranted. Any future Water Quality Standard revision and/or TMDL modification must receive USEPA approval prior to implementation.

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]	
Iron, total (mg/L)	--	1.5	--	1.0	1.5
Dissolved oxygen	Not less than 5 mg/L at any time	Not less than 5 mg/L at any time	Not less than 6 mg/L at any time	Not less than 6 mg/L at any time	Not less than 5 mg/L at any time
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 unless otherwise noted.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average unless otherwise noted.
Source: 47 *CSR*, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*.

3.0 WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

The South Branch Potomac River is a major tributary of the Potomac River. Approximately 139 miles (224 km) long, the South Branch flows north through the eastern panhandle of West Virginia. The South Branch Watershed is located in the Central Appalachian Ridge and Valley ecoregion, and drains by way of the Potomac to the Chesapeake Bay and Atlantic Ocean. The South Branch Watershed encompasses 1,372 square miles (3,553 km^2) in eastern West Virginia (Figure 3-1). Of the 1,372 total square miles in the West Virginia portion of the watershed, only 233 square miles were modeled under this TMDL effort.

The South Branch headwaters begin in Highland County, Virginia, and flow across the state line into Pendleton County in West Virginia. The river flows north, joined by its two major tributaries the North and South Forks, to its confluence with the Potomac River at Green Spring.

The watershed lies in portions of West Virginia’s Pendleton, Hardy, Grant, and Hampshire counties. Tributary streams considered in this TMDL effort include Buffalo Creek, Mudlick Run, Anderson Run, South Fork of Lunice Creek, Robinson Run, Jordan Run, Mill Creek, and Deer Run. Cities and towns in the vicinity of the area of study are Romney, Moorefield, Petersburg, and Franklin.

The highest point in the modeled portion of the South Branch Potomac Watershed is 4,130 feet above sea level on the Allegheny Front that forms the eastern continental divide between the Atlantic and Mississippi drainages. The lowest point in the modeled portion of the watershed is 636 feet at the confluence of Buffalo Creek with the South Branch several miles north of

Romney. The average elevation in the modeled portion of the watershed is 1,529 feet. The total population living in the subject watersheds of this report is estimated to be 7,500 people.

The Shenandoah River is a major tributary of the Potomac River. The majority of the Shenandoah River Watershed falls within the state of Virginia. However, several small headwater streams are located in Hardy County, West Virginia, in close proximity to the South Branch Potomac River Watershed. These streams exit West Virginia as they flow across the state line into Virginia. Many miles downstream, the Shenandoah River re-enters West Virginia near its confluence with the Potomac River at Harpers Ferry in Jefferson County.

The Shenandoah River Watershed is located in the Central Appalachian Ridge and Valley ecoregion, and drains by way of the Potomac to the Chesapeake Bay and Atlantic Ocean. The Shenandoah River Watershed encompasses 2,937 square miles (7,607 km2) in Virginia and West Virginia. In West Virginia, and in cross-border areas of Virginia draining to West Virginia TMDL streams, only 8.7 square miles were modeled under this TMDL effort.

The modeled portion of the Shenandoah River Watershed lies in Hardy County, West Virginia and Rockingham County, Virginia. Tributary streams considered in this TMDL effort are UNT/Capon Run RM 4.49 and Crab Run. The community of Mathias in Hardy County is located several miles north of the modeled watersheds.

The highest point in the modeled portion of the Shenandoah River Watershed is 2,890 feet above sea level in the headwaters of UNT/Capon Run RM 4.49. The lowest point in the modeled portion of the watershed is 1578 feet where Crab Run crosses the West Virginia state line. The average elevation in the modeled portion of the watershed is 1,886 feet. The total population living in the subject watersheds of this report is estimated to be less than 200 people.

This project was organized into 13 TMDL watersheds: Anderson Run, Buffalo Creek, Deer Run, Dumpling Run, Mill Creek, Powers Hollow, Robinson Run, South Fork/Lunice Creek, UNT/South Branch Potomac River RM 40.44, UNT/South Branch Potomac River RM 59.19, UNT/South Branch RM 21.86/Potomac River, Crab Run, and Capon Run. **Figure 3-1** displays the extent of the South Branch Potomac River Watershed and Shenandoah River Watersheds associated with this project.

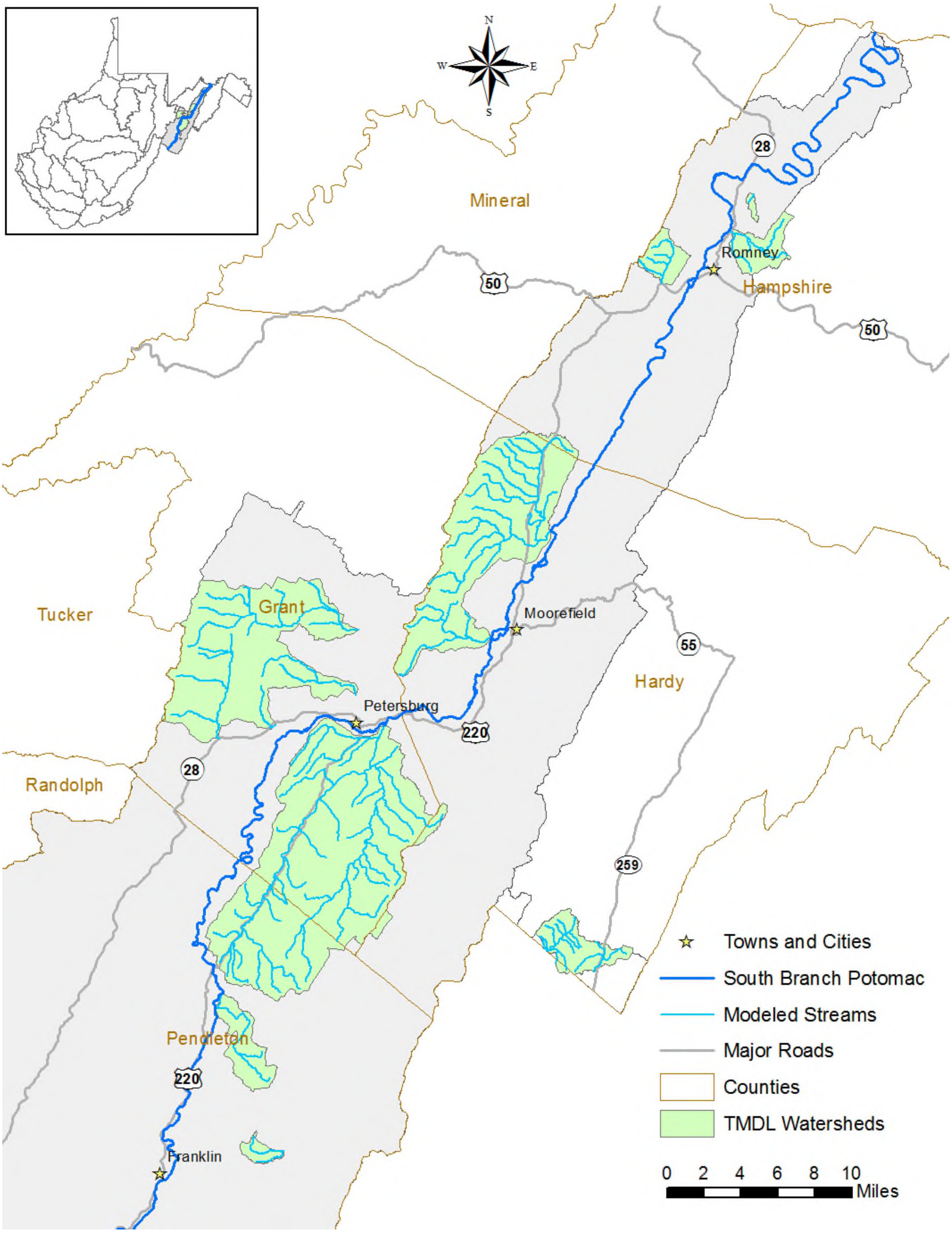


Figure 3-1. Location of the South Branch Potomac River and Shenandoah River Watershed TMDL Project Area in West Virginia

Landuse and land cover estimates were originally obtained from vegetation data gathered from the National Land Cover Dataset (NLCD) 2006. The Multi-Resolution Land Characteristics Consortium (MRLC) produced the NLCD coverage. The NLCD database for West Virginia was derived from satellite imagery taken during the early 2000s, and it includes detailed vegetative spatial data. Enhancements and updates to the NLCD coverage were made to create a modeled landuse by custom edits derived primarily from WVDEP source tracking information and 2011 aerial photography with 1-meter resolution. Additional information regarding the NLCD spatial database is provided in **Appendix D** of the Technical Report.

Table 3-1 displays the landuse distribution for the TMDL watersheds derived from NLCD as described above. The dominant landuse is forest, which constitutes 75.85 percent of the total landuse area. Other important modeled landuse types are grassland (10.97 percent), pasture (7.35 percent), urban/residential (3.82 percent), and forestry (1.09 percent). Individually, all other land cover types compose less than one percent of the total watershed area.

Table 3-1. Modified landuse for the TMDL watershed

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Barren	251.44	0.39	0.15%
Cropland	709.21	1.11	0.42%
Forest	128,746.18	201.16	75.85%
Forestry	1,858.00	2.90	1.09%
Grassland	18,614.01	29.08	10.97%
Mining/Quarry	456.05	0.71	0.27%
Oil and Gas	18.80	0.03	0.01%
Pasture	12,471.14	19.49	7.35%
Urban/Residential	6,483.54	10.13	3.82%
Water	119.31	0.19	0.07%
Total	169,727.69	265.19	100.00%

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. These data describe the physical conditions of the TMDL watersheds, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. Prior to TMDL development, WVDEP collected comprehensive water quality data throughout the watershed. This pre-TMDL monitoring effort contributed the largest amount of water quality data to the process and is summarized in the Technical Report, **Appendix J**. The geographic information is provided in the ArcGIS Viewer Project.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Sources
Watershed physiographic data	Stream network	USGS National Hydrography Dataset (NHD)
	Landuse	National Land Cover Dataset 2006 (NLCD)
	NAIP 2011 Aerial Photography (1-meter resolution)	U.S. Department of Agriculture (USDA)
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau
	Soils	State Soil Geographic Database (STATSGO) USDA, Natural Resources Conservation Service (NRCS) soil surveys
	Hydrologic Unit Code boundaries	U.S. Geological Survey (USGS)
	Topographic and digital elevation models (DEMs)	National Elevation Dataset (NED)
	Dam locations	USGS
	Roads	U.S. Census Bureau 2011 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)
	Permitted facility information	WVDEP Division of Water and Waste Management (DWWM), WVDEP Division of Mining and Reclamation (DMR)
	Timber harvest data	WV Division of Forestry
	Oil and gas operations coverage	WVDEP Office of Oil and Gas (OOG)
	Abandoned mining coverage	WVDEP DMR
Monitoring data	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

Type of Information		Data Sources
	National Pollutant Discharge Elimination System (NPDES) data	WVDEP DMR, WVDEP DWWM
	Discharge Monitoring Report data	WVDEP DMR, Mining Companies
	Abandoned mine land data	WVDEP DMR, WVDEP DWWM
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 water quality monitoring of streams in the project area from 2011 through 2012. The results of that effort were used to confirm the impairments of waterbodies identified on previous 303(d) lists and to identify other impaired waterbodies that were not previously listed.

In this TMDL development effort, modeling at baseline conditions demonstrated additional pollutant impairments to those identified via monitoring. The prediction of impairment through modeling is validated by applicable federal guidance for 303(d) listing. WVDEP could not perform water quality monitoring and source characterization at frequencies or sample location resolution sufficient to comprehensively assess water quality under the terms of applicable water quality standards, and modeling was needed to complete the assessment. Where existing pollutant sources were confidently predicted to cause noncompliance with a particular criterion, the subject water was characterized as impaired. In this project model predicted impairments were determine only for total iron water quality criteria..

TMDLs were developed for impaired waters in 13 TMDL watersheds (**Figure 3-2**). The impaired waters for which TMDLs have been developed are presented in **Table 3-3**. The table includes the TMDL watershed, stream code, stream name, and impairments for each stream.

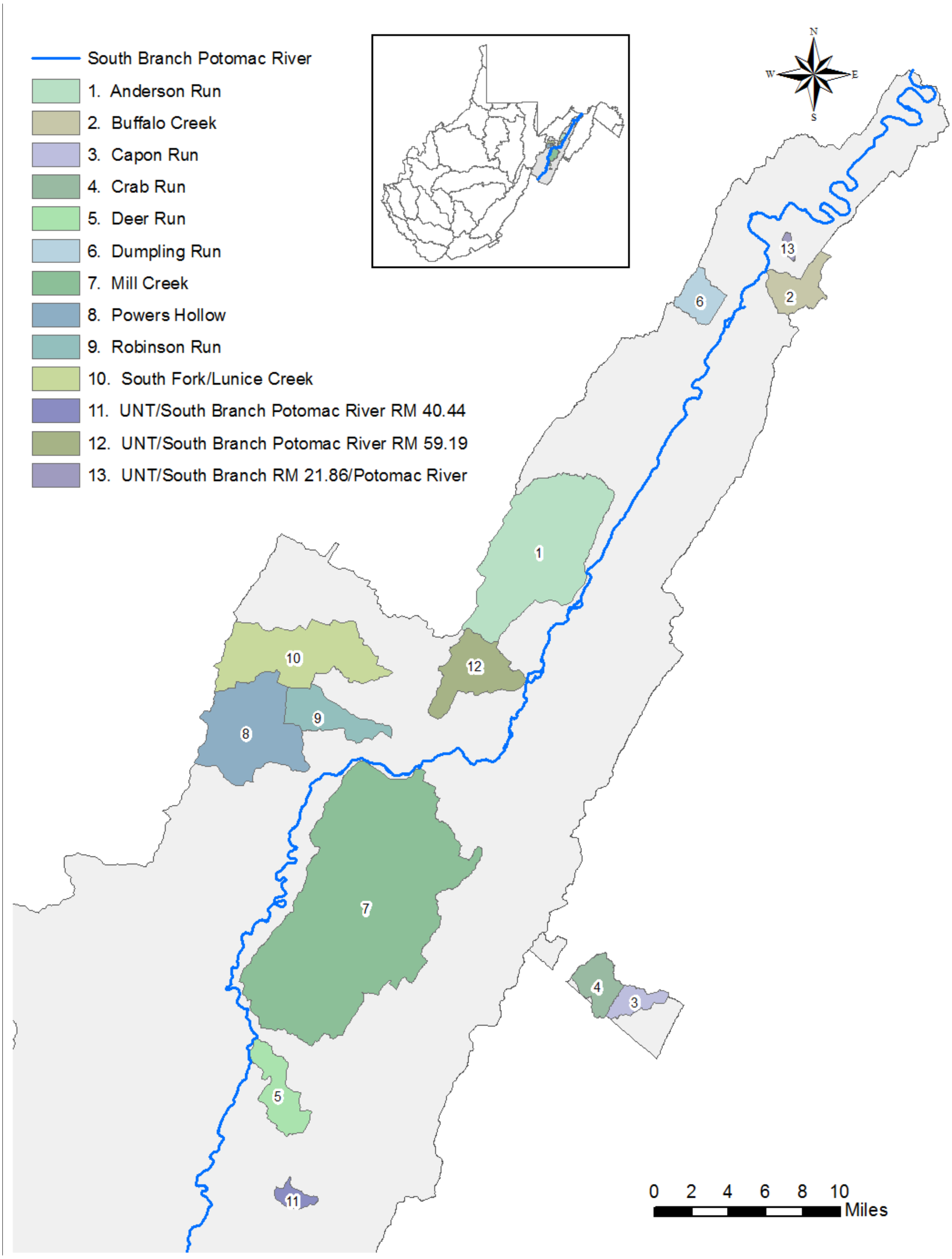


Figure 3-2. South Branch Potomac and Shenandoah River TMDL Watersheds

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

TMDL Watershed	Stream Name	NHD Code	Trout	DO	Fe	FC
UNT/South Branch RM 21.86/Potomac River	UNT/UNT RM 1.38/UNT RM 0.30/South Branch Potomac River RM 21.86	WV-PSB-16-A-1				X
Buffalo Creek	Buffalo Creek	WV-PSB-30				X
Dumpling Run	Dumpling Run	WV-PSB-35-B			M	X
Anderson Run	Anderson Run	WV-PSB-62			M	X
Anderson Run	Mudlick Run	WV-PSB-62-C			X	X
Anderson Run	UNT/Mudlick Branch RM 4.62	WV-PSB-62-C-12			M	
Anderson Run	UNT/Mudlick Run RM 5.61	WV-PSB-62-C-15			M	
Anderson Run	UNT/Mudlick Run RM 5.63	WV-PSB-62-C-16			M	
Anderson Run	UNT/Mudlick Run RM 2.88	WV-PSB-62-C-3			M	X
Anderson Run	UNT/UNT RM 1.62/Mudlick Run RM 2.88	WV-PSB-62-C-3-B				X
Anderson Run	Turnmill Run	WV-PSB-62-C-4			X	X
Anderson Run	UNT/Mudlick Run RM 3.62	WV-PSB-62-C-6			M	
Anderson Run	UNT/Anderson Run RM 3.30	WV-PSB-62-I			M	
Anderson Run	Walnut Bottom Run	WV-PSB-62-J			M	X
UNT/South Branch Potomac River RM 40.44	UNT/South Branch Potomac River RM 40.44	WV-PSB-79-DL				X
UNT/South Branch Potomac River RM 40.44	UNT/UNT RM 0.07/South Branch Potomac River RM 40.44	WV-PSB-79-DL-1			M	
UNT/South Branch Potomac River RM 59.19	UNT/South Branch Potomac River RM 59.19	WV-PSB-82			M	X
UNT/South Branch Potomac River RM 59.19	UNT/UNT RM 1.61/South Branch Potomac River RM 59.19	WV-PSB-82-C			M	
UNT/South Branch Potomac River RM 59.19	UNT/UNT RM 2.27/South Branch Potomac River RM 59.19	WV-PSB-82-E			M	X
UNT/South Branch Potomac River RM 59.19	UNT/UNT RM 4.07/South Branch Potomac River RM 59.19	WV-PSB-82-F				X
Mill Creek	Mill Creek	WV-PSB-97				X
Mill Creek	Johnson Run	WV-PSB-97-B			M	X
Mill Creek	UNT/Johnson Run RM 1.12	WV-PSB-97-B-2			M	
Mill Creek	North Mill Creek	WV-PSB-97-E			M	X
Mill Creek	Brushy Run	WV-PSB-97-E-47			X	X
Mill Creek	UNT/Brushy Run RM 2.99	WV-PSB-97-E-47-G			M	
Mill Creek	Stony Creek	WV-PSB-97-E-48			X	X
Mill Creek	South Mill Creek	WV-PSB-97-F				X
Mill Creek	UNT/South Mill Creek RM 0.24	WV-PSB-97-F-1			M	
Mill Creek	Kessner Run	WV-PSB-97-F-42			M	
Robinson Run	Robinson Run	WV-PSB-98-G			M	X
Robinson Run	UNT/Robinson Run RM 2.84	WV-PSB-98-G-4		X	M	X
South Fork/Lunice Creek	South Fork/Lunice Creek	WV-PSB-98-T	X	X	X	X
South Fork/Lunice Creek	Big Star Run	WV-PSB-98-T-11	X			X
South Fork/Lunice Creek	UNT/South Fork RM 0.93/Lunice Creek	WV-PSB-98-T-2			M	
South Fork/Lunice Creek	UNT/South Fork RM 1.75/Lunice	WV-PSB-98-T-3			M	

	Creek					
Powers Hollow	Powers Hollow	WV-PSB-105-B				X
Powers Hollow	Jordan Run	WV-PSB-105-J				X
Powers Hollow	Laurel Run	WV-PSB-105-J-10	X			X
Deer Run	Deer Run	WV-PSB-139			M	X
Deer Run	UNT/Deer Run RM 5.68	WV-PSB-139-F			M	
Capon Run	UNT/Capon Run RM 4.49	WV-PSN-201-P			X	X
Crab Run	Crab Run	WV-PSN-207			X	X
Crab Run	UNT/Crab Run RM 3.92	WV-PSN-207-M			M	
Crab Run	UNT/Crab Run RM 3.97	WV-PSN-207-N			X	X
Crab Run	UNT/Crab Run RM 5.65	WV-PSN-207-T			X	X

Note:
RM river mile
UNT unnamed tributary
DO Dissolved Oxygen
Fe iron impairment
FC fecal coliform bacteria impairment
M Impairment determined via modeling
Trout Trout Stream

4.0 BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

The narrative water quality criterion of 47 CSR 2 §3.2.i prohibits the presence of wastes in State waters that cause or contribute to significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems. Historically, WVDEP based assessment of biological integrity on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). WVSCI-based "biological impairments" were included on West Virginia's Section 303(d) lists from 2002 through 2010.

During the 2012 Session, the Legislature passed Senate Bill 562, which directed the agency to develop and secure legislative approval of new rules to interpret the narrative criterion for biological impairment found in 47 CSR 2 §3.2.i. A copy of the legislation may be viewed at:

http://www.legis.state.wv.us/Bill_Text_HTML/2012_SESSIONS/RS/pdf_bills/SB562%20SUB1%20enr%20PRINTED.pdf

In accordance with the legislation, WVDEP began and is still in the process of developing a method other than WVSCI for interpreting 47 CSR 2 §3.2.i, which it will use upon approval to determine biological impairment and develop TMDLs. As a further result of this legislative mandate, WVDEP has suspended biological impairment TMDL development pending legislative approval of the new assessment methodology.

The above notwithstanding, biological impairment listings within the project area were subjected to the biological stressor identification process described in this section. This process allowed stream-specific identification of the significant stressors associated with benthic macroinvertebrate community impact. If those stressors are resolved through the attainment of numeric water quality criteria, and TMDLs addressing such criteria are developed and approved, then additional "biological TMDL" development work is not needed. Although this project does not include "biological impairment" TMDLs, stressor identification results are presented for nine streams with benthic macroinvertebrate impacts so that they may be considered in listing/delisting decision-making in future 303(d) processes (See **Appendix K**). The SI process demonstrated that biological stress would be resolved in six of those streams through the implementation of numeric criterion TMDLs developed in this project provided in **Table 4-1**.

4.1 Introduction

Impact to benthic macroinvertebrate communities were rated using a multimetric index developed for use in the wadeable streams of West Virginia. The West Virginia Stream Condition Index (WVSCI; Gerritsen et al., 2000) was designed to identify streams with benthic communities that are different from the reference condition presumed to constitute biological integrity. A Stressor Identification (SI) process was implemented to identify the significant stressors associated with identified impacts. Streams with WVSCI scores less than 68 were included in the process.

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 impact. Elements of that guidance were used and custom analyses of biological data were performed to supplement the recommended framework.

The general SI process entailed reviewing available information, forming and analyzing possible stressor scenarios, and implicating causative stressors. The SI method provides a consistent process for evaluating available information. **Section 7** of the Technical Report discusses biological impairment and the stressor identification (SI) process in detail.

4.2 Data Review

WVDEP generated the primary data used in SI 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, WVDEP mining activities data, NLCD 2006 landuse information, Natural Resources Conservation Service (NRCS) State Soil Geographic database (STATSGO) soils data, National Pollutant Discharge Elimination System (NPDES) point source data, and literature sources.

4.3 Candidate Causes/Pathways

The first step in the SI process was to develop a list of candidate causes, or stressors. The candidate causes considered are listed below:

1. Metals contamination (including metals contributed through soil erosion) causes toxicity
2. Acidity (low pH) causes toxicity
3. Basic (high pH >9) causes toxicity
4. Increased ionic strength causes toxicity

5. Organic enrichment (e.g. sewage discharges and agricultural runoff cause habitat alterations
6. Increased metals flocculation and deposition causes habitat alterations (e.g., embeddedness)
7. Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations
8. Altered hydrology causes higher water temperature, resulting in direct impacts
9. Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
10. Algal growth causes food supply shift
11. High levels of ammonia cause toxicity (including increased toxicity due to algal growth)
12. Chemical spills cause toxicity

A conceptual model was developed to examine the relationship between candidate causes and potential biological effects. The conceptual model (**Figure 4-1**) depicts the sources, stressors, and pathways that affect the biological community.

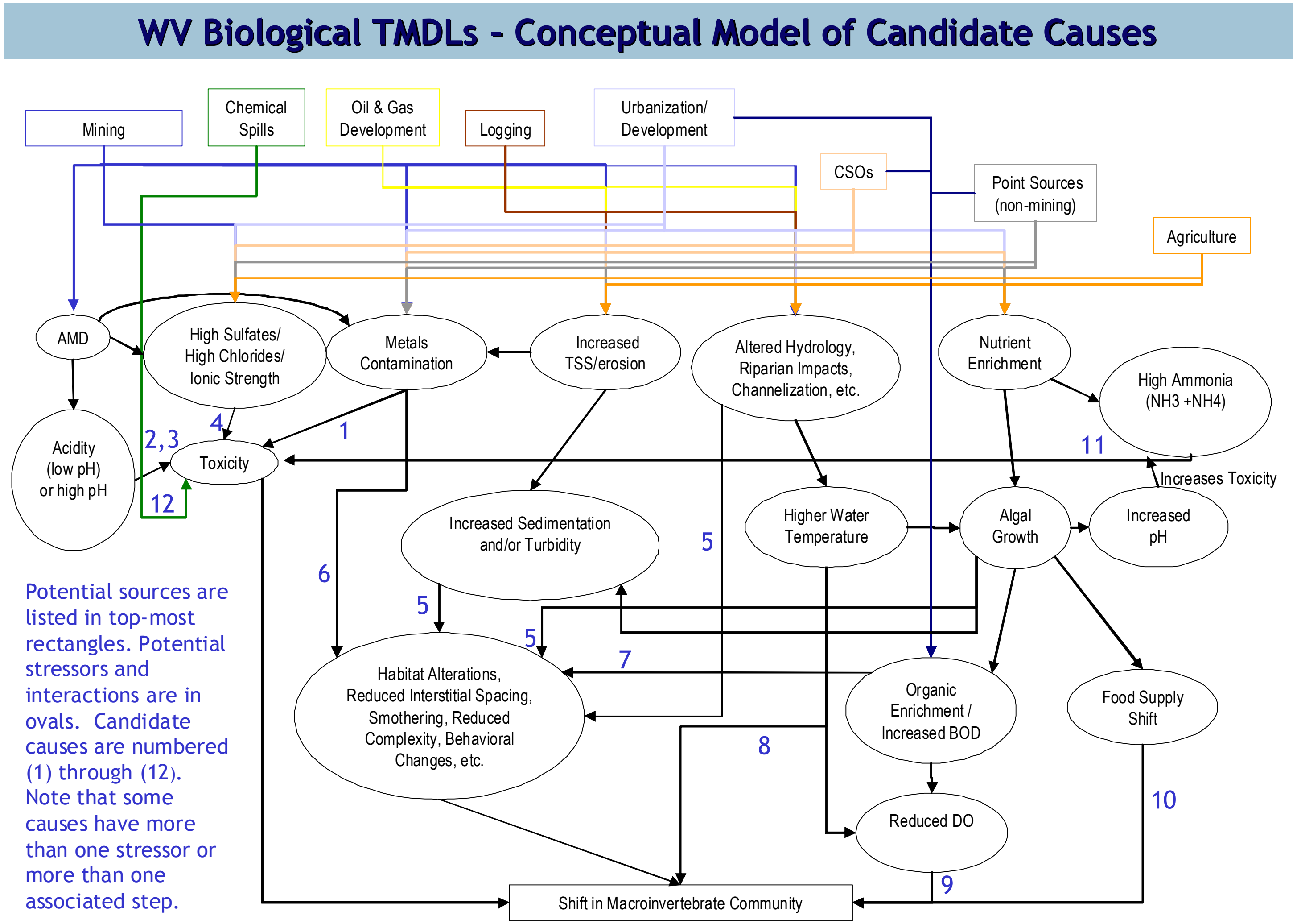


Figure 4-1. Conceptual model of candidate causes and potential biological effects

4.4 Stressor Identification Results

The SI process identified significant biological stressors for each stream. Biological impact was linked to a single stressor in some cases and multiple stressors in others. The SI process identified the following stressors to be present in the impacted waters in the South Branch Potomac River Watershed:

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

After stressors were identified, WVDEP also determined the pollutants in need of control to address the impacts.

In all streams for which the SI process identified organic enrichment as a significant biological stressor, data also indicated violations of the fecal coliform water quality criteria. The predominant sources of both organic enrichment and fecal coliform bacteria in the watershed are inadequately treated sewage and runoff from agricultural landuses. WVDEP determined that implementation of fecal coliform TMDLs would remove untreated sewage and significantly reduce loadings in agricultural runoff and thereby resolve organic enrichment stress.

Streams for which the SI process identified sedimentation as a significant stressor are also impaired pursuant to total iron water quality criteria and the TMDL assessment for iron included representation and allocation of iron loadings associated with sediment. WVDEP compared the amount of sediment reduction necessary in the iron TMDLs to the amount of reduction needed to achieve the normalized sediment loading of an unimpacted reference stream. In these streams, the sediment loading reduction necessary for attainment of water quality criteria for iron exceeds that which was determined to be necessary using the reference approach. Implementation of the iron TMDLs will resolve biological stress from sedimentation in these streams. See the Technical Report for further descriptions of the correlation between sediment and iron and the comparisons of sediment reductions under iron criterion attainment and reference watershed approaches.

The streams for which biological stress to benthic macroinvertebrates would be resolved through the implementation of the pollutant-specific TMDLs developed in this project are presented in **Table 4-1**.

Table 4-1. Biological impacts resolved by implementation of pollutant-specific TMDLs

Stream Name	NHD-Code	Significant Stressors	TMDLs Developed
Anderson Run	WV-PSB-62	Organic enrichment, sedimentation	Fecal coliform, total iron
UNT/South Branch Potomac River RM 40.44	WV-PSB-79-DL	Organic enrichment	Fecal coliform
UNT/South Branch Potomac River RM 59.19	WV-PSB-82	Organic enrichment, sedimentation	Fecal coliform, total iron

Stream Name	NHD-Code	Significant Stressors	TMDLs Developed
UNT/UNT RM 2.27/South Branch Potomac River	WV-PSB-82-E	Organic enrichment, sedimentation	Fecal coliform, total iron
Robinson Run	WV-PSB-98-G	Organic enrichment	Fecal coliform
South Fork/Lunice Creek	WV-PSB-98-T	Organic enrichment, sedimentation	Fecal coliform, total iron

5.0 METALS SOURCE ASSESSMENT

This section identifies and examines the potential sources of metals impairments in the South Branch Potomac River and Shenandoah River Watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources.

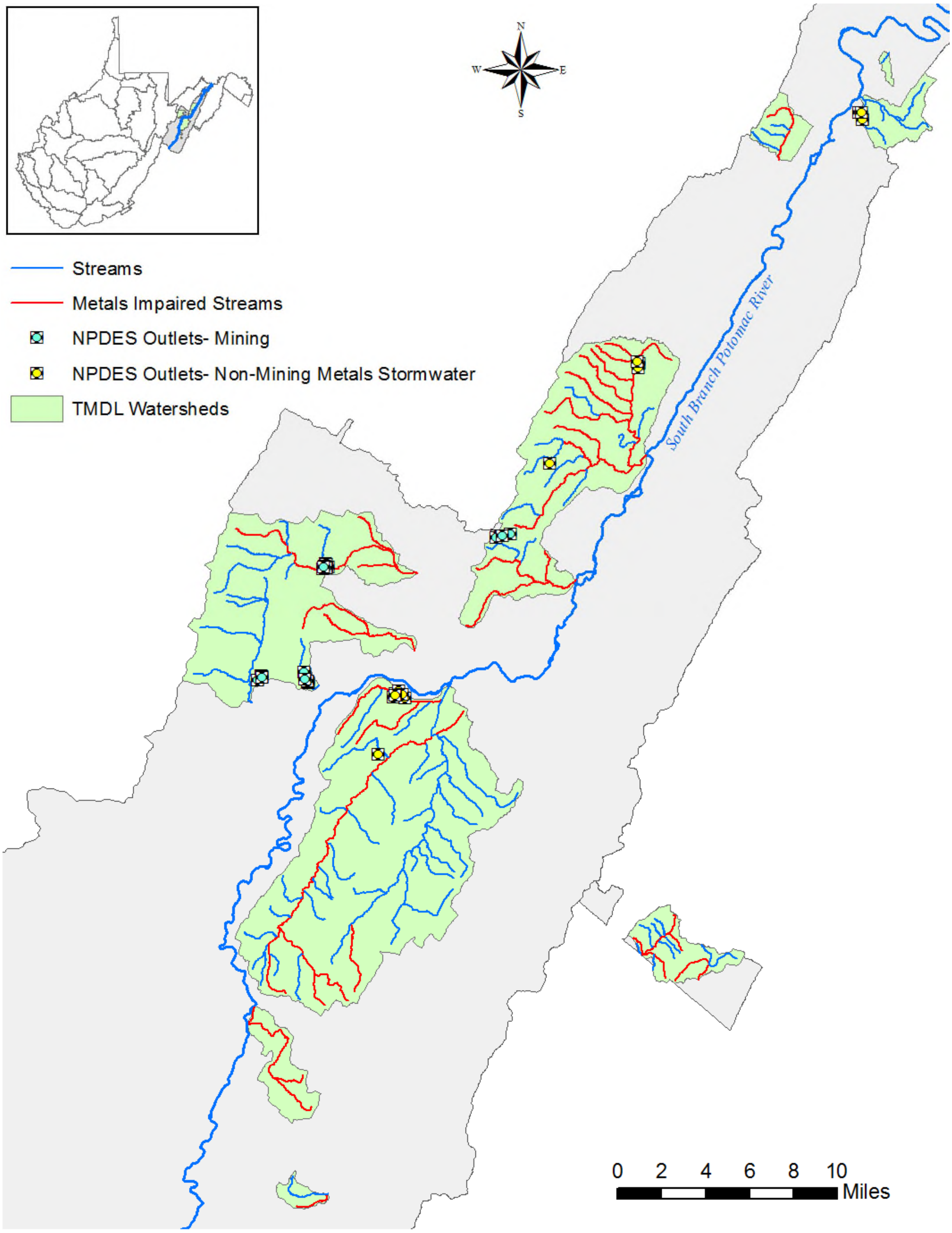
A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or may be discharged. The 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.

Nonpoint sources of pollutants are diffuse, non-permitted sources. They most often result from precipitation-driven runoff. For the purposes of these TMDLs only, WLAs are given to NPDES-permitted discharge points, and LAs are given to discharges from activities that do not have an associated NPDES permit.

The physiographic data discussed in **Section 3.2** enabled the characterization of pollutant sources. As part of the TMDL development process, WVDEP performed additional field-based source tracking activities to supplement the available source characterization data. WVDEP staff recorded physical descriptions of pollutant sources and the general stream condition 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 GIS software. Detailed information, including the locations of pollutant sources, is provided in the following sections, the Technical Report, and the ArcGIS Viewer Project.

5.1 Metals Point Sources

Metals point sources are classified by the mining- and non-mining-related permits issued by WVDEP. The following sections discuss the potential impacts and the characterization of these source types, the locations of which are displayed in **Figure 5-1**.



(Note: permits in close proximity appear to overlap in the figure)

Figure 5-1. Metals point sources in the South Branch Potomac River Watershed

5.1.1 Mining Point Sources

WVDEP's Division of Mining and Reclamation (DMR) regulates coal and non-coal mining activities with permits issues pursuant to the Surface Mining Control and Reclamation Act (SMCRA) and the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES). DMR provided spatial coverage of the mining permit areas and related SMCRA and NPDES permit information. DMR also provided a spatial coverage of the mining-related NPDES permit outlets. The spatial coverage was used to determine the location of the permitted outlets. The NPDES discharge permits for mining-related activities commonly include effluent limits for total iron, total manganese, total aluminum, total suspended solids, and pH. The discharge characteristics, related permit limits, and discharge data for these NPDES outlets were acquired from West Virginia's ERIS database system. WVDEP DWWM personnel used the information contained in the SMCRA and NPDES permits to further characterize the mining point sources. Information gathered included type of discharge, pump capacities, and drainage areas (including total and disturbed areas). Using this information, the mining point sources were then represented in the model and assigned individual WLAs for metals.

There are no existing permitted coal mining facilities in the iron impaired watersheds of this project. Four NPDES permits, with 25 associated outlets exist for non-coal mining facilities. A complete list of the permits and outlets is provided in Appendix F of the Technical Report. Figure 5-1 illustrates the extent of the mining NPDES outlets in the watershed.

5.1.2 Non-mining Point Sources

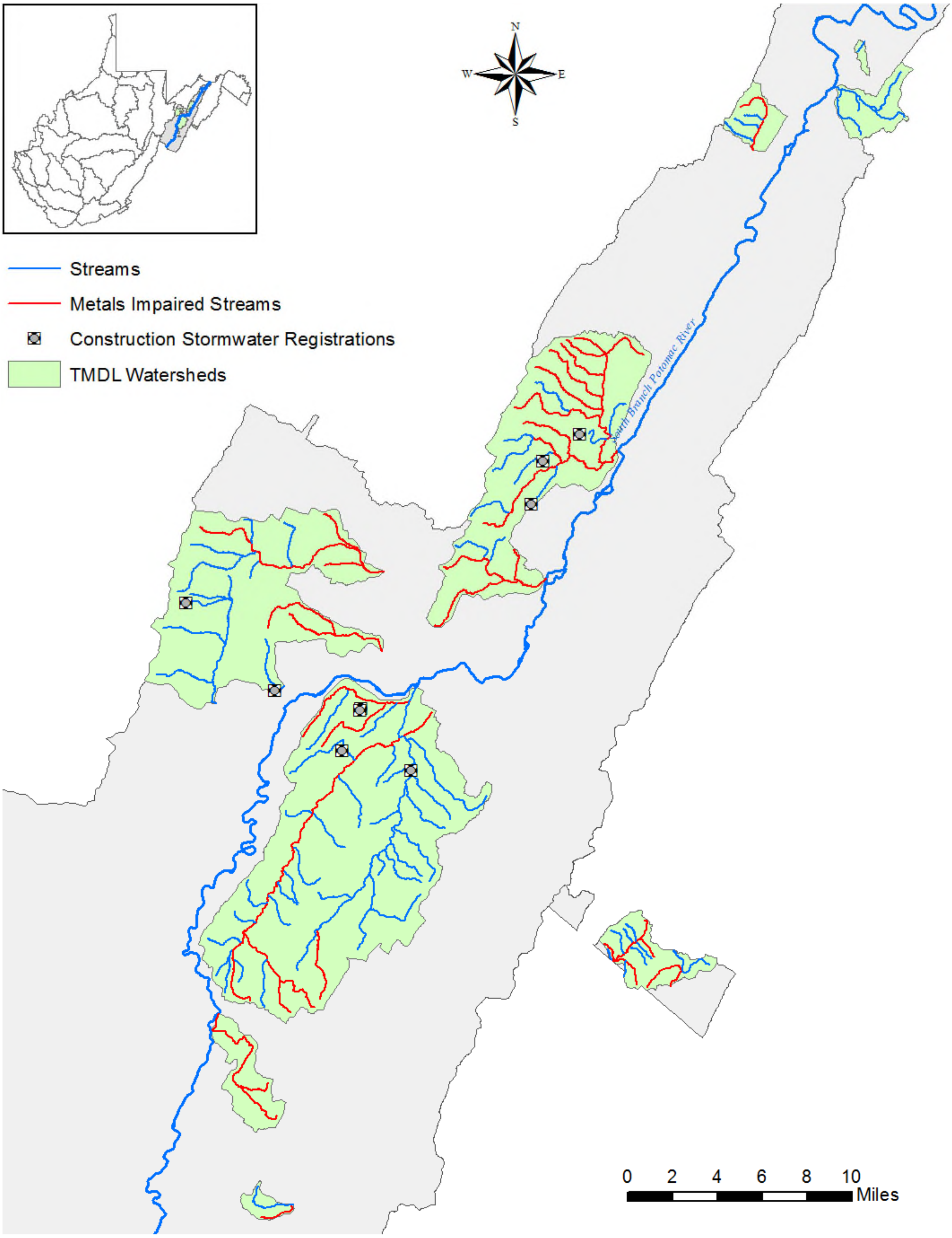
WVDEP DWWM controls water quality impacts from non-mining activities with point source discharges through the issuance of NPDES permits. WVDEP's OWRNPDES GIS coverage was used to determine the locations of these sources, and detailed permit information was obtained from WVDEP's ERIS database. Sources may include the process wastewater discharges from water treatment plants and industrial manufacturing operations, and stormwater discharges associated with industrial activity. There are 9 non-mining permits with 10 permitted outlets in the watersheds of metals impaired streams, all of which are stormwater discharges associated with industrial activity. The assigned WLAs for all non-mining NPDES outlets allow for continued discharge under existing permit requirements. A complete list of the permits and outlets is provided in **Appendix F** of the Technical Report.

Sewage treatment facilities for which existing NPDES permits did not contain iron effluent limitations were not considered to be substantive metals sources and were not explicitly represented in the modeling. Existing discharges from such sources do not require wasteload allocations pursuant to the metals TMDLs. A list of such negligible sources also appears in **Appendix F** of the Technical Report. Any metals loading associated with such sources is contained in the background loading and accounted for in model calibration.

5.1.3 Construction Stormwater Permits

The discharges from construction activities that disturb more than one acre of land are legally defined as point sources and the sediment introduced from such discharges can contribute iron. WVDEP issues a General NPDES Permit (permit WV0115924) to regulate stormwater discharges associated with construction activities with a land disturbance greater than one acre. These permits require that the site have properly installed best management practices (BMPs), such as silt fences, sediment traps, seeding/mulching, and riprap, to prevent or reduce erosion and sediment runoff. The BMPs will remain intact until the construction is complete and the site has been stabilized. Individual registration under the General Permit is usually limited to less than one year.

At the time of model set-up, 9 active construction sites with a total disturbed acreage of 115.81 acres registered under the Construction Stormwater General Permit (CSGP) were represented in the watersheds of metals impaired waters (**Figure 5-2**). Specific WLAs are not prescribed for individual sites. Instead, subwatershed-based allocations are provided for concurrently disturbed area registered under the permits as described in **Sections 8.7.1** and **10.0**.



(Note: permits in close proximity appear to overlap in the figure)

Figure 5-2. Construction stormwater permits in the South Branch Potomac River Watershed

5.2 Metals Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals. Land disturbance can increase sediment loading to impaired waters. The control of sediment-producing sources has been determined to be necessary to meet water quality criteria for total iron during high-flow conditions. Nonpoint sources of sediment include forestry operations, oil and gas operations, roads, agriculture, stormwater from construction sites less than one acre, and stormwater from urban and residential land. Additionally, streambank erosion represents a significant sediment source throughout the watershed. Upland sediment nonpoint sources are summarized below.

Forestry

The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the metals impaired TMDL watersheds. This information included the 1807 acres of harvested area within the TMDL impaired streams watersheds, of which subset of land disturbed by roads and landings is 144.56 acres. In addition, 9.7 acres of burned forest were reported and included as disturbed land.

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. The act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated access roads can increase sediment loading to streams. According to the Division of Forestry, illicit logging operations represent approximately 2.5 percent of the total harvested forest area (registered logging sites) throughout West Virginia. These illicit operations do not have properly installed BMPs and can contribute sediment to streams. This rate of illicit activity has been represented in the model. **Figure 5-3** shows the extent of forestry operations in TMDL watersheds.

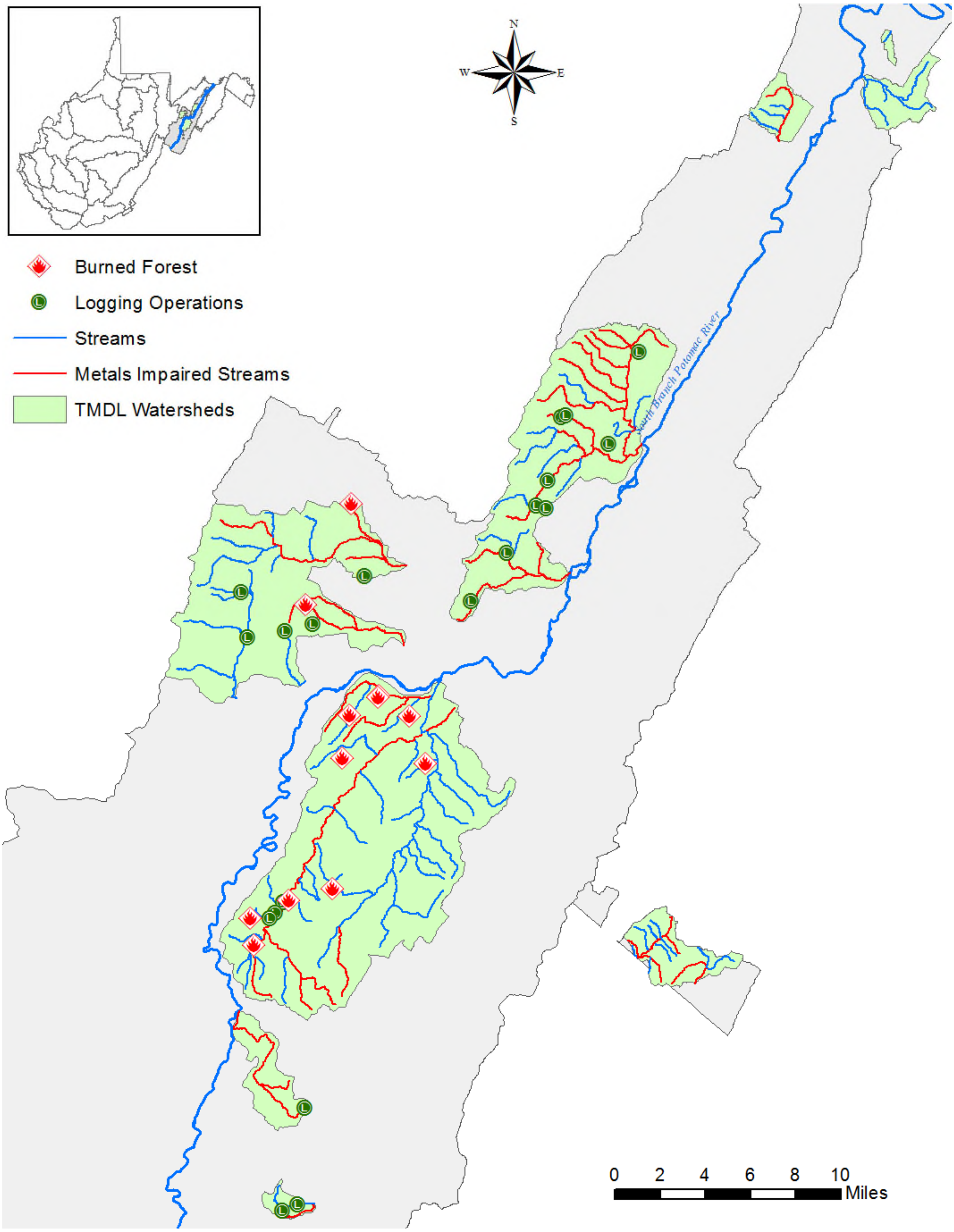


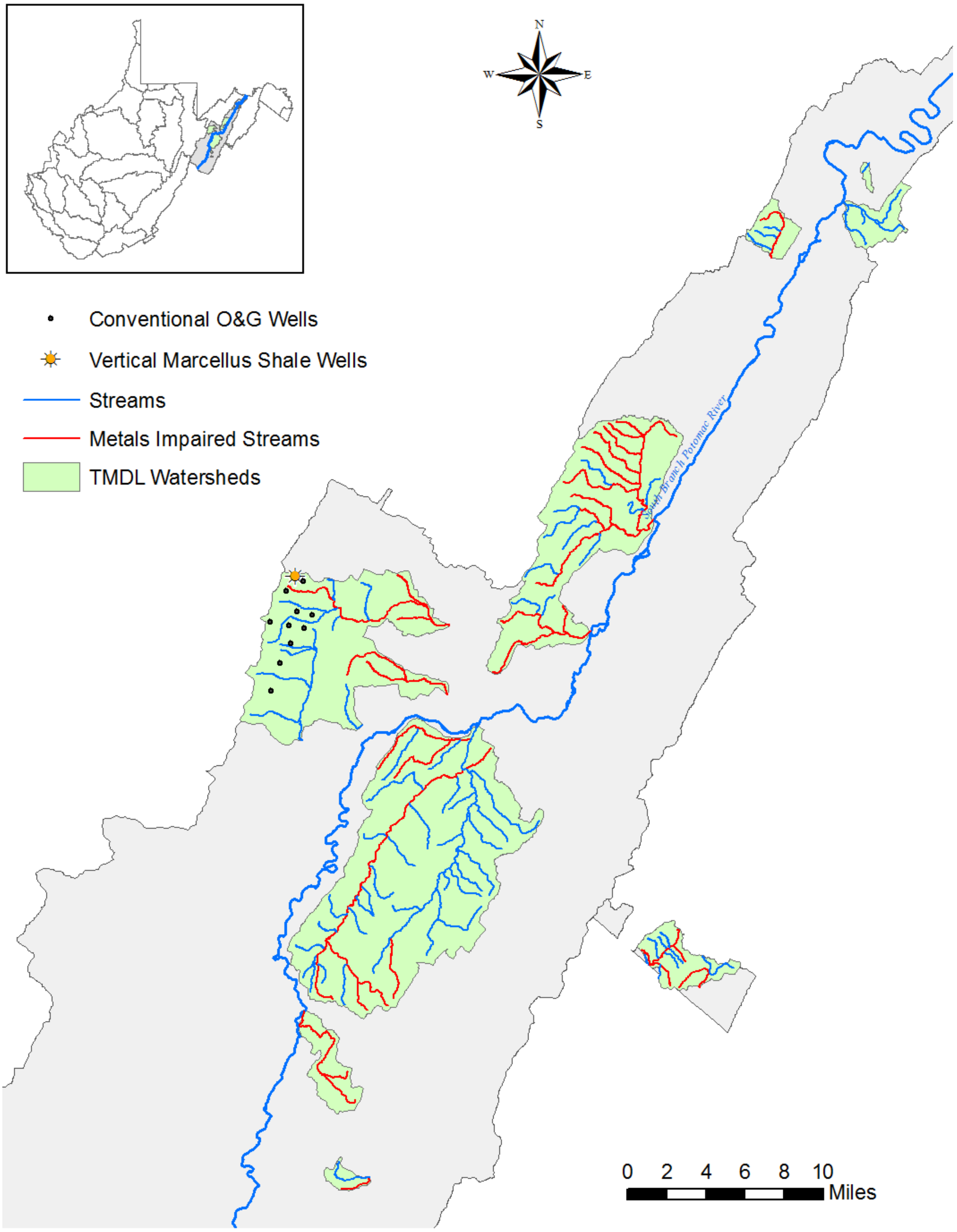
Figure 5-3. Forestry non-point metals sources in the South Branch Potomac River Watershed

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, and manages the Abandoned Well Plugging and Reclamation Program. The OOG also ensures that surface water and groundwater are protected from oil and gas activities.

Recent drilling of new gas wells targeting the Marcellus Shale geologic formation has occurred in the watershed. Because of the different drilling techniques, the overall amount of land disturbance can be significantly higher for Marcellus wells than for conventional wells. Horizontal Marcellus drilling sites typically require a flat "pad" area of several acres to hold equipment, access roads capable of supporting heavy vehicle traffic, and temporary ponds for storing water used during the drilling process.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There are 10 active conventional oil and gas wells, one vertical Marcellus drilling site, comprising 18.8 acres represented in the metals impaired TMDL watersheds addressed in this report. There are no horizontal Marcellus drilling sites represented in the watersheds of impaired streams. Runoff from unpaved access roads to these wells and the disturbed areas around the wells contribute sediment to adjacent streams (**Figure 5-4**).



(Note: wells in close proximity appear to overlap in the figure)

Figure 5-4. Oil and Gas Well locations in the South Branch Potomac River Watershed

Roads

Heightened stormwater runoff from paved roads (impervious surface) 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 2011 TIGER/Line shapefiles from the US Census Bureau and the WV Roads GIS coverage prepared by WVU. Unpaved roads that were not included in either GIS coverage were digitized from topographic maps.

Agriculture

Agricultural landuses account for 7.8 percent of the modeled land area in metals impaired TMDL watersheds. Agricultural activity is a significant localized nonpoint source of iron and sediment. Upland loading representation was based on precipitation and runoff, in which accumulation rates were developed using source tracking information regarding number of livestock, proximity and access to streams, and overall runoff potential. Sedimentation/iron impacts from agricultural landuses are also indirectly reflected in the streambank erosion allocations.

Streambank Erosion

Streambank erosion has been determined to be a significant sediment source across the watershed. WVDEP conducted a series of special bank erosion pin studies which, combined with soils data and vegetative cover assessments, formed the foundation for representation of the baseline streambank sediment and iron loadings. The sediment loading from bank erosion is considered a nonpoint source and LAs are assigned .

Other Land-Disturbance Activities

Stormwater runoff from residential and urban landuses is a significant source of sediment in parts of the watershed. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified NLCD 2006 landuse data were used to determine the extent of residential and urban areas and source representation was based upon precipitation and runoff.

The NLCD 2006 landuse data also classifies certain areas as “barren” land. In the model configuration process, portions of the barren landuse were reclassified to account for other known sources (mining permits, oil and gas wells, and construction stormwater permits). The remainder is represented as a specific nonpoint source category in the model.

Construction activities disturbing less than one acre are not subject to construction stormwater permitting. While not specifically represented in the model, their impact is indirectly accounted for in the loading rates established for the urban/residential landuse category.

6.0 FECAL COLIFORM SOURCE ASSESSMENT

6.1 Fecal Coliform Point Sources

Publicly and privately owned sewage treatment facilities and home aeration units are point sources of fecal coliform bacteria. Combined sewer overflows (CSOs) and discharges from MS4s are additional point sources that may contribute loadings of fecal coliform bacteria to receiving streams. The following sections discuss the specific types of fecal coliform point sources that were identified in the TMDL watersheds.

6.1.1 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 sewage treatment facilities with extensive wastewater collection systems, whereas private facilities are usually used in smaller applications such as subdivisions and shopping centers. Additionally specific discharges from industrial facilities are regulated for fecal coliform bacteria. These sources are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 mL [geometric mean monthly] and 400 counts/100 mL [maximum daily]). Compliant facilities do not cause fecal coliform bacteria impairments because effluent limitations are more stringent than water quality criteria.

In the subject watersheds of this report, there are no individually permitted POTW discharge treated effluent to TMDL streams.

6.1.2 Overflows

CSOs are outfalls from POTW sewer systems that discharge untreated domestic waste and surface runoff. CSOs are permitted to discharge only during precipitation events. Sanitary sewer overflows (SSOs) are unpermitted overflows that occur as a result of excess inflow and/or infiltration to POTW separate sanitary collection systems. Both types of overflows contain fecal coliform bacteria.

There are no CSO or significant SSO discharges represented in the model.

6.1.3 Municipal Separate Storm Sewer Systems (MS4)

Runoff from residential and urbanized areas during storm events can be a significant fecal coliform source. USEPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified urbanized areas. As such, MS4 stormwater discharges are considered point sources and are prescribed WLAs.

There are no MS4 entities in subject watersheds of this report.

6.1.4 General Sewage Permits

General sewage permits are designed to cover like 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 50,000 gallons per day (gpd) or less. 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. In the areas draining to streams for which fecal coliform TMDLs have been developed, three facilities are registered under the "package plant" general permit. There are no facilities registered under the HAU general permit.

6.2 Fecal Coliform Nonpoint Sources

6.2.1 On-site Treatment Systems

Failing septic systems and straight pipes are significant nonpoint sources of fecal coliform bacteria. Information collected during source tracking efforts by WVDEP yielded an estimate of 1,072 homes that are not served by centralized sewage collection and treatment systems and are within 100 meters of a stream. Homes located more than 100 meters from a stream were not considered significant potential sources of fecal coliform because of the natural attenuation of fecal coliform concentrations that occurs because of bacterial die-off during overland travel (Walsh and Kunapo, 2009). Estimated septic system failure rates across the watershed range from three percent to 24 percent.

Due to a wide range of available literature values relating to the bacteria loading associated with failing septic systems, a customized Microsoft Excel spreadsheet tool was created to represent the fecal coliform bacteria contribution from failing on-site septic systems. WVDEP's pre-TMDL monitoring and source tracking data were used in the calculations. To calculate loads, values for both wastewater flow and fecal coliform concentration are needed.

To calculate failing septic wastewater flows, the TMDL watersheds were divided into four septic failure zones. During the WVDEP source tracking process, septic failure zones were delineated by soil characteristics (soil permeability, depth to bedrock, depth to groundwater and drainage capacity) as shown in United States Department of Agriculture (USDA) county soil survey maps. Two types of failure were considered, complete failure and periodic failure. For the purposes of this analysis, complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters and periodic failure was defined as 25 gallons per house per day. **Figure 6-1** shows the failing septic flows represented in the model by subwatershed.

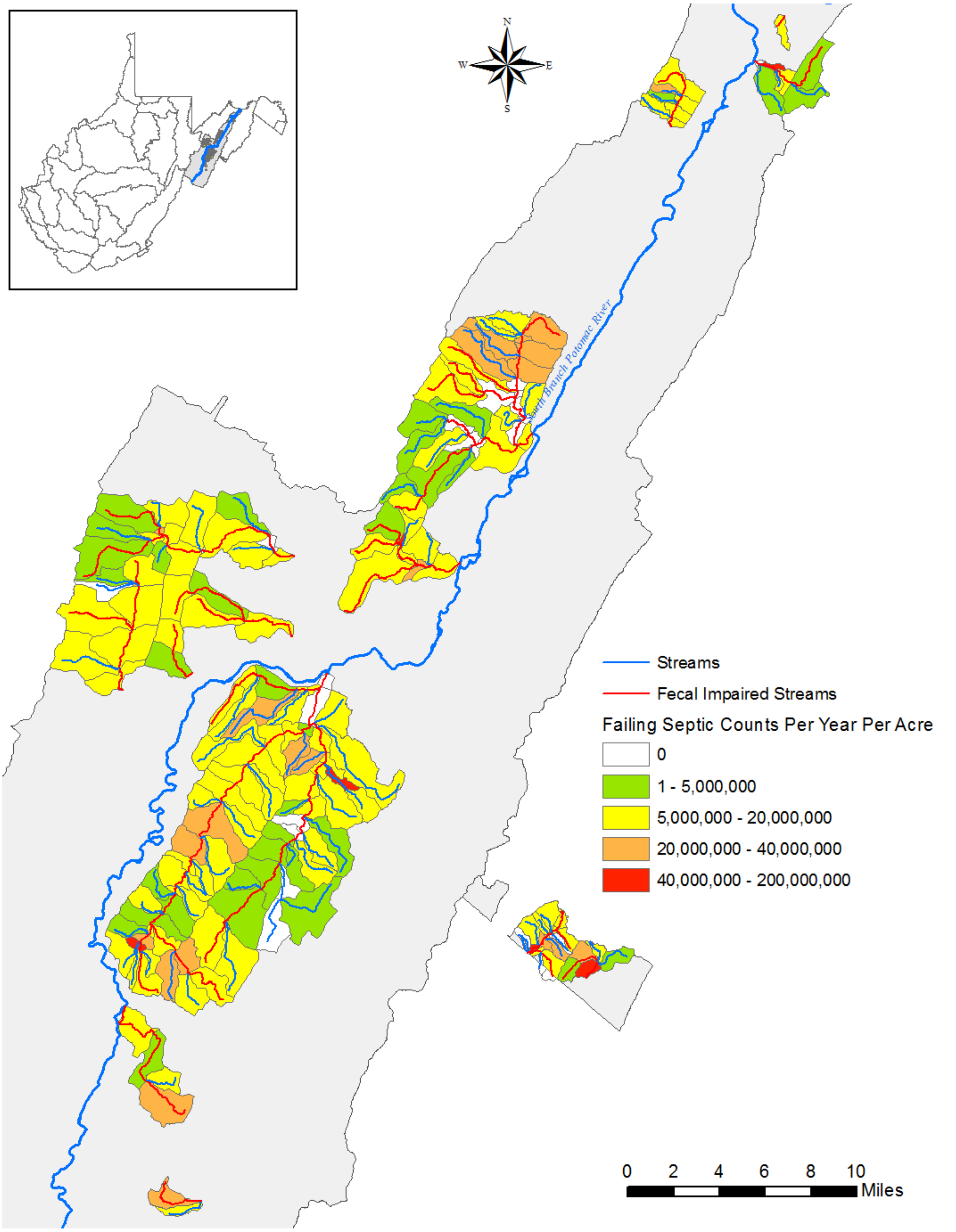


Figure 6-1. Failing septic loads in the TMDL watersheds

Once failing septic flows were modeled, a fecal coliform concentration was determined at the TMDL watershed scale. Based on past experience with other West Virginia TMDLs, a base concentration of 10,000 counts per 100 ml was used as a beginning concentration for failing septic systems. This concentration was further refined during model calibration. A sensitivity analysis was performed by varying the modeled failing septic concentrations in multiple model runs, and then comparing model output to pre-TMDL monitoring data. Additional details of the failing septic analyses are elucidated in the Technical Report.

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 LAs to those sources does not reflect a determination by WVDEP or USEPA as to whether they are, in fact, non-permitted point source discharges. Likewise, by establishing these TMDLs with failing septic systems and straight pipes treated as nonpoint sources, WVDEP and USEPA are not determining that such discharges are exempt from NPDES permitting requirements.

6.2.2 Urban/Residential Runoff

Stormwater runoff from residential and urbanized areas can be a significant source of fecal coliform bacteria. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified NLCD 2006 landuse data were used to determine the extent of residential and urban areas and source representation was based upon precipitation and runoff.

6.2.3 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. These bacteria are then available for wash-off and transport during rain events. In addition, livestock with unrestricted access can deposit feces directly into streams.

Agriculture is a significant localized nonpoint source of fecal coliform bacteria. Source tracking efforts identified pastures and feedlots near impaired segments that have localized impacts on instream bacteria levels. Source representation was based upon precipitation and runoff, and source tracking information regarding number of livestock, proximity and access to stream, and overall runoff potential were used to develop accumulation rates.

6.2.4 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 West Virginia’s Division of Natural Resources (WVDNR). In addition, WVDEP conducted storm-sampling on a 100 percent forested subwatershed (Shrewsbury Hollow) within the Kanawha State Forest, Kanawha County, West Virginia to determine wildlife contributions of fecal coliform. These results were used during the model calibration process. On the basis of the low fecal accumulation rates for forested areas, the storm water sampling results, and model simulations, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the watershed.

7.0 DISSOLVED OXYGEN SOURCE ASSESSMENT

As noted in **Table 3-3**, UNT/Robinson Run RM 2.84 (WV-PSB-98-G-4) and South Fork/Lunice Creek (WV-PSB-98-T) are impaired for dissolved oxygen and fecal coliform bacteria, both commonly associated with organic enrichment. Excessive amounts of organic matter increase fecal coliform bacteria counts and reduce dissolved oxygen levels. Generally, point and non-point sources contributing to dissolved oxygen impairments are the same as those for fecal coliform.

Dissolved oxygen impairment in UNT/Robinson Run RM 2.84 is most likely caused by organic enrichment by livestock manure. A large pasture is located in the middle of this very small stream near the monitoring station. The stream is not fenced, allowing cattle direct access to the stream. Pre-TMDL monitoring documented nonattainment with fecal coliform and dissolved oxygen criteria. Summertime dissolved oxygen concentrations below 5 mg/L coincided with an excessive amount of fecal coliform with maximum levels of 4,200 counts/100 mL.

Similarly, the dissolved oxygen impairment in South Fork/Lunice Creek also is most likely caused by organic enrichment by livestock manure. The South Fork/Lunice Creek is a larger stream with several first order tributaries (**Figure 7-1**). Agricultural source tracking field investigations discovered several subwatersheds within the South Fork/Lunice Creek TMDL watershed with a high percentage of available grassland being used to intensively pasture cattle. Pre-TMDL monitoring also documented nonattainment with fecal coliform and dissolved oxygen criteria. Dissolved oxygen concentrations below 3 mg/L that were detected during low-flow periods in the summer months coincided with an excessive amount of fecal coliform with maximum levels of 60,000 counts/100 mL.

The actions typically used to reduce instream fecal coliform levels, such as restricting livestock stream access, adding streambank buffer zones, developing nutrient management plans, and eliminating failing septic systems, will reduce fecal coliform levels and increase dissolved oxygen levels. Fecal coliform TMDLs are presented for UNT/Robinson Run RM 2.84 (WV-PSB-98-G-4) and South Fork/Lunice Creek (WV-PSB-98-T). Successful implementation of the 97.5% fecal coliform reduction prescribed for agriculture in the UNT/Robinson Run RM 2.84 watershed (model subwatershed 1222) would necessitate installation of BMPs to cease releases of animal wastes to the stream, which, in turn, would result in attainment of the dissolved oxygen criterion. Likewise, implementation of 95% reductions to significant agricultural sources of fecal coliform in South Fork/Lunice Creek watershed (model subwatersheds 1201-1216) would also result in attainment of the dissolved oxygen criterion. Both streams also have prescriptions to reduce fecal coliform loadings from failing septic systems 100%.

As such, the UNT/Robinson Run RM 2.84 and South Fork/Lunice Creek fecal coliform TMDLs are an appropriate surrogate for the dissolved oxygen impairment. **Figure 7-1** shows the relative intensity of agricultural sources of fecal coliform contributing to the dissolved oxygen impairments.

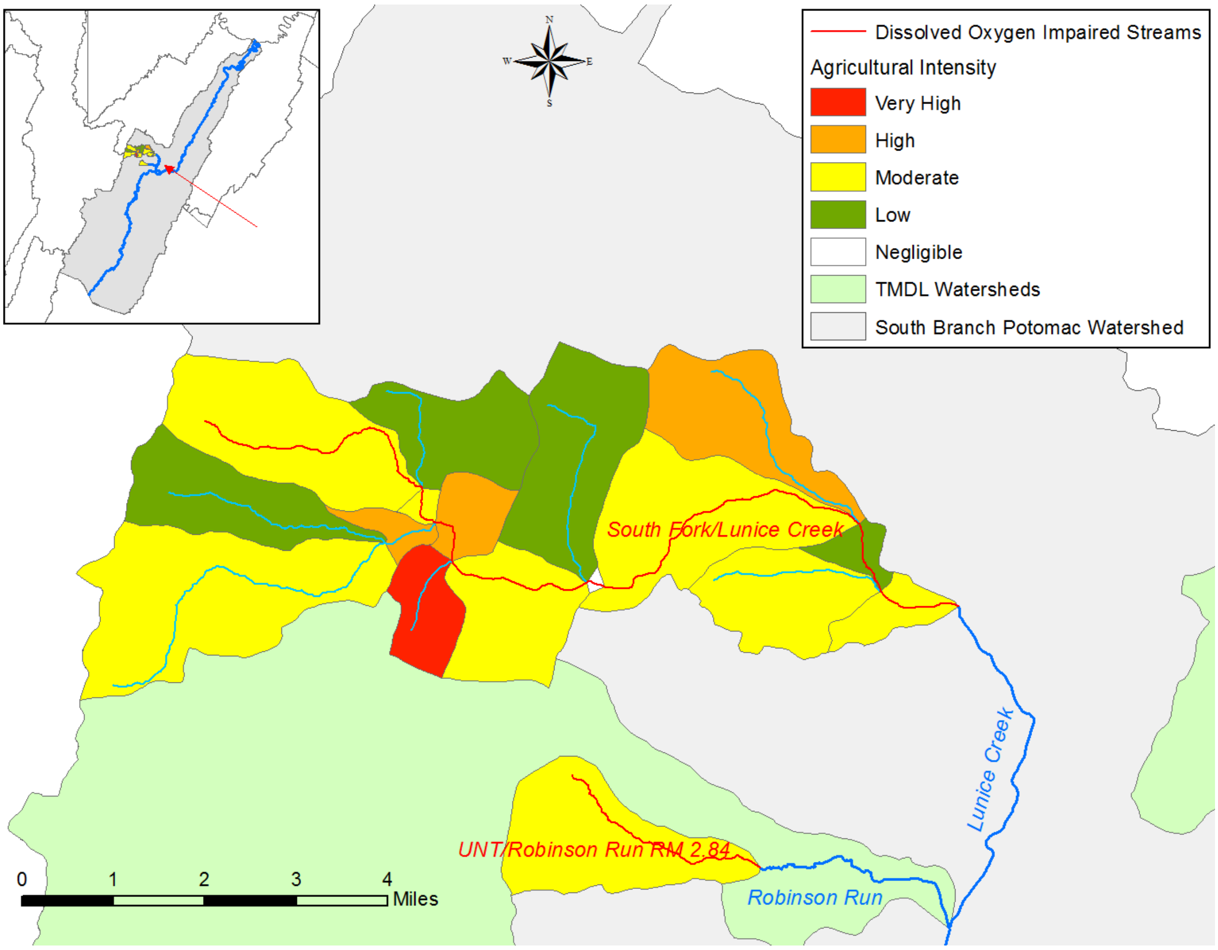


Figure 7-1. Location of dissolved oxygen impaired streams and contributing sources.

8.0 MODELING PROCESS

Establishing the relationship between the instream water quality targets and source loadings is a critical component of TMDL development. It allows for the 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 instream response for TMDL development in the watersheds.

8.1 Model Selection

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
- Point and nonpoint sources
- Metals and fecal coliform bacteria impairments are temporally variable and occur at low, average, and high flow conditions
- Total iron loadings and instream concentrations are related to sediment
- Time-variable aspects of land practices have a large effect on instream metals and bacteria concentrations
- Metals and bacteria transport mechanisms are highly variable and often weather-dependent

The primary regulatory factor that influenced 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 criteria for iron, dissolved oxygen, and fecal coliform bacteria in West Virginia are presented in **Section 2.2**, **Table 2-1**. West Virginia numeric 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 instream concentrations under a variety of flow conditions to evaluate critical flow periods for comparison with criteria.

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and instream fate. In the TMDL watersheds, an array of point and nonpoint sources contributes to the various impairments. Most nonpoint sources are rainfall-driven with pollutant loadings primarily related to surface runoff, but some, such as inadequate onsite residential sewage treatment systems, function as continuous discharges. Similarly, certain point sources are precipitation-induced while others are continuous discharges. While loading function variations must be recognized in the representation of the various sources, the TMDL allocation process must prescribe WLAs for all contributing point sources and LAs for all contributing nonpoint sources.

The Mining Data Analysis System (MDAS) was developed specifically for TMDL application in West Virginia to facilitate large scale, data intensive watershed modeling applications. The 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 instream response. The MDAS is used to simulate watershed hydrology and pollutant transport as well as stream hydraulics and instream water quality. It is capable of simulating different flow regimes and pollutant loading variations. A key advantage of the MDAS' development framework is that it has no inherent limitations in terms of modeling size or upper limit of model operations. In addition, the MDAS model allows for seamless integration with modern-day, widely available software such as Microsoft Access and Excel. Sediment, total iron, and fecal coliform bacteria were modeled using the MDAS.

8.2 Model Setup

Model setup consisted of configuring the following two separate MDAS models: iron/sediment, and fecal coliform bacteria.

8.2.1 General MDAS Configuration

Configuration of the MDAS model involved subdividing the TMDL watersheds into subwatershed modeling units connected by stream reaches. Physical characteristics of the subwatersheds, weather data, landuse information, continuous discharges, and stream data were used as input. Flow and water quality were continuously simulated on an hourly time-step.

The 13 TMDL watersheds were broken into 199 separate subwatershed units, based on the groupings of impaired streams shown in **Figure 3-2**. The TMDL watersheds were divided to allow evaluation of water quality and flow at pre-TMDL monitoring stations. This subdivision process also ensures a proper stream network configuration within the basin.

8.2.2 Iron and Sediment Configuration

The modeled landuse categories contributing metals via precipitation and runoff include forest, pasture, cropland, wetlands, barren, residential/urban impervious, and residential/urban pervious. These sources were represented explicitly by consolidating existing NLCD 2006 landuse categories to create modeled landuse groupings. Several additional landuse categories were created to account for landuses either not included in the NLCD 2006 and/or representing recent land disturbance activities (i.e., harvested forest and skid roads, oil and gas operations, paved and unpaved roads, and active mining). The process of consolidating and updating the modeled landuses is explained in further detail in the Technical Report. In addition, non-sediment related iron land-based sources were modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget.

Sediment-producing landuses and bank erosion are sources of iron because the relatively high iron content of the soils in the watershed. Statistical analyses using pre-TMDL monitoring data collected in the TMDL watersheds were performed to establish the correlation between in-stream sediment and iron metals concentrations. The results were then applied to the sediment from sediment-producing landuses and bank erosion to calculate the iron loads delivered to the streams.

Generation of upland sediment loads depends on the intensity of surface runoff. It also varies by landuse and the characteristics of the soil. Surface sediment sources were modeled as soil detachment and sediment transport by landuse. Soil erodibility and sediment washoff coefficients varied among soil types and landuses and were used to simulate sediment erosion by surface runoff. Sediment delivery paths modeled were surface runoff erosion, and streambank erosion. Streambank erosion was modeled as a unique sediment source independent of other upland-associated erosion sources.

The MDAS bank erosion model takes into account stream flow and bank stability using the following methodology. Each stream segment has a flow threshold above which streambank erosion occurs. This threshold is estimated as the flow that occurs at bank full depth. The bank erosion rate per unit area is a function of bank flow volume above the specified threshold and the bank erodible area. The bank scouring process is a power function dependent on high-flow events, defined as exceeding the flow threshold. Bank erosion rates increase with flow above the threshold.

The wetted perimeter and reach length represent ground area covered by water (**Figure 8-1**). The erodible wetted perimeter is equal to the difference between the actual wetted perimeter and wetted perimeter during threshold flow conditions. The bank erosion rate per unit area was multiplied by the erodible perimeter and the reach length to obtain an estimate of sediment mass eroded corresponding to the stream segment.

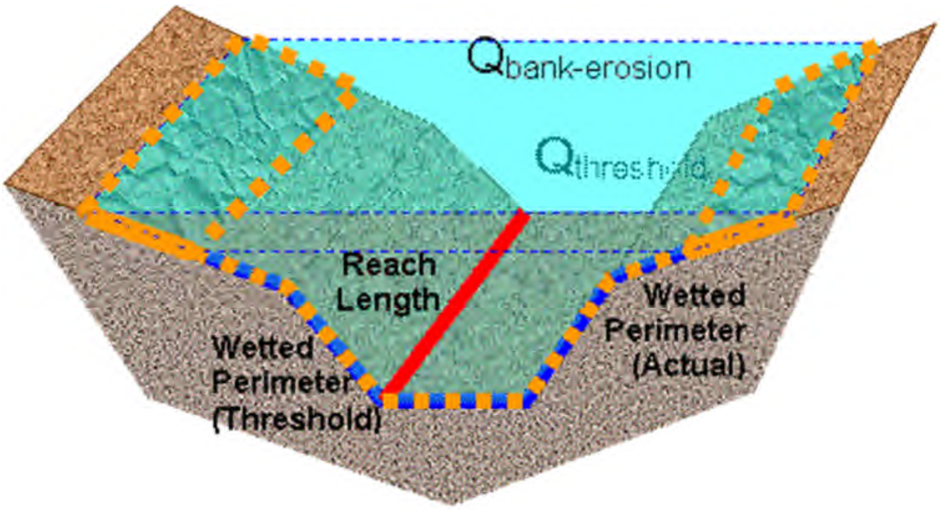


Figure 8-1. Conceptual diagram of stream channel components used in the bank erosion model

Another important variable in the prediction of sediment yield is bank stability as defined by coefficient for scour of the bank matrix soil (kber) for the reach. Both quantitative and qualitative assessments indicated that vegetative cover was the most important factor controlling bank stability. Overall bank stability was initially characterized by assessing and rating bank vegetative cover from aerial photography on a subwatershed basis. The erodibility coefficient from soils data was used to refine this assessment. Using the aerial assessment and the soil erodibility data together, the subwatershed's bank condition was scored and each level was associated with a kber value. Modeled streambank erosion annual soil loss results were compared to field data available from previous WVDEP streambank erosion pin studies to verify that the amount of lost sediment generated by the model was within reason.

The Technical Report provides more detailed discussions on the technical approaches used for streambank erosion and sediment modeling.

8.2.3 Fecal Coliform Configuration

Modeled landuse categories contributing bacteria via precipitation and runoff include pasture, cropland, urban/residential pervious lands, urban/residential impervious lands, grassland, forest, barren land, and wetlands. Other sources, such as failing septic systems, straight pipes, and discharges from sewage treatment facilities, were modeled as direct, continuous-flow sources in the model.

The basis for the initial bacteria loading rates for landuses and direct sources is described in the Technical Report. The initial estimates were further refined during the model calibration. A variety of modeling tools were used to develop the fecal coliform bacteria TMDLs, including the MDAS, and a customized spreadsheet to determine the fecal loading from failing residential septic systems identified during source tracking efforts by the WVDEP. **Section 6.2.1** describes the process of assigning flow and fecal coliform concentrations to failing septic systems.

8.3 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Typically, hydrology calibration involves a comparison of model results to in-stream flow observations from USGS flow gauging stations throughout the watershed. There were no USGS flow gauging stations with adequate data records for hydrology calibration on streams modeled for this study. USGS gages on the South Branch Potomac mainstem were not appropriate for this effort because the mainstem was not modeled. Instead, a reference approach was used to define hydrologic parameters used in the model. Model parameters developed for the recently completed MDAS model for the nearby and hydrologically similar North Branch Potomac River were transferred to the South Branch Potomac model. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring. A detailed description of the hydrology calibration and a summary of the results and validation are presented in the Technical Report in **Appendix I**.

8.4 Water Quality Calibration

After the model was configured and calibrated for hydrology, the next step was to perform water quality calibration for the subject pollutants. The goal of water quality calibration was to refine model parameter values to reflect the unique characteristics of the watershed so that model output would predict field conditions as closely as possible. Both spatial and temporal aspects were evaluated through the calibration process.

The water quality was calibrated by comparing modeled versus observed pollutant concentrations. The water quality calibration consisted of executing the MDAS model, comparing the model results to available observations, and adjusting water quality parameters within reasonable ranges. Initial model parameters for the various pollutant parameters were derived from previous West Virginia TMDL studies, storm sampling efforts, and literature values. Available monitoring data in the watershed were identified and assessed for application to calibration. Monitoring stations with observations that represented a range of hydrologic conditions, source types, and pollutants were selected. The time-period for water quality calibration was selected based on the availability of the observed data and their relevance to the current conditions in the watershed.

WVDEP also conducted storm monitoring on Shrewsbury Hollow in Kanawha State Forest, Kanawha County, West Virginia. The data gathered during this sampling episode was used in the calibration of fecal coliform and to enhance the representation of background conditions from undisturbed areas. The results of the storm sampling fecal coliform calibration are shown in **Figure 8-2**.

Sediment calibration consisted of adjusting the soil erodibility and sediment transport parameters by landuse, and the coefficient of scour for bank-erosion. Initial values for these parameters were based on available landuse-specific storm-sampling monitoring data. Initial values were adjusted so that the model's suspended solids output closely matched observed instream data in watersheds with predominately one type of source.

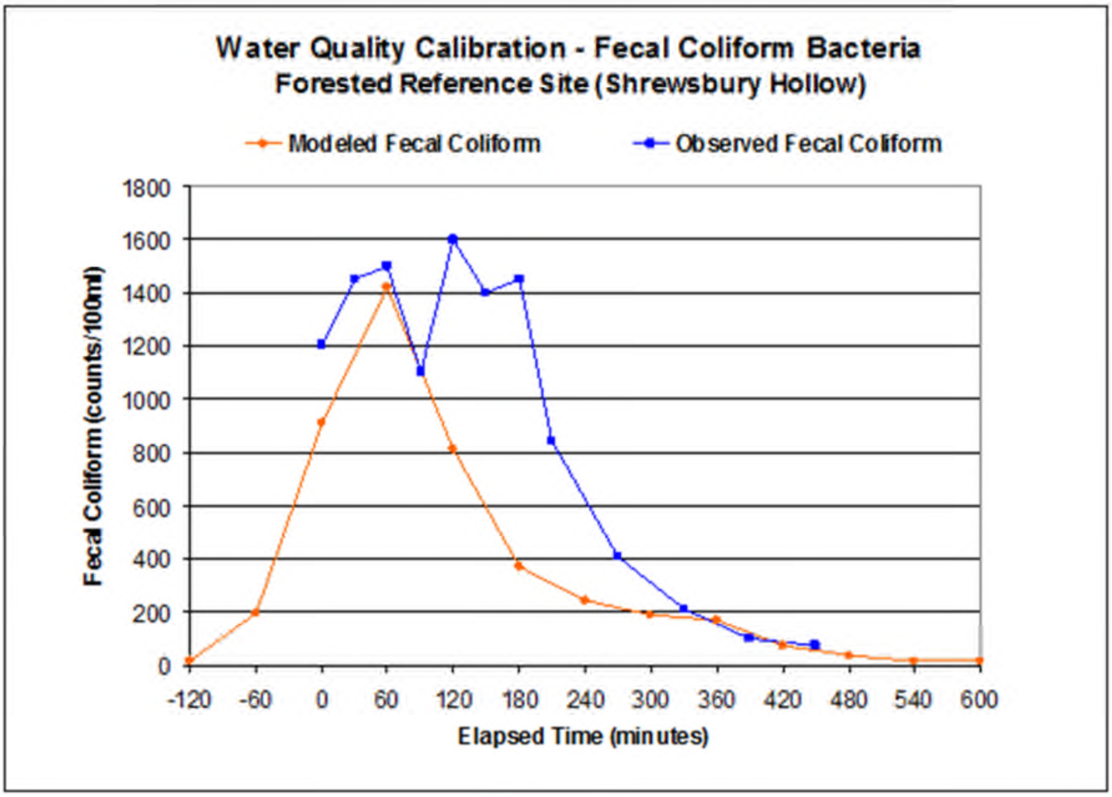


Figure 8-2. Shrewsbury Hollow fecal coliform observed data

8.5 Modeling Technique for Biological Impacts with Sedimentation Stressors

The SI process discussed in **Section 4** identified sedimentation as a significant biological stressor in some of the streams. The sediment reduction necessary to attain iron criteria was compared to the sediment reduction necessary to resolve biological stress under a "reference watershed" approach. The approach was based on selecting a non-impacted watershed that shares similar landuse, ecoregion, and geomorphologic characteristics with the impacted watershed. The normalized loading associated with the reference stream is assumed to represent the conditions needed to resolve sedimentation stress in impacted streams. Given these parameters and a WVSCI score greater than 68.0, UNT/Buffalo Creek RM 2.22 (WV-PSB-30-D) was selected as the reference watershed.

All of the sediment impacted streams exhibited impairments pursuant to total iron water quality criteria. Upon finalization of modeling based on the reference watershed approach, it was determined that sediment reductions necessary to ensure compliance with iron criteria are greater than those necessary to correct the biological impacts associated with sediment. As such, the iron TMDLs presented for the subject waters are appropriate surrogates to address impacts related to sediment. Refer to the Technical Report for details regarding a table of load reductions required for streams to achieve iron criterion versus reference watershed endpoints.

8.6 Allocation Strategy

As explained in **Section 2**, a TMDL is composed of the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background levels. In addition, the TMDL must include a 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 units. Conceptually, this definition is denoted by the equation:

TMDL = sum of WLAs + sum of LAs + MOS

To develop the TMDLs for each of the impairments 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

8.6.1 TMDL Endpoints

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. In general, West Virginia’s numeric water quality criteria for the subject pollutants and an explicit five percent MOS were used to identify endpoints for TMDL development. The TMDL endpoints for the various criteria are displayed in **Table 7-1**.

The five percent explicit MOS was used to counter uncertainty in the modeling process. Long-term water quality monitoring data were used for model calibration. Although these data represented actual conditions, they were not of a continuous time series and might not have captured the full range of instream conditions that occurred during the simulation period.

Table 8-1. TMDL endpoints

Water Quality Criterion	Designated Use	Criterion Value	TMDL Endpoint
Total Iron	Aquatic Life, warmwater fisheries	1.5 mg/L (4-day average)	1.425 mg/L (4-day average)
Fecal Coliform	Water Contact Recreation and Public Water Supply	200 counts / 100 mL (Monthly Geometric Mean)	190 counts / 100 mL (Monthly Geometric Mean)
Fecal Coliform	Water Contact Recreation and Public Water Supply	400 counts / 100 mL (Daily, 10% exceedance)	380 counts / 100 mL (Daily, 10% exceedance)

TMDLs are presented as average daily loads that were developed to meet TMDL endpoints under a range of conditions observed throughout the year. For most pollutants, analysis of available data indicated that critical conditions occur during both high- and low-flow events. 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.

8.6.2 Baseline Conditions and Source Loading Alternatives

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

Baseline Conditions for MDAS

The MDAS model was run for baseline conditions using hourly precipitation data for a representative six year simulation period (January 1, 2004 through December 31, 2009). The precipitation experienced over this period was applied to the landuses and pollutant sources as they existed at the time of TMDL development. Predicted instream concentrations were compared directly with the TMDL endpoints. This comparison allowed for 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 8-3** presents the annual rainfall totals for the years 2000 through 2012 at the Grant County Airport (WBAN 13866) weather station in Petersburg, West Virginia. The years 2004 to 2009 are highlighted to indicate the range of precipitation conditions used for TMDL development.

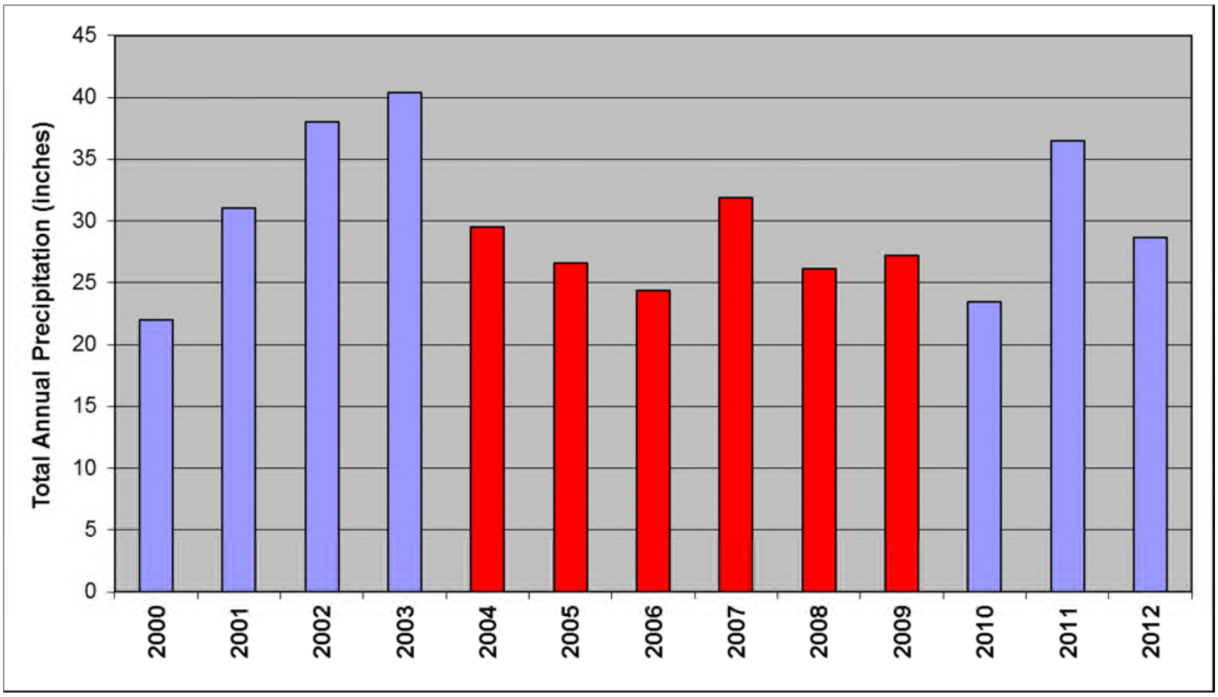


Figure 8-3. Annual precipitation totals for the Grant County Airport (WBAN 03725) weather station

In the baseline condition, mining discharges that are influenced by precipitation were represented using precipitation and drainage area. Iron baseline concentrations were generally established at the technology based (3.2 mg/l) or water quality based (1.5 mg/l) concentrations, as applicable to each permit. Baseline concentration for facilities without existing iron limits were established at technology based requirements. In the limited instances where existing effluent limitations vary from the displayed values, the outlets were represented at next higher condition. For example, existing iron effluent limits between 1.5 and 3.2 mg/L were represented at 3.2 mg/L.

Certain non-mining discharges (stormwater associated with non-construction, industrial activity) were represented using precipitation, drainage area, and the stormwater benchmark iron value of 1.0 mg/L.

Based upon guidance from WVDEP's permitting program, 2.5 percent of the total subwatershed area was allotted for concurrent construction activity under the CSGP. Baseline loadings were based upon precipitation and runoff and an assumption that proper installation and maintenance of required BMPs will achieve a TSS benchmark value of 100 mg/L.

Sediment producing nonpoint source and background loadings were represented using precipitation, drainage area, and the iron loading associated with their predicted sediment contributions.

Effluents from sewage treatment plants were represented under baseline conditions as continuous discharges, using the design flow for each facility and the monthly geometric mean fecal coliform effluent limitation of 200 counts/100 mL.

Source Loading Alternatives

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

Multiple allocation scenarios were run for the impaired waterbodies. Successful scenarios achieved the TMDL endpoints under all flow conditions throughout the modeling period. The averaging period and allowable exceedance frequency associated with West Virginia water quality criteria were considered in these assessments. In general, loads contributed by sources that had the greatest impact on instream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, less significant source contributions were subsequently reduced.

Figure 8-4 shows an example of model output for a baseline condition and a successful TMDL scenario.

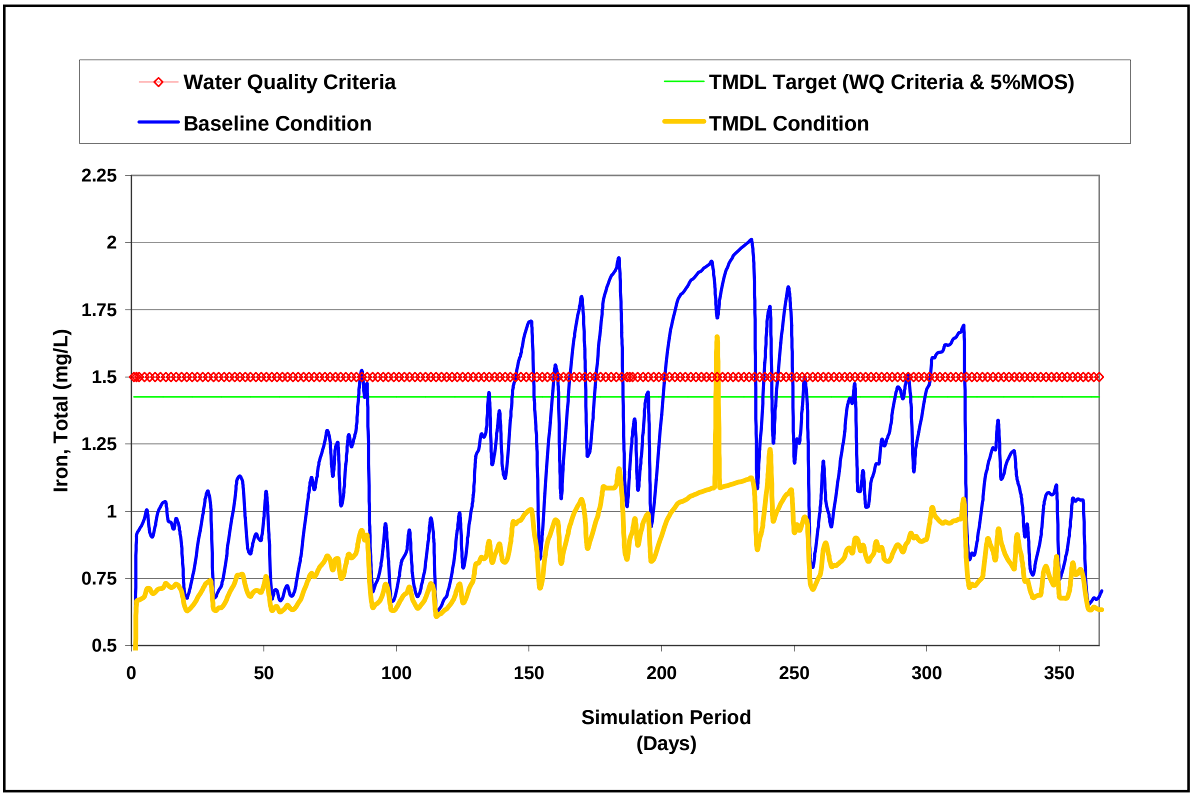


Figure 8-4. Example of baseline and TMDL conditions for total iron

8.7 TMDLs and Source Allocations

8.7.1 Total Iron TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the iron impaired streams. In order to meet iron criterion and allow for equitable allocations, reductions to existing sources were first assigned using the following general rules:

1. The loading from streambank erosion was first reduced to the loading characteristics of the streams with the best observed streambank conditions.
2. The following land disturbing sources were equitably reduced to the iron loading associated with 100 mg/L TSS.
   - Barren
   - Cropland
   - Pasture
   - Urban/MS4 Pervious
   - Oil and gas
   - Harvested Forest and Skid Roads
   - Unpaved Roads
3. Burned Forest was reduced to the sediment and iron loading associated with Forest

In addition to reducing the streambank erosion and source contributions, activity under the CSGP was considered. Area based WLAs were provided for each subwatershed to accommodate existing and future registrations under the CSGP. 2.5 percent of the subwatershed area was allocated for CSGP activity in each subwatershed.

After executing the above provisions, model output was evaluated and it was determined that criterion was attained and no further reductions were required.

Using this method ensured that contributions from all sources were weighted equitably and that cumulative load endpoints were met at the most downstream subwatershed for each impaired stream. 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 allocated loadings less than natural conditions. Permitted source reductions did not result in allocated loadings to a permittee that would be more stringent than water quality criteria.

Wasteload Allocations (WLAs)

WLAs were developed for all point sources permitted to discharge iron under a NPDES permit. Because of the established relationship between iron and TSS, iron WLAs are also provided for facilities with stormwater discharges that are regulated under NPDES permits that contain TSS and/or iron effluent limitations or benchmarks values and facilities registered under the General NPDES permit for construction stormwater.

Active Mining Operations

WLAs are provided for all existing outlets of NPDES permits for mining activities. All allocations were established at technology based limits.

In certain instances, prescribed WLAs may be less stringent than existing effluent limitations. However, the TMDLs are not intended to relax effluent limitations that were developed under the alternative basis of WVDEP's implementation of the antidegradation provisions of the Water Quality Standards, which may result in more stringent allocations than those resulting from the TMDL process. Whereas TMDLs prescribe allocations that minimally achieve water quality criteria (i.e. 100 percent use of a stream's assimilative capacity), the antidegradation provisions of the standards are designed to maintain the existing quality of high-quality waters. Antidegradation provisions may result in more stringent allocations that limit the use of remaining assimilative capacity. Also, water quality-based effluent limitations developed in the NPDES permitting process may dictate more stringent effluent limitations for discharge locations that are upstream of those considered in the TMDLs. TMDL allocations reflect pollutant loadings that are necessary to achieve water quality criteria at distinct locations (i.e., the pour points of delineated subwatersheds). In contrast, effluent limitation development in the permitting process is based on the achievement/maintenance of water quality criteria at the point of discharge.

Discharges regulated by the Multi Sector Stormwater Permit

Certain registrations under the general permit for stormwater associated with industrial activity implement TSS and/or iron benchmark values. Facilities that are compliant with such limitations are not considered to be significant sources of sediment or iron. Facilities that are present in the watersheds of iron-impaired streams are assigned WLAs that allow for continued discharge under existing permit conditions.

Construction Stormwater

Specific WLAs for activity under the CSGP are provided at the subwatershed scale and are described in **Section 8.6.2**. An allocation of 2.5 percent of undeveloped subwatershed area was provided with loadings based upon precipitation and runoff and an assumption that required BMPs, if properly installed and maintained, will achieve a TSS benchmark value of 100 mg/L. If the existing level of activity under the CSGP does not conform to the subwatershed allocations, the WVDEP, DWWM permitting program will require stabilization and permit termination in the shortest time possible. Thereafter the program will maintain concurrently disturbed area as allocated or otherwise control future activity through provisions described in **Section 10**.

Load Allocations (LAs)

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

- Sediment sources: loading associated with sediment contributions from barren land, harvested forest, oil and gas well operations, agricultural landuses, and residential/urban/road landuses and streambank erosion
- Background and other nonpoint sources: loading from undisturbed forest and grasslands (loadings associated with this category were represented but not reduced)

8.7.2 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired streams and their tributaries on a subwatershed basis throughout the watershed. The following general methodology was used when allocating loads to fecal coliform bacteria sources:

- The effluents from all NPDES permitted sewage treatment plants were set at the permit limit (200 counts/100 mL monthly geometric mean)
- Because West Virginia Bureau for Public Health regulations prohibit the discharge of raw sewage into surface waters, all illicit discharges of human waste (from failing septic systems and straight pipes) were reduced by 100 percent in the model
- If further reduction was necessary, non-point source loadings from agricultural lands and residential areas were subsequently reduced until in-stream water quality criteria were met

Wasteload Allocations (WLAs)

WLAs were developed for all facilities permitted to discharge fecal coliform bacteria, as described below.

Sewage Treatment Plant Effluents

The fecal coliform effluent limitations for NPDES permitted sewage treatment plants are more stringent than water quality criteria; therefore, all effluent discharges from sewage treatment facilities were given WLAs equal to existing monthly fecal coliform effluent limitations of 200 counts/100 mL.

Load Allocations (LAs)

Fecal coliform LAs are assigned to the following source categories:

- Pasture/Cropland
- On-site Sewage Systems — loading from all illicit discharges of human waste (including failing septic systems and straight pipes)
- Residential — loading associated with urban/residential runoff
- Background and Other Nonpoint Sources — loading associated with wildlife sources from all other landuses (contributions/loadings from wildlife sources were not reduced)

8.7.3 Seasonal Variation

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 pollutant concentrations simulated on a daily time step by the model were compared with TMDL endpoints. Allocations that met these endpoints throughout the modeling period were developed.

8.7.4 Critical Conditions

A critical condition represents a scenario where water quality criteria are most susceptible to violation. Analysis of water quality data for the impaired streams addressed in this effort shows high pollutant concentrations during both high- and low-flow thereby precluding selection of a single critical condition. 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.

Nonpoint source loading is typically precipitation-driven and impacts tend to occur during wet weather and high surface runoff. During dry periods little or no land-based runoff occurs, and elevated instream pollutant levels may be due to point sources (Novotny and Olem, 1994). Also, nonpoint sources (such as failing onsite septic systems), represented as continuous flow discharges often have an associated low-flow critical condition, particularly where such sources are located on small receiving waters.

8.7.5 TMDL Presentation

The TMDLs for all impairments are shown in **Section 9** of this report. The TMDLs for iron are presented as average daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in average number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed over the modeling period. TMDLs and their components are also presented in the allocation spreadsheets associated with this report. The filterable spreadsheets also display detailed source allocations and include multiple display formats that allow comparison of pollutant loadings among categories and facilitate implementation.

The iron WLAs for active mining operations are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are the operable allocations and are to be implemented by conversion to monthly average and daily maximum effluent limitations using USEPA’s Technical Support Document for Water Quality-based Toxics Control (USEPA, 1991). The iron WLAs for Construction Stormwater General Permit registrations are presented as both annual average loads, for comparison with other sources, and equivalent area registered under the permit. The registered area is the operable allocation.

The fecal coliform bacteria WLAs for sewage treatment plant effluents are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are the operable allocations for NPDES permit implementation.

9.0 TMDL RESULTS

Table 9-1. Iron TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Dumpling Run	WV-PSB-35-B	Dumpling Run	2.06	0.39	0.13	2.58
Anderson Run	WV-PSB-62	Anderson Run	38.42	2.50	2.15	43.07
Anderson Run	WV-PSB-62-C	Mudlick Run	18.96	1.54	1.08	21.58
Anderson Run	WV-PSB-62-C-12	UNT/Mudlick Branch RM 4.62	1.27	0.10	0.07	1.44
Anderson Run	WV-PSB-62-C-15	UNT/Mudlick Run RM 5.61	0.50	0.05	0.03	0.58
Anderson Run	WV-PSB-62-C-16	UNT/Mudlick Run RM 5.63	0.84	0.09	0.05	0.98
Anderson Run	WV-PSB-62-C-3	UNT/Mudlick Run RM 2.88	4.11	0.35	0.23	4.69
Anderson Run	WV-PSB-62-C-4	Turnmill Run	0.98	0.09	0.06	1.13
Anderson Run	WV-PSB-62-C-6	UNT/Mudlick Run RM 3.62	2.19	0.16	0.12	2.48
Anderson Run	WV-PSB-62-I	UNT/Anderson Run RM 3.30	3.30	0.02	0.17	3.50
Anderson Run	WV-PSB-62-J	Walnut Bottom Run	5.96	0.47	0.34	6.77
UNT/South Branch Potomac River RM 40.44	WV-PSB-79-DL-1	UNT/UNT RM 0.07/South Branch Potomac River RM 40.44	0.48	0.02	0.03	0.53
UNT/South Branch Potomac River RM 59.19	WV-PSB-82	UNT/South Branch Potomac River RM 59.19	9.42	2.81	0.64	12.87
UNT/South Branch Potomac River RM 59.19	WV-PSB-82-C	UNT/UNT RM 1.61/South Branch Potomac River RM 59.19	1.21	0.07	0.07	1.35
UNT/South Branch Potomac River RM 59.19	WV-PSB-82-E	UNT/UNT RM 2.27/South Branch Potomac River RM 59.19	2.79	0.32	0.16	3.27
Mill Creek	WV-PSB-97-B	Johnson Run	6.89	0.45	0.39	7.72
Mill Creek	WV-PSB-97-B-2	UNT/Johnson Run RM 1.12	1.65	0.10	0.09	1.84
Mill Creek	WV-PSB-97-E	North Mill Creek	36.35	3.05	2.07	41.47
Mill Creek	WV-PSB-97-E-47	Brushy Run	5.18	0.57	0.30	6.05
Mill Creek	WV-PSB-97-E-47-G	UNT/Brushy Run RM 2.99	1.43	0.13	0.08	1.64

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Mill Creek	WV-PSB-97-E-48	Stony Creek	2.56	0.29	0.15	3.00
Mill Creek	WV-PSB-97-F-1	UNT/South Mill Creek RM 0.24	2.60	0.05	0.14	2.79
Mill Creek	WV-PSB-97-F-42	Kessner Run	1.58	0.16	0.09	1.83
Robinson Run	WV-PSB-98-G	Robinson Run	9.15	0.52	0.51	10.18
Robinson Run	WV-PSB-98-G-4	UNT/Robinson Run RM 2.84	2.12	0.16	0.12	2.40
South Fork/Lunice Creek	WV-PSB-98-T	South Fork/Lunice Creek	16.20	3.17	1.02	20.39
South Fork/Lunice Creek	WV-PSB-98-T-2	UNT/South Fork RM 0.93/Lunice Creek	1.24	0.06	0.07	1.36
South Fork/Lunice Creek	WV-PSB-98-T-3	UNT/South Fork RM 1.75/Lunice Creek	2.08	0.07	0.11	2.26
Deer Run	WV-PSB-139	Deer Run	6.17	0.40	0.35	6.91
Deer Run	WV-PSB-139-F	UNT/Deer Run RM 5.68	0.82	0.05	0.05	0.92
Capon Run	WV-PSN-201-P	UNT/Capon Run RM 4.49	1.99	0.27	0.12	2.37
Crab Run	WV-PSN-207	Crab Run	3.14	0.49	0.19	3.82
Crab Run	WV-PSN-207-M	UNT/Crab Run RM 3.92	0.14	0.03	0.01	0.17
Crab Run	WV-PSN-207-N	UNT/Crab Run RM 3.97	0.50	0.12	0.03	0.65
Crab Run	WV-PSN-207-T	UNT/Crab Run RM 5.65	0.16	0.05	0.01	0.22

UNT = unnamed tributary; RM = river mile.

Table 9-2. Fecal Coliform Bacteria TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocations (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
UNT/South Branch RM 21.86/Potomac River	WV-PSB-16-A-1	UNT/UNT RM 1.38/UNT RM 0.30/South Branch Potomac River RM 21.86	1.39E+09	0.00E+00	7.33E+07	1.47E+09
Buffalo Creek	WV-PSB-30	Buffalo Creek	1.31E+10	4.54E+07	6.90E+08	1.38E+10
Dumpling Run	WV-PSB-35-B	Dumpling Run	9.97E+09	0.00E+00	5.25E+08	1.05E+10
Anderson Run	WV-PSB-62	Anderson Run	9.29E+10	0.00E+00	4.89E+09	9.78E+10
Anderson Run	WV-PSB-62-C	Mudlick Run	4.63E+10	0.00E+00	2.44E+09	4.87E+10
Anderson Run	WV-PSB-62-C-3	UNT/Mudlick Run RM 2.88	1.06E+10	0.00E+00	5.59E+08	1.12E+10

TMDL Watershed	Stream Code	Stream Name	Load Allocations (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
Anderson Run	WV-PSB-62-C-3-B	UNT/UNT RM 1.62/Mudlick Run RM 2.88	2.18E+09	0.00E+00	1.15E+08	2.29E+09
Anderson Run	WV-PSB-62-C-4	Turnmill Run	3.51E+09	0.00E+00	1.85E+08	3.70E+09
Anderson Run	WV-PSB-62-J	Walnut Bottom Run	1.88E+10	0.00E+00	9.92E+08	1.98E+10
UNT/South Branch Potomac River RM 40.44	WV-PSB-79-DL	UNT/South Branch Potomac River RM 40.44	3.94E+09	0.00E+00	2.07E+08	4.15E+09
UNT/South Branch Potomac River RM 59.19	WV-PSB-82	UNT/South Branch Potomac River RM 59.19	2.87E+10	0.00E+00	1.51E+09	3.02E+10
UNT/South Branch Potomac River RM 59.19	WV-PSB-82-E	UNT/UNT RM 2.27/South Branch Potomac River	9.21E+09	0.00E+00	4.85E+08	9.69E+09
UNT/South Branch Potomac River RM 59.19	WV-PSB-82-F	UNT/UNT RM 4.07/South Branch Potomac River RM 59.19	4.09E+09	0.00E+00	2.15E+08	4.30E+09
Mill Creek	WV-PSB-97	Mill Creek	2.40E+11	8.47E+07	1.26E+10	2.53E+11
Mill Creek	WV-PSB-97-B	Johnson Run	2.23E+10	0.00E+00	1.17E+09	2.35E+10
Mill Creek	WV-PSB-97-E	North Mill Creek	1.13E+11	0.00E+00	5.96E+09	1.19E+11
Mill Creek	WV-PSB-97-E-47	Brushy Run	1.90E+10	0.00E+00	9.99E+08	2.00E+10
Mill Creek	WV-PSB-97-E-48	Stony Creek	1.57E+10	0.00E+00	8.25E+08	1.65E+10
Mill Creek	WV-PSB-97-F	South Mill Creek	1.02E+11	8.47E+07	5.36E+09	1.07E+11
Robinson Run	WV-PSB-98-G	Robinson Run	1.64E+10	0.00E+00	8.63E+08	1.73E+10
Robinson Run	WV-PSB-98-G-4	UNT/Robinson Run RM 2.84	4.55E+09	0.00E+00	2.40E+08	4.79E+09
South Fork/Lunice Creek	WV-PSB-98-T	South Fork/Lunice Creek	4.93E+10	0.00E+00	2.60E+09	5.19E+10
South Fork/Lunice Creek	WV-PSB-98-T-11	Big Star Run	1.30E+10	0.00E+00	6.82E+08	1.36E+10
Powers Hollow	WV-PSB-105-B	Powers Hollow	6.88E+09	7.56E+07	3.66E+08	7.32E+09
Powers Hollow	WV-PSB-105-J	Jordan Run	4.21E+10	0.00E+00	2.22E+09	4.43E+10
Powers Hollow	WV-PSB-105-J-10	Laurel Run/Jordan Run	8.85E+09	0.00E+00	4.66E+08	9.31E+09
Deer Run	WV-PSB-139	Deer Run	1.80E+10	0.00E+00	9.49E+08	1.90E+10
Capon Run	WV-PSN-201-P	UNT/Capon Run RM 4.49	7.56E+09	0.00E+00	3.98E+08	7.96E+09
Crab Run	WV-PSN-207	Crab Run	1.25E+10	0.00E+00	6.59E+08	1.32E+10

TMDL Watershed	Stream Code	Stream Name	Load Allocations (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
Crab Run	WV-PSN-207-N	UNT/Crab Run RM 3.97	2.80E+09	0.00E+00	1.48E+08	2.95E+09
Crab Run	WV-PSN-207-T	UNT/Crab Run RM 5.65	1.02E+09	0.00E+00	5.37E+07	1.07E+09

NA = not applicable; UNT = unnamed tributary; RM = river mile.

"Scientific notation" is a method of writing or displaying numbers in terms of a decimal number between 1 and 10 multiplied by a power of 10. The scientific notation of 10,492, for example, is 1.0492 $\times 10^4$ or 1.0492E+4.

10.0 FUTURE GROWTH

10.1 Iron

With the exception of allowances provided for CSGP registrations discussed below, this TMDL does not include specific future growth allocations. However, the absence of specific future growth allocations does not prohibit the permitting of new or expanded activities in the watersheds of streams for which iron 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 WLAs 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:

- 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 effluent limitations for metals to be prescribed in the total recoverable form. West Virginia water quality criteria for iron are in total recoverable form and may be directly implemented. The alternative precipitation provisions of 40 CFR 434 that suspend applicability of iron and TSS limitations cannot be applied to new discharges in iron TMDL watersheds.

- Reclamation and release of existing permits could provide an opportunity for future growth provided that permit release is conditioned on achieving discharge quality better than the WLA prescribed by the TMDL.

- Most traditional, non-mining point source discharges are assigned technology-based TSS effluent limitations. The iron associated with such discharges would not cause or contribute to violations of iron water quality standards. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 100 mg/L. New point sources may be permitted in the watersheds of iron impaired streams with the implementation of applicable technology based TSS requirements. If iron is identified as a pollutant of concern in a process wastewater discharge from a new, non-mining activity, then the discharge can be permitted if effluent limitations are based on the achievement of water quality standards at end-of-pipe.

- Subwatershed-specific future growth allowances have been provided for site registrations under the CSGP. The successful TMDL allocation provides subwatershed-specific disturbed areas that may be registered under the general permit at any point in time. The iron allocation spreadsheet also provides cumulative area allowances of disturbed area for the immediate subwatershed and all upstream contributing subwatersheds. Projects in excess of the acreage provided for the immediate subwatershed may also be registered under the general permit, provided that the total registered disturbed area in the immediate subwatershed and all upstream subwatersheds is less than the cumulative area provided. Furthermore, projects with disturbed area larger than allowances may be registered under the general permit under any of the following provisions:

- A larger total project area can be registered if the construction activity is authorized in phases that adhere to the future growth area allowances.
- All disturbed areas that will occur on non-background land uses can be registered without regard to the future growth allowances.
- Registration may be conditioned by implementing controls beyond those afforded by the general permit, if it can be demonstrated that the additional controls will result in a lower unit area loading condition than the 100 mg/l TSS expectation for typical permit BMPs and that the improved performance is proportional to the increased area.

10.2 Fecal Coliform Bacteria

Specific fecal coliform bacteria future growth allocations are not prescribed. The absence of specific future growth allocations does not prohibit new development in the watersheds of streams for which fecal coliform bacteria TMDLs have been developed, or preclude the 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 may be permitted anywhere in the watershed, provided that the permit includes monthly geometric mean 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 nor permit overflows from newly constructed collection systems.

11.0 PUBLIC PARTICIPATION

11.1 Public Meetings

An informational public meeting was held on June 7, 2011 at the Moorefield High School in Moorefield, WV. The June 7, 2011 meeting occurred prior to pre-TMDL stream monitoring and pollutant source tracking, and included a general TMDL overview and a presentation of planned monitoring and data gathering activities. A TMDL status update meeting was held at Moorefield City Hall in Moorefield on August 6, 2014. A public meeting was held to present the draft TMDLs on Novermber 5, 2014 at Moorefield City Hall. The meeting provided information to stakeholders, and was intended to facilitate comments on the draft TMDLs.

11.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised in various local newspapers beginning on October 23, 2014. Interested parties are invited to submit comments during the public comment period, which begins on October 23, 2014 and ended on November 21, 2014. The electronic documents are also posted on the WVDEP's internet site at www.dep.wv.gov/tmdl.

11.3 Response Summary

If WVDEP receives written comments on the draft TMDLs, comments will be compiled and responded to in a response summary.

12.0 REASONABLE ASSURANCE

Reasonable assurance for maintenance and improvement of water quality in the affected watershed rests primarily with two programs. The NPDES permitting program is implemented by WVDEP to control point source discharges. The West Virginia Watershed Network is a cooperative nonpoint source control effort involving many state and federal agencies, whose task is protection and/or restoration of water quality.

12.1 NPDES Permitting

WVDEP's Division of Water and Waste Management (DWWM) is responsible for issuing non-mining NPDES permits within the State. WVDEP's Division of Mining and Reclamation (DMR) develops NPDES permits for mining activities. As part of the permit review process, permit writers have the responsibility to incorporate the required TMDL WLAs into new or reissued permits. New facilities will be permitted in accordance with future growth provisions described in **Section 10**.

Both the permitting and TMDL development processes have been synchronized with the Watershed Management Framework cycle, such that TMDLs are completed just before the permit expiration/reissuance time frames. The reissuance of mining permits will begin January 1, 2016.

12.2 Watershed Management Framework Process

The Watershed Management Framework is a tool used to identify priority watersheds and coordinate efforts of state and federal agencies with the goal of developing and implementing watershed management strategies through a cooperative, long-range planning effort.

The West Virginia Watershed Network is an informal association of state and federal agencies, and nonprofit organizations interested in the watershed movement in West Virginia. Membership is voluntary and everyone is invited to participate. The Network uses the Framework to coordinate existing programs, local watershed associations, and limited resources.

This coordination leads to the development of Watershed Based Plans to implement TMDLs and document environmental results.

The principal area of focus of watershed management through the Framework process is correcting problems related to nonpoint source pollution. Network partners have placed a greater emphasis on identification and correction of nonpoint source pollution. The combined resources of the partners are used to address all different types of nonpoint source pollution through both public education and on-the-ground projects.

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. The Framework 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 a Watershed Based Plan to improve water quality.

Each year, the Framework is included on the agenda of the Network to evaluate the restoration potential of watersheds within a certain Hydrologic Group. This evaluation includes a review of TMDL recommendations for the watersheds under consideration. Development of Watershed Based Plans is based on the efforts of local project teams. These teams are composed of Network 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. Additional information regarding upcoming Network activities can be obtained from the Potomac Nonpoint Source Program Basin Coordinator, Alana Hartman (alana.c.hartman@wv.gov).

There are citizen-based watershed associations representing the mainstem or tributaries in the South Branch Potomac River Watershed For additional information concerning the associations, contact the above mentioned Basin Coordinator or visit http://www.dep.wv.gov/WWE/getinvolved/WSA_Support/Pages/WAs.aspx.

12.3 Public Sewer Projects

Within WVDEP DWWM, 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 POTWs prior to permit issuance or modification. For further information on upcoming projects, a list of funded and pending water and wastewater projects in West Virginia can be found at http://www.wvinfrastructure.com/projects/index.php.

13.0 MONITORING PLAN

The following monitoring activities are recommended:

13.1 NPDES Compliance

WVDEP's DWWM and DMR have the responsibility to ensure that NPDES permits contain effluent limitations as prescribed by the TMDL WLAs and to assess and compel compliance. Compliance schedules may be implemented that achieve compliance as soon as possible while providing the time necessary to accomplish corrective actions. The length of time afforded to achieve compliance may vary by discharge type or other factors and is a case-by-case determination in the permitting process. Permits will contain 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 WLAs.

13.2 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.

13.3 TMDL Effectiveness Monitoring

TMDL effectiveness monitoring should be performed to document water quality improvements after significant implementation activity has occurred where 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.

14.0 REFERENCES

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