


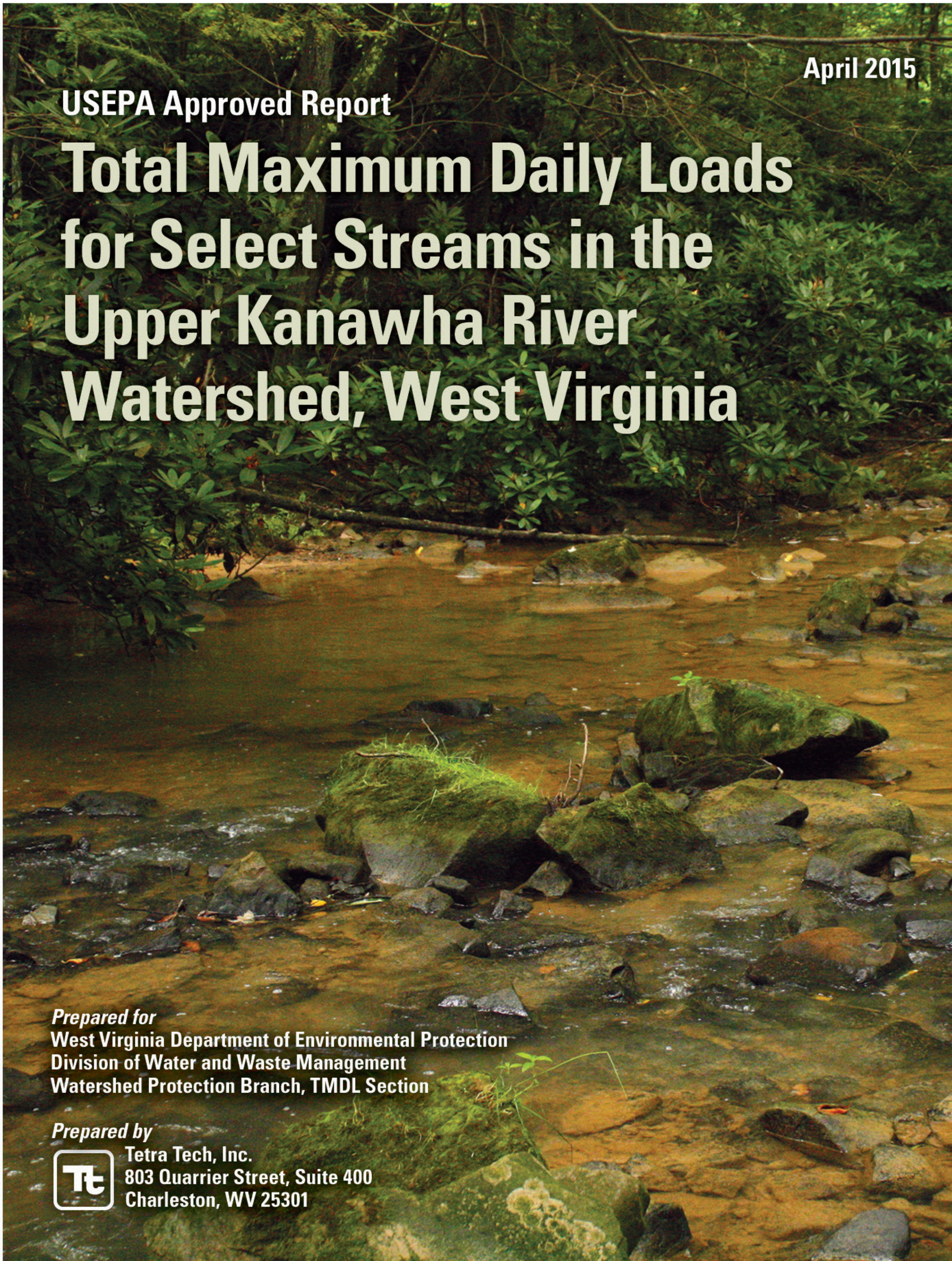

April 2015

USEPA Approved Report

Total Maximum Daily Loads for Select Streams in the Upper Kanawha River Watershed, West Virginia

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

Prepared by
Tetra Tech, Inc.
803 Quarrier Street, Suite 400
Charleston, WV 25301

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

CONTENTS

TABLES

FIGURES

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. In this report, the Upper Kanawha River and its drainage area begins at the confluence of the New and Gauley Rivers in Fayette County and ends downstream at the confluence of the Elk River in the City of Charleston. This 39 mile long river segment is referred to as the Upper Kanawha River. Throughout this report, the Upper Kanawha River watershed refers to the tributary streams that ultimately drain to the Upper Kanawha River (**Figure I-1**). The term "watershed" is also used more generally to refer to the land area that contributes precipitation runoff that eventually drains to the Upper Kanawha River.

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 64 impaired streams contained within 18 TMDL watersheds in the Upper Kanawha 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 18 TMDL watersheds have been subdivided into 226 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

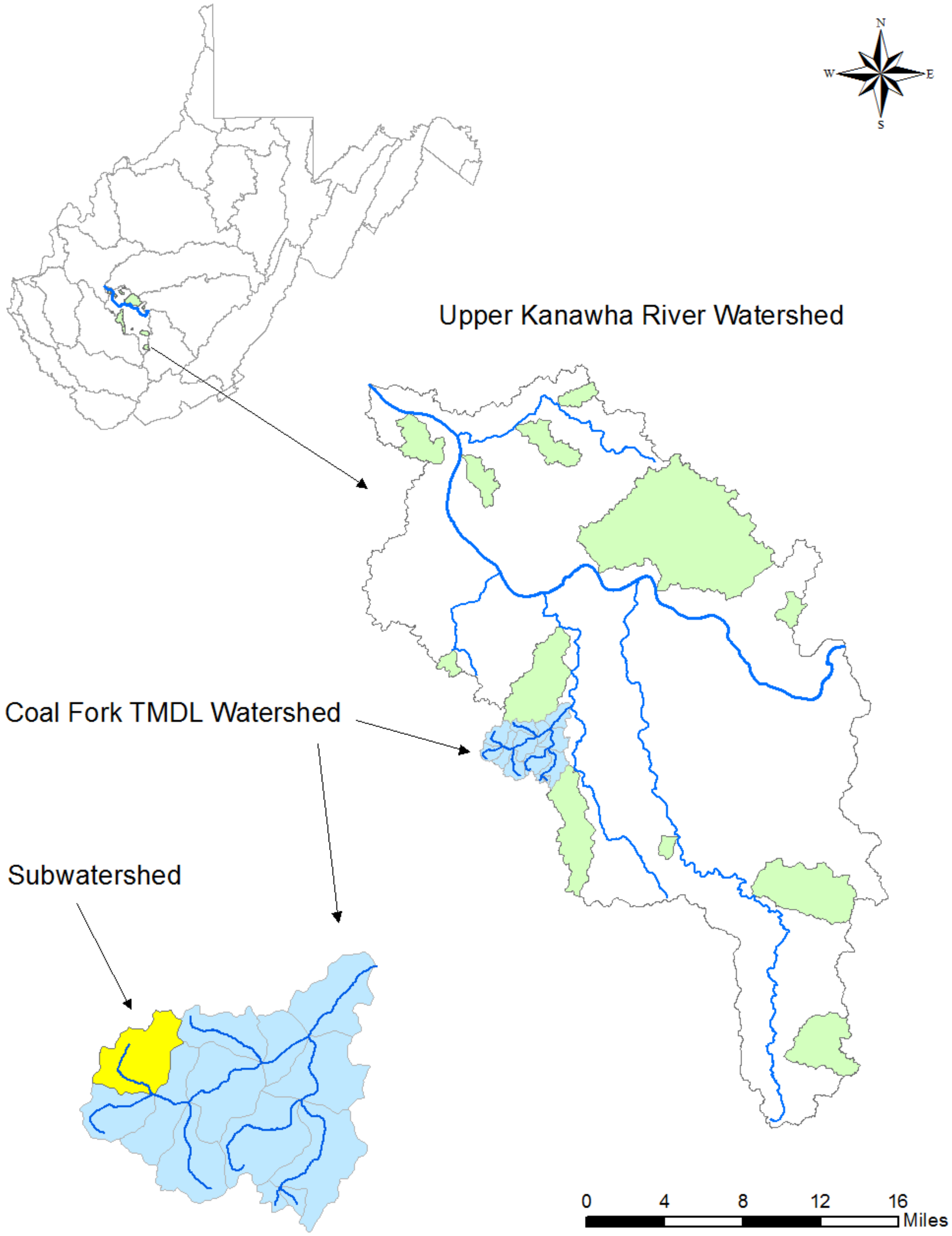


Figure I-1. Examples of a watershed, TMDL watershed, and subwatershed

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 64 impaired streams in the Upper Kanawha watershed, which consists of land draining to a segment of the Kanawha River that starts at the confluence with the Gauley River, and ends downstream at the confluence of the Elk River in the City of Charleston. This project was organized into 18 TMDL watersheds : Bullpush Fork, Cedar Creek, Coal Fork, Fourmile Fork, Georges Creek, Hughes Creek, Kellys Creek, Longbottom Creek, Lower Donnally Branch, Mission Hollow (Venable Branch), Mossy Creek, New West Hollow, North Sand Branch, Pointlick Fork, Rattlesnake Hollow, Tenmile Fork, Toms Fork, and Wet Branch.

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 impaired streams are included on the West Virginia's 2012 Section 303(d) List or draft 2014 Section 303(d) List. Documented impairments are related to numeric water quality criteria for total iron, total manganese, dissolved aluminum, total selenium, pH, chloride, and fecal coliform bacteria.

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, 17 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 18 TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these 18 TMDL watersheds were further divided into 226 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 linkage between pollutant sources and instream responses for fecal coliform bacteria, iron, selenium, manganese, chloride, pH, and aluminum. 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, and stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s). The presence of individual source categories and their relative significance varies by subwatershed.

Iron impairments are also attributable to both point and nonpoint sources. Nonpoint sources of iron include abandoned mine lands (AML), roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance and streambank erosion. Iron point sources include the permitted discharges from mining activities, bond forfeiture sites and stormwater contributions from MS4, 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.

Chloride impairments in the watershed are caused by certain point source discharges associated with mining activities. Impaired streams New West Hollow (WV-KU-19-R-1), Longbottom Creek (WV- KU-26-N), Laurel Fork/Longbottom Creek (WV- KU-26-N-5), Coal Fork (WV-KU-26-U), and UNT/Coal Fork RM 4.63 (WV- KU-26-U-18) are under the influence of pumped discharge point sources that comprise most of their stream flows, especially during dry weather low flow conditions.

The only total manganese impaired streams in the Upper Kanawha River Watershed are Horsemill Branch and Sugarcamp Branch. The impairments are solely attributed to discharges associated with legacy mining activities in the watershed.

Twenty-four selenium impaired streams in 11 TMDL watersheds are addressed in this report. Active, reclaimed, and abandoned mining are dominant landuses in these TMDL watersheds and presumed to be the contributing sources of selenium.

The overlapping pH and dissolved aluminum impairments are caused by acidity introduced by legacy mining activities. Atmospheric acid deposition was additionally represented in the model as was the aluminum loading from permitted point sources. Atmospheric deposition was not found to be a causative source of impairment as effects are mitigated by available watershed buffering capacity. All active mining sources were represented. Prescribed WLAs were not more stringent than existing NPDES permit limits. The TMDLs for pH and dissolved aluminum impairments were developed using an iterative approach where alkalinity additions to offset acid load from legacy mining sources were coupled with total iron and aluminum reductions until attainment of both criteria was predicted.

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 2001 and 2005, EPA and WVDEP developed various TMDLs for impaired streams in the Upper Kanawha River Watershed (WVDEP, 2001; WVDEP, 2005). With two exceptions, this project does not include new TMDLs that override previous work. These exceptions are discussed in **Section 1**. Re-evaluation also determined that dissolved aluminum impairments for which TMDLs were developed in 2005 are no longer effective due to West Virginia water quality standard revisions and new water quality monitoring. The previous TMDLs were based upon a chronic aquatic life protection dissolved aluminum criterion of 0.087 mg/l which has been revised to 0.750 mg/l. The recent monitoring associated with this project documents attainment of the currently effective dissolved aluminum criteria in twelve streams for which TMDLs were developed in the 2005 project. As such, those TMDLs should no longer be considered operative.

Considerable resources were used to acquire recent water quality and pollutant source information upon which the TMDLs are based. Project development included valuable assistance from the local watershed association. 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 Upper Kanawha River Watershed, 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 Upper Kanawha River Watershed. **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 2001 and 2005, USEPA and WVDEP developed various TMDLs for impaired streams in the Upper Kanawha River Watershed (WVDEP, 2001; WVDEP, 2005). With two exceptions, this project does not include new TMDLs that override previous work. The exceptions include the previously developed pH TMDL for Cedar Branch of Paint Creek and the Total Iron TMDL for Long Branch of Paint Creek. The older TMDLs were developed by USEPA in 2001 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.

Re-evaluation also determined that dissolved aluminum impairments for which TMDLs were developed in 2005 are no longer effective due to West Virginia water quality standard revisions and new water quality monitoring. The previous TMDLs were based upon a chronic aquatic life protection dissolved aluminum criterion of 0.087 mg/l which has been revised to 0.750 mg/l. The recent monitoring associated with this project documents attainment of the currently effective dissolved aluminum criteria in twelve streams for which TMDLs were developed in the 2005 project. As such, those TMDLs should no longer be considered operative.

Appendix A of the Technical Report indicates the previous TMDLs for which new TMDLs are developed and describes previous TMDLs that are no longer effective.

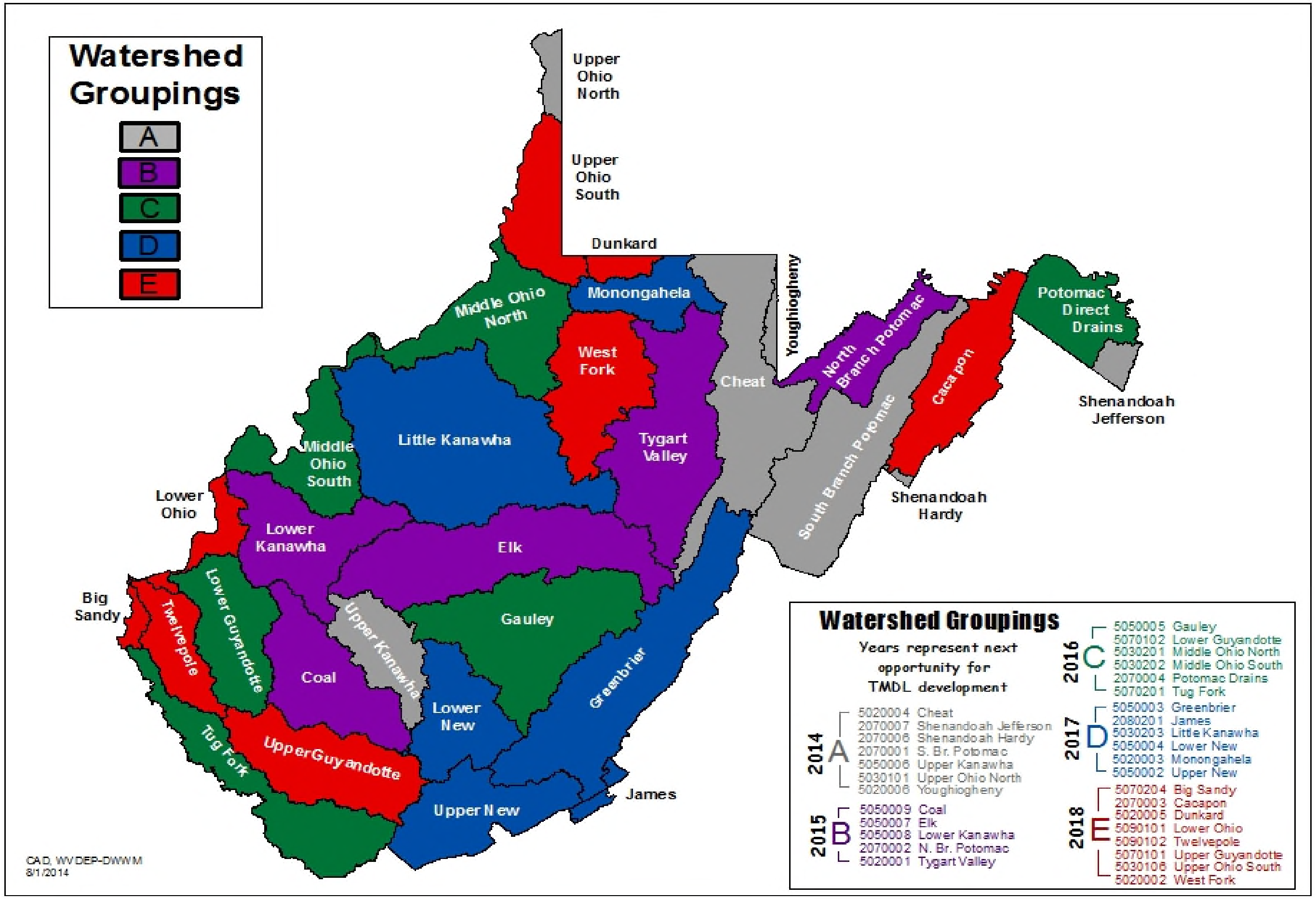


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

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 Upper Kanawha River Watershed, warmwater fishery aquatic life use impairments have been determined pursuant to exceedances of total iron, dissolved aluminum, total selenium, chloride and/or pH numeric 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, pH, chloride, total manganese, total selenium, and total iron.

The manganese water quality criterion is applicable to five-mile zones upstream of known public or private water supply intakes used for human consumption. Based upon known intake locations, WVDEP delineated five-mile distances in an upstream direction along watercourses to determine streams within the zone of applicability of the criterion. WVDEP then assessed compliance with the criterion by reviewing available water quality monitoring results from streams within the zone and evaluated the base condition portrayed by the TMDL model. The evaluation determined that the manganese criterion is applicable and exceeded in Horsemill Branch and Sugarcamp Branch.

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]	
Aluminum, dissolved (µg/L)	750	750	750	87	--
Iron, total (mg/L)	--	1.5	--	1.0	1.5
Chloride (mg/L)	860	230	860	230	250
Selenium, total (µg/L)	20	5	20	5	50
Manganese, total (mg/L)	--	--	--	--	1.0[c]
pH	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0
Fecal coliform bacteria	**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.				

[a] One-hour average concentration not to be exceeded more than once every 3 years on the average, unless otherwise noted.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average, unless otherwise noted.
[c] Not to exceed 1.0 mg/L within the five-mile zone upstream of known public or private water supply intakes used for human consumption.

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

Located within the Central Appalachian ecoregion, the Kanawha River is a major tributary of the Ohio River, which joins the Mississippi and flows to the Gulf of Mexico. The Upper Kanawha River Watershed consists of land draining to a segment of the Kanawha River that starts at the confluence of the New and Gauley Rivers, and ends downstream at the confluence of the Elk River in the City of Charleston. This river segment is approximately 39 miles (63 km) long, and its watershed encompasses 519 square miles (1,344 km^2). Of the 519 total square miles in the watershed, only 105 square miles were modeled under this TMDL effort.

The Upper Kanawha Watershed lies within the coalfields of south-central West Virginia, and spans portions of Kanawha, Fayette, and Raleigh counties Cities and towns in the vicinity of the area of study are Charleston, Cedar Grove, Montgomery, Oak Hill, and Beckley. The highest point in the modeled portion of the Upper Kanawha Watershed is 2,706 feet above sea level on Lick Fork Ridge in the headwaters of Lick Fork near Mossy. The lowest point in the modeled portion of the watershed is 570 feet at the confluence of Mission Hollow and the Kanawha River in Charleston. The average elevation in the modeled portion of the watershed is 1,420 feet. The total population living in the subject watersheds of this report is estimated to be 6,750 people.

This project was organized into 18 TMDL watersheds : Bullpush Fork, Cedar Creek, Coal Fork, Fourmile Fork, Georges Creek, Hughes Creek, Kellys Creek, Longbottom Creek, Lower Donnally Branch, Mission Hollow (Venable Branch), Mossy Creek, New West Hollow, North Sand Branch, Pointlick Fork, Rattlesnake Hollow, Tenmile Fork, Toms Fork, and Wet Branch. Figure 3-1 displays the extent of the Upper Kanawha River watershed and the TMDL watersheds associated with this project.

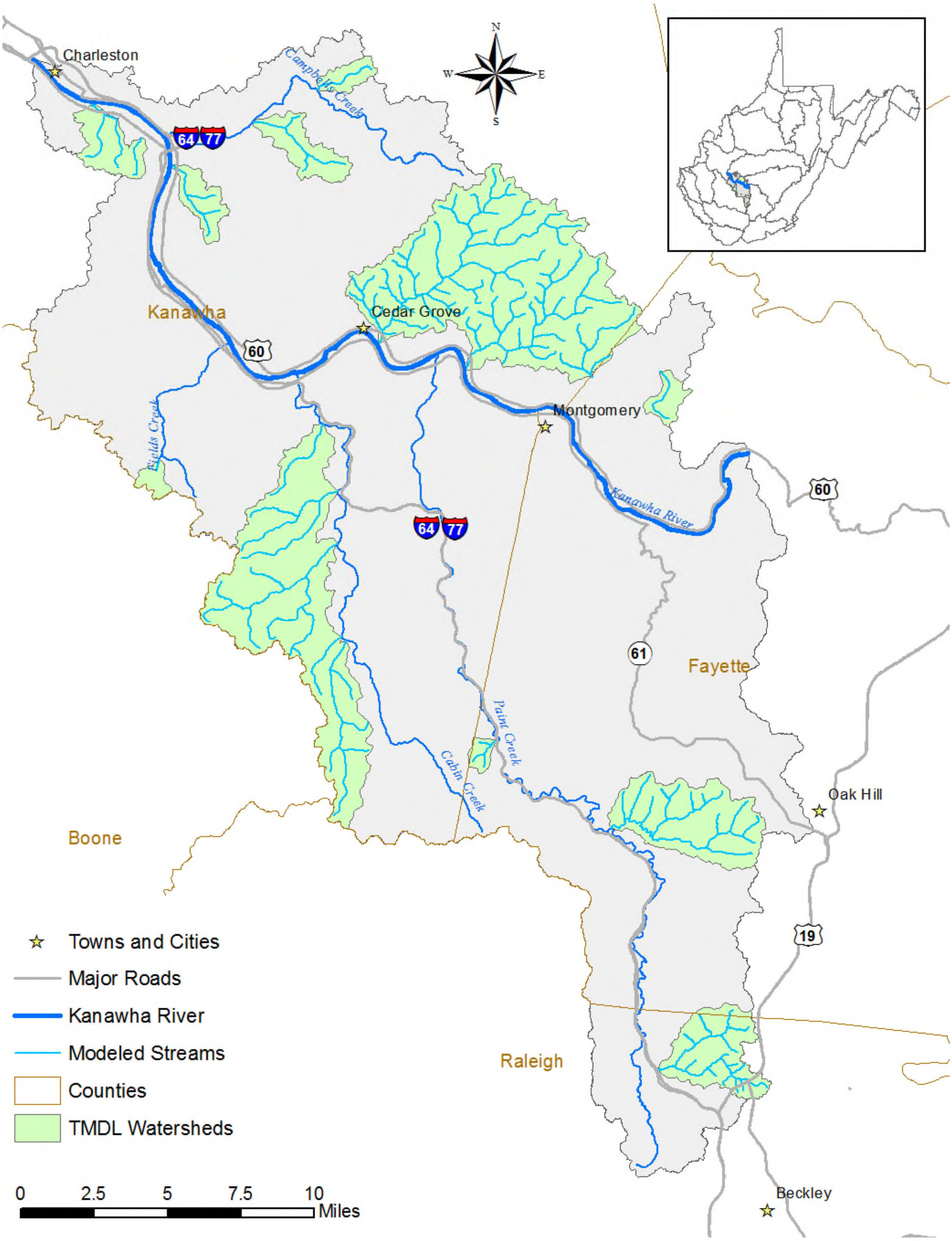


Figure 3-1. Location of the Upper Kanawha River Watershed TMDL Project Area in West Virginia

Landuse and land cover estimates were originally obtained from vegetation data gathered from the National Land Cover Dataset (NLCD) (USGS 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 watershed derived from NLCD as described above. The dominant landuse is forest, which constitutes 64.63 percent of the total landuse area. Other important modeled landuse types are mining (22.52 percent), grassland (5.13 percent), and urban/residential (5.66 percent). Individually, all other land cover types compose less than one percent of the total watershed area.

Table 3-1. Modified landuse for the Upper Kanawha TMDL watershed

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Barren	97.99	0.15	0.15%
Cropland	22.68	0.04	0.03%
Forest	43342.25	67.72	64.63%
Forestry	554.00	0.87	0.83%
Grassland	3438.17	5.37	5.13%
Mining/Quarry	15100.18	23.59	22.52%
Oil and Gas	391.16	0.61	0.58%
Pasture	294.37	0.46	0.44%
Urban/Residential	3793.30	5.93	5.66%
Water	22.91	0.04	0.03%
Total	67057.01	104.78	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	2011 U.S. Census Bureau TIGER, WVU WV Roads
	Water quality monitoring station locations	WVDEP, USEPA STORET
	Meteorological station locations	National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC)
	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 extensive water quality monitoring throughout the Upper Kanawha River Watershed from 2010 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 for that pollutant.

TMDLs were developed for impaired waters in 18 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.

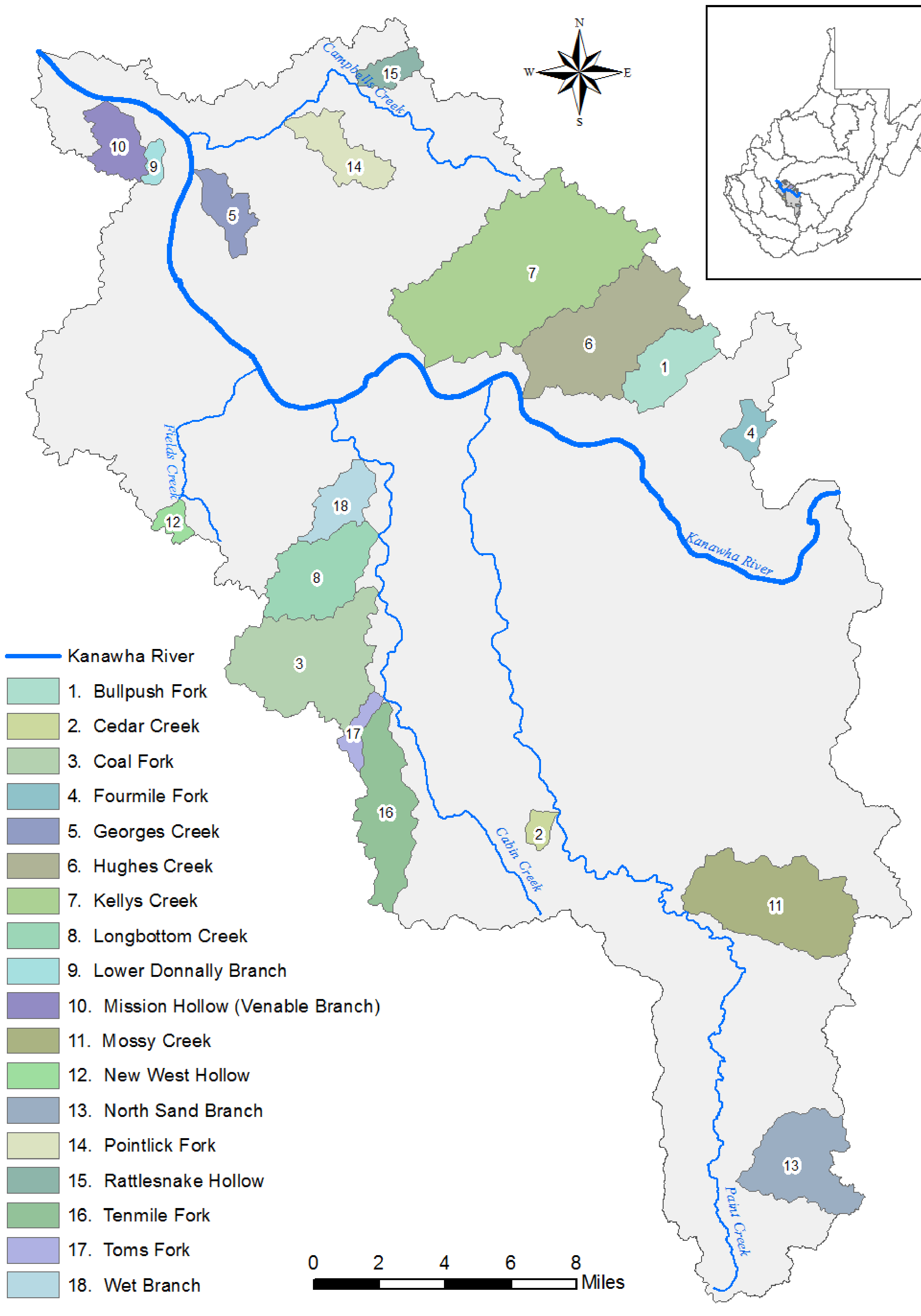


Figure 3-2. Upper Kanawha TMDL Watersheds

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

TMDL Watershed	Stream Name	NHD Code	pH	Fe	Al	Cl	Se	Mn	FC
Mission Hollow (Venable Branch)	Mission Hollow (Venable Branch)	WV-KU-3							X
Mission Hollow (Venable Branch)	Chappel Hollow (Chappel Branch)	WV-KU-3-A							X
Lower Donnally Branch	Lower Donnally Branch	WV-KU-5		X					X
Pointlick Fork	Pointlick Fork	WV-KU-6-F					X		
Pointlick Fork	UNT/Pointlick Fork RM 2.26	WV-KU-6-F-4					X		
Rattlesnake Hollow	Rattlesnake Hollow	WV-KU-6-N					X		
Georges Creek	Georges Creek	WV-KU-8							X
New West Hollow	New West Hollow	WV-KU-19-R-1				X	X		
Toms Fork	Toms Fork	WV-KU-26-AC					X		
Tenmile Fork	Tenmile Fork	WV-KU-26-AD					X		
Tenmile Fork	UNT/Tenmile Fork RM 1.22	WV-KU-26-AD-1					X		
Tenmile Fork	UNT/Tenmile Fork RM 4.17	WV-KU-26-AD-10					X		
Tenmile Fork	UNT/Tenmile Fork RM 3.98	WV-KU-26-AD-9					X		
Wet Branch	Wet Branch	WV-KU-26-E					X		
Longbottom Creek	Longbottom Creek	WV-KU-26-N				X			
Longbottom Creek	Laurel Fork	WV-KU-26-N-5				X			
Coal Fork	Coal Fork	WV-KU-26-U				X	X		
Coal Fork	UNT/Coal Fork RM 4.63	WV-KU-26-U-18				X	X		
Coal Fork	Laurel Fork	WV-KU-26-U-7					X		
Coal Fork	Left Fork/Laurel Fork	WV-KU-26-U-7-E					X		
Coal Fork	UNT/Left Fork RM 1.99/Laurel Fork	WV-KU-26-U-7-E-4					X		
Kellys Creek	Kellys Creek	WV-KU-33		X					X
Kellys Creek	Horsemill Branch	WV-KU-33-B	X	M	M			X	X
Kellys Creek	UNT/Horsemill Branch RM 0.50	WV-KU-33-B-1	X		X				
Kellys Creek	UNT/Horsemill Branch RM 0.83	WV-KU-33-B-2	X	M	X				
Kellys Creek	UNT/Horsemill Branch RM 1.21	WV-KU-33-B-3		M					
Kellys Creek	UNT/Horsemill Branch RM 1.58	WV-KU-33-B-4	X	X	X				
Kellys Creek	Frozen Branch	WV-KU-33-C					X		X
Kellys Creek	Sugarcamp Branch	WV-KU-33-D	X					X	
Kellys Creek	UNT/Sugarcamp Branch RM 0.58	WV-KU-33-D-1		M					
Kellys Creek	Fourmile Fork	WV-KU-33-L		M					
Kellys Creek	Fivemile Fork	WV-KU-33-M		M					
Kellys Creek	UNT/Fivemile Fork RM 1.29	WV-KU-33-M-1		M					
Kellys Creek	Left Fork/Kellys Creek	WV-KU-33-N		M					
Kellys Creek	Slabcamp Hollow	WV-KU-33-N-2		M					
Kellys Creek	UNT/Left Fork RM 2.23/Kellys Creek	WV-KU-33-N-5		M					

TMDL Watershed	Stream Name	NHD Code	pH	Fe	Al	Cl	Se	Mn	FC
Kellys Creek	UNT/UNT RM 0.51/Left Fork RM 2.23/Kellys Creek	WV-KU-33-N-5-A		M					
Kellys Creek	Hurricane Fork	WV-KU-33-O		M			X		X
Kellys Creek	UNT/Hurricane Fork RM 2.11	WV-KU-33-O-1		M					
Kellys Creek	Rich Hollow	WV-KU-33-O-2		M					
Kellys Creek	Goose Hollow	WV-KU-33-P							X
Cedar Creek	Cedar Creek	WV-KU-39-AK	X		X				
Mossy Creek	Mossy Creek	WV-KU-39-BM		M					X
Mossy Creek	Toney Creek	WV-KU-39-BM-10		M					
Mossy Creek	Painter Creek	WV-KU-39-BM-11		M					
Mossy Creek	Long Branch	WV-KU-39-BM-7		M					X
Mossy Creek	Lick Fork	WV-KU-39-BM-8		M					
North Sand Branch	North Sand Branch	WV-KU-39-DG-2		M					X
North Sand Branch	Maple Fork	WV-KU-39-DG-2-A		X					X
North Sand Branch	UNT/Maple Fork RM 1.17	WV-KU-39-DG-2-A-2		M					
North Sand Branch	UNT/Maple Fork RM 1.91	WV-KU-39-DG-2-A-3		M					
North Sand Branch	UNT/North Sand Branch RM 2.56	WV-KU-39-DG-2-E		M					
Hughes Creek	Hughes Creek	WV-KU-42		X			X		
Hughes Creek	Martin Hollow	WV-KU-42-J		M					
Hughes Creek	Barn Hollow	WV-KU-42-K		M			X		
Hughes Creek	Graveyard Hollow	WV-KU-42-L		M			X		
Hughes Creek	Shadrick Fork	WV-KU-42-N		M					
Hughes Creek	Dry Lick Hollow	WV-KU-42-N-3		M					
Hughes Creek	UNT/Dry Lick Hollow RM 0.24	WV-KU-42-N-3-A		M					
Hughes Creek	Sixmile Hollow	WV-KU-42-Q		M			X		
Bullpush Fork	Bullpush Fork	WV-KU-55-F		M			X		
Bullpush Fork	Burnett Hollow	WV-KU-55-F-3		M					X
Bullpush Fork	Riffle Hollow	WV-KU-55-F-5					X		
Fourmile Fork	Fourmile Fork	WV-KU-55-P					X		

Note:

RM river mile
UNT unnamed tributary
pH acidity impairment
Fe iron impairment
Al aluminum impairment
Cl chloride impairment
Se selenium impairment
Mn manganese impairment
FC fecal coliform bacteria impairment
M Impairment determined via modeling

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 17 streams with benthic macroinvertebrate impacts in **Appendix K** of the Technical Report, so that they may be considered in listing/delisting decision-making in future 303(d) processes. The SI process demonstrated that biological stress would be resolved in nine of those streams through the implementation of numeric criterion TMDLs developed in this project (**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.

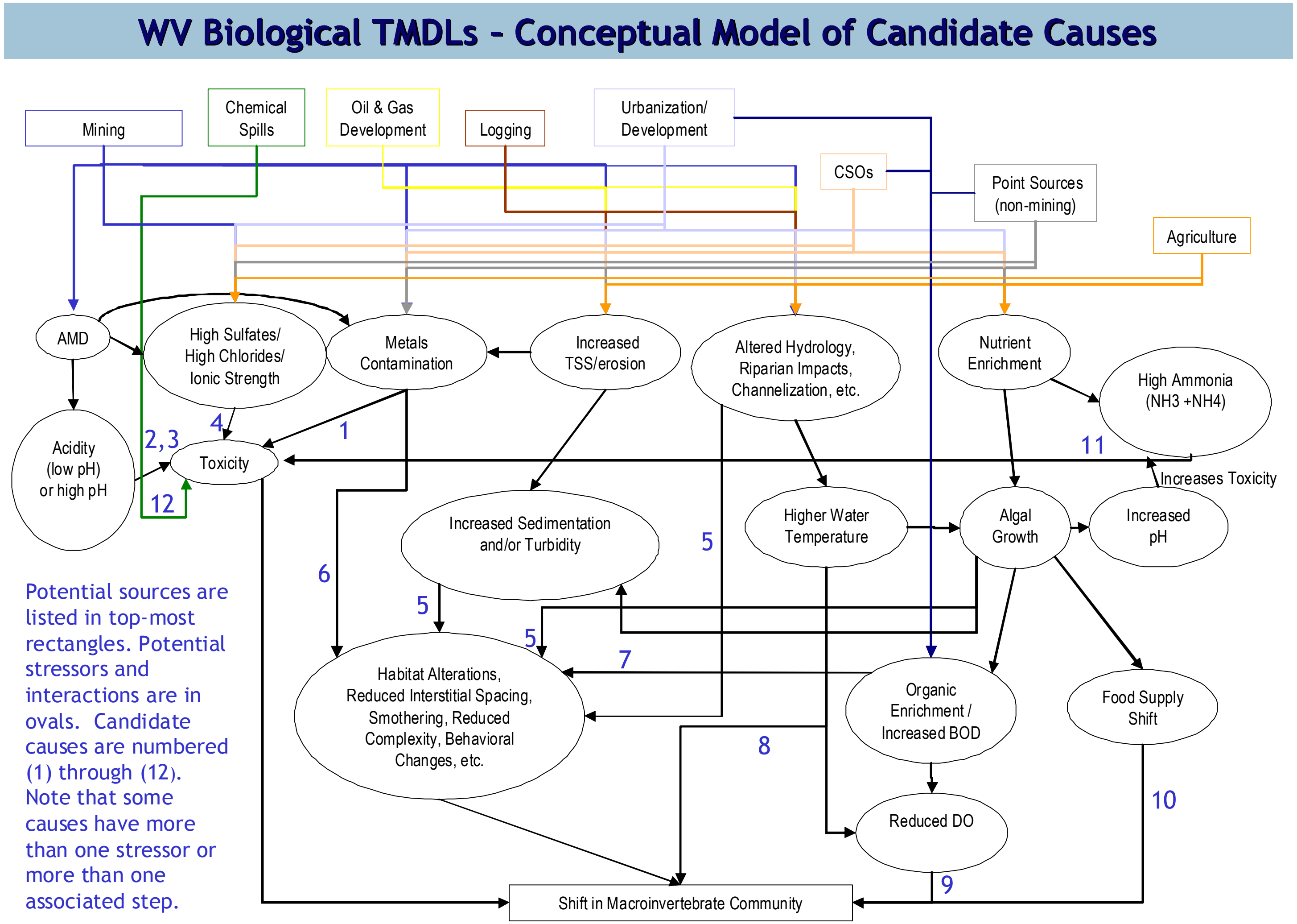


Figure 4-1. Conceptual model of candidate causes and potential biological effects

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 Upper Kanawha River Watershed:

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

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

The SI process identified aluminum and pH toxicity as significant biological stressors in waters that also demonstrated violations of the aluminum and pH water quality criteria for protection of aquatic life. WVDEP determined that the implementation of those pollutant-specific TMDLs would address those stressors.

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.

Certain 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**. There are eight streams for which the SI process did not indicate that TMDLs for numeric criteria would resolve the biological impacts. Reference **Appendix K** of the Technical Report for complete stressor identification results.

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

Stream Name	NHD-Code	Significant Stressors	TMDLs Developed
Kellys Creek	KU-33	Organic Enrichment, Sedimentation	Fecal Coliform, Total Iron
Horsemill Branch	KU-33-B	pH, Dissolved Metals, Sedimentation	pH, Aluminum, Total Iron
Cedar Creek	KU-39-AK	pH, Dissolved Metals	pH, Aluminum
Long Branch	KU-39-BM-7	Organic Enrichment, Sedimentation	Fecal Coliform, Total Iron
North Sand Branch	KU-39-DG-2	Organic Enrichment	Fecal Coliform
Maple Fork	KU-39-DG-2-A	Sedimentation	Total Iron
Lower Donnally Branch	KU-5	Organic Enrichment, Sedimentation	Fecal Coliform, Total Iron
Georges Creek	KU-8	Organic Enrichment	Fecal Coliform
Sugarcamp Branch	WV-KU-33-D	pH, Dissolved Metals, Sediment	pH, Aluminum (TMDL for contributing tributary), Total Iron (load reductions to Sugarcamp Branch for downstream impairment)

5.0 METALS, CHLORIDE AND SELENIUM SOURCE ASSESSMENT

This section identifies and examines the potential sources of metals, chloride, and selenium impairments in the Upper Kanawha River Watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources. For the sake of consistency, the same modeled landuse setup was used for all non-fecal coliform nonpoint sources. Mining and non-mining point sources were also modeled consistently in terms of drainage area and flow, although chemical concentrations were configured specifically for each pollutant modeled.

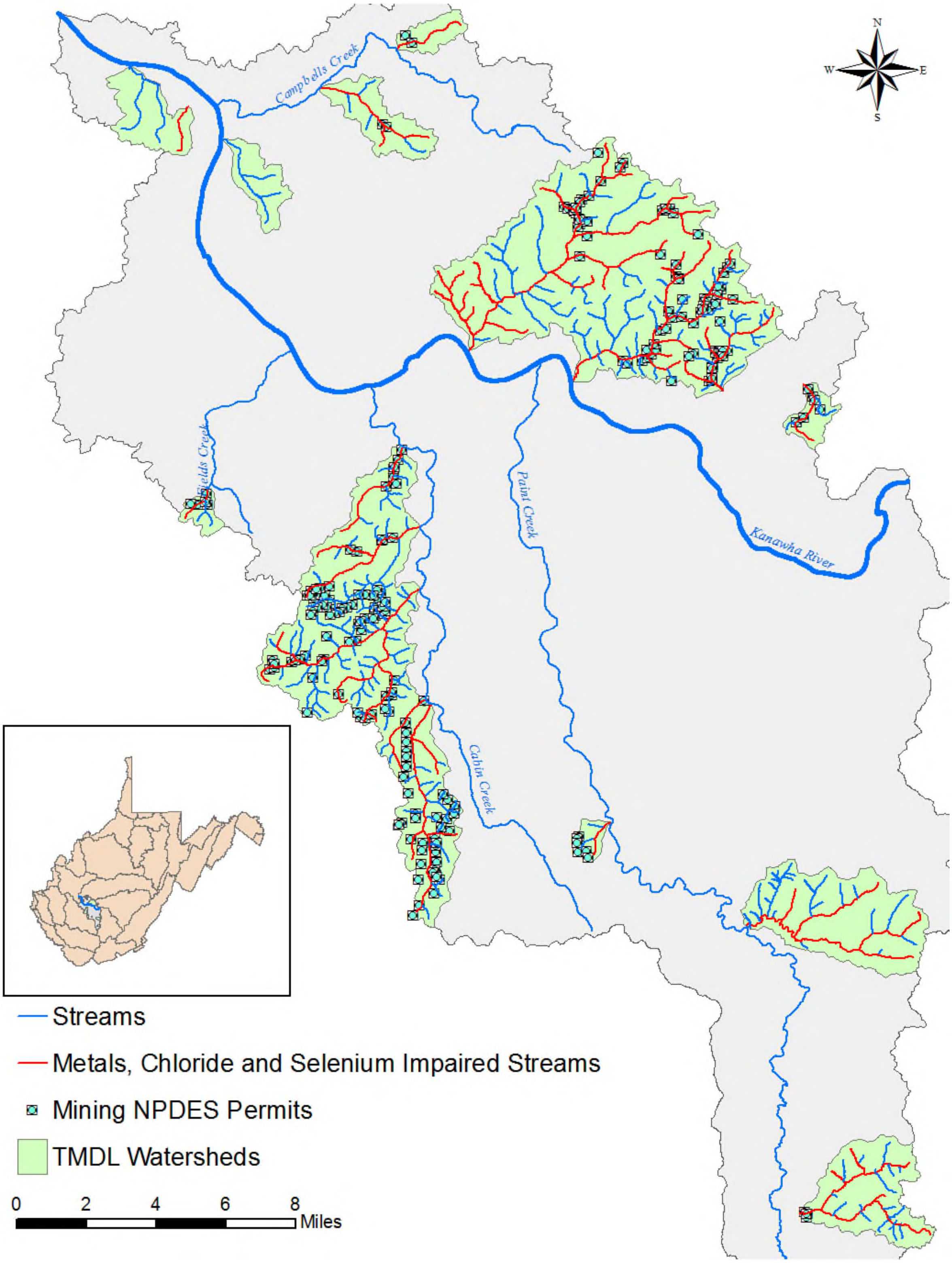
A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel 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, such as AML. The assignment of LAs to AML does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within this landuse. Likewise, by establishing these TMDLs with mine drainage discharges treated as LAs, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements.

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, Chloride and Selenium 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. Point sources in the Upper Kanawha River Watershed

5.1.1 Mining Point Sources

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

SMCRA Title IV is designed to provide assistance for the reclamation and restoration of abandoned mines; whereas Title V states that any surface coal mining operations must be required to meet all applicable performance standards. Some general performance standards include the following:

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

Untreated mining-related point source discharges from deep, surface, and other mines may have low pH values (i.e. acidic) and contain high concentrations of metals (iron and aluminum). Mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, total manganese, total suspended solids, and pH. Many permits also include effluent monitoring requirements for total aluminum and some, more recently issued permits include aluminum water quality based effluent limits. WVDEP's Division of Mining and Reclamation (DMR) provided a spatial coverage of the mining-related NPDES permit outlets. The discharge characteristics, related permit limits, and discharge data for these NPDES outlets were acquired from West Virginia's ERIS database system. The spatial coverage was used to determine the location of the permit outlets. Additional information was needed, however, to determine the areas of the mining activities. WVDEP DMR also provided spatial coverage of the mining permit areas and related SMCRA Article 3 and NPDES permit information. WVDEP DWWM personnel used the information contained in the SMCRA Article 3 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 36 mining-related NPDES permits, with 228 associated outlets in the metals impaired watersheds of the Upper Kanawha River Watershed. Some permits include multiple outlets with discharges to more than one TMDL watershed. 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 SMCRA Bond Forfeiture Sites

Facilities subject to the Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) during active operations are required to post a performance bond to ensure the completion of reclamation requirements. Bond forfeited sites and abandoned operations can be a significant source of metals. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. The Office of Special Reclamation in WVDEP's Division of Land Restoration provided bond forfeiture site locations and information regarding the status of land reclamation and water treatment activities. Sites with unreclaimed land disturbance and unresolved water quality impacts were represented, as were sites with ongoing water treatment activities. There is one such bond forfeiture site (5 outlets) located in the metals impaired TMDL watersheds.

In past TMDLs, bond forfeiture sites were classified as nonpoint sources. A recent judicial decision (West Virginia Highlands Conservancy, Inc., and West Virginia Rivers Coalition, Inc. v. Randy Huffman, Secretary, West Virginia Department of Environmental Protection. [1:07CV87]. 2009) requires WVDEP to obtain an NPDES permit for discharges from forfeited sites. As such, this TMDL project classifies bond forfeiture sites as point sources and provides WLAs. Six acid mine discharges (seeps) are associated with bond forfeiture sites and are represented as point sources.

5.1.3 Non-mining Point Sources

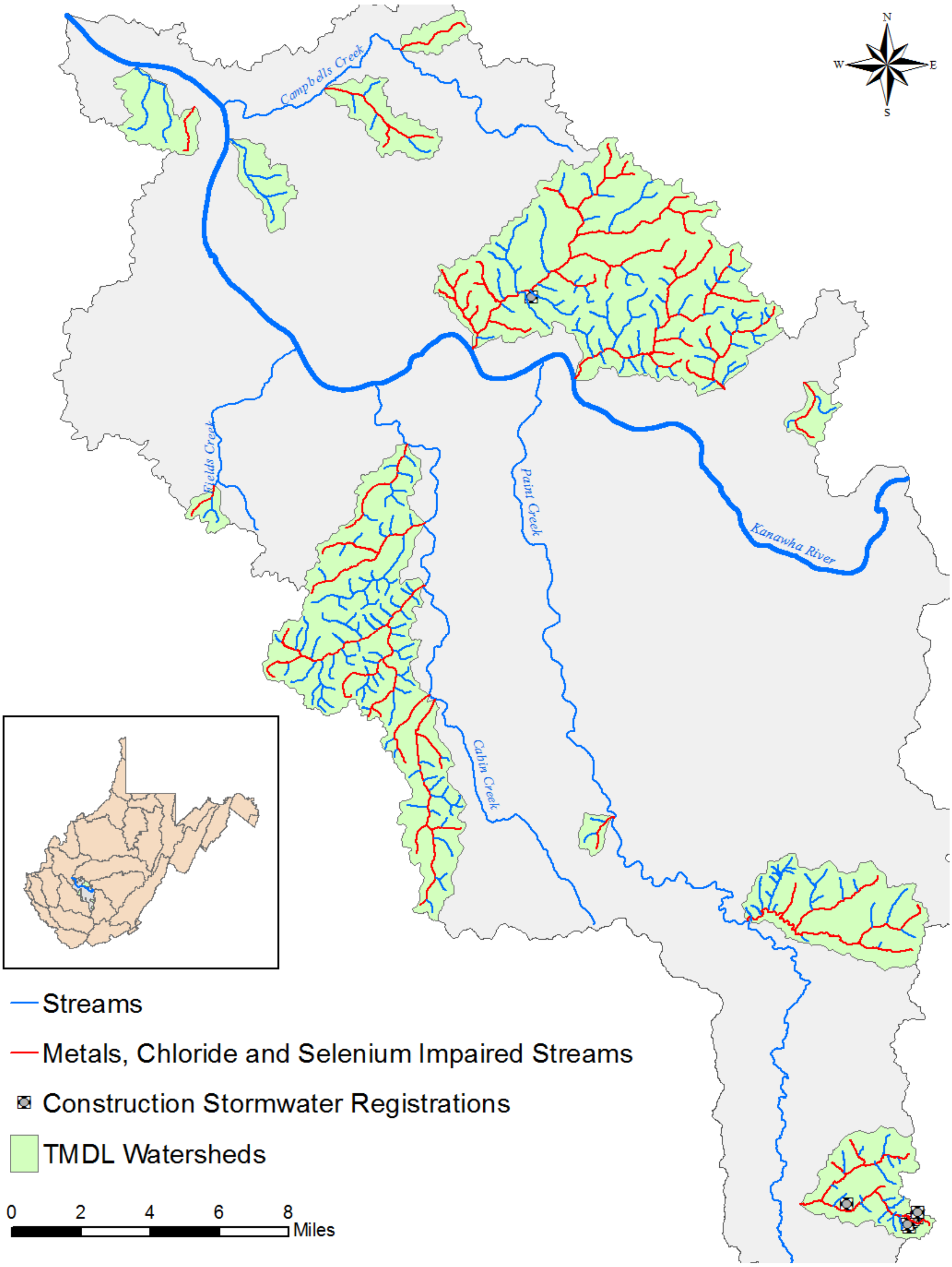
WVDEP DWWM controls water quality impacts from non-mining activities with point source discharges through the issuance of NPDES permits. WVDEP's OWRNPDES GIS coverage was used to determine the locations of these sources, and detailed permit information was obtained from WVDEP's ERIS database. Sources may include the process wastewater discharges from water treatment plants and industrial manufacturing operations, and stormwater discharges associated with industrial activity. There are no industrial wastewater discharges in the watersheds of metals impaired streams in the Upper Kanawha Watershed.

There are limited sewage treatment facilities existing in the watersheds of metals impaired streams. The NPDES permits for those facilities do not contain iron or aluminum 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 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.

5.1.4 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 and aluminum. 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, nine active construction sites with a total disturbed acreage of 37 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 Upper Kanawha River Watershed

5.1.5 Municipal Separate Storm Sewer Systems (MS4)

Runoff from residential and urbanized areas during storm events can be a significant sediment 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, their stormwater discharges are considered point sources and are prescribed WLAs. The MS4 entities are registered under the MS4 General Permit (WV0116025). Individual registration numbers for the MS4 entities are City of Charleston (WVR030006), and the West Virginia Division of Highways (WVDOH) (WVR030004).

The City of Charleston MS4 permit area falls within the established city limits. WVDOH MS4 area occurs inside and on the eastern periphery of the City of Charleston, and on the northern periphery of the City of Beckley municipal area. The City of Beckley MS4 permit area does not fall in the TMDL project area.

MS4 source representation was based upon precipitation and runoff from landuses determined from the modified NLCD 2006 landuse data, the jurisdictional boundary of the city, and the transportation-related drainage areas for which WVDOH has MS4 responsibility. The representation also includes streambank erosion loads for the portions of streams within the MS4 boundaries. WVDEP consulted with the City of Charleston and obtained information to determine drainage areas to the respective systems and best represent MS4 pollutant loadings. The location and extent of the MS4 jurisdiction are shown in **Figure 5-3**.

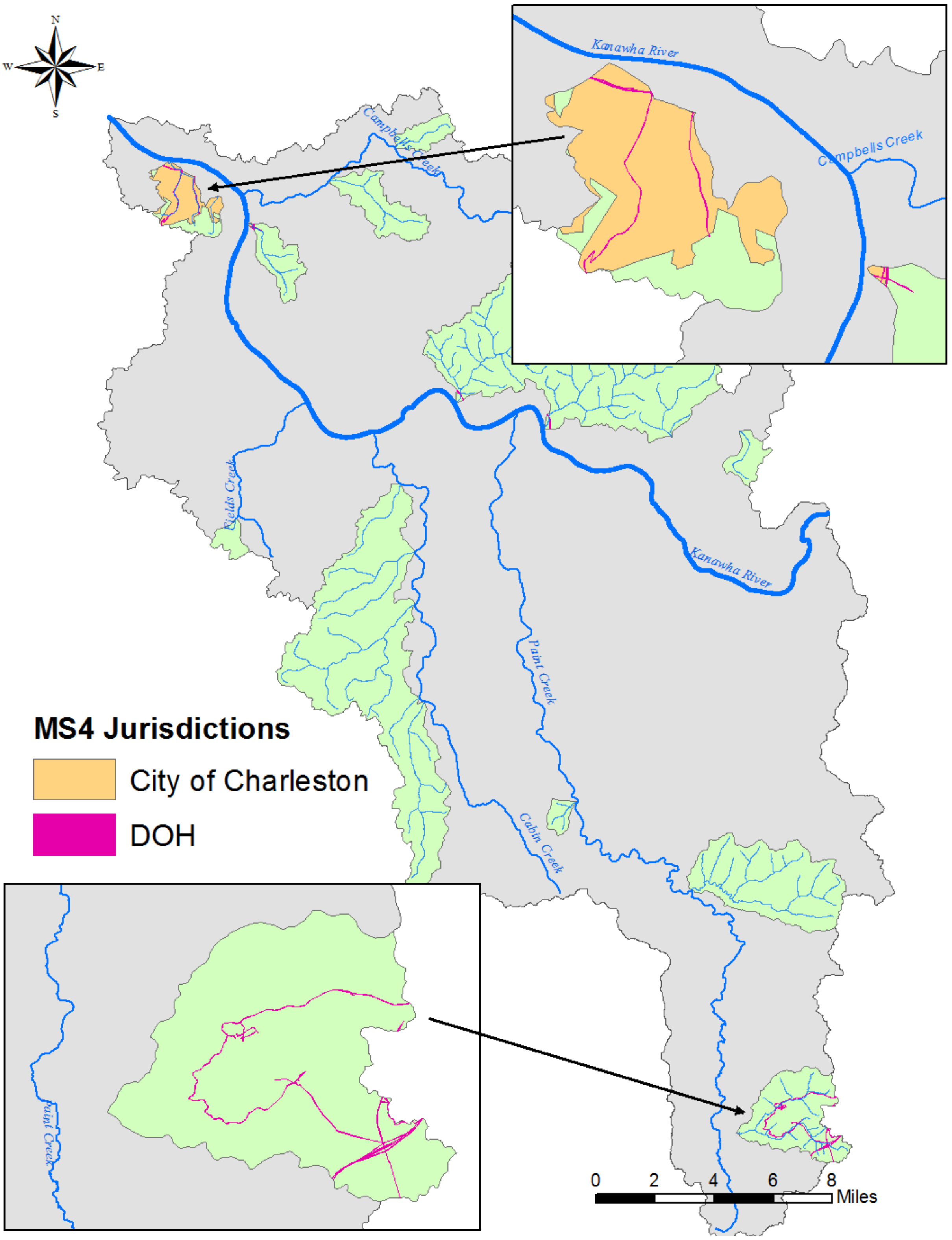


Figure 5-3. MS4 jurisdictions in the Upper Kanawha River Watershed

5.2 Metals, Chloride and Selenium Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals. AML may contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface water. Also, land disturbing activities that introduce excess sediment are considered nonpoint sources of metals.

5.2.1 Abandoned Mine Lands

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

The Office of AML&R identified locations of AML in the Upper Kanawha River Watershed from their records. In addition, source tracking efforts by WVDEP DWWM and AML&R identified additional AML sources (discharges, seeps, portals, and refuse piles). Field data, such as GPS locations, water samples, and flow measurements, were collected to represent these sources and characterize their impact on water quality. Based on this work, AML represent a significant source of metals in certain metals impaired streams for which TMDLs are presented. In TMDL watersheds with metals, chloride, and selenium impairments, a total 18 seeps associated with legacy mine practices at AML sites, were incorporated into the TMDL model (**Figure 5-4**).

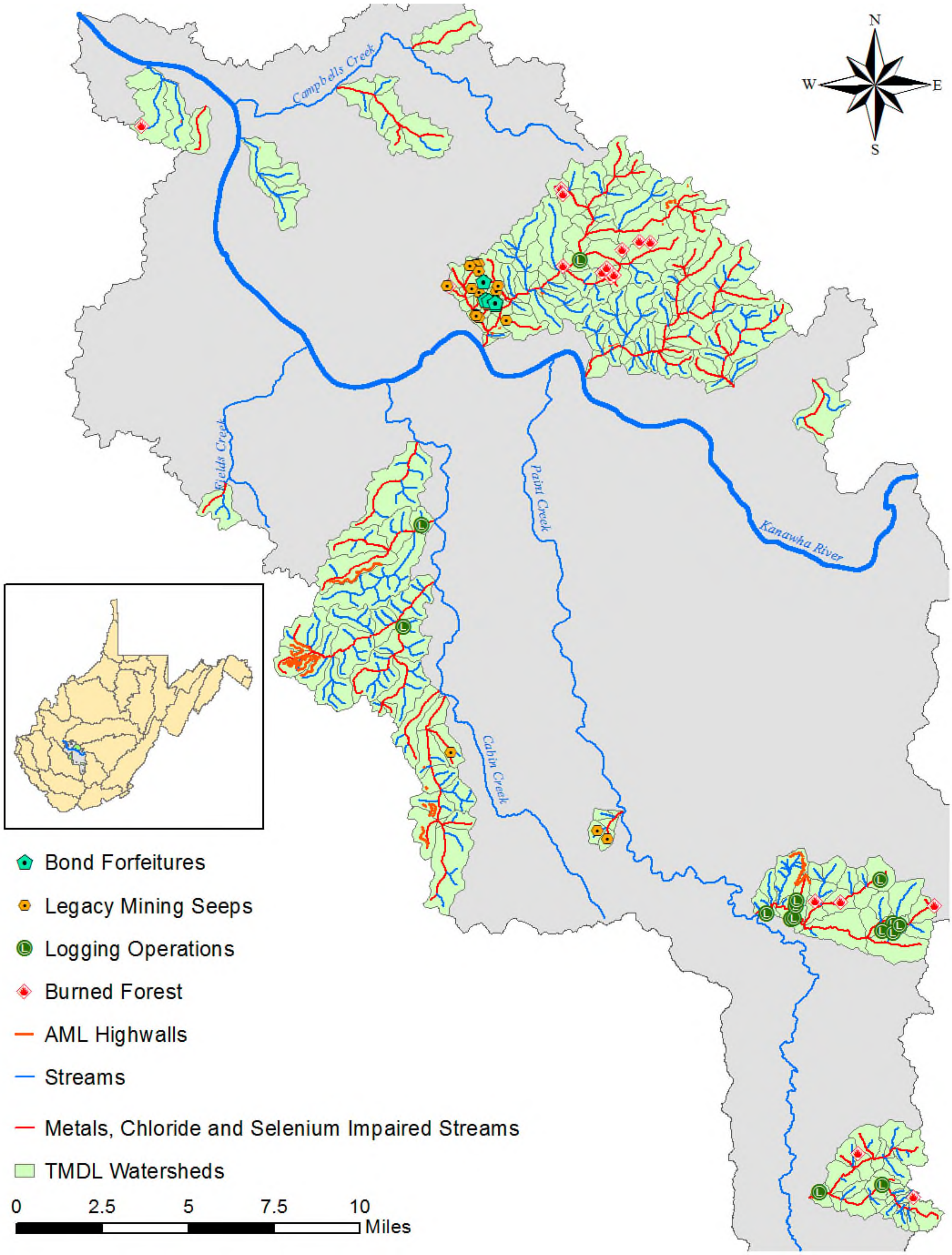


Figure 5-4. Nonpoint sources in the Upper Kanawha River Watershed

5.2.2 Sediment Sources

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 in non-MS4 areas. 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 554 acres of harvested area within the TMDL impaired streams watersheds, of which subset of land disturbed by roads and landings is 44.3 acres. In addition, 445.9 acres of burned forest were reported and included as disturbed land.

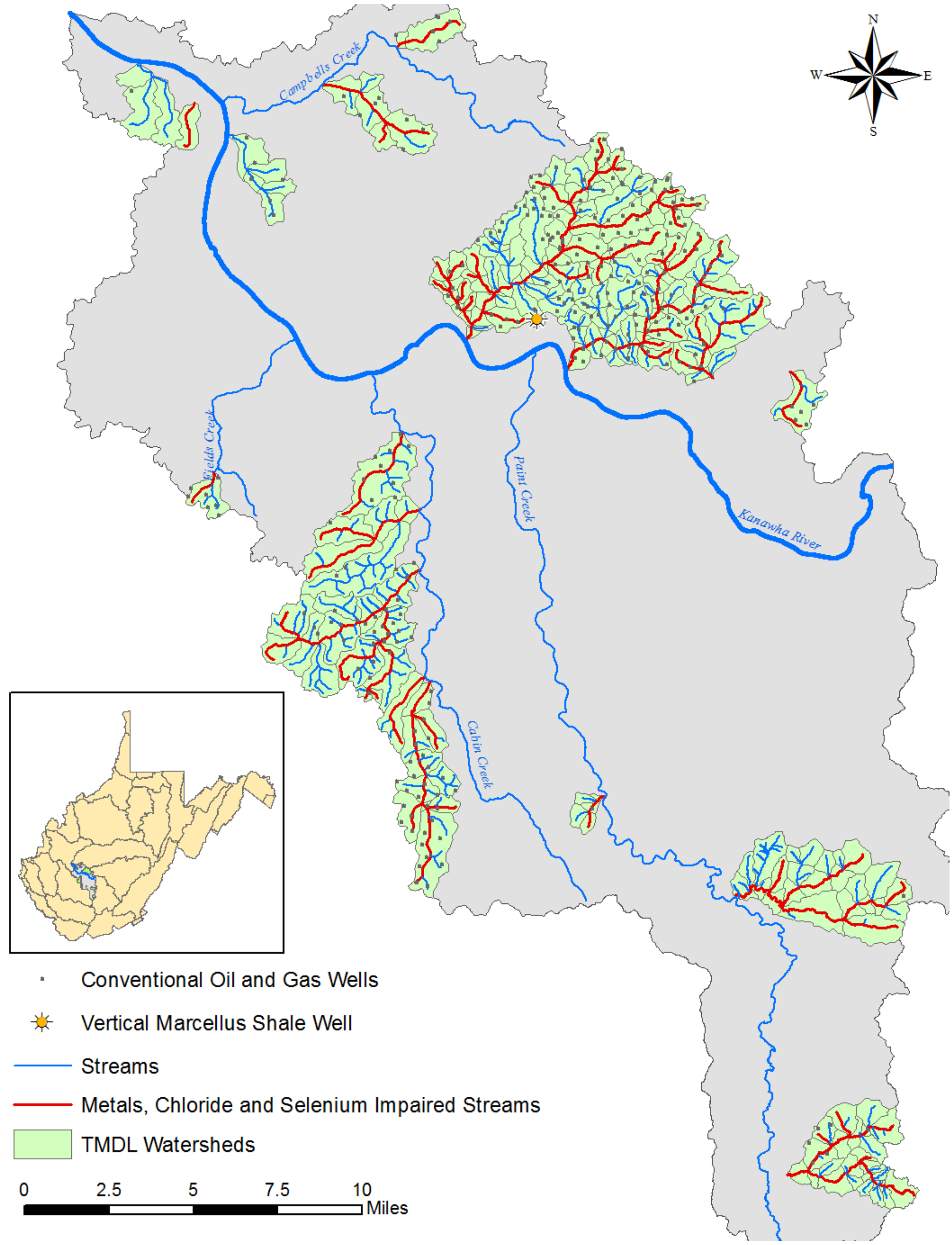
West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992, the West Virginia Legislature passed the Logging Sediment Control Act. The act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated 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.

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 increased in the watershed with the development of new hydraulic fracturing techniques. 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. In addition to conventional wells, one vertical Marcellus drilling site was identified and represented in the model. No horizontal Marcellus drilling sites occurred in the watersheds of impaired streams.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There are 292 active oil and gas wells (comprising 391.2 acres represented in the metals impaired TMDL watersheds addressed in this report. Runoff from unpaved access roads to these wells and the disturbed areas around the wells contribute sediment to adjacent streams (**Figure 5-5**).



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

Figure 5-5. Oil and Gas Well locations in the Upper Kanawha 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 less than one percent of the modeled land area in metals impaired TMDL watersheds. Although agricultural activity accounts for a small percentage of the overall watershed, agriculture 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 for stream segments outside of MS4 areas.

Other Land-Disturbance Activities

Stormwater runoff from residential and urban landuses in non-MS4 areas is a significant source of sediment in parts of the watershed. Outside urbanized area boundaries, 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 not subject to MS4 permitting requirements 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 (abandoned mine lands, mining permits, etc.). 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.

5.3 Chloride Source Assessment

Permitted, high-volume, pumped discharges associated with mining activities are the prevalent sources in chloride impaired streams in the watershed. WVDEP's Division of Mining and Reclamation (DMR) provided a spatial coverage of the mining-related NPDES permit outlets and additional information regarding the subset of those outlets for which chloride has been determined to be a pollutant of concern. The discharge characteristics, related permit limits and discharge data for these NPDES outlets were acquired from West Virginia's ERIS database system. Using this information, 12 such sources were represented as constant flow discharges of different chloride concentration in the model and assigned individual wasteload allocations. The high-volume pumped discharge outlets discharging to chloride-impaired streams in the New West Hollow, Longbottom Creek, and Coal Fork TMDL watersheds are shown in **Figure 5-6**. Drainage associated with other mining related NPDES permits contains only low level chloride concentrations and was represented as a "background" source throughout the watersheds of chloride impaired streams. Non-mining related point sources were similarly represented.

All nonpoint source runoff contains low level chloride concentrations and chloride loadings from groundwater are an additional background source. The influence of abandoned mine land sources upon chloride water quality was evaluated and such sources, inclusive of continuous flow seeps, were found to contribute negligible chloride loadings. Multiple land use types with varying chloride characteristics were represented as "background" sources throughout the watersheds of chloride impaired streams. Urban impervious landuses were represented as sources slightly higher than background, due to the potential for de-icing activities in winter.

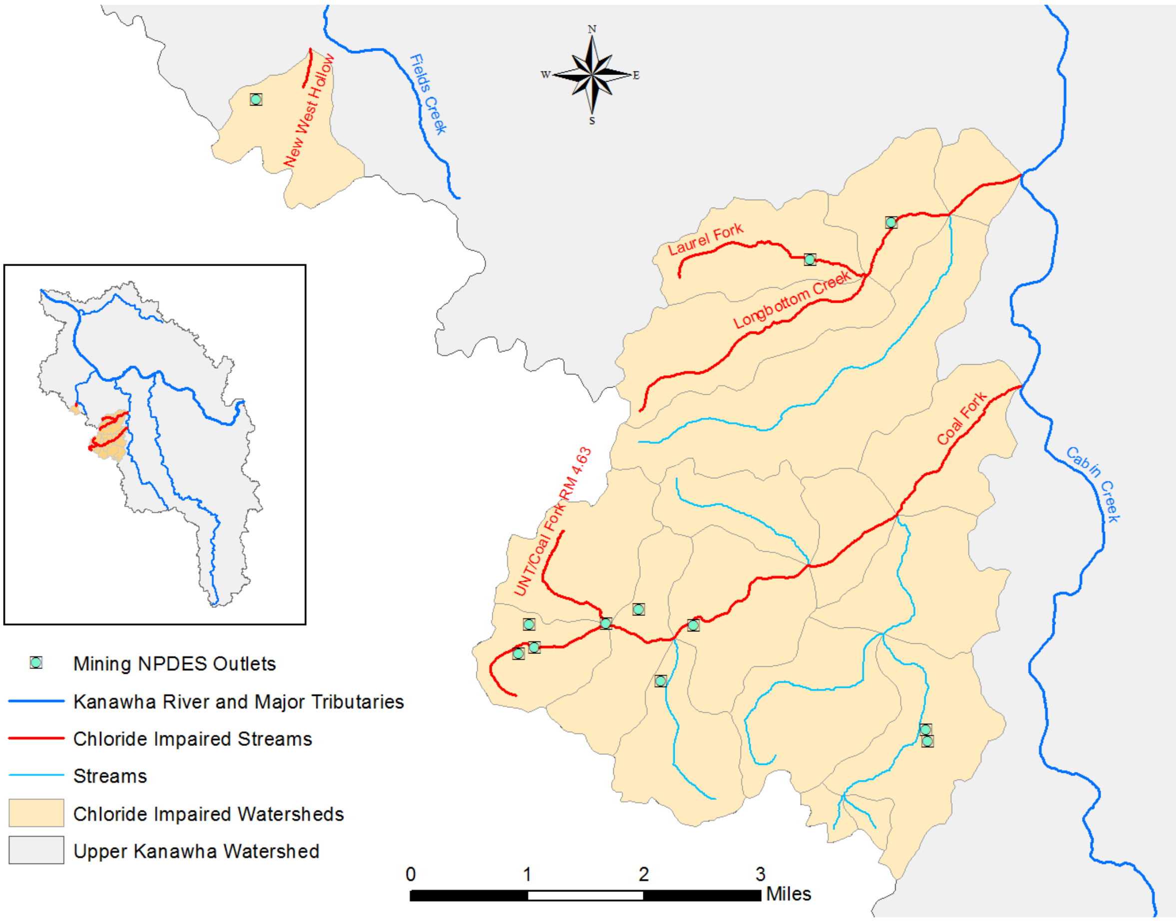


Figure 5-6. Chloride point sources in the Upper Kanawha River Watershed

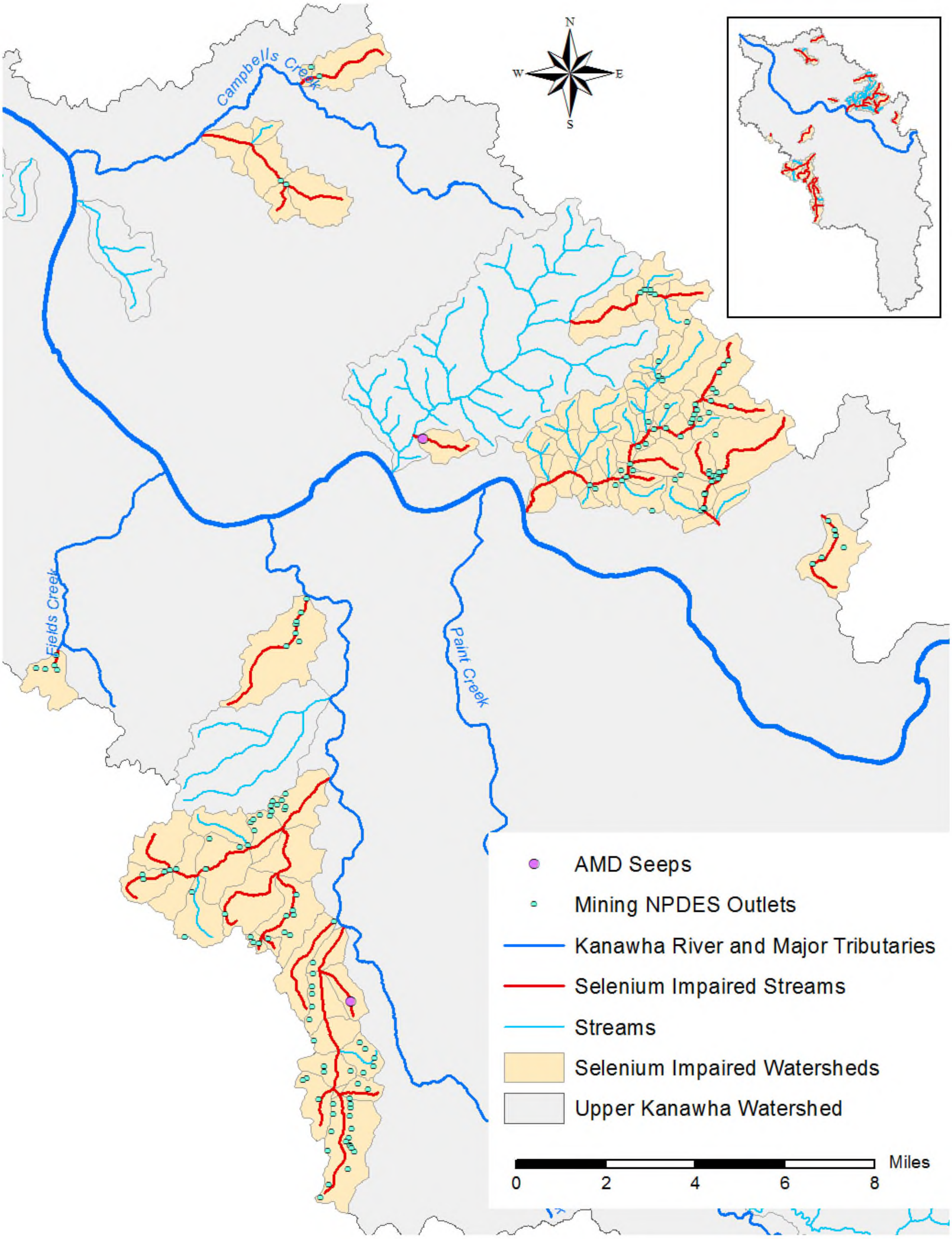
5.4 Selenium Source Assessment

Selenium is a naturally occurring element that is found in Cretaceous marine sedimentary rocks, coal and other fossil fuel deposits (Dreher and Finkelman 1992; CCREM 1987; USEPA 1987; Haygarth 1994). When such deposits are mined, mobilization of selenium is typically enhanced from crushing of ore and waste materials along with the resulting increase in surface area of material exposed to weathering processes. Studies have shown that selenium mobilization appears to be associated with various surface disturbance activities associated with surface coal mining in Wyoming and western Canada (Dreher and Finkelman 1992; McDonald and Strosher 1998). In West Virginia coal beds of the Middle Pennsylvanian exhibit the highest selenium contents. Lower selenium content is found in Lower Pennsylvanian and Upper Pennsylvanian. (WVGES, 2002). Selenium is contained in those coals and mining also exposes partings and interburden of selenium containing shales.

Twenty-four streams in this TMDL project have been listed in the WV 2012 303(d) list or draft 2014 303(d) list pursuant to the aquatic life criteria for selenium, based on pre-TMDL data collected by WVDEP from 2010- 2012. Extensive surface mining operations exist in the impaired watersheds, and active and reclaimed mining are the dominant landuses. Given the selenium content of coals being mined in this region, and the prevalence of mining activity in proximity to observed exceedances of the selenium water quality criterion, the disturbances associated with the existing and legacy mining operations are assumed to contribute to the selenium impairment. Two AML seeps were identified as contributing selenium to two impaired streams, Frozen Branch (WV-KU-33-C) and UNT/Tenmile Fork RM 1.22 (WV-KU-26-AD-1) that had no active mining or other point or nonpoint sources.

Other nonpoint sources associated with surface disturbances (i.e., barren areas, unpaved roads, and oil and gas well operations) were considered to be negligible sources of selenium because these land disturbances typically do not disrupt subsurface strata that contain selenium. In this and prior TMDL development efforts, WVDEP did not identify selenium impairments in streams where surface-disturbing nonpoint sources were prevalent in the watershed and mining activities were absent.

Figure 5-7 displays the extent of mining in the selenium impaired watersheds. Technical Report Appendix F identifies permitted outlets in the watershed.



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

Figure 5-7. Selenium impaired watersheds in the Upper Kanawha River Watershed

6.0 pH SOURCE ASSESSMENT

pH impairments in the study area are caused by acidity introduced by legacy mining activities. Upper Kanawha WVDEP source tracking and pre-TMDL water quality monitoring were used to determine the causative sources.

Discharges from historical mining activities can cause low pH impairments, iron and/or aluminum impairments. Because of the complex chemical interactions that occur between dissolved metals and acidity, the TMDL approach focused on reducing metals concentrations to meet metals water quality criteria while accounting for watershed dynamics associated with buffering capacity. Where necessary, the approach prescribes additional alkalinity to achieve pH water quality criteria.

Although atmospheric acid deposition was represented in the model, it is not the causative source for impaired waters in the Upper Kanawha River Watershed. While acid precipitation and the low buffering capacity of certain watersheds can contribute to lower observed pH, the Upper Kanawha River Watershed has sufficient buffering capacity to counter those effects.

7.0 FECAL COLIFORM SOURCE ASSESSMENT

7.1 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 Upper Kanawha River Watershed.

7.1.1 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.

In the subject watersheds of this report, one individually permitted POTW discharge treated effluent at one outlet. Six mining bathhouse facilities discharge to TMDL streams in the Upper Kanawha River TMDL watersheds via seven outlets.

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.

7.1.2 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.

7.1.3 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.

MS4 entities and their areas of responsibility are described in **Section 5.1.5** and displayed in **Figure 5-3**. MS4 source representation is based upon precipitation and runoff from landuses determined from the modified NLCD 2006 landuse data, the jurisdictional boundary of the cities, and the transportation-related drainage areas for which WVDOH has MS4 responsibility. In certain areas, urban/residential stormwater runoff may drain to both CSO and MS4 systems. WVDEP consulted with local governments and obtained information to determine drainage areas to the respective systems and best represent MS4 pollutant loadings.

7.1.4 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, one facility is registered under the "package plant" general permit, and seven are registered under the HAU general permit.

7.2 Fecal Coliform Nonpoint Sources

7.2.1 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 1,133 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 7-1** shows the failing septic flows represented in the model by subwatershed.

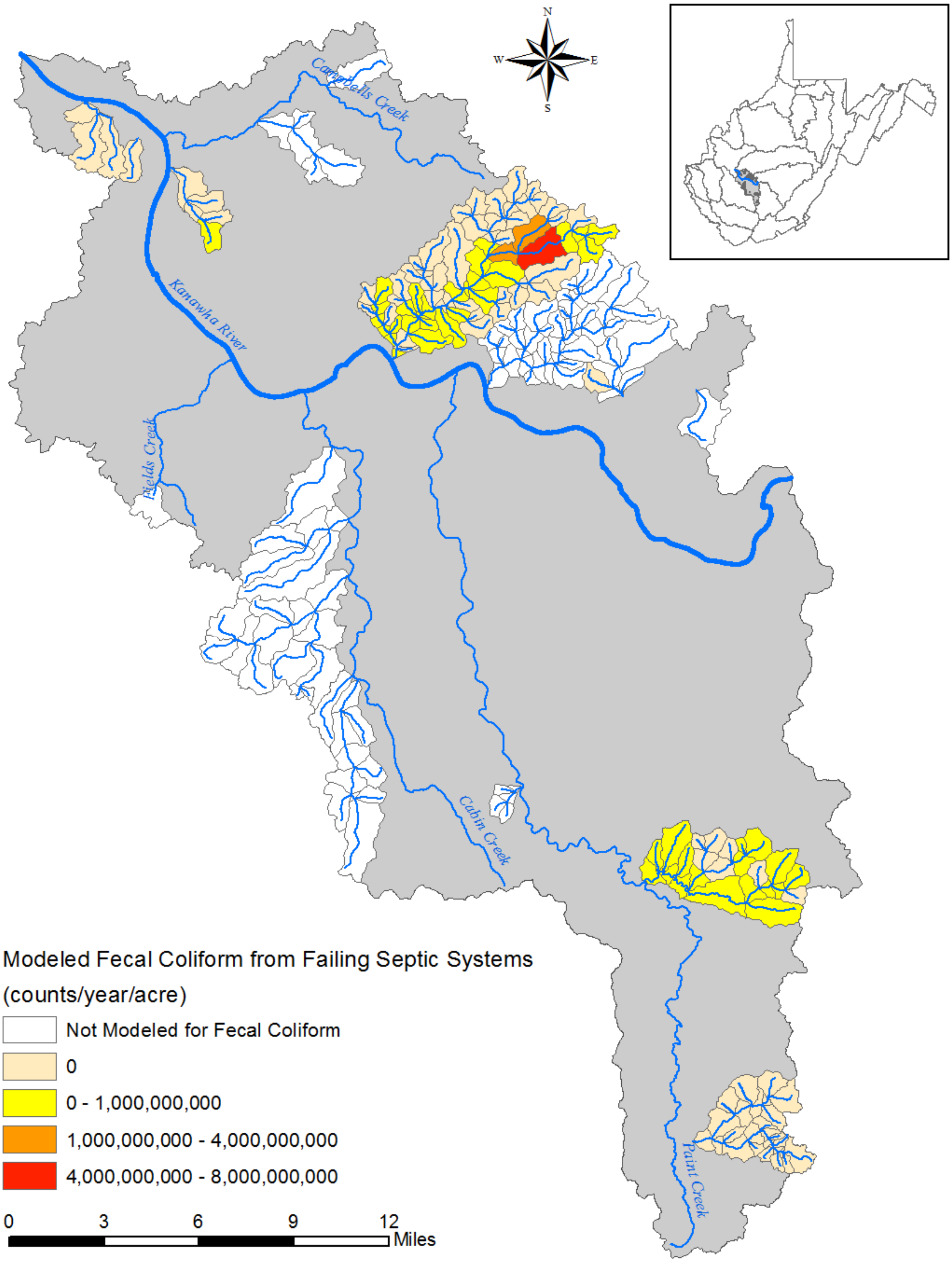


Figure 7-1. Failing septic loads in the Upper Kanawha River Watershed

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.

7.2.2 Urban/Residential Runoff

Stormwater runoff from residential and urbanized areas that are not subject to MS4 permitting requirements 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 not subject to MS4 permitting requirements and source representation was based upon precipitation and runoff.

7.2.3 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.

Although agricultural activity accounts for a small percentage of the overall watershed, 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.

7.2.4 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.

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 Upper Kanawha River Watershed.

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
- Dissolved aluminum impairments are related to pH water quality
- Total iron and total aluminum 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
- Selenium concentrations are largely dependent on mining activity and discharges during low-flow stream conditions have the largest impact
- Chloride concentrations are largely dependent on mining discharge practices (i.e. pumping) and discharges during low-flow stream conditions have the largest impact

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, aluminum, selenium, manganese, chloride, pH, 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 Upper Kanawha River Watershed, 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 AMD seeps and 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, dissolved aluminum, pH, chloride, manganese, selenium, and fecal coliform bacteria were modeled using the MDAS.

8.2 Model Setup

Model setup consisted of configuring the following five separate MDAS models: iron/sediment, aluminum/pH/manganese, chloride, selenium, 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 18 TMDL watersheds were broken into 226 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. abandoned mine lands, 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.

Traditional point sources (active deep mine discharges, water treatment plant backwash discharges, industrial discharges, solid waste landfill leachates) were modeled as direct, continuous-flow sources in the model, with the baseline flow and pollutant characteristics obtained from permitting databases.

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.

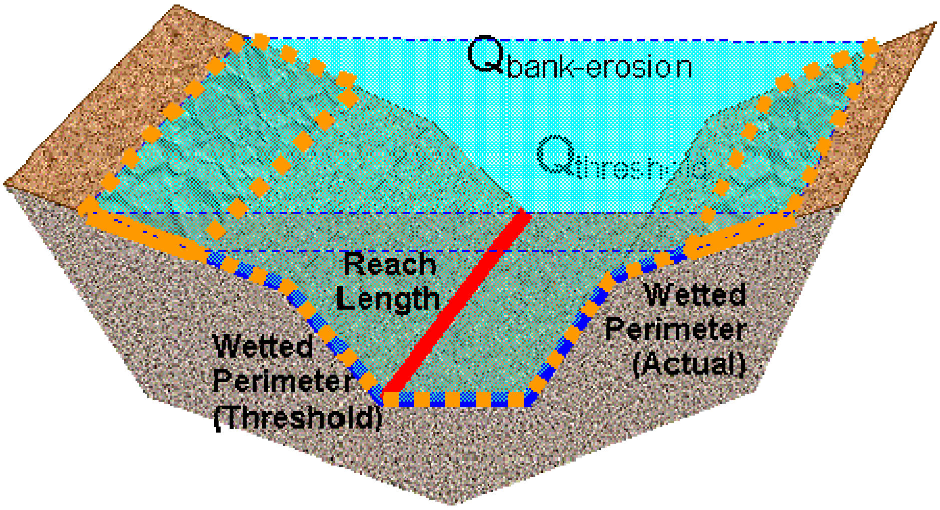


Figure 8-1. Conceptual diagram of stream channel components used in the bank erosion model

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 Aluminum, Manganese, and pH Configuration

To derive the dissolved aluminum and pH TMDLs, it was necessary to include additional MDAS modules capable of representing instream chemical reactions of several water quality components. MDAS includes a dynamic chemical species fate and transport module that simulates soil subsurface and in-stream water quality taking into account chemical species interaction and transformation. The time series for total chemical concentration and flows generated by MDAS are used as inputs for the modules' pollutant transformation and transport routines. The modules simulate soil subsurface and in-stream chemical reactions, assuming instant mixing and concentrations equally distributed throughout soil and stream segments. The model supports major chemical reactions, including acid/base, complexation, precipitation, and dissolution reactions and some kinetic reactions, if selected by the user. The manganese component was configured in the model to simulate loadings from different non-point/point sources within a watershed. The model also simulates reactive transport of manganese within each modeled reach simulating chemical kinetics (precipitation/dissolution) and speciation. The model selection process, modeling methodologies, and technical approaches are discussed further in the Technical Report.

AMD seeps were modeled as direct, continuous-flow sources in the model. Flow information and discharge characteristics were obtained during source tracking. AML and other land-based sources (including precipitation induced point sources) were modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget. The contributions of acidity and species that impact the calculation of alkalinity and pH were directly represented in the direct loadings and land-based loadings in the model.

With the atmospheric deposition module, MDAS is able to model acidity loading from wet deposition. Wet deposition was represented similarly for land uses and included contributions for each of the major ionic species, including aluminum, iron, inorganic carbon, and pH. Concentrations for wet deposition were modeled using data obtained from the USEPA Office of Air Quality Planning and Standards at Research Triangle Park, North Carolina. The data are a result of air quality modeling in support of the Final Clean Air Intestate Rule (CAIR), (USEPA, 2005). National Atmospheric Deposition Program (NADP) monitoring data collected at the USDA Forest Service Northeastern Research Station, Tucker County, WV was also used to characterize the extent of atmospheric deposition in the watershed.

Because of the complex chemical interactions that occur between dissolved metals and acidity, the TMDL approach focused on reducing metals concentrations, using the MDAS model previously described, to meet metals water quality criteria and then verifying that the resultant pH associated with the metals TMDL condition would be in compliance with pH criteria. Where necessary, the approach prescribes additional alkalinity to achieve pH water quality criteria.

8.2.4 Chloride Configuration

Modeled landuse categories contributing chloride via surface runoff and groundwater recharge primarily include urban/residential areas and roads. These land-based sources were modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget. Initial loading rates were refined through calibration based upon pre-TMDL monitoring of streams that do not receive high chloride point source discharges. The point source discharges associated with mining activities were modeled as direct, continuous-flow sources in the model based upon available information obtained from the permitting database.

8.2.5 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 7.2.1** describes the process of assigning flow and fecal coliform concentrations to failing septic systems.

8.2.6 Selenium Configuration

The modeled landuse categories contributing selenium from precipitation and runoff include forest and grassland, oil and gas, residential/urban/developed, disturbed and undisturbed mining area. Existing NLCD 2006 landuse categories were modified to account for known land use disturbances from roads, oil and gas, and active mining permits. Selenium model setup generally followed the same procedures used for iron and sediment model setup. The process of consolidating and updating the modeled landuses is explained in further detail in the Technical Report. Non-mining landuses were modeled for selenium using calibration-derived concentrations for the surface, interflow and groundwater portions of the water budget. Two AML seeps were identified as contributing significant loadings to impaired streams.

Mining permits were the dominant source of selenium in selenium impaired streams. Several types of mining permits were modeled: on-bench sediment control structures, instream ponds, and continuous pumped discharges. If a mining permit had been assigned a selenium limit, discharges associated with that permit were modeled at the permit limit concentration. Permits without selenium limits were modeled at the 95th percentile of the maximum reported values of discharge monitoring report data collected from all permitted mining outlets in the TMDL watersheds.

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 in the Upper Kanawha River modeled for this study. USGS gages on the Upper Kanawha 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 Elk River were transferred to the Upper Kanawha model. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP’s pre-TMDL monitoring in the Upper Kanawha River watershed. 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.

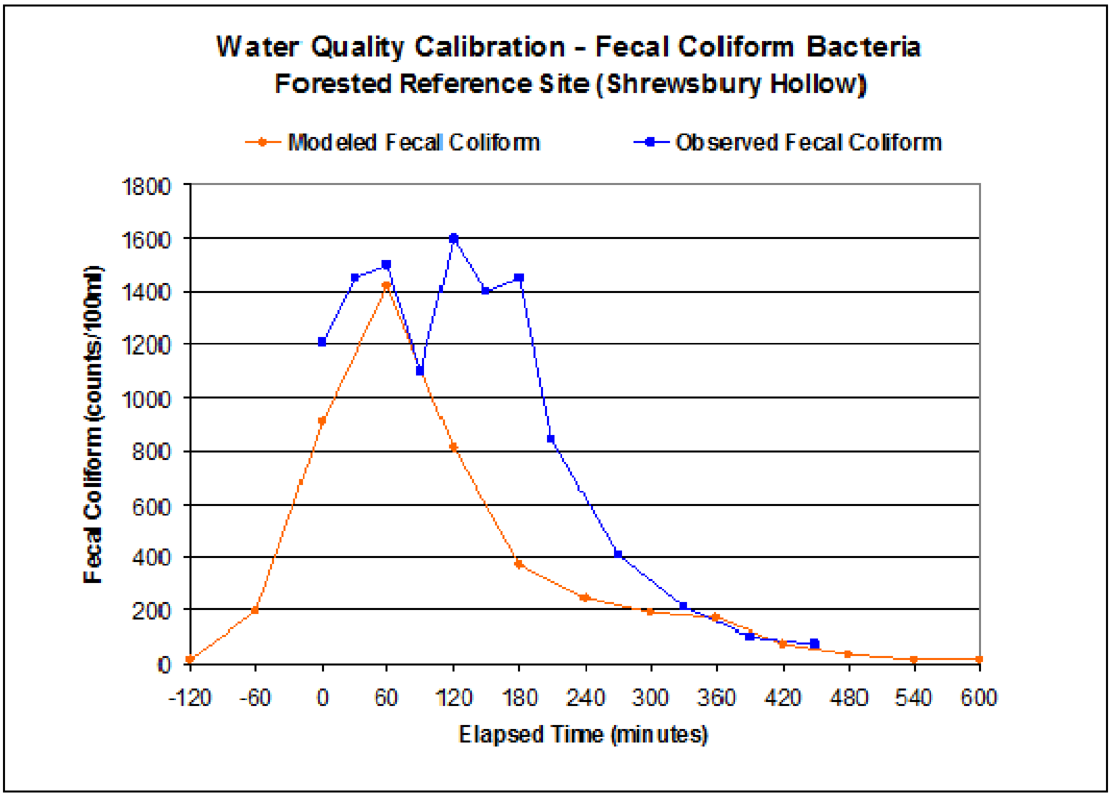


Figure 8-2. Shrewsbury Hollow fecal coliform observed data

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, Mossy Creek (WV-KU-39-BM) was selected as the reference watershed.

Certain 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 8-1**.

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.

An explicit MOS was not applied for total iron and chloride TMDLs in certain subwatersheds where mining point sources create an effluent dominated scenario and/or the regulated mining activity encompasses a large percentage of the watershed area. Within these scenarios, WLAs are established at the value of the criteria and little uncertainty is associated with the source/water quality linkage. An explicit MOS was not included in selenium TMDLs because little modeling uncertainly exists. Non-attainment is directly related to point sources regulated by WV/NPDES permits and AMD seeps. Such sources universally have allocations established at the water quality criterion and if met will result in criterion attainment.

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)
Dissolved Aluminum	Aquatic Life, warmwater fisheries	0.75 mg/L (1-hour average)	0.7125 mg/L (1-hour average)
Chloride	Aquatic Life	230 mg/L (4-day average)	218.5 mg/L (4-day average)
pH	Aquatic Life	6.00 Standard Units (Minimum)	6.02 Standard Units (Minimum)
Total Manganese	Public Water Supply	1.0 mg/L (within 5 upstream miles of a public water intake)	0.95 mg/L
Selenium	Aquatic Life	0.005 mg/L (4-day average)	0.005 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 Charleston Yeager Airport (WBAN 13866) weather station in West Virginia. The years 2004 to 2009 are highlighted to indicate the range of precipitation conditions used for TMDL development in the Upper Kanawha River Watershed.

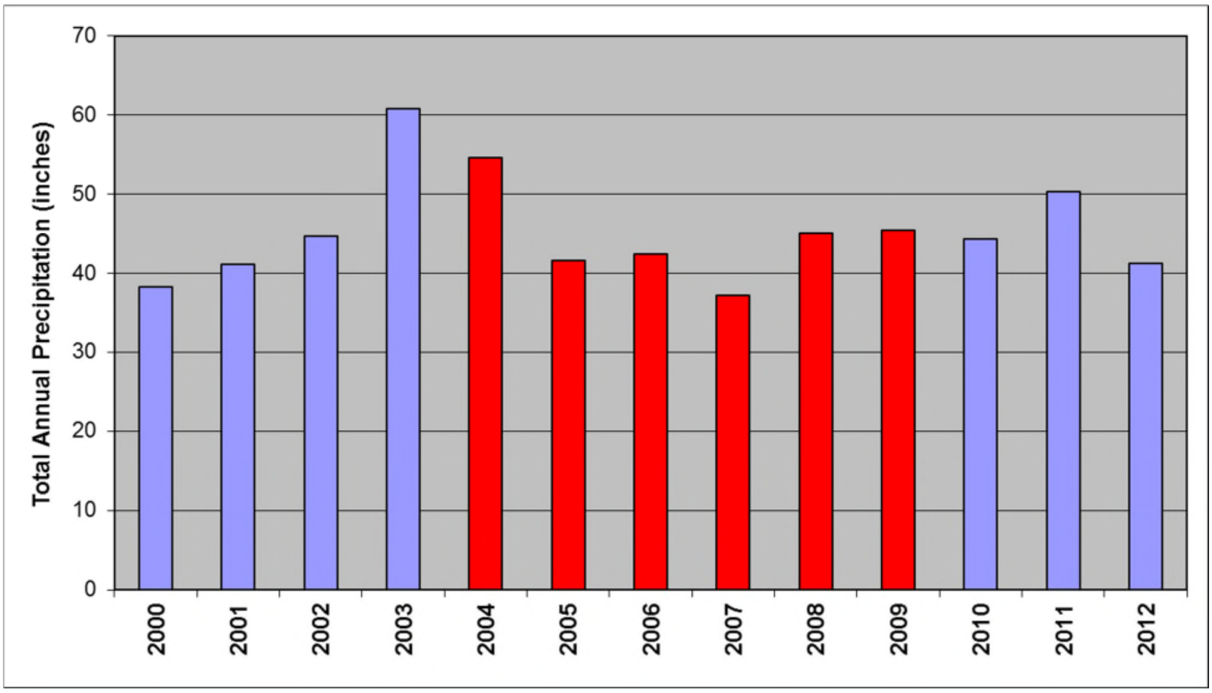


Figure 8-3. Annual precipitation totals for the Charleston Yeager Airport (WBAN 13866) weather station

NPDES permits contain effluent limitations for iron, aluminum, manganese, selenium and/or chloride concentrations. In the baseline condition, mining discharges that are influenced by precipitation were represented using precipitation and drainage area. For non-precipitation-induced mining discharges, available flow and/or pump capacity information was used. Baseline concentrations varied by parameter. For 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. These concentrations accurately represent existing WLAs for the majority of mining discharges. 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. For aluminum, discharges are not necessarily compliant with interim limits and the permits allow pursuit of aluminum translators that may result in less stringent final limits. Baseline total aluminum concentrations were set at the 95th percentile of maximum values from Discharge Monitoring Reports (0.92 mg/l) Similarly for chloride, existing discharges are not necessarily compliant with existing water quality based effluent limitations and baseline concentrations were equal to discharge-specific calibration concentrations. For selenium, many discharges did not have a selenium limit. If a mining permit had been assigned a selenium limit, under baseline conditions, discharges associated with that permit were modeled at the permit limit, which was 5 ug/l. For baseline representation of permits without selenium limits, these permits were modeled at the

95th percentile of the maximum reported values of discharge monitoring report data collected from all permitted mining outlets in the TMDL watersheds.

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. Baseline characteristics for non-stormwater industrial wastewater sources were obtained from effluent limitations and other permitting information.

MS4, nonpoint source and background loadings for fecal coliform were represented using drainage area, precipitation, and pollutant accumulation and wash off rates, as appropriate for each landuse.

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.

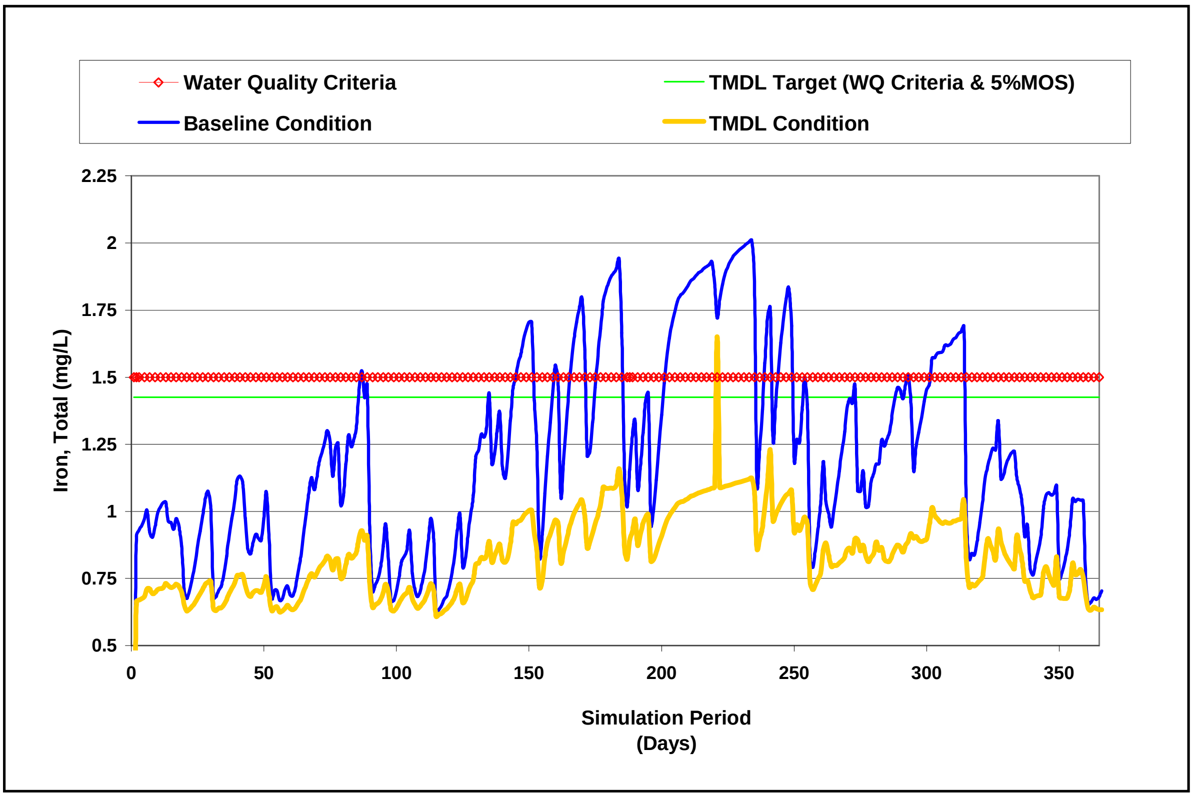


Figure 8-4. Example of baseline and TMDL conditions for total iron

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 of the Upper Kanawha River Watersheds. 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.

4. AMD seeps were reduced to water quality criterion end of pipe (1.5 mg/L iron).
5. Active mining permits and other point sources were reduced to water quality criterion end of pipe (1.5 mg/L iron) in subwatersheds where the model indicated non-attainment.

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. Initially, 2.5 percent of the subwatershed area was allocated for CSGP activity in each subwatershed.

After executing the above provisions, model output was evaluated to determine the criterion attainment status at all subwatershed pour points. Where the model indicated non-attainment with the total iron criterion, further reductions to iron loading from land disturbing sources were made on a subwatershed basis depending on land cover, concentration of sediment associated iron, and dominant disturbances. The iron loads from the dominant source were incrementally reduced below the associated 100 mg/l TSS threshold, but not less than 90 mg/l TSS.

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, MS4 facilities, 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, except those where reclamation has progressed to the point where existing limitations are based upon the Post-Mining Area provisions of Subpart E of 40 CFR 434. The WLAs for active mining operations consider the functional characteristics of the permitted outlets (i.e. precipitation driven, pumped continuous flow, gravity continuous flow, commingled) and their respective impacts at high and low flow conditions.

The federal effluent guidelines for the coal mining point source category (40 CFR 434) provide various alternative limitations for discharges caused by precipitation. Under those technology-based guidelines, effluent limitations for total iron and TSS may be replaced with an alternative limitation for “settleable solids” during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs and future growth provisions of the iron TMDLs preclude the applicability of the “alternative precipitation” iron provisions of 40 CFR 434. Also, the established relationship between iron and TSS requires continuous control of TSS concentration in permitted discharges to achieve iron WLAs. As such, the "alternative precipitation" TSS provisions of 40 CFR 434 should not be applied to point source discharges associated with the iron TMDLs.

In certain instances, prescribed WLAs may be less stringent than existing effluent limitations. However, the TMDLs are not intended to relax effluent limitations that were developed under the alternative basis of 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.

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

Bond Forfeiture Sites

WLAs were established for bond forfeiture sites. Baseline iron conditions were generally established under the same protocols used for active mining operations. In instances where effluent characteristics were not directly available, baseline conditions were established at the technology based effluent limits of 40 CFR 434 and reduced as necessary to attain the TMDL endpoints.

Municipal Separate Storm Sewer System (MS4)

USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. In the TMDL watersheds of the Upper Kanawha there are two designated MS4 entities listed below. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe WLAs. Individual registration numbers for the MS4 entities are as follows:

- City of Charleston WVR030006
- West Virginia Division of Highways WVR030004

In the majority of the subwatersheds where MS4 entities have areas of responsibility, the urban, residential and road landuses strongly influence bank erosion. As such, portions of the baseline and allocated loads associated with bank erosion are included in the MS4 WLAs. The subdivision of the bank erosion component between point and nonpoint sources, and where applicable, between multiple MS4 entities, is proportional to their respective drainage areas within each subwatershed. Model representation of bank erosion is accomplished through consideration of a number of inputs including slope, soils, imperviousness, and the stability of existing streambanks. Bank erosion loadings are most strongly influenced by upland impervious area and bank stability. The decision to include bank erosion in the MS4 WLAs results from the predominance of urban/residential/road landuses and impacts in MS4 areas. WVDEP's assumption is that upland management practices will be implemented under the MS4 permit to directly address impacts from bank erosion. However, even if the implementation of stormwater controls on uplands is maximized, and the volume and intensity of stormwater runoff are minimized, the existing degraded stability of streambanks may continue to accelerate erosion. The erosion of unstable streambanks is a nonpoint source of sediment that is included in the MS4 allocations. Natural attenuation of legacy impacts cannot be expected in the short term, but may be accelerated by bank stabilization projects. The inclusion of the bank erosion load component in the WLAs of MS4 entities is not intended to prohibit or discourage cooperative bank stabilization projects between MS4 entities and WVDEP's Nonpoint Source Program, or to prohibit the use of Section 319 funding as a component of those projects.

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. In certain areas, the existing level of activity under the CSGP does not conform to the subwatershed allocations. In these instances 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:

- AML: loading from abandoned mine lands, including loads from highwalls, deep mine discharges and seeps
- 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 in non-MS4 areas
- Background and other nonpoint sources: loading from undisturbed forest and grasslands (loadings associated with this category were represented but not reduced)

8.7.2 Dissolved Aluminum and pH TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the dissolved aluminum and/or pH impaired streams of the Upper Kanawha River Watershed. Low pH and metal acidity (especially from iron and aluminum) from the upland and/or stream adjacent acidic sources (AML, seeps, etc.) could result in considerably low instream pH and high instream dissolved aluminum concentration. As general steps of acidity/metal loading reduction processes, substantive sources (e.g., seeps) of total iron were reduced at first as described in **Section 8.7.1** because, depending on stream's buffering capacity, existing instream dissolved iron concentrations could significantly reduce pH. Once the model results indicated the achievement of the iron criterion, dissolved aluminum and pH model results were evaluated under the reduced iron loadings condition. If model results predicted non-attainment of the pH and dissolved aluminum criteria, additional load reductions were made to total aluminum source water discharges along with modifications of pH. The following methodology was used to predict necessary alkalinity additions and total aluminum reductions in the model simulation:

- Multiple regressions derived from the observed metal data collected above pH 6.5 in pre-TMDL monitoring were used to estimate realistic dissolved aluminum concentrations associated with the improved source water pH and reduced total aluminum conditions.
- Once the improved pH and the reduced total aluminum concentrations (particulate and dissolved) were determined, the required alkalinity necessary to achieve the improved water quality conditions were quantified and added to the source water discharges. These additions were made throughout the modeling period to simulate instream water quality conditions based on the improved source water loads.
- If the model predicted non-attainment, further total aluminum reduction and/or alkalinity additions were made to source water discharges on a subwatershed basis to the extent necessary to attain dissolved aluminum and pH water quality criteria instream.

All sources were represented and provided allocations in terms of the total aluminum loadings that are necessary to attain the dissolved aluminum water quality criteria. The reductions of total aluminum loading from land-based sources, coupled with the mitigation of acid loading by alkalinity addition, are predicted to result in attainment of both dissolved aluminum and pH water quality criteria at all evaluated locations in the pH and dissolved aluminum impaired streams.

Wasteload Allocations (WLAs)

WLAs were developed for active mining point source discharges regulated by NPDES permits effluent limitations. The WLAs for active mining operations consider the functional characteristics of the permitted outlets (i.e. precipitation driven, pumped continuous flow, gravity continuous flow, commingled) and their respective impacts at high- and low-flow conditions.

Baseline loadings from non-mining point sources, including facilities registered under the MS4, and Construction Stormwater General Permits were represented to properly account for aluminum associated with sediment sources. Negligible amounts of acidity or dissolved aluminum are attributed to these sources, thus no reductions were necessary and aluminum-specific control actions are not prescribed.

Load Allocations (LAs)

LAs of total aluminum were determined for contributing nonpoint source categories as follows:

- AML: loading from abandoned mine lands, including loads from highwalls, deep mine discharges and seeps
- Other nonpoint sources: loading associated with sediment contributions from barren land, harvested forest, oil and gas well operations, agriculture, undisturbed forest and grasslands, and residential/urban/road landuses were represented but not reduced

Baseline and TMDL load allocations (LAs) include the natural background sources of buffering capacity. The additional acidity reduction (alkalinity addition) for acidic sources to meet instream pH water quality criterion are presented in the TMDL load allocations for the pH impaired streams.

8.7.3 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, MS4s, and 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, including MS4s, 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.

Municipal Separate Storm Sewer System (MS4)

USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. The City of Charleston, and the WVDOH are designated MS4 entities in the subject watersheds. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe WLAs.

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 from non-MS4 areas
- Background and Other Nonpoint Sources — loading associated with wildlife sources from all other landuses (contributions/loadings from wildlife sources were not reduced)

8.7.4 Chloride TMDLs

The top-down methodology was followed to develop the chloride TMDLs and allocate loads to sources. Source allocations were developed for all modeled subwatersheds contributing to the chloride impaired streams in the watershed.

Individual chloride WLAs were developed for the high-volume, pumped discharge, mining NPDES outlets. The pumped discharges dominate receiving stream flow and necessitate WLAs that are based upon the achievement of the chronic aquatic life protection criterion in the discharge.

No other point sources of chloride were identified within the watersheds of chloride impaired streams. Certain land uses generally associated with point sources (ex. registered area under the Construction Stormwater General Permit, precipitation-induced mining outlets) were not classified as chloride point sources because they do not contribute chloride appreciably greater than background. Existing discharges from such sources do not require wasteload allocations pursuant to the chloride TMDLs. Their modeled loadings are contained within the aggregated load allocation for background sources discussed in the following section.

Load Allocations (LAs)

Chloride loadings are represented for multiple nonpoint and background sources and source categories. Exclusive of runoff from urban/residential impervious surfaces, precipitation-induced nonpoint sources are not characterized as chloride sources because they do not contribute chloride significantly greater than expected background. Continuous flow AMD seeps were also found to contribute negligible chloride loadings. The modeled chloride loadings for all “background” sources are contained within the aggregated LA for Background and Other Nonpoint Sources.

Road and impervious surface de-icing activities contribute non-negligible chloride loads to receiving waters and LAs are presented for the urban residential land uses. Reduction was not necessary to attain water quality chloride criteria.

8.7.5 Total Manganese TMDLs

As described previously, the top-down methodology was followed to allocate loads to sources and develop the manganese TMDL. In the watersheds of Horsemill Branch and Sugarcamp Branch, only AMD seeps contribute significant manganese loadings. Reductions of those sources allowed the manganese water quality endpoint to be met. Loadings from other sources were represented but not reduced in the allocation process. Where present, WLAs were developed for bond forfeiture sites and LAs were developed for all other sources.

8.7.6 Selenium TMDLs

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

1. The loading from instream ponds was reduced to water quality criterion end of pipe (5 ug/L selenium).
2. The loading from continuous discharges (including AMD seeps) was reduced to water quality criterion end of pipe.
3. The loading from on bench structures was reduced to water quality criterion end of pipe using a top-down approach in subwatersheds where the model indicated non-attainment.

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 mining related point source discharges. WLAs for active mining operations considered the functional characteristics of the permitted outlets (i.e. precipitation driven, pumped continuous flow, or commingled) and their respective impacts at high and low flow conditions.

Load Allocations (LAs)

LAs were developed for AMD seeps, background sources, and other nonpoint sources. LAs were divided into several landuse categories: undisturbed forest and grasslands; areas disturbed by oil and gas development; and urban, residential, or otherwise developed areas. Loadings associated with AMD seeps were represented as continuous discharges in the model, and were reduced to the water quality criterion. Loadings associated with background and other nonpoint sources were represented but not reduced.

8.7.7 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.

8.7.8 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, AMD seeps (categorized as nonpoint sources but represented as continuous flow discharges) often have an associated low-flow critical condition, particularly where such sources are located on small receiving waters.

In chloride-impaired waters, pumped point source discharges associated with mining activity were determined to be the causative source of impairments. Because of the minimal dilution available at 7Q10, this low-flow condition was determined critical. Similar low-flow conditions are associated with selenium.

8.7.9 TMDL Presentation

The TMDLs for all impairments are shown in **Section 9** of this report. The TMDLs for iron chloride, manganese, selenium and aluminum and are presented as average daily loads, in pounds per day. The dissolved aluminum TMDLs are based on a dissolved aluminum TMDL endpoint; however, components and allocations are provided in the form of total metal. The pH TMDLs are presented as average daily loads of net acidity, 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, chloride, manganese, aluminum, and selenium WLAs for active mining operations and bond forfeitures 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.

The WLAs for precipitation induced MS4 discharges are presented in terms of average annual daily loads (Fe) or average number of colonies per year (FC) and the percent pollutant reduction from baseline conditions. The "MS4 WLA Summary" tabs of the allocation spreadsheets contain the operable allocations expressed as percent reductions. The "MS4 WLA Detailed" tabs on the allocation spreadsheets provide drainage areas of various land use types represented in the baseline condition (without BMPs) for each MS4 entity at the subwatershed scale. That information is intended to assist registrants under the MS4 General Permit in describing the management practices to be employed to achieve prescribed allocations.

9.0 TMDL RESULTS

Table 9-1. Dissolved aluminum TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	WLA (lbs/day)	Margin of Safety (lbs/day)	Dis Al TMDL (lbs/day)
Kellys Creek	KU-33-B	Horsemill Branch	13.85	2.78	0.88	17.51
Kellys Creek	KU-33-B-1	UNT/Horsemill Branch RM 0.50	0.50	0.58	0.06	1.14
Kellys Creek	KU-33-B-2	UNT/Horsemill Branch RM 0.83	1.10	2.20	0.17	3.47
Kellys Creek	KU-33-B-4	UNT/Horsemill Branch RM 1.58	2.39	0.00	0.13	2.52
Cedar Creek	KU-39-AK	Cedar Creek	8.56	0.50	0.48	9.54

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

Table 9-2. 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)
Kellys Creek	KU-33	Kellys Creek	98.73	288.93	20.40	408.06
Kellys Creek	KU-33-B	Horsemill Branch	3.00	0.91	0.21	4.11
Kellys Creek	KU-33-B-2	UNT/Horsemill Branch RM 0.83	0.47	0.56	0.05	1.09
Kellys Creek	KU-33-B-3	UNT/Horsemill Branch RM 1.21	0.21	0.01	0.01	0.23
Kellys Creek	KU-33-B-4	UNT/Horsemill Branch RM 1.58	0.35	0.04	0.02	0.42
Kellys Creek	KU-33-D-1	UNT/Sugarcamp Branch RM 0.58	0.36	0.61	0.05	1.02
Kellys Creek	KU-33-L	Fourmile Fork	0.89	0.09	0.05	1.03
Kellys Creek	KU-33-M	Fivemile Fork	3.62	32.72	1.91	38.26
Kellys Creek	KU-33-M-1	UNT/Fivemile Fork RM 1.29	0.34	0.03	0.02	0.39
Kellys Creek	KU-33-N	Left Fork/Kellys Creek	12.10	135.22	7.75	155.07
Kellys Creek	KU-33-N-2	Slabcamp Hollow	1.72	1.00	0.14	2.86
Kellys Creek	KU-33-N-5	UNT/Left Fork RM 2.23/Kellys Creek	2.45	32.80	1.86	37.10

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Kellys Creek	KU-33-N-5-A	UNT/UNT RM 0.51/Left Fork RM 2.23/Kellys Creek	1.06	32.71	1.78	35.55
Kellys Creek	KU-33-O	Hurricane Fork	8.03	117.25	6.59	131.87
Kellys Creek	KU-33-O-1	UNT/Hurricane Fork RM 2.11	0.60	0.07	0.04	0.71
Kellys Creek	KU-33-O-2	Rich Hollow	0.43	3.00	0.18	3.61
Mossy Creek	KU-39-BM	Mossy Creek	27.05	1.72	1.51	30.28
Mossy Creek	KU-39-BM-10	Toney Creek	5.98	0.38	0.33	6.69
Mossy Creek	KU-39-BM-11	Painter Creek	1.98	0.19	0.11	2.29
Mossy Creek	KU-39-BM-7	Long Branch	0.78	0.06	0.04	0.88
Mossy Creek	KU-39-BM-8	Lick Fork	5.80	0.52	0.33	6.65
North Sand Branch	KU-39-DG-2	North Sand Branch	16.12	6.13	1.17	23.42
North Sand Branch	KU-39-DG-2-A	Maple Fork	6.76	0.28	0.37	7.41
North Sand Branch	KU-39-DG-2-A-2	UNT/Maple Fork RM 1.17	0.77	0.02	0.04	0.83
North Sand Branch	KU-39-DG-2-A-3	UNT/Maple Fork RM 1.91	1.12	0.03	0.06	1.21
North Sand Branch	KU-39-DG-2-E	UNT/North Sand Branch RM 2.56	0.47	0.02	0.03	0.51
Hughes Creek	KU-42	Hughes Creek	16.79	73.04	4.73	94.56
Hughes Creek	KU-42-J	Martin Hollow	0.05	7.20	0.38	7.63
Hughes Creek	KU-42-K	Barn Hollow	0.01	2.87	0.15	3.03
Hughes Creek	KU-42-L	Graveyard Hollow	0.30	7.45	0.41	8.15
Hughes Creek	KU-42-N	Shadrick Fork	2.88	2.08	0.26	5.23
Hughes Creek	KU-42-N-3	Dry Lick Hollow	0.56	0.87	0.08	1.50
Hughes Creek	KU-42-N-3-A	UNT/Dry Lick Hollow RM 0.24	0.33	0.45	0.04	0.82
Hughes Creek	KU-42-Q	Sixmile Hollow	0.06	9.22	0.49	9.77
Lower Donnally Branch	KU-5	Lower Donnally Branch	0.55	2.06	0.14	2.75
Bullpush Fork	KU-55-F	Bullpush Fork	2.99	54.97	3.05	61.01
Bullpush Fork	KU-55-F-3	Burnett Hollow	0.01	6.72	0.35	7.09

UNT = unnamed tributary; RM = river mile.

Table 9-3. Chloride TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Chloride TMDL (lbs/day)
New West Hollow	KU-19-R-1	New West Hollow	163.39	322.76	25.59	511.74
Longbottom Creek	KU-26-N	Longbottom Creek	425.32	4706.12	270.08	5401.51
Longbottom Creek	KU-26-N-5	Laurel Fork/Longbottom Creek	39.54	2768.30	147.78	2955.63
Coal Fork	KU-26-U	Coal Fork	994.46	10221.16	590.30	11805.92
Coal Fork	KU-26-U-18	UNT/Coal Fork RM 4.63	231.12	1278.63	79.46	1589.21

UNT = unnamed tributary; RM = river mile.

Table 9-4. Manganese TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Manganese TMDL (lbs/day)
Kellys Creek	KU-33-B	Horsemill Branch	3.15	3.68	0.36	7.19
Kellys Creek	KU-33-D	Sugarcamp Branch	2.16	0.84	0.16	3.16

UNT = unnamed tributary; RM = river mile.

Table 9-5. Selenium TMDLs

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Selenium TMDL (lbs/day)
Pointlick Fork	KU-6-F	Pointlick Fork	0.0197	0.0783	0.0052	0.1032
Pointlick Fork	KU-6-F-4	UNT/Pointlick Fork RM 2.26	0.0000	0.0168	0.0009	0.0176
Rattlesnake Hollow	KU-6-N	Rattlesnake Hollow	0.0036	0.0456	0.0026	0.0518
New West Hollow	KU-19-R-1	New West Hollow	0.0013	0.0406	0.0022	0.0440
Wet Branch	KU-26-E	Wet Branch	0.0117	0.1975	0.0110	0.2202
Coal Fork	KU-26-U	Coal Fork	0.0812	0.3733	0.0239	0.4784
Coal Fork	KU-26-U-7	Laurel Fork	0.0297	0.0591	0.0047	0.0935

TMDL Watershed	Stream Code	Stream Name	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Selenium TMDL (lbs/day)
Coal Fork	KU-26-U-7-E	Left Fork/Laurel Fork	0.0058	0.0521	0.0030	0.0610
Coal Fork	KU-26-U-7-E-4	UNT/Left Fork RM 1.99/Laurel Fork	0.0005	0.0029	0.0002	0.0036
Coal Fork	KU-26-U-18	UNT/Coal Fork RM 4.63	0.0000	0.0750	0.0039	0.0790
Toms Fork	KU-26-AC	Toms Fork	0.0000	0.0765	0.0040	0.0805
Tenmile Fork	KU-26-AD	Tenmile Fork	0.0535	0.1068	0.0084	0.1687
Tenmile Fork	KU-26-AD-1	UNT/Tenmile Fork RM 1.22	0.0074	0.0000	0.0004	0.0078
Tenmile Fork	KU-26-AD-9	UNT/Tenmile Fork RM 3.98	0.0020	0.0248	0.0014	0.0282
Tenmile Fork	KU-26-AD-10	UNT/Tenmile Fork RM 4.17	0.0026	0.0051	0.0004	0.0081
Kellys Creek	KU-33-C	Frozen Branch	0.0078	0.0000	0.0004	0.0082
Kellys Creek	KU-33-O	Hurricane Fork	0.0279	0.3898	0.0220	0.4396
Hughes Creek	KU-42	Hughes Creek	0.0853	0.2220	0.0162	0.3235
Hughes Creek	KU-42-K	Barn Hollow	0.0000	0.0095	0.0005	0.0100
Hughes Creek	KU-42-L	Graveyard Hollow	0.0006	0.0246	0.0013	0.0266
Hughes Creek	KU-42-Q	Sixmile Hollow	0.0000	0.0300	0.0016	0.0315
Bullpush Fork	KU-55-F	Bullpush Fork	0.0117	0.1505	0.0085	0.1707
Bullpush Fork	KU-55-F-5	Riffle Hollow	0.0027	0.0093	0.0006	0.0127
Fourmile Fork	KU-55-P	Fourmile Fork	0.0035	0.0457	0.0026	0.0518

UNT = unnamed tributary; RM = river mile.

Table 9-6. pH TMDLs

TMDL Watershed	Stream Code	Stream Name	LA Average Daily Net Acidity Load (lbs as CaCO3/day)	WLA Average Daily Net Acidity Load (lbs as CaCO3/day)	MOS Average Daily Net Acidity Load (lbs as CaCO3/day)	TMDL Average Daily Net Acidity Load (lbs as CaCO3/day)
Kellys Creek	KU-33-B	Horsemill Branch	-574.27	N/A	-30.22	-604.49
Kellys Creek	KU-33-B-1	UNT/Horsemill Branch RM 0.50	-8.05	N/A	-0.42	-8.47
Kellys Creek	KU-33-B-2	UNT/Horsemill Branch RM 0.83	-124.26	N/A	-6.54	-130.80
Kellys Creek	KU-33-B-4	UNT/Horsemill Branch RM 1.58	-12.58	N/A	-0.66	-13.24

TMDL Watershed	Stream Code	Stream Name	LA Average Daily Net Acidity Load (lbs as CaCO3/day)	WLA Average Daily Net Acidity Load (lbs as CaCO3/day)	MOS Average Daily Net Acidity Load (lbs as CaCO3/day)	TMDL Average Daily Net Acidity Load (lbs as CaCO3/day)
Kellys Creek	KU-33-D	Sugarcamp Branch	-74.90	N/A	-3.94	-78.84
Cedar Creek	KU-39-AK	Cedar Creek	-242.20	N/A	-12.75	-254.95

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

Table 9-7. 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)
Mission Hollow (Venable Branch)	WV-KU-3	Mission Hollow (Venable Branch)	3.51E+09	1.65E+10	1.05E+09	2.11E+10
Mission Hollow (Venable Branch)	WV-KU-3-A	Chappel Hollow (Chappel Branch)	2.16E+09	5.02E+09	3.78E+08	7.56E+09
Lower Donnally Branch	WV-KU-5	Lower Donnally Branch	2.17E+09	2.27E+09	2.33E+08	4.67E+09
Georges Creek	WV-KU-8	Georges Creek	1.43E+10	3.52E+08	7.70E+08	1.54E+10
Kellys Creek	WV-KU-33	Kellys Creek	1.38E+11	4.97E+07	7.28E+09	1.46E+11
Kellys Creek	WV-KU-33-B	Horsemill Branch	9.85E+09	0.00E+00	5.18E+08	1.04E+10
Kellys Creek	WV-KU-33-C	Frozen Branch	4.00E+09	0.00E+00	2.10E+08	4.21E+09
Kellys Creek	WV-KU-33-O	Hurricane Fork	1.79E+10	3.48E+07	9.42E+08	1.88E+10
Kellys Creek	WV-KU-33-P	Goose Hollow	7.37E+09	0.00E+00	3.88E+08	7.76E+09
Mossy Creek	WV-KU-39-BM	Mossy Creek	6.62E+10	2.72E+07	3.49E+09	6.98E+10
Mossy Creek	WV-KU-39-BM-7	Long Branch	2.29E+09	0.00E+00	1.20E+08	2.41E+09
North Sand Branch	WV-KU-39-DG-2	North Sand Branch	4.30E+10	7.57E+09	2.66E+09	5.33E+10
North Sand Branch	WV-KU-39-DG-2-A	Maple Fork	2.22E+10	2.80E+06	1.17E+09	2.34E+10
Bullpush Fork	WV-KU-55-F-3	Burnett Hollow	2.50E+09	0.00E+00	1.31E+08	2.63E+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, Aluminum, Manganese, and pH

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 metals and pH 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. Because aluminum water quality criteria are in dissolved form, a dissolved/total pollutant translator is needed to determine effluent limitations. A new facility could be permitted in the aluminum impaired watersheds if total aluminum effluent limitations are based on the dissolved aluminum, acute, aquatic life protection criterion and a dissolved/total aluminum translation equal to 1.0. As described previously, 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.

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

- 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.

- Lands associated with the MS4, Construction Stormwater and Multi-sector Stormwater General Permits are not significant or causative sources of dissolved aluminum, manganese, or pH or impairments. New registrations may be permitted in the watersheds of impaired streams without specific wasteload allocations for those parameters.

- 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.

10.3 Selenium and Chloride

Specific future growth allocations are not prescribed. The absence of specific future growth allocations does not prohibit new discharges in the watersheds of streams for which selenium and chloride TMDLs have been developed. A new discharge may be permitted anywhere in the watershed, provided that effluent limitations are based on the achievement of water quality standards at end-of-pipe.

11.0 PUBLIC PARTICIPATION

11.1 Public Meetings

An informational public meeting was held on August 18, 2011 at DEP Headquarters (601 57th Street SE) in Charleston, WV. The 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 project status update meeting was held at DEP Headquarters on August 12, 2014 to provide the public with the projected timeframe for a public release and preliminary findings. A public meeting will held to present the draft TMDLs on October 22, 2014 at WVDEP Headquarters in the Coopers Rock Room, Charleston, WV starting at 6:30 PM. The meeting will provide information to stakeholders 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 9, 2014. Interested parties were invited to submit comments during the public comment period, which began on October 9, 2014 and ended on November 10, 2014. The electronic documents were also posted on the WVDEP's internet site at www.dep.wv.gov/tmdl.

11.3 Response Summary

The WVDEP received written comments on the draft TMDLs from Appalachian Mountain Advocates and the West Virginia Coal Association. Comments have been compiled and responded to in this response summary. Comments and comment summaries are in boldface and italic. Agency responses appear in plain text.

A commenter stated that the report discussion of biological impairment and stressor identification violates the Senate Bill 562 mandate to develop new rules to interpret the narrative water quality criterion related to biological impairment and recommended removal of the discussion from the TMDL report.

WVDEP interprets Senate Bill 562 to require the agency to develop a new methodology for assessing the narrative criterion at 47 CSR 2 §3.2.i for legislative approval. WVDEP has not developed biological impairment TMDLs in this project. Streams for which biological stressor identifications were performed are contained on the West Virginia 2012 Section 303(d) list. The evaluations determined the causative stressors associated with the benthic macroinvertebrate impacts upon which the listings were based. As stated in the draft report, the stressor identification results are presented for consideration in future 303(d) decision making. This work may allow future removal of the listed biological impairments displayed in Table 4-1 because implementation of the TMDLs developed pursuant to numeric water quality criteria has been determined to address all of the significant stressors.

A commenter stated that the project does not meet the requirements of the Clean Water Act as prescribed by USEPA regulations at 40 CFR 130.7(c)(1)(ii) because a TMDL for each stream and impairment is not included. The commenter's concern lies with the lack of TMDL development for biological impairments for which ionic toxicity has been determined to be a significant stressor. The commenter stated that USEPA cannot approve the pending TMDLs and that USEPA must develop the TMDLs that DEP has failed to develop.

WVDEP agrees that TMDLs must be developed for all 303(d) listed impairments but disagrees that the presented TMDLs are made invalid by the omission of TMDLs for the subject biological impairments. Additionally, WVDEP does not interpret 40 CFR 130.7(c)(1)(ii) as mandating concurrent TMDL development for all impairments.

Prior to the passage of SB 562, WVDEP and USEPA were implementing a TMDL development plan for "ionic stress" biological impairments. TMDL development has been paused with the passage of SB 562 because it potentially changes the basis for determining impairment and requires a new assessment methodology to be presented to the West Virginia Legislature prior to its implementation.

The Clean Water Act and its implementing regulations do not prescribe an exact time frame between initial 303(d) listing and TMDL development. Biological impairments for which TMDLs have not been developed, including, but not limited to those in this project will remain on the 303(d) list. WVDEP recognizes the long time periods of 303(d) listing for some of the impairments and will develop TMDLs as soon as practicable after the accomplishing SB 562 requirements.

A commenter suggested that data available from NPDES mining permittees were not considered and should have been used in model calibration. The commenter specifically questioned the iron model calibration for Slabcamp Hollow (KU-33-N-2). The commenter stated that mining NPDES permits with outlets in the Slabcamp Hollow watershed have instream monitoring data that if used would change model calibration.

WVDEP implements two provisions that utilize permittee-generated data in model calibration when it is available. WVDEP assesses Discharge Monitoring Report (DMR) results for permitted outlets in the project watershed to develop average effluent concentrations to apply to mining outlets in calibration. The concentrations applied to mining point sources in calibration are significantly lower than existing iron effluent limitations. However, determinations of impairment result from evaluation of the baseline model scenario in which permitted sources are represented at existing effluent limitations. In each project, WVDEP also requests permittees to provide raw stream monitoring data (the summary data reported under the permit cannot be used in calibration) to supplement agency data used in model set up and calibration. The stream data associated with the referenced permits were specifically requested, but not provided.

The Slabcamp Hollow iron calibration is reasonable. Modeled concentrations greater than instantaneous observations are not an absolute indication of poor model calibration because the limited observations likely do not capture the critical iron conditions that routinely occur due to significant precipitation events present in the design hydrology.

A commenter stated the TMDLs should not reduce existing technology-based permit effluent limitations based upon faulty modeling.

WVDEP does not agree that the modeling supporting this TMDL project is faulty. Models have been carefully configured and calibrated. The models allow evaluation of attainment of the specific magnitude, exposure duration and exceedance frequency components of water quality criteria under loadings from existing point and nonpoint sources. The baseline condition model scenario represents all permitted discharges at existing permit limits. Allocation methodologies in the report describe the order and magnitude of allocations. Wasteload allocations representing reductions from existing point sources are made only if the model demonstrates that they are necessary after load reductions from other sources. In this project, wasteload allocations that prescribe pollutant reductions from sources subject to existing technology-based requirements were made in approximately 40% of applicable scenarios.

A commenter stated that the report discussion of aluminum translators on page 52 misrepresents their purpose and impact on compliance with water quality standards and appears to be superfluous.

The referenced discussion is not superfluous as it describes considerations for configuring the baseline model scenario. For some permits and pollutant parameters, existing permit limitations are used in the baseline scenario. Alternative approaches are used for other pollutants and permit types. Existing total aluminum effluent limitations in mining NPDES permits are not used in the baseline scenario because existing permits often impose total effluent limitations equal to the value of the dissolved criterion (i.e dissolved: total translator =1) while also authorizing the permittee's pursuit of a translator study that may support future relaxation of the stringent existing total aluminum limits. If existing limits are included in the baseline scenario, then they would remain in the allocation scenario thereby negating the potential for alternative total aluminum limitations that could be supported by the speciation determined in the TMDL study. In this and past TMDL projects, WVDEP uses the 95th percentile of maximum effluent values reported on Discharge Monitoring Reports as the baseline total aluminum concentration for all permitted outlets in the project area. Reductions to baseline concentrations are made only if determined in allocation to be necessary to achieve dissolved aluminum water quality criteria. In this project, wasteload allocations for existing sources are provided at the baseline concentration that is less stringent than existing limitations.

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. Permits for existing nonmining facilities in the Upper Kanawha River Watershed will be reissued beginning in July 2015 and the reissuance of mining permits will begin January 1, 2016.

In regard to chloride TMDLs, the causative sources of impairment in some instances are NPDES permitted facilities that are not achieving currently prescribed effluent limitations. WVDEP will implement TMDLs through regulatory actions necessary to compel compliance with NPDES permit limits.

The MS4 permitting program is being implemented to address stormwater impacts from urbanized areas. West Virginia has developed a General NPDES Permit for MS4 discharges (WV0110625). All of the cities with MS4 permits in subject waters of this report, plus the West Virginia Department of Transportation, WVDOH are registered under the permit. The permit is based upon national guidance and is non-traditional in that it does not contain numeric effluent limitations, but instead proposes Best Management Practices that must be implemented. At permit reissuance, registrants will be expected to specifically describe management practices intended for implementation that will achiever the WLAs prescribed in applicable TMDLs. A mechanism to assess the effectiveness of the BMPs in achieving the WLAs must also be provided. The TMDLs are not intended to mandate imposition of numerical effluent limitations and/or discharge monitoring requirements for MS4s. Reasonable alternative methodologies may be employed for targeting and assessing BMP effectiveness in relation to prescribed WLAs. The "MS4 WLA Detailed" tabs on the allocation spreadsheets WLAs provide drainage areas of various land use types represented in the baseline condition (without BMPs) for each MS4 entity at the subwatershed scale. Through consideration of anticipated removal efficiencies of selected BMPs and their areas of application, it is anticipated that this information will allow MS4 permittees to make meaningful predictions of performance under the permit.

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 Western Nonpoint Source Program Basin Coordinator, Tomi Bergstrom (Tomi.M.Bergstrom@wv.gov).

There are several active citizen-based watershed associations representing tributaries in the Upper Kanawha River Watershed (e.g., North Sand Branch, Upper Paint Creek, Loup Creek, Cabin Creek, Morris Creek, Lower Paint Creek, Kellys Creek, Campbells Creek). 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.

12.4 AML Projects

Within WVDEP, the Office of Abandoned Mine Lands and Reclamation (AML&R) manages the reclamation of lands and waters affected by mining prior to the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977. Title IV of the act addresses adverse impacts associated with abandoned mine lands. Funding for reclamation activities is derived from fees placed on coal mined which are placed in a fund and annually distributed to state and tribal agencies.

Various abandoned mine land reclamation activities are addressed by the program as necessary to protect public health, safety, and property from past coal mining and to enhance the environment through the reclamation and restoration of land and water resources. Portions of the annual grant are also used to repair or replace drinking water supplies that were substantially damaged by pre-SMCRA coal mining and to administer the program.

In December 2006, Congress passed legislation amending SMCRA and the Title IV program and in November 2008, the Office of Surface Mining finalized rules to implement the amendments. After an initial ramp-up period, AML&R will realize significant increases in its annual reclamation funding and the flexibility to direct a larger portion of those funds to address water resource impacts from abandoned mine drainage (AMD).

Title IV now contains a “30% AMD set-aside” provision that allows a state to use up to 30% of its annual grant to address AMD problems. In determining the amount of money to set-aside, AML&R must balance its multiple areas of responsibility under the program and ensure that funding is available for perpetual operation and maintenance of treatment facilities. In regard to water resource impacts, project prioritization will consider treatment practicability and sustainability and will be accomplished under a methodology that provides for the efficient application of funds to maximize restoration of fisheries across AML impacted areas of the State.

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.

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