July 2014

USEPA Approved Report

# Total Maximum Daily Loads for the West Fork 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*

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## ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

| | |
|---|---|
| 7Q10 | 7-day, 10-year low flow |
| AD | Acid Deposition |
| AMD | acid mine drainage |
| AML | abandoned mine land |
| AML&R | [WVDEP] Office of Abandoned Mine Lands & Reclamation |
| BMP | best management practice |
| BOD | biochemical oxygen demand |
| BPH | [West Virginia] Bureau for Public Health |
| CFR | Code of Federal Regulations |
| CSGP | Construction Stormwater General Permit |
| CSO | combined sewer overflow |
| CSR | Code of State Rules |
| DEM | Digital Elevation Model |
| DMR | [WVDEP] Division of Mining and Reclamation |

| | |
|---|---|
| DNR | West Virginia Division of Natural Resources |
| DO | dissolved oxygen |
| DWWM | [WVDEP] Division of Water and Waste Management |
| ERIS | Environmental Resources Information System |
| GIS | geographic information system |
| gpd | gallons per day |
| GPS | global positioning system |
| HAU | home aeration unit |
| LA | load allocation |
| µg/L | micrograms per liter |
| MDAS | Mining Data Analysis System |
| mg/L | milligrams per liter |
| mL | milliliter |
| MF | membrane filter counts per test |
| MPN | most probable number |
| MOS | margin of safety |
| MRLC | Multi-Resolution Land Characteristics Consortium |
| MS4 | Municipal Separate Storm Sewer System |
| NED | National Elevation Dataset |
| NLCD | National Land Cover Dataset |
| NOAA-NCDC | National Oceanic and Atmospheric Administration, National Climatic Data Center |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resources Conservation Service |
| OOG | [WVDEP] Office of Oil and Gas |
| POTW | publicly owned treatment works |
| SI | stressor identification |
| SMCRA | Surface Mining Control and Reclamation Act |
| SRF | State Revolving Fund |
| SSO | sanitary sewer overflow |
| STATSGO | State Soil Geographic database |
| TMDL | Total Maximum Daily Load |
| TSS | total suspended solids |
| USDA | U.S. Department of Agriculture |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| UNT | unnamed tributary |
| WLA | wasteload allocation |
| WVDEP | West Virginia Department of Environmental Protection |
| WVDOH | West Virginia Division of Highways |
| WVSCI | West Virginia Stream Condition Index |
| WVU | West Virginia University |

***Watershed***

A general term used to describe a drainage area within the boundary of a United States Geologic Survey's 8-digit hydrologic unit code. In this report, the West Fork River and its drainage area begins at the confluence of two small headwater tributaries known as Straight Fork and Whites Camp Fork near the community of Rock Cave in southwestern Upshur County. Stonewall Jackson Lake is located in the headwaters of the West Fork River. However, Stonewall Jackson Lake and nearby Stonecoal Lake were not considered in this modeling effort because they are not impaired waterbodies. It then flows north through Lewis, Harrison, and Marion Counties to the City of Fairmont where it joins the Tygart Valley River to form the Monongahela River. This 103 mile long river is referred to as the West Fork River. Throughout this report, the West Fork River watershed refers to the tributary streams that ultimately drain to the West Fork 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 West Fork 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 305 impaired streams contained within 52 TMDL watersheds in the West Fork 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 52 TMDL watersheds have been subdivided into 700 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

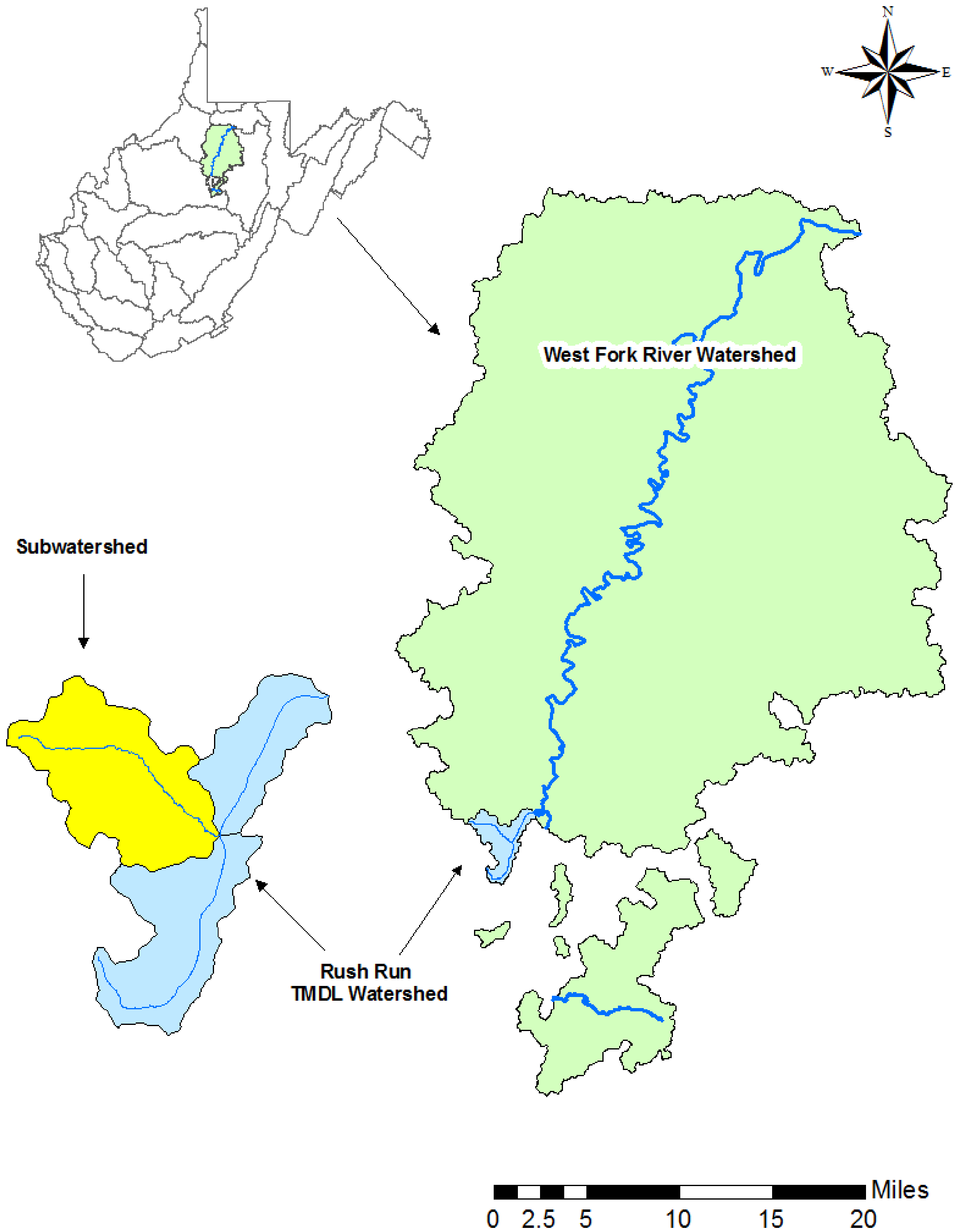



**Figure I-1.** Examples of a watershed, TMDL watershed, and subwatershed

# EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 305 impaired streams in the West Fork watershed which encompasses all the land area draining from the West Fork's headwaters down to its confluence with the Tygart Valley River.

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.

The subject impaired streams are included on West Virginia's 2012 Section 303(d) List. Documented impairments are related to numeric water quality criteria for total iron, dissolved aluminum, 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. The original scope of work for this project included 52 biological impairments for which TMDLs were to be developed and the potential need for biological TMDL development for additional 86 streams. EPA's final action on the 2012 Section 303(d) list added an additional 37 biologically impaired streams that were not included in earlier 303(d) lists.

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, all of the 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 **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 52 TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these 52 TMDL watersheds were further divided into 700 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, 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 systems, direct discharges of untreated sewage, and precipitation runoff from agricultural and residential areas are significant nonpoint sources of fecal coliform bacteria. Point sources of fecal coliform bacteria include the effluents of sewage treatment facilities, collection system overflows (CSOs) from publicly owned treatment works (POTWs), and stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s).

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, construction sites and non-mining industrial facilities. The presence of individual source categories and their relative significance 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.

Most often, chloride impairments in the watershed are caused by certain point source discharges associated with mining activities. Impaired streams Bingamon Creek (WV-MW-14), Harris Fork (WV-MW-14-V), and UNT/Harris Fork RM 0.65 (WV-MW-14-V-2) are under the influence of a large pumped discharge point source that comprises most of the stream flow in UNT/Harris Fork RM 0.65.

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 and 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 were 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 2002, USEPA, with support from WVDEP, developed the metals and pH TMDLs for the West Fork River Watershed (USEPA, 2002). In this project, all streams/impairments for which TMDLs were developed in 2002 have been re-evaluated and new TMDLs, consistent with currently effective water quality criteria, are presented for all identified impairments. Upon approval, all of the TMDLs presented herein shall supersede those developed previously. Re-evaluation also determined that certain impairments for which TMDLs were developed in 2002 are no longer effective due to West Virginia water quality standard revisions and new water quality monitoring. All total aluminum TMDLs developed in 2002 are not effective because of water quality criteria revision from total to dissolved. All such TMDLs are no longer effective.

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 10** 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 West Fork 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 10** 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 2013 TMDLs should be pursued in Hydrologic Group E, which includes the West Fork 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 2002, USEPA, with support from WVDEP, developed the metals and pH TMDLs for the West Fork River Watershed (USEPA, 2002). Significant aluminum and manganese water quality criterion revisions have been enacted since USEPA approval of this current (2013) TMDL project rendering the existing TMDLs obsolete. The form of the aluminum criteria was changed from total to dissolved and the chronic criterion value for warmwater fisheries was revised. The manganese water quality standard revision now limits applicability of the criterion to five mile stream segments upstream of existing public water supplies. The goal for this project is to produce TMDLs for the West Fork River Watershed that are consistent with effective water quality criteria. All streams/impairments for which TMDLs were developed in 2002 have been re-evaluated.

Upon approval, the TMDLs presented herein shall supersede those developed previously. All total aluminum TMDLs developed for 99 streams in 2002 are no longer effective because of the criteria revisions. However, new dissolved aluminum TMDLs are presented for 4 of the 99 original streams. The remaining 95 streams for which total aluminum TMDLs were developed in 2002 attain the dissolved aluminum criterion. Newly identified dissolved aluminum impairments are also addressed. Previously developed total manganese TMDLs are no longer effective in all of the original 99 TMDL streams, because the manganese criterion is not applicable to those waters. Total iron TMDLs were previously presented for 99 streams. Most of those streams were determined to be impaired with new iron TMDLs presented for them. Six streams (Ward Run, WV-MW-112-F; Big Elk Creek, WV-MW-27-E-14; Fitz Run, WV-MW-112-D; UNT/Booths Creek RM 1.39, WV-MW-5-A; Turkey Run, WV-MW-37-G; Stone Lick, WV-MW-96) were found not to be iron impaired based on new assessments. With respect to previously developed pH TMDLs, certain waters were determined to be attaining criteria. New pH TMDLs are presented for the remaining impaired waters. **Appendix A** of the Technical Report lists the 2002 TMDLs for metals and pH impairments, indicates those for which new TMDLs are developed and where applicable describes previous TMDLs that are no longer effective, and indicates those streams for which new TMDLs are presented.

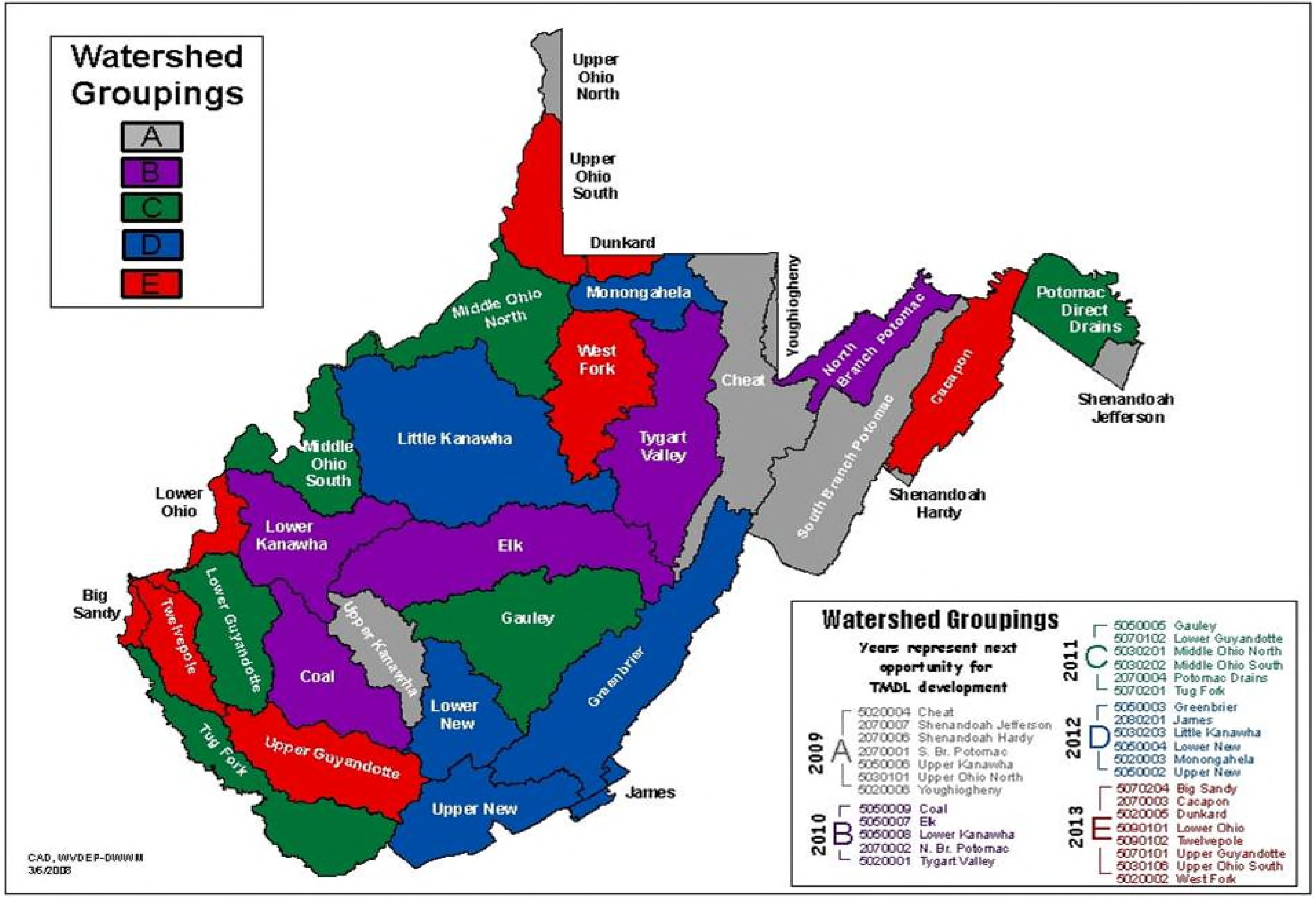



**Figure 2-1.** Hydrologic groupings of West Virginia's watersheds

## 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 West Fork River Watershed, warmwater fishery aquatic life use impairments have been determined pursuant to exceedances of iron, dissolved aluminum, 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, and total iron.

All West Virginia waters are subject to the narrative criteria in Section 3 of the Standards. That section, titled "Conditions Not Allowable in State Waters," contains various general provisions related to water quality. The narrative water quality criterion at Title 47 CSR Series 2 – 3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts to the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision has historically been the basis for "biological impairment" determinations. Recent legislation has altered procedures used by WVDEP to assess biological integrity and, therefore, biological impairment TMDLs are not being developed. The legislation and related issues are discussed in detail in **Section 4** of this report.

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

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

**Table 2-1.** Applicable West Virginia water quality criteria

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

[a] One-hour average concentration not to be exceeded more than once every 3 years on the average.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average.
Source: 47 *CSR*, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*.

# 3.0 WATERSHED DESCRIPTION AND DATA INVENTORY

## 3.1 Watershed Description

The **West Fork River** is a principal tributary of the Monongahela River, 103 miles (166 km) long, in north-central West Virginia in the United States. Via the Monongahela and Ohio Rivers, it is part of the watershed of the Mississippi River, draining an area of 881 square miles (2,284 km²) on the unglaciated portion of the Allegheny Plateau.

The West Fork River Watershed is 103 mile long and encompasses 881 square miles in north central West Virginia (**Figure 3-1**). Of the 881 total square miles in the watershed, only 825 square miles were modeled under this TMDL effort. There are two major lakes in the watershed, Stonecoal Lake and Stonewall Jackson Lake that are not considered to be impaired. These lakes and unimpaired tributaries to the lakes were not considered in this TMDL effort. The West Fork River begins near the community of Rock Cave in southwestern Upshur County at the confluence of its headwater streams Straight Fork and Whites Camp Fork. The river flows north until it joins the Tygart Valley River to form the Monongahela River. The watershed lies in portions of Marion, Harrison, Lewis, Barbour, Taylor and Upshur counties. The major tributaries within the watershed are the Stonecoal Creek, Hackers Creek, Elk Creek, Simpson Creek, and Tenmile Creek. Cities and towns in the vicinity of the area of study are Clarksburg, Fairmont, West Milford, Lumberport, Shinnston, Enterprise, Worthington, Monongah, and Weston.

The highest point in the modeled portion of the West Fork River Watershed is 1953 feet in the headwaters of Elk Creek on an unnamed ridge 4 miles west of Philippi. The lowest point in the

West Fork River Watershed is 863 feet at the confluence of the West Fork with the Tygart Valley River at Fairmont, WV. The average elevation in the watershed is 1,205 feet. The total population living in the subject watersheds of this report is estimated to be 90,000 people.

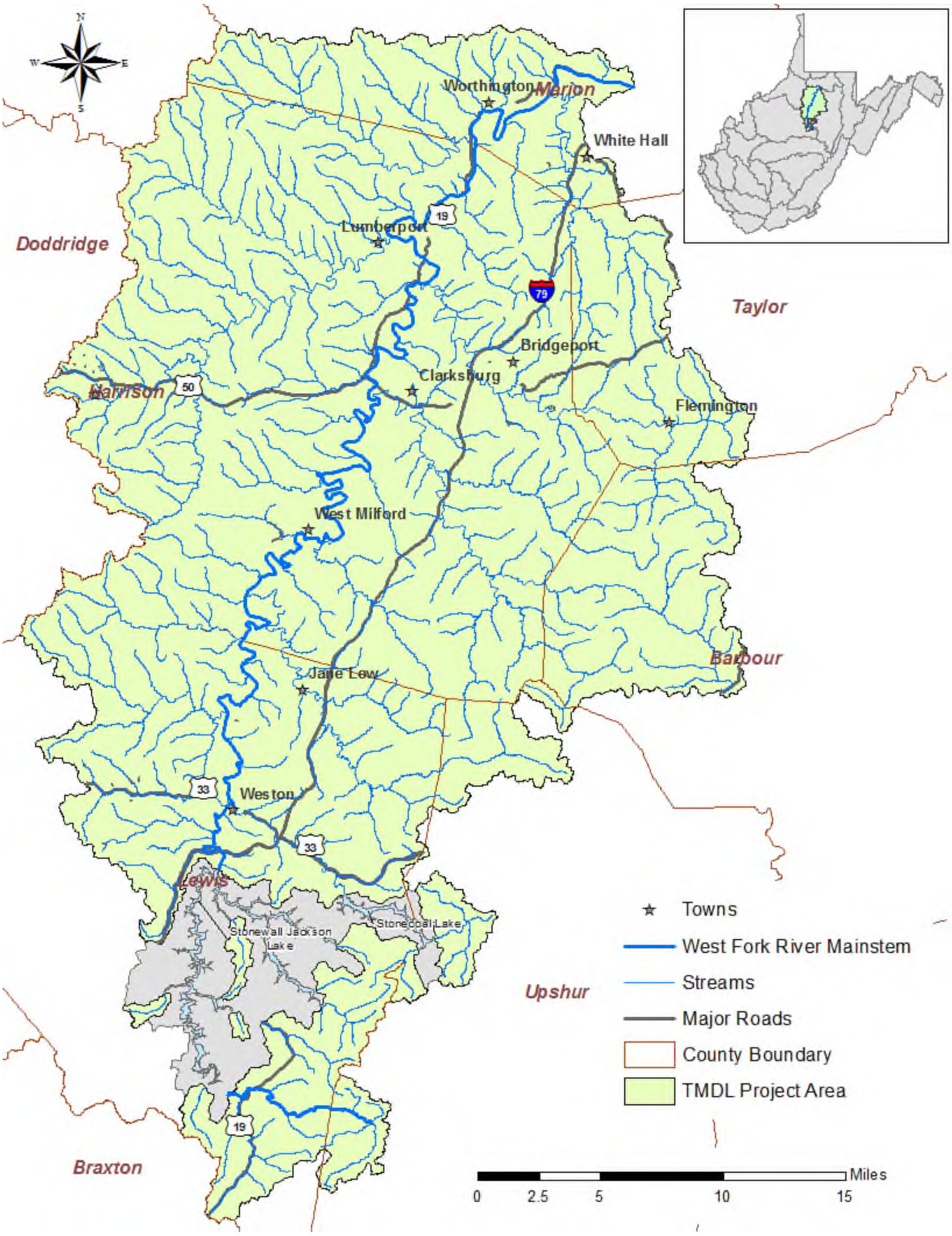



**Figure 3-1.** Location of the West Fork River Watershed TMDL Project Area in West Virginia

Landuse and land cover estimates were originally obtained from vegetation data gathered from the National Land Cover Dataset (NLCD) 2006. The Multi-Resolution Land Characteristics Consortium (MRLC) produced the NLCD coverage. The NLCD database for West Virginia was derived from satellite imagery taken during the early 2000s, and it includes detailed vegetative spatial data. Enhancements and updates to the NLCD coverage were made to create a modeled landuse by custom edits derived primarily from WVDEP source tracking information and 2003 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 700 modeled subwatersheds in the West Fork River Watershed, derived from NLCD as described above. The dominant landuse is forest, which constitutes 71.3 percent of the total landuse area. Other important modeled landuse types are grassland (9.7 percent), agriculture (6.2 percent), and urban/residential (5.6 percent). Individually, all other land cover types compose less than 2 percent of the total watershed area.

**Table 3-1.** Modified landuse for the West Fork TMDL watershed

| Landuse Type | Area of Watershed | | |
|---|---|---|---|
| | Acres | Square Miles | Percentage |
| AML | 3,016.05 | 4.71 | 0.57% |
| Barren | 5,299.09 | 8.28 | 1.00% |
| Cropland | 7,047.51 | 11.01 | 1.33% |
| Forest | 376,713.86 | 588.62 | 71.30% |
| Forestry | 9,788.60 | 15.29 | 1.85% |
| Grassland | 51,322.14 | 80.19 | 9.71% |
| Mining/Quarry | 8,352.37 | 13.05 | 1.58% |
| Oil and Gas | 9,145.35 | 14.29 | 1.73% |
| Pasture | 25,666.38 | 40.10 | 4.86% |
| Urban/Residential | 29,926.93 | 46.76 | 5.66% |
| Water | 2,047.02 | 3.20 | 0.39% |
| Total | 528,325.29 | 825.51 | 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) |
| | 2003 Aerial Photography (1-meter resolution) | WVDEP |
| | Counties | U.S. Census Bureau |
| | Cities/populated places | U.S. Census Bureau |
| | Soils | State Soil Geographic Database (STATSGO) U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) soil surveys |
| | Hydrologic Unit Code boundaries | U.S. Geological Survey (USGS) |
| | Topographic and digital elevation models (DEMs) | National Elevation Dataset (NED) |
| | Dam locations | USGS |
| | Roads | U.S. Census Bureau 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 West Fork River Watershed from July 2010 through June 2011. 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 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 52 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.

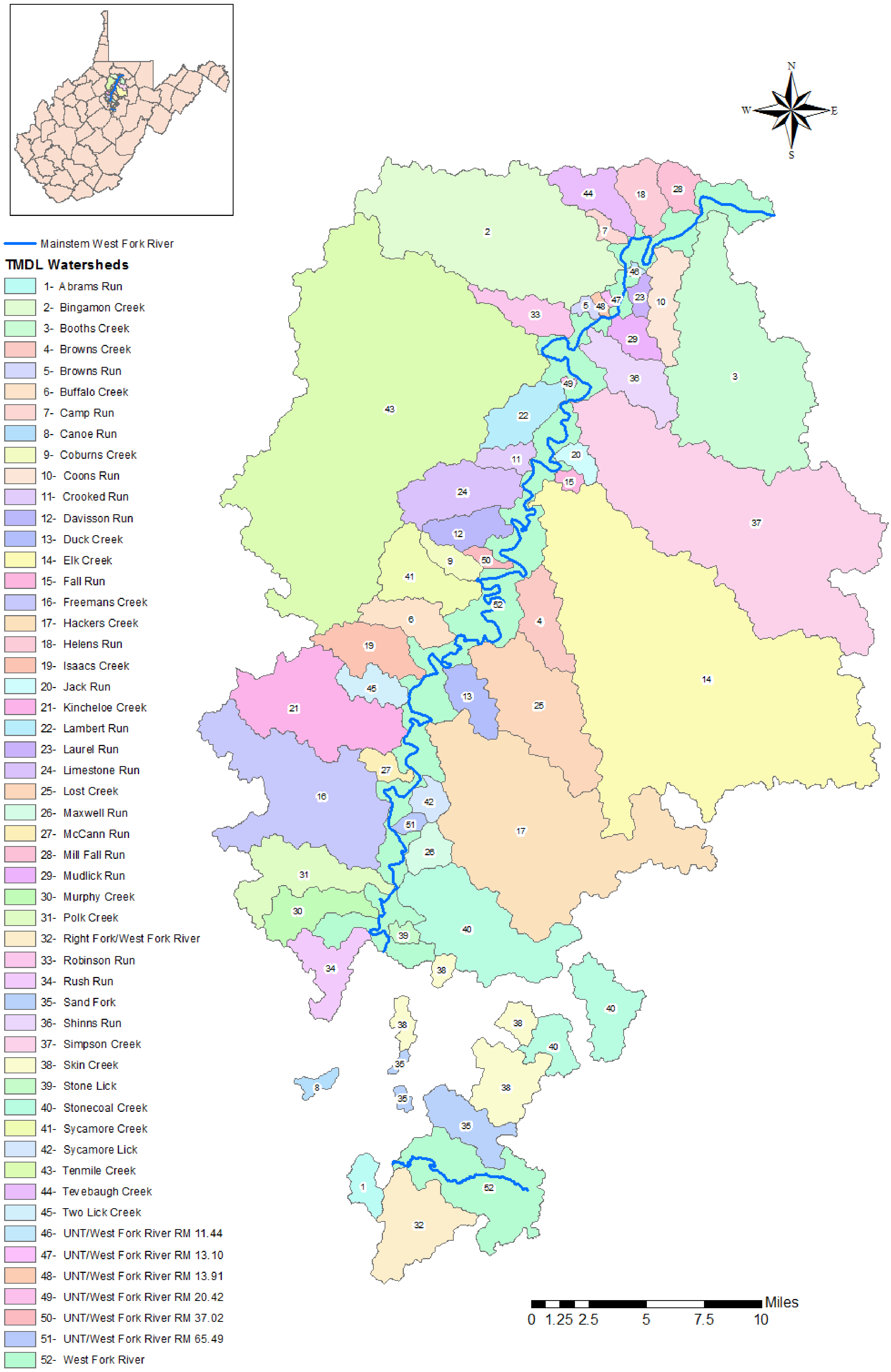



**Figure 3-2.** West Fork TMDL Watersheds

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

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| West Fork River | West Fork River | WV-MW | | x | | | x |
| West Fork River | Upper Portion of West Fork River | WV-MW | | M | | | x |
| Tevebaugh Creek | Tevebaugh Creek | WV-MW-10 | | M | | | x |
| Tevebaugh Creek | Parrish Run | WV-MW-10-C | | M | | | |
| Canoe Run | Canoe Run | WV-MW-111 | | M | | | x |
| Sand Fork | Sand Fork | WV-MW-112 | | M | | | |
| Sand Fork | Dunkin Run | WV-MW-112-B | | x | | | |
| Sand Fork | Sammy Run | WV-MW-112-M | | x | | | x |
| Camp Run | Camp Run | WV-MW-12 | | M | | | x |
| Abrams Run | Abrams Run | WV-MW-129 | | x | | | x |
| Right Fork/West Fork River | Right Fork/West Fork River | WV-MW-132 | | M | | | x |
| Right Fork/West Fork River | Big Run | WV-MW-132-C | | x | | | x |
| Right Fork/West Fork River | Sugarcamp Run | WV-MW-132-G | | | | | x |
| Right Fork/West Fork River | McChord Run | WV-MW-132-H | | M | | | |
| West Fork River | Laurel Run | WV-MW-137 | | M | | | |
| West Fork River | Wolfpen Run | WV-MW-139 | | M | | | |
| Bingamon Creek | Bingamon Creek | WV-MW-14 | | x | | x | x |
| West Fork River | Fall Run | WV-MW-143 | | M | | | |
| West Fork River | Crooked Run | WV-MW-144 | | M | | | |
| West Fork River | Straight Fork | WV-MW-145 | | M | | | |
| West Fork River | Whites Camp Fork | WV-MW-146 | | M | | | |
| Bingamon Creek | Little Bingamon Creek | WV-MW-14-A | | x | | | x |
| Bingamon Creek | UNT/Little Bingamon Creek RM 1.59 | WV-MW-14-A-3 | | x | | | x |
| Bingamon Creek | UNT/Little Bingamon Creek RM 2.27 | WV-MW-14-A-4 | | M | | | |
| Bingamon Creek | UNT/Little Bingamon Creek RM 3.80 | WV-MW-14-A-6 | | M | | | |
| Bingamon Creek | Long Run | WV-MW-14-B | | x | | | x |
| Bingamon Creek | Elklick Run | WV-MW-14-C | | x | | | x |
| Bingamon Creek | Cunningham Run | WV-MW-14-F | | x | | | x |
| Bingamon Creek | UNT/Cunningham Run RM 1.78 | WV-MW-14-F-2 | | M | | | |
| Bingamon Creek | UNT/Bingamon Creek RM 8.41 | WV-MW-14-H | | M | | | |
| Bingamon Creek | UNT/Bingamon Creek RM 8.68 | WV-MW-14-I | | M | | | |
| Bingamon Creek | Big Indian Run | WV-MW-14-N | | M | | | |
| Bingamon Creek | Glade Fork | WV-MW-14-P | | M | | | x |
| Bingamon Creek | Coal Lick Run | WV-MW-14-P-1 | | M | | | x |
| Bingamon Creek | Crabapple Run | WV-MW-14-P-1-A | | M | | | |
| Bingamon Creek | Road Fork | WV-MW-14-P-1-B | | M | | | |
| Bingamon Creek | Tucker Fork | WV-MW-14-P-5 | | M | | | |
| Bingamon Creek | Harris Fork | WV-MW-14-V | | M | | x | x |
| Bingamon Creek | UNT/Harris Fork RM 0.65 | WV-MW-14-V-2 | | | | x | |
| Bingamon Creek | Quaker Fork | WV-MW-14-W | | M | | | x |
| UNT/West Fork River RM 11.44 | UNT/West Fork River RM 11.44 | WV-MW-15 | | x | | | x |
| Laurel Run | Laurel Run | WV-MW-18 | | x | | | x |
| UNT/West Fork River RM 13.10 | UNT/West Fork River RM 13.10 | WV-MW-19 | | x | | | x |
| Mudlick Run | Mudlick Run | WV-MW-20 | | x | | | x |
| Mudlick Run | UNT/Mudlick Run RM 1.27 | WV-MW-20-A | | M | | | |
| UNT/West Fork River RM | UNT/West Fork River RM 13.91 | WV-MW-21 | | x | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| 13.91 | | | | | | | |
| Browns Run | Browns Run | WV-MW-22 | | x | | | x |
| Shinns Run | Shinns Run | WV-MW-23 | x | x | x | | x |
| Shinns Run | UNT/Shinns Run RM 2.81 | WV-MW-23-D | | M | | | |
| Shinns Run | UNT/Shinns Run RM 3.69 | WV-MW-23-E | | M | | | x |
| Shinns Run | UNT/Shinns Run RM 4.15 | WV-MW-23-F | x | x | x | | |
| Shinns Run | UNT/Shinns Run RM 5.61 | WV-MW-23-G | x | x | x | | |
| Shinns Run | UNT/Shinns Run RM 5.97 | WV-MW-23-H | | M | | | |
| Robinson Run | Robinson Run | WV-MW-26 | | x | | | x |
| Robinson Run | Pigotts Run | WV-MW-26-A | | M | | | |
| Robinson Run | UNT/Robinson Run RM 1.08 | WV-MW-26-B | | x | | | |
| Tenmile Creek | Tenmile Creek | WV-MW-27 | | x | | | x |
| Tenmile Creek | Jack Run | WV-MW-27-A | | x | | | x |
| Tenmile Creek | Turkey Foot Run | WV-MW-27-AB | | M | | | |
| Tenmile Creek | Wizardism Run (Holt Run) | WV-MW-27-AC | | M | | | |
| Tenmile Creek | UNT/Tenmile Creek RM 22.53 | WV-MW-27-AK | | x | | | x |
| Tenmile Creek | Coburn Fork | WV-MW-27-AM | | M | | | x |
| Tenmile Creek | Shaw Run | WV-MW-27-AM-3 | | M | | | x |
| Tenmile Creek | Rush Run | WV-MW-27-AP | | M | | | |
| Tenmile Creek | Turtletree Fork | WV-MW-27-AU | | M | | | |
| Tenmile Creek | Jones Creek | WV-MW-27-B | | x | | | x |
| Tenmile Creek | Nolan Run | WV-MW-27-B-3 | | x | | | x |
| Tenmile Creek | UNT/Tenmile Creek RM 4.19 | WV-MW-27-D | | M | | | |
| Tenmile Creek | Little Tenmile Creek | WV-MW-27-E | | x | | | x |
| Tenmile Creek | UNT/Little Tenmile Creek RM 0.40 | WV-MW-27-E-1 | | M | | | |
| Tenmile Creek | Little Elk Creek | WV-MW-27-E-11 | | M | | | x |
| Tenmile Creek | Big Elk Creek | WV-MW-27-E-14 | | | | | x |
| Tenmile Creek | Middle Run/Little Tenmile Creek | WV-MW-27-E-15 | | x | | | x |
| Tenmile Creek | Barnes Run | WV-MW-27-E-16 | | M | | | |
| Tenmile Creek | Mudlick Run | WV-MW-27-E-18 | | M | | | x |
| Tenmile Creek | Peters Run | WV-MW-27-E-2 | | M | | | x |
| Tenmile Creek | UNT/Little Tenmile Creek RM 1.91 | WV-MW-27-E-3 | | M | | | x |
| Tenmile Creek | Bennett Run | WV-MW-27-E-4 | | x | | | |
| Tenmile Creek | UNT/Bennett Run RM 0.76 | WV-MW-27-E-4-A | | M | | | |
| Tenmile Creek | Caldwell Run | WV-MW-27-E-5 | | M | | | |
| Tenmile Creek | Laurel Run | WV-MW-27-E-7 | | M | | | x |
| Tenmile Creek | Jake Run | WV-MW-27-E-9 | | M | | | |
| Tenmile Creek | Isaac Creek | WV-MW-27-H | | x | | | x |
| Tenmile Creek | Little Isaac Creek | WV-MW-27-H-1 | | M | | | |
| Tenmile Creek | Gregory Run | WV-MW-27-I | | x | | | x |
| Tenmile Creek | Katy Lick Run | WV-MW-27-K | | x | | | x |
| Tenmile Creek | Flag Run | WV-MW-27-L | | x | | | x |
| Tenmile Creek | UNT/Tenmile Creek RM 10.82 | WV-MW-27-M | | x | | | x |
| Tenmile Creek | Rockcamp Run | WV-MW-27-N | | M | | | x |
| Tenmile Creek | Little Rockcamp Run | WV-MW-27-N-2 | | M | | | x |
| Tenmile Creek | UNT/Little Rockcamp Run RM 1.22 | WV-MW-27-N-2-C | | M | | | |
| Tenmile Creek | UNT/Tenmile Creek RM 13.15 | WV-MW-27-Q | | M | | | |
| Tenmile Creek | Grass Run | WV-MW-27-R | | M | | | x |
| Tenmile Creek | UNT/Grass Run RM 3.26 | WV-MW-27-R-7 | | M | | | |
| Tenmile Creek | Indian Run | WV-MW-27-V | | M | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| Tenmile Creek | UNT/Indian Run RM 3.07 | WV-MW-27-V-7 | | M | | | |
| Tenmile Creek | Salem Fork | WV-MW-27-X | | M | | | x |
| Tenmile Creek | UNT/Salem Fork RM 2.43 | WV-MW-27-X-2 | | | | | x |
| Tenmile Creek | Raccoon Run | WV-MW-27-X-3 | | M | | | |
| Tenmile Creek | Cherrycamp Run | WV-MW-27-X-4 | | M | | | x |
| Tenmile Creek | Patterson Fork | WV-MW-27-X-8 | | M | | | x |
| Tenmile Creek | UNT/Patterson Fork RM 0.59 | WV-MW-27-X-8-B | | M | | | x |
| Tenmile Creek | Jacobs Run | WV-MW-27-X-9 | | M | | | |
| Tenmile Creek | Rush Run | WV-MW-27-Z | | M | | | |
| UNT/West Fork River RM 20.42 | UNT/West Fork River RM 20.42 | WV-MW-30 | | x | | | x |
| Simpson Creek | Simpson Creek | WV-MW-31 | | x | | | x |
| Simpson Creek | UNT/Simpson Creek RM 1.23 | WV-MW-31-A | | x | | | |
| Simpson Creek | West Branch/Simpson Creek | WV-MW-31-AA | | x | | | |
| Simpson Creek | UNT/West Branch RM 0.63/Simpson Creek | WV-MW-31-AA-1 | | x | | | |
| Simpson Creek | Stillhouse Run | WV-MW-31-AA-2 | | x | | | x |
| Simpson Creek | UNT/West Branch RM 1.57/Simpson Creek | WV-MW-31-AA-4 | | M | | | x |
| Simpson Creek | Camp Run | WV-MW-31-AB | | x | | | |
| Simpson Creek | UNT/Simpson Creek RM 26.94 | WV-MW-31-AC | | x | | | x |
| Simpson Creek | Jack Run | WV-MW-31-B | | M | | | |
| Simpson Creek | Smith Run | WV-MW-31-C | x | x | x | | x |
| Simpson Creek | UNT/Smith Run RM 0.72 | WV-MW-31-C-1 | | M | | | |
| Simpson Creek | UNT/Simpson Creek RM 5.48 | WV-MW-31-D | | M | | | |
| Simpson Creek | UNT/Simpson Creek RM 6.14 | WV-MW-31-E | | M | | | |
| Simpson Creek | Barnett Run | WV-MW-31-F | | M | | | x |
| Simpson Creek | Stouts Run | WV-MW-31-F-2 | | M | | | |
| Simpson Creek | Davisson Run | WV-MW-31-J | | M | | | x |
| Simpson Creek | Ann Run | WV-MW-31-K | | M | | | x |
| Simpson Creek | Peddler Run | WV-MW-31-M | | M | | | |
| Simpson Creek | Beards Run | WV-MW-31-O | | M | | | x |
| Simpson Creek | Pigtail Run | WV-MW-31-O-3 | | M | | | |
| Simpson Creek | Jerry Run | WV-MW-31-P | | M | | | |
| Simpson Creek | Berry Run | WV-MW-31-T | | x | | | x |
| Simpson Creek | Right Fork/Simpson Creek | WV-MW-31-U | | x | | | x |
| Simpson Creek | UNT/Right Fork RM 0.33/Simpson Creek | WV-MW-31-U-2 | x | x | x | | |
| Simpson Creek | Buck Run | WV-MW-31-U-3 | | x | | | x |
| Simpson Creek | Sand Lick Run | WV-MW-31-U-4 | | x | | | x |
| Simpson Creek | Gabe Fork | WV-MW-31-U-5 | | x | | | x |
| Simpson Creek | Flag Run | WV-MW-31-U-6 | | M | | | |
| Simpson Creek | UNT/Simpson Creek RM 21.92 | WV-MW-31-X | | x | | | x |
| Simpson Creek | Bartlett Run | WV-MW-31-Y | | M | | | x |
| Simpson Creek | UNT/Simpson Creek RM 22.72 | WV-MW-31-Z | | x | | | x |
| Lambert Run | Lambert Run | WV-MW-32 | | x | | | |
| Lambert Run | UNT/Lambert Run RM 1.49 | WV-MW-32-B | | x | | | |
| Lambert Run | UNT/Lambert Run RM 2.77 | WV-MW-32-C | | x | | | x |
| Jack Run | Jack Run | WV-MW-33 | | x | | | x |
| Fall Run | Fall Run | WV-MW-34 | | x | | | |
| Crooked Run | Crooked Run | WV-MW-35 | | x | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| Crooked Run | UNT/Crooked Run RM 0.47 | WV-MW-35-A | | M | | | |
| Limestone Run | Limestone Run | WV-MW-36 | | M | | | x |
| Limestone Run | Stone Coal Run | WV-MW-36-A | | M | | | x |
| Limestone Run | Simpson Fork | WV-MW-36-C | | M | | | x |
| Limestone Run | Johnson Fork | WV-MW-36-D | | x | | | |
| Limestone Run | UNT/Limestone Run RM 3.97 | WV-MW-36-F | | M | | | |
| Limestone Run | Phoenix Hollow | WV-MW-36-H | | x | | | x |
| Elk Creek | Elk Creek | WV-MW-37 | | x | | | x |
| Elk Creek | Birds Run | WV-MW-37-AA | | x | | | x |
| Elk Creek | Arnold Run | WV-MW-37-AC | | M | | | x |
| Elk Creek | Isaacs Run | WV-MW-37-AK | | M | | | x |
| Elk Creek | Stewart Run | WV-MW-37-AM | | x | | | x |
| Elk Creek | UNT/Stewart Run RM 1.58 | WV-MW-37-AM-3 | | M | | | |
| Elk Creek | UNT/Elk Creek RM 27.87 | WV-MW-37-AS | | M | | | x |
| Elk Creek | Indian Fork | WV-MW-37-AT | | M | | | |
| Elk Creek | UNT/Elk Creek RM 3.39 | WV-MW-37-B | | M | | | |
| Elk Creek | Murphy Run | WV-MW-37-C | | x | | | x |
| Elk Creek | Ann Moore Run | WV-MW-37-D | | M | | | x |
| Elk Creek | UNT/Ann Moore Run RM 2.00 | WV-MW-37-D-1 | | M | | | |
| Elk Creek | Nutter Run | WV-MW-37-F | | x | | | x |
| Elk Creek | Turkey Run | WV-MW-37-G | | | | | x |
| Elk Creek | Hooppole Run | WV-MW-37-H | | x | | | x |
| Elk Creek | Brushy Fork | WV-MW-37-J | | x | | | x |
| Elk Creek | Glade Run | WV-MW-37-J-11 | | | | | x |
| Elk Creek | Stonecoal Run | WV-MW-37-J-15 | | M | | | x |
| Elk Creek | UNT/Brushy Fork RM 3.37 | WV-MW-37-J-4 | | x | | | x |
| Elk Creek | UNT/Brushy Fork RM 4.59 | WV-MW-37-J-5 | | M | | | |
| Elk Creek | Coplin Run | WV-MW-37-J-8 | | M | | | x |
| Elk Creek | Zachs Run | WV-MW-37-L | | | | | x |
| Elk Creek | Chub Run | WV-MW-37-M | | M | | | x |
| Elk Creek | Suds Run | WV-MW-37-M-1 | | M | | | |
| Elk Creek | Fall Run | WV-MW-37-P | | M | | | x |
| Elk Creek | Hastings Run | WV-MW-37-R | | M | | | x |
| Elk Creek | Gnatty Creek | WV-MW-37-V | | M | | | x |
| Elk Creek | Peeltree Run | WV-MW-37-V-10 | | M | | | |
| Elk Creek | UNT/Gnatty Creek RM 8.02 | WV-MW-37-V-13 | | M | | | |
| Elk Creek | Right Branch/Gnatty Creek | WV-MW-37-V-15 | | M | | | |
| Elk Creek | Charity Fork | WV-MW-37-V-15-A | | M | | | |
| Elk Creek | Left Branch/Gnatty Creek | WV-MW-37-V-16 | | M | | | |
| Elk Creek | Cranes Fork | WV-MW-37-V-16-B | | M | | | |
| Elk Creek | Rooting Creek | WV-MW-37-V-3 | | M | | | x |
| Elk Creek | UNT/Rooting Creek RM 1.54 | WV-MW-37-V-3-C | | M | | | |
| Elk Creek | UNT/Rooting Creek RM 5.22 | WV-MW-37-V-3-L | | M | | | |
| Elk Creek | Raccoon Creek | WV-MW-37-V-6 | | M | | | |
| Elk Creek | Stouts Run | WV-MW-37-W | | x | | | x |
| Mill Fall Run | Mill Fall Run | WV-MW-4 | | M | | | x |
| Davisson Run | Davisson Run | WV-MW-40 | | M | | | x |
| Davisson Run | Washburncamp Run | WV-MW-40-B | | M | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| UNT/West Fork River RM 37.02 | UNT/West Fork River RM 37.02 | WV-MW-43 | | M | | | x |
| Browns Creek | Browns Creek | WV-MW-45 | | M | | | x |
| Coburns Creek | Coburns Creek | WV-MW-46 | | M | | | x |
| Sycamore Creek | Sycamore Creek | WV-MW-47 | | M | | | x |
| Sycamore Creek | UNT/Sycamore Creek RM 3.04 | WV-MW-47-F | | M | | | |
| Mill Fall Run | Little Mill Fall Run | WV-MW-4-A | | M | | | |
| Booths Creek | Booths Creek | WV-MW-5 | | x | | | x |
| Lost Creek | Lost Creek | WV-MW-55 | | M | | | x |
| Lost Creek | UNT/Lost Creek RM 3.32 | WV-MW-55-C | | M | | | x |
| Lost Creek | UNT/Lost Creek RM 4.23 | WV-MW-55-F | | x | | | |
| Lost Creek | UNT/Lost Creek RM 4.77 | WV-MW-55-G | | M | | | |
| Lost Creek | UNT/Lost Creek RM 5.95 | WV-MW-55-I | | M | | | |
| Lost Creek | Bonds Run | WV-MW-55-J | | M | | | x |
| Lost Creek | UNT/Lost Creek RM 6.91 | WV-MW-55-K | | M | | | x |
| Buffalo Creek | Buffalo Creek | WV-MW-59 | | M | | | x |
| Buffalo Creek | UNT/Buffalo Creek RM 1.68 | WV-MW-59-B | | M | | | |
| Booths Creek | UNT/Booths Creek RM 1.39 | WV-MW-5-A | | | | | x |
| Booths Creek | UNT/Booths Creek RM 3.58 | WV-MW-5-C | | x | | | x |
| Booths Creek | UNT/Booths Creek RM 4.11 | WV-MW-5-D | | M | | | x |
| Booths Creek | UNT/Booths Creek RM 4.81 | WV-MW-5-E | | x | | | |
| Booths Creek | Hog Lick Run | WV-MW-5-F | | x | | | x |
| Booths Creek | Sapp Run | WV-MW-5-G | | x | | | x |
| Booths Creek | Sweep Run | WV-MW-5-I | | M | | | |
| Booths Creek | Horners Run | WV-MW-5-J | | x | | | |
| Booths Creek | Purdys Run | WV-MW-5-J-1 | x | M | x | | |
| Booths Creek | UNT/Booths Creek RM 8.22 | WV-MW-5-K | | M | | | |
| Booths Creek | Hustead Fork | WV-MW-5-L | | x | | | x |
| Booths Creek | Plummer Run | WV-MW-5-L-7 | | M | | | |
| Booths Creek | Corbin Branch | WV-MW-5-M | | M | | | x |
| Booths Creek | UNT/Corbin Branch RM 4.56 | WV-MW-5-M-11 | | M | | | |
| Booths Creek | UNT/Corbin Branch RM 2.37 | WV-MW-5-M-6 | | M | | | |
| Booths Creek | UNT/Corbin Branch RM 3.36 | WV-MW-5-M-8 | | M | | | |
| Booths Creek | UNT/Corbin Branch RM 3.65 | WV-MW-5-M-9 | | M | | | |
| Booths Creek | Thomas Fork | WV-MW-5-N | | M | | | x |
| Booths Creek | Sugarcamp Run | WV-MW-5-N-3 | | M | | | |
| Duck Creek | Duck Creek | WV-MW-62 | | M | | | x |
| Duck Creek | UNT/Duck Creek RM 2.78 | WV-MW-62-J | | M | | | x |
| Isaacs Creek | Isaacs Creek | WV-MW-66 | | x | | | x |
| Isaacs Creek | UNT/Isaacs Creek RM 2.90 | WV-MW-66-E | | M | | | x |
| West Fork River | UNT/West Fork River RM 54.90 | WV-MW-68 | | M | | | |
| Two Lick Creek | Two Lick Creek | WV-MW-69 | | M | | | x |
| West Fork River | UNT/West Fork River RM 56.68 | WV-MW-71 | | M | | | |
| Hackers Creek | Hackers Creek | WV-MW-72 | | x | | | x |
| Hackers Creek | Buckhannon Run | WV-MW-72-AA | | x | | | x |
| Hackers Creek | Frog Run | WV-MW-72-AA-3 | | M | | | |
| Hackers Creek | Lefthand Fork | WV-MW-72-AJ | | x | | | x |
| Hackers Creek | McKinney Run | WV-MW-72-F | | M | | | x |
| Hackers Creek | UNT/McKinney Run RM 1.55 | WV-MW-72-F-2 | | M | | | |
| Hackers Creek | West Run | WV-MW-72-I | | x | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| Hackers Creek | Jesse Run | WV-MW-72-K | | x | | | x |
| Hackers Creek | UNT/Jesse Run RM 6.59 | WV-MW-72-K-14 | | M | | | |
| Hackers Creek | UNT/Jesse Run RM 2.65 | WV-MW-72-K-6 | | M | | | |
| Hackers Creek | UNT/Jesse Run RM 3.51 | WV-MW-72-K-7 | | M | | | |
| Hackers Creek | Bills Lick | WV-MW-72-K-8 | | M | | | |
| Hackers Creek | Lifes Run | WV-MW-72-P | | M | | | x |
| Hackers Creek | Stony Run | WV-MW-72-R | | M | | | x |
| Hackers Creek | Bloody Run | WV-MW-72-V | | M | | | x |
| Hackers Creek | UNT/Hackers Creek RM 13.79 | WV-MW-72-X | | M | | | |
| Hackers Creek | Laurel Lick | WV-MW-72-Y | | x | | | x |
| Hackers Creek | UNT/Laurel Lick RM 1.12 | WV-MW-72-Y-3 | | M | | | |
| Kincheloe Creek | Kincheloe Creek | WV-MW-75 | | x | | | x |
| Kincheloe Creek | Hollick Run | WV-MW-75-A | | M | | | |
| Kincheloe Creek | Browns Run | WV-MW-75-C | | x | | | x |
| Kincheloe Creek | UNT/Browns Run RM 0.30 | WV-MW-75-C-1 | | M | | | |
| Kincheloe Creek | Right Fork/Kincheloe Creek | WV-MW-75-G | | x | | | x |
| Kincheloe Creek | Stutler Fork | WV-MW-75-G-4 | | M | | | |
| Kincheloe Creek | Tanner Fork | WV-MW-75-O | | x | | | x |
| West Fork River | Broad Run | WV-MW-77 | | M | | | |
| McCann Run | McCann Run | WV-MW-79 | | x | | | x |
| Coons Run | Coons Run | WV-MW-8 | | x | | | x |
| Sycamore Lick | Sycamore Lick | WV-MW-80 | | x | | | x |
| Freemans Creek | Freemans Creek | WV-MW-83 | | x | | | x |
| Freemans Creek | Geelick Run | WV-MW-83-A | | x | | | x |
| Freemans Creek | Horse Run | WV-MW-83-C | | M | | | |
| Freemans Creek | Millstone Run | WV-MW-83-D | | M | | | |
| Freemans Creek | Mare Run | WV-MW-83-F | | x | | | x |
| Freemans Creek | Right Fork/Freemans Creek | WV-MW-83-G | | x | | | x |
| Freemans Creek | Elk Lick Run | WV-MW-83-G-2 | | M | | | |
| Freemans Creek | Left Fork/Freemans Creek | WV-MW-83-H | | x | | | x |
| Freemans Creek | Rush Run | WV-MW-83-H-1 | | M | | | |
| UNT/West Fork River RM 65.49 | UNT/West Fork River RM 65.49 | WV-MW-85 | | x | | | x |
| Maxwell Run | Maxwell Run | WV-MW-88 | | x | | | x |
| Polk Creek | Polk Creek | WV-MW-89 | | x | | | x |
| Polk Creek | Keith Fork | WV-MW-89-E | | M | | | |
| Polk Creek | Dry Fork | WV-MW-89-G | | x | | | x |
| Polk Creek | Sassafras Run | WV-MW-89-L | | | | | x |
| Helens Run | Helens Run | WV-MW-9 | | M | | | x |
| Stonecoal Creek | Stonecoal Creek | WV-MW-90 | | x | | | x |
| Stonecoal Creek | Smith Run | WV-MW-90-B | | M | | | |
| Stonecoal Creek | UNT/Stonecoal Creek RM 2.43 | WV-MW-90-C | | M | | | x |
| Stonecoal Creek | Mud Lick | WV-MW-90-D | | M | | | |
| Stonecoal Creek | Hilly Upland Run | WV-MW-90-F | | M | | | x |
| Stonecoal Creek | Grass Run | WV-MW-90-I | | x | | | x |
| Stonecoal Creek | Right Fork/Stonecoal Creek | WV-MW-90-L | | x | | | x |
| Stonecoal Creek | Upper Portion of Right Fork/Stonecoal Creek | WV-MW-90-L | | x | | | x |
| Stonecoal Creek | Pringle Fork | WV-MW-90-L-11 | | x | | | x |
| Stonecoal Creek | Glady Fork | WV-MW-90-L-16 | | x | | | x |

| TMDL Watershed | Stream Name | NHD Code | ph | Fe | Al | Cl | FC |
|---|---|---|---|---|---|---|---|
| Stonecoal Creek | Fall Run | WV-MW-90-L-16-A | | x | | | x |
| Stonecoal Creek | UNT/Glady Fork RM 1.45 | WV-MW-90-L-16-D | | M | | | |
| Stonecoal Creek | Spruce Fork | WV-MW-90-L-17 | | x | | | x |
| Murphy Creek | Murphy Creek | WV-MW-93 | | x | | | x |
| Murphy Creek | Sand Run | WV-MW-93-C | | M | | | |
| Murphy Creek | Limestone Run | WV-MW-93-F | | M | | | |
| West Fork River | Middle Run | WV-MW-94 | | M | | | |
| Rush Run | Rush Run | WV-MW-95 | | x | | | x |
| Stone Lick | Stone Lick | WV-MW-96 | | | | | x |
| West Fork River | Washburn Run | WV-MW-97 | | M | | | |
| Skin Creek | Skin Creek | WV-MW-98 | | M | | | x |
| Skin Creek | Wolf Fork | WV-MW-98-C | | | | | x |
| Skin Creek | Glady Fork | WV-MW-98-F | | M | | | x |
| Skin Creek | Linger Run | WV-MW-98-G-8-A | | | | | x |
| Skin Creek | Hughes Fork | WV-MW-98-O | | M | | | |
| Skin Creek | Keith Fork | WV-MW-98-Q | | M | | | |
| Skin Creek | Wheeler Fork | WV-MW-98-S | | M | | | |
| Skin Creek | Wildcat Run | WV-MW-98-T | | M | | | |
| Skin Creek | UNT/Skin Creek RM 12.34 | WV-MW-98-U | | M | | | |
| Helens Run | UNT/Helens Run RM 1.77 | WV-MW-9-B | | M | | | |

Note:

RM river mile
UNT unnamed tributary
pH acidity impairment
Fe iron impairment
Al aluminum impairment
Cl chloride impairment
FC fecal coliform bacteria impairment
M Iron 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. The original scope of work for this project included 52 biological impairments for which TMDLs were to be developed and identified a potential need for biological TMDL development for an additional 86 streams. EPA's final action on the 2012 Section 303(d) list added an additional 37 biologically impaired streams that were not included in earlier 303(d) lists.

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 did not add new WVSCI-based biological impairments to the 2012 303(d) list that was submitted to EPA for approval on December 21, 2012. WVDEP has also suspended biological impairment TMDL development pending legislative approval of the new assessment methodology.

On March 25, 2013, EPA partially approved and partially disapproved West Virginia's 2012 Section 303(d) list submittal. EPA disapproved West Virginia's failure to list multiple waters for which available biological information would have been deemed impairment pursuant to 47 CSR 2 §3.2.i if assessed using the WVSCI methodology as in past listing cycles. On April 8, 2013 EPA published a notice in the *Federal Register* of its proposal to add 255 waters to West Virginia's 2012 303(d) list and opened a 30-day public comment period regarding the same. Information regarding the public notice, the public comments received, and EPA's response to the same may be viewed in their entirety at: http://www.epa.gov/reg3wapd/tmdl/303list.html

On May 8, 2013, WVDEP submitted comments to EPA that expressed general disagreement with the proposed over-list action and provided technical considerations regarding proposed specific stream listings. EPA considered WVDEP's comments and altered their final action based on those comments, by removing eight streams that EPA initially proposed to add, adding one stream, and revising the segmentation of four streams. The final EPA action also delisted twelve streams that WVDEP included on its draft list. However, EPA declined to follow WVDEP's suggestion regarding waters for which WVDEP deemed the biological results uncertain based on the WVSCI methodology (i.e. WVSCI scores between 60.6 and 68). The above notwithstanding, all of the potentially impacted streams on the 2012 Section 303(d) list were subjected to the biological stressor identification process described in this Chapter. 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 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 through the implementation of TMDLs developed in this project pursuant to effective numeric water quality criteria for the streams identified in **Table 4-1**.

## 4.1 Introduction

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

USEPA developed *Stressor Identification: Technical Guidance Document* (Cormier et al., 2000) to assist water resource managers in identifying stressors and stressor combinations that cause biological impact. Elements of that guidance were used and custom analyses of biological data were performed to supplement the recommended framework.

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

## 4.2 Data Review

WVDEP generated the primary data used in SI through its pre-TMDL monitoring program. The program included water quality monitoring, benthic sampling, and habitat assessment. In addition, the biologists' comments regarding stream condition and potential stressors and sources were captured and considered. Other data sources were: source tracking data, WVDEP mining activities data, NLCD 2006 landuse information, Natural Resources Conservation Service (NRCS) State Soil Geographic database (STATSGO) soils data, National Pollutant Discharge Elimination System (NPDES) point source data, and literature sources.

## 4.3 Candidate Causes/Pathways

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

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

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

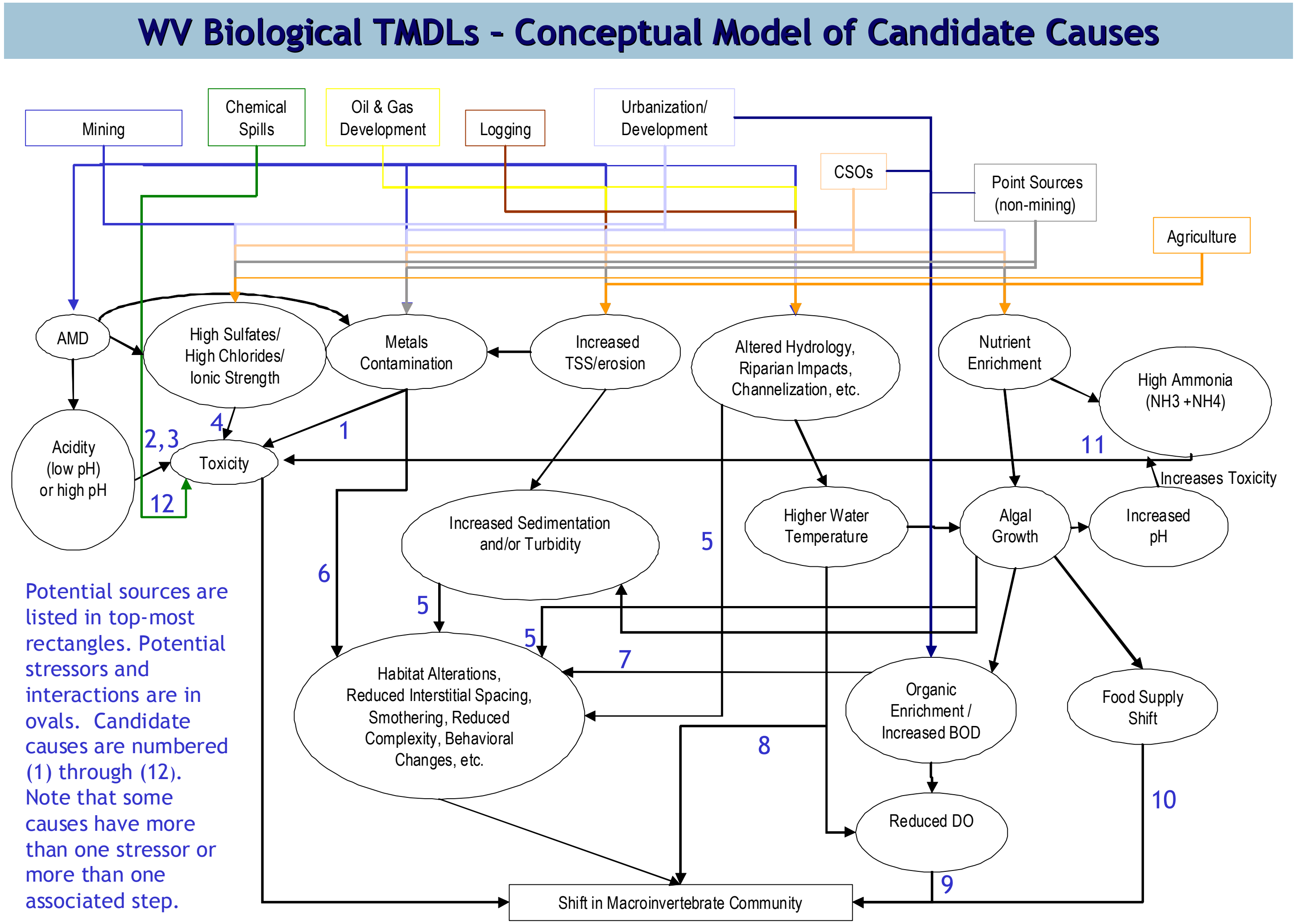



**Figure 4-1.** Conceptual model of candidate causes and potential biological effects

## 4.4 Stressor Identification Results

The SI process identified significant biological stressors for each stream. Biological impact was linked to a single stressor in some cases and multiple stressors in others. The SI process identified the following stressors to be present in the impacted waters in the West Fork 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.

All of the 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 each stream, 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. See the Technical Report for further description of the correlation between sedimentation and iron.

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

**Table 4-1.** Significant stressors of biologically impacted streams in the West Fork River Watershed and pollutant TMDL to be developed.

| Stream Name | NHD-Code | Significant Stressors | TMDLs Developed |
|---|---|---|---|
| West Fork River | WV-MW | Sedimentation, Organic Enrichment, | Iron, Fecal Coliform |
| Mill Fall Run | WV-MW-4 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Booths Creek | WV-MW-5 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Sapp Run | WV-MW-5-G | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Booths Creek RM 8.22 | WV-MW-5-K | Sedimentation | Iron |
| Corbin Branch | WV-MW-5-M | Sedimentation | Iron |
| Thomas Fork | WV-MW-5-N | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Helens Run | WV-MW-9 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Tevebaugh Creek | WV-MW-10 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Little Bingamon Creek | WV-MW-14-A | Sedimentation | Iron |
| UNT/Little Bingamon Creek RM 1.59 | WV-MW-14-A-3 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Long Run | WV-MW-14-B | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Coal Lick Run | WV-MW-14-P-1 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Quaker Fork | WV-MW-14-W | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Little Elk Creek | WV-MW-27-E-11 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Middle Run/Little Tenmile Creek | WV-MW-27-E-15 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Mudlick Run | WV-MW-27-E-18 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Little Rockcamp Run | WV-MW-27-N-2 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Salem Fork | WV-MW-27-X | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Salem Fork RM 2.43 | WV-MW-27-X-2 | Organic Enrichment | Fecal Coliform |
| Cherrycamp Run | WV-MW-27-X-4 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Patterson Fork | WV-MW-27-X-8 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Patterson Fork RM 0.59 | WV-MW-27-X-8-B | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Coburn Fork | WV-MW-27-AM | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Ann Run | WV-MW-31-K | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Phoenix Hollow | WV-MW-36-H | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Brushy Fork RM 3.37 | WV-MW-37-J-4 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Zachs Run | WV-MW-37-L | Organic Enrichment | Fecal Coliform |
| Chub Run | WV-MW-37-M | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Fall Run | WV-MW-37-P | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Hastings Run | WV-MW-37-R | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/West Fork River RM 37.02 | WV-MW-43 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Lost Creek RM 6.91 | WV-MW-55-K | Organic Enrichment | Fecal Coliform |
| Isaacs Creek | WV-MW-66 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Isaacs Creek RM 2.90 | WV-MW-66-E | Sedimentation | Iron |
| West Run | WV-MW-72-I | Sedimentation | Iron |

| Stream Name | NHD-Code | Significant Stressors | TMDLs Developed |
|---|---|---|---|
| Jesse Run | WV-MW-72-K | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Lifes Run | WV-MW-72-P | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Laurel Lick | WV-MW-72-Y | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Buckhannon Run | WV-MW-72-AA | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Lefthand Fork | WV-MW-72-AJ | Sedimentation | Iron |
| Right Fork/Kincheloe Creek | WV-MW-75-G | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Tanner Fork | WV-MW-75-O | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| McCann Run | WV-MW-79 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Sycamore Lick | WV-MW-80 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Freemans Creek | WV-MW-83 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Geelick Run | WV-MW-83-A | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Left Fork/Freemans Creek | WV-MW-83-H | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/West Fork River RM 65.49 | WV-MW-85 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Maxwell Run | WV-MW-88 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Stonecoal Creek | WV-MW-90 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| UNT/Stonecoal Creek RM 2.43 | WV-MW-90-C | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Hilly Upland Run | WV-MW-90-F | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Spruce Fork | WV-MW-90-L-17 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Glady Fork | WV-MW-90-L-16 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Fall Run | WV-MW-90-L-16-A | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Polk Creek | WV-MW-89 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Dry Fork | WV-MW-89-G | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Skin Creek | WV-MW-98 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Hughes Fork | WV-MW-98-O | Sedimentation | Iron |
| Right Fork/West Fork River | WV-MW-132 | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Big Run | WV-MW-132-C | Sedimentation, Organic Enrichment | Iron, Fecal Coliform |
| Peddler Run | WV-MW-31-M | Sedimentation | Iron |
| Sand Fork | WV-MW-112 | Sedimentation | Iron |

Note:
RM is River Mile
UNT is unnamed tributary.

# 5.0 METALS SOURCE ASSESSMENT

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

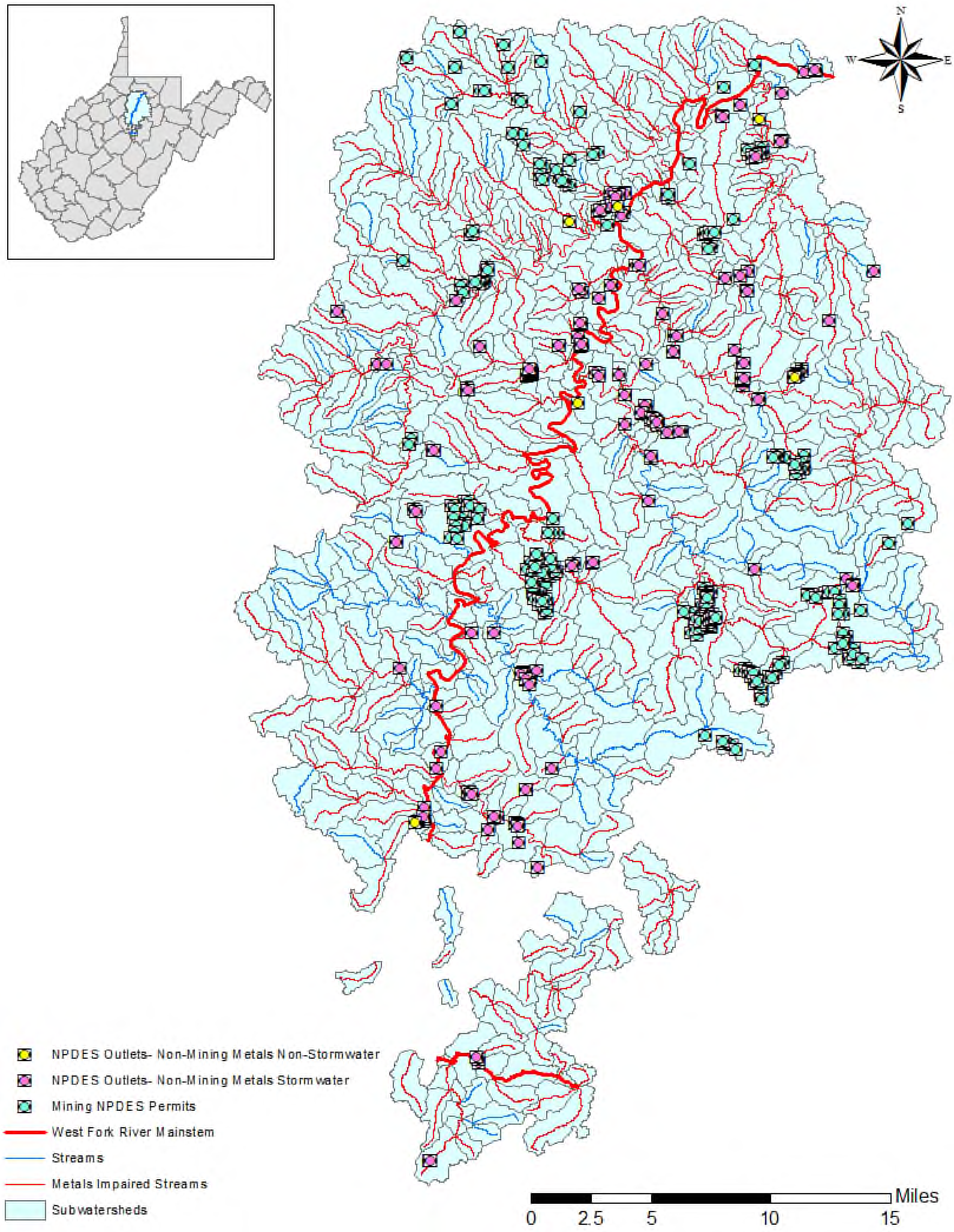
A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or may be discharged. The NPDES program, established under Clean Water Act Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. For purposes of this TMDL, NPDES-permitted discharge points are considered point sources.

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

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




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

**Figure 5-1.** Metals point sources in the West Fork 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 39 mining-related NPDES permits, with 220 associated outlets in the metals impaired watersheds of the West Fork 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 are eight such bond forfeiture sites (13 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, TMDL project classifies bond forfeiture sites as point sources and provides WLAs.

### 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.

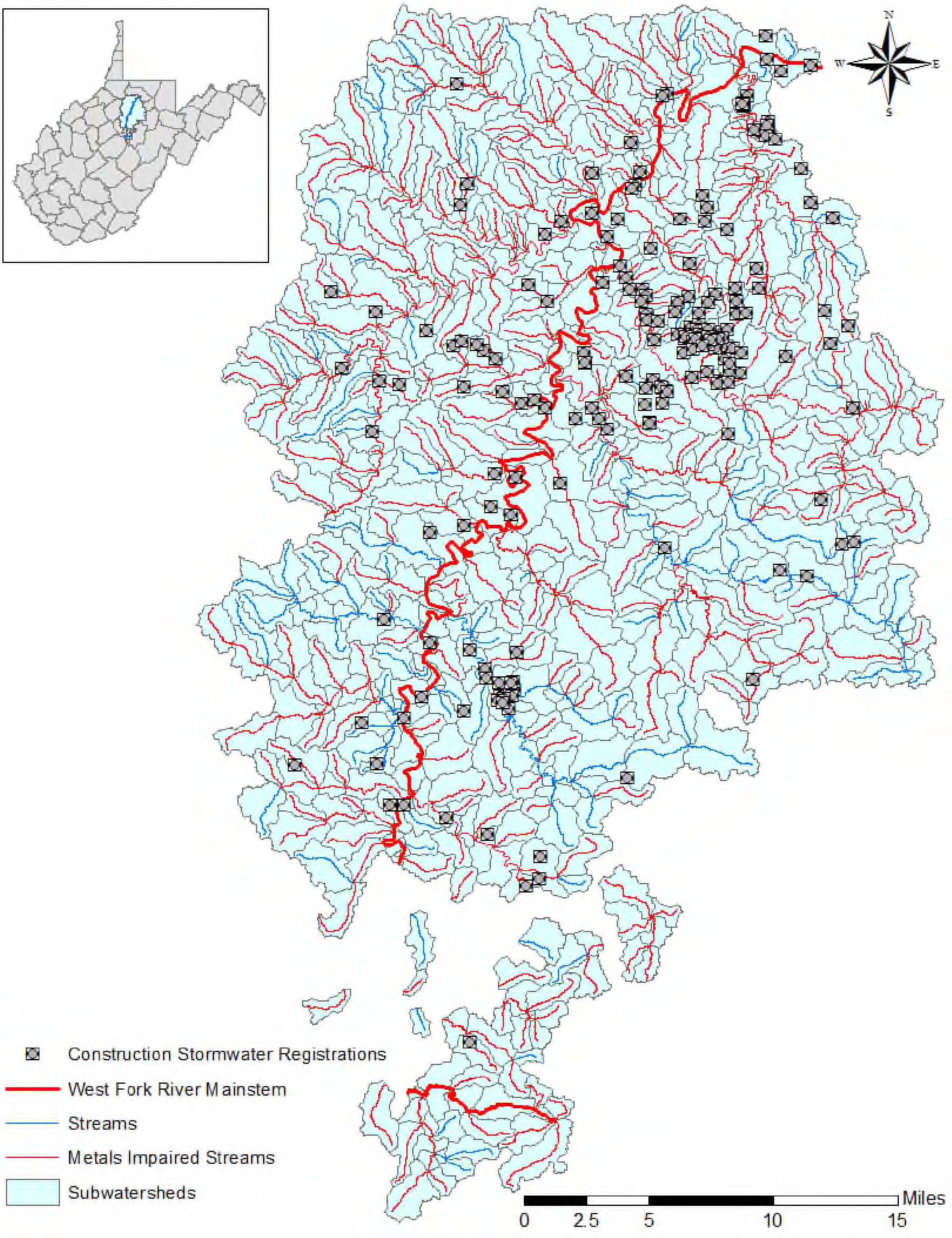
Non-stormwater municipal and industrial sources for which existing NPDES permits did not contain iron or aluminum effluent limitations were not considered to be substantive metals sources and were not explicitly represented in the modeling. Existing discharges from such sources do not require wasteload 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.

There are 246 modeled non-mining NPDES permitted outlets (four water treatment plant discharges, one individual industrial wastewater discharge, 80 individual industrial stormwater discharges, 144 storm water industrial general permit discharges, and 10 solid waste landfill discharges, and seven POTW stormwater discharges) in the watersheds of metals impaired streams, which are displayed in **Figure 5-1**. The assigned WLAs for all non-mining NPDES outlets allow for continued discharge under existing permit requirements. A complete list of the permits and outlets is provided in **Appendix F** of the Technical Report.

### 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, 173 active construction sites with a total disturbed acreage of 2092 acres registered under the Construction Stormwater General Permit (CSGP) were represented in the watersheds of metals impaired waters (**Figure 5-2**). One individual construction stormwater NPDES permit with 24 outlets and 946 acres of disturbed area was also represented. 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 9.7.1** and **11.0**.




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

**Figure 5-2.** Construction stormwater permits in the West Fork 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 Fairmont (WVR030038), City of Clarksburg (WVR030034), and the West Virginia Division of Highways (WVDOH) (WVR030004).

The City of Fairmont and City of Clarksburg MS4 permit area falls within the established city limits of both entities. WVDOH MS4 area occurs inside and on the periphery of the municipal MS4 entities listed above.

MS4 source representation was 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. The representation also includes streambank erosion loads for the portions of streams within the MS4 boundaries. WVDEP consulted with local governments and obtained information to determine drainage areas to the respective systems and best represent MS4 pollutant loadings. The location and extent of the MS4 jurisdictions are shown in **Figure 5-3**.

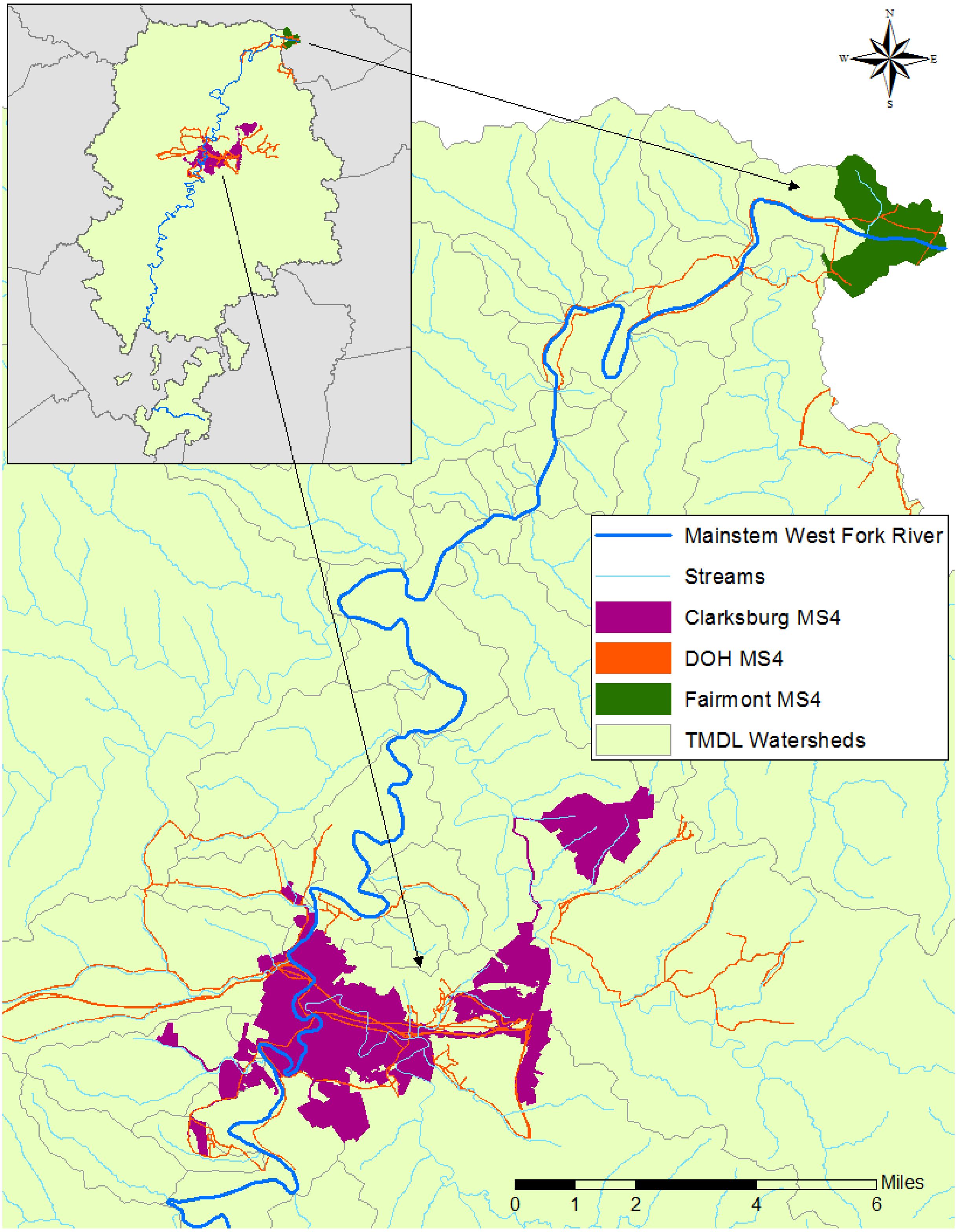



**Figure 5-3.** MS4 jurisdictions in the West Fork River Watershed

## 5.2 Metals 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 West Fork 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 impairments, a total of 379.2 miles (3016 acres) of AML highwall and 131 AML seeps, were incorporated into the TMDL model (**Figure 5-4**).

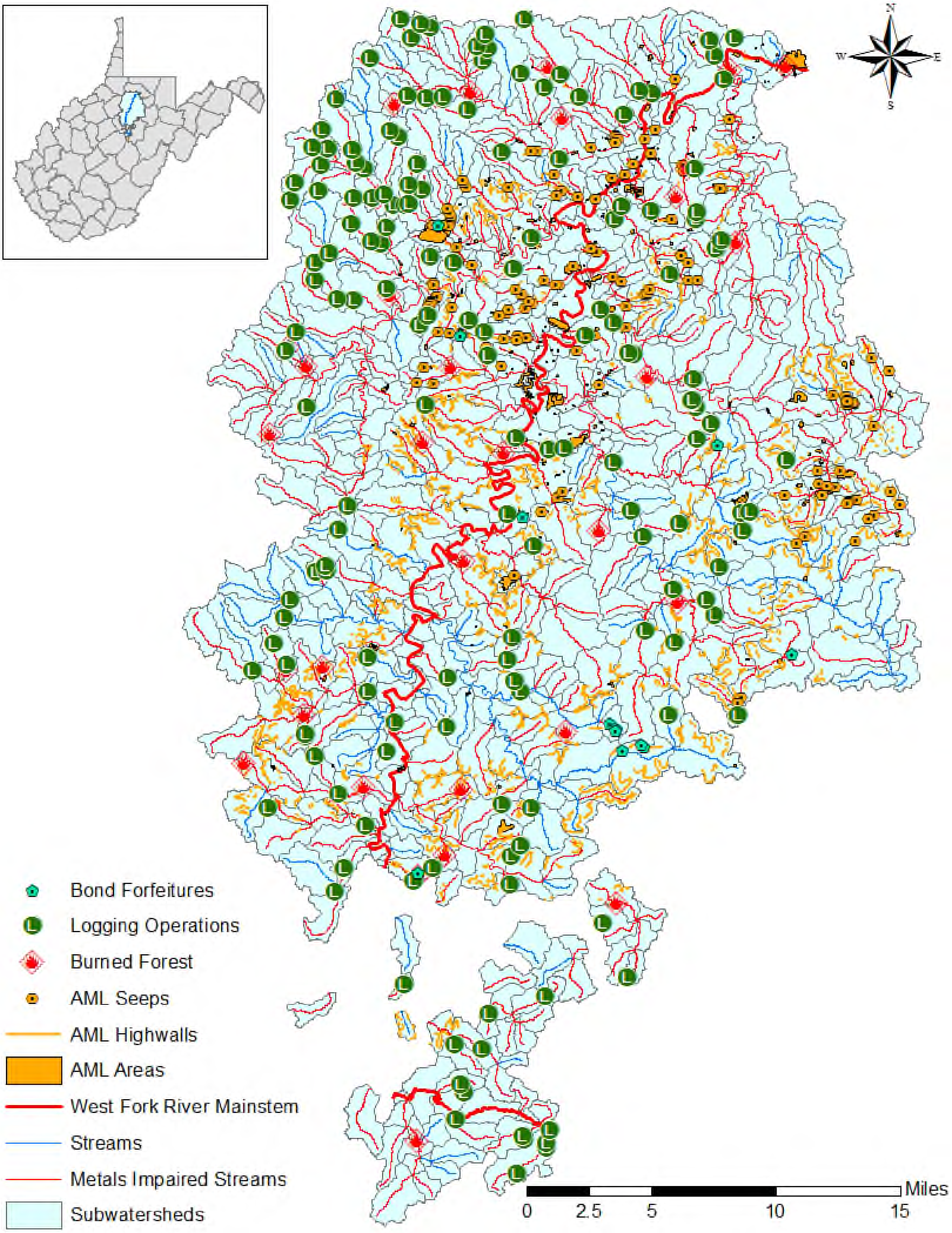



**Figure 5-4.** Metals non-point sources in the West Fork River Watershed

### 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 9685 acres of harvested area within the TMDL impaired streams watersheds, of which subset of land disturbed by roads and landings is 774.8 acres. In addition, 103.6 acres of burned forest were reported and included as disturbed land. .

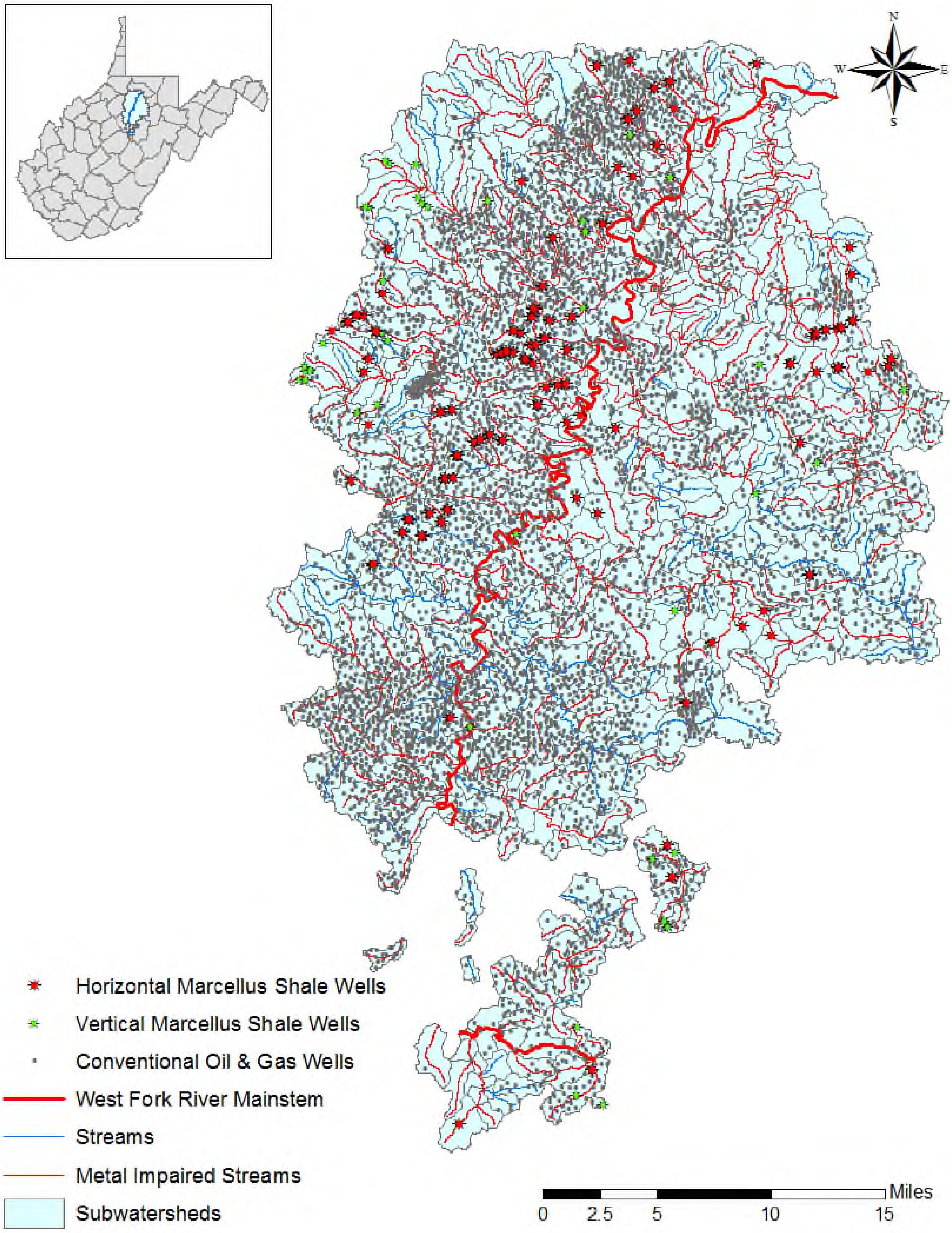
West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992, the West Virginia Legislature passed the Logging Sediment Control Act. The act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated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

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There are 5906 conventional active oil and gas wells (comprising 8150.3 acres), 67 vertical Marcellus wells (229.1 acres), and 311 horizontal Marcellus wells (765.9 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: permits in close proximity appear to overlap in the figure)

**Figure 5-5**. Oil and Gas Well locations in the West Fork 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 2009 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 activities can contribute sediment loads to nearby streams. Agricultural landuses account for approximately 6 percent of the modeled land area in metals impaired TMDL watersheds. Agricultural runoff can contribute excess sediment loads when farming practices allow soils to be washed into the stream. 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 special bank erosion pin study that 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.

# 6.0 pH SOURCE ASSESSMENT

pH impairments in the study area are caused by acidity introduced by legacy mining activities. West Fork 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.

While acid precipitation and the low buffering capacity of certain watersheds can contribute to lower observed pH, it is not the causative source for impaired waters in the West Fork River Watershed. The presence of limestone deposits within the subwatersheds mitigates adverse impacts from of acidic precipitation.

# 7.0 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, 4 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 Bingamon Creek watershed are shown in **Figure 7-1**. 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 higher than background, due to de-icing activities.

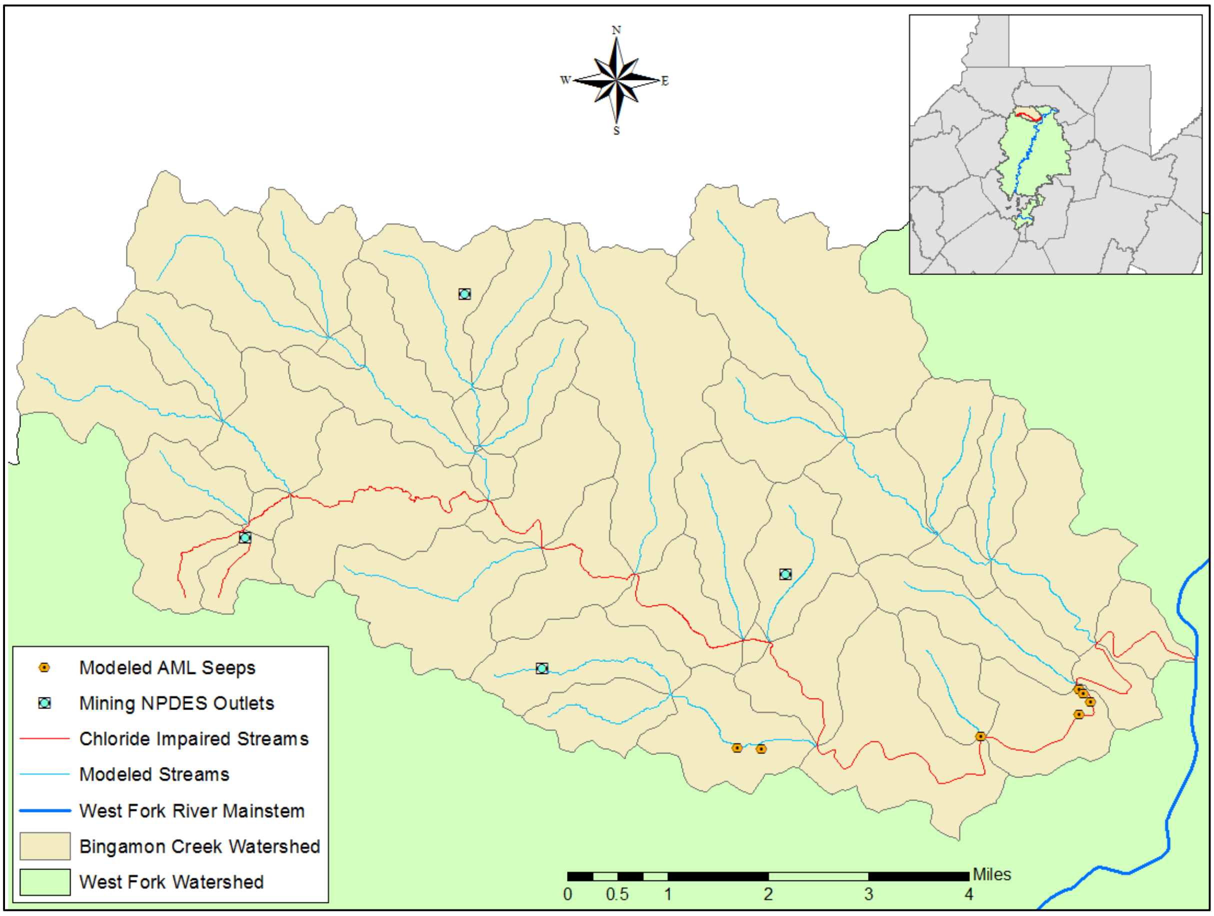



**Figure 7-1**. Chloride point sources in the West Fork River Watershed

# 8.0 FECAL COLIFORM SOURCE ASSESSMENT

## 8.1 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 West Fork River Watershed.

### 8.1.1 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, 12 individually permitted POTW's discharge treated effluent at 13 outlets. Those permits also include 7 stormwater outlets with fecal coliform limits. There are two outlets regulating treated sewage at individually permitted industrial facilities. Four mining bathhouse facilities discharge to TMDL streams in the West Fork River TMDL watersheds.

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.

### 8.1.2 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.

In the subject watersheds, there were a total of 93 CSO outlets associated with POTW collection systems operated by the City of Bridgeport (10), City of Clarksburg (56), City of Fairmont (7), the City of Shinnston (10), the City of Weston (5), the Town of Monongah (2), and the Town of Nutter Fort (3). No significant SSO discharges were represented in the model.

### 8.1.3 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.

### 8.1.4 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, 67 facilities are registered under the "package plant" general permit, one outlet is registered under the WVDOH Municipal Maintenance Facility registration permit, and 611 are registered under the HAU general permit.

## 8.2 Fecal Coliform Nonpoint Sources

### 8.2.1 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 10,200 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 8-1** shows the failing septic flows represented in the model by subwatershed.

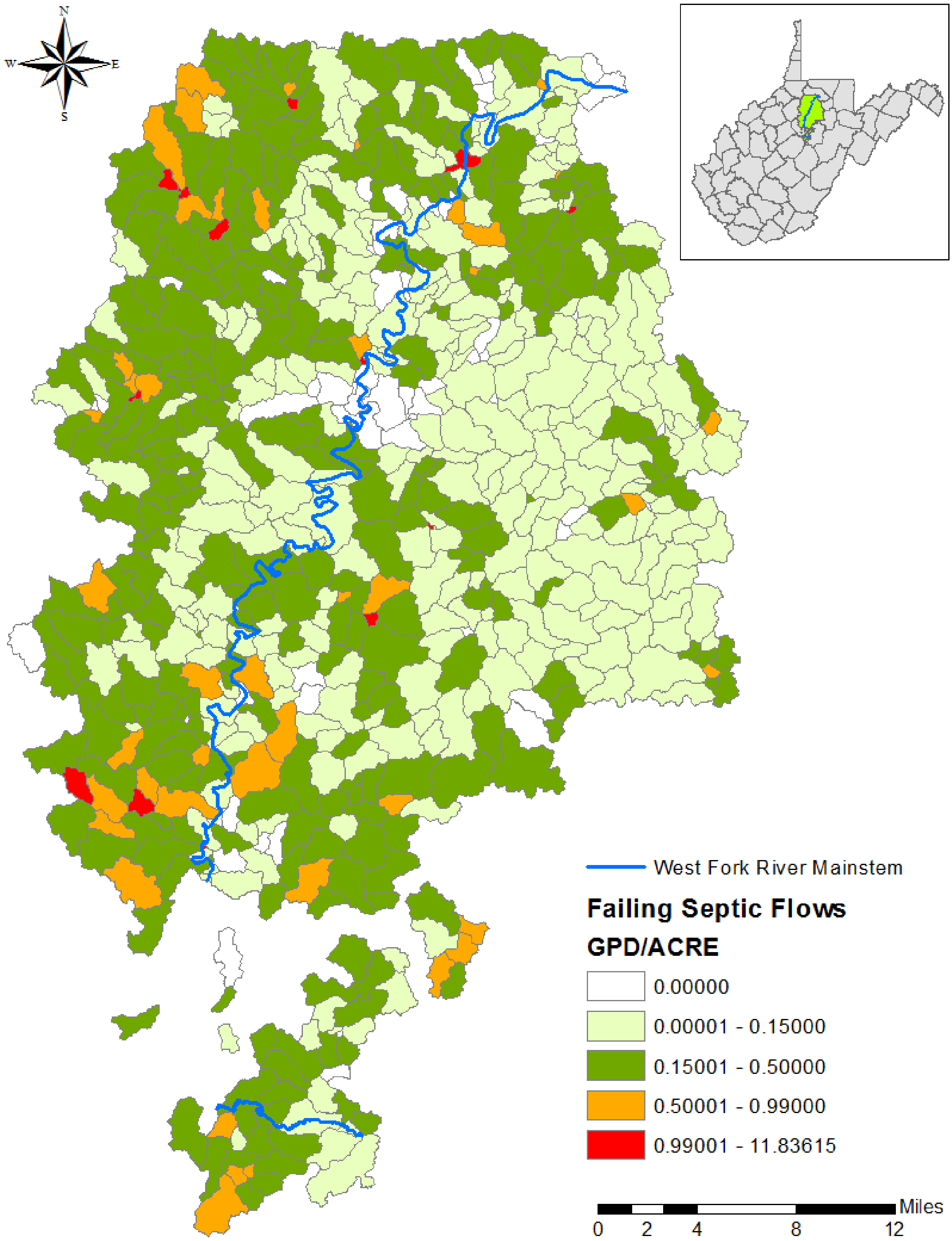



**Figure 8-1.** Failing septic flows in the West Fork River Watershed

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.

### 8.2.2 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.

### 8.2.3 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.

### 8.2.4 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.

# 9.0 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 West Fork River Watershed.

## 9.1 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
- 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, chloride, pH, and fecal coliform bacteria in West Virginia are presented in **Section 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 West Fork 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 AML 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, and fecal coliform bacteria were modeled using the MDAS.

## 9.2 Model Setup

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

### 9.2.1 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 52 TMDL watersheds were broken into 700 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.

### 9.2.2 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.

Flow withdrawal from one significant water user, the Harrison Power Station facility, was represented in the model. A substantive water loss occurs due to evaporation at this facility. Withdrawal and discharge data provided by the facility were used to inform flow rates represented in the model.

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 9-1**). 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.

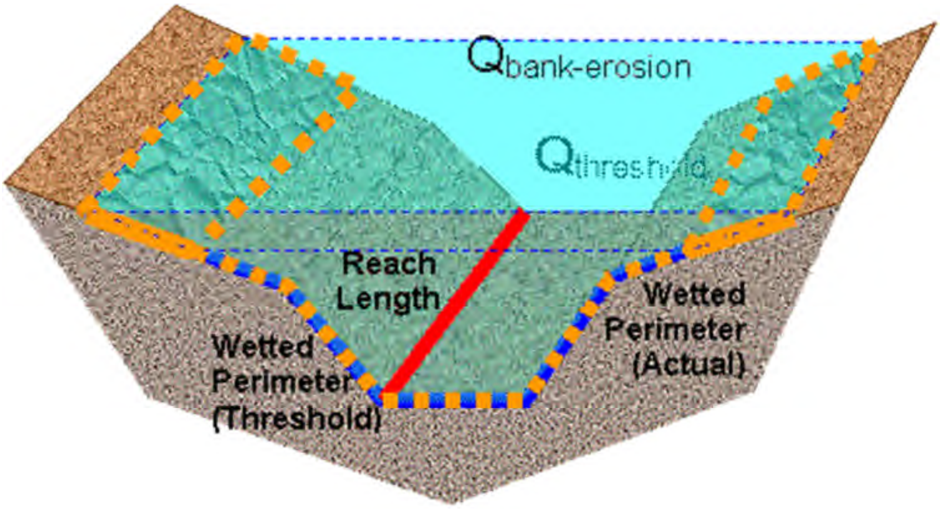



**Figure 9-1.** Conceptual diagram of stream channel components used in the bank erosion model

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. In order to understand the bank stability for the West Fork River Watershed, the WVDEP conducted a bank erosion pin study. Observed data from the erosion pin study were processed to calculate the annual sediment loading from streambank erosion in the studied streams segments. Both quantitative and qualitative assessments indicated that vegetative coverage 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 bank vegetative cover was scored and each level was associated with a kber value.

The bank erosion component of the watershed model was then run using various kber values and the modeled loads were compared with the calculated loads from the pin study. Using the pin study streams as reference, the kber values were assigned to subwatersheds through a process that compared stream size, slope, and riparian condition as assessed through aerial photography.

The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling, including the pin study.

### 9.2.3 Aluminum 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 model selection process, modeling methodologies, and technical approaches are discussed further in the Technical Report.

AML 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, 2005c). 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.

### 9.2.4 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.

### 9.2.5 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 8.2.1** describes the process of assigning flow and fecal coliform concentrations to failing septic systems.

## 9.3 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 with instream flow observations from USGS flow gauging stations throughout the watershed. USGS gauging station 03061000 West Fork River At Enterprise, WV had adequate data records for hydrology calibration for the West Fork River Watershed.

Hydrology calibration was based on observed data from that station and the landuses present in the watersheds from January 1, 2003 to October 31, 2006. Key considerations for hydrology calibration included the overall water balance, the high- and low-flow distribution, storm flows, and seasonal variation. The hydrology was validated for the time period of January 1, 2002 to December 30, 2011. As a starting point, many of the hydrology calibration parameters originated from the USGS Scientific Investigations Report 2005-5099 (Atkins, 2005). Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the West Fork River Watershed. A detailed description of the hydrology calibration and a summary of the results and validation are presented in the Technical Report.

## 9.4 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 9-2**.

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.

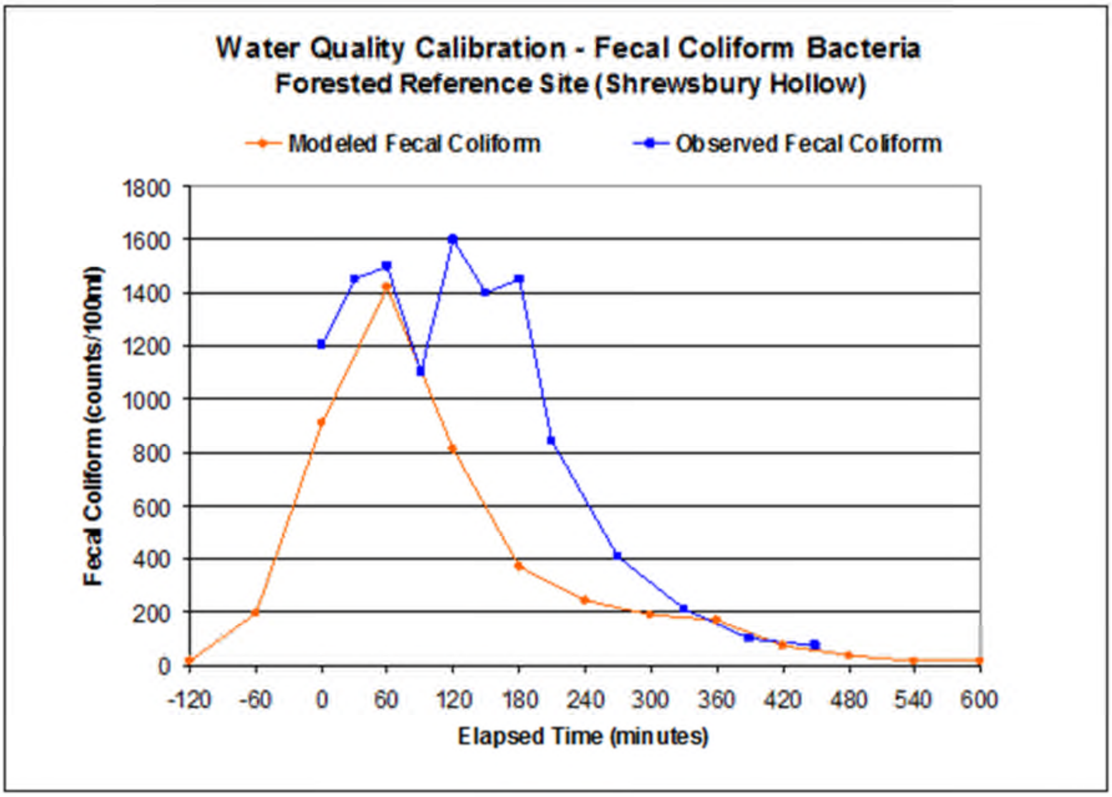



**Figure 9-2.** Shrewsbury Hollow fecal coliform observed data

## 9.5 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, Plummer Run (WV-MW-5-L-7) was selected as the reference watershed.

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

## 9.6 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:

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

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

### 9.6.1 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 9-1**.

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.

**Table 9-1.** 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) |
| 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.

### 9.6.2 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 9-3** presents the annual rainfall totals for the years 1999 through 2010 at the Harrison/Marion County Regional Airport (WBAN 03802) 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 West Fork River Watershed.

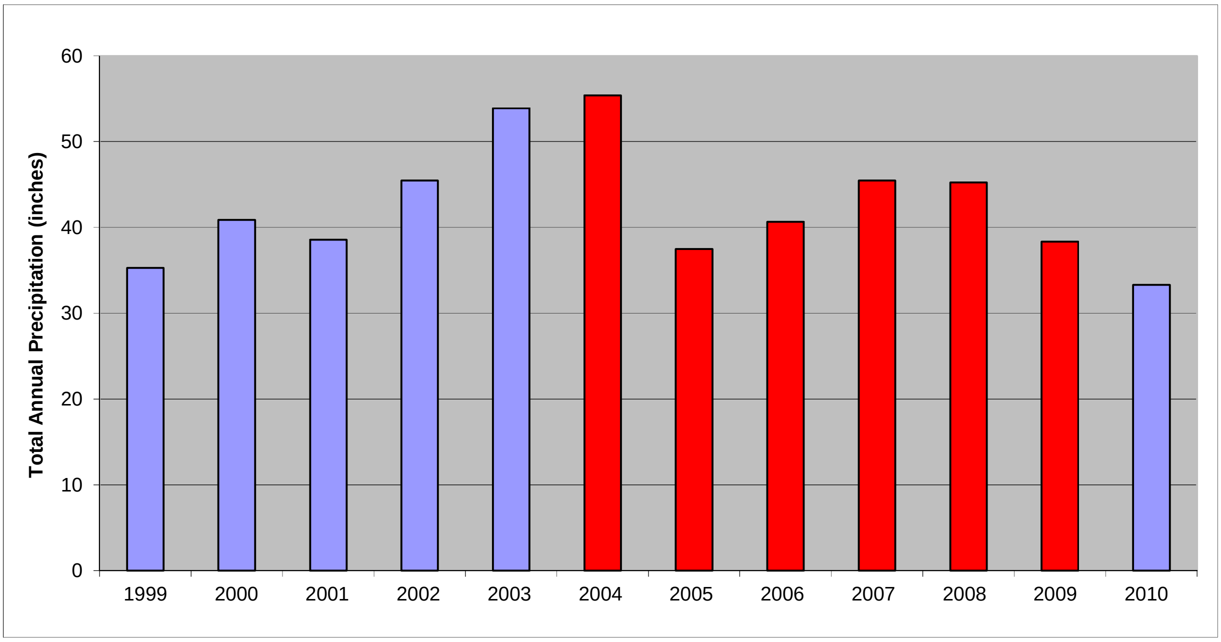



**Figure 9-3.** Annual precipitation totals for the Harrison/Marion County Regional Airport (WBAN 03802) weather station

The metals and chloride concentrations associated with common effluent limitations in mining NPDES permits are iron, aluminum and chloride. 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 95$^{th}$ percentile of maximum values from Discharge Monitoring Reports (1.2 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.

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, a range of 0.0 to 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.

CSO outlets were represented as discreet point sources in the model. CSO flow and discharge frequency was derived from overflow data supplied by the POTWs, when available. This information was augmented with precipitation analysis and watershed modeling to develop model inputs needed to build fecal coliform loading values for a ten-year time series from which annual average fecal coliform loading values could be calculated. CSO effluent was represented in the model at a concentration of 100,000 counts/100 mL to reflect baseline conditions for untreated CSO discharges.

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 9-4** shows an example of model output for a baseline condition and a successful TMDL scenario.

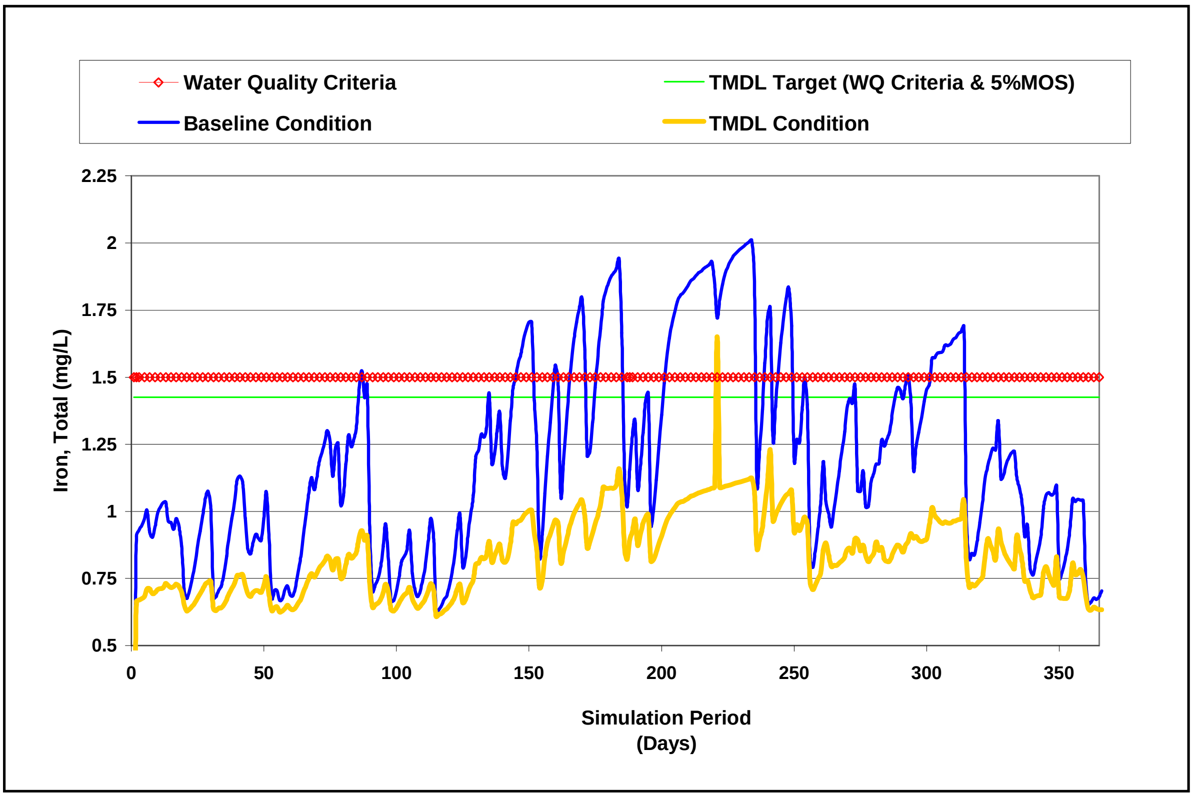



**Figure 9-4.** Example of baseline and TMDL conditions for total iron

## 9.7 TMDLs and Source Allocations

### 9.7.1 Total Iron TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the iron impaired streams of the West Fork 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, as determined by the bank erosion pin study.
2. The following land disturbing sources were equitably reduced to the iron loading associated with 100 mg/L TSS.
   - Abandoned mine lands
   - Barren
   - Cropland
   - Pasture
   - Urban/MS4 Pervious
   - Oil and gas
   - Harvested Forest and Skid Roads

- Burned Forest
- Unpaved Roads

3. AML seeps were reduced to water quality criterion end of pipe (1.5 mg/L iron).
4. 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 CSGP activity area allowances or 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 CSGP activity area allowances for subwatersheds contributing to non-attaining downstream subwatersheds were incrementally reduced from 2.5 percent to 0.5 percent area allowances. The iron loads from the dominant source were incrementally reduced below the associated 100 mg/l TSS threshold, but not less than 70 mg/l TSS.

After executing the reductions to iron loads from dominant sources, the model continued to indicate non-attainment at the pour points of a limited number of subwatersheds. In those subwatersheds, further reductions were made to the CSGP activity area allowance to zero percent.

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.

### Discharges regulated by the Multi Sector Stormwater Permit

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

**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 West Fork there are three 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 Fairmont WVR030038
- City of Clarksburg WVR030034
- 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 9.6.2**. An allocation of 0.0 to 2.5 percent of 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 11**.

**Other Non-mining Point Sources**

WLAs were established for non-mining iron point sources equal to baseline conditions for all sources. A separate analysis was performed to determine if the water withdrawal and associated wastewater treatment operations at the Harrison Power Station result in an overall reduction of iron in the West Fork River, and if, under the TMDL scenario, a wasteload allocation less stringent than the iron water quality criterion could be afforded to the facility. It was determined that facility operations may reduce the iron loading in the river if a long term period is evaluated, but a less stringent wasteload allocation could not be shown to result in criterion attainment. The data provided demonstrates that intake rates are often greater than annual average rates during months associated with critical low flow conditions and discharge flows approach permit limitations during those periods, thereby precluding the assignment of a less stringent allocation.

Non-stormwater municipal and industrial sources for which existing NPDES permits did not contain iron were not considered to be substantive sources and were not explicitly represented in the modeling. Existing discharges from such sources do not require wasteload allocations pursuant to the iron TMDLs. Any metals loading associated with such sources is contained in the background loading and accounted for in model calibration.

**Load Allocations (LAs)**

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

- AML: loading from abandoned mine lands, including loads from disturbed land, 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)

### 9.7.2 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 West Fork River Watershed. Substantive sources (e.g., seeps) of total iron were reduced as described in **Section 9.7.1** because existing instream dissolved iron concentrations can significantly reduce pH during precipitation processes. Reduced pH could result in re-dissolution of aluminum minerals (e.g. amorphous aluminum oxides) and could affect instream dissolved aluminum concentrations. During the iron reduction process, the model retained information regarding the phases of total iron, metal acidity, and added alkalinity, that was then linked to dissolved aluminum and pH simulations. If model results predicted non-attainment of the pH and dissolved aluminum criteria, additional reductions were potentially made to other sources of total iron, simultaneously with alkalinity additions and total aluminum reductions to source water discharges. Iron reductions for the aluminum/pH model were developed from the baseline scenario for the iron TMDL model, and were the same as the final allocations of the iron TMDL. 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 Multi-sector Stormwater, 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 disturbed land, 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 alkalinity from carbonate geologic formations. The additional acidity reduction (alkalinity addition) required to meet pH water quality criterion are presented in the TMDL load allocations for the pH impaired streams.

### 9.7.3 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
- All CSO discharges were assigned WLAs at the value of the fecal coliform water quality criterion (200 counts/100ml).
- 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.

#### Combined Sewer Overflows

In TMDL watersheds there are a total of 93 CSO outlets associated with POTWs operated by the municipalities or sanitary districts listed below (**Table 9-2**). These systems have Long Term Control Plans, but currently experience frequent stormwater-related CSO discharges, and do not have systems in place to store or treat CSO discharges.

**Table 9-2.** Combined sewer overflows in the West Fork River Watershed

| City | Modeled Sub-watershed | Receiving Stream | Receiving Stream Code | Permit ID | Outlet |
|---|---|---|---|---|---|
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C002 |
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C003 |
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C004 |
| Bridgeport | 1421 | Simpson Creek | WV-MW-31 | WV0025461 | C005 |
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C006 |
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C007 |
| Bridgeport | 1419 | Simpson Creek | WV-MW-31 | WV0025461 | C008 |
| Bridgeport | 1422 | Ann Run | WV-MW-31-K | WV0025461 | C009 |
| Bridgeport | 1422 | Ann Run | WV-MW-31-K | WV0025461 | C011 |
| Bridgeport | 1421 | Simpson Creek | WV-MW-31 | WV0025461 | C013 |
| Clarksburg | 1482 | West Fork River | WV-MW | WV0023302 | C002 |
| Clarksburg | 1482 | West Fork River | WV-MW | WV0023302 | C003 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C004 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C004B |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C005 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C006 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C007 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C008 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C009 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C010 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C011 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C012 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C013 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C014 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C015 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C016 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C017 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C018 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C019 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C020 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C021 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C022 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C023 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C025 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C027 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C028 |

| City | Modeled Sub-watershed | Receiving Stream | Receiving Stream Code | Permit ID | Outlet |
|---|---|---|---|---|---|
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C030 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C033 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C034 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C036 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C038 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C040 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C042 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C044 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C045 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C046 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C047 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C049 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C050 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C051 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C052 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C053 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C057 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C060 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C062 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C064 |
| Clarksburg | 1511 | Elk Creek | WV-MW-37 | WV0023302 | C065 |
| Clarksburg | 1501 | Elk Creek | WV-MW-37 | WV0023302 | C066 |
| Clarksburg | 1511 | Elk Creek | WV-MW-37 | WV0023302 | C067 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C069 |
| Clarksburg | 1511 | Elk Creek | WV-MW-37 | WV0023302 | C072 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C073 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C077 |
| Clarksburg | 1595 | West Fork River | WV-MW | WV0023302 | C078 |
| Clarksburg | 1482 | West Fork River | WV-MW | WV0023302 | C081 |
| Clarksburg | 1494 | West Fork River | WV-MW | WV0023302 | C082 |
| Fairmont | 1002 | Goose Run | WV-MW-2 | WV0023353 | C003 |
| Fairmont | 1001 | West Fork River | WV-MW | WV0023353 | C004 |
| Fairmont | 1001 | West Fork River | WV-MW | WV0023353 | C005 |
| Fairmont | 1001 | West Fork River | WV-MW | WV0023353 | C007 |
| Fairmont | 1001 | West Fork River | WV-MW | WV0023353 | C010 |
| Fairmont | 1001 | West Fork River | WV-MW | WV0023353 | C044 |
| Fairmont | 1003 | West Fork River | WV-MW | WV0023353 | C049 |

| City | Modeled Sub-watershed | Receiving Stream | Receiving Stream Code | Permit ID | Outlet |
|---|---|---|---|---|---|
| Monongah | 1007 | West Fork River | WV-MW | WV0027324 | C001 |
| Monongah | 1008 | Booths Creek | WV-MW-5 | WV0027324 | C002 |
| Nutter Fort | 1511 | Elk Creek | WV-MW-37 | WV0100901 | C001 |
| Nutter Fort | 1511 | Elk Creek | WV-MW-37 | WV0100901 | C002 |
| Nutter Fort | 1511 | Elk Creek | WV-MW-37 | WV0100901 | C003 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C002 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C003 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C004 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C005 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C006 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C007 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C008 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C009 |
| Shinnston | 1129 | West Fork River | WV-MW | WV0054500 | C010 |
| Shinnston | 1141 | West Fork River | WV-MW | WV0054500 | C011 |
| Weston | 1799 | West Fork River | WV-MW | WV0028088 | C002 |
| Weston | 1799 | West Fork River | WV-MW | WV0028088 | C003 |
| Weston | 1808 | Stonecoal Creek | WV-MW-90 | WV0028088 | C004 |
| Weston | 1823 | West Fork River | WV-MW | WV0028088 | C005 |
| Weston | 1823 | West Fork River | WV-MW | WV0028088 | C006 |

All fecal coliform bacteria WLAs for CSO discharges have been established at 200 counts/100mL Implementation can be accomplished by CSO elimination or by disinfection treatment and discharge in compliance with the operable, concentration-based allocations.

In establishing the WLAs for CSOs, WVDEP first considered the appropriateness of mixing zones for bacteria. WVDEP concluded that mixing zones would allow elevated levels of bacteria that may not conform to the mixing zone provisions at 47 CSR 2 §5.2.c., 5.2.g. and 5.2.h.3. Because 47 CSR 2 §5.2.c. prohibits pollutant concentrations greater than criteria for the protection of human health at any point unless a mixing zone has been assigned, the CSO WLAs were established at the value of the fecal coliform water quality criterion.

It is important to note that even if mixing zone rules are alternatively interpreted or changed in the future, dilution is generally not available to allow CSO allocations to be substantively greater than criteria. WVDEP used the calibrated model to examine the magnitude of CSO allocations that could be shown to result in criteria attainment when coupled with the allocations for other sources prescribed in this project. The analysis demonstrated nonattainment at multiple modeled locations when CSO were modestly increased above 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 Clarksburg, City of Fairmont, 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)

### 9.7.4 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. 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 AML 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 non-MS4 urban residential land uses. Reduction was not necessary to attain water quality chloride criteria. Elsewhere, point source reduction will result in criteria attainment with nonpoint source loading at baseline conditions.

### 9.7.5 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 metals, chloride and fecal coliform 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.

### 9.7.6 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, AML 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.

### 9.7.7 TMDL Presentation

The TMDLs for all impairments are shown in **Section 10** of this report. The TMDLs for iron chloride, 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, and aluminum 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 iron WLAs for non-construction sectors registered under the Multi Sector Stormwater Permit are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are operable, and because they are equivalent to existing effluent limitations/benchmark values, they are to be directly implemented.

The fecal coliform bacteria WLAs for sewage treatment plant effluents and CSOs for 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. 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.

# 10.0 TMDL RESULTS

**Table 10-1.** 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) |
|---|---|---|---|---|---|---|
| Booths Creek | WV-MW-5-J-1 | Purdys Run | 2.80 | 0.064 | 0.15 | 3.01 |
| Shinns Run | WV-MW-23 | Shinns Run | 7.18 | 1.178 | 0.44 | 8.80 |
| Shinns Run | WV-MW-23-F | UNT/Shinns Run RM 4.15 | 1.61 | 0.392 | 0.11 | 2.11 |
| Shinns Run | WV-MW-23-G | UNT/Shinns Run RM 5.61 | 0.12 | 0.001 | 0.01 | 0.13 |
| Simpson Creek | WV-MW-31-C | Smith Run | 8.79 | 2.636 | 0.60 | 12.03 |
| Simpson Creek | WV-MW-31-U-2 | UNT/Right Fork RM 0.33/Simpson Creek | 11.20 | 0.126 | 0.60 | 11.93 |

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

**Table 10-2.** 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) |
|---|---|---|---|---|---|---|
| West Fork River | WV-MW | West Fork River | 8525.01 | 1371.43 | 520.87 | 10417.30 |
| West Fork River | WV-MW | Upper Portion of West Fork River | 126.10 | 8.44 | 7.08 | 141.62 |
| Mill Fall Run | WV-MW-4 | Mill Fall Run | 9.98 | 0.93 | 0.57 | 11.48 |
| Mill Fall Run | WV-MW-4-A | Little Mill Fall Run | 3.19 | 0.30 | 0.18 | 3.67 |
| Booths Creek | WV-MW-5 | Booths Creek | 261.14 | 26.71 | 15.15 | 303.00 |
| Booths Creek | WV-MW-5-C | UNT/Booths Creek RM 3.58 | 0.88 | 0.03 | 0.05 | 0.95 |
| Booths Creek | WV-MW-5-D | UNT/Booths Creek RM 4.11 | 2.45 | 0.16 | 0.14 | 2.75 |
| Booths Creek | WV-MW-5-E | UNT/Booths Creek RM 4.81 | 0.98 | 0.07 | 0.06 | 1.10 |
| Booths Creek | WV-MW-5-F | Hog Lick Run | 1.22 | 7.28 | 0.45 | 8.95 |
| Booths Creek | WV-MW-5-G | Sapp Run | 5.30 | 0.35 | 0.30 | 5.95 |
| Booths Creek | WV-MW-5-I | Sweep Run | 1.66 | 0.11 | 0.09 | 1.87 |
| Booths Creek | WV-MW-5-J | Horners Run | 12.30 | 10.15 | 1.18 | 23.63 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Booths Creek | WV-MW-5-J-1 | Purdys Run | 4.30 | 0.22 | 0.24 | 4.76 |
| Booths Creek | WV-MW-5-K | UNT/Booths Creek RM 8.22 | 1.03 | 0.08 | 0.06 | 1.17 |
| Booths Creek | WV-MW-5-L | Hustead Fork | 50.22 | 2.87 | 2.79 | 55.88 |
| Booths Creek | WV-MW-5-L-7 | Plummer Run | 16.05 | 1.05 | 0.90 | 18.00 |
| Booths Creek | WV-MW-5-M | Corbin Branch | 38.63 | 1.70 | 2.12 | 42.45 |
| Booths Creek | WV-MW-5-M-6 | UNT/Corbin Branch RM 2.37 | 2.96 | 0.00 | 0.16 | 3.12 |
| Booths Creek | WV-MW-5-M-8 | UNT/Corbin Branch RM 3.36 | 4.91 | 0.25 | 0.27 | 5.43 |
| Booths Creek | WV-MW-5-M-9 | UNT/Corbin Branch RM 3.65 | 4.55 | 0.37 | 0.26 | 5.18 |
| Booths Creek | WV-MW-5-M-11 | UNT/Corbin Branch RM 4.56 | 3.51 | 0.26 | 0.20 | 3.97 |
| Booths Creek | WV-MW-5-N | Thomas Fork | 16.33 | 0.65 | 0.89 | 17.87 |
| Booths Creek | WV-MW-5-N-3 | Sugarcamp Run | 3.84 | 0.10 | 0.21 | 4.16 |
| Coons Run | WV-MW-8 | Coons Run | 28.72 | 1.63 | 1.60 | 31.95 |
| Helens Run | WV-MW-9 | Helens Run | 14.11 | 1.01 | 0.80 | 15.92 |
| Helens Run | WV-MW-9-B | UNT/Helens Run RM 1.77 | 1.83 | 0.16 | 0.10 | 2.09 |
| Tevebaugh Creek | WV-MW-10 | Tevebaugh Creek | 14.85 | 1.27 | 0.85 | 16.97 |
| Tevebaugh Creek | WV-MW-10-C | Parrish Run | 3.02 | 0.30 | 0.17 | 3.50 |
| Camp Run | WV-MW-12 | Camp Run | 3.26 | 0.19 | 0.18 | 3.63 |
| Bingamon Creek | WV-MW-14 | Bingamon Creek | 308.02 | 163.92 | 24.84 | 496.78 |
| Bingamon Creek | WV-MW-14-A | Little Bingamon Creek | 38.36 | 2.94 | 2.17 | 43.47 |
| Bingamon Creek | WV-MW-14-A-3 | UNT/Little Bingamon Creek RM 1.59 | 1.40 | 0.15 | 0.08 | 1.63 |
| Bingamon Creek | WV-MW-14-A-4 | UNT/Little Bingamon Creek RM 2.27 | 3.07 | 0.29 | 0.18 | 3.53 |
| Bingamon Creek | WV-MW-14-A-6 | UNT/Little Bingamon Creek RM 3.80 | 3.22 | 0.36 | 0.19 | 3.76 |
| Bingamon Creek | WV-MW-14-B | Long Run | 2.64 | 0.28 | 0.15 | 3.08 |
| Bingamon Creek | WV-MW-14-C | Elklick Run | 2.26 | 0.27 | 0.13 | 2.67 |
| Bingamon Creek | WV-MW-14-F | Cunningham Run | 8.75 | 20.00 | 1.51 | 30.27 |
| Bingamon Creek | WV-MW-14-F-2 | UNT/Cunningham Run RM 1.78 | 1.49 | 0.94 | 0.13 | 2.56 |
| Bingamon Creek | WV-MW-14-H | UNT/Bingamon Creek RM 8.41 | 5.73 | 47.62 | 2.81 | 56.16 |
| Bingamon Creek | WV-MW-14-I | UNT/Bingamon Creek RM 8.68 | 3.67 | 0.40 | 0.21 | 4.28 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Bingamon Creek | WV-MW-14-N | Big Indian Run | 5.55 | 0.69 | 0.33 | 6.57 |
| Bingamon Creek | WV-MW-14-P | Glade Fork | 25.06 | 26.12 | 2.69 | 53.87 |
| Bingamon Creek | WV-MW-14-P-1 | Coal Lick Run | 7.93 | 24.27 | 1.70 | 33.90 |
| Bingamon Creek | WV-MW-14-P-1-A | Crabapple Run | 1.73 | 0.13 | 0.10 | 1.96 |
| Bingamon Creek | WV-MW-14-P-1-B | Road Fork | 2.91 | 23.75 | 1.40 | 28.06 |
| Bingamon Creek | WV-MW-14-P-5 | Tucker Fork | 2.77 | 0.79 | 0.19 | 3.75 |
| Bingamon Creek | WV-MW-14-V | Harris Fork | 8.26 | 52.43 | 3.19 | 63.88 |
| Bingamon Creek | WV-MW-14-W | Quaker Fork | 12.92 | 1.58 | 0.76 | 15.26 |
| UNT/West Fork River RM 11.44 | WV-MW-15 | UNT/West Fork River RM 11.44 | 1.04 | 0.07 | 0.06 | 1.17 |
| Laurel Run | WV-MW-18 | Laurel Run | 4.12 | 6.44 | 0.56 | 11.12 |
| UNT/West Fork River RM 13.10 | WV-MW-19 | UNT/West Fork River RM 13.10 | 1.25 | 0.06 | 0.07 | 1.38 |
| Mudlick Run | WV-MW-20 | Mudlick Run | 11.83 | 1.32 | 0.69 | 13.85 |
| Mudlick Run | WV-MW-20-A | UNT/Mudlick Run RM 1.27 | 4.05 | 0.29 | 0.23 | 4.57 |
| UNT/West Fork River RM 13.91 | WV-MW-21 | UNT/West Fork River RM 13.91 | 2.40 | 0.10 | 0.13 | 2.63 |
| Browns Run | WV-MW-22 | Browns Run | 4.07 | 0.25 | 0.23 | 4.55 |
| Shinns Run | WV-MW-23 | Shinns Run | 36.05 | 6.04 | 2.22 | 44.30 |
| Shinns Run | WV-MW-23-D | UNT/Shinns Run RM 2.81 | 1.89 | 0.22 | 0.11 | 2.23 |
| Shinns Run | WV-MW-23-E | UNT/Shinns Run RM 3.69 | 3.31 | 2.69 | 0.32 | 6.31 |
| Shinns Run | WV-MW-23-F | UNT/Shinns Run RM 4.15 | 5.80 | 1.41 | 0.38 | 7.58 |
| Shinns Run | WV-MW-23-G | UNT/Shinns Run RM 5.61 | 1.51 | 0.08 | 0.08 | 1.68 |
| Shinns Run | WV-MW-23-H | UNT/Shinns Run RM 5.97 | 1.09 | 0.34 | 0.07 | 1.50 |
| Robinson Run | WV-MW-26 | Robinson Run | 20.43 | 15.71 | 1.90 | 38.04 |
| Robinson Run | WV-MW-26-A | Pigotts Run | 2.73 | 0.44 | 0.17 | 3.33 |
| Robinson Run | WV-MW-26-B | UNT/Robinson Run RM 1.08 | 1.48 | 0.13 | 0.08 | 1.70 |
| Tenmile Creek | WV-MW-27 | Tenmile Creek | 803.47 | 203.49 | 53.00 | 1059.96 |
| Tenmile Creek | WV-MW-27-A | Jack Run | 1.79 | 0.13 | 0.10 | 2.02 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Tenmile Creek | WV-MW-27-B | Jones Creek | 29.95 | 9.45 | 2.07 | 41.48 |
| Tenmile Creek | WV-MW-27-B-3 | Nolan Run | 1.77 | 7.79 | 0.50 | 10.06 |
| Tenmile Creek | WV-MW-27-D | UNT/Tenmile Creek RM 4.19 | 2.11 | 0.16 | 0.12 | 2.39 |
| Tenmile Creek | WV-MW-27-E | Little Tenmile Creek | 166.63 | 7.76 | 9.18 | 183.57 |
| Tenmile Creek | WV-MW-27-E-1 | UNT/Little Tenmile Creek RM 0.40 | 1.30 | 0.07 | 0.07 | 1.45 |
| Tenmile Creek | WV-MW-27-E-2 | Peters Run | 1.82 | 0.14 | 0.10 | 2.06 |
| Tenmile Creek | WV-MW-27-E-3 | UNT/Little Tenmile Creek RM 1.91 | 0.91 | 0.08 | 0.05 | 1.04 |
| Tenmile Creek | WV-MW-27-E-4 | Bennett Run | 8.81 | 0.59 | 0.49 | 9.89 |
| Tenmile Creek | WV-MW-27-E-4-A | UNT/Bennett Run RM 0.76 | 1.22 | 0.13 | 0.07 | 1.42 |
| Tenmile Creek | WV-MW-27-E-5 | Caldwell Run | 3.82 | 0.28 | 0.22 | 4.32 |
| Tenmile Creek | WV-MW-27-E-7 | Laurel Run | 3.27 | 0.30 | 0.19 | 3.76 |
| Tenmile Creek | WV-MW-27-E-9 | Jake Run | 1.92 | 0.04 | 0.10 | 2.06 |
| Tenmile Creek | WV-MW-27-E-11 | Little Elk Creek | 5.38 | 0.54 | 0.31 | 6.23 |
| Tenmile Creek | WV-MW-27-E-15 | Middle Run/Little Tenmile Creek | 6.29 | 0.62 | 0.36 | 7.27 |
| Tenmile Creek | WV-MW-27-E-16 | Barnes Run | 3.62 | 0.38 | 0.21 | 4.20 |
| Tenmile Creek | WV-MW-27-E-18 | Mudlick Run | 4.63 | 0.48 | 0.27 | 5.38 |
| Tenmile Creek | WV-MW-27-H | Isaac Creek | 8.63 | 3.48 | 0.64 | 12.75 |
| Tenmile Creek | WV-MW-27-H-1 | Little Isaac Creek | 1.23 | 0.08 | 0.07 | 1.38 |
| Tenmile Creek | WV-MW-27-I | Gregory Run | 5.84 | 0.39 | 0.33 | 6.56 |
| Tenmile Creek | WV-MW-27-K | Katy Lick Run | 6.71 | 2.06 | 0.46 | 9.23 |
| Tenmile Creek | WV-MW-27-L | Flag Run | 4.45 | 1.10 | 0.29 | 5.85 |
| Tenmile Creek | WV-MW-27-M | UNT/Tenmile Creek RM 10.82 | 3.97 | 0.15 | 0.22 | 4.34 |
| Tenmile Creek | WV-MW-27-N | Rockcamp Run | 53.53 | 66.95 | 6.34 | 126.83 |
| Tenmile Creek | WV-MW-27-N-2 | Little Rockcamp Run | 15.86 | 1.53 | 0.92 | 18.30 |
| Tenmile Creek | WV-MW-27-N-2-C | UNT/Little Rockcamp Run RM 1.22 | 3.60 | 0.34 | 0.21 | 4.15 |
| Tenmile Creek | WV-MW-27-Q | UNT/Tenmile Creek RM 13.15 | 1.25 | 0.09 | 0.07 | 1.41 |
| Tenmile Creek | WV-MW-27-R | Grass Run | 23.84 | 2.32 | 1.38 | 27.54 |
| Tenmile Creek | WV-MW-27-R-7 | UNT/Grass Run RM 3.26 | 4.83 | 0.45 | 0.28 | 5.56 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Tenmile Creek | WV-MW-27-V | Indian Run | 17.21 | 1.81 | 1.00 | 20.02 |
| Tenmile Creek | WV-MW-27-V-7 | UNT/Indian Run RM 3.07 | 3.10 | 0.33 | 0.18 | 3.61 |
| Tenmile Creek | WV-MW-27-X | Salem Fork | 80.75 | 4.71 | 4.50 | 89.96 |
| Tenmile Creek | WV-MW-27-X-3 | Raccoon Run | 4.69 | 0.44 | 0.27 | 5.40 |
| Tenmile Creek | WV-MW-27-X-4 | Cherrycamp Run | 6.61 | 0.47 | 0.37 | 7.45 |
| Tenmile Creek | WV-MW-27-X-8 | Patterson Fork | 12.14 | 1.08 | 0.70 | 13.92 |
| Tenmile Creek | WV-MW-27-X-8-B | UNT/Patterson Fork RM 0.59 | 4.02 | 0.45 | 0.24 | 4.70 |
| Tenmile Creek | WV-MW-27-X-9 | Jacobs Run | 6.57 | 0.60 | 0.38 | 7.54 |
| Tenmile Creek | WV-MW-27-Z | Rush Run | 1.67 | 0.18 | 0.10 | 1.95 |
| Tenmile Creek | WV-MW-27-AB | Turkey Foot Run | 3.22 | 0.28 | 0.18 | 3.68 |
| Tenmile Creek | WV-MW-27-AC | Wizardism Run (Holt Run) | 1.35 | 0.13 | 0.08 | 1.55 |
| Tenmile Creek | WV-MW-27-AK | UNT/Tenmile Creek RM 22.53 | 0.28 | 0.03 | 0.02 | 0.33 |
| Tenmile Creek | WV-MW-27-AM | Coburn Fork | 14.48 | 1.43 | 0.84 | 16.74 |
| Tenmile Creek | WV-MW-27-AM-3 | Shaw Run | 2.12 | 0.18 | 0.12 | 2.42 |
| Tenmile Creek | WV-MW-27-AP | Rush Run | 1.82 | 0.19 | 0.11 | 2.12 |
| Tenmile Creek | WV-MW-27-AU | Turtletree Fork | 8.53 | 0.88 | 0.49 | 9.90 |
| UNT/West Fork River RM 20.42 | WV-MW-30 | UNT/West Fork River RM 20.42 | 1.35 | 0.06 | 0.07 | 1.48 |
| Simpson Creek | WV-MW-31 | Simpson Creek | 447.97 | 38.27 | 25.59 | 511.83 |
| Simpson Creek | WV-MW-31-A | UNT/Simpson Creek RM 1.23 | 1.41 | 0.13 | 0.08 | 1.62 |
| Simpson Creek | WV-MW-31-B | Jack Run | 2.90 | 0.32 | 0.17 | 3.39 |
| Simpson Creek | WV-MW-31-C | Smith Run | 9.39 | 1.86 | 0.59 | 11.84 |
| Simpson Creek | WV-MW-31-C-1 | UNT/Smith Run RM 0.72 | 0.87 | 1.30 | 0.11 | 2.28 |
| Simpson Creek | WV-MW-31-D | UNT/Simpson Creek RM 5.48 | 2.12 | 0.20 | 0.12 | 2.44 |
| Simpson Creek | WV-MW-31-E | UNT/Simpson Creek RM 6.14 | 1.59 | 1.31 | 0.15 | 3.06 |
| Simpson Creek | WV-MW-31-F | Barnett Run | 6.36 | 1.61 | 0.42 | 8.39 |
| Simpson Creek | WV-MW-31-F-2 | Stouts Run | 1.88 | 0.06 | 0.10 | 2.04 |
| Simpson Creek | WV-MW-31-J | Davisson Run | 9.25 | 0.46 | 0.51 | 10.22 |
| Simpson Creek | WV-MW-31-K | Ann Run | 9.52 | 0.38 | 0.52 | 10.42 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Simpson Creek | WV-MW-31-M | Peddler Run | 11.95 | 0.79 | 0.67 | 13.40 |
| Simpson Creek | WV-MW-31-O | Beards Run | 18.63 | 7.96 | 1.40 | 28.00 |
| Simpson Creek | WV-MW-31-O-3 | Pigtail Run | 3.82 | 7.03 | 0.57 | 11.43 |
| Simpson Creek | WV-MW-31-P | Jerry Run | 5.21 | 0.82 | 0.32 | 6.35 |
| Simpson Creek | WV-MW-31-T | Berry Run | 7.45 | 0.45 | 0.42 | 8.31 |
| Simpson Creek | WV-MW-31-U | Right Fork/Simpson Creek | 48.78 | 2.71 | 2.71 | 54.19 |
| Simpson Creek | WV-MW-31-U-2 | UNT/Right Fork RM 0.33/Simpson Creek | 7.53 | 0.09 | 0.40 | 8.02 |
| Simpson Creek | WV-MW-31-U-3 | Buck Run | 7.35 | 0.55 | 0.42 | 8.31 |
| Simpson Creek | WV-MW-31-U-4 | Sand Lick Run | 5.91 | 0.58 | 0.34 | 6.84 |
| Simpson Creek | WV-MW-31-U-5 | Gabe Fork | 6.49 | 0.51 | 0.37 | 7.37 |
| Simpson Creek | WV-MW-31-U-6 | Flag Run | 4.73 | 0.41 | 0.27 | 5.41 |
| Simpson Creek | WV-MW-31-X | UNT/Simpson Creek RM 21.92 | 2.70 | 0.25 | 0.16 | 3.10 |
| Simpson Creek | WV-MW-31-Y | Bartlett Run | 3.13 | 0.31 | 0.18 | 3.63 |
| Simpson Creek | WV-MW-31-Z | UNT/Simpson Creek RM 22.72 | 1.13 | 0.09 | 0.06 | 1.28 |
| Simpson Creek | WV-MW-31-AA | West Branch/Simpson Creek | 31.99 | 1.60 | 1.77 | 35.36 |
| Simpson Creek | WV-MW-31-AA-1 | UNT/West Branch RM 0.63/Simpson Creek | 12.44 | 0.22 | 0.67 | 13.33 |
| Simpson Creek | WV-MW-31-AA-2 | Stillhouse Run | 3.55 | 0.27 | 0.20 | 4.02 |
| Simpson Creek | WV-MW-31-AA-4 | UNT/West Branch RM 1.57/Simpson Creek | 4.58 | 0.48 | 0.27 | 5.33 |
| Simpson Creek | WV-MW-31-AB | Camp Run | 7.80 | 0.53 | 0.44 | 8.77 |
| Simpson Creek | WV-MW-31-AC | UNT/Simpson Creek RM 26.94 | 4.09 | 0.33 | 0.23 | 4.65 |
| Lambert Run | WV-MW-32 | Lambert Run | 34.66 | 2.19 | 1.94 | 38.79 |
| Lambert Run | WV-MW-32-B | UNT/Lambert Run RM 1.49 | 11.11 | 0.47 | 0.61 | 12.18 |
| Lambert Run | WV-MW-32-C | UNT/Lambert Run RM 2.77 | 6.45 | 0.44 | 0.36 | 7.26 |
| Jack Run | WV-MW-33 | Jack Run | 7.00 | 0.59 | 0.40 | 7.99 |
| Fall Run | WV-MW-34 | Fall Run | 2.99 | 0.31 | 0.17 | 3.47 |
| Crooked Run | WV-MW-35 | Crooked Run | 10.95 | 1.68 | 0.66 | 13.30 |
| Crooked Run | WV-MW-35-A | UNT/Crooked Run RM 0.47 | 1.71 | 0.52 | 0.12 | 2.35 |
| Limestone Run | WV-MW-36 | Limestone Run | 35.92 | 7.53 | 2.29 | 45.73 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Limestone Run | WV-MW-36-A | Stone Coal Run | 2.74 | 0.50 | 0.17 | 3.41 |
| Limestone Run | WV-MW-36-C | Simpson Fork | 4.86 | 0.65 | 0.29 | 5.80 |
| Limestone Run | WV-MW-36-D | Johnson Fork | 3.25 | 0.22 | 0.18 | 3.65 |
| Limestone Run | WV-MW-36-F | UNT/Limestone Run RM 3.97 | 1.86 | 0.26 | 0.11 | 2.24 |
| Limestone Run | WV-MW-36-H | Phoenix Hollow | 1.25 | 0.12 | 0.07 | 1.44 |
| Elk Creek | WV-MW-37 | Elk Creek | 574.58 | 157.71 | 38.54 | 770.83 |
| Elk Creek | WV-MW-37-B | UNT/Elk Creek RM 3.39 | 1.06 | 0.28 | 0.07 | 1.41 |
| Elk Creek | WV-MW-37-C | Murphy Run | 3.35 | 2.53 | 0.31 | 6.19 |
| Elk Creek | WV-MW-37-D | Ann Moore Run | 12.01 | 4.23 | 0.85 | 17.10 |
| Elk Creek | WV-MW-37-D-1 | UNT/Ann Moore Run RM 2.00 | 6.04 | 1.60 | 0.40 | 8.04 |
| Elk Creek | WV-MW-37-F | Nutter Run | 2.57 | 0.51 | 0.16 | 3.25 |
| Elk Creek | WV-MW-37-H | Hooppole Run | 1.39 | 0.13 | 0.08 | 1.60 |
| Elk Creek | WV-MW-37-J | Brushy Fork | 77.75 | 7.44 | 4.48 | 89.68 |
| Elk Creek | WV-MW-37-J-4 | UNT/Brushy Fork RM 3.37 | 3.19 | 0.29 | 0.18 | 3.66 |
| Elk Creek | WV-MW-37-J-5 | UNT/Brushy Fork RM 4.59 | 3.11 | 0.26 | 0.18 | 3.55 |
| Elk Creek | WV-MW-37-J-8 | Coplin Run | 5.78 | 3.79 | 0.50 | 10.07 |
| Elk Creek | WV-MW-37-J-15 | Stonecoal Run | 6.85 | 0.35 | 0.38 | 7.58 |
| Elk Creek | WV-MW-37-M | Chub Run | 10.60 | 0.94 | 0.61 | 12.15 |
| Elk Creek | WV-MW-37-M-1 | Suds Run | 5.96 | 0.61 | 0.35 | 6.92 |
| Elk Creek | WV-MW-37-P | Fall Run | 4.38 | 0.36 | 0.25 | 4.99 |
| Elk Creek | WV-MW-37-R | Hastings Run | 5.97 | 0.52 | 0.34 | 6.83 |
| Elk Creek | WV-MW-37-V | Gnatty Creek | 120.90 | 44.12 | 8.69 | 173.71 |
| Elk Creek | WV-MW-37-V-3 | Rooting Creek | 41.86 | 5.78 | 2.51 | 50.14 |
| Elk Creek | WV-MW-37-V-3-C | UNT/Rooting Creek RM 1.54 | 3.92 | 0.24 | 0.22 | 4.38 |
| Elk Creek | WV-MW-37-V-3-L | UNT/Rooting Creek RM 5.22 | 2.83 | 0.26 | 0.16 | 3.25 |
| Elk Creek | WV-MW-37-V-6 | Raccoon Creek | 4.70 | 0.32 | 0.26 | 5.29 |
| Elk Creek | WV-MW-37-V-10 | Peeltree Run | 7.50 | 2.98 | 0.55 | 11.04 |
| Elk Creek | WV-MW-37-V-13 | UNT/Gnatty Creek RM 8.02 | 1.87 | 0.13 | 0.11 | 2.11 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Elk Creek | WV-MW-37-V-16 | Left Branch/Gnatty Creek | 15.07 | 2.64 | 0.93 | 18.64 |
| Elk Creek | WV-MW-37-V-16-B | Cranes Fork | 6.53 | 0.93 | 0.39 | 7.86 |
| Elk Creek | WV-MW-37-V-15 | Right Branch/Gnatty Creek | 5.31 | 29.17 | 1.81 | 36.30 |
| Elk Creek | WV-MW-37-V-15-A | Charity Fork | 1.12 | 14.30 | 0.81 | 16.24 |
| Elk Creek | WV-MW-37-W | Stouts Run | 4.47 | 0.33 | 0.25 | 5.05 |
| Elk Creek | WV-MW-37-AA | Birds Run | 4.67 | 0.35 | 0.26 | 5.29 |
| Elk Creek | WV-MW-37-AC | Arnold Run | 6.08 | 0.52 | 0.35 | 6.95 |
| Elk Creek | WV-MW-37-AK | Isaacs Run | 2.93 | 2.98 | 0.31 | 6.22 |
| Elk Creek | WV-MW-37-AM | Stewart Run | 17.77 | 2.91 | 1.09 | 21.78 |
| Elk Creek | WV-MW-37-AM-3 | UNT/Stewart Run RM 1.58 | 3.97 | 1.84 | 0.31 | 6.12 |
| Elk Creek | WV-MW-37-AS | UNT/Elk Creek RM 27.87 | 2.47 | 0.19 | 0.14 | 2.80 |
| Elk Creek | WV-MW-37-AT | Indian Fork | 7.81 | 18.04 | 1.36 | 27.21 |
| Davisson Run | WV-MW-40 | Davisson Run | 11.48 | 2.46 | 0.73 | 14.67 |
| Davisson Run | WV-MW-40-B | Washburncamp Run | 2.14 | 0.58 | 0.14 | 2.86 |
| UNT/West Fork River RM 37.02 | WV-MW-43 | UNT/West Fork River RM 37.02 | 1.76 | 0.40 | 0.11 | 2.27 |
| Browns Creek | WV-MW-45 | Browns Creek | 26.46 | 2.05 | 1.50 | 30.01 |
| Coburns Creek | WV-MW-46 | Coburns Creek | 6.75 | 0.43 | 0.38 | 7.56 |
| Sycamore Creek | WV-MW-47 | Sycamore Creek | 20.01 | 1.31 | 1.12 | 22.45 |
| Sycamore Creek | WV-MW-47-F | UNT/Sycamore Creek RM 3.04 | 8.24 | 0.69 | 0.47 | 9.40 |
| Lost Creek | WV-MW-55 | Lost Creek | 73.11 | 16.95 | 4.74 | 94.80 |
| Lost Creek | WV-MW-55-C | UNT/Lost Creek RM 3.32 | 4.64 | 4.16 | 0.46 | 9.25 |
| Lost Creek | WV-MW-55-F | UNT/Lost Creek RM 4.23 | 1.58 | 2.40 | 0.21 | 4.20 |
| Lost Creek | WV-MW-55-G | UNT/Lost Creek RM 4.77 | 2.54 | 5.81 | 0.44 | 8.79 |
| Lost Creek | WV-MW-55-I | UNT/Lost Creek RM 5.95 | 4.10 | 0.23 | 0.23 | 4.56 |
| Lost Creek | WV-MW-55-J | Bonds Run | 2.40 | 0.23 | 0.14 | 2.77 |
| Lost Creek | WV-MW-55-K | UNT/Lost Creek RM 6.91 | 8.00 | 0.65 | 0.45 | 9.10 |
| Buffalo Creek | WV-MW-59 | Buffalo Creek | 16.67 | 5.04 | 1.14 | 22.85 |
| Buffalo Creek | WV-MW-59-B | UNT/Buffalo Creek RM 1.68 | 2.54 | 0.18 | 0.14 | 2.86 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Duck Creek | WV-MW-62 | Duck Creek | 10.16 | 11.23 | 1.13 | 22.51 |
| Duck Creek | WV-MW-62-J | UNT/Duck Creek RM 2.78 | 0.30 | 3.96 | 0.22 | 4.49 |
| Isaacs Creek | WV-MW-66 | Isaacs Creek | 19.44 | 2.21 | 1.14 | 22.78 |
| Isaacs Creek | WV-MW-66-E | UNT/Isaacs Creek RM 2.90 | 3.01 | 0.27 | 0.17 | 3.45 |
| West Fork River | WV-MW-68 | UNT/West Fork River RM 54.90 | 3.49 | 0.14 | 0.19 | 3.82 |
| Two Lick Creek | WV-MW-69 | Two Lick Creek | 7.31 | 0.54 | 0.41 | 8.26 |
| West Fork River | WV-MW-71 | UNT/West Fork River RM 56.68 | 1.76 | 0.11 | 0.10 | 1.97 |
| Hackers Creek | WV-MW-72 | Hackers Creek | 272.86 | 32.41 | 16.07 | 321.33 |
| Hackers Creek | WV-MW-72-F | McKinney Run | 9.90 | 0.40 | 0.54 | 10.85 |
| Hackers Creek | WV-MW-72-F-2 | UNT/McKinney Run RM 1.55 | 4.20 | 0.09 | 0.23 | 4.51 |
| Hackers Creek | WV-MW-72-I | West Run | 5.52 | 0.34 | 0.31 | 6.16 |
| Hackers Creek | WV-MW-72-K | Jesse Run | 30.02 | 10.13 | 2.11 | 42.27 |
| Hackers Creek | WV-MW-72-K-6 | UNT/Jesse Run RM 2.65 | 2.64 | 0.17 | 0.15 | 2.95 |
| Hackers Creek | WV-MW-72-K-7 | UNT/Jesse Run RM 3.51 | 2.54 | 0.19 | 0.14 | 2.87 |
| Hackers Creek | WV-MW-72-K-8 | Bills Lick | 2.46 | 0.22 | 0.14 | 2.82 |
| Hackers Creek | WV-MW-72-K-14 | UNT/Jesse Run RM 6.59 | 1.34 | 8.34 | 0.51 | 10.19 |
| Hackers Creek | WV-MW-72-P | Lifes Run | 7.80 | 0.55 | 0.44 | 8.79 |
| Hackers Creek | WV-MW-72-R | Stony Run | 2.49 | 0.20 | 0.14 | 2.83 |
| Hackers Creek | WV-MW-72-V | Bloody Run | 3.84 | 0.28 | 0.22 | 4.34 |
| Hackers Creek | WV-MW-72-X | UNT/Hackers Creek RM 13.79 | 2.55 | 0.24 | 0.15 | 2.94 |
| Hackers Creek | WV-MW-72-Y | Laurel Lick | 12.28 | 0.92 | 0.70 | 13.90 |
| Hackers Creek | WV-MW-72-Y-3 | UNT/Laurel Lick RM 1.12 | 2.35 | 0.19 | 0.13 | 2.68 |
| Hackers Creek | WV-MW-72-AA | Buckhannon Run | 10.06 | 0.89 | 0.58 | 11.53 |
| Hackers Creek | WV-MW-72-AA-3 | Frog Run | 3.23 | 0.34 | 0.19 | 3.76 |
| Hackers Creek | WV-MW-72-AJ | Lefthand Fork | 5.50 | 0.48 | 0.31 | 6.30 |
| Kincheloe Creek | WV-MW-75 | Kincheloe Creek | 76.94 | 4.57 | 4.29 | 85.80 |
| Kincheloe Creek | WV-MW-75-A | Hollick Run | 2.51 | 0.21 | 0.14 | 2.86 |
| Kincheloe Creek | WV-MW-75-C | Browns Run | 2.22 | 0.18 | 0.13 | 2.53 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Kincheloe Creek | WV-MW-75-C-1 | UNT/Browns Run RM 0.30 | 0.70 | 0.06 | 0.04 | 0.80 |
| Kincheloe Creek | WV-MW-75-G | Right Fork/Kincheloe Creek | 13.78 | 1.10 | 0.78 | 15.66 |
| Kincheloe Creek | WV-MW-75-G-4 | Stutler Fork | 4.86 | 0.43 | 0.28 | 5.57 |
| Kincheloe Creek | WV-MW-75-O | Tanner Fork | 4.12 | 0.40 | 0.24 | 4.76 |
| West Fork River | WV-MW-77 | Broad Run | 4.91 | 0.11 | 0.26 | 5.29 |
| McCann Run | WV-MW-79 | McCann Run | 5.68 | 0.30 | 0.31 | 6.29 |
| Sycamore Lick | WV-MW-80 | Sycamore Lick | 5.35 | 0.25 | 0.29 | 5.90 |
| Freemans Creek | WV-MW-83 | Freemans Creek | 114.71 | 5.39 | 6.32 | 126.42 |
| Freemans Creek | WV-MW-83-A | Geelick Run | 10.96 | 0.70 | 0.61 | 12.26 |
| Freemans Creek | WV-MW-83-C | Horse Run | 4.36 | 0.25 | 0.24 | 4.86 |
| Freemans Creek | WV-MW-83-D | Millstone Run | 2.79 | 0.25 | 0.16 | 3.20 |
| Freemans Creek | WV-MW-83-F | Mare Run | 5.07 | 0.45 | 0.29 | 5.81 |
| Freemans Creek | WV-MW-83-H | Left Fork/Freemans Creek | 17.18 | 0.83 | 0.95 | 18.96 |
| Freemans Creek | WV-MW-83-H-1 | Rush Run | 2.60 | 0.11 | 0.14 | 2.86 |
| Freemans Creek | WV-MW-83-G | Right Fork/Freemans Creek | 28.75 | 2.40 | 1.64 | 32.78 |
| Freemans Creek | WV-MW-83-G-2 | Elk Lick Run | 4.57 | 0.44 | 0.26 | 5.28 |
| UNT/West Fork River RM 65.49 | WV-MW-85 | UNT/West Fork River RM 65.49 | 2.16 | 0.23 | 0.13 | 2.52 |
| Maxwell Run | WV-MW-88 | Maxwell Run | 7.28 | 0.64 | 0.42 | 8.34 |
| Polk Creek | WV-MW-89 | Polk Creek | 30.87 | 1.72 | 1.72 | 34.31 |
| Polk Creek | WV-MW-89-E | Keith Fork | 1.81 | 0.11 | 0.10 | 2.02 |
| Polk Creek | WV-MW-89-G | Dry Fork | 6.24 | 0.42 | 0.35 | 7.01 |
| Stonecoal Creek | WV-MW-90 | Stonecoal Creek | 187.49 | 5.30 | 10.15 | 202.94 |
| Stonecoal Creek | WV-MW-90-B | Smith Run | 9.54 | 0.73 | 0.54 | 10.81 |
| Stonecoal Creek | WV-MW-90-C | UNT/Stonecoal Creek RM 2.43 | 1.27 | 0.10 | 0.07 | 1.44 |
| Stonecoal Creek | WV-MW-90-D | Mud Lick | 4.28 | 0.48 | 0.25 | 5.01 |
| Stonecoal Creek | WV-MW-90-F | Hilly Upland Run | 4.77 | 0.39 | 0.27 | 5.44 |
| Stonecoal Creek | WV-MW-90-I | Grass Run | 4.07 | 0.39 | 0.23 | 4.70 |
| Stonecoal Creek | WV-MW-90-L | Right Fork/Stonecoal Creek | 35.06 | 0.30 | 1.86 | 37.21 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| Stonecoal Creek | WV-MW-90-L | Upper Portion of Right Fork/Stonecoal Creek | 23.68 | 1.24 | 1.31 | 26.24 |
| Murphy Creek | WV-MW-93 | Murphy Creek | 25.59 | 2.19 | 1.46 | 29.24 |
| Murphy Creek | WV-MW-93-C | Sand Run | 1.38 | 0.11 | 0.08 | 1.56 |
| Murphy Creek | WV-MW-93-F | Limestone Run | 3.41 | 0.35 | 0.20 | 3.96 |
| West Fork River | WV-MW-94 | Middle Run | 4.57 | 0.37 | 0.26 | 5.21 |
| Rush Run | WV-MW-95 | Rush Run | 13.47 | 0.99 | 0.76 | 15.22 |
| West Fork River | WV-MW-97 | Washburn Run | 3.16 | 0.50 | 0.19 | 3.85 |
| Stonecoal Creek | WV-MW-90-L-17 | Spruce Fork | 6.50 | 0.43 | 0.36 | 7.29 |
| Stonecoal Creek | WV-MW-90-L-16-A | Fall Run | 1.67 | 0.06 | 0.09 | 1.82 |
| Stonecoal Creek | WV-MW-90-L-16 | Glady Fork | 9.66 | 0.36 | 0.53 | 10.56 |
| Stonecoal Creek | WV-MW-90-L-16-D | UNT/Glady Fork RM 1.45 | 3.49 | 0.10 | 0.19 | 3.78 |
| Stonecoal Creek | WV-MW-90-L-11 | Pringle Fork | 8.65 | 1.01 | 0.51 | 10.17 |
| Skin Creek | WV-MW-98-F | Glady Fork | 3.61 | 0.38 | 0.21 | 4.21 |
| Skin Creek | WV-MW-98-O | Hughes Fork | 5.42 | 0.54 | 0.31 | 6.27 |
| Skin Creek | WV-MW-98 | Skin Creek | 22.57 | 1.85 | 1.29 | 25.70 |
| Skin Creek | WV-MW-98-S | Wheeler Fork | 6.29 | 0.55 | 0.36 | 7.20 |
| Skin Creek | WV-MW-98-T | Wildcat Run | 2.99 | 0.36 | 0.18 | 3.53 |
| Skin Creek | WV-MW-98-U | UNT/Skin Creek RM 12.34 | 2.34 | 0.26 | 0.14 | 2.73 |
| Skin Creek | WV-MW-98-Q | Keith Fork | 2.62 | 0.24 | 0.15 | 3.01 |
| Sand Fork | WV-MW-112-B | Dunkin Run | 1.64 | 0.11 | 0.09 | 1.84 |
| Sand Fork | WV-MW-112 | Sand Fork | 23.20 | 2.15 | 1.33 | 26.68 |
| Sand Fork | WV-MW-112-M | Sammy Run | 4.98 | 0.48 | 0.29 | 5.75 |
| Right Fork/West Fork River | WV-MW-132 | Right Fork/West Fork River | 38.85 | 2.71 | 2.19 | 43.74 |
| Right Fork/West Fork River | WV-MW-132-C | Big Run | 4.19 | 0.35 | 0.24 | 4.78 |
| Right Fork/West Fork River | WV-MW-132-H | McChord Run | 1.89 | 0.16 | 0.11 | 2.15 |
| West Fork River | WV-MW-137 | Laurel Run | 4.14 | 0.36 | 0.24 | 4.74 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocation (lbs/day) | Wasteload Allocation (lbs/day) | Margin of Safety (lbs/day) | Iron TMDL (lbs/day) |
|---|---|---|---|---|---|---|
| West Fork River | WV-MW-139 | Wolfpen Run | 5.40 | 0.67 | 0.32 | 6.39 |
| West Fork River | WV-MW-143 | Fall Run | 2.40 | 0.25 | 0.14 | 2.79 |
| West Fork River | WV-MW-144 | Crooked Run | 2.86 | 0.22 | 0.16 | 3.25 |
| West Fork River | WV-MW-146 | Whites Camp Fork | 13.04 | 1.21 | 0.75 | 15.00 |
| West Fork River | WV-MW-145 | Straight Fork | 6.41 | 0.61 | 0.37 | 7.39 |
| Abrams Run | WV-MW-129 | Abrams Run | 6.54 | 0.60 | 0.38 | 7.52 |
| Canoe Run | WV-MW-111 | Canoe Run | 2.74 | 0.28 | 0.16 | 3.18 |

**Table 10-3.** 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) |
|---|---|---|---|---|---|---|
| Bingamon Creek | WV-MW-14 | Bingamon Creek | 6887.79 | 20070.20 | 1418.84 | 28376.83 |
| Bingamon Creek | WV-MW-14-V | Harris Fork | 478.55 | 7336.00 | 411.29 | 8225.85 |
| Bingamon Creek | WV-MW-14-V-2 | UNT/Harris Fork RM 0.65 | 296.18 | 7336.00 | 401.69 | 8033.88 |

UNT = unnamed tributary; RM = river mile.

**Table 10-4.** 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) |
|---|---|---|---|---|---|---|
| Booths Creek | WV-MW-5-J-1 | Purdys Run | -2.04 | N/A | -0.11 | -2.15 |
| Shinns Run | WV-MW-23 | Shinns Run | -2144.54 | N/A | -112.87 | -2257.41 |
| Shinns Run | WV-MW-23-F | UNT/Shinns Run RM 4.15 | -8.74 | N/A | -0.46 | -9.20 |
| Shinns Run | WV-MW-23-G | UNT/Shinns Run RM 5.61 | -13.99 | N/A | -0.74 | -14.73 |
| Simpson Creek | WV-MW-31-C | Smith Run | -56.46 | N/A | -2.97 | -59.43 |

| 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) |
|---|---|---|---|---|---|---|
| Simpson Creek | WV-MW-31-U-2 | UNT/Right Fork RM 0.33/Simpson Creek | -40.20 | N/A | -2.12 | -42.32 |

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

**Table 10-5.** 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) |
|---|---|---|---|---|---|---|
| West Fork River | WV-MW | West Fork River | 4.04E+12 | 2.44E+11 | 2.25E+11 | 4.51E+12 |
| West Fork River | WV-MW | Upper Portion of West Fork River | 1.61E+11 | 4.17E+07 | 8.49E+09 | 1.70E+11 |
| Mill Fall Run | WV-MW-4 | Mill Fall Run | 1.54E+10 | 1.68E+07 | 8.11E+08 | 1.62E+10 |
| Booths Creek | WV-MW-5 | Booths Creek | 2.16E+11 | 1.44E+09 | 1.14E+10 | 2.29E+11 |
| Booths Creek | WV-MW-5-A | UNT/Booths Creek RM 1.39 | 2.59E+09 | 5.04E+05 | 1.36E+08 | 2.72E+09 |
| Booths Creek | WV-MW-5-C | UNT/Booths Creek RM 3.58 | 1.35E+09 | 4.55E+06 | 7.10E+07 | 1.42E+09 |
| Booths Creek | WV-MW-5-D | UNT/Booths Creek RM 4.11 | 3.14E+09 | 5.72E+06 | 1.65E+08 | 3.31E+09 |
| Booths Creek | WV-MW-5-F | Hog Lick Run | 5.72E+09 | 0.00E+00 | 3.01E+08 | 6.02E+09 |
| Booths Creek | WV-MW-5-G | Sapp Run | 6.95E+09 | 3.05E+07 | 3.67E+08 | 7.34E+09 |
| Booths Creek | WV-MW-5-L | Hustead Fork | 8.28E+10 | 3.12E+08 | 4.38E+09 | 8.75E+10 |
| Booths Creek | WV-MW-5-M | Corbin Branch | 3.64E+10 | 2.90E+08 | 1.93E+09 | 3.86E+10 |
| Booths Creek | WV-MW-5-N | Thomas Fork | 2.37E+10 | 2.55E+08 | 1.26E+09 | 2.52E+10 |
| Coons Run | WV-MW-8 | Coons Run | 2.79E+10 | 6.36E+07 | 1.47E+09 | 2.95E+10 |
| Helens Run | WV-MW-9 | Helens Run | 2.80E+10 | 1.27E+07 | 1.48E+09 | 2.95E+10 |
| Tevebaugh Creek | WV-MW-10 | Tevebaugh Creek | 2.96E+10 | 1.67E+07 | 1.56E+09 | 3.12E+10 |
| Camp Run | WV-MW-12 | Camp Run | 5.71E+09 | 4.34E+04 | 3.01E+08 | 6.01E+09 |
| Bingamon Creek | WV-MW-14 | Bingamon Creek | 2.49E+11 | 3.10E+08 | 1.31E+10 | 2.62E+11 |
| Bingamon Creek | WV-MW-14-A | Little Bingamon Creek | 4.87E+10 | 1.14E+07 | 2.57E+09 | 5.13E+10 |
| Bingamon Creek | WV-MW-14-A-3 | UNT/Little Bingamon Creek RM 1.59 | 3.34E+09 | 0.00E+00 | 1.76E+08 | 3.51E+09 |
| Bingamon Creek | WV-MW-14-B | Long Run | 6.33E+09 | 3.79E+06 | 3.34E+08 | 6.67E+09 |
| Bingamon Creek | WV-MW-14-C | Elklick Run | 4.15E+09 | 0.00E+00 | 2.18E+08 | 4.37E+09 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Bingamon Creek | WV-MW-14-F | Cunningham Run | 1.66E+10 | 7.58E+06 | 8.74E+08 | 1.75E+10 |
| Bingamon Creek | WV-MW-14-P | Glade Fork | 4.35E+10 | 4.55E+06 | 2.29E+09 | 4.58E+10 |
| Bingamon Creek | WV-MW-14-P-1 | Coal Lick Run | 1.83E+10 | 0.00E+00 | 9.64E+08 | 1.93E+10 |
| Bingamon Creek | WV-MW-14-V | Harris Fork | 1.14E+10 | 0.00E+00 | 5.98E+08 | 1.20E+10 |
| Bingamon Creek | WV-MW-14-W | Quaker Fork | 2.08E+10 | 3.79E+06 | 1.09E+09 | 2.18E+10 |
| Bingamon Creek | WV-MW-15 | UNT/West Fork River RM 11.44 | 1.89E+09 | 0.00E+00 | 9.94E+07 | 1.99E+09 |
| Laurel Run | WV-MW-18 | Laurel Run | 6.56E+09 | 7.58E+06 | 3.46E+08 | 6.92E+09 |
| UNT/West Fork River RM 13.10 | WV-MW-19 | UNT/West Fork River RM 13.10 | 2.34E+09 | 3.79E+06 | 1.24E+08 | 2.47E+09 |
| Mudlick Run | WV-MW-20 | Mudlick Run | 1.60E+10 | 1.52E+08 | 8.48E+08 | 1.70E+10 |
| UNT/West Fork River RM 13.91 | WV-MW-21 | UNT/West Fork River RM 13.91 | 2.33E+09 | 3.79E+06 | 1.23E+08 | 2.46E+09 |
| Browns Run | WV-MW-22 | Browns Run | 3.95E+09 | 0.00E+00 | 2.08E+08 | 4.15E+09 |
| Shinns Run | WV-MW-23 | Shinns Run | 4.04E+10 | 5.99E+08 | 2.16E+09 | 4.32E+10 |
| Shinns Run | WV-MW-23-E | UNT/Shinns Run RM 3.69 | 5.99E+09 | 0.00E+00 | 3.15E+08 | 6.30E+09 |
| Robinson Run | WV-MW-26 | Robinson Run | 2.42E+10 | 1.12E+08 | 1.28E+09 | 2.56E+10 |
| Tenmile Creek | WV-MW-27 | Tenmile Creek | 6.63E+11 | 3.96E+09 | 3.51E+10 | 7.02E+11 |
| Tenmile Creek | WV-MW-27-A | Jack Run | 2.48E+09 | 0.00E+00 | 1.31E+08 | 2.61E+09 |
| Tenmile Creek | WV-MW-27-B | Jones Creek | 5.66E+10 | 2.50E+07 | 2.98E+09 | 5.96E+10 |
| Tenmile Creek | WV-MW-27-B-3 | Nolan Run | 6.16E+09 | 0.00E+00 | 3.24E+08 | 6.49E+09 |
| Tenmile Creek | WV-MW-27-E | Little Tenmile Creek | 1.55E+11 | 5.83E+07 | 8.14E+09 | 1.63E+11 |
| Tenmile Creek | WV-MW-27-E-2 | Peters Run | 4.62E+09 | 3.79E+06 | 2.43E+08 | 4.87E+09 |
| Tenmile Creek | WV-MW-27-E-3 | UNT/Little Tenmile Creek RM 1.91 | 3.25E+09 | 0.00E+00 | 1.71E+08 | 3.43E+09 |
| Tenmile Creek | WV-MW-27-E-7 | Laurel Run/Little Tenmile Creek | 7.42E+09 | 0.00E+00 | 3.90E+08 | 7.81E+09 |
| Tenmile Creek | WV-MW-27-E-11 | Little Elk Creek | 1.30E+10 | 4.55E+06 | 6.85E+08 | 1.37E+10 |
| Tenmile Creek | WV-MW-27-E-14 | Big Elk Creek | 2.52E+10 | 7.58E+06 | 1.33E+09 | 2.65E+10 |
| Tenmile Creek | WV-MW-27-E-15 | Middle Run/Little Tenmile Creek | 1.43E+10 | 7.58E+06 | 7.52E+08 | 1.50E+10 |
| Tenmile Creek | WV-MW-27-E-18 | Mudlick Run | 1.16E+10 | 3.79E+06 | 6.10E+08 | 1.22E+10 |
| Tenmile Creek | WV-MW-27-H | Isaac Creek | 1.13E+10 | 3.79E+06 | 5.94E+08 | 1.19E+10 |
| Tenmile Creek | WV-MW-27-I | Gregory Run | 9.88E+09 | 1.43E+07 | 5.21E+08 | 1.04E+10 |
| Tenmile Creek | WV-MW-27-K | Katy Lick Run | 1.20E+10 | 1.97E+07 | 6.31E+08 | 1.26E+10 |
| Tenmile Creek | WV-MW-27-L | Flag Run | 9.01E+09 | 0.00E+00 | 4.74E+08 | 9.48E+09 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Tenmile Creek | WV-MW-27-M | UNT/Tenmile Creek RM 10.82 | 5.08E+09 | 0.00E+00 | 2.67E+08 | 5.35E+09 |
| Tenmile Creek | WV-MW-27-N | Rockcamp Run | 6.90E+10 | 2.27E+07 | 3.63E+09 | 7.26E+10 |
| Tenmile Creek | WV-MW-27-N-2 | Little Rockcamp Run | 2.50E+10 | 1.14E+07 | 1.32E+09 | 2.64E+10 |
| Tenmile Creek | WV-MW-27-R | Grass Run | 3.63E+10 | 1.67E+07 | 1.91E+09 | 3.82E+10 |
| Tenmile Creek | WV-MW-27-V | Indian Run | 2.69E+10 | 3.79E+06 | 1.42E+09 | 2.83E+10 |
| Tenmile Creek | WV-MW-27-X | Salem Fork | 8.62E+10 | 3.25E+09 | 4.71E+09 | 9.41E+10 |
| Tenmile Creek | WV-MW-27-X-2 | UNT/Salem Fork RM 2.43 | 4.58E+09 | 7.58E+06 | 2.41E+08 | 4.83E+09 |
| Tenmile Creek | WV-MW-27-X-4 | Cherrycamp Run | 1.25E+10 | 9.09E+06 | 6.60E+08 | 1.32E+10 |
| Tenmile Creek | WV-MW-27-X-8 | Patterson Fork | 1.74E+10 | 7.88E+07 | 9.22E+08 | 1.84E+10 |
| Tenmile Creek | WV-MW-27-X-8-B | UNT/Patterson Fork RM 0.59 | 7.03E+09 | 4.70E+07 | 3.72E+08 | 7.45E+09 |
| Tenmile Creek | WV-MW-27-AK | UNT/Tenmile Creek RM 22.53 | 6.52E+08 | 0.00E+00 | 3.43E+07 | 6.86E+08 |
| Tenmile Creek | WV-MW-27-AM | Coburn Fork | 2.34E+10 | 3.79E+06 | 1.23E+09 | 2.46E+10 |
| Tenmile Creek | WV-MW-27-AM-3 | Shaw Run | 4.58E+09 | 3.79E+06 | 2.41E+08 | 4.83E+09 |
| UNT/West Fork River RM 20.42 | WV-MW-30 | UNT/West Fork River RM 20.42 | 1.27E+09 | 0.00E+00 | 6.67E+07 | 1.33E+09 |
| Simpson Creek | WV-MW-31 | Simpson Creek | 3.69E+11 | 3.80E+10 | 2.14E+10 | 4.28E+11 |
| Simpson Creek | WV-MW-31-C | Smith Run | 1.11E+10 | 2.08E+09 | 6.93E+08 | 1.39E+10 |
| Simpson Creek | WV-MW-31-F | Barnett Run | 1.20E+10 | 4.29E+09 | 8.58E+08 | 1.72E+10 |
| Simpson Creek | WV-MW-31-J | Davisson Run | 1.75E+10 | 1.29E+07 | 9.21E+08 | 1.84E+10 |
| Simpson Creek | WV-MW-31-K | Ann Run | 1.49E+10 | 8.60E+07 | 7.90E+08 | 1.58E+10 |
| Simpson Creek | WV-MW-31-O | Beards Run | 3.87E+10 | 9.62E+07 | 2.04E+09 | 4.08E+10 |
| Simpson Creek | WV-MW-31-T | Berry Run | 1.59E+10 | 3.79E+06 | 8.36E+08 | 1.67E+10 |
| Simpson Creek | WV-MW-31-U | Right Fork/Simpson Creek | 6.16E+10 | 2.50E+07 | 3.24E+09 | 6.49E+10 |
| Simpson Creek | WV-MW-31-U-3 | Buck Run | 1.45E+10 | 4.55E+06 | 7.62E+08 | 1.52E+10 |
| Simpson Creek | WV-MW-31-U-4 | Sand Lick Run | 9.69E+09 | 3.79E+06 | 5.10E+08 | 1.02E+10 |
| Simpson Creek | WV-MW-31-U-5 | Gabe Fork | 8.79E+09 | 4.55E+06 | 4.63E+08 | 9.26E+09 |
| Simpson Creek | WV-MW-31-X | UNT/Simpson Creek RM 21.92 | 6.08E+09 | 0.00E+00 | 3.20E+08 | 6.40E+09 |
| Simpson Creek | WV-MW-31-Y | Bartlett Run | 7.31E+09 | 3.79E+06 | 3.85E+08 | 7.70E+09 |
| Simpson Creek | WV-MW-31-Z | UNT/Simpson Creek RM 22.72 | 2.31E+09 | 0.00E+00 | 1.21E+08 | 2.43E+09 |
| Simpson Creek | WV-MW-31-AA-2 | Stillhouse Run | 4.00E+09 | 4.55E+06 | 2.11E+08 | 4.22E+09 |
| Simpson Creek | WV-MW-31-AA-4 | UNT/West Branch RM 1.57/Simpson Creek | 7.28E+09 | 0.00E+00 | 3.83E+08 | 7.66E+09 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Simpson Creek | WV-MW-31-AC | UNT/Simpson Creek RM 26.94 | 4.82E+09 | 0.00E+00 | 2.54E+08 | 5.07E+09 |
| Lambert Run | WV-MW-32-C | UNT/Lambert Run RM 2.77 | 7.31E+09 | 0.00E+00 | 3.85E+08 | 7.70E+09 |
| Jack Run | WV-MW-33 | Jack Run | 8.89E+09 | 9.18E+05 | 4.68E+08 | 9.36E+09 |
| Crooked Run | WV-MW-35 | Crooked Run | 1.32E+10 | 1.58E+09 | 7.76E+08 | 1.55E+10 |
| Limestone Run | WV-MW-36 | Limestone Run | 5.44E+10 | 4.46E+09 | 3.10E+09 | 6.20E+10 |
| Limestone Run | WV-MW-36-A | Stone Coal Run | 5.32E+09 | 5.70E+08 | 3.10E+08 | 6.20E+09 |
| Limestone Run | WV-MW-36-C | Simpson Fork | 1.11E+10 | 3.14E+08 | 6.01E+08 | 1.20E+10 |
| Limestone Run | WV-MW-36-H | Phoenix Hollow | 2.23E+09 | 3.82E+06 | 1.18E+08 | 2.35E+09 |
| Elk Creek | WV-MW-37 | Elk Creek | 5.89E+11 | 2.26E+10 | 3.22E+10 | 6.44E+11 |
| Elk Creek | WV-MW-37-C | Murphy Run | 5.78E+09 | 4.29E+09 | 5.30E+08 | 1.06E+10 |
| Elk Creek | WV-MW-37-D | Ann Moore Run | 2.27E+10 | 3.31E+09 | 1.37E+09 | 2.74E+10 |
| Elk Creek | WV-MW-37-F | Nutter Run | 4.83E+09 | 9.77E+08 | 3.05E+08 | 6.11E+09 |
| Elk Creek | WV-MW-37-G | Turkey Run | 5.19E+09 | 0.00E+00 | 2.73E+08 | 5.46E+09 |
| Elk Creek | WV-MW-37-H | Hooppole Run | 3.84E+09 | 2.65E+07 | 2.03E+08 | 4.07E+09 |
| Elk Creek | WV-MW-37-J | Brushy Fork | 1.02E+11 | 1.25E+08 | 5.38E+09 | 1.08E+11 |
| Elk Creek | WV-MW-37-J-4 | UNT/Brushy Fork RM 3.37 | 6.66E+09 | 6.53E+07 | 3.54E+08 | 7.08E+09 |
| Elk Creek | WV-MW-37-J-8 | Coplin Run | 9.78E+09 | 4.55E+06 | 5.15E+08 | 1.03E+10 |
| Elk Creek | WV-MW-37-J-11 | Glade Run | 6.72E+09 | 8.33E+06 | 3.54E+08 | 7.08E+09 |
| Elk Creek | WV-MW-37-J-15 | Stonecoal Run | 9.08E+09 | 4.55E+06 | 4.78E+08 | 9.57E+09 |
| Elk Creek | WV-MW-37-L | Zachs Run | 8.99E+09 | 1.30E+08 | 4.80E+08 | 9.60E+09 |
| Elk Creek | WV-MW-37-M | Chub Run | 1.64E+10 | 3.11E+07 | 8.64E+08 | 1.73E+10 |
| Elk Creek | WV-MW-37-P | Fall Run | 9.53E+09 | 3.79E+06 | 5.02E+08 | 1.00E+10 |
| Elk Creek | WV-MW-37-R | Hastings Run | 1.30E+10 | 8.33E+06 | 6.85E+08 | 1.37E+10 |
| Elk Creek | WV-MW-37-V | Gnatty Creek | 1.68E+11 | 2.35E+07 | 8.85E+09 | 1.77E+11 |
| Elk Creek | WV-MW-37-V-3 | Rooting Creek | 6.09E+10 | 3.79E+06 | 3.20E+09 | 6.41E+10 |
| Elk Creek | WV-MW-37-W | Stouts Run | 1.10E+10 | 3.79E+06 | 5.78E+08 | 1.16E+10 |
| Elk Creek | WV-MW-37-AA | Birds Run | 9.10E+09 | 0.00E+00 | 4.79E+08 | 9.58E+09 |
| Elk Creek | WV-MW-37-AC | Arnold Run | 1.29E+10 | 0.00E+00 | 6.77E+08 | 1.35E+10 |
| Elk Creek | WV-MW-37-AK | Isaacs Run | 7.05E+09 | 0.00E+00 | 3.71E+08 | 7.42E+09 |
| Elk Creek | WV-MW-37-AM | Stewart Run | 2.44E+10 | 0.00E+00 | 1.29E+09 | 2.57E+10 |
| Elk Creek | WV-MW-37-AS | UNT/Elk Creek RM 27.87 | 4.94E+09 | 8.33E+06 | 2.61E+08 | 5.21E+09 |
| Davisson Run | WV-MW-40 | Davisson Run | 2.08E+10 | 5.77E+09 | 1.40E+09 | 2.80E+10 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Davisson Run | WV-MW-40-B | Washburncamp Run | 4.07E+09 | 1.04E+09 | 2.69E+08 | 5.38E+09 |
| UNT/West Fork River RM 37.02 | WV-MW-43 | UNT/West Fork River RM 37.02 | 4.88E+09 | 1.01E+09 | 3.10E+08 | 6.21E+09 |
| Browns Creek | WV-MW-45 | Browns Creek | 3.34E+10 | 4.55E+07 | 1.76E+09 | 3.52E+10 |
| Coburns Creek | WV-MW-46 | Coburns Creek | 1.24E+10 | 0.00E+00 | 6.55E+08 | 1.31E+10 |
| Sycamore Creek | WV-MW-47 | Sycamore Creek | 4.51E+10 | 0.00E+00 | 2.37E+09 | 4.75E+10 |
| Lost Creek | WV-MW-55 | Lost Creek | 9.55E+10 | 2.02E+08 | 5.04E+09 | 1.01E+11 |
| Lost Creek | WV-MW-55-C | UNT/Lost Creek RM 3.32 | 9.28E+09 | 0.00E+00 | 4.89E+08 | 9.77E+09 |
| Lost Creek | WV-MW-55-J | Bonds Run | 5.93E+09 | 8.33E+06 | 3.12E+08 | 6.25E+09 |
| Lost Creek | WV-MW-55-K | UNT/Lost Creek RM 6.91 | 1.11E+10 | 1.55E+08 | 5.95E+08 | 1.19E+10 |
| Buffalo Creek | WV-MW-59 | Buffalo Creek | 2.69E+10 | 0.00E+00 | 1.42E+09 | 2.84E+10 |
| Duck Creek | WV-MW-62 | Duck Creek | 2.27E+10 | 4.92E+07 | 1.20E+09 | 2.39E+10 |
| Duck Creek | WV-MW-62-J | UNT/Duck Creek RM 2.78 | 2.41E+09 | 0.00E+00 | 1.27E+08 | 2.54E+09 |
| Isaacs Creek | WV-MW-66 | Isaacs Creek | 3.82E+10 | 8.33E+06 | 2.01E+09 | 4.02E+10 |
| Isaacs Creek | WV-MW-66-E | UNT/Isaacs Creek RM 2.90 | 6.05E+09 | 0.00E+00 | 3.18E+08 | 6.36E+09 |
| Two Lick Creek | WV-MW-69 | Two Lick Creek | 1.81E+10 | 3.79E+06 | 9.52E+08 | 1.90E+10 |
| Hackers Creek | WV-MW-72 | Hackers Creek | 2.85E+11 | 1.22E+09 | 1.51E+10 | 3.02E+11 |
| Hackers Creek | WV-MW-72-F | McKinney Run | 1.73E+10 | 3.79E+06 | 9.13E+08 | 1.83E+10 |
| Hackers Creek | WV-MW-72-I | West Run | 9.49E+09 | 3.79E+06 | 5.00E+08 | 1.00E+10 |
| Hackers Creek | WV-MW-72-K | Jesse Run | 5.31E+10 | 1.67E+07 | 2.79E+09 | 5.59E+10 |
| Hackers Creek | WV-MW-72-P | Lifes Run | 1.45E+10 | 7.58E+06 | 7.64E+08 | 1.53E+10 |
| Hackers Creek | WV-MW-72-R | Stony Run | 4.97E+09 | 0.00E+00 | 2.61E+08 | 5.23E+09 |
| Hackers Creek | WV-MW-72-V | Bloody Run | 7.10E+09 | 0.00E+00 | 3.74E+08 | 7.48E+09 |
| Hackers Creek | WV-MW-72-Y | Laurel Lick | 2.26E+10 | 4.55E+06 | 1.19E+09 | 2.38E+10 |
| Hackers Creek | WV-MW-72-AA | Buckhannon Run | 2.14E+10 | 1.21E+07 | 1.12E+09 | 2.25E+10 |
| Hackers Creek | WV-MW-72-AJ | Lefthand Fork | 1.17E+10 | 0.00E+00 | 6.17E+08 | 1.23E+10 |
| Kincheloe Creek | WV-MW-75 | Kincheloe Creek | 1.10E+11 | 1.21E+07 | 5.80E+09 | 1.16E+11 |
| Kincheloe Creek | WV-MW-75-C | Browns Run | 4.48E+09 | 4.55E+06 | 2.36E+08 | 4.72E+09 |
| Kincheloe Creek | WV-MW-75-G | Right Fork/Kincheloe Creek | 2.75E+10 | 3.79E+06 | 1.45E+09 | 2.89E+10 |
| Kincheloe Creek | WV-MW-75-O | Tanner Fork | 9.62E+09 | 0.00E+00 | 5.06E+08 | 1.01E+10 |
| McCann Run | WV-MW-79 | McCann Run | 1.02E+10 | 0.00E+00 | 5.39E+08 | 1.08E+10 |
| Sycamore Lick | WV-MW-80 | Sycamore Lick | 1.21E+10 | 4.55E+06 | 6.36E+08 | 1.27E+10 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Freemans Creek | WV-MW-83 | Freemans Creek | 1.58E+11 | 9.62E+07 | 8.31E+09 | 1.66E+11 |
| Freemans Creek | WV-MW-83-A | Geelick Run | 2.38E+10 | 4.77E+07 | 1.25E+09 | 2.51E+10 |
| Freemans Creek | WV-MW-83-F | Mare Run | 1.05E+10 | 3.79E+06 | 5.55E+08 | 1.11E+10 |
| Freemans Creek | WV-MW-83-H | Left Fork/Freemans Creek | 3.28E+10 | 1.74E+07 | 1.73E+09 | 3.45E+10 |
| Freemans Creek | WV-MW-83-G | Right Fork/Freemans Creek | 5.72E+10 | 0.00E+00 | 3.01E+09 | 6.02E+10 |
| UNT/West Fork River RM 65.49 | WV-MW-85 | UNT/West Fork River RM 65.49 | 5.23E+09 | 0.00E+00 | 2.75E+08 | 5.50E+09 |
| Maxwell Run | WV-MW-88 | Maxwell Run | 1.72E+10 | 1.24E+08 | 9.14E+08 | 1.83E+10 |
| Polk Creek | WV-MW-89 | Polk Creek | 6.50E+10 | 1.21E+08 | 3.43E+09 | 6.86E+10 |
| Polk Creek | WV-MW-89-G | Dry Fork | 1.24E+10 | 0.00E+00 | 6.54E+08 | 1.31E+10 |
| Polk Creek | WV-MW-89-L | Sassafras Run | 1.50E+10 | 0.00E+00 | 7.90E+08 | 1.58E+10 |
| Stonecoal Creek | WV-MW-90 | Stonecoal Creek | 1.50E+11 | 1.74E+08 | 7.91E+09 | 1.58E+11 |
| Stonecoal Creek | WV-MW-90-C | UNT/Stonecoal Creek RM 2.43 | 4.09E+09 | 0.00E+00 | 2.15E+08 | 4.30E+09 |
| Stonecoal Creek | WV-MW-90-F | Hilly Upland Run | 9.52E+09 | 2.58E+07 | 5.03E+08 | 1.01E+10 |
| Stonecoal Creek | WV-MW-90-I | Grass Run | 9.87E+09 | 3.79E+06 | 5.20E+08 | 1.04E+10 |
| Stonecoal Creek | WV-MW-90-L | Right Fork/Stonecoal Creek | 3.18E+10 | 7.58E+07 | 1.68E+09 | 3.35E+10 |
| Murphy Creek | WV-MW-93 | Murphy Creek | 3.83E+10 | 1.14E+07 | 2.01E+09 | 4.03E+10 |
| Rush Run | WV-MW-95 | Rush Run | 3.58E+10 | 2.05E+07 | 1.89E+09 | 3.77E+10 |
| Stone Lick | WV-MW-96 | Stone Lick | 6.84E+09 | 0.00E+00 | 3.60E+08 | 7.20E+09 |
| Stonecoal Creek | WV-MW-90-L | Upper Portion of Right Fork/Stonecoal Creek | 4.42E+10 | 1.52E+07 | 2.33E+09 | 4.65E+10 |
| Stonecoal Creek | WV-MW-90-L-17 | Spruce Fork | 1.48E+10 | 3.79E+06 | 7.80E+08 | 1.56E+10 |
| Stonecoal Creek | WV-MW-90-L-16-A | Fall Run | 3.91E+09 | 1.14E+07 | 2.06E+08 | 4.13E+09 |
| Stonecoal Creek | WV-MW-90-L-16 | Glady Fork | 1.55E+10 | 0.00E+00 | 8.15E+08 | 1.63E+10 |
| Stonecoal Creek | WV-MW-90-L-11 | Pringle Fork | 2.15E+10 | 4.55E+06 | 1.13E+09 | 2.27E+10 |
| Skin Creek | WV-MW-98-F | Glady Fork | 6.99E+09 | 0.00E+00 | 3.68E+08 | 7.36E+09 |
| Skin Creek | WV-MW-98-G-8-A | Linger Run | 1.34E+10 | 0.00E+00 | 7.07E+08 | 1.41E+10 |
| Skin Creek | WV-MW-98 | Skin Creek | 3.34E+10 | 0.00E+00 | 1.76E+09 | 3.51E+10 |
| Skin Creek | WV-MW-98-C | Wolf Fork | 8.75E+09 | 0.00E+00 | 4.60E+08 | 9.21E+09 |
| Sand Fork | WV-MW-112-M | Sammy Run | 9.34E+09 | 4.55E+06 | 4.92E+08 | 9.84E+09 |
| Right Fork/West Fork River | WV-MW-132 | Right Fork/West Fork River | 6.42E+10 | 1.89E+07 | 3.38E+09 | 6.76E+10 |

| TMDL Watershed | Stream Code | Stream Name | Load Allocations (counts/day) | Wasteload Allocation (counts/day) | Margin of Safety (counts/day) | TMDL (counts/day) |
|---|---|---|---|---|---|---|
| Right Fork/West Fork River | WV-MW-132-C | Big Run | 8.83E+09 | 0.00E+00 | 4.65E+08 | 9.29E+09 |
| Right Fork/West Fork River | WV-MW-132-G | Sugarcamp Run | 1.47E+10 | 7.58E+06 | 7.71E+08 | 1.54E+10 |
| Abrams Run | WV-MW-129 | Abrams Run | 1.54E+10 | 7.58E+06 | 8.09E+08 | 1.62E+10 |
| Canoe Run | WV-MW-111 | Canoe Run | 6.22E+09 | 0.00E+00 | 3.27E+08 | 6.55E+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.

# 11.0 FUTURE GROWTH

## 11.1 Iron, Aluminum, 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 causative sources of dissolved aluminum 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.

## 11.2 Fecal Coliform Bacteria

Specific fecal coliform bacteria future growth allocations are not prescribed. The absence of specific future growth allocations does not prohibit new development in the watersheds of streams for which fecal coliform bacteria TMDLs have been developed, or preclude the permitting of new sewage treatment facilities.

In many cases, the implementation of the TMDLs will consist of providing public sewer service to unsewered areas. The NPDES permitting procedures for sewage treatment facilities include technology-based fecal coliform effluent limitations that are more stringent than applicable water quality criteria. Therefore, a new sewage treatment facility may be permitted anywhere in the watershed, provided that the permit includes monthly geometric mean and maximum daily fecal coliform limitations of 200 counts/100 mL and 400 counts/100 mL, respectively. Furthermore, WVDEP will not authorize construction of combined collection systems nor permit overflows from newly constructed collection systems.

### 11.3 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 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.

## 12.0 PUBLIC PARTICIPATION

### 12.1 Public Meetings

An informational public meeting was held on July 27, 2010 at the Waldomore Building (former Clarksburg-Harrison County Library) in Clarksburg, WV. The July 27, 2010 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 public meeting was held to present the draft TMDLs on April 21, 2014 at Fairmont State University in Fairmont, WV. The meeting provided information to stakeholders intended to facilitate comments on the draft TMDLs.

### 12.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised in various local newspapers beginning on April 10, 2014. Interested parties were invited to submit comments during the public comment period, which began on April 10, 2014 and ended on May 9, 2014. The electronic documents were also posted on the WVDEP's internet site at www.dep.wv.gov/tmdl.

### 12.3 Response Summary

The West Virginia Department of Environmental Protection received written comments on the draft TMDLs from Appalachian Mountain Advocates and Sovereign Consulting, Inc. 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.

***One commenter stated that the project does not meet the requirements of the Clean Water Act as prescribed by EPA 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 EPA cannot approve the pending TMDLs and that EPA must develop the TMDLs that DEP has failed to develop since 2005.***

DEP 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, DEP 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, DEP and EPA were implementing the TMDL development plan for “ionic stress” biological impairments referenced in the comments. EPA funded dissolved ion modeling in the Upper Kanawha and Monongahela River watersheds and DEP was actively participating in all aspects of the projects. DEP provided dissolved ion stream monitoring and source tracking to support the modeling and similar work was underway (and subsequently completed) in the watersheds of all of the other streams for which biological TMDL development had been deferred. 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 the West Fork River watershed, will remain on the 303(d) list. DEP 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.

***One commenter interpreted the TMDL process as inappropriately targeting coal mines that are held responsible for the bulk of degraded water quality while ignoring the impacts of other growing sources like “gas/oil well sites”. The commenter asked if the model penalizes mines while other sources remain unquantified.***

Known significant pollutant sources are not ignored in the TMDL process. Model representation of point and nonpoint pollutant sources is based upon scientific assessment of available information sources. to The extent and characterization of oil and gas sites is derived from permitting databases. Traditional sites are distinguished from those associated with vertical and horizontal drilling of the Marcellus formation. Load allocations are consistent with the methodology prescribed for all sediment producing nonpoint sources.

***One commenter asked: “Can other entities help collect data to continue to calibrate the model?” The commenter also stated “… instances where streams are impaired only by modeling, calibrations are made using conditions in other watersheds, and those cases where actual conditions doesn’t resemble the model will continue to be problematic.”***

When developing this project, DEP specifically requested NPDES-based stream monitoring data. Information received was examined to identify sources contributions, support model set up and model calibration. In response to the comment, additional analyses were performed to specifically investigate if there were instances where available monitoring data contradicted modeled impairment determinations. There were no NPDES data in the watersheds with modeled impairment determinations. Elsewhere, the available NPDES data supported the impairment assessments derived from DEP monitoring data.

The commenter’s interpretation of the model calibration is inaccurate. The calibration process does not use data or conditions from other watersheds. The goal of the modeling calibration was to determine a set of parameters to best describe the hydrologic and water quality processes in the West Fork River Watershed. Extreme care and diligence were taken to thoroughly examine and analyze the myriad of available data that included many types and formats originating from various sources (including data collected and submitted by industry).

The hydrology and water quality calibration process first objective is not to match every sampled point, but to adequately replicate processes occurring in the watershed and streams and to ensure that the model is simulating low flow, mean flow, and storm peaks within observed ranges. Composite analysis of the available in-stream data from all monitoring stations was performed to establish low-flow, high-flow and seasonal trends. Background values were established by using a composite of samples from watersheds that were minimally disturbed, according to the landuse coverage. In addition, the sediment-metals relationship was determined, and applied to those watersheds where metals-sediment correlation was observed. For the abandoned mine lands, the concentrations were based on the source tracking monitoring. Values for permitted mines used for calibration were based on DMR data.

The various models used to derive the draft TMDLs are satisfactorily calibrated such that continued calibration is not needed to support prescribed management actions.

***One commenter asked if error statistics similar to those used for hydrology calibration were considered in water quality calibration.***

Although error statistics are often used in evaluating model calibration, their use for water quality calibration is not recommended due to the following reasons:

- Most of the available data for calibration were instantaneous grab samples, not continuous sampling. Instantaneous grab sample data only permits comparison during a snapshot in time, and this snapshot is representative of only a single condition. Although multiple water quality data are available at many locations, they are not necessarily representative of all conditions (which are, in fact, simulated by the model because it is continuous).
- Making a “point-by-point” comparison (i.e. a comparison of a water quality observation for a given date and time versus the modeled value for the same date and time) will likely result in poor statistical results, because the precise timing of all physical, chemical, and biological phenomenon are likely not perfect in a model.
- Various simplifications were used when configuring the modeling framework, so it is unrealistic to assume that the model will be able to precisely predict each and every condition.

Examining a time series plot of modeled versus observed data provides more insight into the nature of the system and is more useful in water quality calibration than a statistical comparison. Trends in the observed data and cause-effect relationships between various parameters can be replicated with a model, although precise values at each and every point in time may not be. As long as the trends, relationships, and magnitudes are well-represented, and thus the underlying physics and kinetics are also being represented, a model is successful and can be used for simulating management alternatives.

***One commenter questioned the impact to calibration if formerly unrecognized sources of pollution are identified on a waterway?***

Point sources and non-point sources were characterized in the model based upon extensive investigations of land use, permit information, NPDES and Water Assessment Branch monitoring data, and pollutant source tracking investigations. In some instances during model calibration, additional investigations were conducted to identify sources in areas where the model was under-representing observed conditions. The extensive efforts to link sources to water quality impacts minimize the likelihood of incorrectly assigning causative sources of impairment.

***One commenter questioned the adequacy of the characterization of background pollutant loadings.***

Initial model parameters representing loading rates for background landuses were established by considering the following: result of a field study where model parameters were calibrated to water quality observations from a 100% forested watershed; previously calibrated model parameters in neighboring watersheds; an examination of the iron/sediment relationship using observed data in the TMDL project watershed; and literature values. The sediment parameters (e.g., iron potency factors and soil detachment) vary by soil type, and not only differ from one watershed to the next but also within watersheds. Additionally, during iron model calibration, the initial loading rates for background landuses are adjusted by controlling multiple model parameters - both for iron concentration of surface, interflow, and groundwater, and sediment - until model output matches the observed in-stream water quality data in subwatersheds dominated with background landuses. Fecal coliform parameters for background loading rates were developed and are calibrated using a similar methodology.

***One commenter questioned the water quality effect of recent changes like the Northern West Virginia Water Treatment Plant.***

The calibrated models for this TMDL development project represent stream conditions and sources that were present during the in 2010/2011 period when monitoring and pollutant source tracking were performed. The Northern West Virginia Water Treatment Plant, constructed to treat various problematic chloride discharges in the Dunkard Creek, West Fork and Monongahela River watersheds, began operation in 2013. Prior to TMDL development, chloride criteria end-of-pipe effluent limitations were imposed upon Outlet 011 of WV/NPDES Permit No. WV0093505. That outlet is the only source targeted for reduction by the draft chloride TMDLs and the chloride wasteload allocation prescribed in convert to the existing permit limitations. Chloride-containing wastestreams contributing to the subject outlet were required by order to be directed to the new treatment facility. If the corrective actions required by the order have occurred, then the implementation expected by the draft TMDLs has already been accomplished. Since the outlet is the only source targeted for reduction, its relocation and treatment should result in chloride water quality criteria attainment in the impaired streams for which TMDLs were developed. Stream condition with respect to chloride will be assessed in future DEP monitoring activities.

***One commenter stated that "chloride limits now proposed for Robinson Run outfalls" have unintended consequences such as building water treatment plants and transferring salt loadings to landfills.***

The subject TMDL project does not include a chloride TMDL for the stream named Robinson Run nor prescribe any chloride reductions in the Robinson Run watershed. Chloride TMDLs are presented for three segments in the Bingamon Creek watershed and prescribe chloride reductions only for the individual mining outlet discussed in the previous comment response. This outlet is associated with the mine named Robinson Run. The chloride wasteload allocation prescribed for that outlet in the draft TMDLs is consistent with the NPDES permit limitations imposed prior to TMDL development.

***One commenter asked if there were opportunities for trading between mining discharges.***

Because of the fine scale of segments assessed in the project, only limited trading between existing mining discharges may be available. To be approvable, permit limits/requirements would have to ensure that the altered allocations of the trading entities protect water quality criteria at their respective discharge locations. Additionally, the functionality of variable discharge types (i.e continuous vs. precipitation induced discharges) involved in potential trades would have to be considered as criteria attainment may be critical at different stream flow conditions. Trading consideration/approval would be a case-by-case determination in the permitting process.

***One commenter asked if there have been any recent scientific discoveries regarding selenium in fly ash that would change anything related to the draft TMDLs.***

This project doesn't include any TMDLs for selenium impairments.

***One commenter stated that the TMDL report "purports to support reasonable assurance that TMDLs can be met, as it impacts the local economy and resources" without defining the methods, costs and impacts of wastewater treatment by mining point sources.***

TMDLs must provide wasteload allocations for point sources and load allocations for nonpoint sources that result in attainment of water quality standards. In the context of TMDLs, the term "reasonable assurance" involves demonstrating the practicability of achieving load allocations for nonpoint sources when prescribing less restrictive wasteload allocations for point sources in mixed source TMDLs. It does not include consideration of the economics of wasteload allocation implementation by point sources. If reasonable assurance cannot be demonstrated, then pollutant reductions must be maximized in the wasteload allocations for point sources. In many instances in the project area, wasteload allocations for point sources are prescribed at the value of the water quality criterion and are not dependent upon a "reasonable assurance" demonstration. In some of the mixed source TMDLs of this project, wasteload allocations less stringent that criteria end-of-pipe have been prescribed. Within the watersheds of those impaired streams, DEP has determined that the load allocations prescribed for nonpoint sources are practicable.

***One commenter asked DEP to consider economic costs to meet limits proposed by TMDLs for mining outfalls.***

The TMDLs provide wasteload allocations for point sources and load allocations to nonpoint sources that result in attainment of water quality standards. Implementation costs are not calculated in the development process but are indirectly considered in the preparation of reasonable wasteload allocations. With respect to the mining outfalls, compliance costs are not prohibitive as many existing permits within the watershed contain effluent limitations of magnitude equal to the most stringent allocations prescribed in the TMDLs.

***One commenter indicated that compliance with antidegradation based limits is costly and the benefit is unknown.***

Antidegradation requirements are beyond the scope of the draft TMDLs. TMDLs address impaired waters whereas antidegradation requirements are intended to maintain designated uses in unimpaired waters by limiting the use of remaining assimilative capacity.

# 13.0 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.

## 13.1 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 11**.

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 West Fork River Watershed will be reissued beginning in July 2013 and the reissuance of mining permits will begin January 1, 2014.

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.

DWWM also implements a program to control discharges from CSOs. Specified fecal coliform WLAs for CSOs will be implemented in accordance with the provisions of the national Combined Sewer Overflow Control Policy and the state Combined Sewer Overflow Strategy. Those programs recognize that comprehensive CSO control may require significant resources and an extended period of time to accomplish. The WLAs prescribed for CSOs are necessary to achieve current fecal coliform water quality criteria. However, the TMDL should not be construed to supersede the prioritization and scheduling of CSO controls and actions pursuant to the national CSO program. Nor are the TMDLs intended to prohibit the pursuit of the water quality standard revisions envisioned in the national policy. TMDLs may be modified to properly implement future water quality standard revisions (designated use and/or criteria), if enacted and approved by the USEPA.

## 13.2 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 Northern Nonpoint Source Program Basin Coordinator, Martin Christ (Martin.J.Christ@wv.gov).

Guardians of the West Fork is the active watershed association in the West Fork River Watershed. For additional information concerning the associations, contact the above mentioned Basin Coordinator.

### 13.3 Public Sewer Projects

Within WVDEP DWWM, the Engineering and Permitting Branch's Engineering Section is charged with the responsibility of evaluating sewer projects and providing funding, where available, for those projects. All municipal wastewater loans issued through the State Revolving Fund (SRF) program are subject to a detailed engineering review of the engineering report, design report, construction plans, specifications, and bidding documents. The staff performs periodic on-site inspections during construction to ascertain the progress of the project and compliance with the plans and specifications. Where the community does not use SRF funds to undertake a project, the staff still performs engineering reviews for the agency on all POTWs prior to permit issuance or modification. For further information on upcoming projects, a list of funded and pending water and wastewater projects in West Virginia can be found at http://www.wvinfrastructure.com/projects/index.php.

### 13.4 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.

# 14.0 MONITORING PLAN

The following monitoring activities are recommended:

## 14.1 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.

## 14.2 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.

## 14.3 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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