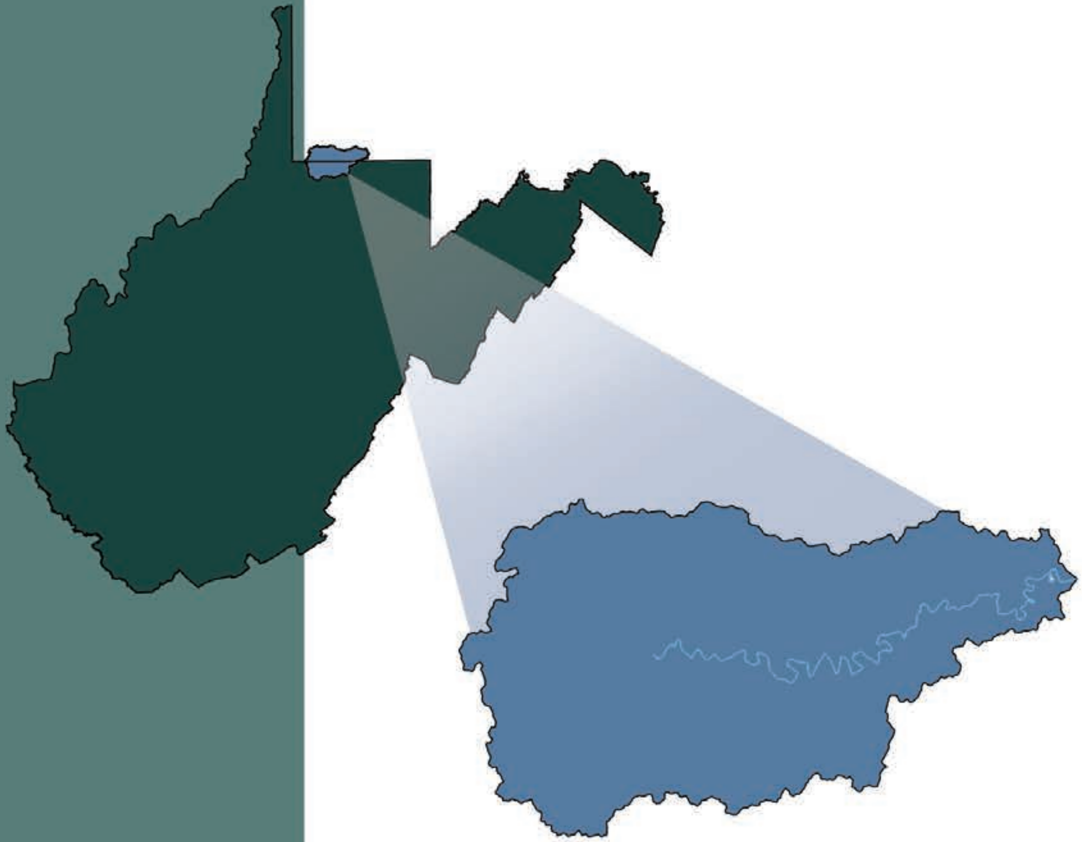

September 2009

FINAL USEPA
APPROVED REPORT

Total Maximum Daily Loads for Selected Streams in the Dunkard Watershed, West Virginia

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

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Total Maximum Daily Loads for Selected Streams in the Dunkard Creek Watershed, West Virginia

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CONTENTS

FIGURES

TABLES

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

7Q10	7-day, 10-year low flow
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
CFR	Code of Federal Regulations
CSO	combined sewer overflow
CSR	Code of State Rules
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
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
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. Throughout this report, the Dunkard Creek watershed refers to the tributary streams that eventually drain to Dunkard Creek (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 Dunkard Creek.

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 45 impaired streams contained within 9 TMDL watersheds in the Dunkard Creek 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 9 TMDL watersheds have been subdivided into 196 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

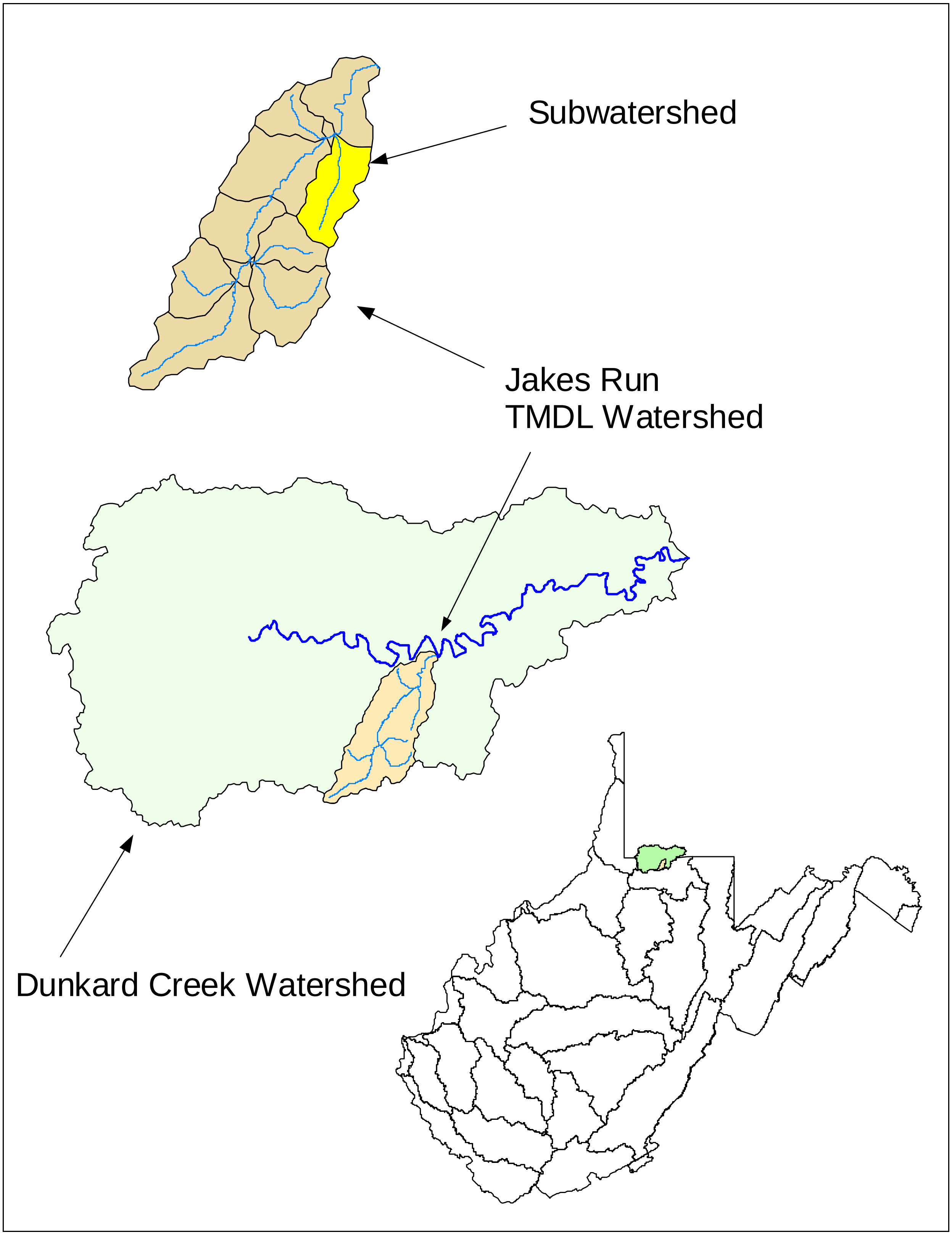


Figure I-1. Examples of a watershed, TMDL watershed, and subwatersheds

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 45 impaired streams in the Dunkard Creek watershed located in north central West Virginia. 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 majority of the subject impaired streams are included on West Virginia's Draft 2008 Section 303(d) List. Documented impairments are related to numeric water quality criteria for total iron, chloride, and fecal coliform bacteria. Certain waters are also biologically impaired based on the narrative water quality criterion of 47 CSR 2–3.2.i, which prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems.

From 1997 through September 2003, the U.S. Environmental Protection Agency (USEPA), Region 3, developed West Virginia TMDLs under the settlement of a 1995 lawsuit, Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al. v. Browner et al. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 Section 303(d) list. The schedule has been recently modified to extend TMDL development dates to September 2009.

Since October 2003, West Virginia's TMDLs have been developed by the West Virginia Department of Environmental Protection (WVDEP). This report accommodates the timely development of the remaining Dunkard Creek watershed TMDLs required by the consent decree (mine drainage impairments of Dunkard Creek mainstem) and also presents TMDLs for additional impairments of Dunkard Creek.

Impaired waters were organized into nine TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these nine TMDL watersheds were further divided into 196 smaller subwatershed units for modeling. 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, total iron, and chlorides. 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.

Dunkard Creek originates in West Virginia at the confluence of the West Virginia Fork and the Pennsylvania Fork and crosses the West Virginia/Pennsylvania border at multiple locations before finally exiting West Virginia at river mile 18.7 (i.e. 18.7 miles upstream of its confluence with the Monongahela River in Pennsylvania). TMDLs for the Dunkard Creek mainstem are presented for total iron, fecal coliform, and biological impairment. Pollutant loads are allocated to contributing sources in the watershed upstream of river mile 18.7.

The TMDLs do not prescribe specific load and wasteload allocations for contributing drainage areas in Pennsylvania. Instead, they assign a gross load expressed as a load allocation by modeled subwatershed, thereby allowing Pennsylvania the flexibility to determine appropriate and necessary point and nonpoint source reductions.

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.

Iron impairments are also attributable to both point and nonpoint sources. Nonpoint sources of iron include roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance, and streambank erosion. Iron point sources include the permitted discharges from mining activities, and stormwater contributions from 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.

Biological integrity/impairment is based on a rating of the stream’s benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). The first step in TMDL development for biologically impaired waters is stressor identification (SI). Section 4 discusses the SI process. SI was followed by stream-specific determinations of the pollutants for which TMDLs must be developed. Ionic toxicity, organic enrichment and sedimentation were identified as causative stressors for the biologically impaired streams addressed in this effort.

Organic enrichment was identified as a significant biological stressor in many waters. All such waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. It was determined that implementation of fecal coliform TMDLs would removed untreated sewage and significantly reduce animal wastes, thereby reducing the organic and nutrient loading causing the biological impairment.

Where sedimentation was identified as a significant stressor, sediment TMDLs were initially developed within the MDAS using a reference watershed approach. The MDAS was configured to examine upland sediment loading and streambank erosion and depositional processes. Load reductions for sediment-impaired waters were projected based upon the sediment loading present in an unimpaired reference watershed. For all of those waters, a strong, positive correlation between iron and total suspended solids (TSS) was identified and iron TMDLs are presented. It was universally determined that the sediment reductions necessary for the attainment of iron water quality criteria exceed those necessary to address biological stress from sedimentation. As such, the iron TMDLs serve as surrogates for the biological impairments caused by sedimentation.

The causative pollutants and impairment thresholds associated with ionic toxicity are not well understood. In certain waters, chlorides water quality criteria are not attained and chlorides TMDLs are presented. Although the reduction of chlorides concentrations should positively impact stream biology, it could not be determined that the attainment of chlorides water quality criteria alone would resolve the biological impairments. A strong presence of sulfates and other dissolved solids exists in those waters and in all other streams where ionic toxicity has been determined to be a significant biological stressor. Because available information is insufficient to address biological impairment attributed to ionic toxicity, TMDLs have not been presented for their biological impairments and those impairments will be retained on the Section 303(d) List.

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 wasteload allocations (WLAs) were no more stringent than numeric water quality criteria.

Applicable TMDLs are displayed in Section 9 of this report. Accompanying spreadsheets provide TMDLs and allocations of loads to categories of point and nonpoint sources that achieve the total TMDL. Also provided is an interactive ArcExplorer geographic information system (GIS) project that allows for the exploration of spatial relationships among the source assessment data. A Technical Report is also available that describes the detailed technical approaches used in the process and displays data upon which the TMDLs are based.

Considerable resources were used to acquire recent water quality and pollutant source information upon which the TMDLs are based. The TMDL modeling is among the most sophisticated available, and incorporates sound scientific principles. TMDL outputs are presented in various formats to assist user comprehension and facilitate use in implementation.

1.0 REPORT FORMAT

This report describes the overall total maximum daily load (TMDL) development process for the Dunkard Creek 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 a compact disc (CD) containing an interactive ArcExplorer GIS project that provides further details on the data and allows the user to explore the spatial relationships among the source assessment data. With this tool, users can magnify streams and other features of interest. Also included on the CD are spreadsheets (in Microsoft Excel format) that provide detailed source allocations associated with successful TMDL scenarios. A Technical Report is also included that describes the detailed technical approaches used in the process and displays 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:

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

From 1997 through September 2003, the U.S. Environmental Protection Agency (USEPA), Region 3, developed West Virginia TMDLs under the settlement of a 1995 lawsuit, Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al. v. Browner et al. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia’s 1996 Section 303(d) list. The schedule has been recently modified to extend TMDL development dates to September 2009.

Since October 2003, West Virginia’s TMDLs have been developed by WVDEP. This report accommodates the timely development of the remaining Dunkard Creek watershed TMDLs required by the consent decree (mine drainage impairments of Dunkard Creek mainstem) and also presents TMDLs for additional impairments of Dunkard Creek.

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 in 2008 TMDLs should be pursued in Hydrologic Group E, which includes the Dunkard Creek 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. WVDEP then presents its allocation strategies in a second public meeting, after which final TMDL reports are developed. The draft TMDL is advertised for public review and comment, and a third informational meeting is held during the public comment period. Public comments are addressed, and the draft TMDL is submitted to USEPA for approval.

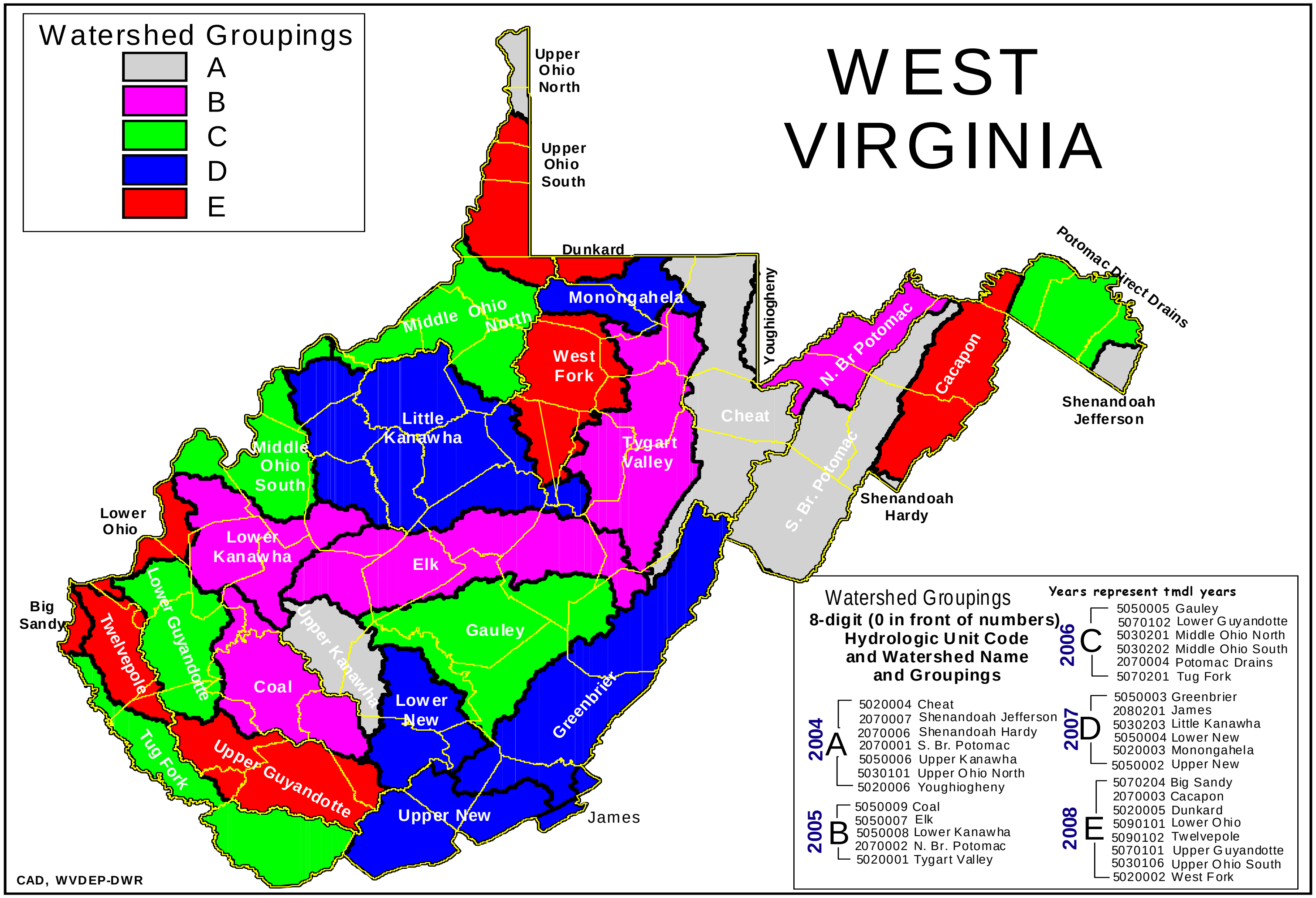


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

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://www.wvsos.com/csr/verify.asp?TitleSeries=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 Dunkard Creek watershed, warmwater fishery aquatic life use impairments have been determined pursuant to exceedances of total iron and chloride. 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, total iron and chloride.

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 is the basis for "biological impairment" determinations. Biological impairment signifies a stressed aquatic community, and is discussed in detail in Section 4.

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 both numeric and narrative 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 EPA approval prior to implementation.

Table 2-1. Applicable West Virginia water quality criteria

POLLUTANT	USE DESIGNATION				
	Aquatic Life				Human Health
	Warmwater Fisheries		Troutwaters		Contact Recreation/Public Water Supply
	Acute[a]	Chronic[b]	Acute[a]	Chronic[b]	
Iron, total (mg/L)	--	1.5	--	0.5	1.5
Chloride (mg/L)	860	230	860	230	250
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

As shown in Figure 3-1, the Dunkard Creek watershed lies within Monongalia County in West Virginia, and Greene County in Pennsylvania. In West Virginia and Pennsylvania, its drainage area encompasses approximately 180 square miles. Major West Virginia tributaries include West Virginia Fork, Pennsylvania Fork, Miracle Run, Jakes Run, and Dolls Run. The average elevation in the watershed is 1,248 feet. The highest point is 1,711 feet near Bake Oven Knob, northwest of Fairview, West Virginia. The minimum elevation is 785 feet located at the confluence of Dunkard Creek and the Monongahela River. The total population living in the subject watersheds of this report is estimated to be approximately 14,000 people.

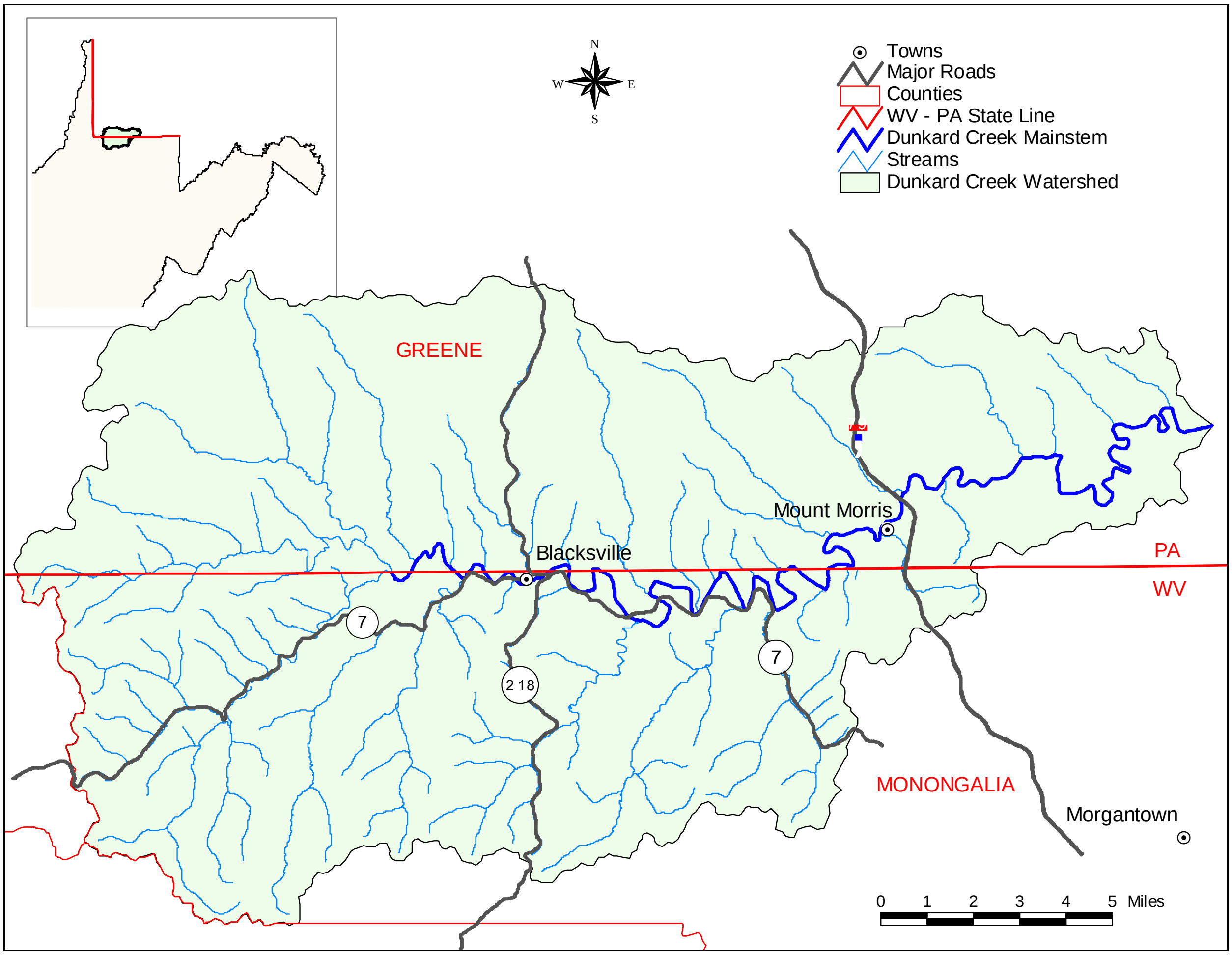


Figure 3-1. Location of the Dunkard Creek watershed

Table 3-1 displays the landuse distribution for the 196 modeled subwatersheds in the Dunkard Creek watershed. The dominant landuse is forest, which constitutes 79.8 percent of the total landuse area. Other important modeled landuse types are grassland (6.0 percent), urban/residential (5.2 percent), mining (4.2 percent), pasture (2.4 percent), and cropland (2.2 percent). Individually, all other land cover types compose one percent or less of the total watershed area.

Landuse and land cover estimates were originally obtained from vegetation data gathered from the National Land Cover Dataset (NLCD) 2001. 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 C of the Technical Report.

Table 3-1. Modified landuse for the Dunkard Creek TMDL watersheds

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Water	197.03	0.308	0.17
Wetland	70.48	0.110	0.06
Barren	18.02	0.028	0.02
Forest	91741.74	143.346	79.75
Grassland	6948.49	10.857	6.04
Cropland	2493.28	3.896	2.17
Pasture	2748.33	4.294	2.39
Urban/Residential	6014.93	9.398	5.23
Mining	4800.64	7.501	4.17
AML	2.69	0.004	0.00
Total Area	115035.62	179.743	100.00

Note: < = less than

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 I. The geographic information is provided in the ArcExplorer GIS project included on the CD version of this report.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Sources
Watershed physiographic data	Stream network	West Virginia Division of Natural Resources (WVDNR)
	Landuse	National Land Cover Dataset 2001 (NLCD)
	2003 Aerial Photography (1-meter resolution)	WVDEP
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau

Type of Information		Data Sources
	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
	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 Dunkard Creek watershed from July 2005 through June 2006. 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 nine 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.

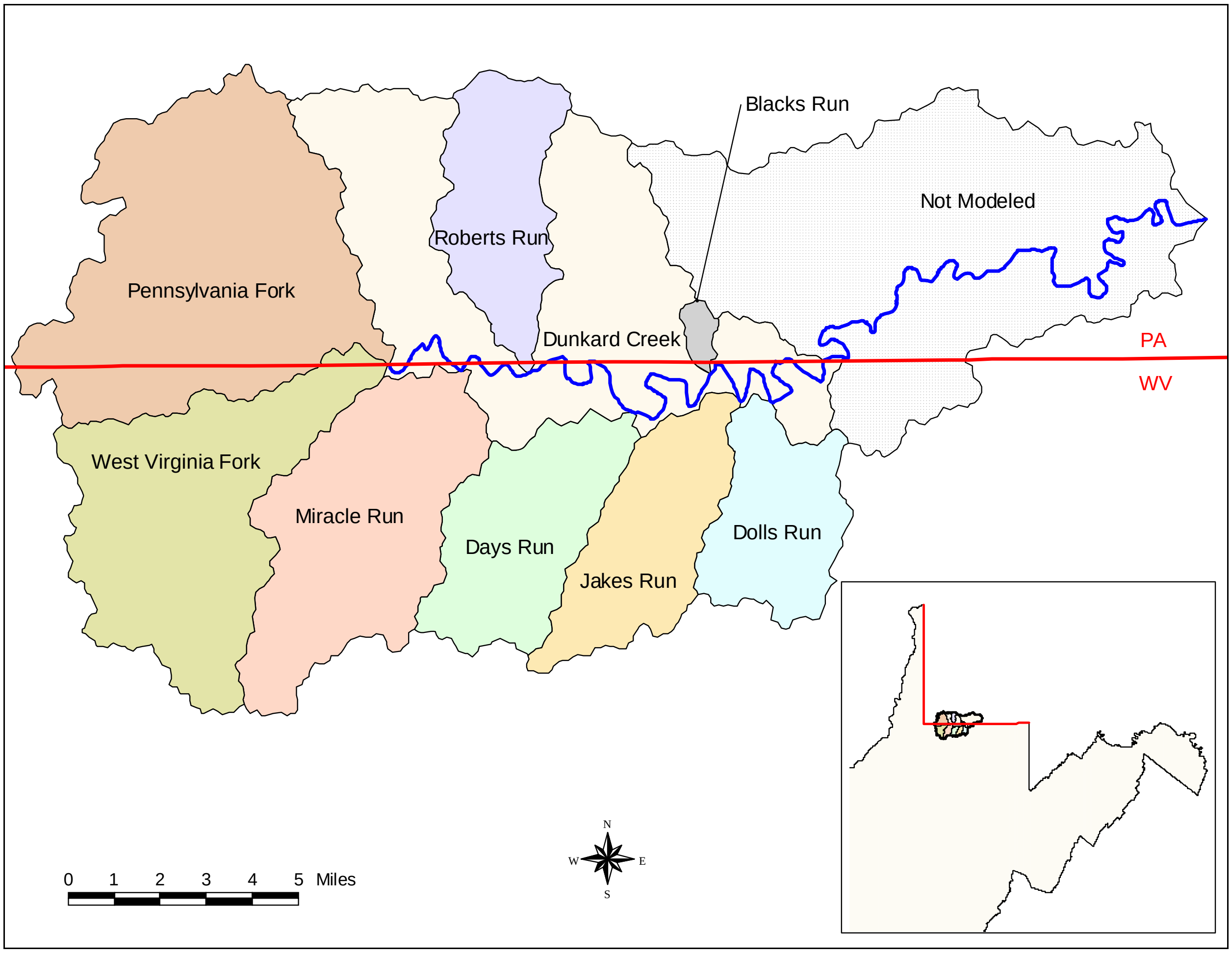


Figure 3-2. Dunkard Creek TMDL watersheds

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

Subwatershed	Stream Name	NHD_Code	Fe	Cl	FC	BIO
Dunkard Creek	Dunkard Creek	WV-ML-128	x		x	x
Dolls Run	Dolls Run	WV-ML-128-AC	X		x	x
Dolls Run	Pedlar Run	WV-ML-128-AC-4	X		x	x
Dolls Run	UNT/Pedlar Run RM 1.20	WV-ML-128-AC-4-B	X		x	
Dolls Run	Smoky Drain	WV-ML-128-AC-5	X		x	x
Dolls Run	Berry Hollow	WV-ML-128-AC-6	X			
Jakes Run	Jakes Run	WV-ML-128-AE	X		x	x
Jakes Run	UNT/Jakes Run RM 5.5	WV-ML-128-AE-12	X		x	
Jakes Run	UNT/Jakes Run RM 2.33	WV-ML-128-AE-4			x	
Blacks Run	Blacks Run	WV-ML-128-AF	X			x
Dunkard Creek	Hackelbender Run	WV-ML-128-AG	X			
Days Run	Days Run	WV-ML-128-AJ	X		x	x
Dunkard Creek	UNT/Days Run RM 6.2	WV-ML-128-AJ-10	X			
Dunkard Creek	UNT/Days Run RM 7.3	WV-ML-128-AJ-12	X			
Dunkard Creek	Indian Camp Run	WV-ML-128-AJ-4	X			
Days Run	Shriver Run (ML-128-AJ-8)	WV-ML-128-AJ-8	x		x	x
Days Run	Building Run (ML-128-AJ-8-C)	WV-ML-128-AJ-8-C	X		x	
Days Run	UNT/Days Run RM 5.8	WV-ML-128-AJ-9	X		x	x
Dunkard Creek	UNT/UNT RM 0.89/Days Run RM 5.8	WV-ML-128-AJ-9-C	X			
Dunkard Creek	Kings Run	WV-ML-128-AP	X			
Roberts Run	Roberts Run	WV-ML-128-AR	X		x	
Miracle Run	Miracle Run	WV-ML-128-AV	X		x	
Miracle Run	Thomas Run	WV-ML-128-AV-1			x	
Miracle Run	Scott Run	WV-ML-128-AV-11			x	
Miracle Run	UNT/Miracle Run RM 5.50	WV-ML-128-AV-16	X			
Miracle Run	UNT/Miracle Run RM 6.55	WV-ML-128-AV-18	X			
Miracle Run	Right Branch/Miracle Run	WV-ML-128-AV-3	X		x	x
PA Fork Dunkard Creek	Pennsylvania Fork/Dunkard Creek	WV-ML-128-BA	X		x	
PA Fork Dunkard Creek	Brushy Fork	WV-ML-128-BA-12	X			
PA Fork Dunkard Creek	UNT/Pennsylvania Fork RM 8.2	WV-ML-128-BA-15	X			
PA Fork Dunkard Creek	UNT/Pennsylvania Fork RM 9.55	WV-ML-128-BA-18	X			
PA Fork Dunkard Creek	Pumpkin Run	WV-ML-128-BA-4	X			
WV Fork Dunkard Creek	West Virginia Fork/Dunkard Creek	WV-ML-128-BB	x	x	x	
WV Fork Dunkard Creek	Shriver Run (ML-128-BB-10)	WV-ML-128-BB-10	X			
WV Fork Dunkard Creek	Range Run	WV-ML-128-BB-13	X		x	x

Subwatershed	Stream Name	NHD_Code	Fe	Cl	FC	BIO
WV Fork Dunkard Creek	South Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-14	x	x	x	
WV Fork Dunkard Creek	Middle Fork/South Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-14-A			x	
WV Fork Dunkard Creek	UNT/South Fork RM 3.0/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-14-F	X	x		
WV Fork Dunkard Creek	North Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-15	X		x	x
WV Fork Dunkard Creek	Camp Run	WV-ML-128-BB-15-B	X		x	x
WV Fork Dunkard Creek	Browns Run	WV-ML-128-BB-15-B-1	X			
WV Fork Dunkard Creek	Joy Run	WV-ML-128-BB-15-B-2	X			
WV Fork Dunkard Creek	Briar Run	WV-ML-128-BB-15-B-4	X			
WV Fork Dunkard Creek	Hughes Run	WV-ML-128-BB-3	X			
WV Fork Dunkard Creek	Wise Run	WV-ML-128-BB-9	X		x	x

Note:

UNT = unnamed tributary; RM = river mile.
CL indicates chloride impairment
FC indicates fecal coliform bacteria impairment
BIO indicates a biological impairment

4.0 BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

Initially, TMDL development in biologically impaired waters requires identification of the pollutants that cause the stress to the biological community. Sources of those pollutants are often analogous to those already described: mine drainage, untreated sewage, and sediment. Section 2 of the Technical Report discusses biological impairment and the SI process in detail.

4.1 Introduction

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

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

The general 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. TMDLs were established for the responsible pollutants at the conclusion of the SI process. As a result, the TMDL process established a link between the impairment and benthic community stressors.

4.2 Data Review

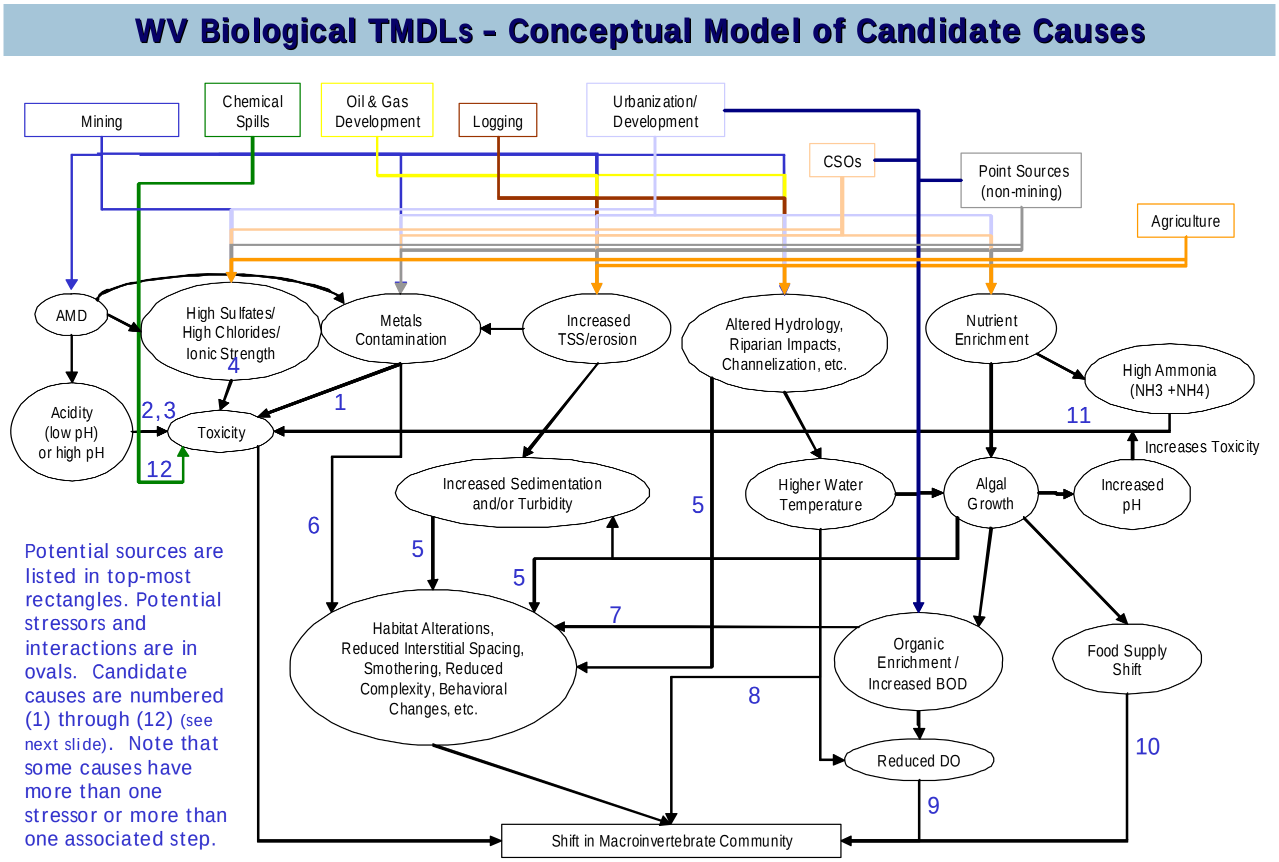
WVDEP generated the primary data used in SI through its pre-TMDL monitoring program. The program included water quality monitoring, benthic sampling, and habitat assessment. In addition, the biologists' comments regarding stream condition and potential stressors and sources were captured and considered. Other data sources were: source tracking data, WVDEP mining activities data, NLCD 2001 landuse information, Natural Resources Conservation Service (NRCS) State Soil Geographic database (STATSGO) soils data, National Pollution 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 responsible for biological impairments are listed below:

- Metals contamination (including metals contributed through soil erosion) causes toxicity
- Acidity (low pH) causes toxicity
- Increased ionic strength causes toxicity
- Organic enrichment (e.g. sewage discharges and agricultural runoff) cause habitat alterations
- Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations
- Altered hydrology causes higher water temperature, resulting in direct impacts
- Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
- Algal growth causes food supply shift
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth)
- Chemical spills cause toxicity

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



WV Biological TMDLs - Conceptual Model of Candidate Causes

Potential sources are listed in top-most rectangles. Potential stressors and interactions are in ovals. Candidate causes are numbered (1) through (12) (see next slide). Note that some causes have more than one stressor or more than one associated step.

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

4.4 Stressor Identification Results

The SI process determined the significant causes of biological impairment. Biological impairment was linked to a single stressor in some cases and multiple stressors in others. The SI process identified the following stressors for the biologically impaired waters in the Dunkard Creek watershed:

- 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 determined the pollutants for which TMDLs were required to address the impairment.

Where the SI process identified organic enrichment as the cause of biological impairment, 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 resolve the biological impairment in these streams. Therefore, fecal coliform TMDLs will serve as a surrogate where organic enrichment was identified as a stressor.

WVDEP initially pursued the development of TMDLs directly for sediment to address the sedimentation biological stressor. The intended approach involved selection of a reference stream with an unimpaired biological condition, prediction of the sediment loading present in the reference stream, and use of the area-normalized sediment loading of the reference stream as the TMDL endpoint for sediment impaired waters.

UNT/Days Run RM 4.32 (WV-ML-128-AJ-6) was selected as the achievable reference stream, as it shares similar landuse, ecoregion and geomorphologic characteristics with the sediment impaired streams. The location of UNT/Days Run RM 4.32 is shown in Figure 4-2.

All of the biologically impaired waters for which sedimentation was identified 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. 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. As such, the iron TMDLs are acceptable surrogates for biological impairments from sedimentation.

In certain waters (Miracle Run, Building Run, West Virginia Fork/Dunkard Creek, South Fork/West Virginia Fork/Dunkard Creek), the SI process determined ionic toxicity to be a significant stressor. In certain waters, the chloride water quality criteria are not in attainment and chloride TMDLs are presented. Although the reduction of chloride concentrations should positively impact stream biology, it could not be determined that the attainment of the chloride water quality criterion alone would resolve the biological impairments. A strong presence of sulfates and other dissolved solids exists in those waters and in all other streams where ionic toxicity has been determined to be a significant biological stressor. There is insufficient information available regarding the causative pollutants and their associated impairment thresholds for biological TMDL development for ionic toxicity at this time. Therefore, WVDEP is deferring biological TMDL development for ionic toxicity stressed streams and retaining those waters on the Section 303(d) list.

Table 4-1. Significant stressors of biologically impaired streams

TMDL Watershed	Stream Name	NHD_Code	Biological Stressors	TMDLs Developed
Dunkard Creek	Dunkard Creek	WV-ML-128	Sedimentation Organic Enrichment	Total Iron Fecal Coliform
Dolls Run	Dolls Run	WV-ML-128-AC	Sedimentation Organic Enrichment	Total Iron Fecal Coliform
Dolls Run	Pedlar Run	WV-ML-128-AC-4	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Dolls Run	Smoky Drain	WV-ML-128-AC-5	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Jakes Run	Jakes Run	WV-ML-128-AE	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Blacks Run	Blacks Run	WV-ML-128-AF	Sedimentation	Total Iron
Days Run	Days Run	WV-ML-128-AJ	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Days Run	Shriver Run	WV-ML-128-AJ-8	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Days Run	UNT/Days Run RM 5.8	WV-ML-128-AJ-9	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
Miracle Run	Miracle Run	WV-ML-128-AV	Organic Enrichment Sedimentation Ionic Stress	Fecal Coliform Total Iron Ionic Strength (To remain on the 303d List)
Miracle Run	Building Run	WV-ML-128-AV-15	Ionic Stress	Ionic Strength (To remain on the 303d List)
Miracle Run	Right Branch/Miracle Run	WV-ML-128-AV-3	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
WV Fork	West Virginia Fork/Dunkard Creek	WV-ML-128-BB	Sedimentation Organic Enrichment Ionic Stress	Total Iron Fecal Coliform Ionic Strength (To remain on the 303d List)
WV Fork	Range Run	WV-ML-128-BB-13	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
WV Fork	South Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-14	Ionic Stress Organic Enrichment Sedimentation	Ionic Strength (To remain on the 303d List) Fecal Coliform Total Iron
WV Fork	North Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-15	Organic Enrichment Sedimentation	Fecal Coliform Total Iron
WV Fork	Camp Run	WV-ML-128-BB-15-B	Organic Enrichment	Fecal Coliform
WV Fork	Wise Run	WV-ML-128-BB-9	Organic Enrichment Sedimentation	Fecal Coliform Total Iron

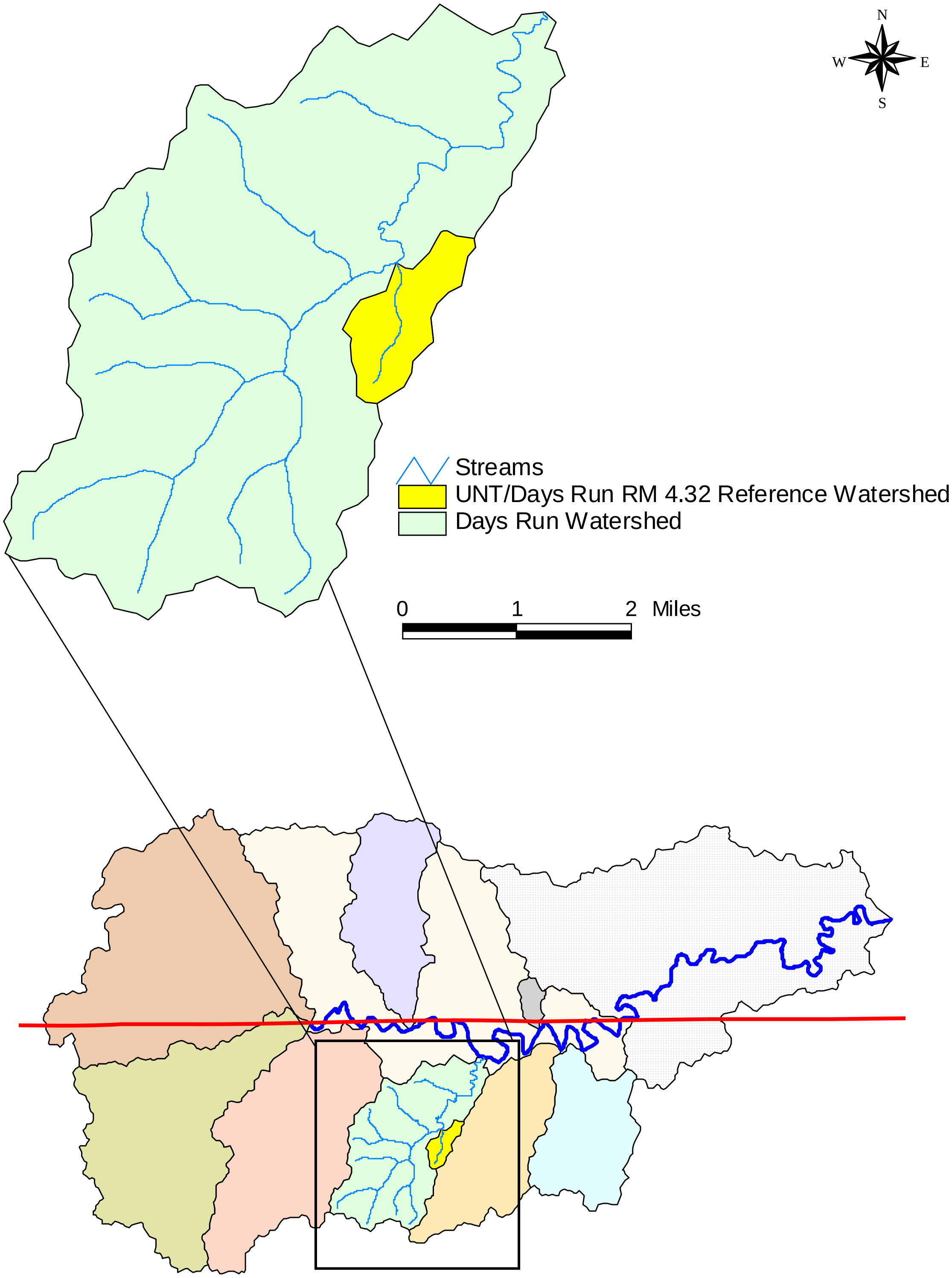


Figure 4-2. Sediment reference stream location, UNT/Days Run RM 4.32 (WV-ML-128-AJ-6)

5.0 TOTAL IRON SOURCE ASSESSMENT

This section identifies and examines the potential sources of total iron impairments in the Dunkard Creek watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources.

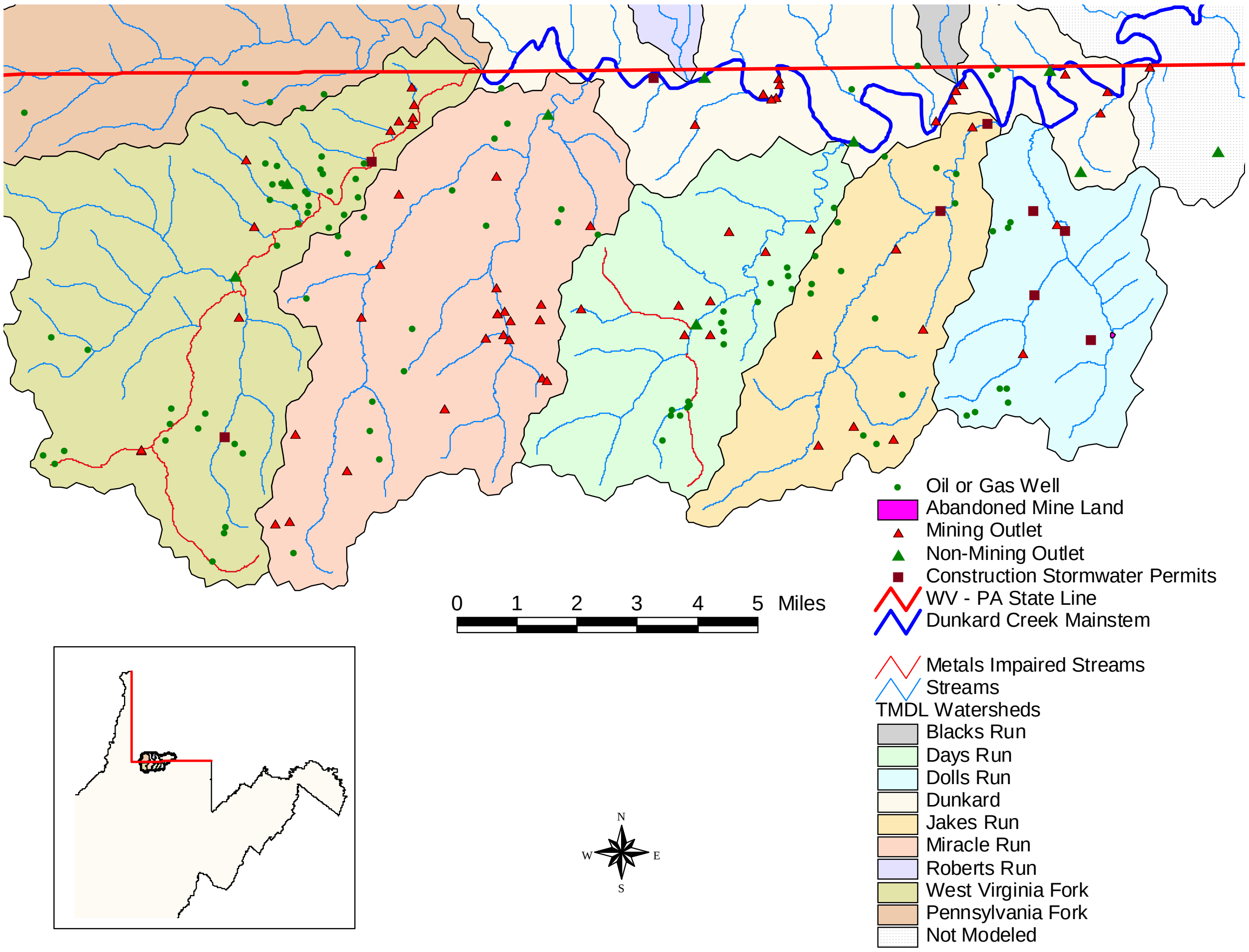
A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel 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 bond forfeiture sites and AML. The assignment of LAs to AML and bond forfeiture sites does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within these landuses. 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 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 ArcExplorer project on the CD version of this TMDL report.

5.1 Total Iron Point Sources

Iron 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.



NOTES: Some mapped features in close proximity to each other may plot as one location on the map.

Figure 5-1. Iron sources in the Dunkard Creek 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 aluminum, 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 Environmental Resources Information System (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 iron.

There are four mining-related NPDES permits with 35 outlets in the West Virginia portion of the Dunkard Creek 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 G of the Technical Report. Figure 5-1 illustrates the extent of the mining NPDES outlets in the watershed.

5.1.2 Non-mining Point Sources

WVDEP DWWM controls water quality impacts from non-mining activities with point source discharges through the issuance of NPDES permits. WVDEP's OWRNPDES GIS coverage was used to determine the locations of these sources, and detailed permit information was obtained from WVDEP's ERIS database. Sources may include the process wastewater discharges from water treatment plants and industrial manufacturing operations, and stormwater discharges associated with industrial activity.

There is one modeled non-mining NPDES permit in the West Virginia portion of the Dunkard Creek watershed .This permit (WVG611273) regulates stormwater associated with industrial activity and implements stormwater benchmark values of 100 mg/L TSS and/or 1.0 mg/L total iron. The permit location is displayed in Figure 5-1. The assigned WLAs allow for continued discharge under existing permit requirements.

5.1.3 Construction Stormwater Permits

The discharges from construction activities that disturb more than one acre of land are legally defined as point sources and the sediment introduced from such discharges can contribute iron 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.

There are nine active construction sites with a total disturbed acreage of 53.3 acres registered under the Construction Stormwater General Permit in the West Virginia portion of the Dunkard Creek watershed .Although specific wasteload allocations are not prescribed for these sites, the associated disturbed areas conform to the subwatershed-based allocations for registrations under the permit, as described in Section 9.0.

5.2 Total Iron Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to iron. AML may contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface water. Similarly, facilities that were subject to SMCRA during active operations and subsequently forfeited their bonds and abandoned operations can be a significant source of metals. Also, land disturbing activities that introduce excess sediment are considered nonpoint sources of iron.

5.2.1 Abandoned Mine Lands and Bond Forfeiture Sites

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.

AML&R identified locations of AML in the Dunkard Creek watershed from their records. Source tracking efforts by WVDEP DWWM did not identify any additional AML sources. In the West Virginia portion of the watershed, only 2.7 acres of highwall were incorporated into the

TMDL model. No unreclaimed bond forfeiture sites were identified in the West Virginia portion of the 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. 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 West Virginia portion of the watershed. This information included the harvested area (2,274 acres) and the subset of land disturbed by roads and landings (148 acres) in the metals impaired TMDL watersheds. Burned forest accounts for a total of 6.7 acres.

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 best management practices (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.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There are 149.2 acres of active oil and gas wells in the West Virginia portion of the watershed. Runoff from unpaved access roads to these wells and the disturbed areas around the wells contribute sediment to adjacent streams.

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 2000 TIGER/Line shapefiles from the U.S. Census Bureau and the WV Roads GIS coverage prepared by West Virginia University (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. While agricultural landuses account for approximately 4.56 percent of the modeled land area in the watershed, source tracking information shows minimal upland loading impact from these sources. Sedimentation/iron impacts from agricultural landuses are indirectly reflected in the streambank erosion allocations.

Streambank Erosion

Streambank erosion has been determined to be a significant sediment source. The sediment loading from bank erosion is considered a nonpoint source and LAs are assigned. The streambank erosion modeling process is discussed in Section 9.2.2.

Other Land-Disturbance Activities

Stormwater runoff from residential and urban landuses in non- municipal separate storm sewer system (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 NLCD2001 landuse data were used to determine the extent of residential and urban areas and source representation was based upon precipitation and runoff.

The NLCD 2001 landuse data also classifies certain areas as “barren” land. In the model configuration process, portions of the barren landuse were reclassified to account for known abandoned mine lands sources. 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 CHLORIDE SOURCES

Permitted discharges associated with mining activities are the most prevalent point sources in regard to the chloride impairments in the watershed. WVDEP 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. Many of the permits include effluent limitations for chloride that require the attainment of the chronic aquatic life protection criterion end-of-pipe. Using this information, the mining point sources were then represented in the model and assigned individual WLAs for chloride. There are four permitted outlets discharging to chloride-impaired streams, as shown in Figure 6-1.

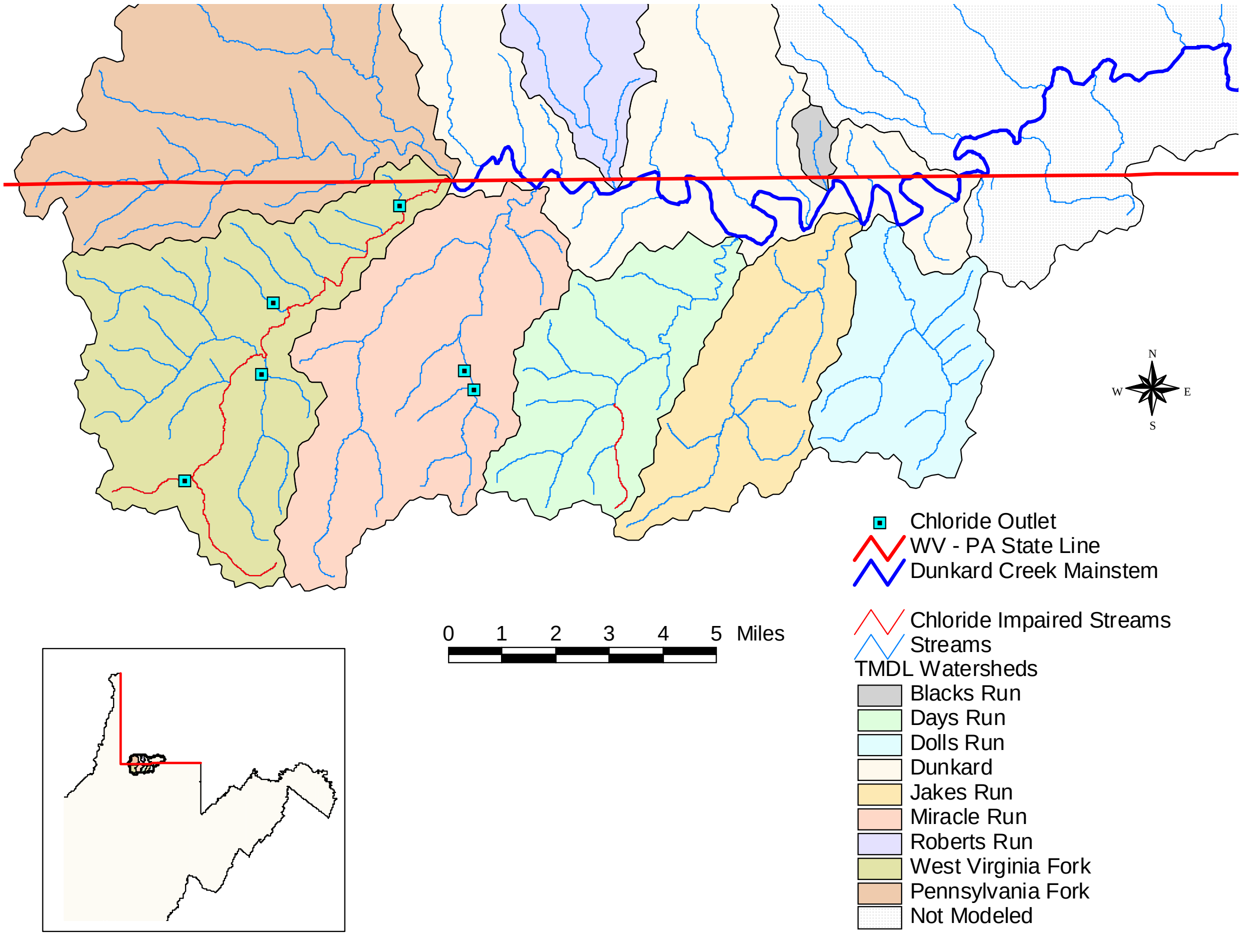


Figure 6-1. Mining permits for Chloride

6.1 Chloride Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to chloride. Nonpoint chloride sources include road de-icing, commercial and industrial de-icing, and fertilizer application, with the primary source being road salt and salt substitutes applied to the dense network of local roads and county and state highways in the watershed. Chloride loadings from nonpoint sources are background sources in the watershed. Their representation was based upon precipitation and chloride water quality monitoring at various locations in the watershed not influenced by chloride point sources. In the absence of chloride point sources, those existing nonpoint sources have not caused water quality criteria exceedances.

7.0 FECAL COLIFORM SOURCE ASSESSMENT

7.1 Fecal Coliform Point Sources

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

7.1.1 Individual NPDES Permits

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

In the West Virginia portion of the watershed, one permitted POTW (Blacksville POTW) discharges treated effluent at one outlet. Mining bathhouse facilities discharge to three outlets in the Dunkard Creek 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 [monthly geometric mean] and 400 counts/100 mL [maximum daily]). Compliant facilities do not cause fecal coliform bacteria impairments because effluent limitations are more stringent than water quality criteria.

7.1.2 Overflows

CSOs are outfalls from POTW sewer systems that carry untreated domestic waste and surface runoff. CSOs are permitted to discharge only during precipitation events. Sanitary sewer overflows (SSOs) are unpermitted overflows that occur as a result of excess inflow and/or infiltration to POTW separate sanitary collection systems. Both types of overflows contain fecal coliform bacteria. There are no CSO or SSO outlets in the subject watersheds.

7.1.3 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 less than 50,000 gallons per day (gpd). General Permit WV0107000 regulates home aeration units (HAUs). HAUs are small sewage treatment plants primarily used by individual residences where site considerations preclude typical septic tank and leach field installation. Both general permits contain fecal coliform effluent limitations identical to those in individual NPDES permits for sewage treatment facilities. In the areas draining to streams for which fecal coliform TMDLs have been developed, seven facilities are registered under the “package plant” general permit and 58 are registered under the “HAU” general permit.

7.2 Fecal Coliform Nonpoint Sources

7.2.1 On-site Treatment Systems

Failing septic systems and straight pipes are significant nonpoint sources of fecal coliform bacteria. Information collected during source tracking efforts by WVDEP yielded an estimate of approximately 2,790 homes that are not served by centralized sewage collection and treatment systems. Estimated septic system failure rates across the watershed range from 13 percent to 24 percent.

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

To calculate failing septic wastewater flows, the TMDL watersheds were divided into four septic failure zones. During the WVDEP source tracking process, septic failure zones were delineated by soil characteristics (soil permeability, depth to bedrock, depth to groundwater and drainage capacity) as shown in United States Department of Agriculture (USDA) county soil survey maps. Two types of failure were considered, complete failure and periodic failure. For the purposes of this analysis, complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters and periodic failure was defined as 25 gallons per house per day. Figure 7-1 shows the failing septic flows represented in the model by subwatershed.

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.

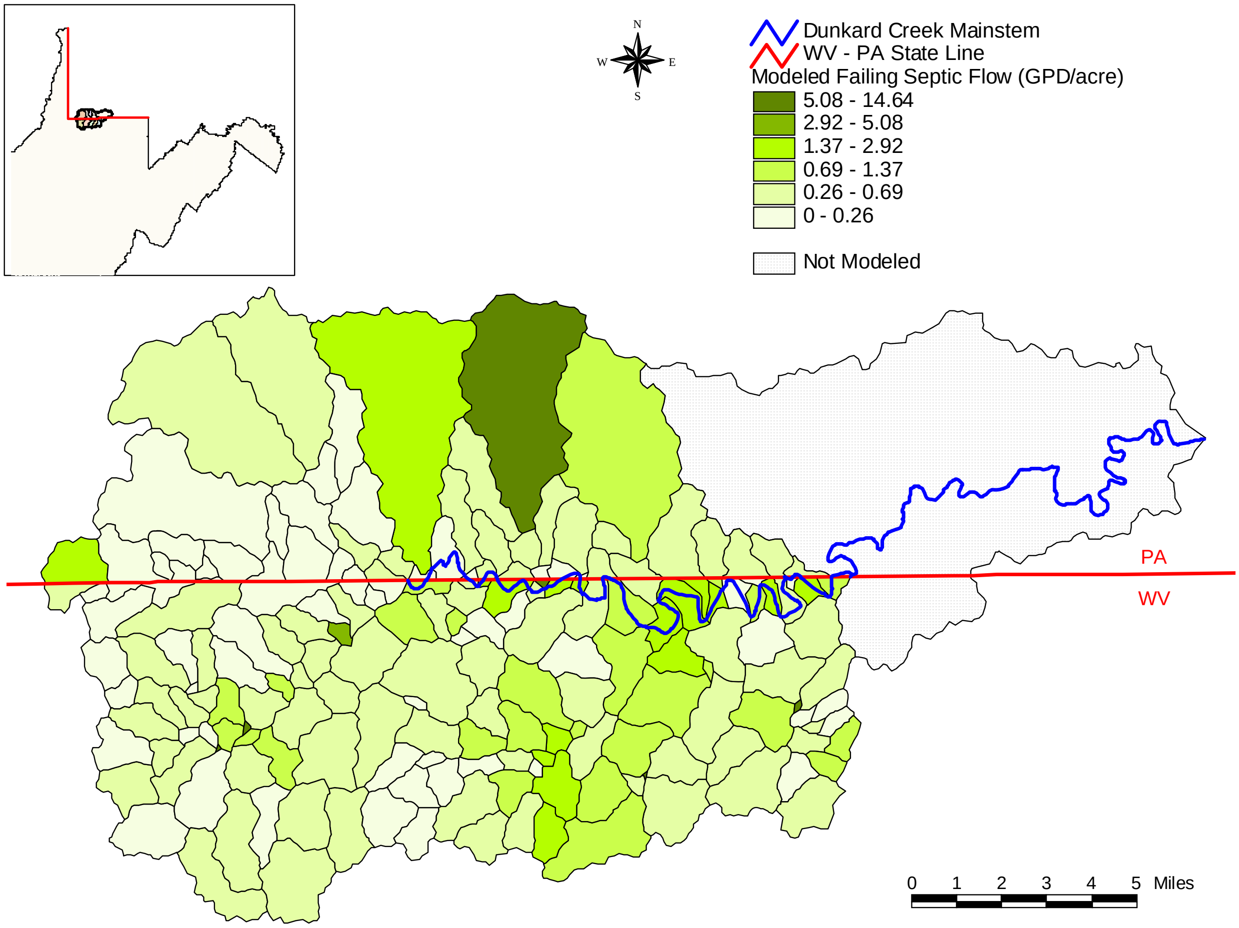


Figure 7-1. Failing septic flows in the Dunkard Creek watershed

7.2.2 Urban/Residential Runoff

Stormwater runoff from residential and urbanized areas can be a significant source of fecal coliform bacteria. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified NLCD 2001 landuse data were used to determine the extent of residential and urban areas and source representation was based upon precipitation and runoff.

7.2.3 Agriculture

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

Although agricultural activity is not the dominant fecal coliform bacteria nonpoint source in the watershed, it is fairly ubiquitous, with pasture/cropland landuses determined to be present in approximately one half of the modeled subwatersheds. Source tracking efforts identified pastures and feedlots near impaired segments that have localized impacts on instream bacteria levels. Source representation was based upon precipitation and runoff, and source tracking information regarding number of livestock, proximity and access to stream, and overall runoff potential were used to develop accumulation rates.

7.2.4 Natural Background (Wildlife)

A certain “natural background” contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested areas. Accumulation rates for fecal coliform bacteria in forested areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from West Virginia’s Division of Natural Resources (DNR). In addition, WVDEP conducted storm-sampling on a 100 percent forested subwatershed (Shrewsbury Hollow) within the Kanawha State Forest, Kanawha County, West Virginia to determine wildlife contributions of fecal coliform. These results were used during the model calibration process. On the basis of the low fecal accumulation rates for forested areas, the storm water sampling results, and model simulations, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the watershed.

8.0 SEDIMENT SOURCE ASSESSMENT

Excess sediment has been identified as a significant stressor in relation to the 16 of the biological impaired streams in the Dunkard Creek watershed. These waters are also impaired pursuant to the numerical water quality criteria for iron. In all of the subject waters, it was determined that the sediment reductions necessary to ensure attainment of the iron water quality criteria exceed those that would be needed to address biological impairment through a reasonably achievable sediment reference approach. Therefore, the iron TMDLs are an appropriate surrogate in place of sediment TMDLs. Sediment sources considered in the TMDL model are described in detail in Section 5.2.3.

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 Dunkard Creek 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
- Iron and fecal coliform bacterial impairments are temporally variable and occur at low, average, and high flow conditions
- Total iron and loadings and instream concentrations are related to sediment
- Time-variable aspects of land practices have a large effect on instream iron and bacteria concentrations
- Iron 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, chloride, 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 Dunkard Creek 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 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 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, chloride, and fecal coliform bacteria were modeled using the MDAS.

9.2 Model Setup

Model setup consisted of configuring the following three separate MDAS models: iron/sediment, 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 nine TMDL watersheds were broken into 196 separate subwatershed units, based on the groupings of impaired streams shown in Figure 9-1. 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.

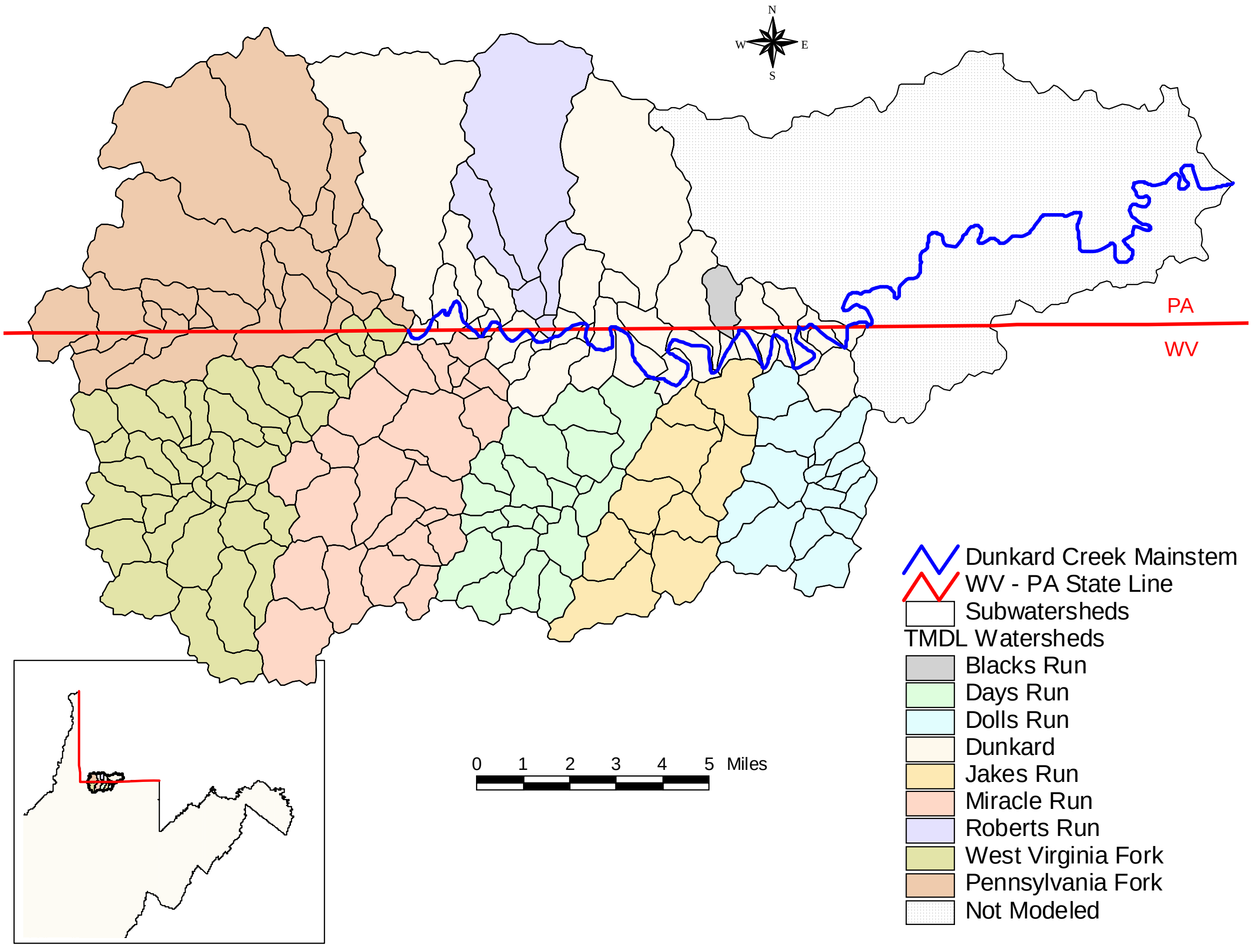


Figure 9-1. TMDL watersheds and subwatershed delineation

9.2.2 Iron and Sediment Configuration

The modeled landuse categories contributing iron 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 2001 landuse categories to create modeled landuse groupings. Several additional landuse categories were created to account for landuses either not included in the NLCD 2001 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. Other sources, such as AML seeps identified by WVDEP's source tracking efforts, and mining pumped discharges were modeled as direct, continuous-flow sources in the model.

Sediment-producing landuses and bank erosion are sources of iron because it is associated with sediment. Statistical analyses using pre-TMDL monitoring data collected in the TMDL watersheds were performed to establish the correlation between sediment and metals concentrations and to evaluate the spatial variability of this correlation. 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 sediment depends on the intensity of surface runoff. It also varies by landuse and the characteristics of the land. Sediment delivery paths modeled were surface runoff erosion, and streambank erosion. Surface sediment sources were modeled using average sediment runoff concentrations by landuse. These concentrations were applied to the corresponding surface runoff flows. Bank erosion was modeled as a rate per unit area of submerged erodible area. Bank erosion will only happen after a critical flow is reached, and as the flow increases, so does the bank erosion yield. Sediment produced during bank erosion episodes is also dependent on the stability of the banks, as defined by the total bank stability score.

The relevant parameters in the bank-erosion algorithms are the threshold flow at which bank erosion starts to occur, and a coefficient for scour of the bank matrix soil for the reach. The threshold flow at which bank erosion starts to occur was estimated as the flow that occurs at bank-full depth. The coefficient for scour of the bank matrix soil was a direct function of the reach’s stability factor (S-value).

The MDAS bank erosion model takes into account stream flow and bank stability. The bank erosion rate per unit area was defined as a function of: bank flow volume above a specified threshold and the bank erodible area. Each stream segment had a flow threshold above which streambank erosion occurred. The bank scouring process is a power function dependent on high-flow events, defined as exceeding the flow threshold. The coefficient of scour for the bank soil was related to the Bank Stability Index. Streambank erosion was modeled as a unique sediment source independent of other upland-associated erosion sources.

The wetted perimeter and reach length represent ground area covered by water (Figure 9-2). 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. The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling.

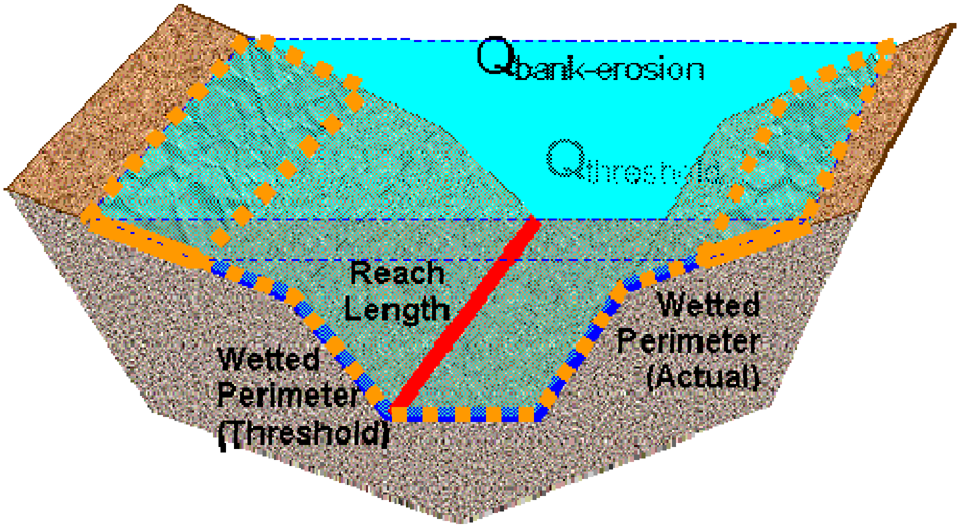


Figure 9-2. Conceptual stream channel components in the bank erosion model

9.2.3 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 effluent limitations and other available information obtained from the permitting database.

9.2.4 Fecal Coliform Configuration

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

The basis for the initial bacteria loading rates for landuses and direct sources is described in the Technical Report. The initial estimates were further refined during the model calibration. A variety of modeling tools were used to develop the fecal coliform bacteria TMDLs, including the MDAS, and a customized spreadsheet to determine the fecal loading from failing residential septic systems identified during source tracking efforts by the WVDEP. Section 7.2.1 describes the process of assigning flow and fecal coliform concentrations to failing septic systems.

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 United States Geological Survey (USGS) flow gauging stations throughout the watershed. LSPC hydrologic parameters were calibrated for the Dunkard Creek watershed model by matching model output to flow data from a USGS gauging station 03072000 on the Dunkard Creek mainstem at Shannopin, Pennsylvania.

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, 1994 to October 31, 2006. 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 Dunkard Creek 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 9-3.

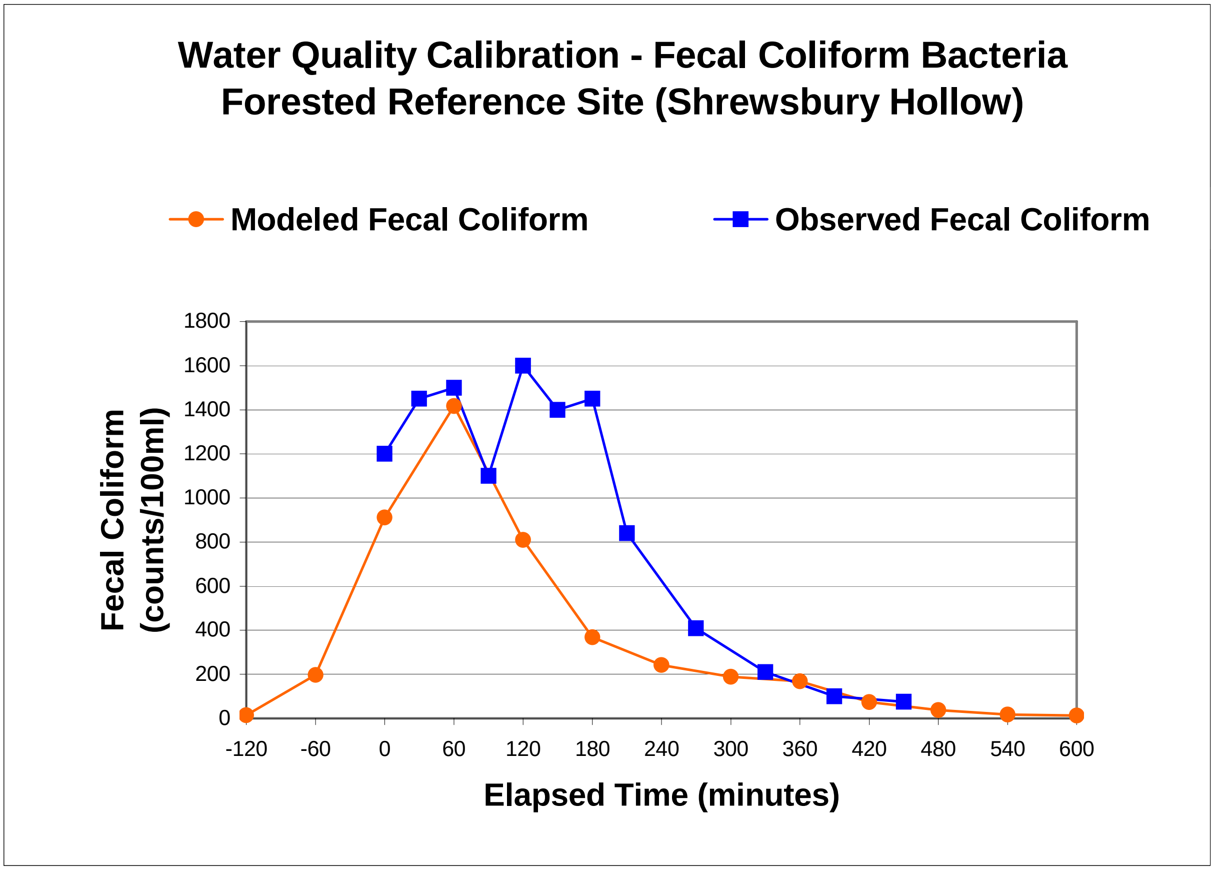


Figure 9-3. Shrewsbury Hollow fecal coliform observed data

The water quality parameters that were adjusted to obtain a calibrated model for sediment were the sediment concentrations by landuse, and the magnitude of the coefficient of scour for bank-erosion. Calibration parameters that were relevant for the land-based sediment calibration were the sediment concentrations (in mg/L) for runoff, interflow, and groundwater. These concentrations were defined for each modeled landuse. Initial values for these parameters were based on available landuse-specific storm-sampling monitoring data. Values were adjusted so that the model's suspended solids output closely matched observed instream data in watersheds with predominately one type of source.

9.5 Modeling Technique for Biological Impairment with Sedimentation Stressor

The SI process discussed in Section 4 indicated a need to reduce the contribution of excess sediment to some of the biologically impaired streams. Initially, a "reference watershed" TMDL development approach was pursued. The approach was based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to be representative of the conditions needed for the impaired streams to attain their designated uses, and the normalized loading associated with the reference stream is used as the TMDL endpoint for the impaired streams. Given these parameters and a non-impaired WVSCI score, UNT/Days

Run RM 4.32 (WV-ML-128-AJ-6) was selected as the reference watershed. The location of the reference watershed is shown in Figure 4-2.

All of the sediment-impaired 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 impairments associated with sediment. As such, the iron TMDLs presented for the subject waters are appropriate surrogates for necessary sediment TMDLs. For affected streams, Table 9-1 contrasts the sediment reductions necessary to attain iron criteria with those needed to resolve biological impairment under the reference watershed approach. Please refer to the Technical Report for details regarding the reference watershed approach.

Table 9-1. Sediment loadings using different modeling approaches

Stream Name	Stream Code	Allocated Sediment Load Iron TMDL (tons/yr)	Allocated Sediment Load Reference Approach (tons/yr)
Dunkard Creek	WV-ML-128	5,119	5,151
Dolls Run	WV-ML-128-AC	293	315
Smoky Drain	WV-ML-128-AC-5	21	25
Pedlar Run	WV-ML-128-AC-4	93	112
Jakes Run	WV-ML-128-AE	332	375
Blacks Run	WV-ML-128-AF	19	25
Days Run	WV-ML-128-AJ	339	418
UNT/Days Run RM 5.8	WV-ML-128-AJ-9	56	71
Shriver Run	WV-ML-128-AJ-8	35	59
Miracle Run	WV-ML-128-AV	477	666
Right Branch/Miracle Run	WV-ML-128-AV-3	235	324
Wise Run	WV-ML-128-BB-9	33	37
Range Run	WV-ML-128-BB-13	95	126
South Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-14	101	178
North Fork/West Virginia Fork/Dunkard Creek	WV-ML-128-BB-15	189	253
West Virginia Fork/Dunkard Creek	WV-ML-128-BB	569	769

9.6 Allocation Analysis

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

An explicit margin of safety was not included for chloride because little modeling uncertainty exists. Nonattainment is directly related to point sources regulated by WV/NPDES permits and water quality criteria will be met if the problematic point sources achieve prescribed criteria end-of-pipe wasteload allocations.

The TMDL endpoints for the various criteria are displayed in Table 9-2.

Table 9-2. 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)
Chloride	Aquatic Life, warmwater fisheries	230 mg/L	230 mg/L
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, 1998 through December 31, 2003). 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 9-4 presents the annual rainfall totals for the years 1990 through 2006 at the Lake Lynn, WV weather station. The years 1998 to 2003 are highlighted to indicate the range of precipitation conditions used for TMDL development in the Dunkard Creek watershed.

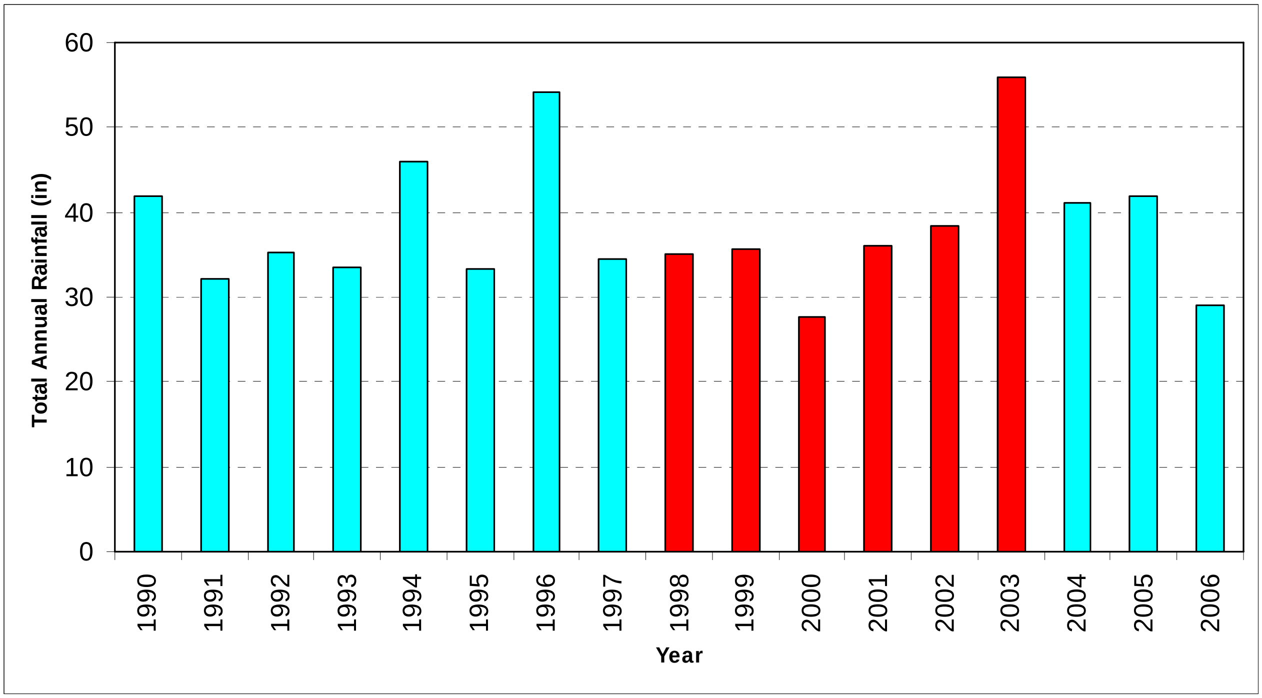


Figure 9-4. Annual precipitation totals for the Lake Lynn, West Virginia weather station

Mining discharges that are influenced by precipitation were represented during baseline conditions using precipitation, drainage area and applicable effluent limitations. For non-precipitation-induced mining discharges, available flow and/or pump capacity information was used in conjunction with applicable effluent limitations. The iron and chlorides concentrations associated with common effluent limitations are presented in Table 9-3. The concentrations displayed in Table 9-3 accurately represent existing wasteload allocations 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.

Table 9-3. Concentrations used in representing permitted conditions for active mining

Pollutant	Technology-based Permits	Water Quality-based Permits
Iron, total	3.2 mg/L	1.5 mg/L
Chloride	NA	230 mg/L

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

A maximum area of 1.0 percent of the total subwatershed area was allotted for concurrent construction activity under the Construction Stormwater General Permit. 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. CSO, SSO and MS4 sources were not present in the fecal coliform impaired modeled watersheds, therefore none were represented in the model.

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 9-5 shows an example of model output for a baseline condition and a successful TMDL scenario.

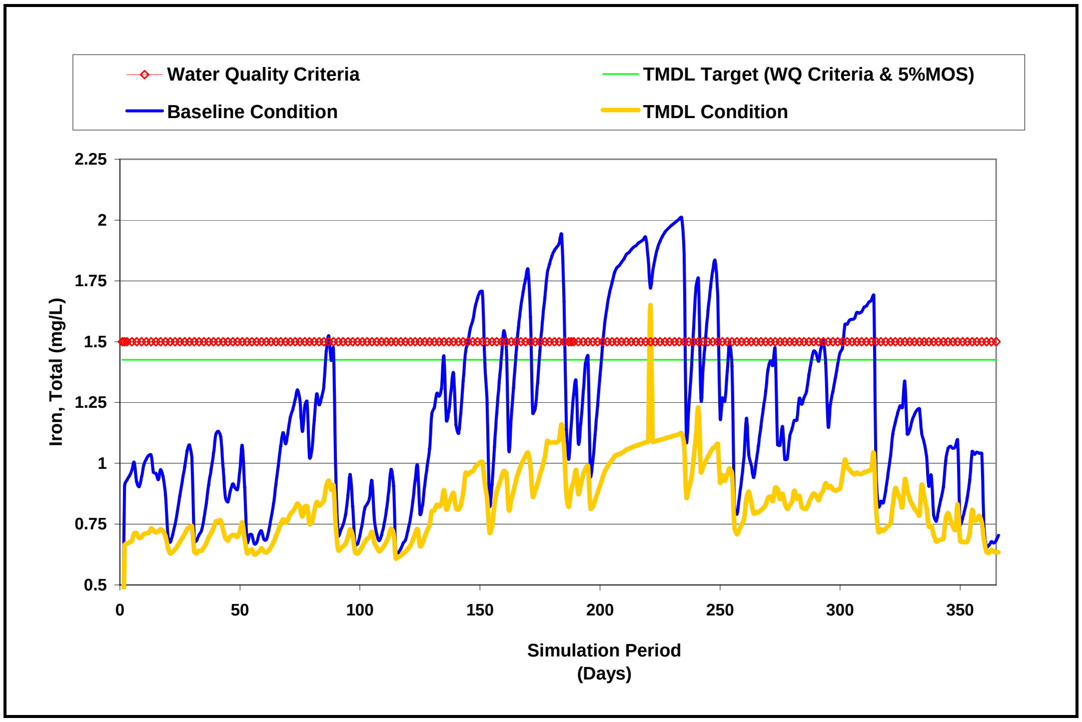


Figure 9-5. Example of baseline and TMDL conditions for total iron

9.7 TMDLs and Source Allocations

9.7.1 Total Iron TMDLs

Source allocations were developed for all modeled subwatersheds contributing to West Virginia iron impaired streams. A top-down methodology was followed to allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in impaired headwaters until criteria were attained at the subwatershed outlet. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream waterbodies. Using this method, contributions from all sources were weighted equitably and ensured 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. The following methodology was used when allocating to iron sources.

- The loading from streambank erosion was first reduced to the loading characteristics of the reference stream.

- If further reduction was necessary, an analysis of the relative impact of sediment-contributing nonpoint sources and mining point sources was performed and loads were practically reduced until water quality criteria were met. Pollutant loads from nonpoint sources were not reduced beyond the loading associated with the forest land use and point source loadings were not reduced beyond loadings resulting from discharge quality equal to the value of the water quality criterion.

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

Active Mining Operations
WLAs are provided for all existing outlets of NPDES permits for mining activities, 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, total aluminum, total manganese and TSS may be replaced with an alternative limitation for “settleable solids” during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs 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.

Discharges regulated by the Multi Sector Stormwater Permit

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

Construction Stormwater

Specific WLAs for future activity under the Construction Stormwater General Permit are provided at the subwatershed scale and are described in Section 11.0. An allocation of 1.0 percent of subwatershed area was provided with loadings 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. In all instances, the existing level of activity under the Construction Stormwater General Permit conforms to the subwatershed allocations. As such, specific WLAs for existing registrations under the General Permit are not presented.

Load Allocations (LAs)
LAs are made for the dominant nonpoint source categories as follows:

- Sediment sources: iron loading associated with sediment contributions from barren land, residential/urban/road landuses and streambank erosion

- Background and other nonpoint sources: iron loading associated with sediment contributions from undisturbed forest and grasslands, and agricultural landuses (loadings associated with this category were represented but not reduced)

9.7.2 Chloride TMDLs

The top-down methodology described in Section 8.7.1 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 of the Dunkard Creek watershed.

Wasteload Allocations (WLAs)
Chloride WLAs were developed for mining NPDES outlets. The only identified problematic chloride sources are pumped mining discharges in the watershed. The TMDL approach calculates the assimilative capacity for chloride available at the mouth of impaired streams at 7Q10 flow, and prescribes WLAs for contributing point sources that are based upon the achievement of the chronic aquatic life protection criterion in the discharge. The established wasteload allocations are equivalent to existing permit limitations after conversion in accordance with USEPA’s Technical Support Document for Water Quality-based Toxics Control (USEPA, 1991).The level of control necessary to achieve criteria during low flow conditions is also protective during higher flow periods.

Load Allocations (LAs)
Chloride LAs are represented for the dominant nonpoint and background source categories. Source reduction is not prescribed for chloride LAs.

9.7.3 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired steams and their tributaries on a subwatershed basis throughout the watershed. As described in Section 9.7.1, a top-down methodology was followed to develop these TMDLs and allocate loads to sources.

The following general methodology was used when allocating loads to fecal coliform bacteria sources:

- The effluents from all NPDES permitted sewage treatment plants were set at the permit limit (200 counts/100 mL monthly geometric mean)

- Because West Virginia Bureau for Public Health regulations prohibit the discharge of raw sewage into surface waters, all illicit discharges of human waste (from failing septic systems and straight pipes) were reduced by 100 percent in the model

- If further reduction was necessary, non-point source loadings from agricultural lands and residential areas were subsequently reduced until in-stream water quality criteria were met

Wasteload Allocations (WLAs)
WLAs were developed for all facilities permitted to discharge fecal coliform bacteria as described below.

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

Load Allocations (LAs)
Fecal coliform LAs are assigned to the following source categories:

- Pasture/Cropland

- On-site Sewage Systems — loading from all illicit discharges of human waste (including failing septic systems and straight pipes)

- Residential — loading associated with urban/residential runoff

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

9.7.4 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 iron, 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.

9.7.5 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, failing on-site sewage systems and AML seeps (both 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.

Pumped, point source discharges associated with mining activity were determined to be the causative source of chloride impairments in the watershed. Because of the minimal dilution available at 7Q10, this low-flow condition was determined critical.

9.7.6 TMDL Presentation

The TMDLs for all impairments are shown in Section 10 of this report. The TMDLs for total iron and chloride are presented as average daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in average number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed over the modeling period. TMDLs and their components are also presented in the allocation spreadsheets associated with this report. The filterable spreadsheets also display detailed source allocations and include multiple display formats that allow comparison of pollutant loadings among categories and facilitate implementation.

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

10.0 TMDL RESULTS

Table 10-1. Total Iron TMDLs

Major Watershed	Stream Code	Stream Name	Metal	LA (lbs/day)	WLA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
Dunkard Creek	WV-ML-128	Dunkard Creek	Iron	1398.03	144.02	81.16	1623.21
Dolls Run	WV-ML-128-AC	Dolls Run	Iron	58.32	2.85	3.22	64.39
Dolls Run	WV-ML-128-AC-5	Smoky Drain	Iron	4.39	0.23	0.24	4.87
Dolls Run	WV-ML-128-AC-6	Berry Hollow	Iron	2.60	0.16	0.15	2.90
Dolls Run	WV-ML-128-AC-4	Pedlar Run	Iron	19.68	1.06	1.09	21.84
Dolls Run	WV-ML-128-AC-4-B	UNT/Pedlar Run RM 1.20	Iron	4.49	0.25	0.25	4.99
Jakes Run	WV-ML-128-AE	Jakes Run	Iron	74.41	3.55	4.10	82.07
Jakes Run	WV-ML-128-AE-12	UNT/Jakes Run RM 5.5	Iron	12.68	0.71	0.70	14.09
Blacks Run	WV-ML-128-AF	Blacks Run	Iron	2.66	0.12	0.15	2.93
Dunkard Creek	WV-ML-128-AG	Hackelbender Run	Iron	5.32	0.30	0.30	5.91
Dunkard Creek	WV-ML-128-AJ	Days Run	Iron	116.41	12.31	6.78	135.50
Dunkard Creek	WV-ML-128-AJ-9	UNT/Days Run RM 5.8	Iron	20.36	1.22	1.14	22.71
Dunkard Creek	WV-ML-128-AJ-9-C	UNT/UNT RM 0.89/Days Run RM 5.8	Iron	6.73	0.36	0.37	7.46
Dunkard Creek	WV-ML-128-AJ-12	UNT/Days Run RM 7.3	Iron	7.41	0.43	0.41	8.26
Dunkard Creek	WV-ML-128-AJ-10	UNT/Days Run RM 6.2	Iron	6.56	0.32	0.36	7.24
Dunkard Creek	WV-ML-128-AJ-8	Shriver Run (ML-128-AJ-8)	Iron	12.75	6.18	1.00	19.93
Dunkard Creek	WV-ML-128-AJ-8-C	Building Run (ML-128-AJ-8-C)	Iron	3.50	2.32	0.31	6.12
Dunkard Creek	WV-ML-128-AJ-4	Indian Camp Run	Iron	8.86	0.55	0.50	9.90
Dunkard Creek	WV-ML-128-AP	Kings Run	Iron	9.81	0.72	0.55	11.08
Roberts Run	WV-ML-128-AR	Roberts Run	Iron	61.63	3.16	3.41	68.19
Miracle Run	WV-ML-128-AV	Miracle Run	Iron	96.08	42.78	7.31	146.17
Miracle Run	WV-ML-128-AV-16	UNT/Miracle Run RM 5.50	Iron	1.27	2.79	0.21	4.27
Miracle Run	WV-ML-128-AV-18	UNT/Miracle Run RM 6.55	Iron	3.89	2.42	0.33	6.64
Miracle Run	WV-ML-128-AV-3	Right Branch/Miracle Run	Iron	50.26	13.51	3.36	67.12
PA Fork Dunkard Creek	WV-ML-128-BA-4	Pumpkin Run	Iron	7.61	0.51	0.43	8.54

Major Watershed	Stream Code	Stream Name	Metal	LA (lbs/day)	WLA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
PA Fork Dunkard Creek	WV-ML-128-BA-12	Brushy Fork	Iron	14.69	0.87	0.82	16.38
PA Fork Dunkard Creek	WV-ML-128-BA	Pennsylvania Fork/Dunkard Creek	Iron	33.77	2.11	1.89	37.77
PA Fork Dunkard Creek	WV-ML-128-BA-15	UNT/Pennsylvania Fork RM 8.2	Iron	7.20	0.48	0.40	8.09
PA Fork Dunkard Creek	WV-ML-128-BA-18	UNT/Pennsylvania Fork RM 9.55	Iron	1.16	0.08	0.07	1.31
WV Fork Dunkard Creek	WV-ML-128-BB	West Virginia Fork/Dunkard Creek	Iron	136.77	53.52	10.02	200.30
WV Fork Dunkard Creek	WV-ML-128-BB-3	Hughes Run	Iron	0.03	3.24	0.17	3.44
WV Fork Dunkard Creek	WV-ML-128-BB-9	Wise Run	Iron	7.05	2.08	0.48	9.61
WV Fork Dunkard Creek	WV-ML-128-BB-10	Shriver Run (ML-128-BB-10)	Iron	0.23	8.57	0.46	9.26
WV Fork Dunkard Creek	WV-ML-128-BB-13	Range Run	Iron	13.31	2.10	0.81	16.22
WV Fork Dunkard Creek	WV-ML-128-BB-14	South Fork/West Virginia Fork/Dunkard Creek	Iron	25.67	25.22	2.68	53.56
WV Fork Dunkard Creek	WV-ML-128-BB-14-F	UNT/South Fork RM 3.0/West Virginia Fork	Iron	0.67	23.98	1.30	25.94
WV Fork Dunkard Creek	WV-ML-128-BB-15	North Fork/West Virginia Fork/Dunkard Creek	Iron	49.99	2.51	2.76	55.27
WV Fork Dunkard Creek	WV-ML-128-BB-15-B	Camp Run	Iron	20.66	1.23	1.15	23.05
WV Fork Dunkard Creek	WV-ML-128-BB-15-B-4	Briar Run	Iron	2.50	0.17	0.14	2.81
WV Fork Dunkard Creek	WV-ML-128-BB-15-B-2	Joy Run	Iron	3.21	0.17	0.18	3.55
WV Fork Dunkard Creek	WV-ML-128-BB-15-B-1	Browns Run	Iron	2.32	0.14	0.13	2.59

Table 10-2. Fecal coliform bacteria TMDLs

Stream Code	Stream Name	Parameter	Load Allocation (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
WV-ML-128	Dunkard Creek	Fecal coliform	7.75E+11	1.14E+09	4.08E+10	8.17E+11
WV-ML-128-AC	Dolls Run	Fecal coliform	4.67E+10	1.52E+07	2.46E+09	4.92E+10
WV-ML-128-AC-4	Pedlar Run	Fecal coliform	1.55E+10	4.90E+06	8.19E+08	1.64E+10
WV-ML-128-AC-4-B	UNT/Pedlar Run RM 1.20	Fecal coliform	3.78E+09	NA	1.99E+08	3.98E+09
WV-ML-128-AC-5	Smoky Drain	Fecal coliform	7.02E+09	NA	3.69E+08	7.39E+09
WV-ML-128-AE	Jakes Run	Fecal coliform	7.06E+10	2.06E+07	3.72E+09	7.44E+10
WV-ML-128-AE-12	UNT/Jakes Run RM 5.5	Fecal coliform	1.42E+10	2.45E+06	7.49E+08	1.50E+10
WV-ML-128-AE-4	UNT/Jakes Run RM 2.33	Fecal coliform	4.73E+09	4.90E+06	2.49E+08	4.98E+09
WV-ML-128-AJ	Days Run	Fecal coliform	6.96E+10	5.26E+07	3.67E+09	7.34E+10
WV-ML-128-AJ-8	Shriver Run	Fecal coliform	1.00E+10	4.90E+06	5.27E+08	1.05E+10
WV-ML-128-AJ-8-C	Building Run	Fecal coliform	2.50E+09	2.45E+06	1.32E+08	2.64E+09
WV-ML-128-AJ-9	UNT/Days Run RM 5.8	Fecal coliform	1.21E+10	2.45E+06	6.37E+08	1.27E+10
WV-ML-128-AR	Roberts Run	Fecal coliform	7.07E+10	NA	3.72E+09	7.44E+10
WV-ML-128-AV	Miracle Run	Fecal coliform	9.29E+10	1.90E+08	4.90E+09	9.79E+10
WV-ML-128-AV-1	Thomas Run	Fecal coliform	6.35E+09	2.94E+06	3.34E+08	6.69E+09
WV-ML-128-AV-11	Scott Run	Fecal coliform	9.00E+09	NA	4.74E+08	9.47E+09
WV-ML-128-AV-3	Right Branch/Miracle Run	Fecal coliform	4.54E+10	9.17E+07	2.40E+09	4.79E+10
WV-ML-128-BA	Pennsylvania Fork/Dunkard Creek	Fecal coliform	1.42E+10	NA	7.46E+08	1.49E+10
WV-ML-128-BB	West Virginia Fork/Dunkard Creek	Fecal coliform	1.08E+11	1.63E+08	5.70E+09	1.14E+11
WV-ML-128-BB-13	Range Run	Fecal coliform	1.90E+10	2.25E+07	1.00E+09	2.01E+10
WV-ML-128-BB-14	South Fork/West Virginia Fork/Dunkard Creek	Fecal coliform	2.02E+10	1.18E+07	1.07E+09	2.13E+10
WV-ML-128-BB-14-A	Middle Fork/South Fork/West Virginia Fork/Dunkard Creek	Fecal coliform	3.42E+09	NA	1.80E+08	3.60E+09
WV-ML-128-BB-15	North Fork/West Virginia Fork/Dunkard Creek	Fecal coliform	3.87E+10	4.90E+06	2.04E+09	4.08E+10
WV-ML-128-BB-15-B	Camp Run	Fecal coliform	1.53E+10	2.45E+06	8.05E+08	1.61E+10
WV-ML-128-BB-9	Wise Run	Fecal coliform	4.10E+09	NA	2.16E+08	4.31E+09

NA = not applicable; UNT = unnamed tributary.

“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 1.0492×10^4.

Table 10-3. Chloride TMDLs

Stream Code	Stream Name	Pollutant	LA (lbs/day)	WLA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
WV-ML-128-BB	West Virginia Fork/Dunkard Creek	Chloride	2234	10014	implicit	12248
WV-ML-128-BB-14	South Fork/West Virginia Fork/Dunkard Creek	Chloride	439	6460	implicit	6899
WV-ML-128-BB-14-F	UNT/South Fork RM 3.0/West Virginia Fork	Chloride	5	6460	implicit	6465

Table 10-4. Biological TMDLs

Stream (NHD_Code)	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
Dunkard Creek (WV-ML-128)	Sedimentation	Total iron	1398.03	144.02	81.16	1623.21	(lbs/day)
	Organic Enrichment	Fecal coliform	7.75E+11	1.14E+09	4.08E+10	8.17E+11	(counts/day)
Dolls Run (WV-ML-128-AC)	Sedimentation	Total iron	58.32	2.85	3.22	64.39	(lbs/day)
	Organic Enrichment	Fecal coliform	4.67E+10	1.52E+07	2.46E+09	4.92E+10	(counts/day)
Pedlar Run (WV-ML-128-AC-4)	Organic Enrichment	Fecal coliform	1.55E+10	4.90E+06	8.19E+08	1.64E+10	(counts/day)
	Sedimentation	Total iron	19.68	1.06	1.09	21.84	(lbs/day)
Smoky Drain (WV-ML-128-AC-5)	Organic Enrichment	Fecal coliform	7.02E+09	NA	3.69E+08	7.39E+09	(counts/day)
	Sedimentation	Total iron	4.39	0.23	0.24	4.87	(lbs/day)
Jakes Run (WV-ML-128-AE)	Organic Enrichment	Fecal coliform	7.06E+10	2.06E+07	3.72E+09	7.44E+10	(counts/day)
	Sedimentation	Total iron	74.41	3.55	4.10	82.07	(lbs/day)
Blacks Run (WV-ML-128-AF)	Sedimentation	Total iron	2.66	0.12	0.15	2.93	(lbs/day)
Days Run (WV-ML-128-AJ)	Organic Enrichment	Fecal coliform	6.96E+10	5.26E+07	3.67E+09	7.34E+10	(counts/day)
	Sedimentation	Total iron	116.41	12.31	6.78	135.50	(lbs/day)
Shriver Run (WV-ML-128-AJ-8)	Organic Enrichment	Fecal coliform	1.00E+10	4.90E+06	5.27E+08	1.05E+10	(counts/day)
	Sedimentation	Total iron	12.75	6.18	1.00	19.93	(lbs/day)
UNT/Days Run RM 5.8 (WV-ML-128-AJ-9)	Organic Enrichment	Fecal coliform	1.21E+10	2.45E+06	6.37E+08	1.27E+10	(counts/day)
	Sedimentation	Total iron	20.36	1.22	1.14	22.71	(lbs/day)
Right Branch/Miracle Run (WV-ML-128-AV-3)	Organic Enrichment	Fecal coliform	4.54E+10	9.17E+07	2.40E+09	4.79E+10	(counts/day)
	Sedimentation	Total iron	50.26	13.51	3.36	67.12	(lbs/day)
Range Run (WV-ML-128-BB-13)	Organic Enrichment	Fecal coliform	1.90E+10	2.25E+07	1.00E+09	2.01E+10	(counts/day)
	Sedimentation	Total iron	13.31	2.10	0.81	16.22	(lbs/day)

Stream (NHD_Code)	Biological Stressor	Parameter	Load Allocation	Wasteload Allocation	Margin of Safety	TMDL	Units
North Fork/West Virginia Fork/Dunkard Creek (WV-ML-128-BB-15)	Organic Enrichment	Fecal coliform	3.87E+10	4.90E+06	2.04E+09	4.08E+10	(counts/day)
	Sedimentation	Total iron	49.99	2.51	2.76	55.27	(lbs/day)
Camp Run (WV-ML-128-BB-15-B)	Organic Enrichment	Fecal coliform	1.53E+10	2.45E+06	8.05E+08	1.61E+10	(counts/day)
Wise Run (WV-ML-128-BB-9)	Organic Enrichment	Fecal coliform	4.10E+09	NA	2.16E+08	4.31E+09	(counts/day)
	Sedimentation	Total iron	7.05	2.08	0.48	9.61	(lbs/day)

“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 × 104.

11.0 FUTURE GROWTH

11.1 Total Iron

With the exception of allowances provided for Construction Stormwater General Permit registrations discussed below, this TMDL does not include specific future growth allocations for iron. 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 TMDLs have been developed. Pursuant to 40 CFR 122.44(d)(1)(vii)(B), effluent limits must be “consistent with the assumptions and requirements of any available wasteload allocation for the discharge....” In addition, the federal regulations generally prohibit issuance of a permit to a new discharger “if the discharge from its construction or operation will cause or contribute to the violation of water quality standards.” A discharge permit for a new discharger could be issued under the following scenarios:

- 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.

- As described previously, the alternative precipitation provisions of 40 CFR 434 that suspend applicability of TSS limitations cannot be applied to new discharges of iron in the Dunkard Creek watershed.

- 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 that would not cause biological impairment. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 100 mg/L. New point sources may be permitted in the watersheds of biologically impaired streams for which sedimentation has been identified as a significant stressor 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 for the pollutants of concern.

- Subwatershed-specific future growth allowances have been provided for site registrations under the Construction Stormwater General Permit. In general, the successful TMDL allocation provides 1.0 percent of modeled subwatershed area to be registered under the general permit at any point in time. Furthermore, the iron allocation spreadsheet provides a cumulative area allowance 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, larger projects may be permitted in phases that adhere to the area allowances or by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that more stringent controls will result in a loading condition commensurate with that afforded by the management practices associated with the general permit.

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 chloride 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 chloride water quality standards at end-of-pipe

12.0 PUBLIC PARTICIPATION

12.1 Public Meetings

Informational public meetings were held on May 24, 2005 and August 26, 2008 at West Virginia University's (WVU) Evansdale Campus in Morgantown, WV. The May 24th 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. The

August 26th meeting occurred prior to allocation of pollutant loads and included a presentation of planned allocation strategies. A public meeting was held to present the draft TMDLs on March 10, 2009 at West Virginia University Evansdale Campus in Morgantown, West Virginia. The meeting began at 6:30 PM and 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 between February 20 and February 27, 2009. Interested parties were invited to submit comments during the public comment period, which began on March 2, 2009 and ended on April 3, 2009.

The electronic documents were also posted on the WVDEP's internet site at http://www.wvdep.org/wvtmdl.

12.3 Response Summary

The West Virginia Department of Environmental Protection (WVDEP) is pleased to provide this response to public comments received on the draft TMDLs. The WVDEP appreciates the efforts commenters have put forth to improve the West Virginia TMDL development process. The following entities provided written comments on the draft TMDLs:

- Consol Energy, Inc.
- Appalachian Center for the Economy & the Environment (on behalf of the Sierra Club and the West Virginia Rivers Coalition)

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.

1) Concern was expressed relative to the presentation of TMDLs for streams and impairments that were not included on the West Virginia 2006 Section 303(d) list.

Given the large number of impaired West Virginia waters and available resources for TMDL development, WVDEP's program must focus on efficiency. When working in a specific geographical area, all impaired waters and all impairments of those waters are attempted to be addressed. Although WVDEP's pre-TMDL monitoring activities are among the most robust efforts implemented nationally, monitoring frequency, duration and sample location resolution are insufficient to comprehensively assess water quality consistent with the exposure duration and exceedance frequency components of applicable water quality criteria. Furthermore, sample collection during critical conditions, either high or low flow, is most often precluded. Water quality modeling is therefore necessary.

Thus, WVDEP has decided to present TMDLs for all named and coded waters where predictive modeling at the baseline condition indicates that pollutant reductions are needed to ensure compliance with water quality criteria. Many of the predicted impairments are consistent with impairment decisions based upon the review of monitoring data. In certain instances, streams were not monitored for the pollutants of concern during the pre-TMDL monitoring effort, but receive source loadings (point and/or nonpoint) predicted to cause impairment. In others waters, the modeling predicts impairment at the baseline condition where permitted discharges are represented to contribute loadings authorized by existing permit limits.

The 303(d) list identifies impaired waters for which TMDLs must be developed. There is no prohibition against TMDL development for waters that are not listed. Evaluation of the results of predictive modeling is mandated by 40 CFR 130.7(b)(5)(ii) and the prediction of impairment through modeling is validated by applicable federal guidance for 303(d) listing. Where predictive modeling indicates that discharge in accordance with existing permit limits would cause violation of water quality criteria, water quality is threatened and the water is subject to TMDL development.

The watershed modeling associated with the Dunkard Creek Watershed TMDLs incorporates a “top down” approach where headwaters are analyzed first and pollutant loadings are transferred to downstream subwatersheds. The predicted pollutant loads in unimpaired headwater segments are directly transferred downstream. Where the model predicts criterion violations in a headwater segment, problematic pollutant sources are appropriately reduced within that subwatershed and the reduced load is transferred downstream. In this way, WVDEP can demonstrate criterion compliance in tributary segments and equitably prescribe pollutant reductions throughout the watershed. Under a protocol that prohibits TMDLs and allocations representing pollutant reductions in “unlisted” tributaries, unreduced problematic loadings would have to be transferred downstream. At a minimum, this will place increased burden on existing downstream sources. In some instances, it would preclude criterion compliance in the downstream segment. Even if the aforementioned allocation obstacles could be rectified, WVDEP believes it is prudent to recognize the results of the modeling and present the TMDLs now, rather than delay development.

2) The classification and model representation of NPDES permitted discharges as point sources and all others as nonpoint sources were questioned.

The commenter confused model representation of sources with the prescription of load and wasteload allocations, and incorrectly perceived that NPDES permitted discharges were represented as continuous flow point sources and others were represented as precipitation-driven nonpoint sources. In the TMDL process, nonpoint sources are given load allocations and point sources are given wasteload allocations. Functionally, certain point sources are precipitation-induced while others are continuous discharges. Similarly, certain nonpoint sources are best represented as continuous discharges and others as precipitation-induced.

Using “effluent type” information contained in WVDEP’s Environmental Resources Information System (ERIS) database, the various NPDES permitted outlets were characterized as precipitation-induced or continuous flow and represented accordingly. For precipitation-induced discharges, the baseline condition incorporated existing effluent limitations, design precipitation, and the total and disturbed drainage area contributing to the outlet. For NPDES outlets categorized as continuous discharges, the baseline condition incorporated effluent limitations and available flow or pump capacity information. Whether represented as precipitation-induced or continuous discharges, all outlets were granted wasteload allocations because they are point source discharges subject to NPDES permitting requirements.

The report portrayal of nonpoint sources is true – most are precipitation-driven, but some are not. Many nonpoint sources were represented based upon surface area and design precipitation. AML seeps, although not identified present in this watershed, would have been represented as continuous sources with flow and pollutant characteristics as determined by WVDEP source tracking activities. Discharges from inadequate onsite residential sewage treatment systems were represented as continuous discharges. Although represented as continuous discharges, those categories are granted load allocations because they are considered nonpoint sources.

3) ***The presentation of TMDLs as average annual loads in light of concentration-based TMDL endpoints was questioned and implementation direction was requested for point sources in the NPDES permitting process.***

TMDLs and load allocations for nonpoint sources are presented as annual average loadings. For consistency and comparability, wasteload allocations for permitted point sources are similarly presented. In addition, wasteload allocations for most point sources are also presented as equivalent concentrations. This convention has been consistently used in West Virginia TMDLs. As stated in Section 9.7.6 and on the introduction pages of the allocation spreadsheets, the concentration-based wasteload allocations for active mining operations and sewage treatment plant effluents are operable. Section 9.7.6 also states that concentration-based allocations are to be converted to monthly average and daily maximum effluent limitations by using the effluent limitation derivation procedures of USEPA’s Technical Support Document for Water Quality Based Toxics Control.

4) ***A commenter noted several streams where pre-TMDL monitoring and or the documentation of calibration conditions do not indicate exceedance of water quality criteria and questioned why TMDLs were presented. The commenter also contended that the baseline conditions predicted by modeling are not presented for review.***

As mentioned previously, WVDEP presents TMDLs for named and coded waters where predictive modeling at the baseline condition indicates that pollutant reductions from existing sources are needed to ensure compliance with water quality criteria. Model calibration differs from the baseline condition model runs. TMDL allocation analyses were conducted from an established baseline condition in order to evaluate the “worst allowable” condition. Baseline conditions consist of representing nonpoint sources at existing conditions and permitted point sources at permit limits. Representing permitted point sources at their existing permit limits may result in predictions of water quality impairment under baseline conditions.

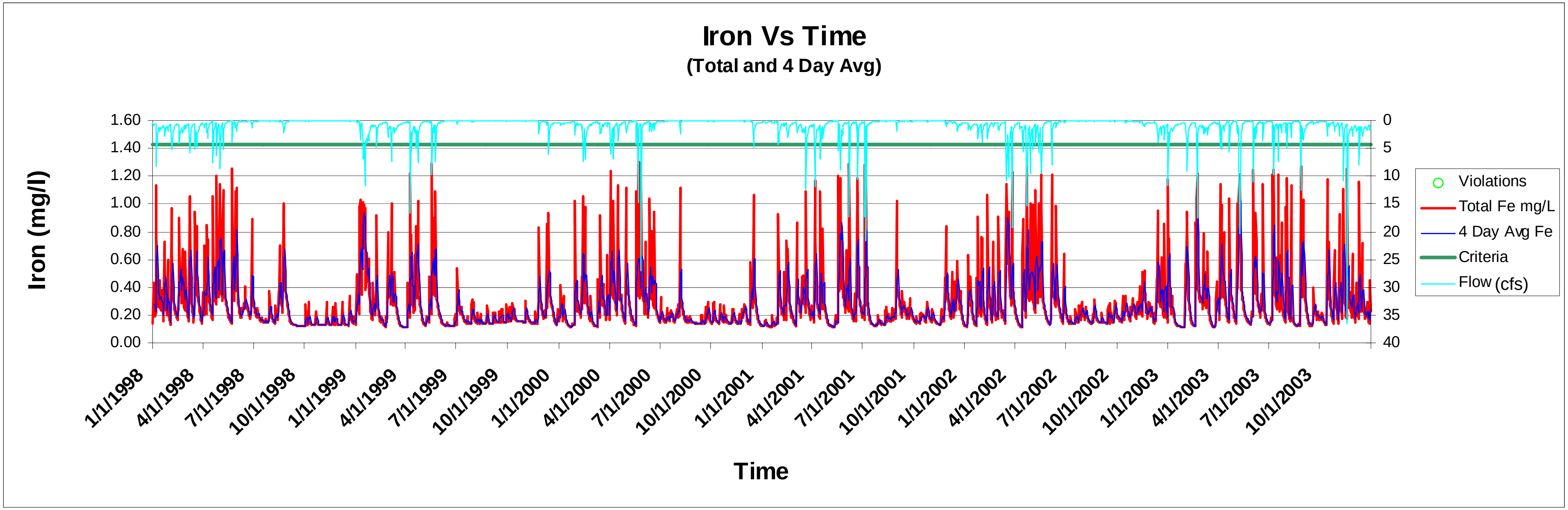
The Dunkard Creek Watershed TMDL modeling generated baseline and TMDL model outputs for 198 subwatersheds for multiple pollutants. All baseline model output is provided in the administrative record associated with this project. The baseline condition predictions are presented throughout the allocation spreadsheets. The TMDL tab summarizes baseline and TMDL loadings for impaired streams for contributing point and nonpoint sources. The LA tab presents baseline and allocation loadings for categories of nonpoint sources for each model subwatershed. The various WLA tabs display baseline and allocated loadings for all NPDES permit/model subwatershed combinations.

In response to this comment, graphical representations of the baseline total iron condition were developed for the specific streams that the commenter questioned TMDL presentation:

- Ripley Run
- Unnamed Tributary of Days Run RM 5.8
- Rudolph Run
- Unnamed Tributary of Thomas Run
- Shriver Run
- Jakes Run
- Blacks Run
- Wise Run
- Berry Hollow
- Days Run
- Unnamed Tributary of Days Run RM 4.32
- Building Run (ML-128-AV-15)
- Kings Run
- Right Branch of Miracle Run
- Pennsylvania Fork Dunkard Creek
- Range Run
- Briar Run

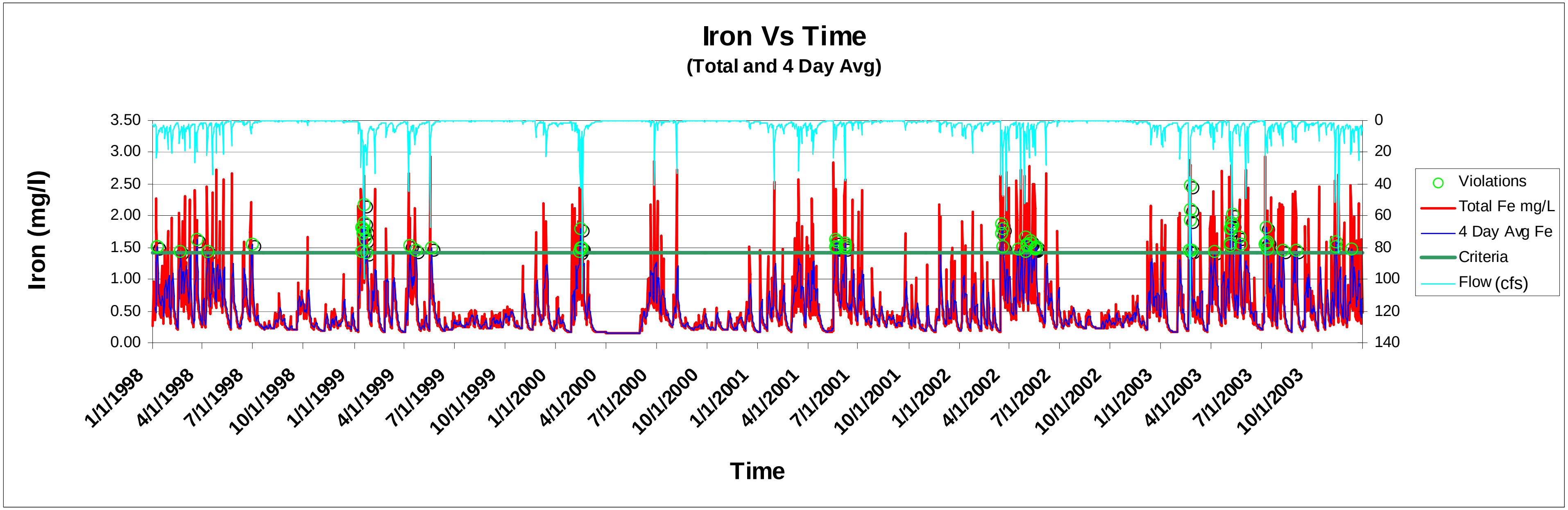
Ripley Run Modeled Baseline Conditions

No iron water quality violations; no TMDL presented



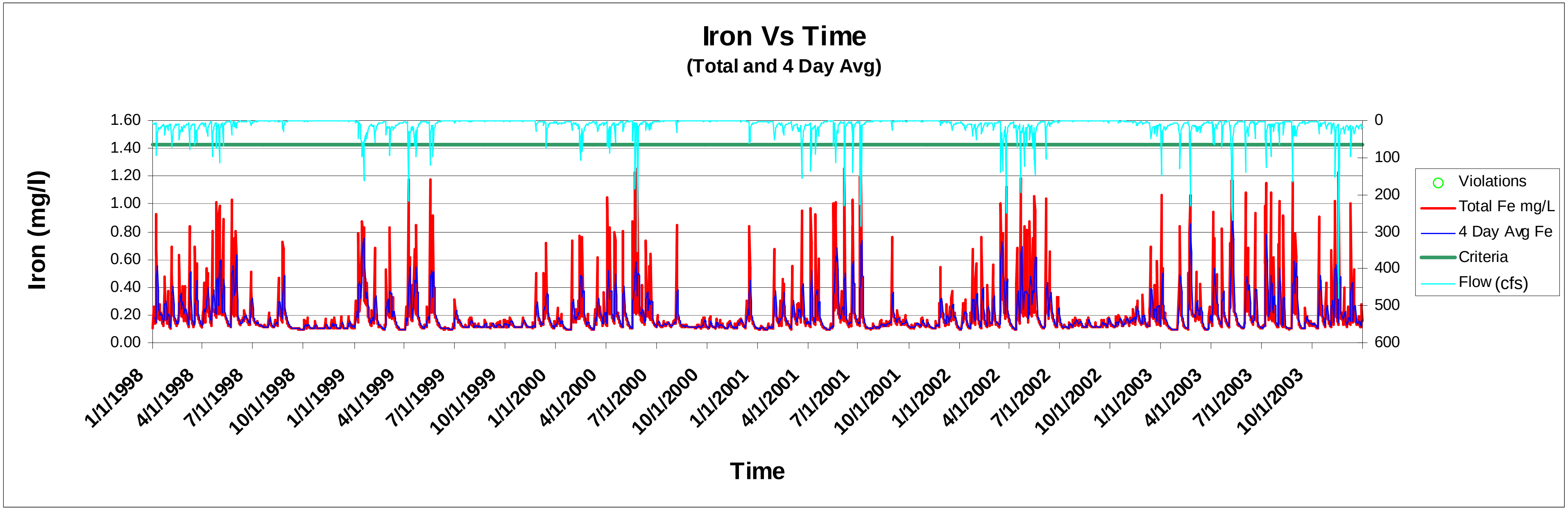
Unnamed Tributary Days Run RM 5.8
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



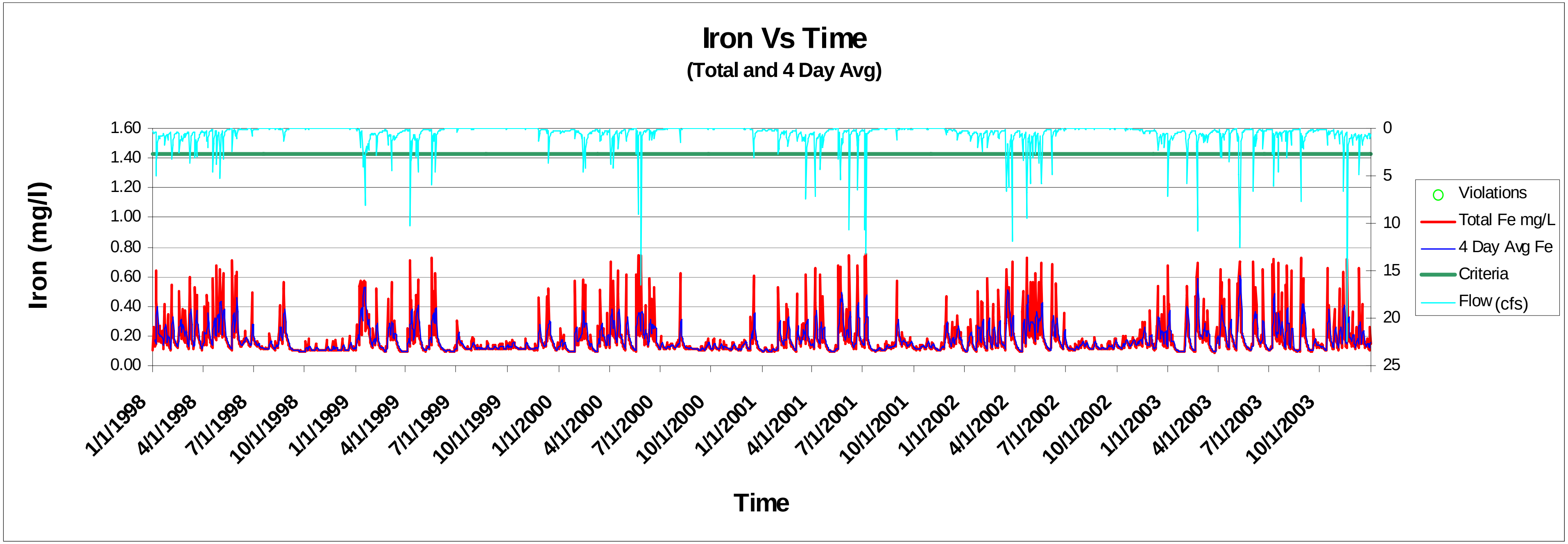
Rudolph Run Modeled Baseline Conditions

No iron water quality violations; no TMDL presented



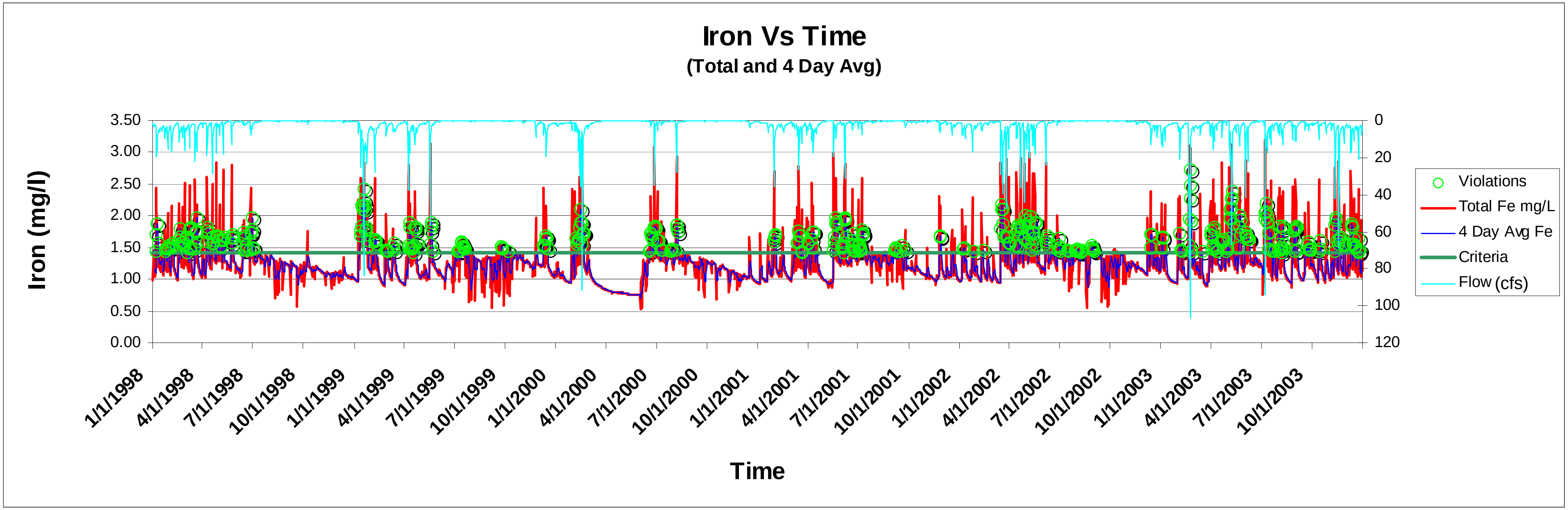
Unnamed Tributary Thomas Run
Modeled Baseline Conditions

No iron water quality violations; no TMDL presented



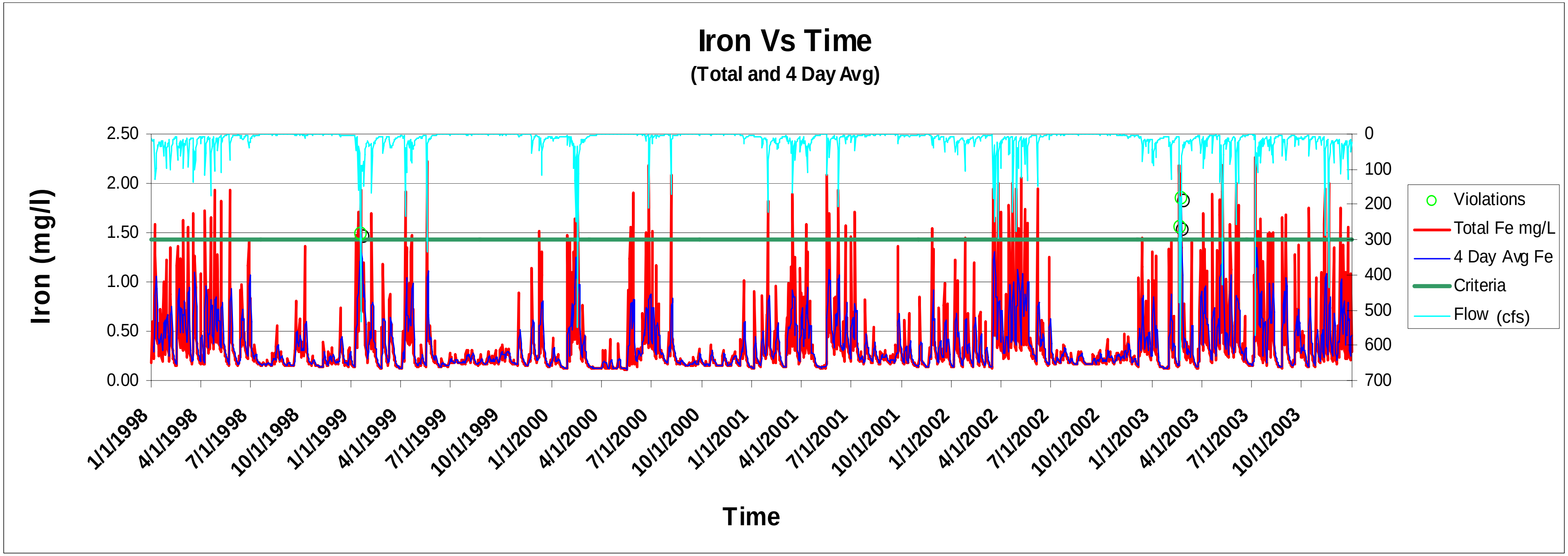
Shriver Run (ML-128-AJ-8)
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



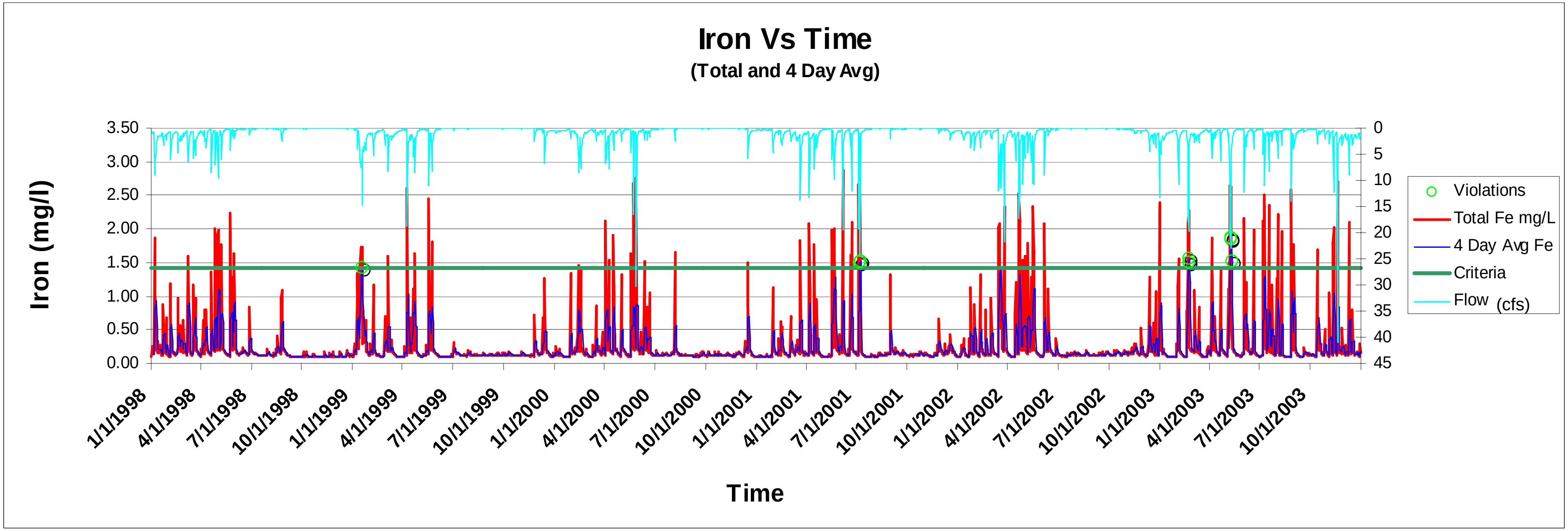
Jakes Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



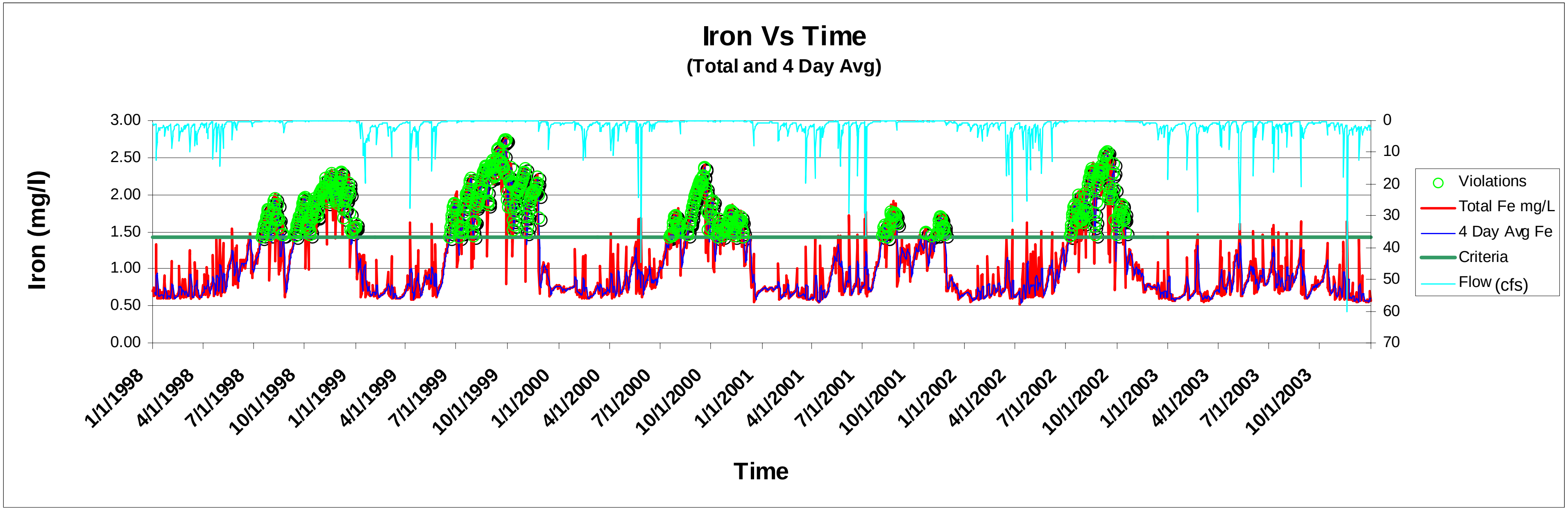
Blacks Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



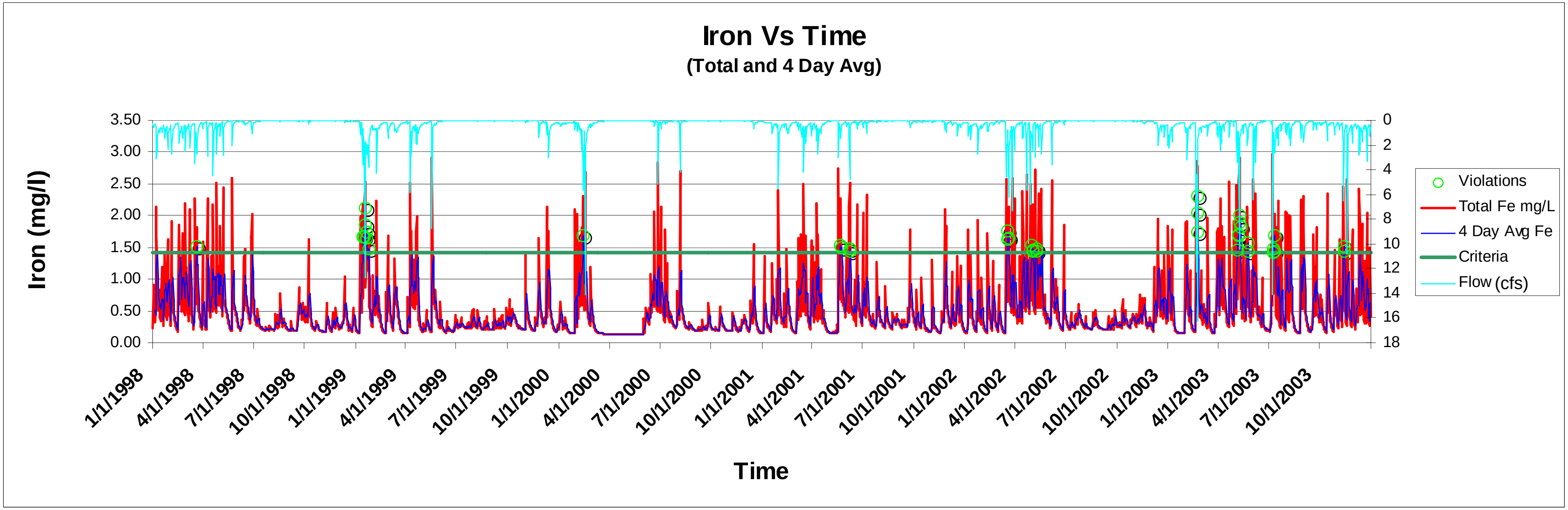
Wise Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



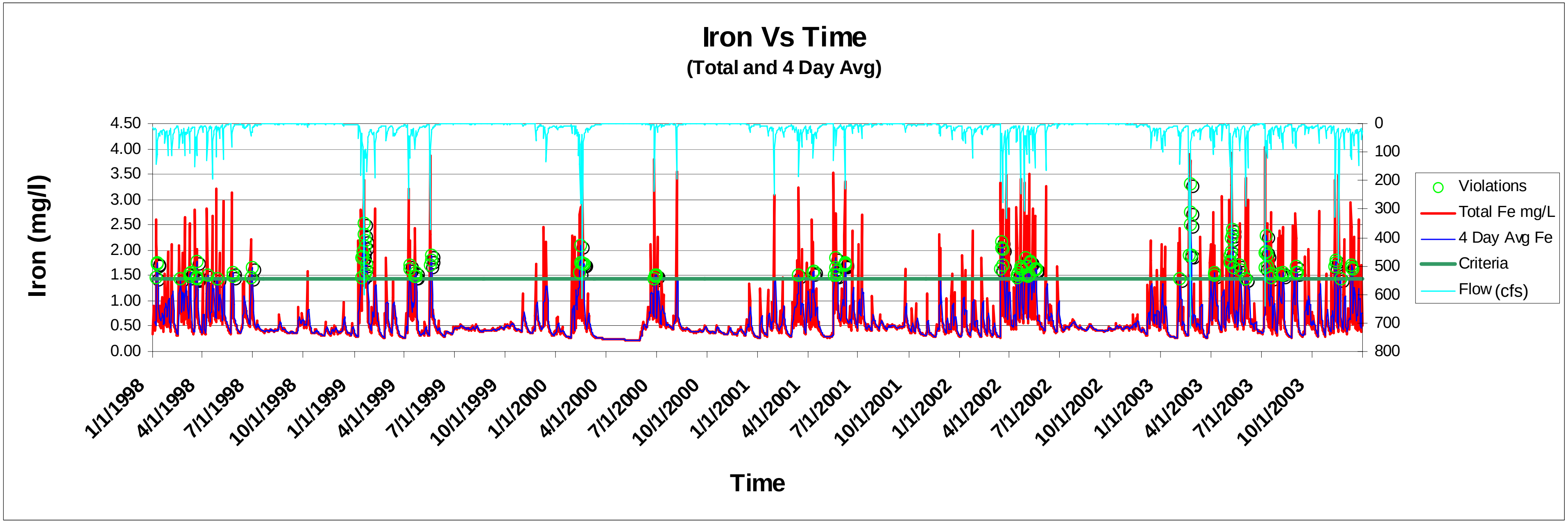
Berry Hollow
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



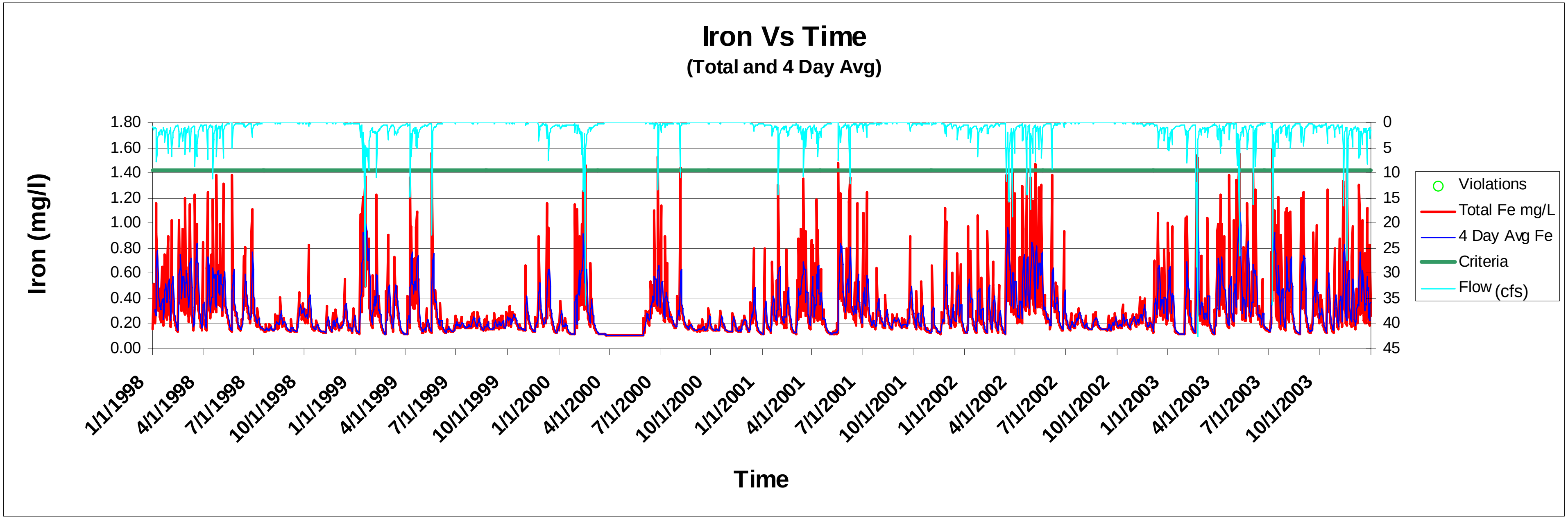
Days Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



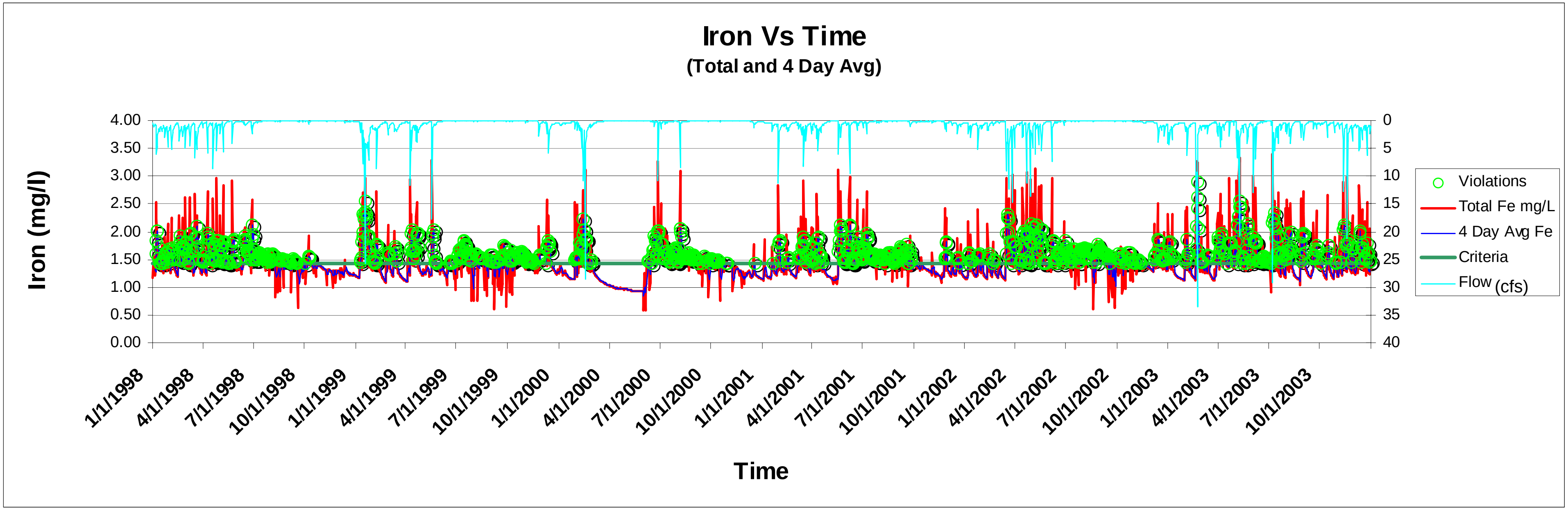
Unnamed Tributary Days Run RM 4.32
Modeled Baseline Conditions

No iron water quality violations; no TMDL presented



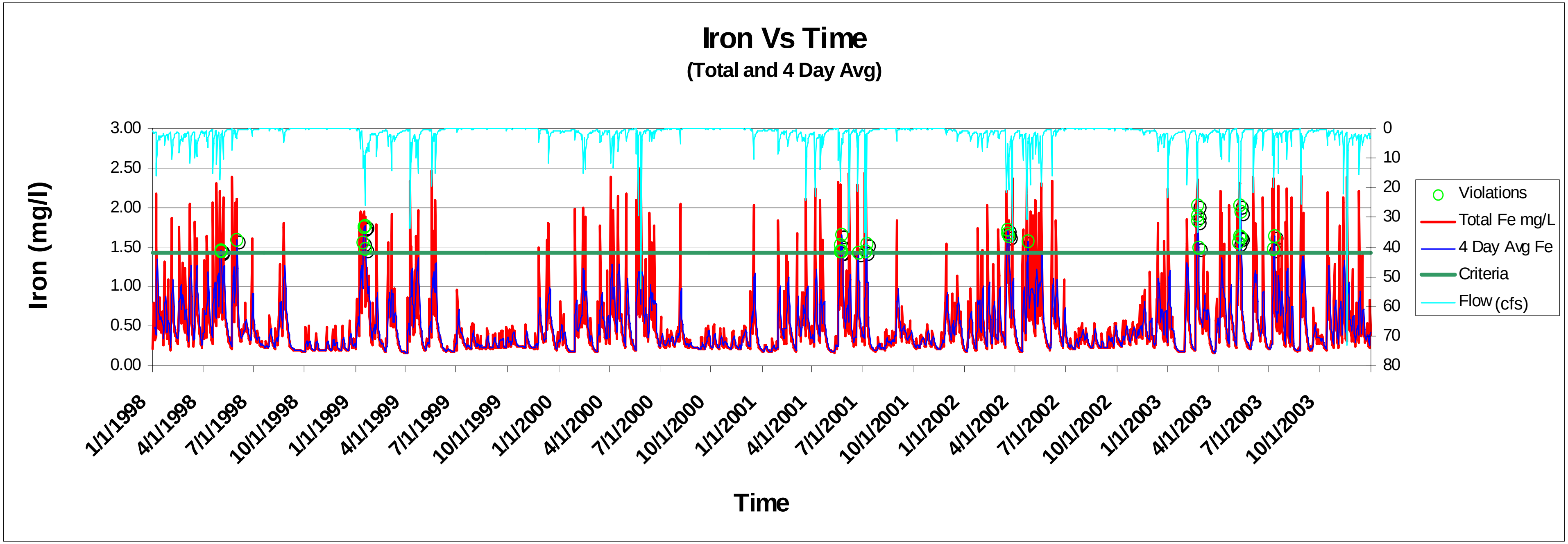
Building Run (ML-128-AV-15)
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



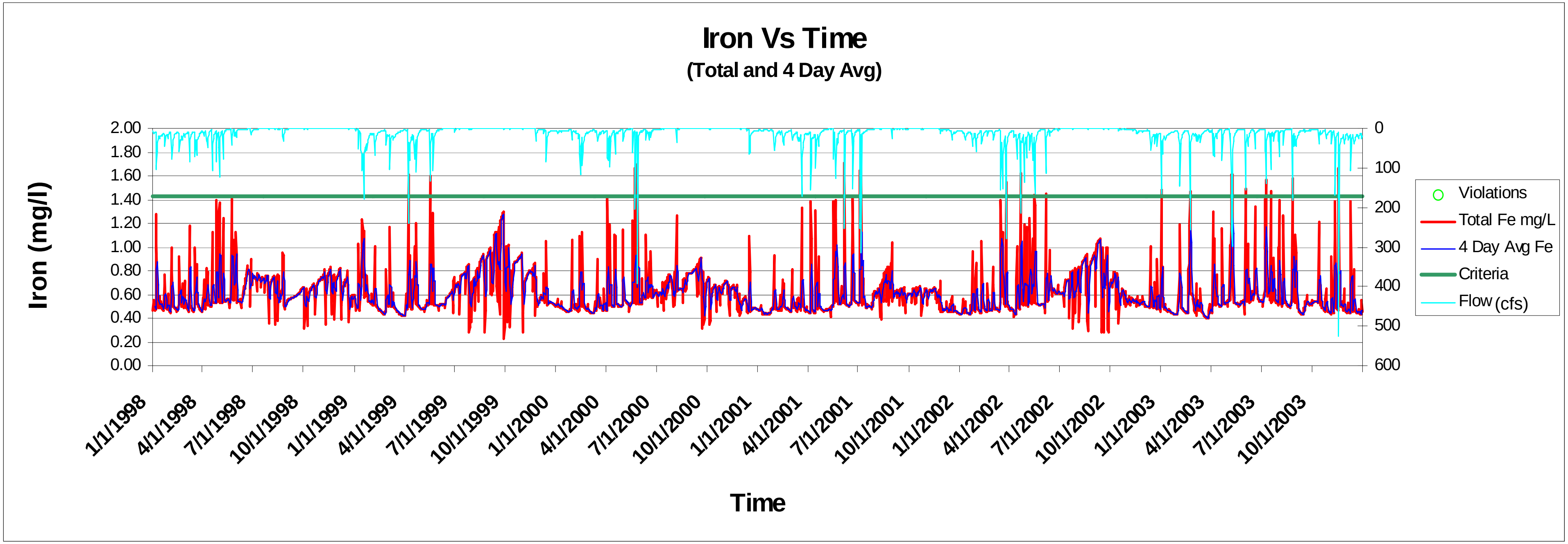
Kings Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



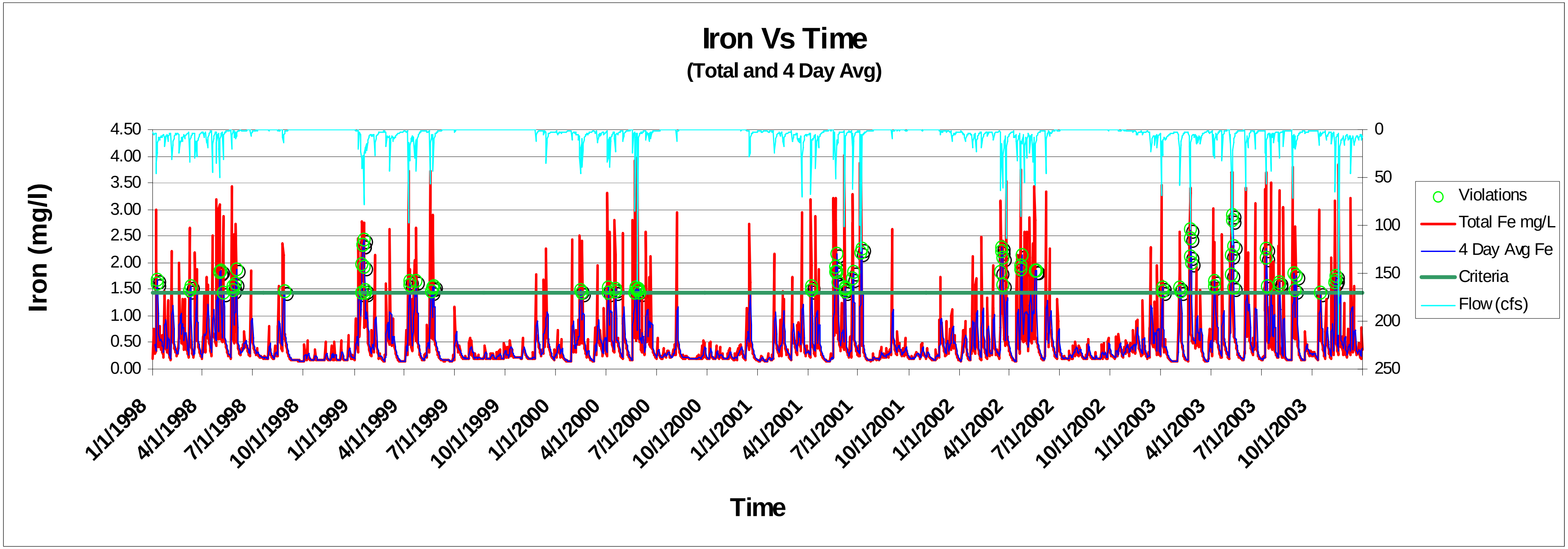
Right Branch Miracle Run
Modeled Baseline Conditions

No iron water quality violations; no TMDL presented



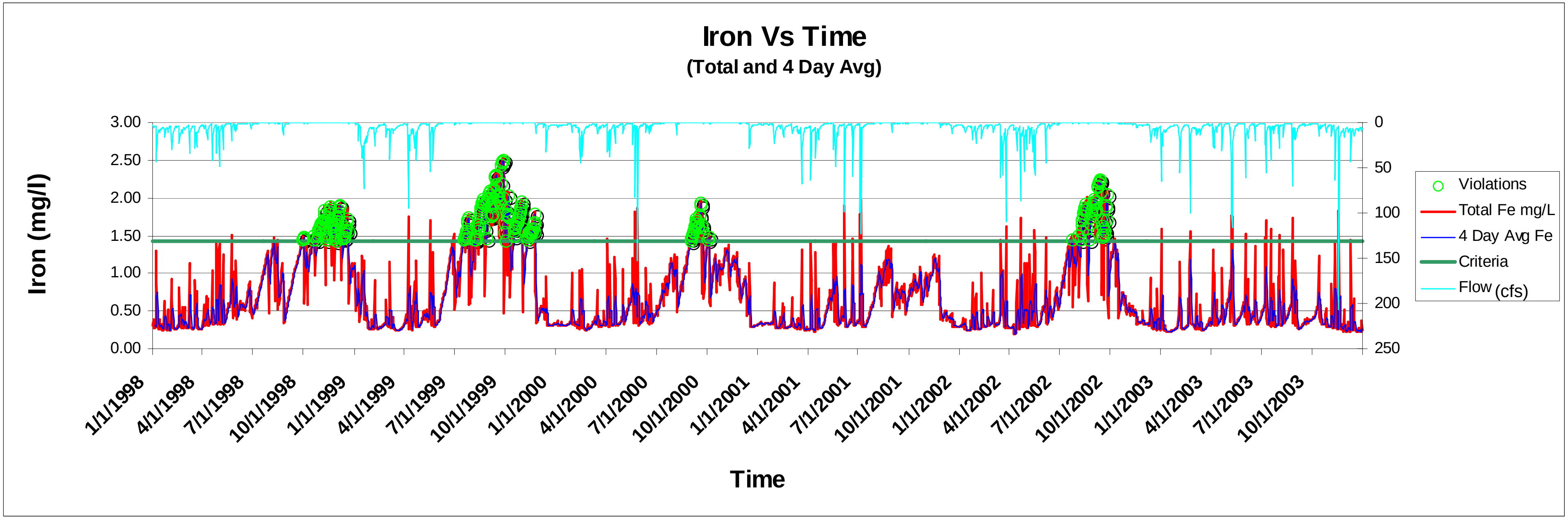
Pennsylvania Fork Dunkard Creek
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



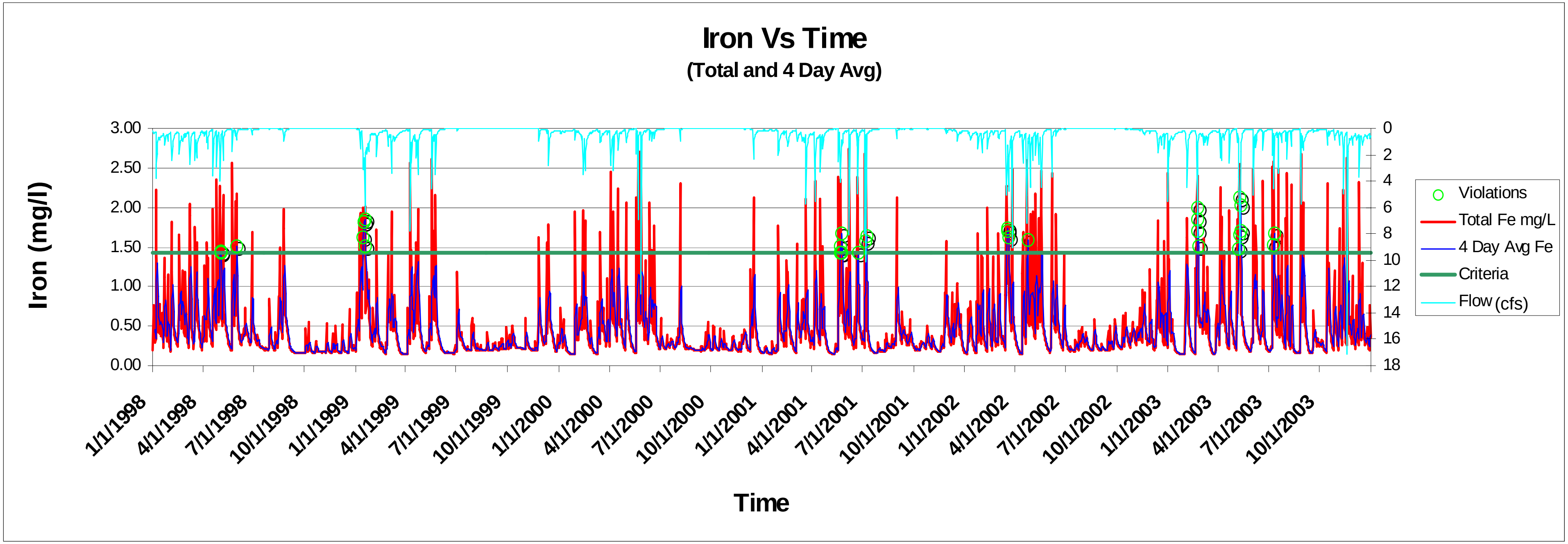
Range Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



Briar Run
Modeled Baseline Conditions

Iron water quality violations; Iron TMDL presented



5) ***General comments were provided indicating disappointment in the level of effort that was given to data analysis, model development, and model calibration, and concern that the models used do not accurately predict instream water chemistry.***

Contrary to the opinion of the commenter, TMDL development for the Dunkard Creek watershed consisted of a very substantial effort over a duration of two years. The technical work was completed by a team of qualified scientists and engineers that possess a breadth of experience in watershed/water quality modeling with a high level of TMDL development experience. 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 sophisticated modeling efforts were supported by carefully crafted technical approaches designed to utilize the best available data while incorporating sound scientific principles to establish representative conditions throughout the watershed.

The goal of the modeling calibration was to determine a set of parameters to best describe the hydrologic and water quality processes in the watershed. 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. The purpose of directly comparing modeled results with data is to assess that the model is simulating low flow, mean flow, and storm peaks within observed ranges.

Composite analysis of the available in-stream data (pre-TMDL monitoring data, in-stream Discharge Monitoring Report data, WVDEP DMR trend station data, etc.) 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 both upland and instream loadings.

Values for permitted mines used for calibration were based on DMR data, although it is important to note that those were changed to represent permitted conditions during the allocation process (Baseline Conditions). From these composite analyses, six separate water quality parameter groups representing many landuse/pollutant-specific parameter combinations were developed. The results of model performance were evaluated at many different locations throughout the watershed following each water quality simulation. Model parameters were further adjusted following iterations to improve model performance. Graphical results for each location were too numerous to display in the Technical report. Therefore, representative examples were displayed in Appendix H.

Although error statistics are often used in evaluating model calibration, their use, particularly for water quality calibration, is not recommended for this modeling effort. 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. Most of the available data for calibration were instantaneous grab samples, not continuous or composite 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). There were data gaps associated with configuring the modeling framework, so it is unrealistic to assume that the model will be able to precisely predict each and every condition. The lack of local weather gages increases model error in terms of amount and timing of water flowing through the system. The sparse weather gage network particularly increases model error during storm events. Modeled continuous flow discharges are simplifications that also increase model error, since they have the potential to have variable flow and water quality.

Looking at 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, in particular, 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. It is important to note that only USEPA approved public domain models were applied during this effort. All models are openly coded and available to anyone who is interested.

6) Identification of the point sources that were modeled as subject to technology-based effluent limitations and those that were modeled as subject to water quality-based effluent limitation was requested. The commenter also asked if any "credit" was given for existing discharges with more stringent antidegradation-based effluent limitations.

Model representations of point sources under baseline and TMDL conditions were based upon permit information contained WVDEP's ERIS database. Effluent limitation data are presented in Appendix G of the Technical Report. Using the limitation information, outlets were represented as either "Technology-based" (existing effluent limitations consistent with 40CFR434 guidelines) or "Water Quality-based" (existing effluent limitations based upon achieving 47CSR2 water quality criteria end-of-pipe). None of the existing discharges in the Dunkard Creek watershed were subject to antidegradation- based effluent limitations; therefore the utilized categorization methodology accurately represented all of the permitted discharges.

7) Dissatisfaction was expressed with the decision to defer TMDL development for biologically impaired streams for which high ionic strength was identified as a significant stressor. The commenter contended, pursuant to 40 CFR 130.7(c)(1)(ii), that WVDEP's failure establish TMDLs for all pollutants requires USEPA's disapproval of the other TMDLs associated with the Dunkard Creek Watershed TMDL project. Further, WVDEP's basis for deferral (insufficient available information regarding the causative pollutants and their associated impairment thresholds) was disputed. The commenter suggested that sufficient information exists to develop the biological impairment TMDLs using a conductivity endpoint of 500 µS/cm or a total dissolved solids endpoint determined through a reference reach approach. The commenter also advocated the "phased" TMDL approach described in USEPA guidance as a mechanism to mitigate scientific uncertainty. The commenter also suggested that WVDEP use GLIMPSS (Genus Level Index of Most Probable Stream Status) to establish end points in the TMDLs for ionic stress.

WVDEP does not interpret 40 CFR 130.7 as requiring simultaneous TMDL development for all impairments of a waterbody. Delayed development of biological impairment TMDLs for the subject streams does not invalidate any other TMDLs presented for total iron, chloride and/or fecal coliform. The biological impairments will remain on the West Virginia Section 303(d) List until such time that the biological impairment TMDLs are developed and approved by USEPA.

USEPA guidance provides 8 to 13 years from the initial listing date as a reasonable timeframe for States to develop TMDLs. The original year of listing of the biological impairments of the subject streams range from 2002 through 2008 and there is ample time remaining for the State to develop the TMDLs. None of the streams for which biological impairment TMDLs are being deferred are subject to the TMDL development requirements of the consent decree in Ohio Valley Environmental Coalition v. Browner.

The above notwithstanding, WVDEP's TMDL development program has historically attempted to comprehensively address all streams and all impairments in a particular watershed simultaneously. The 48-month TMDL development process includes an extensive data generating and gathering effort and is intended to produce scientifically valid TMDLs. The WVDEP approach affords efficiencies to TMDL development and provides a comprehensive basis for the restoration of designated uses. Generally, the program has not accomplished comprehensive watershed TMDL development only when it has been constrained by resources or technical uncertainty.

The biologically impaired streams with ionic stressors pose several TMDL development challenges at this time. The most concentrated ions observed in available water quality monitoring data are chlorides and sulfates, and those pollutants are the suspected contributors to the biological impairments. Some of the subject waters have elevated concentrations of both pollutants. For those waters, WVDEP developed chloride TMDLs based upon the existing numeric chloride water quality criteria. Although the reduction of chloride concentrations as prescribed by those TMDLs should positively impact stream biology, WVDEP could not conclude that the attainment of the chloride water quality criterion alone would resolve the biological impairments.

Other subject waters have elevated sulfates concentrations in the absence of chlorides. The agency is concerned that conflicting conclusions regarding appropriate sulfate thresholds may be reached when considering available information from laboratory toxicity tests versus the empirical biological and water quality data. The inconsistency most likely results from the higher pollution tolerance of organisms used in standardized toxicity tests as compared to the organisms/communities evaluated by the WVSCI. Although USEPA has not proposed national, aquatic life use, water quality criteria for sulfate, they have recently commissioned a study of sulfate toxicity to mayflies by David Buchwalter, Ph.D. with North Carolina State University. WVDEP needs and anticipates USEPA assistance and guidance in the determination of an appropriate toxic threshold for sulfate.

Although WVDEP would prefer to develop TMDLs that are based upon the toxic effect of a causative pollutant, the potential viability of developing TMDLs using a cumulative measure of ionic strength (specific conductance/total dissolved solids) is recognized. The water quality data gaps and scientific uncertainties discussed below are of concern.

In the subject watersheds, WVDEP lacks the water quality and source data necessary to use total dissolved solids in a reference reach approach. As we move forward, our pre-TMDL monitoring efforts are being expanded to address this shortfall. The recently announced plan for the Monongahela River Watershed includes comprehensive monitoring of Total Dissolved Solids and constituent ions throughout the watershed. Specific conductance stream monitoring data is available in the watersheds of the subject streams, but source data is incomplete.

WVDEP is concerned that the ionic strength and constituent make-up of the background and the various point and nonpoint sources existing in the watershed may have dissimilar toxic impacts to the benthic community. The normalization that would be associated with TMDLs based upon total dissolved solids or specific conductance may incorrectly target pollutant reductions from non-problematic sources. Additionally, the synergistic and/or antagonistic effect of mixing multiple ions is not well understood.

Ionic stress and biological integrity issues are receiving increased attention of late, on multiple fronts. USEPA Region III has intervened in permitting activities based upon concerns of ionic stress to benthic macroinvertebrate communities. As mentioned earlier, USEPA is studying sulfate toxicity to mayflies. The State of Pennsylvania intends to propose new total dissolved solids effluent standards and water quality criteria to protect aquatic life designated uses that may directly affect upstream sources in the Dunkard Creek watershed. WVDEP is considering West Virginia water quality standard revisions regarding total dissolved solids. As those processes may provide more concrete TMDL endpoints for ionic stress biological impairment than currently available, WVDEP believes it prudent to delay TMDL development (as afforded by USEPA guidance) to allow their consideration. WVDEP recognizes that the deferral of TMDLs cannot be indefinite. WVDEP and USEPA Region 3 intend to cooperate in the development of a plan that details state and federal activities that will be pursued to ensure the timely development of the deferred TMDLs. This plan will address not only the recent deferrals, but also those in the Upper Kanawha, Coal and Gauley River watersheds. WVDEP will consider all viable methodologies to develop the TMDLs, including but not limited to those proposed by the commenter.

The commenter also suggested the use of GLIMPSS in establishing TMDL endpoints. As evidenced by approved Section 303(d) lists from 2002 through 2008, WVDEP's established procedure to implement the narrative criterion of Section 3.2.i of 47CSR2 is the West Virginia Stream Condition Index (WVSCI). WVDEP and USEPA Region III collaborated in the development of GLIMPSS as an improvement to WVSCI with the goal of establishing a more refined tool that is calibrated by ecoregion and season. While the new index has yet to be formally implemented by WVDEP for 303(d) listing purposes, the genus level taxonomic information obtained in our benthic collections is already an integral component of our stressor identification process.

8) ***It was contended that the model representation of stream segments using the National Hydrography Dataset causes under-prediction of available dilution because the stream reach coverage straightens and shortens stream channels and replaces tributaries with simple runoff. It was also contended that computer simulation of stream dimensions instead of physical stream measurements would "significantly alter the predictability" of the model.***

In the modeling approach, the best available dataset is always used to minimize the level of uncertainty in the model. The resulting model was rigorously tested using both hydrology and water quality observations. Hydrological and water quality models represent a simplified version of reality in the field. To represent the dynamic and diverse watershed conditions, a certain level of abstraction is required to define a mathematical model.

To represent watershed loadings and the resulting concentrations of pollutants of concern, each watershed was divided into hydrologically connected subwatersheds. These subwatersheds represent hydrologic boundaries. The division was based on elevation data (7.5-minute Digital Elevation Model [DEM] from the U.S. Geological Survey [USGS]), stream connectivity (from USGS's National Hydrography Dataset [NHD] stream coverage), the locations of monitoring stations and the impairment status of tributaries. This delineation enabled the evaluation of water quality and flow at multiple locations and load reduction alternatives to be varied by subwatershed. It also provided the framework necessary to develop and present TMDLs for all impaired waters.

The National Hydrography Dataset (NHD) is the most comprehensive set of digital spatial data representing the surface water of the United States. These data are designed to be used in the analysis of surface-water systems. The 7.5-minute Digital Elevation Model [DEM] from the U.S. Geological Survey [USGS] is the most accurate representation of the topography of the studied area. There is generally very little alteration of the streams and terrains by natural forces in the relative short modeling period (1998-2003).

To route flow and pollutants, rating curves were developed for each stream using Manning's equation and representative stream data. Required stream data include slope, Manning's roughness coefficient, and stream dimensions, including mean depths and channel widths. Stream dimensions were estimated using regression curves that related upstream drainage area to stream dimensions (Rosgen, 1996). The simulated model dimensions were used in the model due to the following reasons: 1) The lack of physical stream measurement in every subwatershed restricted the applicability of the actual measured data; 2) The tremendous spatial variation of stream geometry restricted the use of single point stream measurement to represent the whole stream reach. A simulated model dimension is a more realistic representation of the average stream channel. Our model incorporates well established hydrologic parameters and the hydrology calibration results demonstrate accurate predictions of stream flow and available dilution.

9) ***The TMDLs that were developed for streams and impairments not on the 2006 Section 303(d) list were requested to be identified.***

The results of the pre-TMDL monitoring activities in the Dunkard Creek watershed were first available for consideration in the West Virginia 2008 Section 303(d) list which was approved by USEPA on January 16, 2009. Significant expansion of identified impairments occurred between the 2006 and 2008 lists. The impairments identified on the 2008 list are based solely upon the review of stream monitoring. As discussed previously, predictive modeling is necessary to accomplish effective TMDL development under a watershed approach. The following table identifies iron TMDLs that are presented based upon predictive modeling. WVDEP has determined that those streams are impaired by existing sources via consideration of model baseline conditions (Table 12-1).

Table 12-1. Model Determined Streams Impairments

Stream Name	Stream Name	Stream Name	Stream Name
Dolls Run	UNT/Jakes Run RM 5.5	Hughes Run	Indian Camp Run
Pedlar Run	UNT/Pedlar Run RM 1.20	Blacks Run	Shriver Run (ML-128-BB-10)
Kings Run	UNT/Days Run RM 5.8	Wise Run	Building Run (ML-128-AJ-8-C)
Smoky Drain	UNT/Days Run RM 6.2	Brushy Fork	Right Branch/Miracle Run
Berry Hollow	UNT/Days Run RM 7.3	Range Run	Pennsylvania Fork
Jakes Run	UNT/UNT RM 0.89/Days Run RM 5.8	Camp Run	UNT/South Fork RM 3.0/WV Fork
Days Run	UNT/Miracle Run RM 5.50	Browns Run	North Fork/West Virginia Fork
Miracle Run	UNT/Miracle Run RM 6.55	Joy Run	Hackelbender Run
Roberts Run	UNT/Pennsylvania Fork RM 8.2	Briar Run	UNT/Pennsylvania Fork RM 9.55
Pumpkin Run			

10) ***It was claimed that the stressor identification thresholds for sulfates and chlorides are "well below literature values expected to affect aquatic communities" and their use may result in misidentification of stressors.***

Biological thresholds used in TMDL stressor identification are largely based on EPT taxa relationships with concurrent water quality. EPT taxa diversity and abundance have long been recognized as meaningful measures of stream health and may therefore serve as general indicators of community stress. In regard to stressor thresholds for sulfates and chlorides, the results of acute and chronic toxicity analyses are not readily available in the literature for many sensitive members of the EPT orders, particularly important indigenous organisms. However, all EPT taxa were considered in the scatterplot methodology used by WVDEP to demarcate levels of biological community stress; some of these organisms are far more sensitive than the animals commonly used in laboratory toxicity testing. Subsequently, the EPT-based stressor threshold values in regard to these constituents (sulfates and chlorides) are lower than many published toxicity accounts, which were developed using more tolerant organisms. Furthermore, the stressor threshold values are applied to long-term water quality measurements and represent biological community stress that may be occurring at long exposure intervals (e.g. one year) and/or may affect the community at sub-lethal levels. Since the threshold values are applied to the concurrent water quality data in this manner, the resultant stressor identification process more carefully gauges potential ionic stress to biological communities.

11) ***Given the unlikely observation of dissolved oxygen (DO) sags during the daytime hours where water quality monitoring is performed, it was suggested that the observance of supersaturated daytime DO values be used as a potential indication of oxygen deficiency as a biological stressor.***

Water column dissolved oxygen measurements are obtained for each pre-TMDL monitoring event. Photosynthetic activity can result in significant diurnal variation and create supersaturated daytime dissolved oxygen concentrations which may decrease the parameter's utility in the stressor identification process. The suggestion relative to supersaturated daytime observations will be considered in future endeavors.

Some low dissolved oxygen observations were made in the biologically impaired streams and added to the evidence supporting the identification of organic enrichment as a significant stressor. Other lines of evidence are also available to elucidate instances of organic enrichment. WVDEP often relies upon observations of periphyton/phytoplankton levels, odors indicative of substrate anoxia, and water column fecal coliform concentrations (which are associated with the excess nutrient loadings from untreated sewage and agricultural waste). WVDEP does not believe that it overlooked stress associated with low dissolved oxygen, as organic enrichment was identified as a significant stressor in sixteen of the eighteen biologically impaired streams that were evaluated. Attainment of the allocations of the fecal coliform TMDLs will result in significant reduction of the oxygen demanding wastes in the system.

12) Additional information was requested to be provided relative to the empirical model development used for biological stressor identification.

The development of Total Maximum Daily Loads (TMDLs) is required for biologically-impaired streams and mandates the identification of stressors to the biological community and the pollutants that must be controlled. USEPA's Stressor Identification guidance (USEPA-822B-00-25) was used to identify and rank physical, chemical, and biological stressors that may have caused impairments to the aquatic community. This process involved the analysis of all available water quality, habitat, physical, biological, historical, anecdotal, and observational data to infer the likely causes of impairment for each stream. A comprehensive conceptual model (Figure 2-2 in the Technical Report and Figure 4-1 in the TMDL Report) was developed that provides the linkage between potential impairment causes, their sources, and the pathway by which each stressor can impact the benthic macroinvertebrate community.

Stressor identification involved the integration of watershed-based conceptual models of impairment, field biological and chemical monitoring databases, empirical models of biological impairment, and ecotoxicological principles in a strength-of-evidence approach to infer causes of impairment. The stressor identification process included the two biologically-based diagnostic tools that are described in Section 2.1.6 of the Technical Report. Weighted averaging regression models generated taxa tolerance values for individual stressors and the "dirty reference" similarity indices allowed comparison of the taxonomic compositions of observed sites to sites known to be impacted by a single stressor. Each tool provided a line of evidence in the process. The biological tools are a part of the administrative record and are available upon request.

The process culminates in a panel of biologists collectively evaluating the strength of evidence formulated during the stressor identification process. The panel discusses the evidence and arrives at a list of significant stressors to the biological community and the appropriate TMDLs to address those stressors for each biologically impaired stream. The identification of significant stressors to the biological community is by the preponderance of all the data evaluated, and the empirical models do not contain any additional weight than other data being evaluated. Results are presented in Appendix B of the Technical Report.

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 9.

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 sewage treatment facilities in the Dunkard Creek watershed will be reissued beginning in July 2009 and the reissuance of mining permits will begin January 1, 2010.

In regard to chloride TMDLs, the causative sources of impairment are NPDES permitted facilities that are not achieving currently prescribed effluent limitations. TMDL implementation shall be pursuit of regulatory actions necessary to compel compliance by WVDEP.

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 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 Nonpoint Source Program Monongahela Basin Coordinator, Lou Schmidt (louschmidt@frontiernet.net).

The Dunkard Creek Watershed Association Inc. is the only active watershed association in the Dunkard Creek watershed. For additional information concerning the association 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.html.

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 that are consistent with the WLAs prescribed by the TMDL and to assess and compel compliance. 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.

15.0 REFERENCES

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