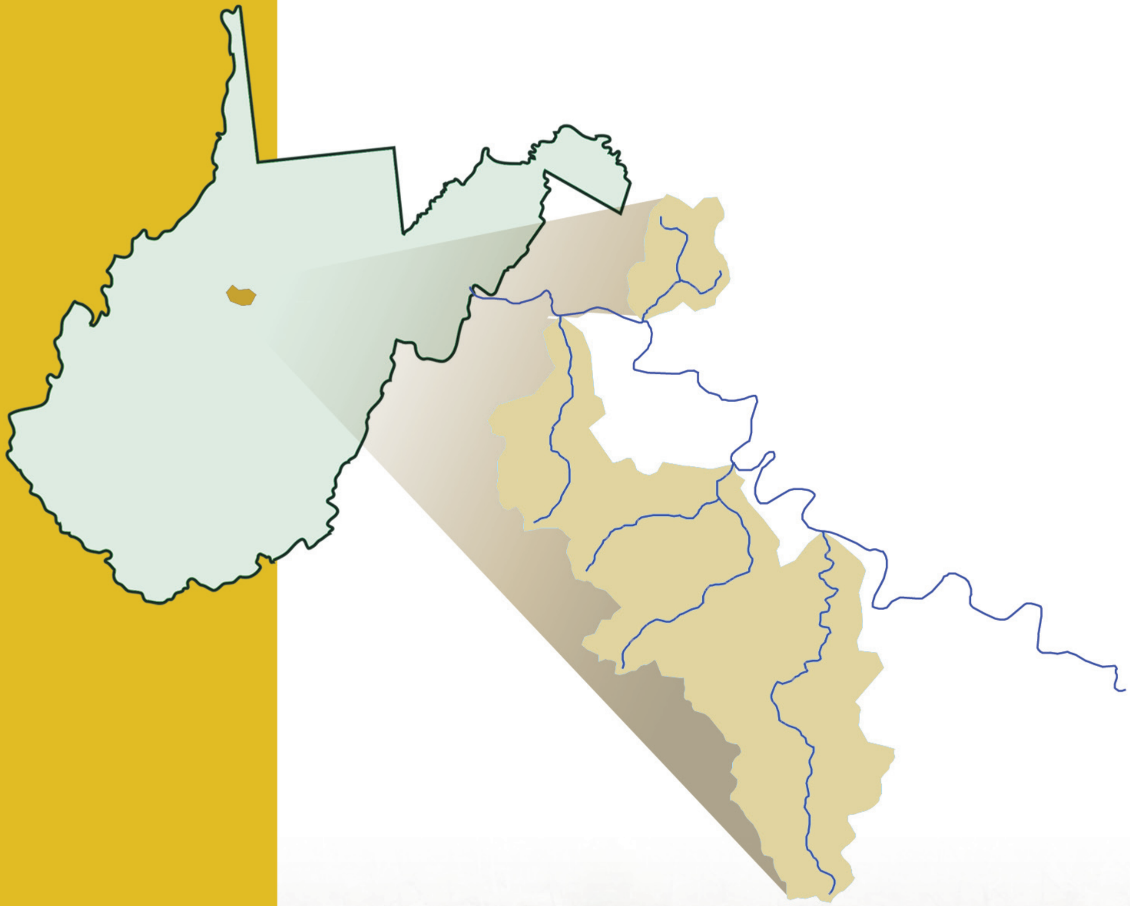
June 2008

Final Approved Report



Total Maximum Daily Loads for Selected Streams in the Little Kanawha River Watershed, West Virginia

Prepared for:

West Virginia Department of Environmental Protection

Division of Water and Waste Management

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

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

PSD	public service district
SI	stressor identification
SMCRA	Surface Mining Control and Reclamation Act
SRF	State Revolving Fund
SO2	sulfur dioxide
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 Little Kanawha River watershed refers to the mainstem of the Little Kanawha River and all of the tributary streams that eventually drain to the Little Kanawha River (Figure I-1). The term "watershed" is also used more generally to refer to the land area that contributes precipitation runoff that eventually drains to the Little Kanawha River.

TMDL watershed

This term is used to describe the total land area draining to an impaired stream for which a TMDL is being developed. This term also takes into account the land area drained by un-impaired tributaries of the impaired stream. This report addresses six impaired streams contained within four TMDL watersheds in the Little Kanawha River watershed (Figure 3-1).

Subwatershed

The subwatershed delineation is the most detailed scale of the delineation that breaks each TMDL watershed into numerous catchments for modeling purposes. The four TMDL watersheds have been subdivided into a total of 25 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

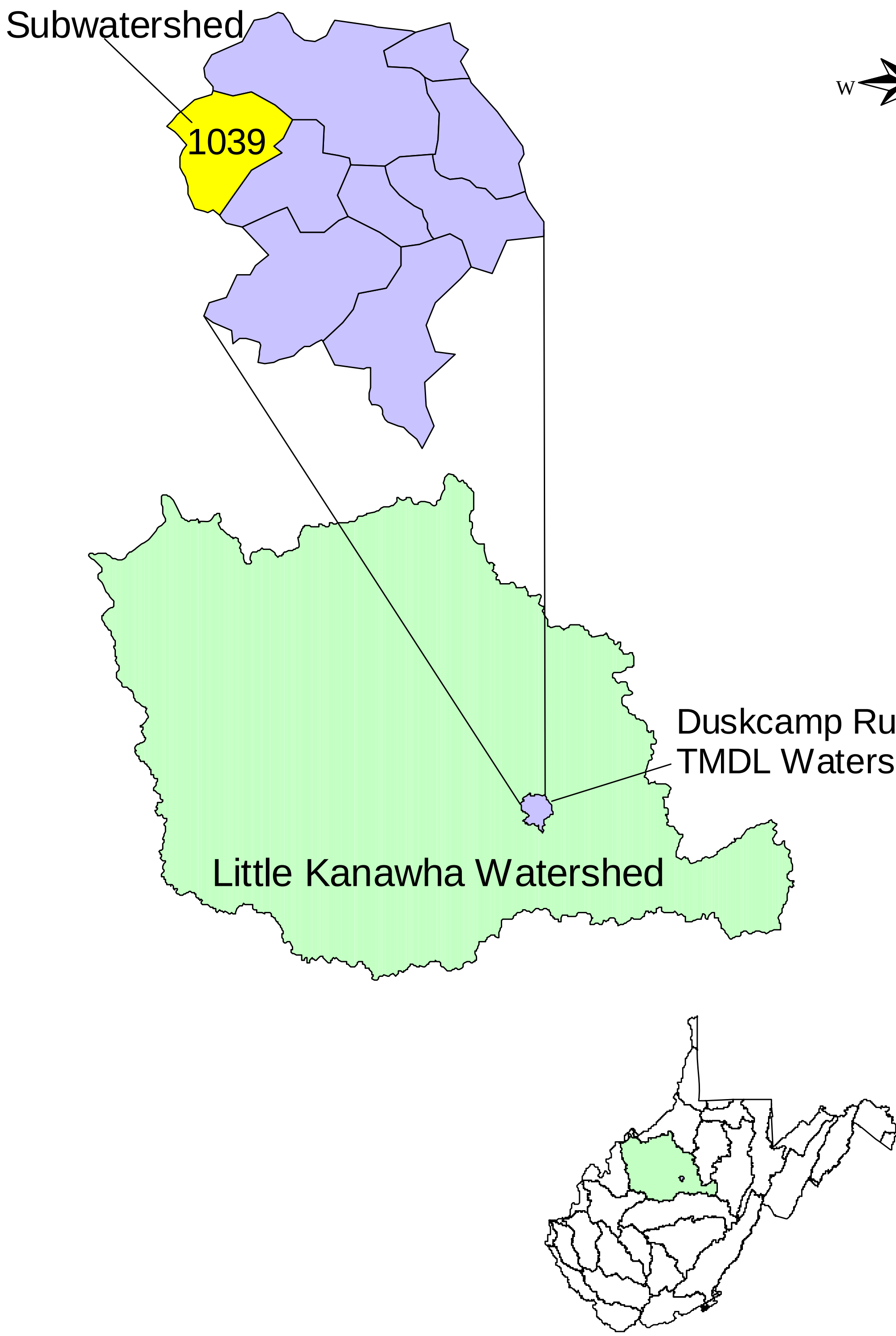


Figure I-1. Examples of a watershed, TMDL watershed, and subwatersheds

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for six impaired streams in the Little Kanawha River watershed: Duck Creek, Lynch Run, UNT/Lynch Run RM 0.9, Duskcamp Run, Right Fork/Duskcamp Run, and Copen Run.

A TMDL establishes the maximum allowable pollutant loading for a waterbody to comply with water quality standards, distributes the load among pollutant sources, and provides a basis for actions needed to restore water quality. West Virginia’s water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, and titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. The standards include designated uses of West Virginia waters and numeric and narrative criteria to protect those uses. The West Virginia Department of Environmental Protection routinely assesses use support by comparing observed water quality data with criteria and reports impaired waters every two years as required by Section 303(d) of the Clean Water Act (“303(d) list”). The act requires that TMDLs be developed for listed impaired waters.

All of the subject streams are included on West Virginia’s 2006 Section 303(d) list. Documented impairments are related to numeric water quality criteria for total iron, total manganese, 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 included TMDL development dates that extend through March 2008. The metal impairments of Duck Creek, Lynch Run and Duskcamp Run are included in the consent decree.

Since October 2003, West Virginia’s TMDLs were and will continue to be developed by WVDEP. This report accommodates the timely development of the remaining Little Kanawha River watershed TMDLs as required by the consent decree and also includes TMDLs for additional impairments, impairments of their tributaries and the impairment of nearby Copen Run. Impaired waters were organized into four TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these four TMDL watersheds were further divided into 25 subwatersheds. 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 iron, manganese and fecal coliform bacteria. 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.

Only nonpoint sources contribute to the fecal coliform bacteria impairments in the TMDL watersheds. The most significant nonpoint sources are those related to the inadequate treatment of sewage. Failing onsite systems and direct discharges of untreated sewage often result in exceedances of the fecal coliform criteria. Precipitation runoff from residential areas and agricultural sources is another nonpoint source of fecal coliform bacteria.

There are no existing permitted point sources present in the modeled subwatersheds of the Little Kanawha River watershed; therefore point sources will not be discussed further. Nonpoint metals sources include abandoned mine lands (AML), roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance and streambank erosion. The presence of individual nonpoint 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. One known source of manganese is an abandoned mine land seep; other potential sources of manganese include additional abandoned mine lands and highwalls that occur in the watershed.

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. Sedimentation has been identified as the causative stressor for the biologically impaired streams addressed in this effort.

SI was followed by stream-specific determinations of the pollutants for which TMDLs must be developed. 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. In the majority of the impaired waters assessed, a strong, positive correlation between iron and total suspended solids (TSS) was identified. Iron TMDLs are also presented for all of the biologically-impaired waters, and it has been 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 main section of the 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. The main report 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.

Accompanying spreadsheets provide TMDLs and example allocations of loads to categories of 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.

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 consists of a main section, a supporting geographic information system (GIS) application, and spreadsheet data tables. The main section describes the overall total maximum daily load (TMDL) development process, identifies impaired streams, and outlines the source assessment of metals, fecal coliform bacteria, and biological stressors. It also describes the modeling process, presents Total Maximum Daily Load (TMDL) allocations, and lists measures that will be taken to ensure that the TMDLs are met. The main section is supported by a compact disc 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 the data used during the TMDL development process, as well as detailed source allocations associated with successful TMDL scenarios. A Technical Report that describes the detailed technical approaches used throughout the TMDL development process is also included.

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:

TMDL = sum of WLAs + sum of LAs + MOS

From 1997 through September 2003, 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 included TMDL development dates that extend through March 2008. The metal impairments of Duck Creek, Lynch Run and Duskcamp Run are included in the consent decree.

Since October 2003, West Virginia's TMDLs were and will continue to be developed by WVDEP. WVDEP's TMDL program accommodates the timely development of the remaining TMDLs required by the consent decree and also includes TMDLs for additional impairments, impairments of their tributaries and the impairment of nearby Copen Run. 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 2007 TMDLs should be pursued in Hydrologic Group D, which includes the Little Kanawha River watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the target year for finalization of each TMDL.

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

The TMDL development process begins with pre-TMDL water quality monitoring and source identification and characterization. Informational public meetings are held in the affected watersheds. Data obtained from pre-TMDL efforts are compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. 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.

This report includes Total Maximum Daily Loads (TMDLs) for six impaired streams in the Little Kanawha River watershed: Duck Creek, Lynch Run, UNT/Lynch Run RM 0.9, Duskcamp Run, Right Fork/Duskcamp Run, and Copen Run. All of the subject streams are included on West Virginia's 2006 Section 303(d) list. The impairments for which USEPA committed to TMDL development by 2008 are addressed in this effort.

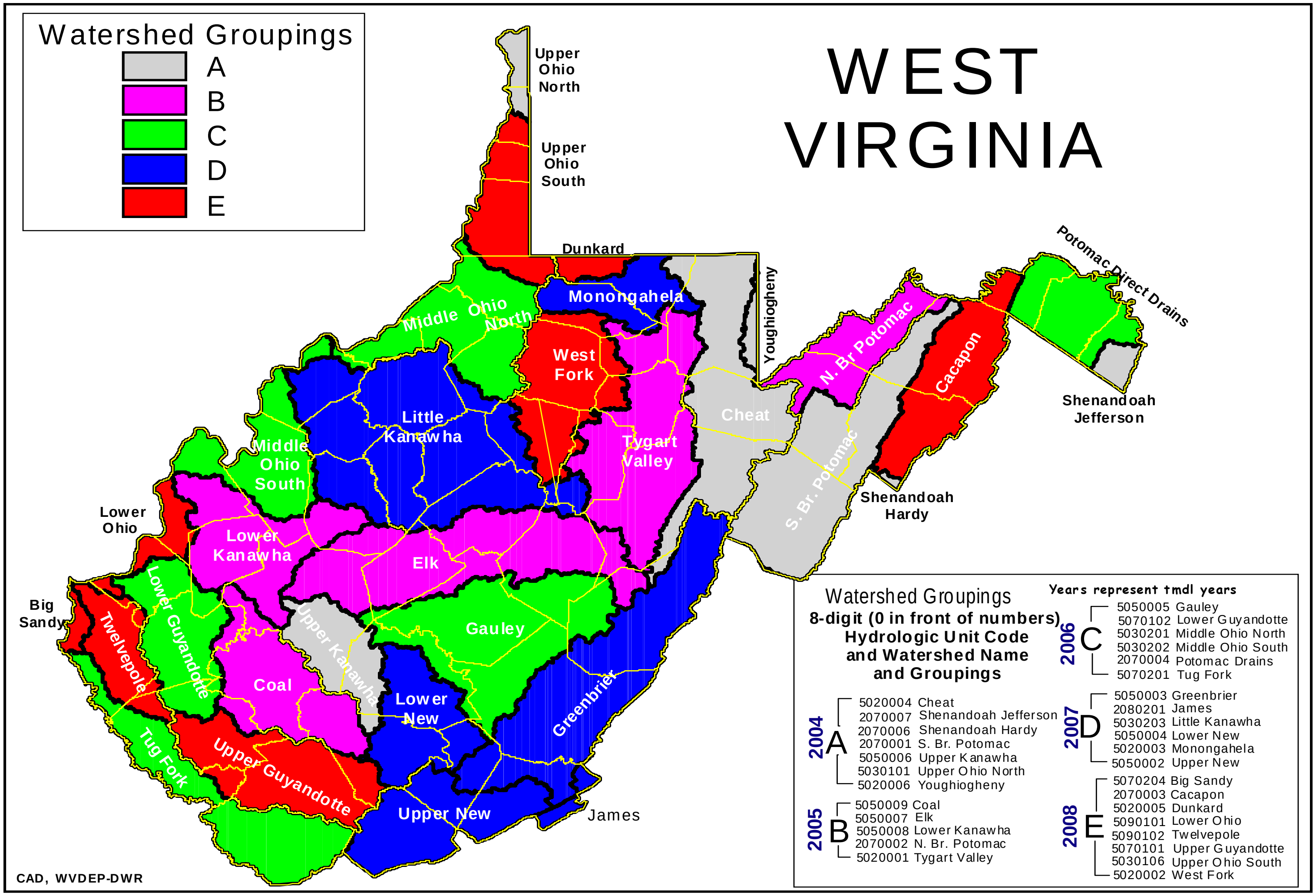


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

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. All of the streams addressed by this report are designated as warmwater fisheries.

Warmwater fishery aquatic life use impairments have been determined pursuant to exceedances of numeric water quality criteria for total iron. Water contact recreation and public water supply use impairments have also been determined pursuant to exceedances of numeric water quality criteria for fecal coliform bacteria.

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

All West Virginia waters are subject to the narrative criteria in Section 3 of the Standards. That section, titled "Conditions Not Allowable in State Waters," contains various general provisions 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 are shown in Table 2-1. The stream-specific impairments related to both numeric and narrative water quality criteria are displayed in Table 3-3.

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
Manganese, total (mg/L)	--	--	--	--	1.0[c]
Fecal coliform bacteria	**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.				

[a] One-hour average concentration not to be exceeded more than once every 3 years on the average.

[b] Four-day average concentration not to be exceeded more than once every 3 years on the average.

[c] Not to exceed 1.0 mg/L within the five-mile zone upstream of known public or private water supply intakes used for human consumption.

Source: 47 CSR, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards.*

3.0 WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

The entire Little Kanawha River watershed is in west central West Virginia and encompasses approximately 2,301 square miles. The majority of the watershed lies within Braxton, Gilmer, and Lewis counties with smaller portions of the watershed in Webster and Upshur counties. However, the focus of this report is on the four TMDL watersheds, which comprise an area of approximately 24 square miles. As shown in Figure 3-1, this TMDL development effort addressed impaired Little Kanawha River tributaries in Gilmer and Braxton counties in central West Virginia. The four TMDL watersheds include: Duck Creek, Lynch Run, Duskcamp Run, and Copen Run.

Table 3-1 displays the modeled landuses in the TMDL watersheds. The dominant landuse is forest, which constitutes 78.8 percent of the total landuse area. Other important modeled landuse types are barren (9.2 percent), grassland (7.5 percent), abandoned mine land (AML) (2.3), pasture (1.1 percent), and urban/residential (1.1 percent). Individually, all other land cover types compose less than one percent of the total watershed area.

Landuse and land cover estimates were originally obtained from vegetation data gathered from the West Virginia Gap Analysis Land Cover Project (GAP). The Natural Resource Analysis Center and the West Virginia Cooperative Fish and Wildlife Research Unit of West Virginia University (WVU) produced the GAP coverage. The GAP database for West Virginia was derived from satellite imagery taken during the early 1990s, and it includes detailed vegetative spatial data. Enhancements and updates to the GAP 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 modeled landuse manipulation is provided in Appendix C of the Technical Report.

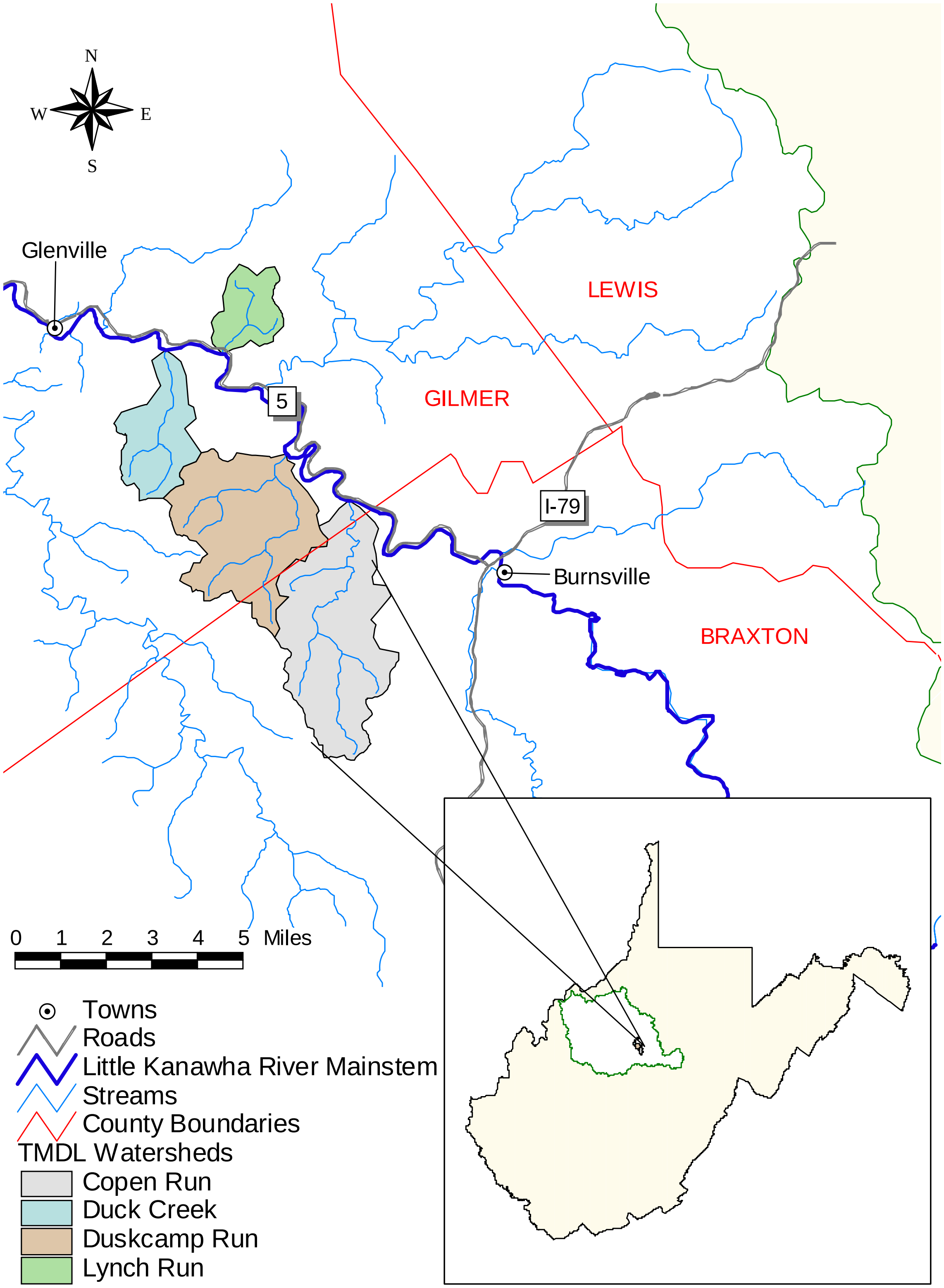


Figure 3-1. Location of the TMDL watersheds

Table 3-1. Modified landuse for the 25 modeled subwatersheds

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Water	9.35	0.01	0.06%
Wetland	1.34	0.00	0.01%
Barren	1395.81	2.18	9.17%
Forest	11991.07	18.74	78.75%
Grassland	1146.11	1.79	7.53%
Cropland	0.00	0.00	0.00%
Pasture	167.75	0.26	1.10%
Urban/Residential	166.79	0.26	1.10%
Mining	0.00	0.00	0.00%
AML	348.15	0.54	2.29%
Total Area	**15226.37**	**23.79**	**100.00%**

3.2 Data Inventory

Various sources of data were used in the TMDL development process. The data were used to identify and characterize sources of pollution and to establish the water quality response to those sources. Review of the data included a preliminary assessment of the watershed's physical and socioeconomic characteristics and current monitoring data. Table 3-2 identifies the data used to support the TMDL assessment and modeling effort. These data describe the physical conditions of the TMDL watersheds, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. Prior to TMDL development, WVDEP collected comprehensive water quality data throughout the watershed. This pre-TMDL monitoring effort contributed the largest amount of water quality data to the process and is summarized in the Technical Report, Appendix 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	WV Gap Analysis Project (GAP)
	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	U.S. Census Bureau, 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 DWMM
	Discharge Monitoring Report data	WVDEP DMR, Mining Companies
	Abandoned mine land data	WVDEP DMR, WVDEP DWMM
Regulatory or policy information	Applicable water quality standards	WVDEP
	Section 303(d) list of impaired waterbodies	WVDEP, USEPA
	Nonpoint Source Management Plans	WVDEP

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring from July 2004 through June 2005. 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.

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.

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

TMDL Watershed	Code	Stream Name	Fe	Mn	FC	BIO
Duck Creek	WVLK-82	Duck Creek	X			X
Lynch Run	WVLK-85	Lynch Run	X	X	X	X
	WVLK-85-C	UNT/Lynch Run RM 0.9	X			
Duskcamp Run	WVLK-88	Duskcamp Run	X		X	X
	WVLK-88-A	Right Fork/Duskcamp Run	X			X
Copen Run	WVLK-90	Copen Run			X	

Note:
UNT = unnamed tributary.
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. 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 West Virginia Stream Condition Index (WVSCI; Gerritsen et al., 2000) is composed of six metrics that were selected to maximize discrimination between streams with known impairments and reference streams. In general, streams with WVSCI scores of less than 60.6 points, on a normalized 0–100 scale, are considered biologically impaired.

Biological assessments are useful in detecting impairment, but they 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, GAP 2000 landuse information, Natural Resources Conservation Service (NRCS) STATSGO soils data, 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
- High sulfates and increased ionic strength cause toxicity
- Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations
- Altered hydrology causes higher water temperature, resulting in direct impacts
- Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
- Algal growth causes food supply shift
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth)

- Chemical spills cause toxicity

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

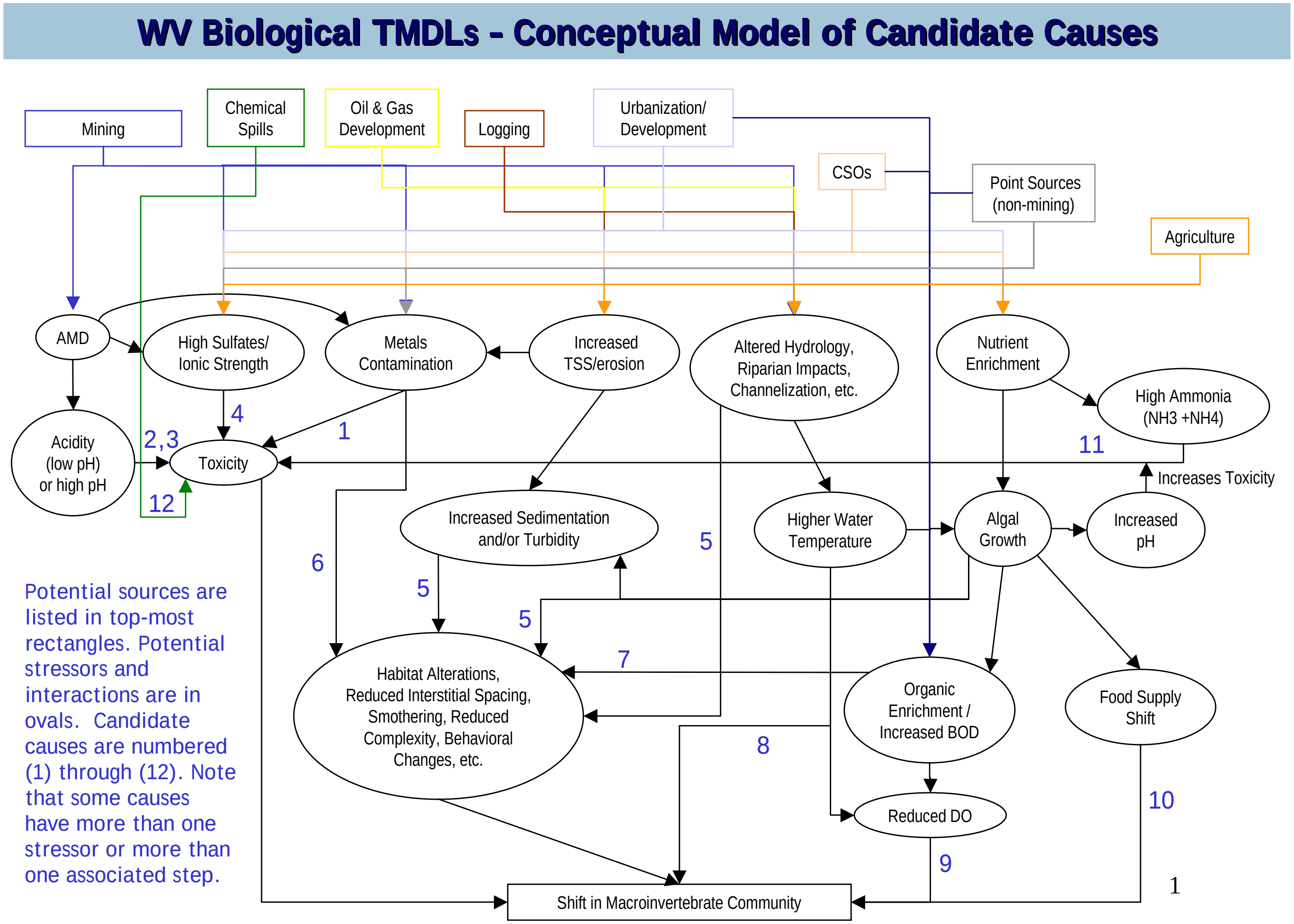


Figure 4-1. Conceptual model of candidate causes and potential biological effects

4.4 Stressor Identification Results

As shown in Table 4-1, sedimentation has been identified as the causative stressor for the biologically impaired streams addressed in this effort. WVDEP initially pursued the development of TMDLs directly for sediment for those streams. 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.

Bower Run (WVLK-90-A) was selected as the achievable reference stream as it shares similar landuse, ecoregion and geomorphologic characteristics with the sediment impaired streams. Although the biological community of Bower Run is not without anthropogenic impacts (its WVSCI score is 62.33), the biological stress does not involve sedimentation. Field evaluations indicate that the substrate quality available to the biological community is not a limiting factor. The location of Bower Run is shown in Figure 4-2.

All of the sediment-impaired waters 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.

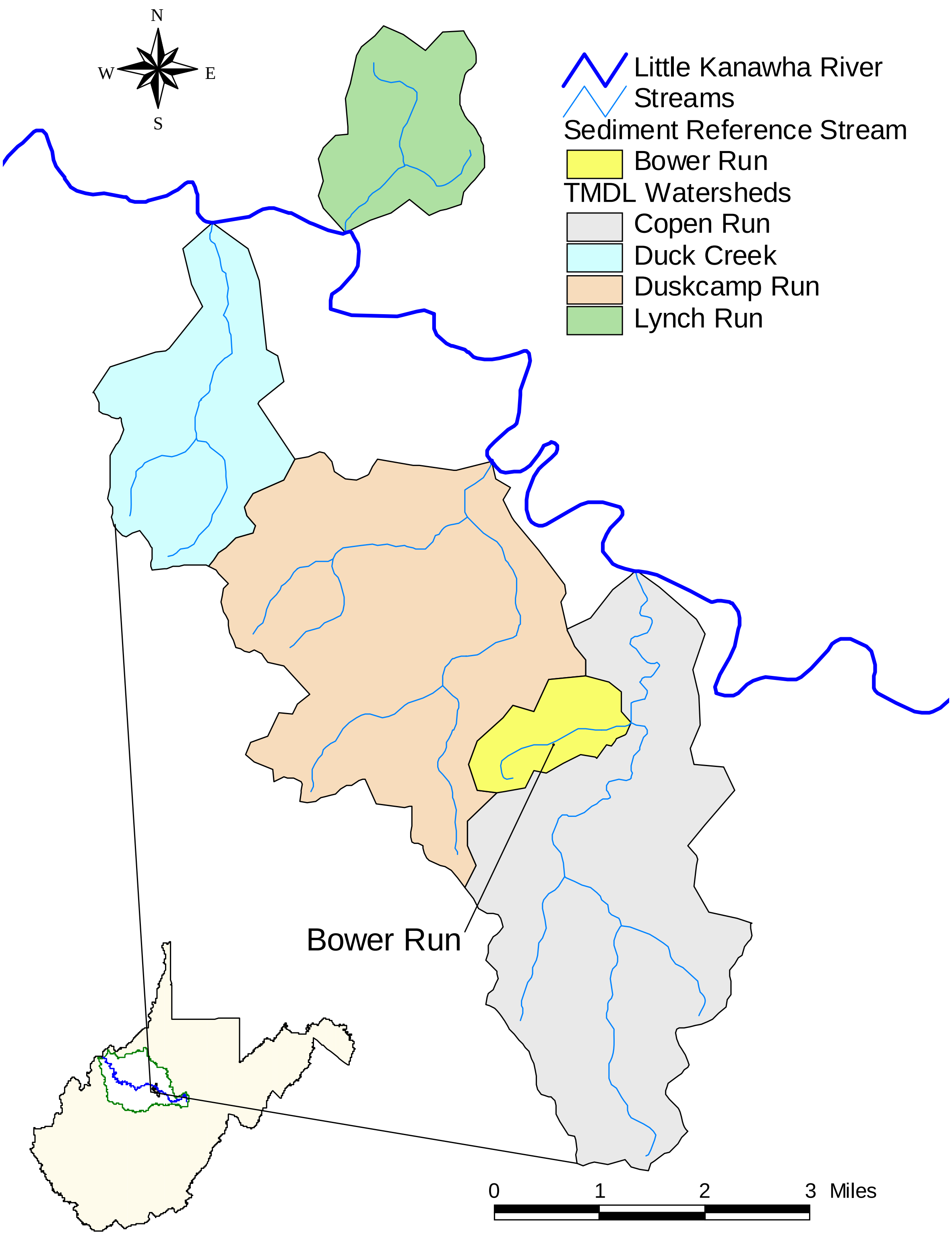


Figure 4-2. Location of the sediment reference stream, Bower Run

Table 4-1. Significant stressors of biologically impaired streams in the Little Kanawha River watershed

TMDL Watershed	Stream	Stream Code	Biological Stressors	TMDLs Developed
Duck Creek	Duck Creek	WVLK-82	Sedimentation	Sediment (Total iron surrogate)
Lynch Run	Lynch Run	WVLK-85	Sedimentation	Sediment (Total iron surrogate)
Duskcamp Run	Duskcamp Run	WVLK-88	Sedimentation	Sediment (Total iron surrogate)
Duskcamp Run	Right Fork/Duskcamp Run	WVLK-88-A	Sedimentation	Sediment (Total iron surrogate)

5.0 METALS SOURCE ASSESSMENT

This section identifies and examines the potential sources of iron and manganese impairments. 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 National Pollutant Discharge Elimination System (NPDES) program, established under Clean Water Act Sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. For purposes of this TMDL, NPDES-permitted discharge points are considered point sources.

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 the previous section 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 Metals Point Sources

Metals point sources are classified by the mining- and non-mining-related permits issued by WVDEP. There are no existing permitted point sources within the metals impaired TMDL watersheds.

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

Although there are no existing sites registered under the permit within the TMDL watersheds, allowances for future activity under the permit are provided in the wasteload allocation components of the iron TMDLs.

5.2 Metals Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals. AML contributes acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface water. Similarly, facilities that were subject to the Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) during active operations and subsequently forfeited their bonds and abandoned operations can be a significant source of metals and low-pH. Also, land disturbing activities that introduce excess sediment are considered nonpoint sources of metals.

5.2.1 Abandoned Mine Lands

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

The Office of AML&R identified locations of AML in the Little Kanawha River watershed from their records. In addition, source tracking efforts by WVDEP DWWM and AML&R identified additional AML sources (discharges, seeps, portals, and refuse piles). Field data, such as GPS locations, water samples, and flow measurements, were collected to represent these sources and characterize their impact on water quality. Based on this work, AML represent a significant source of metals in the TMDL watersheds. In the metals impaired subwatersheds, a total of 235 acres of AML area, 4 AML seeps, and 15 miles of highwall were incorporated into the TMDL model as shown in Figure 5-1. The remaining 113 acres of AML area, as referenced in Table 3-1, is located in the Copen Run watershed which is not metals impaired.

5.2.2 SMCRA Bond Forfeiture Sites

Bond forfeiture sites are not present in the metals impaired TMDL watersheds.

5.2.3 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 three metals impaired TMDL watersheds. This information included the harvested area (295 acres) and the subset of land disturbed by roads and landings (25 acres) for five registered logging sties in the metals impaired TMDL watersheds.

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 117 active oil and gas wells in the metals impaired TMDL watersheds addressed in this report as shown in Figure 5-1. 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 WVU. Unpaved roads that were not included in either GIS coverage were digitized from topographic maps.

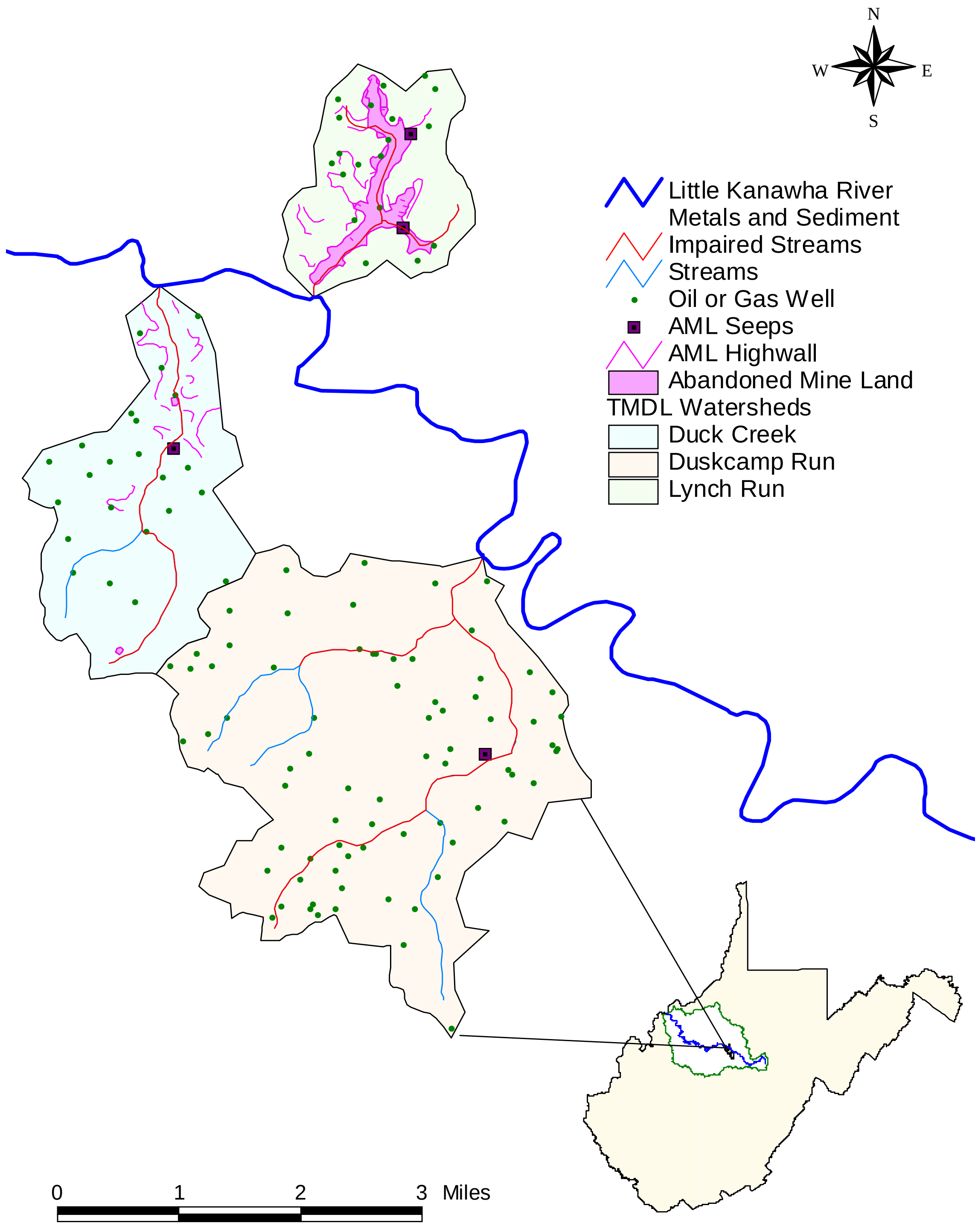
Agriculture
Agricultural activities can contribute sediment loads to nearby streams. However, there is minimal agricultural activity in most TMDL watersheds, with pasture accounting for approximately 1.10 percent of the modeled landuses as shown in (Table 3-1).

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 8.1.3.

Other Land-Disturbance Activities
Stormwater runoff from residential and urbanized areas is a potential source of sediment, but there is minimal urban/residential landuse in the subject watersheds. As such, stormwater from this landuse type is not a significant sediment source.

The GAP 2000 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.



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

Figure 5-1. Metals sources in the metals impaired TMDL watersheds

6.0 FECAL COLIFORM SOURCE ASSESSMENT

6.1 Fecal Coliform Point Sources

Fecal coliform point sources may include the permitted discharges from sewage treatment plants. These facilities (including publicly and privately owned treatment works, and home aeration units) are regulated by NPDES permits. Permits require effluent disinfection and compliance with strict fecal coliform limitations (200 counts/100 milliliters (mL) [average monthly] and 400 counts/100 mL [maximum daily]). However, noncompliant discharges and collection system overflows can also contribute significant loadings of fecal coliform bacteria to receiving streams. WVDEP determined that there are no publicly owned or privately owned wastewater treatment facilities, combined sewer overflows, sanitary sewer overflows, municipal separate storm sewer systems, or general sewage permits within the TMDL watersheds of the Little Kanawha River watershed.

6.2 Fecal Coliform Nonpoint Sources

6.2.1 On-site Treatment Systems

Overall, failing septic systems and straight pipes represent a significant nonpoint source of fecal coliform bacteria. Information collected during source tracking efforts by WVDEP yielded an estimate of 229 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 28 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 USDA county soil survey maps. Two types of failure were considered, complete failure and periodic failure. For the purposes of this analysis, complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters and periodic failure was defined as 25 gallons per house per day. Figure 6-1 shows the failing septic flows represented in the model by subwatershed.

Once failing septic flows had been modeled, then 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 septics. 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.

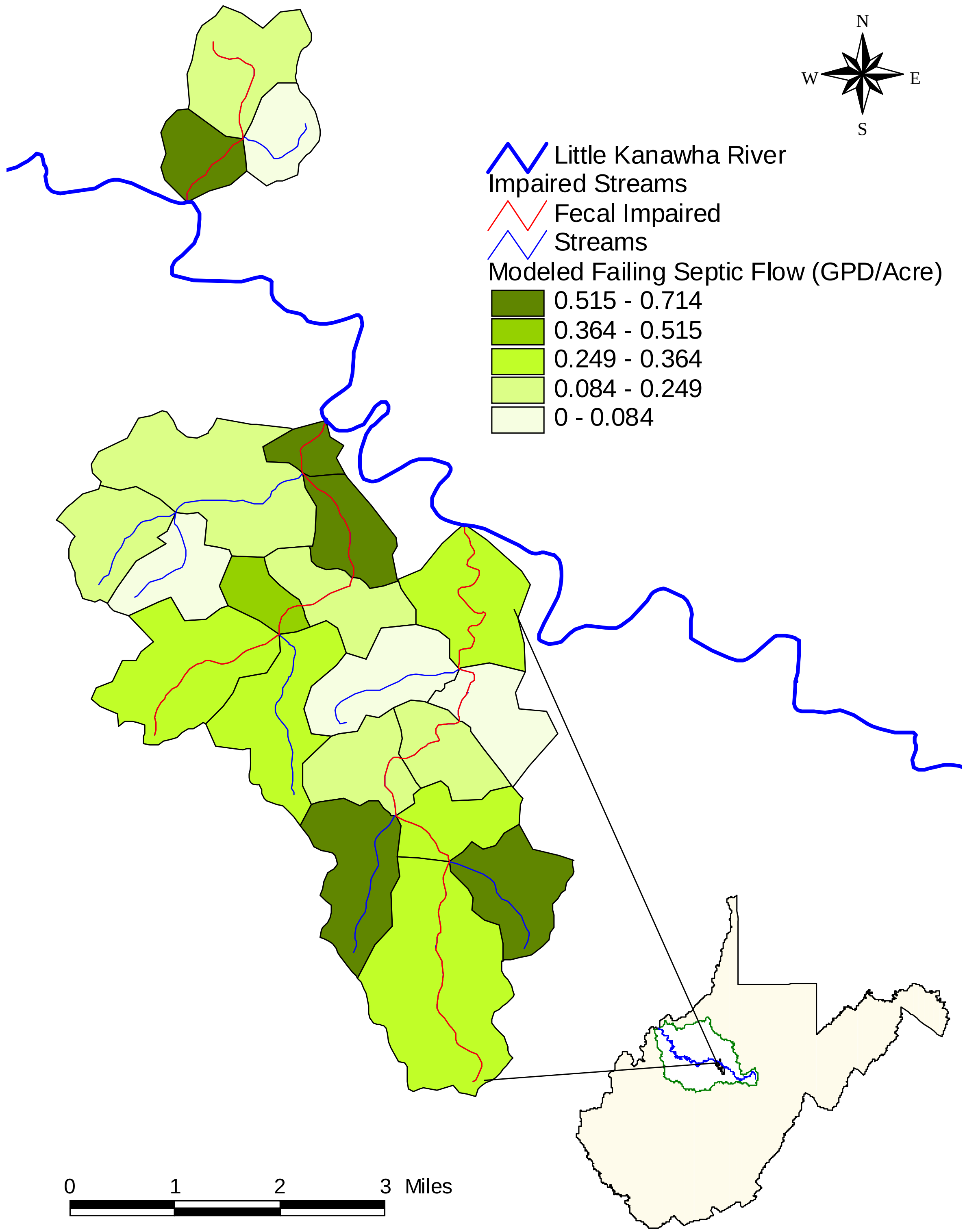


Figure 6-1. Little Kanawha River failing septic flows

6.2.2 Urban/Residential Runoff

Stormwater runoff represents another nonpoint source of fecal coliform bacteria in residential and urbanized areas. Runoff from residential and urbanized areas during storm events can be a significant source, delivering bacteria from the waste of pets and wildlife to the waterbody. GAP 2000 landuse data were used to determine the number of acres of residential and urbanized areas in the Little Kanawha River watershed. Literature reference values were used to determine fecal accumulation rates for these areas.

6.2.3 Agriculture

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

Agriculture is not prevalent in the impaired portions of the Little Kanawha River watershed. Although agriculture is not widespread, source tracking efforts identified isolated instances of pastures and feedlots near impaired segments that have localized impacts on instream bacteria levels. WVDEP source tracking assessments of livestock were used to develop accumulation rates for agricultural sources of fecal coliform bacteria.

6.2.4 Natural Background (Wildlife)

A certain “natural background” contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested areas. Accumulation rates for fecal coliform bacteria in forested areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from West Virginia’s Division of Natural Resources (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 Little Kanawha River watershed.

7.0 SEDIMENT SOURCE ASSESSMENT

Excess sediment has been identified as a significant stressor in relation to the biological impairments of Duck Creek, Lynch Run, Duskcamp Run and Right Fork/Duskcamp Run. 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, and that the iron TMDLs are therefore an appropriate surrogate. Sediment sources are described in Section 5.2.3.

8.0 MODELING PROCESS

Establishing the relationship between the instream water quality targets and source loadings is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses with flow and loading conditions. This section presents the approach taken to develop the linkage between sources and instream response for TMDL development in the Little Kanawha River watershed.

8.1 Modeling Technique for Total Iron and Fecal Coliform Bacteria

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

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

The primary regulatory factor that influenced the selection process was West Virginia’s water quality criteria. According to 40 CFR Part 130, TMDLs must be designed to implement applicable water quality standards. The applicable water quality criteria for iron, manganese 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. Only nonpoint sources contribute to the various impairments for which TMDLs are being presented. Most of the nonpoint sources are rainfall-driven with pollutant loadings primarily related to surface runoff, but some, such as AML seeps and inadequate on-site residential sewage treatment systems, function as 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, total manganese and fecal coliform bacteria were modeled using the MDAS.

8.1.1 MDAS Setup

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 four TMDL watersheds were broken into 25 separate subwatershed units based on the groupings of impaired streams shown in Figure 8-1. 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.

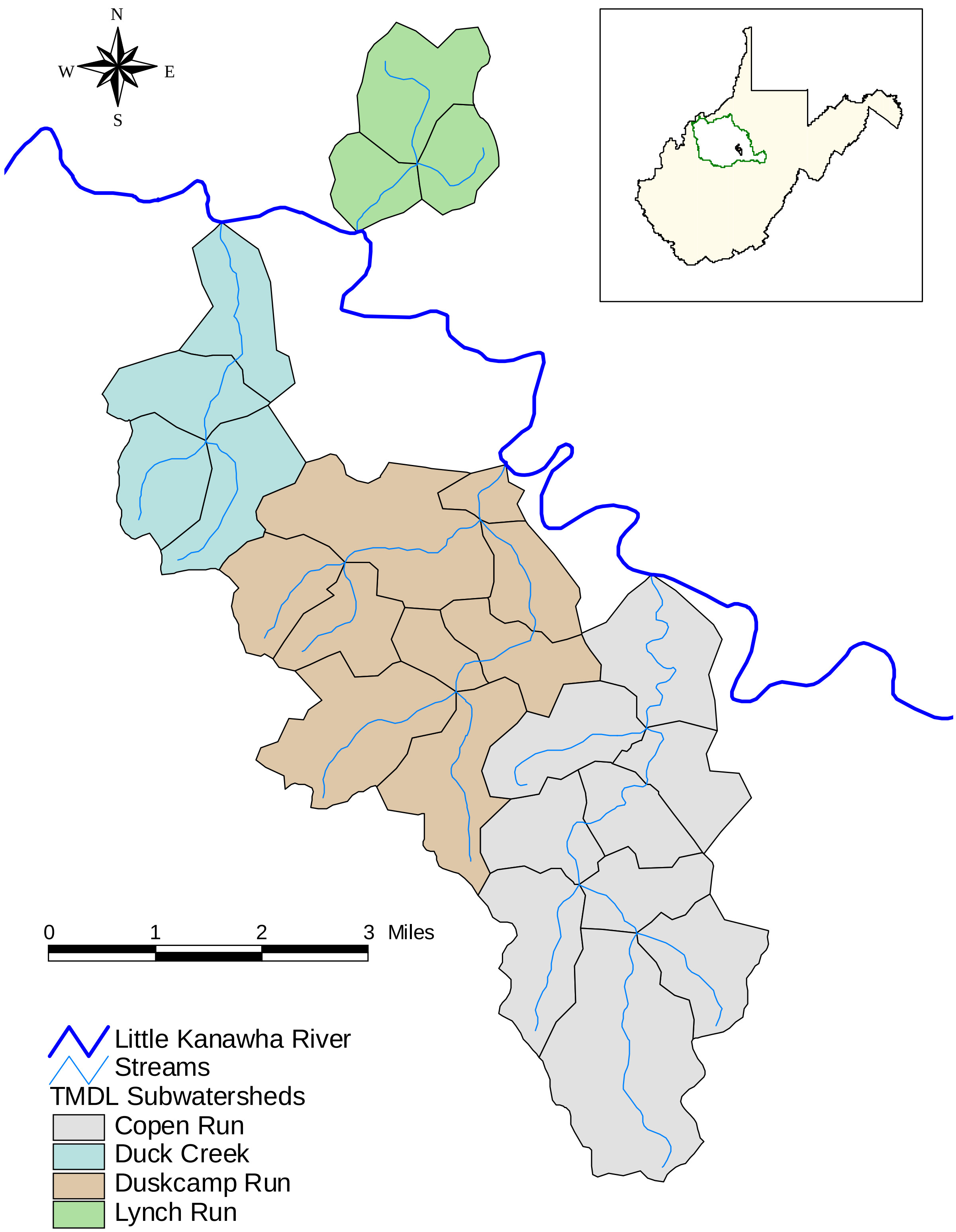


Figure 8-1. TMDL watersheds and subwatershed delineation

The MDAS was configured to model hydrology and water quality for sediment, fecal coliform bacteria, total iron and manganese. Pollutant loads are delivered to the streams through surface runoff, subsurface flow, and continuous discharges.

The modeled landuse categories contributing metals via precipitation and runoff include forest, pastures, cropland, wetlands, barren, residential/urban impervious, and residential/urban pervious. These sources were represented explicitly by consolidating existing GAP2000 landuse categories to create modeled landuse groupings. Several additional landuse categories were created to account for landuses either not included in the GAP 2000 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,). 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 were modeled as direct, continuous-flow sources in the model.

Sediment-producing landuses and bank erosion are also sources of iron because this metal 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 load 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.

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

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

8.1.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Typically, hydrology calibration involves a comparison of model results with instream flow observations from USGS flow gauging stations throughout the watershed. There are a total of five USGS flow gauging stations in the Little Kanawha River watershed, however there is only one with adequate data records for hydrology calibration. The model was calibrated to the observed data recorded at the USGS gage 03151400 Little Kanawha River near Wildcat. Hydrology calibration was based on observed data from that station and the landuses present in the watersheds at that time. 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, 1992 to September 30, 2005. 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 Little Kanawha River watershed. A detailed description of the hydrology calibration and a summary of the results and validation are presented in the Technical Report.

8.1.3 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.

Sediment Calibration

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.

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).

Sediment calibration consisted of adjusting the sediment surface runoff concentrations by landuse, and the coefficient of scour for bank-erosion. Initial values were adjusted so that the model's suspended solids output closely matched observed instream data in watersheds with predominately one type of source.

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 8-2). 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.

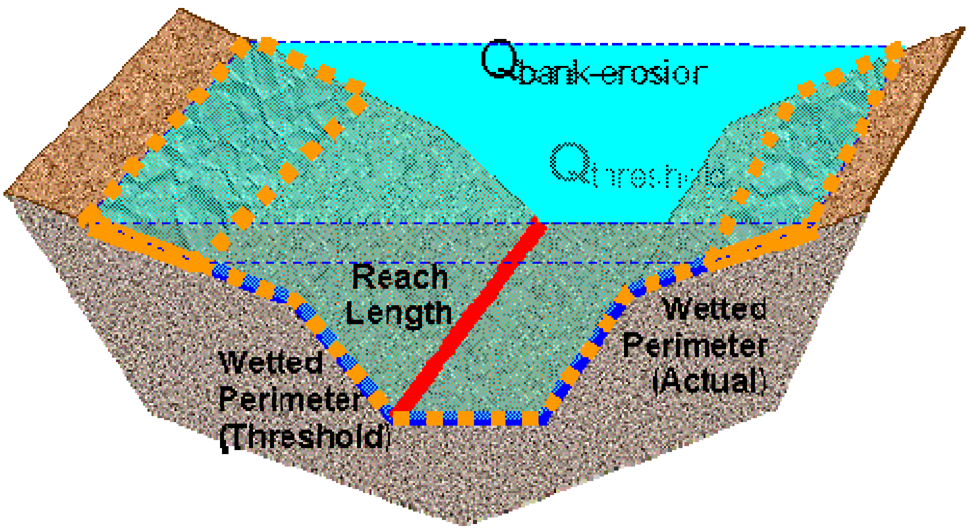


Figure 8-2. Conceptual diagram of stream channel components used in the bank erosion model

Total Iron, Total Manganese, and Fecal Coliform Bacteria Calibration

The water quality was calibrated by comparing modeled versus observed instream metals and fecal coliform bacteria 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. Available monitoring data in the watershed was identified and assessed for application to calibration. Monitoring stations with observations that represented a range of hydrologic conditions, source types, and pollutants were selected. The time-period for water quality calibration was selected based on the availability of the observed data and their relevance to the current conditions in the watershed. WVDEP also conducted storm monitoring on Shrewsbury Hollow in Kanawha State Forest, Kanawha County, West Virginia. The data gathered during this sampling episode was used in the calibration of fecal coliform and to enhance the representation of background conditions from undisturbed areas. The results of the storm sampling fecal coliform calibration are shown in Figure 8-3. Model parameters for sediment and total iron were derived from previous West Virginia TMDL studies, storm sampling efforts, and literature values.

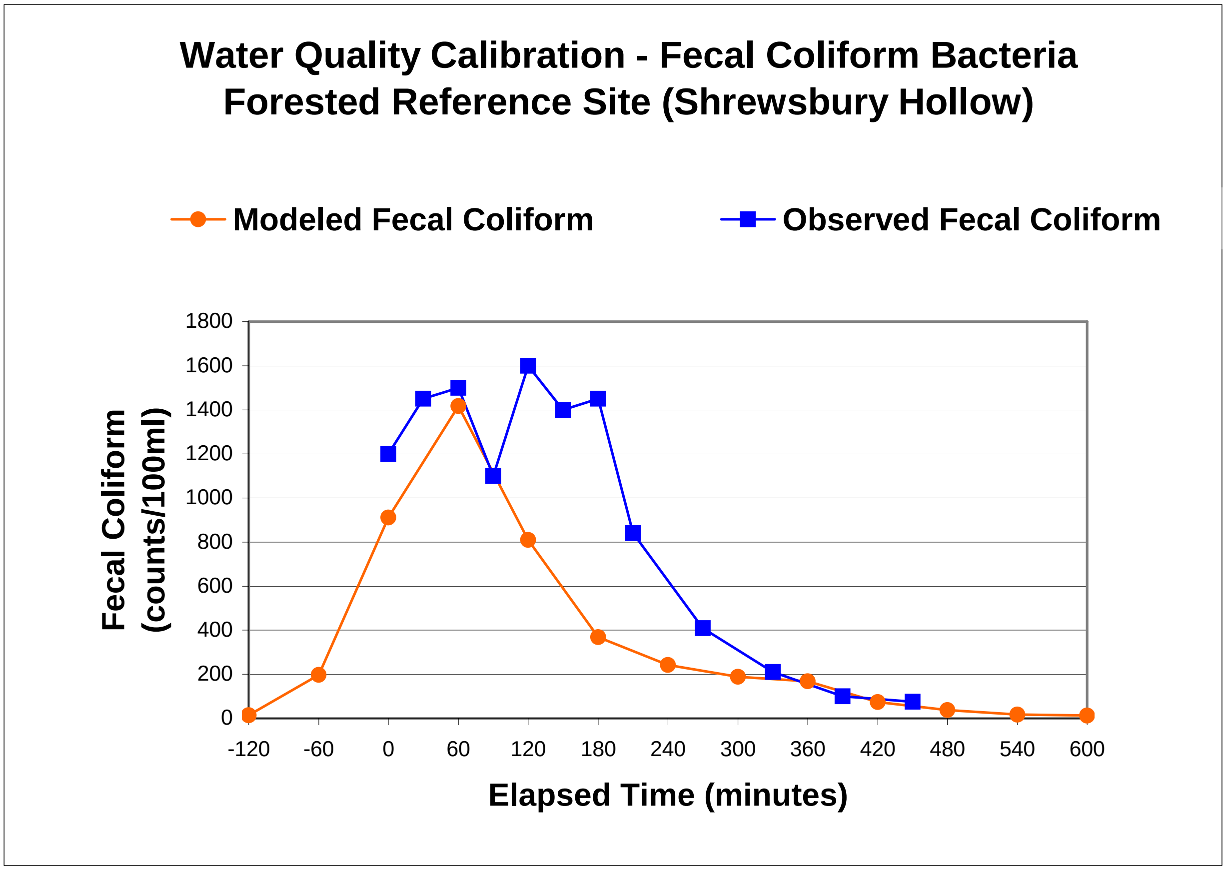


Figure 8-3. Shrewsbury Hollow fecal coliform observed data

8.2 Modeling Technique for Sediment

The SI process discussed in Section 4 indicated a need to reduce the contribution of excess sediment to 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, Bower Run was selected as the reference watershed. The location of the reference watershed is shown in Figure 4-2.

Adequately representing erosion processes and nonpoint source loads in the watershed was a primary concern in selecting the appropriate modeling system. The MDAS model was integrated with a stream routing model that examined streambank erosion and depositional processes.

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 8-1 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 8-1. Sediment loadings using different modeling approaches

Stream Name	Stream Code	Allocated Sediment Load Iron TMDL (tons/yr)	Allocated Sediment Load Bower Run Reference Approach (tons/yr)
Lynch Run	WVLK-85	64.5	67.2
UNT/Lynch Run RM 0.9	WVLK-85-C	17.0	17.3
Duck Creek	WVLK-82	103.5	113.0
Duskcamp Run	WVLK-88	210.4	267.4
Right Fork/Duskcamp Run	WVLK-88-A	76.3	110.9

8.3 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 total iron, total manganese, and fecal coliform bacteria TMDLs for each of the waterbodies listed in Table 3-3 of this report, the following approach was taken:

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

8.3.1 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. The TMDL endpoints for the various criteria are displayed in Table 8-2.

Table 8-2. 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)
Total Manganese	Public Water Supply	1.0 mg/L	0.95 mg/L
Fecal Coliform	Water Contact Recreation and Public Water Supply	200 counts / 100mL (Monthly Geometric Mean)	190 counts / 100mL (Monthly Geometric Mean)
Fecal Coliform	Water Contact Recreation and Public Water Supply	400 counts / 100mL (Daily, 10% exceedance)	380 counts / 100mL (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. Analysis of available data indicated that critical conditions occur during both high- and low-flow events. To appropriately address the low- and high-flow critical conditions, the TMDLs were developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability.

8.3.2 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 8-4).

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

Figure 8-4 presents the annual rainfall totals for the years 1980 through 2004 at the Gassaway (WV3361) weather station in West Virginia. The years 1998 to 2003 are highlighted to indicate the range of precipitation conditions used for TMDL development in the Little Kanawha River watershed.

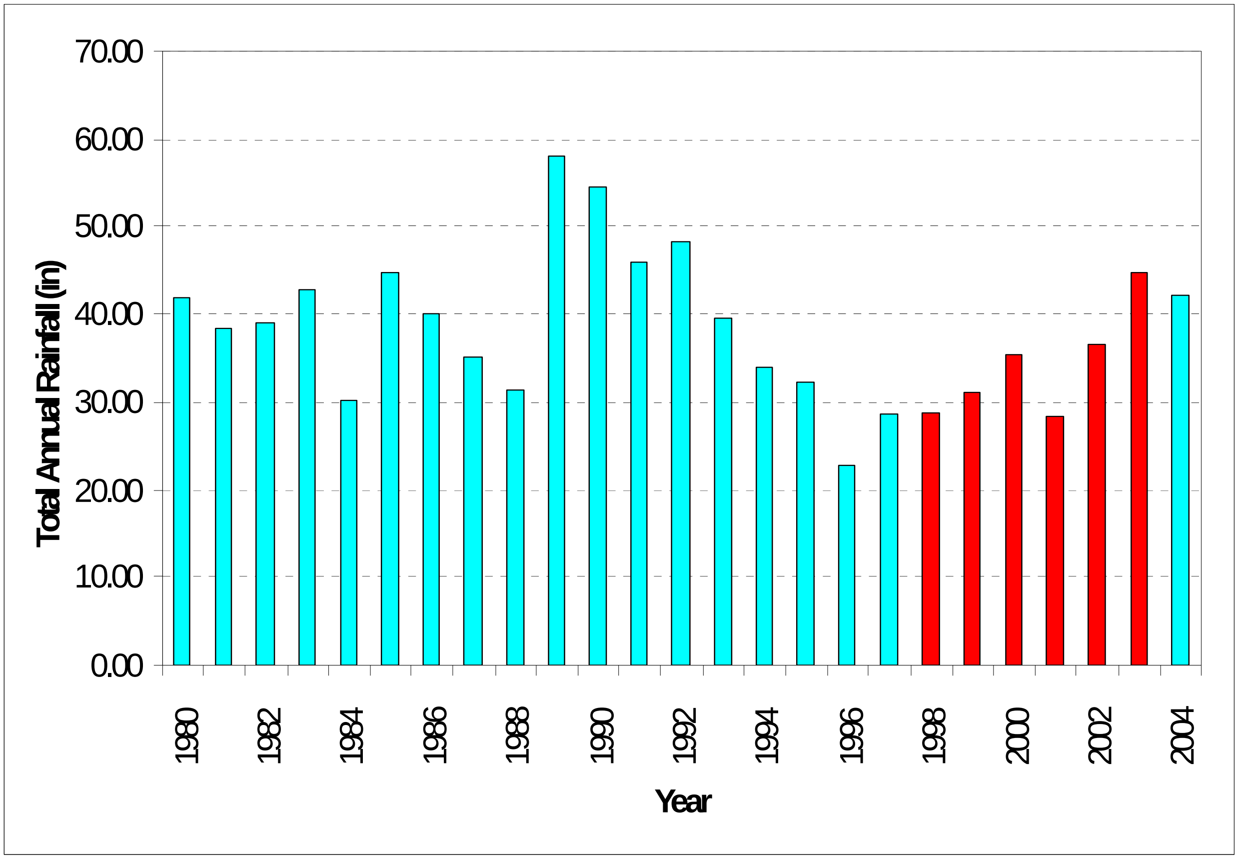


Figure 8-4. Annual precipitation totals for the Gassaway (WV3361) weather station

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 nonpoint sources were individually adjusted; the modeled instream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies (Figure 8-5). Successful scenarios were those which achieved the TMDL endpoints under all flow conditions throughout the modeling period. The averaging period and allowable exceedance frequency associated with West Virginia water quality criteria were considered in these assessments. In general, loads contributed by sources that had the greatest impact on instream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, less significant source contributions were subsequently reduced.

Figure 8-5 shows an example of model output for a baseline condition and a successful TMDL scenario.

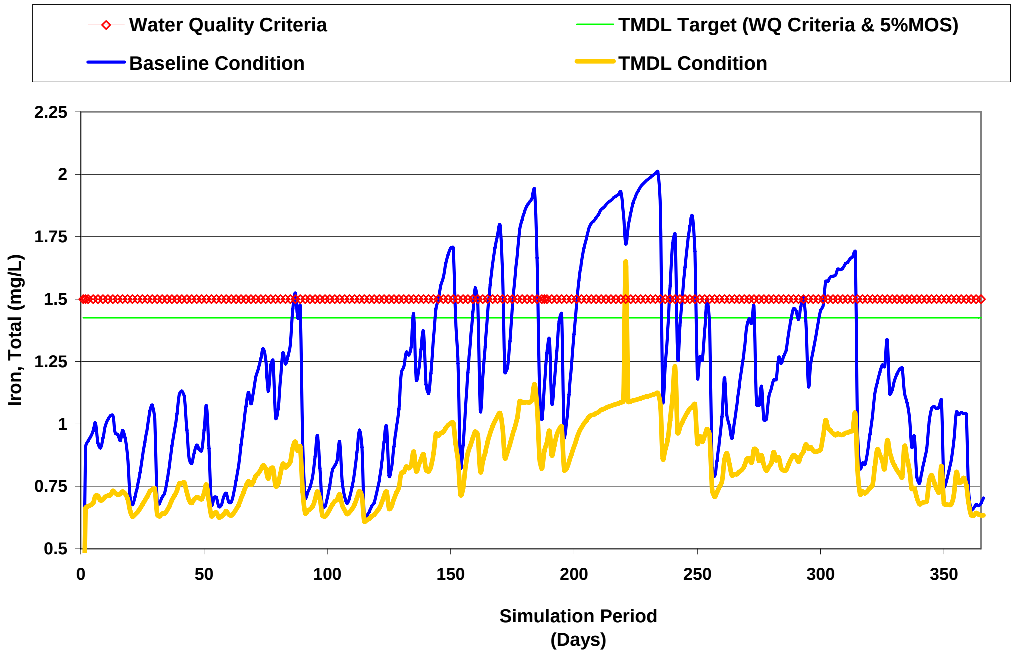


Figure 8-5. Example of baseline and TMDL conditions for total iron

8.4 TMDLs and Source Allocations

8.4.1 Total Iron TMDLs

TMDLs and source allocations were developed for all modeled subwatersheds of Duck Creek, Lynch Run, and Duskcamp Run. A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in these waterbodies, and TMDLs were developed. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream waterbodies. Using this method, contributions from all sources were weighted equitably. Reductions in sources affecting impaired headwaters ultimately led to improvements downstream and effectively decreased necessary loading reductions from downstream sources. Nonpoint source reductions did not result in allocated loadings less than natural conditions. The following methodology was used when allocating to iron sources.

- For subwatersheds where iron impairments are associated with elevated sediment loadings and where streambank erosion was determined to be a significant source of sediment, the loading from streambank erosion was first reduced to the loading characteristics of the reference stream.

- For watersheds where AML sources were present, the AML loads were then reduced until instream water quality criteria were met or until conditions were no less than those of undisturbed forest. If further reductions were required for iron, the loads from sediment-contributing nonpoint sources were reduced until water quality criteria were met.

Wasteload Allocations (WLAs)
No existing point sources of iron are present in the TMDL watersheds. Specific WLAs for future activity under the Construction Stormwater General Permit are provided and are described in Section 10.0. An allocation of 0.5 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.

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

- AML: loading from abandoned mine lands, including loads from disturbed land, highwalls, deep mine discharges and seeps

- Sediment sources: loading associated with sediment contributions from barren land, harvested forest, oil and gas well operations, unpaved roads, and streambank erosion processes

- Background and other nonpoint sources: loading from undisturbed forest and grasslands, paved roads, and urban/residential and agricultural landuses (loadings associated with this category were represented but not reduced)

8.4.2 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for all modeled subwatersheds of Lynch Run, Duskcamp Run and Copen Run. As described in Section 8.4.1, a top-down methodology was followed to develop these TMDLs and allocate loads to sources.

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

- 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.

- In limited subwatersheds where bacteria reductions from precipitation induced nonpoint sources were determined necessary, nonpoint source loadings from agricultural lands were subsequently reduced until attainment of water quality criteria could be demonstrated.

Wasteload Allocations (WLAs)
WLAs were not required for the TMDL watersheds because there are no existing fecal coliform bacteria point source discharges.

Load Allocations (LAs)
For West Virginia TMDLs, fecal coliform LAs are assigned as required to the following source categories:

- Pasture

- 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 (loadings associated with this category were represented but not reduced

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

8.4.3 Lynch Run Manganese TMDL

The top-down methodology described in Section 8.4.1 was followed to develop the Lynch Run manganese TMDL and allocate loads to sources. The only identified problematic manganese sources are AML seeps associated with abandoned mine lands and highwalls in the watershed. Reductions of those sources as prescribed in the load allocation component of the TMDL allowed the manganese water quality endpoint to be met.

8.4.4 Seasonal Variation

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

8.4.5 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.

8.4.6 TMDL Presentation

The TMDLs for iron, manganese, fecal coliform bacteria and biological impairments are shown in Tables 9-1 through 9-4. The TMDLs for iron and manganese are presented as average daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed throughout the year. TMDLs and their components are also presented in the allocation spreadsheets associated with this report. Detailed source allocations are provided 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.

9.0 TMDL RESULTS

Table 9-1. Iron TMDLs for the Little Kanawha River watershed

TMDL Watershed	Stream Code	Stream Name	Parameter	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
Lynch Run	WVLK-85	Lynch Run	Iron	22.01	0.19	1.2	23.4
Lynch Run	WVLK-85-C	UNT/ Lynch Run RM 0.9	Iron	5.98	0.05	0.3	6.3
Duck Creek	WVLK-82	Duck Creek	Iron	37.06	0.31	2.0	39.3
Duskcamp Run	WVLK-88	Duskcamp Run	Iron	73.55	0.74	3.9	78.2
Duskcamp Run	WVLK-88-A	Right Fork/Duskcamp Run	Iron	25.37	0.31	1.4	27.0

Table 9-2. Manganese TMDLs for the Little Kanawha River watershed

TMDL Watershed	Stream Code	Stream Name	Parameter	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	TMDL (lbs/day)
Lynch Run	WVLK-85	Lynch Run	Manganese	9.35	NA	0.5	9.8

Table 9-3. Fecal coliform bacteria TMDLs for the Little Kanawha River watershed

TMDL Watershed	Stream Code	Stream Name	Parameter	Load Allocation (counts/day)	Wasteload Allocation (counts/day)	Margin of Safety (counts/day)	TMDL (counts/day)
Lynch Run	WVLK-85	Lynch Run	Fecal coliform	1.29E+10	NA	6.80E+08	1.36E+10
Duskcamp Run	WVLK-88	Duskcamp Run	Fecal coliform	5.68E+10	NA	2.99E+09	5.98E+10
Copen Run	WVLK-90	Copen Run	Fecal coliform	7.26E+10	NA	3.82E+09	7.65E+10

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 9-4. Biological TMDLs for the Little Kanawha River watershed

TMDL Watershed	Stream Code	Stream Name	Parameter	Load Allocation (lbs Fe/day)	Wasteload Allocation (lbs Fe/day)	Margin of Safety (lbs Fe/day)	TMDL (lbs Fe/day)
Lynch Run	WVLK-85	Lynch Run	Sediment (Total iron surrogate)	22.01	0.19	1.2	23.4
Duck Creek	WVLK-82	Duck Creek	Sediment (Total iron surrogate)	37.06	0.31	2.0	39.3
Duskcamp Run	WVLK-88	Duskcamp Run	Sediment (Total iron surrogate)	73.55	0.74	3.9	78.2
Duskcamp Run	WVLK-88-A	Right Fork/ Duskcamp Run	Sediment (Total iron surrogate)	25.37	0.31	1.4	27.0

10.0 FUTURE GROWTH

10.1 Metals/Sediment

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

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

   NPDES permitting rules mandate effluent limitations for metals to be prescribed in the total recoverable form. For iron and manganese, the West Virginia water quality criteria are in total recoverable form and may be directly implemented.

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

3. 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.

4. Most traditional 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 sediment impaired watersheds with the implementation of applicable technology based TSS requirements. New mining discharges may also be permitted under the 40 CFR 434 technology based effluent guidelines (35 mg/L average monthly, 70 mg/L maximum daily), but the alternative precipitation provisions that suspend applicability of TSS limitations cannot be applied to new discharges in iron TMDL watersheds.

Subwatershed-specific future growth allowances have been provided for site registrations under the Construction Stormwater General Permit. In general, the successful TMDL allocation provides 0.5 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.

10.2 Fecal Coliform Bacteria

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

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

11.0 PUBLIC PARTICIPATION

11.1 Public Meetings

Informational public meetings were held on May 10, 2004 at the Gilmer County public library and May 23, 2007 at the Gilmer County Senior Citizen Center in Glenville, West Virginia. The May 10, 2004 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 May 23, 2007 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 February 14, 2008 at the public library in Glenville. The meeting began at 6:30 PM. and provided information to stakeholders intended to facilitate comments on the draft TMDLs.

11.2 Public Notice and Public Comment Period

The availability of Draft TMDLs was advertised in various local newspapers between January 29 and 31, 2008. Interested parties were invited to submit comments during the public comment period, which began on February 1 and ended March 3, 2008. WVDEP did not receive any comments on the Draft TMDLs. The electronic documents are available on the WVDEP's internet site at http://www.wvdep.org/wvtmdl.

12.0 REASONABLE ASSURANCE

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

12.1 WV/NPDES Permitting

WVDEP DWWM is responsible for issuing non-mining NPDES permits within the State. WV DMR develops NPDES permits for mining activities. As part of the permit review process, permit writers have the responsibility to incorporate the required TMDL WLAs into new or reissued permits. New facilities will be permitted in accordance with future growth provisions described in Section 10.

12.2 Watershed Management Framework Process

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

The West Virginia Watershed Network is an informal association of state and federal agencies, and nonprofit organizations interested in the watershed movement in West Virginia. Membership is voluntary and everyone is invited 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. Development of Watershed Based Plans for priority watersheds 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.

Each year, the Framework is included on the agenda of the Network to prioritize watersheds within a certain Hydrologic Group. This selection process includes a review and evaluation of TMDL recommendations for the watersheds under consideration. The Network intends to prioritize Hydrologic Group D watersheds in March 2008. Development of Watershed Based Plans for priority watersheds 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 Northern Basin Coordinator Jennifer Pauer (jpauer@wvdep.org). There are two active watershed associations within the Little Kanawha River watershed, the Cedarville Community Association, Inc. and the Friends of the Little Kanawha. For information concerning these associations, contact the above mentioned Nonpoint Source Program Northern Basin Coordinator.

12.3 Public Sewer Projects

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

12.4 AML Projects

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

13.0 MONITORING PLAN

The following monitoring activities are recommended:

13.1 NPDES Compliance

WVDEP's DWWM and DMR have the responsibility to ensure that NPDES permits contain effluent limitations as prescribed by the TMDL WLAs and to assess and compel compliance. Permits for any new discharges will contain effluent limitations that are consistent with the TMDLs and will also 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 future growth provisions of the TMDLs.

13.2 Nonpoint Source Project Monitoring

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

13.3 TMDL Effectiveness Monitoring

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

14.0 REFERENCES

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